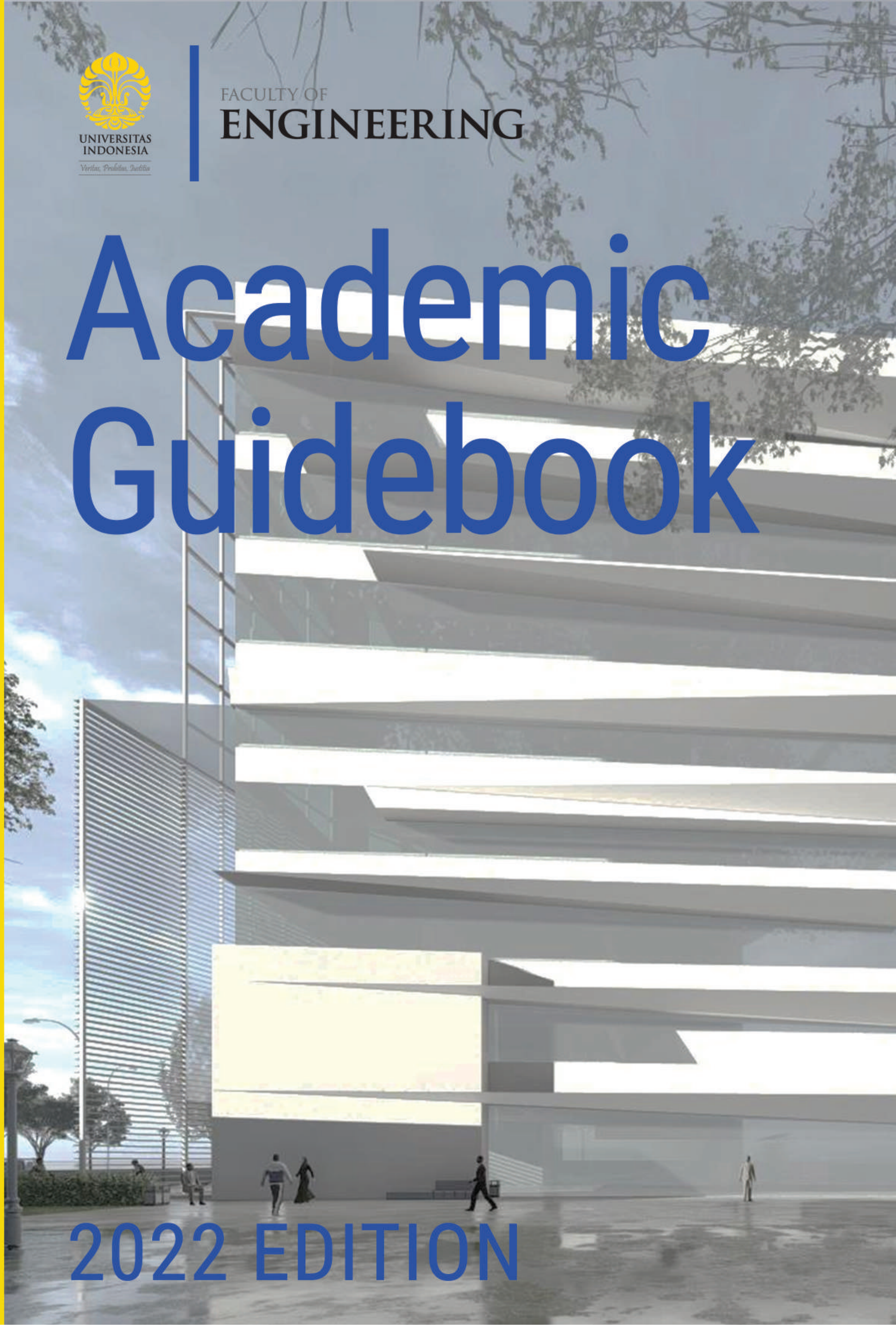

UNIVERSITAS INDONESIA
Veritas, Probitas, Iustitia

FACULTY OF
ENGINEERING

Academic Guidebook

2022 EDITION

FACULTY OF ENGINEERING
UNIVERSITAS INDONESIA
ACADEMIC GUIDEBOOK
2020 - 2024

2022 EDITION

Author
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Email humas@eng.ui.ac.id
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Faculty of Engineering Universitas Indonesia

ACADEMIC GUIDEBOOK

2020 - 2024

2022 Edition

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Design :
Mohammad Anindya Fausta

Published by Faculty of Engineering
Universitas Indonesia

Head Office
Dekanat Building 2nd Floor
+6221 7863504, +6221 7863505
+6221 7270050
http://www.eng.ui.ac.id/

Public Relations and Protocol
Office of Public Relations and Protocol
PAF Building 1st floor
+6221 78888430 ext 118
+6221 78888076
Email : humas@eng.ui.ac.id

PREFACE

Welcome to FTUI !

On behalf of the Faculty of Engineering Universitas Indonesia (FTUI). I would like to extend our warmest welcome to all students joining us this year. Our faculty is one of the largest faculty in the Universitas Indonesia and is proud to call ourselves one of Indonesia's leading education and research institutions. With the support of our faculty members, we provide an excellent learning and research environment for our students.

This 2022 Academic Guidebook is intended for all students of the Undergraduate Program (Regular, Parallel, International), Master Program, Professional Program, and Doctoral Program, to be used during their study at the Faculty of Engineering Universitas Indonesia. The curriculum, syllabus, and academic staff are listed, as well as all support information provided for you. The information contained within this book is also helpful for those considering continuing their study in the engineering field at the Universitas Indonesia.

Continuing the previous Academic Guidebook, we have refined the curriculum design based on the spirit of the Industrial Revolution 4.0 and the concept of "Merdeka Belajar Kampus Merdeka". The curriculum was designed based on the Outcome Based Education (OBE) system. The international standard engineering education outcome has been set in intended to prepare our graduates to be able to compete not only at the national or regional level but also in the global labor market.

In this guidebook, you will also find general information on FTUI and our Department/Study Program. It contains the education system, the academic regulations, the curriculum, and the syllabus of the subject taught in all our programs. In this guidebook, we are also proud to inform that starting the Academic Year 2022/2023, we opened the Professional Engineer Program (PPI) for the Recognition of Past Learning (RPL). This is a formal education program that uses work experience as the basis for continuing education for equality with certain qualifications. In addition, starting the Academic Year 2023/2024, FTUI will open the Master Program by Research. This program is a development of the existing Master Program by Course. This program is opened to provide learning opportunities for the community broad range, both from graduate students, and academics, to practitioners who already have research experience.

Lastly, I would like to convey my gratitude and appreciation to our stakeholders and the curriculum team for their contributions to the renewal curriculum. My sincere thank goes to all faculty members who have helped with the compilation of this academic guidebook, especially the Vice Dean for Academic, Research, and Student Affairs, the Vice Dean for Resources, Venture, and General Administration, the Associate Dean for Academic, the Heads and Vice Heads of Department, the Head of Study Programs, and the committee members. With the spirit of FTUI Entrepreneur Vision #ExcellentImpactful, let us deliver our graduates to be the best engineers in their field wherever they are.

Depok, November 2022
Faculty of Engineering Universitas Indonesia
Dean,

UNIVERSITAS INDONESIA
FAKULTAS TEKNIK

Prof. Dr. Heri Hermansyah, ST., M.Eng., IPU

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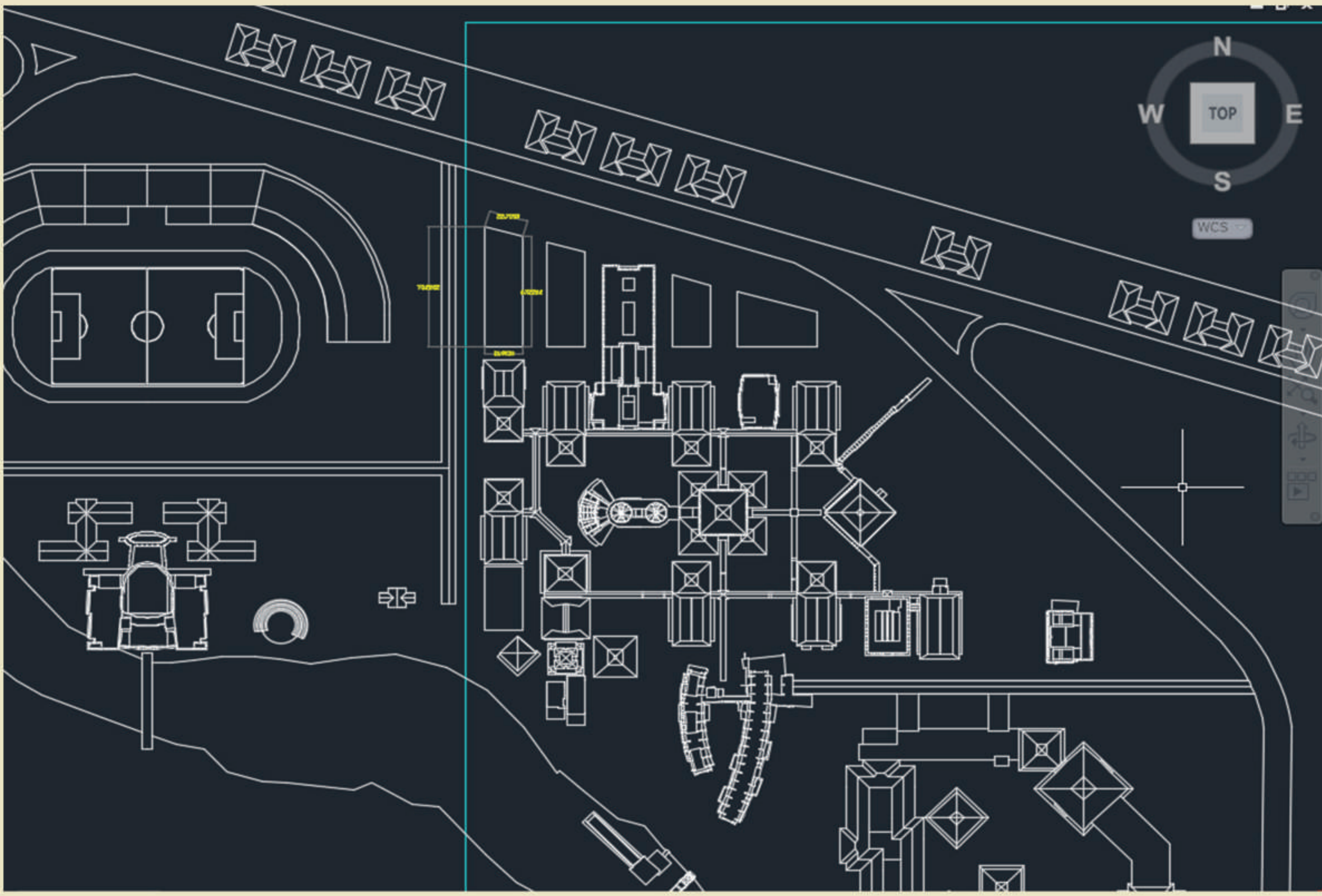

Profile of FTUI & Departments

History of FTUI

The history of the Faculty of Engineering of Universitas Indonesia (FTUI) began with a request made by a group of young engineers belonging to the Society of Engineers of Indonesia (PII) to the first President of the Republic Indonesia, Bung Karno, for the renovations of heavily damaged main roads in Jakarta. At that time Jakarta was preparing for GANEFO, an important International Sports Event. This bid was welcomed by President Soekarno. The young engineers were granted permission to start the renovations under a condition that all work had to be completed within two weeks. Headed by Ir. Bratanata, Ir. Roosseno, Ir. Sutami, and Ir. A.R. Soehoed, the project was completed on time.

After successful accomplishment of the road renovation project, these young engineers with their iron will felt that there was more that they could do to serve their country. But what? Then they thought of a brilliant idea: "Why not establish an engineering faculty in Jakarta as an alternative to the one in Bandung? This way those residing in the country's capital would not need to travel far to Bandung for an engineering education".

During the ceremonial event of Lenso dancing at the Pembangunan Building (formerly known as the Pola Building) to welcome the GANEFO guests of honor, the young engineers brought their idea to President Soekarno to which he responded by inviting them to the Presidential Palace the next day. During the meeting in the Presidential Palace, the President wholeheartedly approved of the idea and even directly appointed Prof. Ir. Rooseno as the first Dean of the Faculty of Engineering. The President also instructed that the new Faculty of Engineering would be part of Universitas Indonesia under the leadership of its Rector, dr. Syarief Thayeb.

The Establishment of Faculty of Engineering UI

Once dr. Syarief Thayeb served as the Minister of Higher Education and Science, he issued the Decree No. 76 dated July 17, 1964 regarding the establishment of the Faculty of Engineering. The Faculty of Engineering was officially established in Jakarta without any official ceremony or celebration under the banner of Universitas Indonesia as the youngest faculty. Thus, the history of the Faculty of Engineering of Universitas Indonesia began with its first three Study Programs and their respective Heads of Study Programs: Ir. Sutami as the Head of the Civil Engineering Study Program, Ir. Ahmad Sayuti as the Head of the Mechanical Engineering Study Program, and Ir. K. Hadinoto as the Head of the Electrical Engineering Study Program.

The Metallurgy and Architecture Study Programs were opened the following year with Dr.Ing. Purnomosidhi H. and Ir. Sunaryo S. as their respective Heads of Study Programs. Ir. Roosseno as the Dean was assisted by Ir. Sutami as the Vice Dean for Academic Affairs, Ir. Slamet Bratanata as the Vice Dean for Administration and Finance, and Dr. Ing Purnomosidhi H. as the Vice Dean for Student Affairs and Alumni. In its early activities in 1964, the Faculty of Engineering of UI was supported by 30 lecturers and 11 non-academic employees offering a 32-course subject curriculum. The first class of the Faculty of Engineering of UI consisted of 199 students. In five and a half years, 18 of them had successfully completed their studies and graduated as certified engineers.

In 1985, the Gas Engineering study program (originally under the Metallurgy Study Program) joined the Chemical Engineering study program (originally under the Mechanical Study Program) and formed the Gas and Petrochemical Engineering Study Program with Dr. Ir. H. Rachmantio as its first Head of the Study Program. The Industrial Engineering Study Program, was opened in 1999 with Ir. M. Dachyar, M.Sc. as its first Head of the Study Program. The Biomedical Engineering Study Program as the youngest study program in the Faculty of Engineering of UI, was opened in 2018 with Dr. Basari S.T., M.Eng. as the first Head of Study Program. The term "major" was later changed into "department", and it is still used today.

Vision and Mission of FTUI

FTUI Vision

To become a globally excellent and competitive engineering institution, through efforts to educate the nation's life to improve people's welfare, thereby contributing to the development of Indonesian society and the world.

FTUI Entrepreneur Vision #ExcellentImpactful

Establishing FTUI Entrepreneurs with Excellent Impact through Productivity-Based Multidisciplinary Collaboration Towards Excellent and Globally Competitive FTUI.

FTUI Mission

1. To provide wide, fair and good quality engineering education,
2. To organize Tridharma engineering activities that are of high quality and relevant to national and global challenges,
3. To create engineers who are highly intellectual, virtuous and able to compete globally.
4. To create academic climate in engineering that can support the realization of UI's vision.

FTUI Three Strategies for 2022-2026

1. Empowering Engineering Entrepreneurship,
2. Impactful Research and Innovation,
3. Modernization of Engineering Education

FTUI 11 Priority Programs for 2022-2026

1. Organization of Multidiscipline Engineering
2. Reverse Engineering Center
3. Engineering Seed Funds and Grants
4. Engineering Revenue Recognition
5. Database Engineering Networks
6. Organization of Strategic Engineering Education
7. Virtual Engineering Education Facility
8. Engineering Professional Program
9. Partnership and Collaboration Package
10. International Academic Recognition
11. Engineering Student Entrepreneur Program

UI and FTUI Administration

UI

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Vice Rector for Academic and Student Affairs

Vita Silvira, S.E., MBA.
Vice Rector for Finance and Logistics

drg. Nurtami, Ph.D., Sp,OF(K)
Vice Rector for Research and Innovation

Prof. Dr. Ir. Dedi Priadi, DEA
Vice Rector for for Human Resources and Assets

dr. Agustin Kusumayati, M.Sc., Ph.D
University Secretary

FTUI

Dean: Prof. Dr. Heri Hermansyah, ST., M.Eng., IPU

Prof. Dr. Ir. Yanuar, M.Eng., M.Sc.
Vice Dean for Academic Research and Student Affairs

Prof. Ir. Mahmud Sudibandriyo, M.Sc., Ph.D.
Vice Dean for Resources, Venture and General Administration

Dr. Nyoman Suwartha, S.T., M.T., M.Agr.
Associate Dean for Academic

Dr.rer.pol. Romadhani Ardi, S.T., M.T.
Associate Dean for Student Affairs, Research and Community Engagement

Dr. Ajib Setyo Arifin, S.T., M.T.
Associate Dean for Human Resource and General Administration (Facilty)

Tikka Anggraeni, S.Sos., M.Si., CPR.
Associate Dean for Public Communication and General Administration

Dr.-Ing. Ir. Dalhar Susanto
Associate Dean for Cooperation, Venture, and Alumni

Prof. Dr. Ir. Winarto, M.Sc.
Head of Academic Quality Assurance Unit

Dr. Muhamad Sahlan, S.Si., M.Eng.
Head of Entrepeneur Innovation Unit and Head of Reverse Engineering Center

Prof. Dr. Ir. Harinaldi, M.Eng.
Head of Education Modernization and Internationalization Unit

Prof. Dr. Ir. Widodo Wahyu Purwanto, DEA.
Head of Interdisciplinary Engineering Education and Research Unit and Head of Master Study Program in Energy Systems Engineering

Departments

The following are list of Head of Department, and Vice Head of Department:

Civil Engineering:
- Ayomi Dita Rarasati, S.T., M.T., Ph.D
- Andyka Kusuma, S.T., M.Sc., Ph.D.

Mechanical Engineering:
- Dr. Agus Sunjarianto Pamitran, ST., M.Eng.
- Dr.-Ing. Mohammad Adhitya, S.T., M.Sc.

Electrical Engineering:
- Dr. Eng. Arief Udhiarto, S.T., M.T., IPM
- Dr. Abdul Halim, M.Eng

Metallurgical & Materials Engineering:
- Dr. Deni Ferdian, S.T., M.Sc.
- Dr. Ahmad Zakiyuddin, S.T., M.Eng.

Architecture:
- Dr. Ir. Achmad Hery Fuad, M.Eng.
- Kristanti Dewi Paramita, S.Ars., M.A., Ph.D.

Chemical Engineering:
- Dr. Bambang Heru Susanto, ST., MT
- Dr. Dianursanti, S.T., M.T

Industrial Engineering:
- Dr. Komarudin, ST., M.Eng
- Dr. Zulkarnain, ST., MT.

Study Programs

Professional Program for Engineers:
- Prof. Dr. Fitri Yuli Zulkifli, M.Sc.

Urban & Regional Planning
- Dr.-Ing. Ova Chandra Dewi, M.Sc

Board of Professors

- Prof. Dr. Ir. Budi Susilo Soepandji
- Prof. Dr.-Ing. Ir. Bambang Suharno
- Prof. Dr. Ir. Sutanto Soehodo, M.Eng
- Prof. Dr. Ir. Bondan T. Sofyan, M.Si
- Prof. Dr. Ir. Tommy Ilyas, M.Eng
- Prof. Ir. Triatno Yudo Harjoko, M.Sc., Ph.D
- Prof. Dr. Ir. Irwan Katili, DEA
- Prof. Dr. Ir. Abimanyu Takdir Alamsyah, MS
- Prof. Dr. Ir. I Made Kartika, Dipl. Ing.
- Prof. Dr. Ir. Widodo Wahyu P, DEA
- Prof. Dr. Ir. Raldi Artono Koestoer
- Prof. Dr. Ir. M. Nasikin, M.Eng
- Prof. Dr. Ir. Bambang Sugiarto, M.Eng
- Prof. Dr. Ir. Anondho W., M.Eng
- Prof. Dr. Ir. Yanuar, M.Eng
- Prof. Dr. Ir. Setijo Bismo, DEA
- Prof. Dr. Ir. Tresna P. Soemardi
- Prof. Dr. Ir. Slamet, M.T
- Prof. Dr. Ir. Budiarso, M.Eng
- Prof. Dr. Ir. T. Yuri M. Zagloel, M.Eng.Sc
- Prof. Dr. Ir. Yulianto S. Nugroho, M.Sc
- Prof. Ir. Sutrasno Kartohardjono, M.Sc., Ph.D
- Prof. Dr.-Ing. Nandy Putra
- Prof. Dr. Ir. Yusuf Latief, MT
- Prof. Dr. Ir. Djoko Hartanto, M.Sc
- Prof. Dr. Ir. Dedi Priadi, DEA
- Prof. Dr. Ir. Dadang Gunawan, M.Eng
- Prof. Dr. Ir. Harinaldi, M.Eng
- Prof. Dr. Ir. Bagio Budiardjo, M.Sc
- Prof. Dr. Ir. Djoko M Hartono, SE., M.Eng
- Prof. Dr. Ir. Eko Tjipto Rahardjo, M.Sc
- Prof. Dr. Ir. Muhammad Anis, M.Met
- Prof. Dr. Ir. Harry Sudibyo
- Prof. Ir. Isti Surjandari Prajitno, MT., MA., Ph.D
- Prof. Ir. Rinaldy Dalimi, M.Sc., Ph.D
- Prof. Dr. Ir. Danardono Agus S, DEA
- Prof. Dr. Ir. Rudy Setiabudy, DEA
- Prof. Dr. Ir. Nji Raden Poespawati, MT
- Prof. Dr. Ir. Iwa Garniwa, MK., MT
- Prof. Dr. Ir. A. Herman Yuwono, M.Phil.Eng
- Prof. Dr. Ir. Muhammad Idrus Alhamid
- Prof. Yandi A. Yatmo, S.T., M.Arch., Ph.D
- Prof. Dr. Ir. Riri Fitri Sari, M.Sc.MM
- Prof. Dr. Ir. Adi Surjosatyo, M.Eng
- Prof. Dr. Benyamin Kusumoputro, M.Eng
- Prof. Ir. Widjojo Adi Prakoso, M.Sc., Ph.D
- Prof. Dr. Ir. Kalamullah Ramli, M.Eng
- Prof. Dr. Ir. Winarto, M.Sc
- Prof. Dr. Ir. Eddy S. Siradj, M.Sc
- Prof. Dr. Ing. Ir. Misri Gozan, M.Tech.
- Prof. Dr. Ir. Johny Wahyuadi Mudaryoto
- Prof. Dr. Ir. Nelson Saksono, MT
- Prof. Dr. Ir. Anne Zulfia, M.Sc
- Prof. Paramita Atmodiwirjo, S.T., M.Arch., Ph.D.
- Prof. Ir. Mahmud Sudibandriyo, M.Sc., Ph.D
- Prof. Dr. Ir. Gandjar Kiswanto, M.Eng
- Prof. Dr. Heri Hermansyah, S.T., M.Eng.
- Prof. Dr.-Ing. Ir. Dwita Sutjiningsih, Dipl.HE
- Prof. Dr. Ir. Sigit P. Hadiwardoyo, DEA
- Prof. Dr. Ir. Fitri Yuli Zulkifli, ST., M.Sc
- Prof. Dr. Kemas Ridwan Kurniawan, ST., M.Sc
- Prof. Dr. Ir. Asep Handaya, M.Eng
- Prof. Dr. Ir. Sunaryo
- Prof. Dr. Ario Sunar Baskoro S.T., M.T., M.Eng.
- Prof. Dr. Ir. M. Dachyar, M.Sc.
- Prof. Dr. Rachmat Nurcahyo
- Prof. Ir. Kamarza Mulia, M.Sc., Ph.D.
- Prof. Dr. Ir. Engkos Achmad Kosasih, M.T
- Prof. Dr.-Ing. Nasruddin
- Prof. Ir. Warjito, M.Sc., Ph.D.
- Prof. Dr. Ir. Muhamad Asvial, M.Eng
- Prof. Dr. Ir. Wahyu Nirbito, MSME
- Prof. Dr. Akhmad Hidayatno, S.T., MBT
- Prof. Dr. Eng. Ir. Sri Harjanto
- Prof. Dr. Ir. Setyo Sarwanto Mursidik, DEA
- Prof. Dr. Ir. Retno Wigajatri Purnamaningsih, MT
- Prof. Dr. Ir. Anak Agung Putri Ratna, M.Eng
- Prof. Mohammad Ali Berawi, ST, MEng.Sc, PhD
- Prof. Dr. Ir. Heru Purnomo, DEA.
- Prof. Ir. Evawani Ellisa, M.Eng., Ph.D.
- Prof. Dr. -Eng. Amalia Suzianti, S.T., M.Sc.

International Adjunct Professor

1. **Prof. Dr. Fumihiko Nishio,** fnishio@faculty.chiba-u.jp (Fundamental Research Field of Remote Sensing: Snow and Ice), Center for Environmental Remote Sensing (CEReS), Chiba University, Japan.
2. **Prof. Dr. Josaphat Tetuko Sri Sumantyo,** tetukoss@faculty.chiba-u.jp (Fundamental Research Field of Remote Sensing: Microwave Remote Sensing), Center for Environmental Remote Sensing (CEReS), Chiba University, Japan.
3. **Prof. Dr.-Ing. Axel Hunger**, axel.hunger@uni-due.de (Adaptive e-Learning, adaptive instructional systems, e-course and its applications, pedagogical analyses of on-line course), University of Duisburg Essen, Germany.
4. **Prof. Dr. Koichi Ito (Printed Antenna,** Small Antenna, Medical Application of Antenna, Evaluation of Mutual Influence between Human Body and Electromagnetic Radiations), Chiba University, Japan.
5. **Prof. Masaaki Nagatsu,** tmnagat@ipc.shizuoka.ac.jp, (Plasma Science and Technology) Research Institute of Electronics,Shizuoka University
6. **Prof. Michiharu Tabe,** tabe.michiharu@shizuoka.ac.jp, (Nano Devices) Research Institute of Electronics, Shizuoka University
7. **Prof. Hiroshi Inokawa,** inokawa06@rie.shizuoka.ac.jp, (Nano Devices), Research Institute of Electronics, Shizuoka University
8. **Prof. Hidenori Mimura,** mimura.hidenori@shizuoka.ac.jp, (Vacuum Electron Devices) Research Institute of Electronics, Shizuoka University
9. **Prof. Chit Chiow (Andy) Tan,** School of Mechanical, Manufacturing and Medical Engineering, Queensland University of Technology, Australia, Mechanical Engineering
10. **Prof. Kozo Obara,** Dept. of Nanostructure and Advanced Materials, Kagoshima University, Japan, Nanomaterial dan Energi
11. **Prof. Freddy Y.C. Boey,** Nanyang Technological University, Singapore, Nanomaterial dan Biomedical Engineering
12. **Prof. Kyoo-Ho Kim, Dr.Eng,** School of Material Science and Engineering, Yeungnam University, Korea, Nanomaterial dan Energi
13. **Prof. Bernard Cambou, Ecole Centrale de Lyon,France,** INRETS (French National Institue for Transport and Safety Engineering), Transport and Safety
14. **Prof. Chia-Fen Chi,** Dept. of Industrial Engineering, National Taiwan University Science and Technology, Industrial Management
15. **Prof. Dr. Katsuhiko Takahashi,** Dept. of Artificial Complex Systems Engineering, Hiroshima University, Japan, Artificial Complex System Engineering
16. **Prof. Martin Betts,** Faculty of Built Environment and Engineering, Queensland University of Technology, Australia.
17. **Prof. L. P. Lighart (Emeritus),** Delft University of Technology, Dutch
18. **Prof. Dr. Koichi Ito** (Printed Antenna, Small Antenna, Medical Application of Antenna, Evaluation of Mutual Influence between Human Body and Electromagnetic Radiations), Chiba University, Japan.
19. **Prof. Dr. Uwe Lahl** Technische Universität Darmstadt, Germany
20. **Prof. Dr. Tae Jo Ko,** tjko@yu.ac.kr (BSc. Pusan National University; MSc. Pusan National University; Ph.D Pohang Institute of Technology) Micromachining, Nontraditional Manufacturing, Machine Tools
21. **Prof. Dr. Keizo Watanabe** keizo@tmu.ac.jp (MSc. Tokyo Metropolitan University, 1970; Dr-Eng. Tokyo Metropolitan University, 1977) Drag Reduction, Fluid Mechanics
22. **Prof. Philippe Lours,** École nationale supérieure des mines d'Albi-Carmaux, (France) Superalloys, aerospace material

Academic Programs at FTUI

FTUI consists of seven Departments and **thirteen Undergraduate Study Programs**:

1. Civil Engineering
2. Environmental Engineering
3. Mechanical Engineering
4. Naval Architecture and Marine Engineering
5. Electrical Engineering
6. Computer Engineering
7. Metallurgical & Materials Engineering
8. Architecture
9. Interior Architecture
10. Chemical Engineering
11. Bioprocess Engineering
12. Industrial Engineering
13. Biomedical Engineering

Twelve Master Programs:

1. Civil Engineering
2. Mechanical Engineering
3. Electrical Engineering
4. Metallurgical and Material Engineering
5. Architecture
6. Chemical Engineering
7. Industrial Engineering
8. Biomedical Technology
9. Energy System Engineering
10. Environmental Engineering
11. Urban & Regional Planning
12. Materials Integrity Management

Seven Doctoral Programs:

1. Civil Engineering
2. Mechanical Engineering
3. Electrical Engineering
4. Metallurgical and Material Engineering
5. Architecture
6. Chemical Engineering
7. Industrial Engineering

and two Professional Program:

1. Professional Program for Engineers
2. Professional Program for Architect

Accreditation of FTUI Academic Programs

The National Board of Accreditation for Higher Education (BAN-PT) has awarded the following accreditation level for all study program in the Faculty of Engineering:

for Bachelor Programs:

1.	Civil Engineering :	Excellent
2.	Mechanical Engineering :	Excellent
3.	Electrical Engineering :	A
4.	Computer Engineering :	Excellent
5.	Metallurgical & Material Engineering :	Excellent
6.	Architecture :	Excellent
7.	Chemical Engineering :	Excellent
8.	Industrial Engineering :	Excellent
9.	Naval Architecture & Marine Engineering :	Excellent
10.	Environmental Engineering :	Excellent
11.	Architecure Interior :	Excellent
12.	Bioprocess Engineering :	Excellent
13.	Biomedical Engineering :	Good

Accreditation for Master Program is as follows:

1.	Civil Engineering :	A
2.	Mechanical Engineering :	A
3.	Electrical Engineering :	A
4.	Metallurgical and Materials Engineering :	A
5.	Architecture :	A
6.	Chemical Engineering :	Excellent
7.	Industrial Engineering :	Excellent
8.	Biomedical Technology :	B
9.	Energy System Engineering :	Very Good
10.	Environmental Engineering :	Good
11.	Urban & Regional Planning :	Good
12.	Materials Integrity Management :	Good

Accreditation for Doctoral Program is as follows:

1.	Civil Engineering :	Excellent
2.	Mechanical Engineering :	Excellent
3.	Electrical Engineering :	A
4.	Metallurgical and Materials Engineering :	Excellent
5.	Architecture :	A
6.	Chemical Engineering :	Excellent
7.	Industrial Engineering :	Excellent

In 2008 & 2010, the Departments of Mechanical Engineering, Civil Engineering, Electrical Engineering, Metallurgical and Materials Engineering, Architecture and Chemical Engineering have been accredited by the Asean University Network (AUN),

In 2013 Departments of Industrial Engineering have been accredited by the ASEAN University Network (AUN).In 2016 Department of Civil Engineering have been re-accredited by AUN. In 2017 Technology Bioprocess and Naval Architecture & Marine Engineering Study Program have been accredited by AUN. In 2017 Department of Chemical Engineering have been accredited by JABEE (Japan Accreditation Board for Engineering Education) & in 2018 Chemical Engineering & Bioprocess Engineering Study Program have been accredited by IABEE (Indonesian Accreditation Board for Engineering Education).

In 2018 Environmental Engineering Study Program have been accredited by AUN In 2019 Computer Engineering Study Program have been accredited by AUN

Undergraduate Regular Class Program

The Undergraduate Program in Universitas Indonesia focuses on producing graduates with the following qualifications:

- Having knowledge of the basic science and skill in particular field of study.
- Being able to implement the science, knowledge and skill acquired in accordance with their respective field of study.
- Being able to keep abreast the development and growth of science and technology.

The aim of Undergraduate Program in FTUI is to produce graduates with competencies set by the Accreditation Board for Engineering and Technology (ABET) and Washington Accord Based as follow:

- Being able to implement the basic science, the basic science of engineering, and technology.
- Being able to design and conduct experiments and data analyses.
- Being able to design system and its components.
- Understanding the professional responsibility and ethics.
- Being able to work together in a multidiscipline group.
- Being able to identify, formulate and solve engineering problems.
- Being able to communicate effectively.
- Having broad knowledge and understand of the technological impacts of their projects in both local and global scale.
- Having the motivation and ability to learn continously.
- Having knowledge of the latest engineering problems.
- Being able and skilled in using the latest engineering methods.
- Producing graduates from the Architecture Study Program with the competence in accordance to the National Architectural Accrediting Board (NAAB).

Besides ABET, FTUI has also received accreditation from the IABEE (Indonesian Accreditation Board for Engineering Education) based on the IABEE Criteria. IABEE Common Criteria (CC) are established as a framework to perform accreditation of higher education programs. These CC comprise of elements that must be fulfilled by the Study Program to be accredited. And the criteria are as follows:

- Programs to be accredited are four-year engineering Bachelor Programs or other higher education programs which IABEE considers as equivalent.
- The Program is not restricted to single Programs operated by a Department or Faculty. A Program may be formed and/or operated by multiple Departments / Faculties. Programs may include matriculated learning activities outside of its home campus, in conjunction with other higher education institutions.
- In cases where a Program is offered as parallel classes, evaluation by IABEE shall encompass all parallel classes. In cases where multiple Programs of the same nomenclature are offered in multiple locations by the same Program-Operating Institution (such as Programs established according to the Program Studi di Luar Kampus Utama (PKSDU) scheme as defined by the Indonesian Ministerial Regulation of Peraturan Menteri Riset, Teknologi, dan Pendidikan Tinggi No. 1/ 2017), evaluation by IABEE shall treat the parallel Programs as separate entities.
- The Program shall define the profile of autonomous professionals to be fostered, and define the knowledge, skills, and attitudes as Learning Outcomes that graduates are expected to master upon completion of their study.
- The Program should promote self-reliance, welfare, advancement, fairness and justice for the national and global community in general, based on science, technology, culture and sustainable utilization of natural resources.
- The Program is required to design the curriculum systematically to ascertain the achievement of Program Learning Outcomes. Student and faculty should be aware of these Learning Outcomes.
- The Program must disclose its Learning Outcomes to the public. The Program is also required to engage in continual improvement and at the same time to consider the sustainability of operation.
- Common Criteria consist of 4 elements, following the management approach of PDCA (Plan-DoCheck-Act) continual improvement cycle. Criterion:
    1. describes the orientation of the graduate competence,
    2. explains the learning implementation,
    3. explains the assessment of the expected Learning Outcomes,
    4. explains the continual improvements.
- In addition to these Common Criteria, Program seeking for accreditation shall fulfill also the Category and Discipline Criteria, as well as eligibility requirements and accreditation policies stipulated in the Rules and Procedures of Evaluation and Accreditation (RPEA).

Undergraduate Parallel Class Program

To improve the capacity usage for educational purposes, Universitas Indonesia has opened the Undergraduate Parallel Class Program. This program is provided with the same facilities and curriculum as those provided for the Undergraduate Regular Program. However, only eight out of thirteen study programs are available for future students to choose from.

The classes are held in FTUI Depok from morning to late evening, different from the classes of the regular program which are held from morning to early evening.

The Undergraduate Parallel Program allows all high school graduates from any years to register to the program. This differs from the Undergraduate Regular Program which limits registration to students with a maximum graduation time of three years. This arrangement makes this program available to all high school graduates from any years to pursue their Bachelor's degree.

Unlike the students of the Undergraduate Regular Program, the students of the Undergraduate Parallel Program are required to pay full education fees in accordance with the listed fees. This means that they are not allowed to apply for Biaya Pendidikan Berkeadilan (BOP-B), i.e. a cost reduction program allocated to their Regular Program classmates. The graduation requirements and accreditation for the Undergraduate Regular Program also apply to the Undergraduate Parallel Program.

International Undergraduate Program (Double-Degree & Single Degree)

Since 1999, the Faculty of Engineering has established an international undergraduate program in engineering (the double-degree program) with the following renowned Australian higher education institutions: Queensland University of Technology (QUT), Monash University, Curtin University of Technology, Deakin University, and the University of Queensland. Students can also continue their studies to the University of Duisburg Essen (UDE), Germany. Graduates from this international undergraduate program will be awarded both a Bachelor of Engineering degree from our University partner and a Sarjana Teknik degree from the Faculty of Engineering of UI when they return to FTUI and fulfill certain requirements. The double degree cooperation with QUT involves the study programs of Civil Engineering, Mechanical Engineering, Electrical Engineering, and Architecture. The double degree cooperation with Monash University involves the study programs of Metallurgical and Materials Engineering and Chemical Engineering. The double degree cooperation with Curtin University involves the study programs of Chemical Engineering, Architecture, Metallurgical and Materials Engineering, and Electrical Engineering, with other study programs to follow. The double degree cooperation with the University of Queensland involves the study programs of Civil Engineering, Mechanical Engineering, Electrical Engineering, Chemical Engineering, and Metallurgical and Materials Engineering. The double degree cooperation with UDE involves the study programs of Electrical Engineering and Metallurgical and Materials Engineering. This international undergraduate program provides high quality engineering education in the international level.

Before continuing their studies at our partner university, students should fulfill the minimum English proficiency in accordance with our partner university's requirement as stated in the Dean's Decree No. 740/D/SK/FTUI/IX/2018.

Since 2011, students have also had a choice to continue their final two years at FTUI as part of the newly opened Single Degree International Program. The undergraduate single degree international program was launched as a result of an increasing demand to provide an international quality education locally. Students in this program are not obligated to continue their last four semesters of studies at one of our partner universities like their classmates who wish to pursue a double degree. However, students of the single degree program are required to study abroad for at least one semester at an overseas university with academic link or cooperation with Universitas Indonesia. The list of universities can be found here: http://international.ui.ac.id/international-engagement.html. The aims are to widen the international perspective of the students, to provide students with the experience of studying in an overseas university, to enhance students' language capability, and to enhance students'

Before finishing their study, students should fulfill the minimum English proficiency level as the set forth in. Dean's Decree No.3 year 2019: achieved a minimum IELTS score of .0 with no bands lower than 5.5 or TOEFL iBT score of 75 with no bands lower than 17.

Undergraduate Parallel Class Program (Diploma Track)

The Undergraduate Parallel Program (Diploma Track) at FTUI was initiated in 1993 and it was named the Extension Program. At the beginning, the program was offered only by four Study Programs (Civil, Mechanical, Electrical, and Metallurgy Engineering). In 1995 the program was also opened by the Chemical Engineering Study Program (Gas and Petrochemical Engineering), followed by Industrial Engineering in 2002. Starting in 2011, the Undergraduate Extension Program of FTUI was closed. However, the faculty still provides future FTUI students that are graduates from the Diploma Program with the opportunity to continue their education at FTUI Undergraduate Program. Students are now able to apply through the Undergraduate Parallel Program (Diploma Track) by using the Credit Transfer System. The number of credits acknowledged will be decided by their respective Departments.

The Undergraduate Parallel Program is a full time academic program where students are expected to be full time students in campus. This is due to the schedule set for the program which starts from morning to afternoon. There are six Study Programs available to choose from: Civil Engineering, Mechanical Engineering, Electrical Engineering, Metallurgy and Materials Engineering, Chemical Engineering, and Industrial Engineering.

Professional Program

Professional Program for Architects

This one-year professional program is intended to provide graduates who have the ability to design with necessary professional skills and competence based on policies (code compliance) to be qualified architects. Graduates of this program may work in various fields within the construction industry as an executive architect or construction supervisor. Graduates may also work as researchers and lecturers at educational institutions associated with the field of architecture. Besides that, graduates may also choose to work in the fields of urban design, real estate, building maintenance, housing and settlements, and the environment, as well as becoming assessors for project feasibility studies or building managers. They might also work in the industry of building materials and elements or in the government sector and take charge of projects related to urban design, building, and development in the area of built environment.

Professional Program for Engineers

The aim of this Professional Program for Engineer is to fulfill the need for graduates with high competence in engineering, in accordance with the Engineer Law.

The Professional Program for Engineer aims to produce engineers with the following characteristics:

- Having an understanding of an engineer's code of ethics and engineer's code of conduct
- Having the necessary technical skills of an engineer, including consultation service, pre-design creation, licensing process, the development of design and completion of various technical and bidding documents.
- Having a sound understanding of code of compliances, including those related to providing service to clients, complying with current regulation, and dealing with various engineering problems such as those related to building construction and mechanical or electrical engineering

The Professional Program for Engineers Study Program is a higher education program which students may take after completing their undergraduate program in order to improve their engineering skills. Completing the Professional Program for Engineers is a prerequisite to acquire the title of an Engineer and to submit an application for professional certification. This program is a continuation of the existing undergraduate program in which graduates are expected to possess certain academic abilities: critical thinking (analytical and synthetic) and the ability to perform creative design. The undergraduate program is designed to be completed in 4 years (8 semesters) with 144 credits. To fulfill the requirements for obtaining the title of an Engineer, a graduate is required to pursue a further professional education for a minimum period of 1 year with 24 credits to complete. The composition of the curriculum of the Professional Program for Engineers is 84% engineering practices, including internship in any industry, case studies, and problem solving, and 16% face-to-face classroom lectures.

In the Ministry of Research, Technology, and Higher Education's Regulation, it is stated that the Professional Program for Engineers is a higher education program as a continuation of the undergraduate Bachelor's program designed to improve students' engineering competency. Graduates of this Professional Program for Engineers Study Program will be awarded with an Professional Engineer Certificate from the university and is entitled to use the professional engineering degree "Ir."

A person with a Professional Engineer Certificate is eligible to take the Professional Engineer Competence Examination held by a professional certification institution. Engineers that have passed this Professional Engineers Competence Examination will be awarded a Certificate of Competence as a professional engineer. Certificate of Competence is an important document which enables an individual to work as an Engineer, and this is also a requirement for obtaining the Engineer Registration Certificate issued by Persatuan Insinyur Indonesia (PII), an Indonesian professional engineers' association.

Master Program

The Master's Degree Program of the Faculty of Engineering, Universitas Indonesia, was opened in 1992 with four study programs: Civil Engineering, Mechanical Engineering, Electrical Engineering, and Metallurgical Engineering. In 2000, the faculty opened the Master's Degree Program for Chemical Engineering (from the Gas Engineering Study Program in the Metallurgical Engineering Department), Industrial Engineering (from the Industrial Management Study Program in the Mechanical Engineering Department), and Architecture.

Each Study Program in the Master's Degree Program is led by a Head of Study Program held ex-officio by the Head of the Department. Each Department has one or more specializations to provide in-depth and more specific engineering knowledge for each student of the said study program.

Types of Classes for Master Program:

- Regular Class Program is held full time from Monday – Friday in FTUI Campus, Depok.
- Special Class Program is held at specific with the following details:
    - Special Class program for Metallurgical & Materials Engineering: Saturday (08.00 am– 07.00 pm) in FTUI Campus, Depok.
    - Special Class program for Industrial Engineering: Friday (05.00 pm – 09.00 pm) and Saturday (08.00 am – 05.00 pm) in FTUI Campus, Salemba.
    - Special Class program for Energy System Engineering, Biomedical Technology, and other Special Class program: Monday – Friday (05.00 pm – 09.30 pm) in FTUI Campus, Salemba.

Doctoral Program

FTUI Doctoral program was officially opened in 2000 with two study programs: Civil Engineering and Electrical Engineering Doctoral Programs. This was followed by the inclusion of the Opto-electrotechnique and Laser Application study programs into the Postgraduate Program of FTUI. The Mechanical Engineering study program was officially opened in 2006, while the Metallurgical and Materials Engineering and Chemical Engineering Doctoral Programs were opened in 2007.

In 2009, the Department of Architecture opened the Architecture Doctoral Program. In 2011, the Opto-electrotechnique and Laser Application study programs were closed and merged into the Electrical Engineering study program. Department of Industrial Engineering opened the Industrial Engineering Doctoral Program in 2014. Each Doctoral study program is led by a Head of Study Program which is held ex-officio by the Head of the relevant Department at the Faculty of Engineering UI. FTUI Doctoral study programs have one or more focuses of study to provide more specific knowledge of a particular engineering field for all students of the program.

Department of Civil Engineering

General

The Department of Civil Engineering Universitas Indonesia has several study programs in the goal to become a center of knowledge and technology in Civil Engineering and Environmental Engineering and to play an important role in global market. Civil Engineering is the oldest engineering discipline and encompasses many specific areas. Civil engineering can be described as the application of engineering to civil society. It applies the principles of engineering to meet society's fundamental needs for housing, building, transportation, sanitation, and other necessities of a modern society. The engineers deal with the design, construction, and maintenance of the physical and naturally built environment, including works like roads, bridges, canals, dams, and buildings. Civil engineering education is to prepare students to be master planners, designers, constructors, and managers of various civil engineering works. The graduates can work in all levels: in the public sector from municipal to national governments, and in the private sector from individual homeowners to multinational companies in responding to current challenges such as construction and maintenance of facilities and infrastructure, climate change, natural disasters, traffic congestion and urban development.

Environmental engineering is defined as the branch of engineering concerned with the application of scientific and engineering principles for protection of human populations from the effects of adverse environmental factors; protection of environments, both local and global, from the potentially deleterious effects of natural and human activities; and improvement of environmental quality. Tasks of environmental engineers include evaluation of environmental quality of water, air, and soil by developing strategies and methods, design of facilities or programs, evaluation of results and assessment of the economics and efficiency of processes. The Environmental Engineering Study Program provides graduates with professional and competence in planning, designing, constructing, and managing environmental infrastructure for: drinking water treatment, liquid and solid waste management, drainage, environmental sanitation, water resources, air pollution, pollution prevention, and environmental impact assessment.

The Civil Engineering Department, previously known as the Civil Engineering Study Program, was established together with the Faculty of Engineering of Universitas Indonesia (FTUI) on July 17th, 1964. During its initial stage of development, the Civil Engineering Department of FTUI offered only one study program, i.e. Civil Engineering, with two majors: structural engineering and water resources engineering. In response to the demand and development of science and technology, the study program was then expanded to cover four additional majors, i.e. transportation engineering, geotechnical engineering, sanitary engineering, and construction management. With the improvement of human resources and facilities, the two-level Postgraduate Programs of Master's Degree (S2) and Doctoral Degree (S3) were established in 1992 and 2001, respectively. In 2006, the Department established the undergraduate program of Environmental Engineering. Previously, Environmental Engineering is one of the majors in Civil Engineering. There are eight specializations for Master's Degree Program and Doctoral Program in Civil Engineering, consisting of structural engineering, geotechnical engineering, water resources management, transportation system and engineering, construction management, environmental engineering, project management, and infrastructure management.

To maintain its quality, the Department has been regularly accredited by the National Accreditation Board (Badan Akreditasi Nasional Pendidikan Tinggi or BAN-PT) since 1998. Civil Engineering Study Programme and Environmental Engineering Study Programme, both have reached the highest grade of "Unggul" and Civil Engineering Magister Study Programme and Civil Engineering Doctoral Study Programme have reached grade "A". The Environmental Engineering Study Program was accredited nationally in 2010. The undergraduate program of Civil Engineering was accredited internationally in 2001 by the Joint Board of Moderators of the Engineering Council consisting of the Institution of Structural Engineers (ISE), Institution of Civil Engineers (ICE), and Chartered Institution of Building Service Engineers of the United Kingdom. However, due to changes in their policy, reaccreditation was discontinued. In 2008, the undergraduate program of Civil Engineering was assessed by the ASEAN University Network – Quality Assurance Program (AUN-QA). In order to maintain the quality of education in the Department, AUN-QA reassessment was conducted in 2015. The Environmental Engineering S1 program assessment was performed by the ASEAN University Network (AUN) in 2018, and the formal results are being processed by AUN. In 2019, Civil Engineering and Environmental Engineering undergraduate programs are accredited with general accreditation by IABEE (Accreditation Board for Engineering Education).

Corresponding Address

Departemen Teknik Sipil

Fakultas Teknik Universitas Indonesia

Kampus UI Depok 16424, Indonesia

Telp: +62-21-7270029

Email: civil@eng.ui.ac.id, civil@ui.ac.id

Website: http://www.civil.ui.ac.id

http://instagram.com/ceeftui

Vision

"To become a center of knowledge and technology in Civil Engineering and Environmental Engineering and to play an important role in global market"

Missions

- To improve the quality of graduates in mastering Civil and Environmental Engineering knowledge with solid foundation, and to provide them with internationally standardized environmental insight
- To actively contribute ideas through research including direct involvement in community service that is oriented to the development of facilities and infrastructure in the Civil and Environmental Engineering discipline, as well as reflecting upon the balanced relationships between human beings and nature.
- To shape and build students that can demonstrate strong leadership and independent personality, along with the ability to socialize, communication effectively and uphold profession ethics.

Staffs of The Department Of Civil Engineering

Ayomi Dita Rarasati , ST, MT, PhD
Head of Department

Ayomi Dita Rarasati , ST, MT, PhD
Head of Civil Engineering Study Program

Dr. Cindy Rianti Priadi, S.T.,
Head of Environmental Engineering Study Program:

Andyka Kusuma, ST, MSc, PhD
Vice Head of Department

Head of Laboratory

Dr-Ing. Josia Irwan Rastandi, ST. MT
Head of Structure and Materials Laboratory

Dr. Ir. Wiwik Rahayu
Head of Soil Mechanics Laboratory

Dr. Dwinanti Rika Marthanty, ST, MT
Head of Hydraulics, Hydrology and River Laboratory

Ir. R. Jachrizal Sumabrata, M.Sc., PhD
Head of Transportation Laboratory

Leni Sagita Riantini, ST, MSc, PhD
Head of Mapping and Surveying Laboratory

Dr. RM. Sandyanto Aditiyosulindro, ST, MSc
Head of Sanitation & Environment Laboratory

Dr-Eng. Mochammad Adhiraga Pratama, ST, MT
Head of Air Quality and Solid Waste Management Laboratory

Board of Professors

1. **Prof. Dr. Ir. Budi Susilo Soepandji, DEA,**
budisus@eng.ui.ac.id (Ir, UI; DEA, Dr, Ecole Centrale Paris; Prof, UI) Geotechnic
2. **Prof. Dr. Ir. Irwan Katili, DEA,**
irwan.katili@gmail.com (Ir, UI; DEA, Dr, Universite Technique de Compiegne; Prof. UI) Structure
3. **Prof. Dr. Ir. Sutanto Soehodho, M.Eng.,**
tanto@eng.ui.ac.id (Ir, UI, M.Eng, Dr, Tokyo University; Prof. UI) Transportation
4. **Prof. Dr. Ir. Yusuf Latief, MT.,**
latief73@eng.ui.ac.id (Ir, UI; MT, Dr, UI; Prof. UI) Project Management
5. **Prof. Dr. Ir. Djoko M. Hartono, SE., M.Eng.,**
djokomh@eng.ui.ac.id (Ir, ITB; M.Eng, Asian Institute of Technology; Dr, UI; Prof, UI) Environment
6. **Prof. Setyo Sarwanto Moersidik,**
ssarwanto@eng.ui.ac.id (Ir, ITB; DEA, Dr, Universite'de Montpellier II) Environment
7. **Prof. Dr. Ir. Sigit Pranowo Hadiwardoyo, DEA.,**
sigit@eng.ui.ac.id (Ir, UI; DEA, Ecole Centrale de Lyon; Dr, Ecole Centrale Paris; Prof. UI) Transportation
8. **Prof. Ir. Widjojo Adi Prakoso, M.Sc., PhD.**
wprakoso@eng.ui.ac.id (Ir, UI; MSc, PhD, Cornell University; Prof. UI) Geotechnic
9. **Prof. Dr.-Ing. Ir. Dwita Sutjiningsih, dipl. HE,**
dwita@eng.ui.ac.id (Ir, UI; Dipl.HE, Institute of Hydraulics Engineering (IHE); Dr.-Ing, Institut fur Wasserwirtshaft, Univ. Hannover) Water Resources Management
10. **Prof. Mohammed Ali Berawi, ST, MEng.Sc, PhD;**
maberawi@eng.ui.ac.id (ST, Unsri; M.Eng.Sc, University of Malaya; Ph.D, Oxford Brookes University) Construction Management: Project Management
11. **Prof. Dr. Ir. Heru Purnomo, DEA**
herupur@eng.ui.ac.id (Ir, UI; DEA, Universite' Blaise Pascal; Dr, Universite'd"Orle'ans) Structure

Full-Time Faculty

1. **Alvinsyah,**
alvinsyah_2004@yahoo.com (Ir, UI; M.S.E., University of Michigan, Ann Arbor, USA) Transportation
2. **Andyka Kusuma,**
andyka.k@ui.ac.id (ST, UI; MSc, Kungliga Tekniska Hogskolan, Swedia; PhD, University of Leeds) Transportation
3. **Ayomi Dita Rarasati,**
ayomi@eng.ui.ac.id (ST, MT, UI; Ph.D, QUT Australia) Construction Management; Project Management
4. **Bastian Okto Bangkit Sentosa,**
bastian.sentosa@ui.ac.id (S.T., UI; M.T., UI; M.Rech.; INSA Lyon, Dr. Université Savoie Mont Blanc), Structure
5. **Budi Susilo Soepandji,**
budisus@eng.ui.ac.id (Ir, UI; DEA, Dr, Ecole Centrale Paris; Prof, UI) Geotechnic
6. **Cindy Rianti Priadi,**
cindy.priadi@eng.ui.ac.id (ST, ITB; MSc, University Paris-7-Paris12-ENPC; Dr, Univ. Paris Sud, 2010) Environmental Engineering
7. **Djoko M. Hartono,**
djokomh@eng.ui.ac.id (Ir, ITB; M.Eng, Asian Institute of Technology; Dr, UI; Prof, UI) Environmental Engineering
8. **Dwita Sutjiningsih,**
dwita@eng.ui.ac.id (Ir, UI; Dipl.HE, Institute of Hydraulics Engineering (IHE); Dr.-Ing, Institut fur Wasserwirtshaft, Univ. Hannover) Water Resources Management
9. **Evi Anggraheni.,**
evi.anggraheni@yahoo.com (S.T., UB; M.T., UI; Dr. (UI-Ecole Centrale de Nantes), Water Resources Engineering
10. **Erly Bahsan,**
erlybahsan@eng.ui.ac.id (ST, M.Kom, UI; Kandidat Dr, NTUST) Geotechnic
11. **Fadhilah Muslim,**
Fadhilahmuslim@ui.ac.id (S.T., UI; M.Sc., École des Ponts ParisTech (ENPC), Ph.D., Imperial College London); Structure, Construction Management
12. **Firdaus Ali,**
firdaus108@hotmail.com (Ir, ITB; MSc, PhD, University of Wisconsin) Environmental Engineering
13. **Gabriel Sudarmini Boedi Andari,**
andari@eng.ui.ac.id (Ir, ITB; M.Eng, RMIT; PhD, Texas Southern University) Environmental Engineering
14. **Henki Wibowo Ashadi,**
henki@eng.ui.ac.id (Ir, UI; Technische Hochschehule Darmstadt; Dr-Ing, TH Darmstadt) Structure
15. **Imam Jauhari Maknun,**
jauhari.imam@gmail.com (S.T., UI; M.T., UI; M.Sc., University of La Rochelle; Dr., University of La Rochelle), Structure
16. **Irwan Katili,**
irwan.katili@gmail.com (Ir, UI; DEA, Dr, Universite Technique de Compiegne; Prof. UI) Structure
17. **Jessica Sjah,**
jessicasjah@eng.ui.ac.id (ST, UI; MT, UI; MSc, Ecole Centrale de Lyon; Dr, Ecole Centrale de Lyon) Structure
18. **Josia Irwan Rastandi,**
jrastandi@eng.ui.ac.id (ST, MT, UI; Dr-Ing, Technische Universtat Munchen) Structure
19. **Leni Sagita,**
lsagita@eng.ui.ac.id (ST, MT, UI; Ph.D., NUS, Singapore) Construction Management: Project Management
20. **Martha Leni Siregar,**
leni@eng.ui.ac.id (Ir, UI; MSc, Univ.of Southampton) Transportation
21. **Mochammad Adhiraga Pratama,**
adhiraga@eng.ui.ac.id (S.T., ITB; M.T., ITB; Dr. Eng., Kyoto University), Environmental Engineering
22. **Mohammed Ali Berawi,**
maberawi@eng.ui.ac.id (ST, Unsri; M.Eng.Sc, University of Malaya; Ph.D, Oxford Brookes University) Construction Management: Project Management
23. **Mulia Orientilize,**
mulia@eng.ui.ac.id (ST, UI; M.Eng, Nanyang Technological University) Structure
24. **Nahry,**
nahry@eng.ui.ac.id (Ir, MT, Dr, UI) Transportation
25. **Nuraziz Handika,**
nuraziz.handika@gmail.com (S.T., UI; M.T., UI; M.Sc., National Taiwan University of Science and Technology; Dipl.-Ing, Ecole Centrale de Nantes; Dr., INSA de Toulouse) Structure
26. **Nyoman Suwartha,**
nsuwartha@eng.ui.ac.id (ST, MT, UGM; M.Agr, Dr, Hokkaido University) Environmental Engineering
27. **Rahayu Setiawaty,**
rahayu.s.arifin@gmail.com (Ir, ITB; MSc, ITB; Dr, UI) Project Management; Construction Management
28. **R. Jachrizal Soemabrata,**
rjs@eng.ui.ac.id (Ir, UI; MSc, Leeds Univ; Dr, Melbourne University) Transport
29. **RM. Sandyanto Adityosulindro,**
rm.sandy.ui@gmail.com (S.T., UI; M.T., UI; M.Sc., Université Lille 1; Dr., Institut National Polytechnique De Toulouse) Environmental Engineering
30. **RR. Dwinanti Rika Marthanty,**
dwinanti@eng.ui.ac.id (ST, MT, UI; Dr, UI, Université Lille 1) Water Resources Management
31. **Setyo Sarwanto Moersidik,**
ssarwanto@eng.ui.ac.id (Ir, ITB; DEA, Dr, Universite'de Montpellier II) Environmental Engineering
32. **Sigit Pranowo Hadiwardoyo,**
sigit@eng.ui.ac.id (Ir, UI; DEA, Ecole Centrale de Lyon; Dr, Ecole Centrale Paris; Prof. UI) Transportation
33. **Sutanto Soehodho,**
tanto@eng.ui.ac.id (Ir, UI, M.Eng, Dr, Tokyo University; Prof. UI) Transportation
34. **Toha Saleh,**
toha@eng.ui.ac.id (ST, UI; MSc, University of Surrey) Water Resources Management
35. **Rossy Armyn Machfudiyanto,**
rossyarmyn@gmail.com (ST, UGM; MT, UI; Dr, UI); Manajemen Proyek; Project Management; Construction Management

36. **Widjojo Adi Prakoso,**
wprakoso@eng.ui.ac.id (Ir, UI; MSc, PhD, Cornell University) Geotechnicsity) Geotechnic

37. **Wisnu Isvara,**
isvara0307@yahoo.com (ST, UI; MT, UI; Dr, UI); Project Management; Construction Manajement

38. **Wiwik Rahayu,**
wrahayu@eng.ui.ac.id (Ir, UI; DEA, Dr, Ecole Centrale de Paris) Geotechnic

39. **Yuskar Lase,**
yuskar@eng.ui.ac.id (Ir, UI; DEA, Dr, Ecole Centrale de Lyon) Structure

40. **Yusuf Latief,**
latief73@eng.ui.ac.id (Ir, UI; MT, Dr, UI; Prof. UI) Project Management; Construction Management

Part-Time Faculty

1. **Prof. Dr. Ir.Tommy Ilyas, M.Eng.,**
t.ilyas@eng.ui.ac.id (Ir, UI; M.Eng, Sheffield University; Dr, UI; Prof. UI) Geotechnic

2. **Alan Marino**
alanmarino@eng.ui.ac.id (Ir, UI; M.Sc., Wisconsin Madison Univ., USA) Transportation

3. **Dwica Wulandari,**
dwicawd@eng.ui.ac.id (ST, UI; MT, UI; M.Sc Chalmers University of Technology); Environmental Engineering

4. **El Khobar Muhaemin Nazech**,
elkhobar@eng.ui.ac.id (Ir, UI; M. Eng, Asian Institute of Technology) Environmental

5. **Ellen SW Tangkudung,**
ellen@eng.ui.ac.id (Ir, UI; M.Sc, ITB) Transportation

6. **Elly Tjahjono,**
elly@eng.ui.ac.id (Ir, UI; DEA, Insa de Lyon, Perancis; Dr, UI) Structure

7. **Essy Ariyuni,**
essy@eng.ui.ac.id (Ir, ITS; MSc, University of Wisconsin; Dr, Queensland University of Technology) Structure

8. **Irma Gusniani,**
iirma@eng.ui.ac.id (Ir, ITB; MSc, University of Colorado) Environmental Engineering

9. **Iwan Renadi Soedigdo,**
irs1210@yahoo.com (Ir, UI; MSCE, The George Washington University; Ph.D, Texas A&M University) Structure

10. **Heddy Rohandi Agah,**
agah@eng.ui.ac.id (Ir, UI; M.Eng, Asian Institute of Technology) Transportation

11. **Madsuri**
madsuri@eng.ui.ac.id (Ir, MT, UI) Structure

12. **Nabila Putriyandri Alifa,**
nabilapalifa@eng.ui.ac.id (ST, UI; MSc, Wageningen University, Belanda); Enviromental Engineering

13. **Sjahril A. Rahim,,**
syahril@eng.ui.ac.id (Ir, UI; M.Eng, Asian Institute of Technology) Structure

14. **Setyo Supriyadi,**
setyosuprijadi@yahoo.com (Ir, Msi, UI) Structure

15. **Siti Murniningsih,**
titik_winarno@yahoo.com (Ir, Undip; MS, ITB) Water Resources Management

16. **Tri Tjahjono,**
tjahjono@eng.ui.ac.id (Ir, UI; MSc, Ph.D, Leeds University) Transportation

17. **Titi Sari Nurul Rachmawati,**
titisari.nurul@gmail.com (ST, UI; MSc, KTH Royal Institute of Technology Swedia); Project Management; Construction Management

18. **Astryd Viandila Dahlan,**
dwicawd@eng.ui.ac.id (ST, ITB; MEng, Tokyo Institute of Technology, JAPAN; Dr, Tokyo Institute of Technology, JAPAN); Enviromental Engineering

19. **Lucky Caesar Direstiyani,**
luckycaesar@eng.ui.ac.id (ST, ITS; MSc, Pusan National University (PNU), Busan, South Korea); Enviromental Engineering

20. **Ni Putu Sri Wahyuningsih,**
nsriwahyuningsih@eng.ui.ac.id (ST, ITB; MSc, Szent István University, Hungary); Environmental Engineering

21. **Nopa Dwi Maulidiany,**
nd.maulidiany@ac.ui.id (ST, ITB; MT, ITB; PhD, Environmental Engineering University of Southampton) Environmental Engineering

22. **Sucipta Laksono,**
sucipta.laksono04@ui.ac.id (S.T., Universitas Indonesia; M.T., Universitas Indonesia, Dr.-Ing., Universität Duisburg-Essen)

23. **Ridwan Hakim,**

24. **Iftita Rahmatika,**
iftita.r@ui.ac.id (ST, PSTL UI; M.Eng, Environmental Engineering Chulalongkorn University, PhD, Department of Urban Engineering, the University of Tokyo)

Department of Mechanical Engineering

General

The Department of Mechanical Engineering was previously known as the Mechanical Engineering Study Program. The department was established at the same time as the Faculty of Engineering of Universitas Indonesia on November 27th, 1964 in Salemba, Jakarta. Currently there are two study programs within the department, which are the Mechanical Engineering Study Program and the Marine Engineering Study Program. The mechanical engineering study program provides its students with the knowledge which focuses on Energy Conversion, Product Design, Manufacturing Process, and also the fundamentals of the industrial operations and managerial system. The Marine Engineering study program provides its students with the knowledge which focuses on ship design, ship manufacturing process, ship maintenance, ship machinery installation, and also marine rules and laws. The graduates of the mechanical engineering program have worked in several areas, such as the automotive industry, oil and gas industry, heavy duty engine industry, educational institutions, research institutions, and other industries. The Department of Mechanical Engineering organizes several academic programs, which consist of Bachelor's Degree (Regular, Parallel, and International classes), Master's Degree, and Doctoral Degree. Since August 2007, the Department of Mechanical Engineering has received the ISO 9001: 2000 for the quality management system in the Mechanical Engineering Study Program. In 2011, the Department of Mechanical Engineering once again received the ISO 9001: 1008 for the quality management system. Certification by international agencies is part of the Department's commitment to maintaining a high-quality management, as well as ensuring and enhancing academic quality and stakeholders' satisfaction. The Mechanical Engineering Study Program also received the highest academic accreditation level as required by the National Accreditation Board in 2005, with the last achievement of "Unggul or Excellent" ranking in 2021. In 2008, the Department of Mechanical Engineering also gained international recognition in the form of accreditation by the ASEAN University Network (AUN). In 2018, the Department of Mechanical Engineering gained international recognition again in the form of General Accreditation by the Indonesia Accreditation Board for Engineering Education (IABEE). This again shows the commitment of the Department of Mechanical Engineering to offering international education and to achieving excellence in its areas of study, as clearly specified in the Department's vision, missions, and goals.

A nation's development very much depends on the development of its human resources. Included in these resources are people who set the direction, determine the goals, implement those goals, and develop their own lives as an integral part of the nation. By having good human resources, the nation is expected to be able to lead its members to prosperity and affluence. Therefore, the development of human resources becomes the key to national development. Higher education in Indonesia is part of the National Education System which aims to develop the intellectual life of the nation by developing its human resources and carrying out three main activities referred to as the "Tridharma", which consist of these obligations:

- To Provide higher level education
- To Conduct scientific research
- To perform the Community service

In order to develop human resources for the welfare of the whole nation, the Department of Mechanical Engineering has determined those three main activities as the main goals and reference when conducting its academic activities. In terms of education, the goal is to produce graduates who are able to analyze and synthesize the characteristics of mechanical systems, to design and plan systems and mechanical equipment, to manage production installations, to analyze and solve various scientific problems, to work together in teams, and to develop their personality and knowledge. Those graduates are also expected to demonstrate commendable intellectual attitudes, as well as being able to apply systematic, logical, and integrated ways of thinking. In terms of research, the Department of Mechanical Engineering has set itself a goal to contribute to and play an active role in the development of mechanical science and technology as well as continuously improving its educational process by taking account of new inputs. Moreover, in terms of community service, the Department aims to share beneficial ideas and to ensure direct involvement in quality improvement and enhancement of community and industry. To answer the demand for graduate academic programs that include character building, leadership, as well as academic and professional excellence in the field of Mechanical Engineering at all levels of education (Bachelor's, Master's, and Doctoral), the Department of Mechanical Engineering has developed a competency-based academic curriculum which is implemented by means of student-centered learning and teaching activities. According to such curriculum, research activities become a major aspect in the Doctoral Degree.

The 2020 curriculum has been designed in such a way as to integrate Bachelor's, Master's, and Doctoral education schemes, so it is possible for a student with an excellent academic record to take courses normally offered in a higher level (i.e. Master's and Doctoral) by adhering to the credit transfer regulation and taking the Fast Track Program.

More detailed information about each of the courses offered by the Mechanical Engineering and Naval Architecture and Marine Engineering Study Programs, about the main academic competence, and about other supporters of the graduates of each study program are given in the following section.

Contact

Department of Mechanical Engineering

Universitas Indonesia

Kampus UI, Depok, 16424.

Tel. +62 21 7270032

Fax +62 21 7270033

e-mail : mesin@eng.ui.ac.id

http://mech.eng.ui.ac.id

Vision

"To Become the center of the excellent research and education services in Mechanical Engineering"

Mission

"To conduct research and research-based education for the development of science and technology in the field of mechanical engineering, and to conduct research and education and use it to improve the quality of life and humanity"

Staffs of The Department Of Mechanical Engineering

Prof. Dr. Ario Sunar Baskoro, ST., MT., M.Eng
Head of Department

Dr. Agus S. Pamitran, ST., M.Eng
Vice Head of Department

Dr. Agus S. Pamitran, ST., M.Eng
Head of Mechanical Engineering Study Program

Dr.-Ing. Mohammad Adhitya, S.T., M.Sc.
Head of Naval Architecture and Marine Engineering Study Program

Dr. Radon Dhelika, B.Eng, M.Eng
Assistant to Vice Head for Academic Affairs

Dr.Eng. Arnas Lubis, ST., MT.
Assistant to Vice Head for Non-Academic Affairs

Dr. Yudan Whulanza, ST., MSc.
Cooperation Relationship Coordinator

Sugeng Supriadi, ST., MS.Eng., Ph.D
Research Coordinator

Agung Shamsuddin, ST., MS.Eng., PhD.
Venture Coordinator / Director of P2M

Head of Laboratory

Prof. Dr. Ir. Wahyu Nirbito, MSME
Head of Mechanical and Biomechanic Design Laboratory

Prof. Dr. Ir. Danardono A.S., DEA, PE
Head of Mechanical Technology Laboratory

Prof. Dr. Ir. Yulianto S. Nugroho, MSc, PhD.
Head of Thermodynamics Laboratory

Prof. Dr. Ir. Engkos Achmad Kosasih, MT.
Head of Heat Transfer Laboratory

Dr.-Ing. Ridho Irwansyah, ST., MT.
Head of Fluid Mechanics Laboratory

Agung Shamsuddin, ST., MS.Eng., PhD.
Head of Manufacture and Otomatization Laboratory

Prof. Dr.-Ing Ir. Nasruddin, M.Eng
Head of Air-conditioning Engineering Laboratory

Head of Research Cluster- Kelompok Ilmu (KI)

Prof. Dr. Ir. Yulianto S. Nugroho, MSc., Ph.D.
Head of Research Cluster of Energy Conversion

Prof. Dr. Ir. Gandjar Kiswanto, M.Eng.
Head of Research Cluster of Design, Manufacture and Automation

Prof. Dr. Ir. Yanuar, M.Eng., M.Sc
Head of Research Cluster of Naval Architecture and Marine Engineering:

Board of Professor

1. **Prof. Dr. Ir. M. ldrus Alhamid,**
mamak@eng.ui.ac.id (Ir. UI, 1978; Dr. K.U. Leuven Belgium, 1988) *Refrigeration and Air Conditioning, Solar Thermal Energy, Energy Conversion*

2. **Prof. Dr. Ir. Sunaryo,**
naryo@eng.ui.ac.id (Ir. UI, 1981; Dr., Strathclyde Univ. Scotland, 1992) *Manajemen Produksi Kapal, Tata Galangan Kapal, Teknik Pembangunan Kapal*

3. **Prof. Dr. Ir. Raldi Artono, DEA,**
koestoer@eng.ui.ac.id (Ir. UI, 1978; DEA Univ.de Poitier, 1980; Dr. Univ. Paris XII France, 1984) *Heat Transfer*

4. **Prof. Dr. Ir. Tresna P. Soemardi, ,**
tresdi@eng.ui.ac.id (SE. UI, 1987; Ir. ITB, 1980; MSi UI, 1985; Dr. Ecole Centrale de Paris France, 1990) *Product Design, Composite*

5. **Prof. Dr. Ir. R. Danardono Agus S., DEA,**
danardon@eng.ui.ac.id (Ir. UI, 1984; DEA Ecole Centrale de Lyon, 1989; Dr. Univ. d'Orleans France, 1993) *Engineering Drawing, Automotive Engineering*

6. **Prof. Dr. Ir. Engkos Achmad Kosasih, MT.,**
kosri@eng.ui.ac.id (Ir. UI, 1991; MT. ITB, 1996; Dr. UI, 2006) *Heat Transfer, Drying Engineering, Numerical Method, Control Engineering*

7. **Prof. Dr-Eng. Ir. Yanuar, M.Eng., MSc.,**
yanuar@eng.ui.ac.id (Ir. UI, 1986; M.Eng. Hiroshima Univ. Japan, 1992; MSc Tokyo Metropolitan Univ. 1996; Dr. Eng. Tokyo Metropolitan Univ. Japan, 1998) *Fluid Mechanics, Ship Resistance and Propulsion*

8. **Prof. Dr. Ir. Adi Suryosatyo,**
adisur@eng.ui.ac.id (Ir. UI, 1996; M.Sc., UTM-Malaysia 1999; Dr., UTM-Malaysia, 2002) *Gasification, Power Generation, Wind Power*

9. **Prof. Dr. Ir. Bambang Sugiarto, M.Eng.,**
bangsugi@eng.ui.ac.id (Ir, UI, 1985; M.Eng, Hokkaido Univ., Japan, 1991; Dr. Eng, Hokkaido Univ., Japan, 1994) *Internal Combustion Engine*

10. **Prof. Ir. Warjito, M.Sc., Ph.D.,,**
warjito@eng.ui.ac.id (Ir. UI, 1988; M.Eng., Hokkaido Univ., 1999; Dr. Eng, Hokkaido Univ., 2002) *Fluid Mechanics, Piping System, Maintenance Engineering*

11. **Prof. Dr. Ir. Yulianto S. Nugroho, M.Sc**
yulianto@eng.ui.ac.id (Ir. UI, 1992; MSc Leeds Univ., UK, 1995; Ph.D. Leeds Univ., UK, 2000) *Energy and Combustion Engineering, Spontaneous Coal Combustion, Fire Safety Engineering*

12. **Prof. Dr. Ir. Harinaldi, M.Eng,**
harinald@eng.ui.ac.id (Ir. UI, 1992; M.Eng, Keio Univ. Japan, 1997; Dr.Eng, Keio Univ. Japan, 2001) *Thermofluids Engineering, Reacted System Fluid Dynamics, Engineering Statistics*

13. **Prof. Dr.-Ing Nandy S. Putra,**
nandyputra@eng.ui.ac.id (Ir. UI, 1994; Dr-Ing. Universität der Bundeswehr Hamburg Germany, 2002) *Heat Transfer, Energy Conversion*

14. **Prof. Dr.-Ing. Nasruddin,**
nasruddin@eng.ui.ac.id (Ir. UI, 1995; M.Eng., KU Leuven Belgium, 1998; Dr.-Ing, RWTH-Aachen, 2005) *Refrigeration Engineering, Energy Conversion, Energy System Optimization*

15. **Prof. Dr. Ir. Gandjar Kiswanto**,
gandjar_kiswanto@eng.ui.ac.id (Ir. UI, 1995; M.Eng, KU Leuven Belgium, 1998; Dr., KU Leuven Belgium, 2003) *Intelligent Manufacturing System, Automation, Robotics, Advanced CAD/CAM, Multi-axis Machining*

16. **Prof. Dr. Ario Sunar Baskoro, ST., MT., M.Eng.,**
ario@eng.ui.ac.id (ST. UI, 1998; MT. UI 2004; MEng – Keio University 2006; Dr., Keio Univ, 2009) *Welding Engineering, Robotics, Mechatronics*

17. **Prof. Dr. Ir. Wahyu Nirbito, MSME,**
bito@eng.ui.ac.id (Ir. UI, 1982; MSME, Univ. of Minessota USA, 1987; Dr. UI, 2011) *Vibration Engineering, Gas Turbine, Condition Monitoring*

International Andjunct Professor

1. **Prof. Dr. Tae Jo Ko,**
tjko@yu.ac.kr (BSc. Pusan National University; MSc. Pusan National University; Ph.D Pohang Institute

of Technology) *Micromachining, Nontraditional Manufacturing, Machine Tools*

2. **Prof. Dr. Keizo Watanabe,**
keizo@tmu.ac.jp (MSc. Tokyo Metropolitan University, 1970; Dr-Eng. Tokyo Metropolitan University, 1977) D*rag Reduction, Fluid Mechanics*

3. **Prof. Dr. Kiyoshi Saito,**
saito@waseda.jp (B.Eng. Waseda Univ, 1992; M.Eng. Waseda Univ, 1994; Dr.Eng. Waseda Univ, Japan, 1997) *Heat Pump, Refrigeration & Air Conditioning*

4. **Prof. Dr. T.M. Indra Mahlia,**
TMIndra.Mahlia@uts.edu.au (Ir. Univ. Syiah Kuala, 1994; M.Eng.Sc. Univ. Malaya, 1997; Ph.D. Univ. Malaya, 2003) *Bioenergy*

Full-Time Faculty

1. **Achmad Riadi,**
achmadriadi@ui.ac.id (ST. Universitas Hasanuddin, 2004; M.Eng. Tokyo Univ. of Marine Science and Technology, 2010; Ph.D. - Tokyo Univ. of Marine Science and Technology, 2013) *Naval Architecture, Maritime Logistic*

2. **Agung Shamsuddin,**
ashamsuddin@eng.ui.ac.id (ST. UI, 2004; MSEng. Yeungnam Univ., 2007; Ph.D - Yeungnam Univ., 2015) *Microfabrication, Manufacturing Engineering*

3. **Agus Sunjarianto Pamitran,**
pamitran@eng.ui.ac.id (ST. UI, 1999; M.Eng. Chonnam University, 2004; Dr. Chonnam University, 2009) *Two-phase Flow, Refrigeration Engineering*

4. **Ahmad Indra Siswantara,**
a_indra@eng.ui.ac.id (Ir. UI, 1991; Ph.D., UTM - Malaysia, 1997) Computational Fluid Dynamics (CFD), Fluid Mechanics

5. **Ardiyansyah,**
ardiyansyah@eng.ui.ac.id (ST. UI, 2002; MEng. Chonaam Univ. 2007; Ph.D, Oklahoma State Univ, USA, 2015) *Heat Transfer, Refrigeration Engineering*

6. **Firman Ady Nugroho,**
firman_ady@eng.ui.ac.id (ST. UI, 2011; MT. UI 2013) *Ship Construction, Ship Materials*

7. **Gatot Prayogo,**
gatot@eng.ui.ac.id (Ir. FTUI, 1984; M.Eng Toyohashi Univ. of Technology-Japan, 1992; Dr. UI, 2011) *Fracture Mechanics, Strength of Materials*

8. **Gerry Liston Putra,**
gerry@eng.ui.ac.id (ST. UI, 2011; MT. UI, 2013; Cand Doctor, Kyushu Univ, Japan) *Ship Material, Ship Structure*

9. **Gunawan**,
gunawan_kapal@eng.ui.ac.id (ST. UI, 2010; MT. UI, 2012; Cand. Doctor – Hiroshima Univ. Japan), *Ship Machinery, Resistance and Propulsion System, Ship Production*

10. **Hendri Dwi Saptioratri Budiono**,
hendri@eng.ui.ac.id (Ir. UI, 1985; M.Eng, Keio Univ. Japan, 1992; Dr. UI, 2014) *Mechanical Design, Design for Manufacture and Assembly*

11. **Henky Suskito Nugroho,**
gagah@eng.ui.ac.id (Ir. UI, 1987; MT. UI; Dr. UI, 2014) *Manufacturing System Design, Manufacturing Performance Assessment & Improvement*

12. **Imansyah Ibnu Hakim,**
imansyah@eng.ui.ac.id (Ir. UI, 1993; M.Eng. Kyushu Univ., 2000; Dr. UI, 2012) *Heat Transfer, Energy Conversion*

13. **Jos Istiyanto,**
josist@eng.ui.ac.id (ST. UI, 1998; MT. UI, 2004; Dr. Yeungnam Univ, 2012) *CAD/CAM, STEP-NC, Microfabrication*

14. **Mohammad Adhitya,**
madhitya@eng.ui.ac.id (ST. UI, 2000; MSc FH Offenburg, 2004; Doctor - Technische Universität Braunschweig, 2017) *Dynamic, Otomotive System*

15. **Muhammad Arif Budiyanto,**
arif@eng.ui.ac.id (ST, UI, 2011; MT, UI, 2012; Dr., Kyushu University, 2016) *Energy Management for Maritime Industry*

16. **Radon Dhelika,**
radon@eng.ui.ac.id (B.Eng. Nanyang Tech. Univ., 2008; M.Eng. Tokyo Inst. of Tech., 2012; Dr.Eng. Tokyo Inst. of Tech., 2015) *Electrostatics, Electromechanical System*

17. **Ridho Irwansyah**,
ridho@eng.ui.ac.id (ST.UI, 2010; MT.UI, 2012; Dr. - Universität der Bundeswehr München, 2017) *Heat Transfer Engineering, Non-intrusive Temperature and Flow Measurement*

18. **Sugeng Supriadi**,
sugeng@eng.ui.ac.id (ST. UI, 2004; MSEng, Yeungnam Univ. 2007; Dr - Tokyo Metropolitan Univ, 2012) *Microfabrication, Fabrication Process Control, Engineering Materials*

19. **Wahyu Nirbito,**
bito@eng.ui.ac.id (Ir. UI, 1982; MSME, Univ. of Minessota USA, 1987; Dr. UI, 2011) *Vibration Engineering, Gas Turbine, Condition Monitoring*

20. **Yudan Whulanza**,
yudan@eng.ui.ac.id (ST. 2000; M.Sc. FH-Aachen, 2005; Dr. Univ. Pisa, 2011) *Microfabrication*

PART-TIME (NON-TENURED) FACULTY

1. **Prof. Dr. Ir. Bambang Suryawan,**
suryawan@eng.ui.ac.id (Ir. UI, 1972; MT. UI, 1994; Dr., UI, 2004) *Thermofluid*

2. **Prof. Dr. Ir. Budiarso, M.Eng.,**
agsub@eng.ui.ac.id (Ir. UI, 1977; Dipl.Ing. Karlsruhe-Germany,1981) *Fluid Mechanics, Energy System Optimization*

3. **Prof. Dr. Ir. I Made Kartika Dhiputra, Dipl-Ing,**
dhiputra_made@yahoo.com (Ir. UI, 1977; Dipl.-ing Karlsruhe University, 1983; Dr. UI, 1988) *Thermodynamics*

4. **Budihardjo,**
budihardjo@eng.ui.ac.id (Ir. UI, 1977; Dipl.Ing. Karlsruhe, 1981; Dr., UI, 1998) *Refrigeration Engineering, Air Dryer, Thermodynamics*

5. **Rusdy Malin,**
rusdi@eng.ui.ac.id (Ir. UI, 1980; MME, UTM Malaysia,1995) *Building Mechanical System, Ventilation System*

6. **Tris Budiono M,**
tribuma@eng.ui.ac.id (Ir. UI, 1980; MSi, UI, 1996) Engineering Drawing, Engineering Materials

7. **Arnas Lubis,**
ararnas@eng.ui.ac.id (ST. UI, 2009; MT. UI, 2012, Dr.Eng. Waseda Univ., 2019) *Absorption Chillers and Heat Pumps*

8. **Ahmad Syihan Auzani.,**
auzani@ui.ac.id (ST. UI, 2014; MT. UI, 2015, Ph.D. Sheffield Univ., 2020) Combustion Kinetics and flame diagnostics

Department of Electrical Engineering

General

The Department of Electrical Engineering, the Faculty of Engineering, Universitas Indonesia was established at the same time as the Faculty of Engineering on July 17th, 1964, even though the classes had started since October 17th, 1964. At the beginning of its establishment, the Department of Electrical Engineering (DTE) was named "Jurusan Listrik", consisting of two fields of studies: (1) Electrical Power and (2) Electronics and Telecommunication. In 1984, the name "Jurusan Listrik" was changed into "Jurusan Elektro", which was renamed the Department of Electrical Engineering in 2004. Initially there were five streams available in this Department, namely (1) Electrical Power Engineering, (2) Electronics Engineering, (3) Telecommunication Engineering, (4) Control Engineering, and (5) Computer Engineering. Since 2006, the Computer Engineering stream has become a new study program: the Computer Engineering Study Program (CESP) within the Department. In 2016, DTE added a new specialization, i.e. Biomedical Engineering. In 2017, based on the Rector's Decree No. 0230/SK/R/UI/2017, the master's degree Program in Biomedical Technology, which was previously held under the University's Postgraduate Program, was transferred under DTE. In 2018 DTE has opened the Undergraduate Study Program on Biomedical Engineering.

Objective

To produce the graduates who be able to provide solutions to the problems in the field of electrical engineering in accordance with professional ethics.

Vision

To become an independent and leading educational institution of electrical engineering that be able to provide solutions to the problems and challenges at the national and global levels.

Missions

The mission of the Department of Electrical Engineering is alignment to the mission of the University of Indonesia which are to:

1. Deliver education that based on the concept of good university governance to produce graduates who are knowledgeable, internationally minded, and have an entrepreneurial spirit.
2. Organize facilities, funding, and participation in applied research and new findings that can provide solutions to national and global problems.
3. Apply appropriate sciences and technologies in community service activities that match with the needs of the communities and industries.
4. Use advanced information technologies in carrying out efficient administration services for stakeholders.

The Targets

Bachelor of Electrical Engineering

1. Able to design components, systems or processes to meet the need for solutions to technical problems within realistic limits, considering aspects, including legal, economic, environmental, social, political, health and safety, as well as their sustainability potential.
2. Able to plan task units within existing limits as part of the process of completing engineering activities.
3. Able to formulate complex engineering problems, and then apply effective methods and tools to solve them.
4. Able to investigate experimental data designed to solve complex problems.
5. Able to identify the need for lifelong learning, including access to knowledge related to relevant current issues.
6. Able to solve complex problems in the field of electrical engineering by applying modern engineering methods, skills, and tools as well as information technology.
7. Able to apply knowledge of mathematics, physics, information communication technology (ICT) and engineering to solve complex problems in the field of electrical engineering.
8. Able to communicate effectively both orally and in writing.
9. Able to play an effective role in a multi-disciplinary team, with integrity, critical thinking, creative, innovative to achieve individual and collective goals.
10. Able to be responsible to the community and fulfill professional ethics in carrying out engineering activities.

Bachelor of Computer Engineering

1. Able to make intelligent, and safe computer technology system designs based on community needs in various fields of life.
2. Able to make information network design.
3. Able to make hardware designs for computer-based systems.
4. Able to make software designs for computer-based systems.
5. Able to design algorithms for specific problems and implement them into programming.
6. Able to solve computer engineering problems by applying the basic principles of mathematics, physics, and data analytic.
7. Able to use the language both spoken and written in the Bahasa Indonesia and English for academic or non-academic activities.
8. Have integrity and are capable of critical thinking, creative, and innovative and have the intellectual curiosity to solve problems at the level of the individual and the group.
9. Able to utilize information communication technology.
10. Able to provide alternative solutions to problems that arise in the environment, society, nation, and country.
11. Able to identify varieties of entrepreneurial efforts that are characterized by innovation and self-reliance based on ethics.

Bachelor of Biomedical Engineering

1. Able to design hardware and software needed in biomedical engineering.
2. Able to design biomedical engineering principles according to Health standards and regulations.
3. Able to design technology based on medical information/ data related to the condition of human physiology.
4. Able to handle general and specific problems in biomedical engineering.

5. Able to apply the basic principles of mathematics, chemistry, physics, and health-safety in solving Biomedical Engineering problems.
6. Able to think critically, creatively, and innovatively and have an intellectual curiosity to solve problems at the individual and group level.
7. Able to identify varieties of entrepreneurial efforts that are characterized by innovation and self-reliance based on ethics.
8. Able to use the language both spoken and written in the Bahasa Indonesia and English for academic or non-academic activities.
9. Able to provide alternative solutions to problems that arise in the environment, society, nation, and country.
10. Able to utilize information communication technology.

Master of Electrical Engineering

1. Able to generate scientific work effectively, both oral and written.
2. Able to provide recommendations in the field of electrical engineering as solution to society based on professional ethics.
3. Able to develop themselves for continuous learning, following the development of science, technology, and relevant contemporary issues in the field of electrical engineering.
4. Able to evaluate data by applying data analysis and processing methods.
5. Able to formulate problem solving in the field of electrical engineering using appropriate research methods.
6. Able to develop innovative technology for electrical engineering industries in the era of Industrial Revolution 4.0.

Majoring in Power and Smart System

1. Able to specify technical and non-technical aspects in the industries of electric power generation and utilization based on smartgrid.
2. Able to recommend strategies to improve efficiency, service quality, and power quality in electric power systems based on smartgrid.
3. Able to integrate new and renewable power generation with smart grid system.
4. Able to assess strategies and risk mitigation in the development of power systems that are reliable, safe, and environmentally friendly.

Majoring in Telecommunication and Smart Wireless System

1. Able to evaluate the latest technology in the field of telecommunications technology and smart wireless systems.
2. Able to design systems and /or devices for smart wireless telecommunications systems.

Majoring in Electronic and Intelligent Embedded System

1. Able to design electronic/photonic devices and/or complex electronic systems.
2. Able to implement complex smart embedded systems to contribute to solving problems in the engineering field.

Majoring in Cyber Security and Future Internet

1. Able to design a comprehensive information and network security system that meets the security standards.
2. Able to evaluate the appropriate security incidents handling and forensic methods of digital data.
3. Able to evaluate the development of computer and future Internet technologies.

Majoring in Automation and Data Analytic Engineering

1. Able to design control systems for industrial application.
2. Able to develop smart automation systems based on data engineering.
3. Able to design integrated automation system.

Majoring in Data Engineering and Business Intelligence

1. Able to design processing engineering, analysis, and data visualization which is efficient and scalable.
2. Able to develop aspects of leadership in the digital economic ecosystem (digital leadership).

Majoring in Telecommunication Management

1. Able to develop policy recommendations and strategies for ICT and telecommunication industries that support the digital economy.
2. Able to develop innovative and visionary nature in the telecommunications and ICT industry in the digital economy era.
3. Able to evaluate technical aspects that support the telecommunications and ICT business infrastructure in the era of industrial revolution 4.0 and digital economy.
4. Able to evaluate laws, policies and regulations oriented towards technological convergence and reinforcement of digital economy.
5. Able to design technoeconimic-based industrial strategies and regulatory policies.
6. Able to develop wise and objective leadership aspects in the national telecommunications and ICT sector (vendors, operatorsm regulators)

Majoring in Power and Energy Management

1. Able to formulate technical, non-technical and economic aspect in the management of generation and utilization of electric power and primary energy industries.
2. Able to recommend strategies to improve efficiency, service quality and power quality in the management of electric power systems.
3. Able to integrate the the management of new and renewable energy power plants with the electric power grid system.
4. Able to recommend strategies and risk mitigation in the development of power systems that are reliable, safe, and environmentally friendly.

Majoring in Information Network Security Management

1. Able to design a comprehensive physical network infrastructure that meets high security principles.
2. Able to recommend information security management in the concept of new technologies for Indonesian national development.
3. Able to evaluate information network security based on

technological rules, laws and applied regulations.

Master of Biomedical Engineering

1. Able to design innovative models of biomedical systems through biomedical engineering principle.
2. Able to compile independent scientific work systematically.
3. Able to formulate a professional management concept for biomedical engineering field.
4. Able to formulate the safety and security that meet the standard and regulation of medical equipment.

Majoring in Biomedical Instrumentation and Medical Imaging

1. Able to design biomedical instrumentation.
2. Able to develop biomedical sensor.
3. Able to design biomedical automation system.
4. Able to design medical imaging technique.

Majoring in Medical Informatics

1. Able to develop Hospital Information System.
2. Able to design e-Health and telemedicine system.
3. Able to design Biomedical Information System.
4. Able to develop decision support system and artificial intelligent

Majoring in Clinical and Hospital Engineering

1. Able to organize problem solving in biomedical technologies.
2. Able to design hospital management.
3. Able to formulate the standard, regulation, and safety of medical equipment's in medical facilities.
4. Able to design Clinical and Hospital technology

Electrical Engineering Staffs

Dr. Eng. Arief Udhiarto, S.T., M.T.
Head of Department

Dr. Eng. Arief Udhiarto, S.T., M.T.
Head of Electrical Engineering Study Program

Dr. Muhammad Salman, ST., MIT
Head of Computer Engineering Study Program

Dr. Basari, S.T., M.Eng.
Head of Biomedic Engineering Study Program

Dr. Abdul Halim, M.Eng
Vice Head of Department:

Head Of Laboratory

Dr.-Ing. Budi Sudiarto S.T., M.T.
Head of High Voltage and Electrical Measurement Laboratory

Ir. Agus R. Utomo M.T.
Head of Electrical Power Conversion Laboratory

Ir. I Made Ardita, MT.
Head of Electrical Power System Laboratory

Taufiq Alif Kurniawan M.T., M.Sc.
Head of Electronics Laboratory

Dr. Abdul Muis S.T., M.Eng.
Head of Control Laboratory

Dr. Eng. Mia Rizkinia S.T., M.T.
Head of Digital Laboratory

Dr. Ir. Catur Apriono S.T., M.T., Ph.D.
Head of Telecommunication Laboratory

Prof. Dr. Ir. Retno Wigajatri Purnamaningsih M.T.
Head of Optoelectronics Laboratory

Dr. Ruki Harwahyu S.T., M.T., M.Sc.
Head of Computer Networks Laboratory:

Mailing address

Departemen Teknik Elektro FTUI Kampus Baru UI, Depok 16424.

Tel. (021) 7270078 Fax. (021) 7270077

e-mail: teknik.elektro@ui.ac.id

http://www.ee.ui.ac.id

Board of Professors

1. **Prof. Dr. Ir. Harry Sudibyo S, DEA.,** harisudi@ee.ui.ac.id (Ir., Universitas Indonesia, 1979; DEA., Univ. Paris VI, 1984; Dr. Ing., Univ. Paris VI, France, 1987; Prof., UI, 2007) Microelectronics & VLSI design.
2. **Prof. Ir. Rinaldy Dalimi, M.Sc, Ph.D.,** rinaldy@ee.ui.ac.id (Ir., Universitas Indonesia, 1980; M.Sc., Michigan State Univ., USA, 1989; Ph.D., Virginia Tech., USA, 1992; Prof., UI, 2007) Electrical power system analysis, energy management.
3. **Prof. Dr. Ir. Eko Tjipto Rahardjo, M.Sc.,** eko.tjipto@ui.ac.id (Ir., Universitas Indonesia, 1981; M.Sc., University of Hawaii, USA, 1989; Ph.D, Saitama University, Japan, 1996; Prof., UI, 2005) Electromagnetic, antenna and wave propagation, microwave.
4. **Prof. Dr. Drs. Benyamin Kusumoputro, M.Eng.** kusumo@ui.ac.id (Drs., Fisika ITB, 1981; M.Eng., Tokyo Inst. Tech., Japan, 1984; Dr., Tokyo Inst. Tech., Japan, 1993; Prof., UI, 2004) Computation intelligence, robotics.
5. **Prof. Dr. Ir. Rudy Setiabudy, DEA,** rudy.setiabudy@ui.ac.id (Ir., Universitas Indonesia, 1982; DEA, INPG Grenoble, France, 1987; Dr., Montpellier II USTL, France, 1991; Prof., UI, 2008) Electrical material technology, electrical measurement.
6. **Prof. Dr. Ir. Dadang Gunawan, M.Eng,** dadang.gunawan@ui.ac.id (Ir., Universitas Indonesia, 1983; M.Eng., Keio University, Japan, 1989; Ph.D., Tasmania University, Australia, 1995; Prof., UI, 2004) Signal processing and compression, multimedia communication.
7. **Prof. Dr. Ir. NR. Poespawati, MT.,IPM** nyi.raden@ui.ac.id (Ir., Universitas Indonesia, 1985, MT., Universitas Indonesia, 1997, Dr., Elektro FTUI, 2004; Prof., UI, 2008) Solar cell devices, laser.
8. **Prof. Dr. Ir. Retno Wigajatri Purnamaningsih, MT,** retno.wigajatri@ui.ac.id (Ir., ITB, 1985; MT., Opto PPSUI, 1992; Dr., Universitas Indonesia, 2006, Prof., UI, 2021) Photonic devices, Optoelecthronic Sensor System

9. **Prof. Dr. Ir. Anak Agung Putri Ratna, M.Eng**
anak.agung@ui.ac.id, ratna@eng.ui.ac.id (Ir., Universitas Indonesia, 1986; M.Eng., Waseda University. Japan., 1990; Dr., FTUI, 2006) Computer network, web-based information system.

10. **Prof. Dr. Ir. Iwa Garniwa, MK., MT.**
ir.iwa@ui.ac.id (Ir., Universitas Indonesia, 1987; MT., Universitas Indonesia, 1998; Dr., Elektro FTUI, 2003; Prof., UI, 2009) High voltage and current, electrical materials.

11. **Prof. Dr.-Ing. Ir. Kalamullah Ramli, M.Eng.**
kalamullah.ramli@ui.ac.id (Ir., Universitas Indonesia, 1993; M.Eng., Univ. of Wollongong, Australia, 1997; Dr.-Ing, Univ. Duisburg-Essen, Germany, 2003, Prof., UI, 2009) Embedded systems.

12. **Prof. Dr. Ir. Muhamad Asvial, M.Eng,**
asvial@eng.ui.ac.id (Ir., Universitas Indonesia, 1993; M.Eng., Keio Univ., Japan, 1998; Ph.D., Surrey Univ. UK, 2003) Spread spectrum, mobile communication, multimedia system, satellite communication.

13. **Prof. Dr. Ir. Riri Fitri Sari, M.Sc., MM., IPM,**
riri@ui.ac.id (Ir., Universitas Indonesia, 1994; M.Sc., Sheffield, 1998; PhD., Leeds Univ., UK, 2004, Prof., UI, 2009) Software engineering, active networks, pervasive computing.

14. **Prof. Dr. Ir. Fitri Yuli Zulkifli, ST., M.Sc,**
fitri.yuli@ui.ac.id, yuli@eng.ui.ac.id (ST., Universitas Indonesia, 1997; M.Sc., Univ. Karlsruhe, Germany, 2002, Dr., Universitas Indonesia, 2008) Antenna and microwave communications.

International Adjunct Professors

1. **Prof. Dr. Fumihiko Nishio,**
fnishio@faculty.chiba-u.jp (Fundamental Research Field of Remote Sensing: Snow and Ice), Center for Environmental Remote Sensing (CEReS), Chiba University, Japan.

2. **Prof. Josaphat Tetuko Sri Sumantyo, Ph.D,**
jtetukoss@faculty.chiba-u.jp (Fundamental Research Field of Remote Sensing: Microwave Remote Sensing), Center for Environmental Remote Sensing (CEReS), Chiba University, Japan.

3. **Prof. Dr. James-Holm Kennedy,**
jhk@pixi.com (Electronic & optical beam management devices, micromechanical sensors, chemical & biochemical sensors, novel electronic devices, force sensors, gas sensors, magnetic sensors, optical sensors.), University of Hawaii, USA.

4. **Prof. Dr.-Ing. Axel Hunger,**
axel.hunger@uni-due.de (Adaptive e-Learning, adaptive instructional systems, e-course and its applications, pedagogical analyses of on-line course), University of Duisburg Essen, Germany.

5. **Prof. Dr. Koichi Ito,**
(Printed Antenna, Small Antenna, Medical Application of Antenna, Evaluation of Mutual Influence between Human Body and Electromagnetic Radiations), Chiba University, Japan.

6. **Prof. Masaaki Nagatsu,**
tmnagat@ipc.shizuoka.ac.jp, (Plasma Science and Technology) Research Institute of Electronics,Shizuoka University

7. **Prof. Michiharu Tabe,**
tabe.michiharu@shizuoka.ac.jp, (Nano Devices) Research Institute of Electronics, Shizuoka University

8. **Prof. Hiroshi Inokawa,**
inokawa06@rie.shizuoka.ac.jp, (Nano Devices), Research Institute of Electronics, Shizuoka University

9. **Prof. Hidenori Mimura,**
mimura.hidenori@shizuoka.ac.jp, (Vacuum Electron Devices) Research Institute of Electronics, Shizuoka University

Full-Time Faculty

1. **Abdul Halim,**
a.halim@ui.ac.id (Bachelor, Keio Univ., Japan, 1995; M.Eng., Keio University, Japan, 1997; Dr.Eng, Tokyo Institute of Technology, Japan, 2000) optimal control system, modelling and optimization, machine learning

2. **Abdul Muis,**
muis@ui.ac.id (ST., Universitas Indonesia, 1998; M.Eng., Keio Univ., 2005; Dr., Keio Univ., Japan 2007) Robotics, control software engineering.

3. **Agus Rustamadji Utomo,**
arutomo@eng.ui.ac.id (Ir., Universitas Indonesia, 1985; MT., Universitas Indonesia, 2000) Electrical power & energy system.

4. **Aji Nur Widyanto,**
widyanto@eng.ui.ac.id (ST., Universitas Indonesia, 2004; MT., Universitas Indonesia, 2009) Electrical power measurement, High Voltage and Current, Power Quality.

5. **Ajib Setyo Arifin,**
ajib.sa@ui.ac.id, ajib@eng.ui.ac.id (ST., Universitas Indonesia, 2009; MT., Universitas Indonesia, 2011; Ph.D., Keio University, 2015) Telecommunication, information theory, telecommunication signal processing, wireless sensor network.

6. **Alfan Prasekal,**
presekal@ui.ac.id (ST., Universitas Indonesia, 2014; M.Sc(DIC), Imperial College London, 2016) Secure Software System / Cyber Security.

7. **Amien Rahardjo,**
amien.rahardjo@ui.ac.id (Ir., Universitas Indonesia, 1984; MT., Universitas Indonesia, 2004) Electromagnetic, electric power energy conversion.

8. **Arief Udhiarto,**
arief.udhiarto@ui.ac.id (ST., Universitas Indonesia, 2001; MT., Universitas Indonesia, 2004; Dr.Eng, Shizuoka University Japan) Nanoelectronics Devices, Organic Electronic Devices

9. **Aries Subiantoro,**
aries.subiantoro@ui.ac.id (ST., Universitas Indonesia, 1995; M.Sc. Univ. Karlsruhe, Germany, 2001; Dr. UI, 2013) Expert control system, system identification.

10. **Basari,**
basari.st@ui.ac.id (ST., Universitas Indonesia, 2002; M.Eng., Chiba University, 2008; D.Eng., Chiba Univ., Japan, 2011) Biomedical engineering applications (medical devices for informatics, diagnosis and therapy), Medical Imaging and Processing (MRI, CT, Microwave Imaging, Ultrasound, EIT), Microwave Engineering, Clinical Engineering Applications.

11. **Budi Sudiarto,**
budi.sudiarto@ui.ac.id (ST., Universitas Indonesia, 2001; MT., Universitas Indonesia, 2005; Dr, UDE Germany, 2017) High voltage and current, electrical measurement.

12. **Catur Apriono,**
catur@eng.ui.ac.id (ST., Universitas Indonesia, 2009; MT., Universitas Indonesia, 2011, Ph.D., Shizuoka University, Japan, 2015, Dr., Universitas Indonesia, 2016) Antenna, microwave, terahertz technology.

13. **Chairul Hudaya,**
c.hudaya@eng.ui.ac.id (ST., Universitas Indonesia, 2006; M.Eng., Seoul National University, 2009; Ph.D., Korea Institute of Science and Technology - University of Science and Technology, Korea, 2016; IPM, 2016) Electric materials, electrical power systems, energy storage and conversion, energy management.

14. **Dodi Sudiana,**
dodi.sudiana@ui.ac.id (Ir., Universitas Indonesia, 1990; M.Eng., Keio University, Japan, 1996; D.Eng., Chiba Univ., Japan, 2005) Image processing, remote sensing.

15. **Eko Adhi Setiawan,**
eko.adhi@ui.ac.id (ST., Trisakti University; MT, Universitas Indonesia, 2000; Dr.-Ing., Universität Kassel, Germany, 2007) Virtual power plant, electrical power supply, electrical energy conversion.

16. **Faiz Husnayain,**
faiz.h@ui.ac.id, faiz@eng.ui.ac.id (S.T., M.T., M.Sc. (S.T., Universitas Indonesia, 2010; MT, Universitas Indonesia, 2013; M.Sc. NTUST, 2013), motor control

17. **F. Astha Ekadiyanto,**
astha.ekadiyanto@ui.ac.id (ST., Universitas Indonesia, 1995; M.Sc., Univ. Duisburg Essen, Germany, 2005) Distributed Peer-to-Peer Systems, Content/Data Centric Network, Cyber Physical Systems.

18. **Feri Yusivar,**
feri.yusivar@ui.ac.id (Ir., Universitas Indonesia, 1992; M.Eng. Waseda University, Japan, 2000; D.Eng., Waseda University, Japan, 2003) Control systems, motor control.

19. **Gunawan Wibisono,**
gunawan@eng.ui.ac.id (Ir., Universitas Indonesia, 1990; M.Eng., Keio Univ., 1995; Ph.D. Keio Univ., Japan, 1998) Coding & wireless communications, optical communications, telecommunication regulation.

20. **I Gde Dharma Nugraha,**
i.gde@ui.ac.id (ST., Universitas Indonesia, 2000; MT., Universitas Indonesia, 2009; Ph.D., Chonnam National University, 2014) Embedded System, Web Application Technology, Big Data, Database Optimization.

21. **I Made Ardita,**
made@eng.ui.ac.id (Ir., Universitas Indonesia, 1985; MT., Universitas Indonesia, 2000) Electro-mechanical conversion, power system planning.

22. **Mia Rizkinia,**
mia@ui.ac.id (ST., Universitas Indonesia, 2008; MT., Universitas Indonesia, 2011; Dr. University of Kitakyushu, Japan, 2018) Image processing, remote sensing.

23. **Muhammad Salman,**
muhammad.salman@ui.ac.id (ST., Universitas Indonesia, 1995; M.Info Tech, Monash University, Australia, 2002;Dr. Universitas Indonesia,2015) Computer networks, multimedia.multimedia.

24. **Muhammad Suryanegara,**
m.suryanegara@ui.ac.id (ST., Universitas Indonesia, 2003; M.Sc., UCL, UK, 2004; Dr.,Tokyo Institute of Technology, Japan, 2011; IPM, 2016) Telecommunication, Mobile Wireless, Technological Innovation and Policy.

25. **Naufan Raharya,**
naufanraharya@ui.ac.id (ST., Universitas Indonesia, 2014; MT., Universitas Indonesia, 2015; Ph.D., The University of Sydney, Australia, 2021) Modelling and Optimization, Machine Learning, Distributed Optimization.

26. **Nur Imaniati Sumantri,**
nur.imaniati@ui.ac.id (S.Si., UIN Syarif Hidayatullah Jakarta, 2014; M.Biotek., Universitas Padjadjaran, 2017) Bioinformatics, Biotechnology

27. **Prima Dewi Purnamasari,**
prima.dp@ui.ac.id (ST., Universitas Indonesia, 2006; MT., Universitas Indonesia, 2009; M.Sc., Univ. Duisburg Essen, Germany, 2008; Dr, Universitas Indonesia, 2017) Distributed system, computer supported collaborative work, EEG Pattern Recognition

28. **Purnomo Sidi Priambodo,**
purnomo.sidhi@ui.ac.id (Ir., Elektro UGM, 1987; M.Sc., Oklahoma State Univ., 1996; Dr., Texas-Arlington, USA, 2003) Semiconductor laser, photonic, physics.

29. **Puspita Anggraini Katili,**
puspita_katili@ui.ac.id (dr., Universitas Indonesia, 2011; M.Sc., University of Nottingham. United Kingdom., 2014; Ph.D., University of Nottingham. United Kingdom., 2020) Stem cells, tissue engineering, regenerative medicine.

30. **Rizal,**
rizal@eng.ui.ac.id (S.Si., Universitas Hasanuddin, 2009; M.Biotech., Universitas Gadjah Mada, 2013; M.Sc., The University of Nottingham, 2016) Stem Cell, Gene and Tissue Engineering

31. **Ruki Harwahyu,**
ruki.h@ui.ac.id (S.T., M.T., M.Sc., Ph.D (S.T., Universitas Indonesia, 2011; M.T Universitas Indonesia, 2013; M.Sc., National Taiwan University of Science and Technology, 2013; Phd., National Taiwan University of Science and Technology, 2018)

32. **Siti Fauziyah Rahman ,**
fauziyah17@ui.ac.id (S.T., Universitas Indonesia, 2010; M. Eng., Chonnam National University, 2012; Ph.D., Chonnam National University, 2016) Biosensor, Biotechnology, and Material

33. **Taufiq Alif Kurniawan,**
taufiq.alif@ui.ac.id (ST., Universitas Indonesia 2009; M.Sc. Eng, NTUST, Taiwan, 2011) Radio frequency integrated circuit, analog integrated circuit, and VLSI.

34. **Tomy Abuzairi,**
tomy.abuzairi@ui.ac.id (ST., Universitas Indonesia 2009; M.Sc., NTUST, Taiwan, 2012; Ph.D., Shizuoka University,2016) Thin film nano-technology, optoelectronic device, biotechnology device.

35. **Yan Maraden Sinaga,**
maradens@eng.ui.ac.id (ST., Universitas Indonesia, 2004; MT., Universitas Indonesia, 2009; M.Sc., Univ. Duisburg Essen, Germany, 2009) Computer Networks and Protocols, Artificial Intelligence, Computer Vision

36. **Yohan Suryanto**
yohansuryanto@ui.ac.id (ST., Institut Teknologi Bandung, 1997; MT., Universitas Indonesia, 2014; Dr., Universitas Indonesia, 2016), Parallel processing for multimedia, terrestrial and satellite network, IoT, cryptography, and information security.

Board Of Emiritus Faculty

1. **Prof. Dr. Ir. Djoko Hartanto, M.Sc.,**
   djoko@ee.ui.ac.id (Ir., Universitas Indonesia, 1971; M.Sc., University of Hawaii, USA, 1989; Dr., Elektro FTUI, 1993; Prof., UI, 1996) Microelectronic devices, sensor devices.
2. **Prof. Dr. Ir. Bagio Budiardjo, M.Sc.,**
   bbdui@ee.ui.ac.id (Ir., Universitas Indonesia, 1972; M.Sc., Ohio State Univ., USA, 1980; Dr., Elektro FTUI, 2002; Prof., UI, 2005) Computer architecture, protocol engineering, pervasive computation.
3. **Prof. Dr. Ir. Djamhari Sirat, M.Sc.,**
   djsirat@ee.ui.ac.id (Ir., Universitas Indonesia, 1972; M.Sc., UMIST; PhD, UMIST, UK, 1985) Telecommunication regulation.
4. **Dr. Ir. Ridwan Gunawan, M.T.,**
   ridwan@eng.ui.ac.id (Ir., Universitas Indonesia, 1978; MT., Universitas Indonesia, 1994; Dr., Universitas Indonesia, 2006) Electrical power transmission and reliability.
5. **Dr. Uno Bintang Sudibyo,DEA**
   uno@ee.ui.ac.id (Ir., Universitas Indonesia, 1972; DEA, INPG Grenoble, France, 1987; Dr., Univ. Montpellier II USTL, France, 1991) Electrical power conversion.
6. **Wahidin Wahab,**
   wahidin.wahab@ui.ac.id (Ir., Universitas Indonesia, 1978; M.Sc., UMIST, 1983; PhD, UMIST, UK, 1985) Control engineering, robotics & automation.
7. **Ir. Endang Sriningsih, MT,**
   endangs@ee.ui.ac.id (Ir., Universitas Indonesia, 1976; MT., Universitas Indonesia, 1995) Digital system

Part-Time Faculty

1. **Diyanatul Husna,**
   ((ST., Universitas Indonesia, 2015; MT., Universitas Indonesia, 2016) Network Security, Big Data

Department of Metallurgical and Materials Engineering

General

Department of Metallurgical Engineering was originally established as a study program under the Faculty of Engineering, Universitas Indonesia, in 1965. Due to the lack of qualified lecturers and infrastructure, the first academic activity was only attended by 25 students. For almost 6 years since 1969, the department had stopped accepting new students and focused on performing activities for existing students. In 1975, the department began to accept students again, and in the same year had its first seven graduates. Ever since, the department has been progressively conducting and developing its academic activities.

As science and technology progress, especially in engineering materials-based industries, and in consideration of the availability of resources within the department, the Department of Metallurgical Engineering consolidated its resources and identified the need to add the word “materials” to its name. The idea came to fruition on November 5th, 2002, when the Rector of Universitas Indonesia issued a decree which officially recognized the Department of Metallurgical and Materials Engineering as one of the departments within the Faculty of Engineering.

The curriculum in Metallurgical and Materials Engineering is structured to address problems associated with various metallurgical aspects, as well as material design and processing, to meet the specific needs of various industries. Emphasis is given on the basic sciences and principles of engineering, as well as the applications of these principles to metallurgical and material behaviors. Students are expected to develop a solid base in chemistry, physics, and mathematics, which are applied in various engineering courses. By attending metallurgical and materials engineering courses, students may establish a firm base in the major areas of metallurgical and materials science as well as in the major areas of engineering materials explored in the courses, including materials properties and selection, computational methods, and capstone design. Students gain in-depth experience in other engineering disciplines through coordinated technical elective sequences.

In 2018, the department has totally graduated almost 2500 graduates with a degree in bachelor of engineering, 200 graduates with a degree in master of engineering, and 30 graduates with a doctoral degree. At the beginning of first semester of 2018/2019, the department has actively 500 undergraduate students from regular and parallel program, 57 students from undergraduate international program, 71 master students, and 24 doctoral students. Considering the high demand to produce qualified graduates and following current trends toward the global competition, Department of Metallurgical and Materials Engineering is committed to continuously improve its academic activities including teaching and learning process as well as research activities. As a part of national education system, which has the objective to develop the intellectual life of the nation through human resources development by conducting three main activities known as tridharma (“three duties”), the department is committed to carry out higher level educations, to conduct scientific research, and to provide community services. During its development stage, the Department of Metallurgical and Materials Engineering has achieved several milestones, such as:

- Grade A Accreditation for Undergraduate Program from National Accreditation Board, Ministry of National

Education (Year 2018 – 2023).

- Establishment of master (1995) and doctoral (2008) programs.
- Grade A Accreditation for Master Program from National Accreditation Board, Ministry of National Education (Year 2019 - 2024)
- Grade A Accreditation for Doctoral Program from National Accreditation Board, Ministry of National Education (Year 2017 - 2022)
- Establishment of ”Dual-degree” International Program with Monash University (2003); Queensland University of Technology, Australia; and Duisburg Essen, Germany
- Grant awards from the Government of Republic Indonesia for:
    - Internal Improvement for non-metallic field competence - PHK-A4 (2004)
    - Improvement for external and regional competence – PHK-A2 (2004-2006)
    - Internationalization of academic and research activities in information technology, energy and nonmaterial – PHKI (2010-2013)
- Establishment of Center for Materials Processings and Failure Analysis (CMPFA), a special task unit to support the materials engineering community and industry (2001).
- Intensive academic and research collaborations with international institutions, such as Monash University (Australia), Kagoshima University (Japan), Nanyang Technological University (Singapore), Yeungnam University and KITECH (Korea) (since 2006).
- Materials Testing Laboratory in CMPFA was accredited SNI-ISO 17025 (accredited since 2011, renewed until 2024)

Contact Address

Department of Metallurgical and Materials Engineering, Faculty of Engineering,

Universitas Indonesia

Kampus UI Depok 16424, Indonesia

Phone: +62-21-7863510

Fax: +62-21-7872350

Email: info@metal.ui.ac.id / dtmm@eng.ui.ac.id

Website: www.metal.ui.ac.id

Vision

In line with the vision and missions of Universitas Indonesia and the Faculty of Engineering, the vision of the Department of Metallurgical and Materials Engineering is “To be a research-based center of excellence, as well as referral center and solution provider for problems in the field of metallurgical and materials engineering in national and global levels.”

Mission

To achieve that vision, Department of Metallurgical and Materials Engineering have the following missions:

- To providing broad access to education and research for the public and industry
- To produce high quality graduates with strong academic background and comprehensive skills in process technology, material engineering and design, who are capable of undertaking active and dynamic role in national, regional and international arenas
- To perform quality *Tridharma* (three duties) relevant to national and global challanges.
- To create conducive academic environment to support the vision of Department of Metallurgical and Materials Engineering

Staff Of The Department Of Metallurgical And Materials Engineering

Dr. Deni Ferdian, S.T., M.Sc.
Head of Department

Dr. Ahmad Zakiyuddin, S.T., M.Eng.
Vice Head of Department

Head Of Laboratory

Muhammad Chalid, S.Si., M.Sc., Ph.D
Head of Chemical Metallurgy Laboratory

Wahyuaji Narotama Putra, ST., MT
Head of Physical Metallurgy Laboratory

Ir. Rahmat Saptono, M.Sc., Ph.D
Head of Mechanical Metallurgy Laboratory

Dr. Ir. Donanta Dhaneswara, M.Sc
Head of Processing Metallurgy Laboratory

Dr. Ir. Myrna Ariati, M.Si
Head of Metallography & Heat Treatment Laboratory

Dr. Ir. Yunita Sadeli, M.Sc
Head of Corrosion & Metal Protection Laboratory

Board Of Professor

1. **Prof. Dr. Ir. Eddy Sumarno Siradj, M.Eng.,**
siradj@metal.ui.ac.id (Prof., Ir, UI; M.Eng, University of Birmingham – UK; Dr, University of Sheffield – UK), Metallurgical Eng., Metallurgical Manufacturing Process & Management, Thermo-mechanical Control Process.
2. **Prof. Dr. Ir. Johny Wahyuadi Soedarsono, DEA.,**
jwsono@metal.ui.ac.id (Prof., Ir, UI; DEA & Dr., École Européenne de Chimie, Polymères et Matériaux de Strasbourg – France), Metallurgical Engineering, Corrosion & Protection, Metallurgy Extraction, Mineral Processing.
3. **Prof. Dr. Ir. Anne Zulfia, M.Phil.Eng.,**
anne@metal.ui.ac.id (Prof., Ir, UI; M.Phil.Eng., & Dr., University of Sheffield – UK), Metallurgical Engineering, Composite Materials & Advance Material.
4. **Prof. Dr-Ing. Ir. Bambang Suharno,**
suharno@metal.ui.ac.id (Prof., Ir, UI; Dr-Ing., RWTH Aachen – Germany), Metallurgical Engineering, Metal Casting and Alloy Design , Iron & Steel Making, Mineral Processing.
5. **Prof. Dr. Ir. Bondan Tiara, M.Si.,**
bondan@eng.ui.ac.id (Prof., Ir, UI; M.Si, UI; Dr, Monash University – Australia), Metallurgical Engineering, Metallurgy of Aluminum Alloy, Nano Technology, Materials Processing and Heat Treatment
6. **Prof. Dr. Ir. Dedi Priadi, DEA.,**
dedi@metal.ui.ac.id (Prof.,Ir, UI ; D.E.A. & Dr, Ecole des Mines de Paris - France), Metal Forming.
7. **Prof. Ir. Muhammad Anis, M.Met., Ph.D.,**
anis@metal.ui.ac.id (Prof., Ir, UI ; M.Met &Ph.D, University Sheffield - UK), Welding Metallurgy and

Metallurgy Physic.

8. **Prof. Dr. Ir. A. Herman Yuwono, M. Phil. Eng**
ahyuwono@metal.ui.ac.id (Prof., Ir, UI; M.Phil.Eng, Univ. of Cambridge - UK, PhD, NUS – Singapore), Nanomaterial.

9. **Prof. Dr. Ir. Winarto, M.Sc.,**
winarto@metal.ui.ac.id (Prof., Ir, UI; M.Sc (Eng), Technical Univ. of Denmark - Denmark; Ph.D, Univ. of Wales, Swansea - UK), Welding Metallurgy & Technology, Failure Analysis of Materials.

10. **Prof. Dr. Eng. Ir. Sri Harjanto,**
harjanto@metal.ui.ac.id (Ir, UI, Dr. Eng, Tohoku University - Japan), Chemical Synthesis of Materials, Mineral & Waste Materials Processing, Extractive Metallurgy.

International Adjunct Professors

1. **Prof. Kyoo-Ho Kim,**
School of Materials Science and Engineering, Yeungnam University (Korea), Energy & nano-materials

2. **Prof. Kozo Obara,**
Department of Nano-structured and Advanced Materials, Kagoshima University (Japan), Energy & nano-materials

3. **Prof. Freddy Y.C. Boey,**
School of Materials Science and Engineering, National Technological University (Singapore), Nano-materials & Biomedical Engineering

4. **Prof. Philippe Lours,**
École nationale supérieure des mines d'Albi-Carmaux, (France) Superalloys, aerospace material

5. **Prof. Akbar Rahamdhani,**
Swinburne University of Technology, Melbourne, Australia, Extractive Metallurgy and Metals Recycling

Full-Time Faculty

1. **Ahmad Zakiyudin,**
zakiyuddin.a@gmail.com (ST, Univ. Indonesia, M.Eng., PhD. Chonnam National University, Korea), Advanced Corrosion

2. **Azizah Intan Pangesty,**
(S.Si UGM; M.Eng, D.Eng. Kyushu University - Japan), Biomaterials, Corrosion

3. **Badrul Munir,**
bmunir@metal.ui.ac.id (ST, UI, M.Sc. Chalmer University - Sweden, PhD, Yeungnam University – Korea), Electronic Material

4. **Bambang Priyono,**
bpriyono@metal.ui.ac.id (Ir, UI; MT, UI, Dr. Candidate, UI), Catalyst Material, Energy Materials.

5. **Deni Ferdian,**
deni@metal.ui.ac.id (ST, UI; M.Sc, Vrije Universiteit Amsterdam – The Netherlands; Dr, Institut National Polytechnique de Toulouse - France), Failure Analysis, Casting & Solidification, Phase Transformation

6. **Donanta Dhaneswara,**
donanta.dhaneswara@ui.ac.id (Ir, UI; M.Si, UI; Dr, UI), Metal Casting and Alloy Design, Ceramic Materials and Membran Technology.

7. **Dwi Marta Nurjaya,**
jaya@metal.ui.ac.id (ST,UI; MT, UI; Dr., UI), Material Characterization and Geo-Polymer Materials

8. **Jaka Fajar Fatriansyah,**
(S.Si; M.S; UGM, Dr. Tohoku University, Japan) Soft Materials

9. **Muhammad Chalid,**
chalid@metal.ui.ac.id (SSi, UI, M.Sc, TU Delft – The Netherland, Ph.D, University of Groningen, The Netherlands), Polymer Technology, Bio-Polymers & Material Chemistry

10. **Myrna Ariati Mochtar,**
myrna@metal.ui.ac.id (Ir, UI ; MS, UI; Dr, UI), Thermo-Mechanical Treatment & Powder Metallurgy

11. **Nofrijon Sofyan,**
nofrijon@metal.ui.ac.id (Drs, Universitas Andalas; M.Si, UI; M.Sc, Auburn University - USA; Ph.D, Auburn University - USA), Nanomaterial, Electronic Ceramic

12. **Rahmat Saptono,**
saptono@metal.ui.ac.id (Ir, UI, M.Sc.Tech, Univ. of New South Wales, Australia, Ph.D, Univ. of Texas Arlington (UTA) - USA), Metal Forming, Mechanical Behaviour of Materials in Design, Manufacture and Engineering Applications

13. **Reza Miftahul Ulum,**
S.T., M.T. Univ. Indonesia, Dr.-ing. Universitat Duisberg Essen, Germany, Extractive Metallurgy

14. **Rini Riastuti,**
riastuti@metal.ui.ac.id (Ir, UI ; M.Sc, University of Manchester Instute of Science & Tech., -UK, Dr, UI), Electro-Cemical & Corrosion.

15. **Sotya Astutiningsih,**
sotya@metal.ui.ac.id (Ir, UI; M.Eng, Katholieke Universiteit Leuven - Belgium; PhD, UWA – Australia), Mechanical Metallurgy & Geo-polymer.

16. **Sri Harjanto,**
harjanto@metal.ui.ac.id (Ir, UI, Dr. Eng, Tohoku University - Japan), Chemical Synthesis of Materials, Mineral & Waste Materials Processing, Extractive Metallurgy.

17. **Wahyuaji Narotama Putra**
(ST, MT, Ph.D Candidate of Nanyang Technological University - Singapore) Electrical Material

18. **Yudha Pratesa,**
yudha@metal.ui.ac.id (ST, UI; MT, UI), Biomaterial, Material Degradation & Protection, Chemical Metallurgy

Part-Time Faculty

1. **Prof. Ir. Sutopo, M.Sc., Ph.D,**
sutopo@metal.ui.ac.id (Ir, UI ; M.Sc & Ph.D, University of Wiscounsin - USA), Composite Material & Thermometallurgy.

2. **Sari Katili,**
sari@metal.ui.ac.id (Dra, UI; MS, UI), Chemical Metallurgy.

3. **Alfian Ferdiansyah,**
alfian@metal.ui.ac.id (ST., Universitas Indonesia; MT., Universitas Indonesia; Dr.-Ing, Freiburg University -Germany) Solar cell materials and renewable energy

4. **Ghiska Ramahdita,**
ghiska@metal.ui.ac.id (ST., MT., Universitas Indonesia; M.Sc., INSA de Lyon – France Bio-materials and nanostructured materials)

5. **Adam Febriyanto Nugraha**
adamf.nugraha@gmail.com (ST, UI; Ph.D., Korea Institute of Science and Technology - Korea) Polymer Materials.

6. **Yunita Sadeli,**
yunce@metal.ui.ac.id (Ir, UI; M.Sc, University of Manchester Instute of Science & Tech., - UK, Dr, UI), Corrosion & Total Quality Management.

Study Program

Department of Metallurgical & Materials Engineering manages the course program as follows:

- Undergraduate Program (S1 Program) of Metallurgical & Materials Engineering.
- Master's Program (S2 Program) of Metallurgical & Materials Engineering
- Doctoral Program (S3 Program) of Metallurgical & Materials Engineering
- Master's Program (S2) of Material Integrity Management

Department of Architecture

General

Department of Architecture at the Universitas Indonesia (formerly known as Architectural Engineering Major) was established in 1965 under the UI Faculty of Engineering (FTUI) in Jakarta (established a year earlier through Presidential Decree No. 76 dated July 17, 1964). In the early days, education at the FTUI Architectural Engineering was done through a system of per-level or per- year full professional education. The average completion time was 7 years with an Engineer (Ir.) degree. Then in 1978, the Semester Credit System (SKS) went into effect with a minimum number of acquired semester credit units of 160 credits. The average duration of the study was five years, and the title was still Engineer (professional education). Since 1996, a four-year bachelor's education program was implemented with a total of 144 credits, producing an academic degree Bachelor of Engineering (ST). In the same year, after 31 years of existence, Architecture Program of Study at UI received its decree by the Directorate General for Higher Education No. 215/DIKTI/ KEP/1996 dated July 11, 1996.

In 2000, Department of Architecture streamlined the 1996 curriculum by publishing the 2000 Curriculum along with the application of problem-based learning method, collaborative and student-centered learning. The 2000 Curriculum stated clearly, that the direction for bachelor's architecture education is pre-professional. In the same year, Master of Architecture program was established with 2 streams, namely Architectural Design and Urban Design. Over the years, the master's program has grown into 6 streams, in addition to the two already mentioned earlier, the specialization program of Urban Housing and Settlements, Real Estate, History and Theories of Architecture and Urbanism and Building Technology and Sustainability were established. At this time, through the new curriculum (2012 Curriculum), the six specializations were streamlined into three which are:

- Creative process stream: Architectural Design, Urban Design, Property Development
- Humanities stream: History and Theories of Architecture, Urban Housing and Settlement
- Technology and sustainability stream: Architecture and Technology

In 2004, Architectural Engineering Major changed to Department of Architecture. The degree for its graduates was also altered from Bachelor of Engineering (ST) to Bachelor of Architecture (S.Ars) for the bachelor graduates and Master of Architecture (M.Ars) for the master's. From 2000 until 2012, the Department of Architecture went through several changes in Curriculum and thus the curriculum is integrated and emphasize several points:

1. Referring to the National Education System based on Competence.
2. Flexibility in following the development of science and technology.
3. Curriculum that responses in fulfilling the demands of professionals within national, regional
4. and also international level.
5. The core of the curriculum is in respect to the profession of architect in collaboration with IAI, and refers to UIA as the international standards.

In 2008 a new study program, Interior Architecture Undergraduate Program is opened, which emphasizes the interiority aspects of the design in architecture. The opening of this Interior Architecture study program allows the opportunity to explore and develop the field of interior architecture in Indonesia.

In 2009 a PhD program and a one-year program of Professional Program of Architect (PPAR) are set. PhD program is intended to strengthen the Department of Architecture as a leading architectural research-based institution. PhD student's research is focused on two areas: major research areas (research based on architectural issues) and minor research area (related to specialized area of study) in which PhD program students have the opportunity to take courses outside the discipline of architectural discipline to specifically support the knowledge, thoughts, and methods of its major. The learning process is conducted through the exploration of the width and depth aspects of knowledge about the studied issues. Meanwhile, for PPAR, the education is carried in a year to complete graduates with the actuality of professional architecture practice. Graduates of PPAR are also allowed to transfer the credit in UI to continue for a master degree in architecture.

Department of Architecture has also commenced an International Class (KKI) of undergraduate degree in architecture, with single degree program (only one semester abroad), or a double degree program (4 semesters in UI and the rest abroad). This program is in collaboration with leading universities in the world such as the Queensland University of Technology (QUT), Curtin University (Australia) and University of Florida. In addition, undergraduate students who have excellent academic achievements are able to attain a Fast-Track program (4 years bachelor + 1 year master), a total of 5 years, to accomplish a Master Degree in Architecture.

The Department of Architecture UI has an A accreditation from the Higher Education BAN, Indonesian Ministry of Research and Higher Education The Undergraduate Program Department of Architecture and Interior Architecture program has been also assessed by the ASEAN University Network (AUN). Both Master and PhD program of Department of Architecture also has an A accreditation from the Higher Education BAN, Indonesian Ministry of Research and Higher Education. For more profiles of FTUI Department of Architecture can be viewed at the website: http://architecture.ui.ac.id.

Vision

Establishing a high-quality Architecture Education Institution that receives national and international recognition, to foster future leaders who are critical, knowledgeable, and creative thinkers, with sensibility to local wisdom and environment sustainability.

Mission

Constructing the Architecture Education institutional system with excellent productivity towards the implementation of Tridarma in higher education.

Corresponding Address

Department of Architecture

Faculty of Engineering, Universitas Indonesia

Kampus UI, Depok 16424

Phone: 021 – 786 3512

Fax: 021 – 786 3514

E-mail: architecture@eng.ui.ac.id;architecture@ui.ac.id

http://architecture.ui.ac.id

Staff Of The Department Of Architecture

Dr. Ir. Achmad Hery Fuad, M.Eng.,
Head of Department and Coordinator of Graduated Program

Kristanti Paramita, S.Ars., M.A., Ph.D.,
Vice Head of Department

Dr. Rini Suryantini, S.T., M.Sc.,
Coordinator of Interior Architecture Program

Ir. Hendrajaya Isnaeni, M.Sc., Ph.D.,
Coordinator of Professional Program

Head of Laboratory

Widyarko, S.Ars., M.Ars.
Head of Fabrication Laboratory and Wood-working Workshop

Dr. Ferro Yudistira S.T., M.T.
Head of Photography Laboratory

Board Of Professors

1. **Prof. Ir. Evawani Ellisa, M.Eng, Ph.D.**
   (Ir., Architecture, Universitas Gadjah Mada; M.Eng., Environmental Engineering, Osaka University, Jepang; Ph.D, Architecture, Osaka University, Jepang) Urban Design; Urban Architecture
2. **Prof. Kemas Ridwan Kurniawan, M.Sc., Ph.D**
   (S.T., Architecture, Universitas Indonesia; M.Sc., Architectural History, University of College London, UK; Ph.D, Architectural History, University of College London, UK) Architectural Theory and History; Heritage in Architecture
3. **Prof. Paramita Atmodiwirjo, ST., M.Arch., M.A.(Ed.), Ph.D.**
   (ST. Architecture Universitas Indonesia; M.Arch. Univ. of Sheffield, UK, Ph.D Architecture, Univ. of Sheffield) Architectural Design, Design/Research Methods in Architecture, Environmental Behavior, Communication Techniques in Architecture.
4. **Prof. Yandi Andri Yatmo, M.Arch., Ph.D**
   (S.T., Architecture, Universitas Indonesia; Dip.Arch., Architecture Univ.Of Sheffield; M.Arch, Architecture, Univ. of Sheffield; Ph.D, Architecture,Univ. of Sheffield) Architecture Design; Design Theory and Methods in Architecture; Urban Architecture

Board Of Emeritus Faculty

1. **Prof. Dr. Ir. Abimanyu T. Alamsyah, M.Si.**
   (Ir., Architecture Universitas Indonesia; M.Si, Perencanaan Pengembangan Wilayah dan Perdesaan, Institut Pertanian Bogor; Dr., Environmental Sciences, Universitas Indonesia) Urban and Regional Planning; Coastal Architecture
2. **Prof. Dr. Ir. Emirhadi Suganda, M.Sc.**
   (Ir., Architecture, Universitas Indonesia; M.Sc., Asian Institute of Technology (AIT) Bangkok, Thailand; Dr., Ilmu Lingkungan, Universitas Indonesia, 2007) Project Management; Building Technology; Architectural Design.
3. **Prof. Ir. Gunawan Tjahjono, Ph.D., M.Arch,**
   (Ir. Architecture Universitas Indonesia; M.Arch., Architecture, University of California Los Angeles, USA; Ph.D., Architecture, University of California Berkeley, USA, 1989) Architectural Design; Theory and Methods in Architecture; Ethics in Architecture

4. **Prof. Ir. Triatno Yudo Harjoko., Msc, Ph.D**
(Ir. Architecture Universitas Indonesia, 1978; M.Sc. in Town Planning, University of Wales, UK, 1986; Ph.D in Environmental Design, University of Canberra, Professor in 2008) Architectural Design; Research Methods in Architecture; Urban Housing and Settlement

Full-Time Faculty

1. **Dr. Ir. Achmad Hery Fuad, M.Eng,**
(Ir., Architecture, Universitas Indonesia; M.Eng., Architecture Urban Design, Waseda University, Japan; Dr., Perancangan Architecture, Universitas Indonesia) Urban Design; Urban Architecture.

2. **Ahmad Gamal, S.Ars., M.U.P., Ph.D.**
(S.Ars., Architecture, Universitas Indonesia; MSc, London School of Public Relation; M.U.P, Urban & Regional Planning, University of Illinois Urbana Champaign, USA; Ph.D., Urban & Regional Planning, University of Illinois Urbana Champaign, USA) Urban dan Regional Planning; Property in Architecture; Spatial Analysis.

3. **Ir. Antony Sihombing, MPD., Ph.D.**
(Ir., Architecture, Universitas Indonesia; MPD. University of Melbourne, Australia; Ph.D. Univer- sity of Melbourne, Australia) Architectural Design, Urban Housing and Settlements, Building Technology.

4. **Arif Rahman Wahid, S.Ars., M.A.**
(S.Ars., Architecture Interior, Universitas Indonesia; M.A., Narrative Environments, University of the Arst London, UK) Interior Architecture; Narrative Environment

5. **Coriesta Dian Sulistiani, S.Ars., M.Ars.**
(S.Ars., Architecture, Universitas Indonesia; M.Ars, Perancangan Architecture, Universitas Indonesia) Interior Architecture; Building Technology

6. **Dr.-Ing. Ir. Dalhar Susanto**
(Ir., Architecture, Universitas Diponegoro, Semarang; Dr.-Ing., Urban Housing, University of Stuttgart, Germany) Building Technology; Urban Housing and Settlements.

7. **Diandra Pandu Saginatari, S.Ars., M.Ars.**
(S.Ars., Architecture, Universitas Indonesia; M.A., Art Space and Nature, The University of Edinburgh, UK) Architectural Design; Architecture and Ecology.

8. **Dita Trisnawan, S.T., M.Arch., STD.**
(S.T., Architecture, Universitas Gajah Mada, Yogjakarta; M.Arch, Suburb and Town Design, University of Miami, USA) Urban Architecture; Urban Design.

9. **Elita Nuraeny, S.Ars., M.A.**
(S.Ars., Architecture Interior, Universitas Indonesia; M.A., Architectural History, The Bartlett School of Architecture, UCL) History and Theory of Architecture; Interior Architecture.

10. **Enira Arvanda, S.T., M.Dipl.**
(ST, Architecture Universitas Indonesia; Master, Instituto Europeo di Disain, Milan, Italy) Interior Architecture, Ergonomy, Furniture Design

11. **Dr. Ferro Yudhistira, S.Ars., M.Ars.**
(S.T., Teknik Architecture, Universitas Sriwijaya, Palembang; M.Ars, Architecture, Universitas Indonesia; Dr., Perancangan Architecture, Universitas Indonesia) Architectural Design; Communication Technique in Architecture; CAD/ArchiCAD

12. **Ir. Finarya S.Legoh, M.Sc., Ph.D.**
(Ir, Architecture, Universitas Indonesia; M.Sc., Room Acoustics Architecture, University of Salford, United Kingdom; Ph.D, Room Acoustics, University of Salford, United Kingdom) Building Physics; Acoustics.

13. **Ir. Hendrajaya Isnaeni, M.Sc., Ph.D.**
(Ir., Architecture, Universitas Indonesia; M.Sc., Environmental Psychology, University of Surrey, UK; Ph.D, Architecture, University of Melbourne, Australia) Architectural Design & Profession.

14. **Ir. Herlily, M.Urb.Des.**
(Ir., Architecture Universitas Indonesia; M.Urb. Des, Architecture, University of Sydney, Australia) Urban Architecture; Community-based Architecture; Architecture, City and Power.

15. **Joko Adianto, S.T., M.Ars., Ph.D.**
(ST, Architecture Universitas Trisakti; M.Ars, Architecture Universitas Indonesia)Architectural Design and Professions, Building Technology, Design Theory & Methods, Urban Informality.

16. **Kristanti Paramita, S.Ars., M.A., Ph.D.**
(S.Ars, Architecture, Universitas Indonesia; M.A, Architecture University of Sheffield, UK; Ph.D, Architecture, University of Sheffield, UK) Architectural Design, Communication Technique in Architecture

17. **Mikhael Johannes, S.Ars., M.Ars.**
(S.Ars, Architecture, Universitas Indonesia; M.Ars, Universitas Indonesia, Universitas Indonesia Architectural Design, Computation-based Architectural Design, Digital Design and Communication Technique in Architecture.

18. **Dr. Miktha Farid Alkadri, S.Ars., M.Ars.**
(S.Ars, Architecture, Universitas Indonesia; M.Ars., Perancangan Architecture, Design Informatics, TU Delft, Netherlands) Building Technology and Sustainability

19. **Mochammad Mirza Yusuf Harahap, S.Ars., M.Des.**
(S.Ars, Architecture Interior, Universitas Indonesia; M.Des., Design, Monash University, Australia) Interior Architecture.

20. **M. Nanda Widyarta, B.Arch., M.Arch.**
(B.Arch, Architecture, University of Oklahoma, USA; M.Arch, Histories and Theories of Architecture, AA School of Architecture London, UK) History and Theory in Architecture, Art History, Architecture and Text.

21. **Nevine Rafa, S.Ars., M.A.**
(S.Ars, Architecture, Universitas Indonesia; M.A., Interior Design, University of Westminster, UK). Interior Architecture, Communication Technique in Interior Architecture.

22. **Dr.-Ing. Ova Candra Dewi, S.T., M.Sc.**
(S.T., Architecture, Universitas Indonesia; M.Sc., Urban Management, Technische Universitat Berlin; Dr.-Ing, Bioconversion and Emission Control, Technische Universitat Hamburg, Germany) Architecture and Sustainability, Environmental Technology.

23. **Dr. Rini Suryantini, S.T., M.Sc.**
(S.T., Architecture, Universitas Indonesia; M.Sc., Regional Science, Institute for Regional Science & Planning University of Karlsruhe (TH), Germany; Dr., Perancangan Architecture, Universitas Indonesia) Architectural Design, Architecture and Ecology, Architecture and Landscape.

24. **Rossa Turpuk Gabe Simatupang, S.Ars., M.Ars.**
(S.Ars, Architecture, Universitas Indonesia; M.Ars, Permukiman dan Perumahan Kota, Universitas Indonesia) Architectural Design, Communication Technique in Architecture, Urban Housing and Settlements.

25. **Widyarko, S.Ars., M.Ars.,**
(S.Ars, Arhitecture Universitas Indonesia; M.Ars, Universitas Indonesia).Building Technology and Materials

26. **Dr.-Ing. Yulia Nurliani Lukito Harahap, S.T., MDesS.**
(S.T., Architecture, Universitas Indonesia; M.Des.S, Architektur, RWTH Aachen University, Germany; Dr.-Ing, Design Studies, Harvard University) History and Theory in Architecture, Heritage Architecture, Architecture and Text.

Part-Time Faculty

1. **Afifah Karimah, S.Ars., M.Ars.**
(S.Ars., Architecture Universitas Indonesia; M.Ars., Perancangan Architecture, Universitas Indonesia Architectural Design.

2. **Agus Danang Ismoyo, S.T., MALD.**
(S.T., Architecture Universitas Indonesia; M.ALD., Architectural Lighting Design, Hochschule Wismar, Germany)Lighting Design.

3. **Ir. Achmad Sadili Somaatmadja, M.T.**
(Ir., Architecture Universitas Indonesia; M.Si, Environmental Sciences Universitas Indonesia) Building Technology, Architectural Design

4. **Amira Paramitha, S.Ars., M.Ars.**
(S.Ars., Architecture Universitas Indonesia; M.Ars., Perancangan Perkotaan, Universitas Indonesia). Architectural Design, Urban Architecture.

5. **Ary Dananjaya Cahyono, S.Sn., M.Fsc.**
(S.Sn, Seni Patung, Bandung Institute of Technology; MFA, Fine Arts Practice, Glasgow School of Arts) Visual Arts, Sculpture.

6. **Ir. Azrar Hadi, Ph.D.**
(Ir., Architecture, Universitas Indonesia; Ph.D., Construction, Man & Economics, Universiti Teknologi Malaysia)Project Management, Urban Housing and Settlements, Building Technology, Property.

7. **Baskoro Laksitoadi, S.Ars., M.Sc.**
(S.Ars., Architecture Universitas Indonesia; M.Sc., Politecnico di Milano, Italy) Building Technology.

8. **Cahyo Wilis Candrawan, S.T., M.Arch.**
(S.T., Architecture, Universitas Indonesia; M.Arch., Architecture, Washington University in St.Louis, USA). Architectural Design.

9. **Ir. Endy Subijono, MPP., Ar.**
(Ir., Architecture, Bandung Institute of Technology; MPP, Planning and Public Policy, Rutger University, USA) Professional Ethics.

10. **Intan Chairunnisa, S.Ars., M.Ars.**
(S.Ars., Architecture, Universitas Indonesia; M.Ars., Architecture and Sustainability, Universitas Indonesia). Building Technology and Materials.

11. **Joice Sandrasari, S.T., M.Arch.**
(S.T., Architecture, Universitas Tarumanegara); M.Arch., Perancangan Pencahayaan, Hochschule Wismar, Germany). Lighting Design.Design, Sustainability in Architecture

12. **Nina Dwi Handayani, S.Sn., M.Ars.**
(S.Sn., Perancangan Interior, Institut Teknologi Bandung; M.Ars., Perancangan Architecture, Universitas Indonesia). Architectural Design; Interior Architecture.

13. **Dra. Ratna Djuwita Chaidir, Dipl. Pschy.**
(Dra., Psychology Universitas Indonesia; Dipl. Pschy, Daarmstaat, Germany) Architectural Psychology.

14. **Ir. Siti Handjarinto, M.Sc.**
(Ir., Architecture Universitas Indonesia; M.Sc., Health Environmental Engineering, University of Hawai'i, USA) Building Technology; Building Physics; Lighting Design; Acoustics.

15. **Ir. Siti Utamini**
(Ir. Architecture, Bandung Institute of Technology) Architectural Design; Communication Technique in Architecture.

16. **Intan Chairunnisa, S.Ars., M.Ars.,**
(Dra., Bandung Institute of Technology; M.Sn., Jakarta Arts Institute/IKJ) Interior Architecture; Furniture Construction.

17. **Ir. Sukisno, MS.**
(Ir., Architecture, Universitas Gajah Mada; MSi, Environmental Sciences, Universitas Indonesia) Building Technology; Urban Ecology.

18. **Dr. Ir. Toga H. Pandjaitan, A.A. Grad. Dipl.**
(Ir., Architecture Universitas Indonesia; A.A. Grad. Dipl., Environment and Energy Studies, Architectural Association Graduate School, UK; Dr., Architecture, Universitas Indonesia) Building Technology; Building Physics; Photography; Ethnic Architecture

Department of Chemical Engineering

General

Department of Chemical Engineering Universitas Indonesia was first established under the name Department of Gas Engineering in 1981. There were two study programs which were developed almost simultaneously in 1981. Initially, the Gas Engineering Study Program was established under the Metallurgy Department to meet the needs of engineering graduates in the field of gas liquefaction. In the same year, the Chemical Engineering Study Program was established under the Department of Mechanical Engineering. This Study Program is aimed at meeting the shortage of workers in the development of industries in the field of Chemical Engineering in Indonesia.

In 1985, the two study programs were combined into the Department of Gas and Petrochemical Engineering, which offered a chemical engineering study program with an emphasis on courses in gas and petrochemical technology. Starting in the academic year 1985/1986, the Department of Gas and Petrochemical Engineering has received first semester students through the New Student Registration Selection (SIPENMARU). In collaboration with PERTAMINA, the Study Program received some assistance in the form of limited education funds, teaching staff who have industry experience, on-the-job training for students as well as visits to related industries.

The Department of Gas and Petrochemical Engineering was initially grouped into the Gas and Petrochemical Engineering Study Program in 1989 but was then grouped into the Chemical Engineering Study Program (PSTK) in 1996. Based on the Statute of the UI-BHMN, the term study program was changed to a department in 2003, and in 2006 the Department of Gas and Petrochemical Engineering changed to the Department of Chemical Engineering. While for the postgraduate level, the Master's Program in Chemical Engineering, the Master's Program in Natural Gas Management, and the Doctoral Program in Chemical Engineering are each inaugurated in 2002, 2004, and 2007. In order to enhance the role of the department in the era of biotechnology and life sciences, Bioprocess Engineering Study Program (PSTB) was opened in 2008.

The primary mission of the Department of Chemical Engineering is to provide the highest quality education so that graduates have the necessary knowledge, skills, and experience in researching the latest topics in the field of chemical engineering and bioprocess engineering.

To date, the Department of Chemical Engineering has 36 permanent academic staff members and about 913 undergraduate and graduate students. The Department of Chemical Engineering has now become one of the leading chemical engineering departments in Indonesia, with excellent accreditations from the National Accreditation Board of Indonesia (BAN), ASEAN University Network (AUN), Japan Accreditation Board for Engineering Education (JABEE), and Indonesian Accreditation Board for Engineering Education (IABEE).

Department of Chemical Engineering offers five academic programs: undergraduate program (regular, parallel, and international), Master's program (regular course and gas management course at Salemba campus), and doctoral program. The department has been adhering to competency-based principles, starting from the application of the 2000 curriculum to the recently updated 2020 curriculum. The current standards of graduate competencies are based on those recommended by ABET and the Bologna Process and on feedback from graduates and industry representatives, aiming at producing graduates who are well-educated and able to contribute effectively to their communities wherever they choose to live and work.

The Department of Chemical Engineering is conducting international classes in collaboration with three Australian universities: Monash University, Curtin University, and the University of Queensland. Students in this international class spend their first four semesters at UI and the subsequent four semesters in Australia. At the end of their study, students will get a "Sarjana Teknik" (Bachelor of Engineering) degree from UI and a Bachelor of Engineering degree from the partner university. Since 2011, international program students may choose to enroll in a single-degree program at UI, following a curriculum that is equivalent to the regular undergraduate curriculum.

The department has also established a double-degree Master's program with the National Taiwan University of Science and Technology (NTUST) and Curtin University. In this double-degree program, students spend their first year at UI and the second year at NTUST or Curtin University. After their studies, students will be awarded a Master of Engineering degree from NTUST or Curtin University.

The 2020 curriculum has been more streamlined and integrated, allowing students to take elective courses previously only available for particular study programs (PSTK or PSTB) or available for a particular academic level (undergraduate or graduate). This means that students could choose the courses that are more suitable to their interests. For those who qualify, there is a fast-track program that allows undergraduate students to obtain both Bachelor's and Master's degrees in ten semesters instead of the regular twelve semesters.

Chemical Engineering Master's program has also prepared a particular curriculum for those without any educational background in chemical engineering. By adopting this specific curriculum, applicants with a non-chemical engineering degree are recommended to take chemical engineering undergraduate core courses to master the fundamentals of chemical engineering before taking the more advanced graduate core courses. Graduates of doctoral programs are expected to contribute to the development of science by conducting independent research, usually under the supervision of a qualified professor.

As one of the departments in the Faculty of Engineering, Universitas Indonesia, the Department of Chemical Engineering has taken part in research collaboration with the theme of sustainable chemical and bioprocess engineering for energy and product development". This research theme is supported by four research groups: chemical and natural product design, sustainable energy, industrial bioprocess engineering, and chemical process intensification. These research activities, which are conducted in the Chemical Engineering Department, receive a lot of government funding to support students who wish to take part in the project.

Corresponding Address

Department of Chemical Engineering

Faculty of Engineering

Universitas Indonesia

Kampus UI Depok 16424, Indonesia

Telp: +62-21-7863516

Fax: +62-21-7863515

Email: dtk@che.ui.ac.id

http://www.che.ui.ac.id

Vision

Becoming a superior and competitive Chemical Engineering Department, through efforts to educate the nation's life to improve people's welfare, thus contributing to the development of Indonesian and world society.

Mission

- Providing broad and fair access, as well as quality education and teaching in Chemical and Bioprocess Engineering;
- Organizing quality Tridharma activities that are relevant to national and global challenges;
- Creating graduates of Chemical and Bioprocess Engineering who are of high quality, noble character, and able to compete globally;
- Creating an academic climate that can support the realization of the vision of the Department of Chemical Engineering

Chemical Engineering Staffs

Dr. Bambang Heru Susanto, S.T., M.T.
Head of Department

Dr. Dianursanti, S.T., M.T.
Vice Head of Department

Dr. Bambang Heru Susanto, S.T., M.T.
Head of Chemical Engineering Study program

Dr. Tania Surya Utami, S.T., M.T.
Head of Bioprocess Engineering Study program

Dr. Ir. Yuliusman, M.Eng
Coordinator of Special Subjects (Internship, Undergraduate Thesis, Master Thesis)

Riezqa Andhika, S.T., Ph.D.
Head of Academic Venture (UPPM)

M. Ibadurrahman, Ph.D.
Assistant to the Head of the Department of Student Affairs, Alumni, and Cooperation

Rahma Muthia, Ph.D.
Assistant to the Head of Academic Affairs

Retno Wahyu Nurhayati, Ph.D.
Health, Safety, Security and Environment Coordinator

Head Of Laboratory

Prof. Drs. Kamarza Mulia, M.Sc., Ph.D.
Head of Chemical and Natural Product Design Laboratory

Dr. Eva Fathul Karamah, ST, MT
Head of Chemical Process Intensification Laboratory

Dr. Ir. Prawati PDK Wulan, MT
Head of Sustainable Energy Laboratory

Apriliana Cahya Khayrani, S.TP., M.Eng., Ph.D.
Head of Bioprocess Engineering Laboratory

Ir. Rita Arbianti, M.Si
Head of Basic Chemical Process Laboratory

Dr. Ir. Abdul Wahid, M.T
Head of Chemical Process System Laboratory

Dr. Ir. Sukirno, M.Eng
Head of Basic Process and Operation Laboratory :

Dr. Kenny Lischer, ST. MT
Head of Services Laboratory

Board of Professors

1. **Prof. Dr. Ir. Widodo W. Purwanto, DEA,**widodo@che.ui.ac.id (Ir, ITS; DEA and Dr, ENSIGC-INP Toulouse, France): Sustainable energy.
2. **Prof. Dr. Ir. Mohammad Nasikin, M.Eng,** mnasikin@che.ui.ac.id (Ir, ITS; M.Eng, Tokyo Institute of Technology, Japan; Dr, UI): Catalysisi and Heterogenous catalyst
3. **Prof. Ir. Sutrasno Kartohardjono, M.Sc, PhD,** sutrasno@che.ui.ac.id (Ir, UI; MSc, UTM, Malaysia; PhD, University of New South Wales, Australia): Gas absorption and desorption in hollow fiber membrane contractor, utilization of hollow fiber membrane for efficient biomass production.
4. **Prof. Dr. Ir. Setijo Bismo, DEA,** bismo@che.ui.ac.id (Ir, ITB; DEA and Dr, ENSIGC Toulouse, France): Ozone and plasma technology.
5. **Prof. Dr. Ir. Slamet, MT,** slamet@che.ui.ac.id (Ir, UGM; MT, UI; Dr, UI): Photocatalysis.
6. **Prof. Ir. Dr.-Ing. Misri Gozan, M.Tech,** mgozan@che.ui.ac.id (Ir, UI; M.Tech, Massey University, New Zealand; Dr.-Ing, TU Dresden, Germany): Environmental bioprocess engineering, waste to energy.
7. **Prof. Dr. Ir. Heri Hermansyah, M.Eng,** heri@che.ui.ac.id (ST, UI; M.Eng and Dr, Tohoku University, Japan): Reaction process engineering, bioprocess and biocatalysis.
8. **Prof. Ir. Mahmud Sudibandriyo, M.Sc., Ph.D,** msudib@che.ui.ac.id (Ir, ITB; M.Sc and PhD, Oklahoma State University, USA): Thermodynamics adsorption & coalbed methane.
9. **Prof. Dr. Ir. Nelson Saksono, MT,** nelson@che.ui.ac.id (Ir, UI; MT, UI; Dr, UI): Elelctrolysis Plasma Technology
10. **Prof. Dr. Ir. Asep Handaya Saputra, M.Eng.** sasep@che.ui.ac.id(Ir, UI; M.Eng and Dr, Tokyo Institute of Technology, Jepang): Composite material, natural gas transportation.
11. **Prof. Ir. Kamarza Mulia, M.Sc., Ph.D,** kmulia@che.ui.ac.id(Drs, ITB; M.Sc, Colorado School of Mines, AS; PhD, Colorado School of Mines, AS):

Controlled release of drug and bioactive compounds, fluid phase equilibria, teaching-learning methods.

Full-Time Faculty Member

1. **Abdul Wahid,**
wahid@che.ui.ac.id (Ir, UI; MT, UI, Ph.D., UTM): Process Modeling, Simulation, and Control; System Dynamics
2. **Andy Noorsaman S.,**
ansommeng@che.ui.ac.id(Ir, UI; DEA UTC, Prancis; Dr, Ecole Centrale de Paris): Process system engineering.
3. **Apriliana Cahya Khayrani,**
apriliana@che.ui.ac.id (S.T.P., IPB, M. Eng., Okayama University, Japan, Ph.D., Okayama University, Japan): Drug Delivery System
4. **Bambang Heru Susanto,**
bambanghs@che.ui.ac.id(ST, UI; MT, UI; Dr, UI):Heterogenous catalysis, biofuel, process computation.
5. **Cindy Dianita,**
cindydianita@che.ui.ac.id (ST, UI; M.Eng, Ufa State Petroleum Technological University): Komputasi proses dan Pipeline.
6. **Dewi Tristantini Budi,**
detris@che.ui.ac.id(Ir, UGM; MT, ITB; PhD, Chalmers University, Swedia): Process catalysis.
7. **Dianursanti,**
danti@che.ui.ac.id (ST, UI; MT, UI; Dr, UI): Biomass production and CO2 fixation of microalgae.
8. **Dijan Supramono,**
dsupramo@che.ui.ac.id(Ir, ITB; M.Sc, UMIST, Inggris):-Fluid mechanics in combustion.
9. **Eva Fathul Karamah,**
eva@che.ui.ac.id (ST, UI; MT, UI; Dr, UI): Wastewater treatment by advanced oxidation processes.
10. **Eny Kusrini,**
ekusrini@che.ui.ac.id(S.Si, UGM; Dr, USM): Lanthanide, nanocomposites, catalyst.
11. **Kenny Lischer,**
kenny.lischer@che.ui.ac.id (ST, UI, MT, UI, Dr, Nara Institute of Science and Technology, Japan): Thermophilic Bacteria.
12. **Muhammad Ibadurrohman,**
ibad@che.ui.ac.id(ST, UI; MT, UI; MScEng, NTUST, Taiwan; Dr, Imperial College London, UK)): Hydrogen production via photocatalysis.
13. **Muhamad Sahlan,**
sahlan@che.ui.ac.id(S.Si, ITB; M.Eng dan Dr, TUAT, Jepang): Protein Engineering, protein vehicles for nutraceuticals, and biocatalysis.
14. **Praswasti PDK Wulan,**
wulan@che.ui.ac.id(Ir, UI; MT, UI; Dr, UI): nano, sustainable energy.
15. **Retno Wahyu Nurhayati, STP, M.Eng, PhD.Eng,**
retno.wahyu01@ui.ac.id (STP, IPB; MEng, Osaka University Jepang ; PhD.Eng, Osaka University Jepang): Stem cells Tissue engineering Bioprocess engineering
16. **Riezqa Andhika,**
riezqa@che.ui.ac.id (ST, UI, PhD, Yeungnam University, South Korea): Chemical process simulation.
17. **Rita Arbianti,**
arbianti@che.ui.ac.id(Ir, UI; M.Si, UI): Natural product.
18. **Setiadi,**
setiadi@che.ui.ac.id(Ir, ITS; M.Eng, Tokyo Institute of Technology, Jepang; Dr, UI): Reaction engineering, catalyst and catalysis for renewable, hydrocarbon chemicals/petrochemicals.
19. **Sukirno,**
sukirnos@che.ui.ac.id(Ir, ITB; M.Eng, Tokyo Institute of Technology, Jepang); Dr, UI): Tribology, lubricant, biolubricant.
20. **Tania Surya Utami,**
nana@che.ui.ac.id(ST, UI; MT, UI; Dr, UI): Bioelectrochemical system, fermentation and extraction, biofiltration
21. **Yuliusman,**
usman@che.ui.ac.id(Ir, UI; M.Eng, UTM, Malaysia): Liquid-liquid extraction, gas and polluttan adsorption, and purification of smoke.
22. **Yuswan Muharam,**
muharam@che.ui.ac.id(Ir, UI; MT, UI; Dr.rer.nat, University of Heidelberg, Germany): Modeling and simulation of chemical process.
23. **Habiburrahman Zulfikri,**
S.Si., M.Sc., Ph.D. (S.Si., ITB, M.Sc., Rijksuniversiteit Groningen, Ph.D., Universiteit Twente)
24. **Rahma Muthia,**
S.T., M.Sc., Ph.D. (S.T., UI, M.Sc., Universiteit Twente, Ph.D., University of Manchester)
25. **Retno Wahyu Nurhayati,**
S.T.P., M.Eng., PhD.Eng. (S.T.P., IPB, M.Eng., PhD.Eng., Osaka University)

Part-Time Faculty

1. **Elsa Krisanti,**
elsakm@che.ui.ac.id(Dra, ITB; MSc; PhD, Colorado School of Mines): Applied chemistry, biomass conversion, teaching-learning methods.
2. **Andre Fahriz Perdana Harahap,**
S.T., M.T. (S.T., UI, M.T., Dr., ITB)
3. **Kanya Citta Hani Alifia,**
S.T., M.Sc. (S.T., UI, M.Sc., Imperial College London)
4. **Ahmad Syauqi,**
S.T., M.T. (S.T., M.T., UI)

Department of Industrial Engineering

General

Industrial Engineering Education in Universitas Indonesia offers unique blends of skills and knowledge in designing, improving, and installing complex integrated systems of people, materials, information, equipment and energy to deliver value to its users.

Our graduates are developed to have a strong problem-finding and problem-solving capabilities using quantitative techniques, process-based systems thinking and design-oriented approaches. With an integration of engineering and management science principles, our graduates are welcome almost in any industrial sectors. You will find our graduates in the service sectors such as banking, government, health sector, consulting, quality management, technology services and others. In the manufacturing sector, our graduates have roles in operations/productions, human resources, maintenance, logistics and distributions.

Our research focuses on the problems faced by our urban communities, due to the facts that UI's location is in the first urban city of Indonesia, our capital city of Jakarta. We want to make sure that we can continuously contribute in developing a sustainable city that are balanced in economic growth, social inclusiveness and environmentally conscious.

Corresponding Address

Department of Industrial Engineering

Faculty of Engineering Universitas Indonesia

Kampus UI Depok 16424, Indonesia

Telp: +62-21-78888805

Fax: +62-21-78885656

Email: sekretariat@ie.ui.ac.id

http://www.ie.ui.ac.id

Vision

"To be at the forefront of Industrial and Systems Engineering education in Indonesia through excellent and sustainable value-adding research and innovations"

Mission

Providing an excellent industrial engineering education, supported with internationally recognised competitive research, and community engagement activities that are adaptive, beneficial and professional to support Indonesia's sustainable development.

Management

Dr. Komarudin, ST., M.Eng
Head of Department

Dr. Zulkarnain, ST., MT.
Vice Head of Department

Head of Laboratory

Prof. Dr. Ir. T. Yuri M. Zagloel, MEngSc
Head of Manufacturing System Laboratory

Prof. Ir. Isti Surjandari P., MT, MA, PhD
Head of Statistics and Quality Engineering Laboratory

Dr. Maya Arlini Puspasari, S.T., M.T., M.B.A.
Head of Human Factors Laboratory

Prof. Dr. Ir. M. Dachyar, M.Sc.
Head of Management Information System and Decision Support Laboratory

Prof. Dr. Akhmad Hidayatno, ST, MBT.
Head of System Engineering Modeling and Simulation Laboratory

Dr.-Ing. Amalia Suzianti, ST, MSc.
Head of Product Development and Innovation Laboratory

Board Of Professors

1. **Prof. Dr. Ir. Teuku Yuri M. Zagloel, MengSc**, yuri@ie.ui.ac.id (Ir, UI; MEngSc., University of New South Wales, Australia ; Dr, UI), Introduction to Industrial Engineering, Total Quality Management, Lean Operations, Sustainable Manufacturing and Innovation, Manufacturing Facilities Planning and Analysis, Manufacturing System.
2. **Prof. Ir. Isti Surjandari P., MT., Ph.D,** isti@ie.ui.ac.id (Ir, UI; MT, ITB; MA, Ohio State University, USA; Ph.D, Ohio State University, USA) Introduction to Economics, Industrial Statistics, Multivariate Analysis, Data Mining, Decisions, Uncertainties and Risks, Service Engineering, Advanced Statistics.
3. **Prof. Dr. Ir. Djoko S. Gabriel, MT.,** dsihono@ie.ui.ac.id (Ir, ITB; MT, ITB; Dr, UI) Plant Layout Design, Industrial Feasibility Analysis, Supply Chain Management, Technology Management.
4. **Prof. Dr. Ir. M. Dachyar, M.Sc.,** mdachyar@yahoo.com, mdachyar@ui.ac.id (Ir, UI; MSc, VU Brussel, Belgium; Dr, IPB) Information System, Industrial Project Management, Customer Relationship Management, Innovation Management, Decisions, Uncertainties and Risks, Service Engineering, Operations Management.
5. **Prof. Dr. Ir. Rahmat Nurcahyo, M.Eng.Sc.,** rahmat@eng.ui.ac.id (Ir, UI; MEngSc. Univ of New South Wales, Australia; Dr, UI) Production Planning and Inventory Control, Total Quality Management, Maintenance System, Industrial Feasibility Analysis, Competitive Analysis, Human Capital Management.
6. **Prof. Dr. Akhmad Hidayatno, ST., MBT.,** akhmad@eng.ui.ac.id (ST, UI; MBT, UNSW, Australia, Dr, UI) System Modelling, Quality System, Industrial Simulation, System Engineering, Technology Management, System Dynamics, Interpersonal Skills, Advance Modelling, System Thinking.
7. **Prof. Dr.-Ing Amalia Suzianti, S.T., M.Sc** suzianti@ie.ui.ac.id (ST, UI; MSc., BTU Cottbus, Germany; Dr.-Ing., TU-Berlin, Germany – University of Luxembourg) Product Design, Industrial Engineering Design, Industrial Technology Management, Product Lifecycle Management, Sustainable Manufacturing and Innovation, Knowledge Management, Industrial System Design, Technology Entrepreneurship.

Full-Time Faculty

1. **Andri Dwi Setiawan,** a.d.setiawan@ui.ac.id (ST, ITB; MSc, TU Delft, The Netherlands; Dr., TU Eindhoven, The Netherlands) Decision under Uncertainty and Risk, Energy Management, Renewable and Sustainable Energy Systems, Systems Engineering, Support and Logistics for Systems Engineering, Technology Policy Modelling with System

Dynamics.

2. **Andri Mubarak,**
andrimubarak@ui.ac.id (ST, UI; M.Sc ,TU Berlin, Germany) Sustainable manufacturing and Innovation, Innovation management, Design Thinking, Facilities Layout Design.

3. **Armand Omar Moeis,**
armand.omar@ui.ac.id (ST, UI; MSc, TU Delft, The Netherlands; Dr., UI) System Modelling, System Engineering, Industrial Simulation, System Dynamics, Advanced Modelling, System Thinking.

4. **Arian Dhini,**
arian@ie.ui.ac.id (ST, ITB; MT, UI; Dr, UI) Statistics and Probability, Industrial Statistics, Cost Accounting, Multivariate Analysis, Advanced Statistics.

5. **Arry Rahmawan,**
arryrahmawan@ui.ac.id (ST, UI; MT, UI) System Modelling, System Engineering, Industrial Simulation, System Dynamics, Serious Simulation Gaming

6. **Billy M. Iqbal,**
billy@eng.ui.ac.id (SDs, ITB; MT, UI) Cognitive Ergonomics, Human Factors in Industrial Design, Product Design Human Digital Modelling and Simulation

7. **Dendi P. Ishak,**
dendi@ie.ui.ac.id (BSIE ; MSIE, Wayne State University, USA; Dr, Universiti Teknologi Mara, Malaysia) Introduction to Industrial Engineering, Maintenance System, Customer Relationship Management, Competitive Analysis, Information System, Industrial Project Management, Safety Engineering and Management.

8. **Erlinda Muslim,**
erlinda@eng.ui.ac.id (Ir, ITB; MEE, UTM Malaysia) Cost Accounting, Product Design, Industrial Feasibility Analysis, Competitive Analysis, Industrial Psychology and Organization, Industrial Strategic Design, Human Capital Management, Technology Policy, Industrial Policy, Industrial System Design.

9. **Fauzia Dianawati,**
fauzia@ie.ui.ac.id (Ir, UI; MSi, UI) Industrial Psychology and Organization, , Industrial Project Management, Industrial Strategic Design, Human Capital Management.

10. **Farizal,**
farizal@ie.ui.ac.id (SMIA, UI; MSc, Oklahoma State University, USA ; PhD. University of Toledo, USA) Engineering Economics, Linear Programming, Finance and Investments, Operations Research, Advanced Operations Research, Advanced Optimization

11. **Inaki M. Hakim,**
inakimhakim@ie.ui.ac.id (ST, Universitas Sebelas Maret Surakarta ; MT, ITB) Production Process, Industrial Psychology and Organization, Sustainable Manufacturing and Innovation, Reconfigurable Manufacturing System

12. **Irvanu Rahman,**
irvanurahman@ui.ac.id (ST, UI; MT, UI; MPA, UCL, United Kingdom) System Analysis, Sustainability, Technology Policy Analysis.

13. **Komarudin,**
komarudin74@ui.ac.id (ST, UI; MEng. UTM, Malaysia; Dr, Vrije Universiteit Brussel, Belgium) System Modelling, Advanced Operations Research, Advanced Optimization, Game Theory, Liniear and Stochastic Programming, Queuing Theory, Data Science

14. **Maya Arlini Puspasari,**
mayaarlini@ui.ac.id (ST, UI; MT, UI;MBA, NTUST; Dr, ITB) Ergonomics, Mental Workload, Safety Engineering

15. **Novandra Rhezza Pratama, S.T., M.T., Ph.D.**
novandra@ui.ac.id (ST, UI; MT, UI; Ph.D, Tokyo Institute of Technology) Management Information System, Enterprise Engineering, Business Process Management, , Industrial Management

16. **Romadhani Ardi,**
romadhani.ardi@ui.ac.id (ST, UI; MT, UI; Dr, UDE, Germany) Production System, Production Planning and Inventory Control, Quality System, Advanced Modelling..

17. **Zulkarnain,**
zulkarnain@ie.ui.ac.id (ST, UI; MT, UI; Dr, Oulu Univ, Finland) Operations Research, Supply Chain Management, Data Mining, Service Engineering, Advanced Statistics.

Part-Time Faculty

1. **Amar Rachman,**
amar@ie.ui.ac.id (Ir, UI; MEIM, KULeuven, Belgium) Linear Programming, Operations Research, Advanced Operations Research, Introduction to Mechanics and Electronics in Factory.

2. **Annisa Marlin Masbar Rus,**
annisamarlin@ui.ac.id (ST, UI; M.Sc., University of Warwick) Data Mining, Healthcare Systems, Statistics and Probability, Industrial Statistics.

3. **Boy Nurtjahyo Moch,**
boymoch@eng.ui.ac.id (Ir, UI; Wayne State University, USA) Methods, Standards and Work Design, Macro Ergonomics, Cognitive Ergonomics, Human Digital Modelling and Simulation, Human Factors in Industrial Design, Safety Engineering and Management.

4. **Ekky Tammarar,**
ekky.tamarar@ui.ac.id (ST, UI; M.Sc. TU Denmark) Innovation Management, Technology Management, Operations Research, Supply Chain Management.

5. **Enrico Laoh,**
enricolaoh@ui.ac.id, (ST, UI; MT, UI) Statistics and Probability, Design of Experiment, Decision Uncertainty and Risk, Operations Research, Computational Methods in Industrial Engineering.

6. **Yadrifil,**
yadrifil@yahoo.com (Ir, UI; MA, Oregon State University, USA) Production System, Production Planning and Inventory Control, Lean Operations, Manufacturing Facilities Planning and Analysis, Manufacturing System, Industrial Strategic Design, Operations Management.

7. **Teuku Naraski Zahari,**
naraski@ui.ac.id (ST, ITB; MT, UI), Decisions, Uncertainties and Risks, Operations Research, Engineering Drawing.

8. **Nurul Lathifah,**
nurul.lathifah02@ui.ac.id (ST, UII; MSc, UGM) Behavioural Operational Research, Simulation, Supply Chain Management

9. **Nora Nisrina,**
   nora.nisrina04@ui.ac.id (ST, ITB; MT,UI) Operations Research, Production Planning & Inventory Control, Supply Chain Management

10. **Rheinanda Kaniaswari,**
    rheinanda.k@ui.ac.id (ST, UI; MT UI) Technology Management, Product Design

11. **Salsabila Annisa Arista,**
    salsabila.annisa04@ui.ac.id (ST, UI; MT, UI) Ergonomics and Human Factors, Design for Aging, Inclusive Design

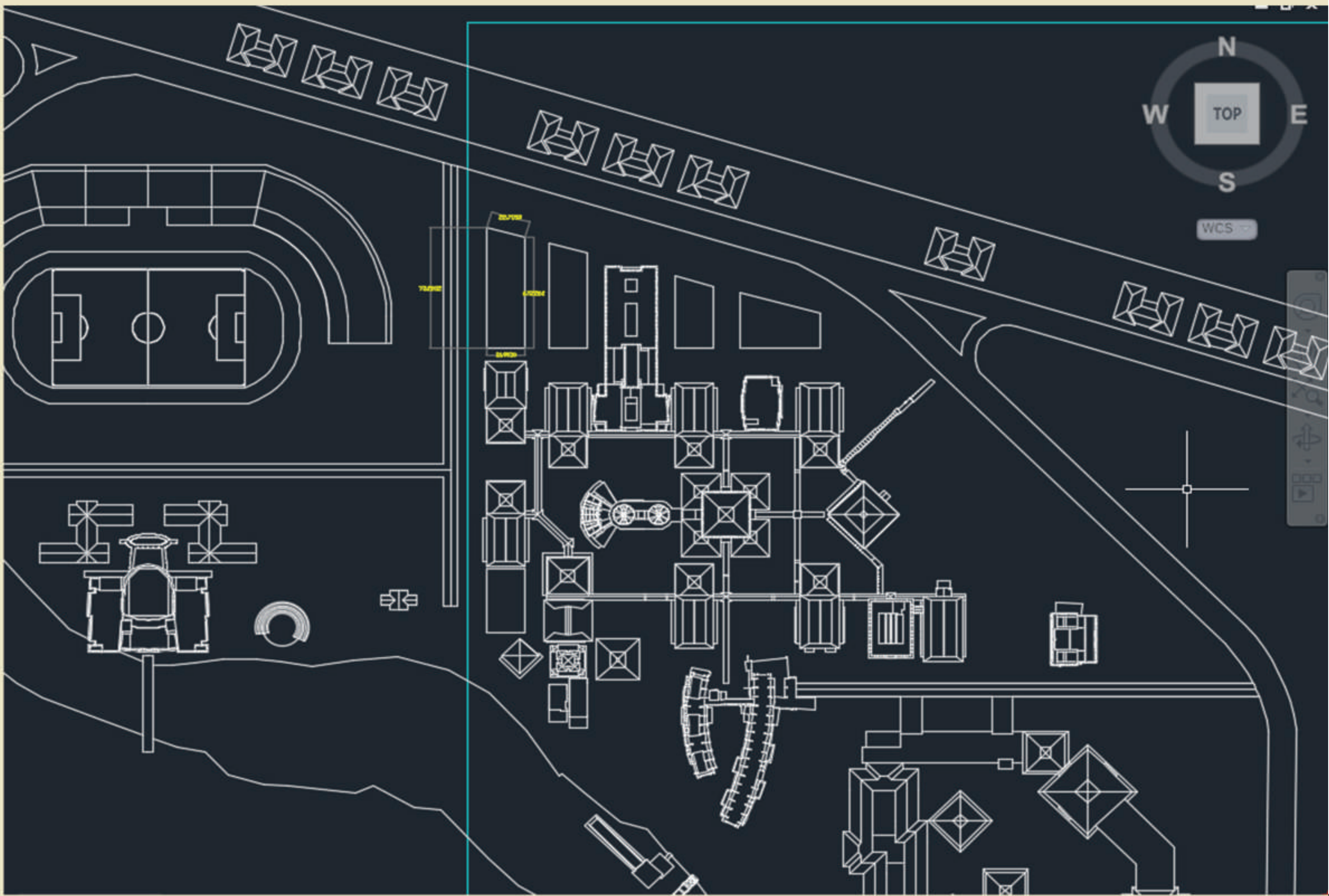
12. **Angella Natalia Ghea Puspita,**
    angella.natalia21@ui.ac.id (ST, IT Telkom; MT, UI) Optimization, Techno Economy, Machine Learning, Mineral Processing

13. **Rahmi Lathifah Islami,**
    rahmi.lathifah@ui.ac.id (S.Stat, Unpad ; M.Stat, Unpad) Operational Research, Applied Statistics

The educational system in the Faculty of Engineering, Universitas Indonesia, refers to the prevailing system of education at Universitas Indonesia.

CHAPTER 2

Academics System and Regulation



Academic System and Regulation

General

Teaching and Learning Activities

One semester is the activity time consisting of 16-18 weeks of lectures or other scheduled activities, including various additional activities such as 2-3 week assessment. These teaching and learning activities are in the form of classes, lab, studio, exams, quizzes, assignments, presentations, seminars, research, practical work, industrial visits, and a thesis.

Semester Credits Units (SKS)

Education in FTUI is provided in a variety of ways, including lectures, assignments (e.g., calculation tasks, planning, designs), practical work, seminars, lab, studio, and research for thesis writing. All educational activities that must be undertaken by a student to earn a bachelor's degree are contained within the academic loads and measured in semester credit units (SKS).

- Semester Credit is the measurement of the learning experience obtained by students in each semester.
- One Semester Credit in lecture, responses, and tutorials includes face-to-face study time for 50 (fifty) minutes per week per semester; structured learning activities with structured assignments for 60 (sixty) minutes per week per semester; and independent study session for 60 (sixty) minutes per week per semester.
- One Semester Credit of seminar or other similar subjects includes face-to-face study time for 100 (one hundred) minutes per week per semester, independent study session of 70 (seventy) minutes per week per semester.
- One Semester Credit in practical training, studio, workshop, on the field training, research and community services, and/or other similar subjects for 170 (one hundred and seventy) minutes per week per semester.
- One Semester Credit of online learning is 170 (one hundred seventy) minutes per week per semester.
- One semester is an effective learning process for at least 16 weeks of lectures or other scheduled activities and additional activities. Also included in the schedule is one week of midterm examination and another one or two weeks of final examination.
- To earn a bachelor's degree, a student must complete all educational activities with a total academic load of 144 credits spread into 8 (eight) semesters. Undergraduate students with an average study load of about 18-20 credits per semester are expected to undergo a week of a minimum of 18-20 hours of scheduled interactions with a lecturer, 18-20 hours of structured activities, and 18-20 hours of independent learning activities.

Subjects

Subjects in the FTUI's undergraduate curriculum are grouped into University General Subjects (6,25%), Basic Engineering Subjects (15-20%), Basic Skills Subjects (30-35%), Core Subjects (35-40%). Subjects are categorized as either compulsory subjects and electives. They can be taken across departments or faculties.

Grade Point Average

Grade Point Average or GPA is used to evaluate students' performance either for a particular semester in terms of Indeks Prestasi Semester (IPS) or Semester Performance Index, or, cumulatively for all of the semester up to the most recent one in terms of Indeks Prestasi Kumulatif (IPK) or CGPA. The formula used to calculate either IPS or IPK is as follows:

The calculation is made by multiplying the number of credits and the letter grade for each course, divided by the number of credits.

$$IP = \left(\frac{\sum_{MA} (\text{Bobotnilai x sks})}{\sum_{MA} \text{sks}} \right)$$

Semester Grade Point Average (SGPA)

Grade Point Average (GPA/IPK)

If the calculation involves the grade point values of all subjects taken during the educational program period, the result is called the Cumulative Grade Point Average (CGPA), which is used as a basis for study evaluation. Courses taken into account are the ones listed in the Study Plan Form (FRS). CGPA is obtained from the summation of all subjects having a grade of 'C' or higher, from the first semester until the last semester, with the exception of subjects with a letter grade of 'BS', 'I', or 'TK'.

Academic Performance Evaluation

Assessment of academic ability is performed on an ongoing basis by CLO (Course Learning Outcomes). There is at least one CLO derived from the Expected Learning Outcome (ELO) for each subject. Each CLO might be derived into several sub-CLO where each sub-CLO consists of several lecture materials and types of learning evaluations. A student will be assessed on their academic ability if they meet the following requirements:

- The courses taken have been registered and verified by Academic Advisor during the academic registration period.
- The student has fulfilled all of the administrative and academic requirements for the ongoing semester.
- The student has completed all of the required academic assignments.

Grades

At the end of every semester, students can download Semester Grade Record as a report of their academic performance from SIAK NG (https://academic.ui.ac.id/). Assessment of study efficacy is carried out using letters and grade points according to Table 2.1.

The highest grade is 'A' with a grade point of 4.00, and the minimum passing grade of a course is 'C' with a grade point of 2.00. A lecturer may assign an 'Incomplete' (I) grade if a student has not made a reasonable attempt to complete major session assignments or laboratory projects. The lecturer should make a reasonable effort to inform the student as early as possible that an essential part of the session work is incomplete. The 'I' mark should be changed to another

grade within one month; otherwise, it will automatically change to 'E' grade. The 'T' mark is given for no attendance in the exam. The 'BS' mark is given for special lecture (such

Table 2.1. Grade Value and Point

Grade Value	Marks	Grade Point
85 – 100	A	4,00
80 - < 85	A-	3,70
75 - < 80	B+	3,30
70 - < 75	B	3,00
65 - < 70	B-	2,70
60 - < 65	C+	2,30
55 - < 60	C	2,00
40 - < 55	D	1,00
00 - < 40	E	0

as internship, seminar, and final project) that has not been completed. These 'BS' courses are not taken into account in the calculation of Semester Study Unit, SGPA, and CGPA.

Length of Study and Academic Load

Undergraduate Program

The academic load students can take proposed by the students for the approval of the Academic Counselor based on their previous Semester Grade Point Average (SGPA) as stated in the Study Plan (FRS). Students must take the entire allocated credits and courses during their first semesters. The minimum academic load for the Undergraduate Program is 144 (one hundred and forty-four) credits, while the maximum academic load is 160 (one hundred and sixty) credits, including the final project. The entire academic load can be completed in a minimum of 7 (seven) semesters and maximum of 12 (twelve) semesters.

As for the second semester, these following rules apply:

- Students can take all credits load allocated for the second semester according to the structure of the applicable curriculum.
- Students can take more credits from the credit load allocated for the second semester if the SGPA obtain in the 1st semester is in accordance with the provision of the maximum credit load amounts shall follow the provision in the Maximum Credit Load Table.

From the third semester onward, the maximum credit load allowed to be taken is determined by the SGPA of the previous Semester (not including the short semester). It follows the provision of Maximum Credit Load as shown in Table 2.2 with respect to course prerequisites (if any). If necessary, the Academic Advisor (PA) can add a maximum of 2 extra credits upon the approval of the Vice Dean.

Master Program

The academic load in the FTUI's Master Program curriculum is set at 40-44 credits after finishing the Undergraduate Program. The length of study is scheduled for 4 (four) semesters and can be completed in minimum 2 (two) semesters and a maximum of 6 (six) semesters; exclude short semester.

Table 2.2. Maximum study load in a semester for undergraduate program

SGPA	Maximum Credit
< 2,00	12
2,00 – 2,49	15
2,50 – 2,99	18
3,00 – 3,49	21
3,50 – 4,00	24

The student's academic load is proposed by the students for the Academic Counselor (PA) approval based on their last semester SGPA as stated in the Semester Grade List (DNS). Provisions on the academic load are as follows:

- AA semester's academic load is registered by a student as they carry out online registration according to the predetermined schedule. Students are required to take all subjects as allocated in the first-semester curriculum.
- For students with SGPA less than 2.50, a provision stating that the number of credits taken for the following semester does not exceed nine credits is applicable.
- The maximum number of credits that can be taken on the Master Program is 18 (eighteen) credits (for Regular Master Program) per semester.
- Any Exemption from the provisions of academic load should be with the permission of the Vice Dean.

Matriculation for Master

The Matriculation Program is aimed at synchronizing the students' ability to achieve the minimum requirements for continuing education in the Master Program of FTUI. The program is compulsory for students coming from a four-year diploma program (D4) or graduates from a non-linear undergraduate study program.

Matriculation is achieved by taking classes of subjects required by each Faculty/Study Program within the Undergraduate Program curriculum. The maximum allowed credit load for this Matriculation Program is 12 (twelve) credits, which can be completed in 2 (two) semesters (6 credits in the first semester and 6 credits in the second semester). Students are allowed to continue their study in the Master Program only if they pass all matriculation subjects in a maximum 2 (two) semesters with a matriculation GPA of 3.00 (three points zero).

Fast Track (Master – Doctoral Program)

Fast Track (Master – Doctoral Program) is an educational program organized to accelerate students who have excellent academic ability to complete their studies in the Master Program and Doctoral Program in the same field of science within a maximum of 10 (ten) semesters.

To take part in the Master-Doctoral Fast-Track Program, students must fulfill the following requirement:

a. have obtained 18 (eighteen) credits with a minimum GPA of 3.50 (three point five zero) at the end of the second semester.

b. The study period for the Master-Doctoral Fast-Track Program is a maximum of 10 (ten) semesters.

c. Study Load on the curriculum of the Master-Doctoral Fast-Track Program, as follows:

1. For the Master program, that is according to the total credits in the master study program including 12 - 16 (twelve to sixteen) the credits include elective courses taken from the compulsory doctoral program;
2. For the Doctoral program, a minimum of 50 (fifty) credits, including 12 - 16 (twelve to sixteen) credits, are courses that are recognized through credit transfers.

Students who cannot complete their education within 10 (ten) semesters only get a Master's Degree.

Doctoral Program

The academic load in the FTUI's Doctoral Program curriculum is set at 50 credits after finishing the Master Program. The students register a semester's academic load through online academic registration during the predetermined schedule. New students are required to take all subjects as allocated in the curriculum for the first and second semesters. Students must retake any research courses with a 'BS' grade from previous semesters. The students propose students' academic load for each semester for the approval of the Academic Counselor (PA) or the Doctorate Promoter.

The length of study is scheduled for 6 (six) semesters and can be completed in a minimum of 4 (four) semesters and a maximum of 10 (ten) semesters. Students in the Doctoral Program may be granted an extension of maximum 2 (two) semesters if they have never received an extension before, have achieved a minimum grade of 'B' for research result examination, and have obtained a recommendation from their Promoter and a guarantee that they will complete their study within the granted extension period. The proposal for such extension is regulated in a Rector's Decree based on the proposal of the Dean.

Undergraduate Final Project (Skripsi)

Undergraduate Final Project (Skripsi) is a compulsory course for undergraduate students of FTUI taken to complete their study and earn a degree in engineering. The course is the application of science that has been obtained student has studied, in the form of a scientific paper, engineering design, assembly or models and accessories. It is equivalent to other skills courses and tailored to the scope of each Study Program. The following requirements, both academic and administrative, must be met before students are allowed to start writing their undergraduate thesis:

- The Undergraduate final project has been registered in the Study Plan Form Form [FRS]
- Students have obtained a minimum of 114 credits with a minimum of grade of C and have passed all mandatory courses both in the faculty and university level.
- Students have fulfilled all prerequisites set by the Study Program.

Undergraduate Final Project can be taken in both odd and even semesters in the running academic year. On SIAK NG, students must fill out the name of their Skripsi Supervisor and the title of their Skripsi to be verified by the Vice Head of Department. At the end of the semester, the supervisor will announce the Skripsi grade on SIAK NG and change the title of the thesis (if necessary). The completed undergraduate final project must be submitted in the form of a hardcover book, and students must upload their final revision in a pdf file to UI-ana (lib.ui.ac. id/unggah). The undergraduate's final project must be assessed in an undergraduate thesis examination by the Supervisor and examiners assigned by the Head of Department.

Thesis (Master Program)

The thesis is a report of research findings in the form of scientific writing. The thesis topic should be a summary of the subject matter that can be scientifically studied on the basis of theory using a certain method. The thesis should be written in Bahasa Indonesia with English abstract. For Master Program students who are given the opportunity to conduct research and thesis preparation abroad, they are allowed to write the thesis in English with a Bahasa Indonesia abstract while still following the appropriate format stated in the Final Project Writing Guidelines of Universitas Indonesia. Exemption from this rule applies only to Study Programs in collaboration with universities abroad, as stated in the cooperation charter.

Requirements for a student to start writing a Thesis are:

- The student's thesis has been registered in the Study Plan Form Form (FRS) every semester.
- The Head of Study Program has designated a lecturer to be the student's Thesis Supervisor.

Students are responsible for all thesis research costs. Students can actively meet with any of their lecturers as potential supervisors to request a thesis topic. In addition, in the middle of the second semester, the Head of Study Program can start announcing thesis topics from which the students of the Master Program can choose to prepare their thesis proposal in the form of a seminar. The Head of Study Program will also announce a list of Thesis Supervisors assigned to guide the students in writing and finish the approved topic. The thesis examination committee consists of a committee chair and a minimum of 3 or a maximum of 5 examiners, including the Thesis Supervisor. Responsible for the implementation of the thesis writing is the Thesis Coordinator in each Department. Thesis counseling should be provided by a maximum of two people, the main Supervisor and the second Supervisor. The main Supervisor should be the permanent university lecture holding a Ph.D degree. The second Supervisor is the university permanent lecture or temporary lecturer or expert from national or international institutions holding a Ph.D. or Master's Degree with professional certifications and qualifications equal to level nine (9) of the Indonesian Qualifications Framework (KKNI).

A thesis can be submitted for a thesis examination when it has met the following academic requirements:

- The thesis has been registered in Study Plan Form Form [FRS] in the said semester
- The thesis has been declared eligible for examination by the Thesis Advisor
- The thesis that has been declared eligible for examination must be submitted to the Department to be listed in the examination schedule determined by the Head of the Study Program.
- Uploading of Summary of Undergraduate Thesis/ Thesis/Dissertation

Dissertation

Dissertation preparation is carried out under the guidance and evaluation of a Promoter with the following qualifications: a full-time university lecturer; a Professor or Doctor with an academic title of Associate Professor; have expertise relevant to the dissertation topic, and within the last 5 (five) years have written at least 1 (one) scientific paper published in an accredited national journal or a reputable international journal or 1 (one) other similar scientific work acknowledged by a team of experts appointed by the Academic Senate of Universitas Indonesia. The Promoter may be assisted by a maximum of 2 (two) Co-promoters from within the University, partner universities, or other institutions in cooperation with the Promoter Team. The Co-promoter must have the following qualifications: a full-time or a part-time lecturer or an expert from another institution; hold a minimum title of Doctor/Ph.D with an academic title of at least Senior Lecturer, and have expertise relevant to the dissertation topic.

Internship for Undergraduate Student

The internship is an out-of-campus activity that encourages students to apply their scientific knowledge in a real work situation. The requirements for internship are set by each Department, and it accounts for part of the total 144 SKS. Students must find the place to carry out their internship themselves, and Departments will help by issuing a formal letter requesting the on-the-job training position. For the Double Degree Undergraduate Program, students are required to complete internships when they are in partner universities (except in UDE, Germany). For example, in Australia, the internship is one of the requirements set by the Institution of Engineers Australia (IEAust) to obtain an accredited B.E. (Bachelor of Engineering) Degree. The internship is a good opportunity for students to apply their skills and build networks in the industry. It is strongly suggested that students do their internships in partner universities. However, if they cannot do so, they are allowed to have their internship in Indonesia with prior permission from the partner universities.

Supplementary Exam

Students are allowed to take a supplementary examination for midterm and final examinations on the following conditions: sick, grievance, or representing Universitas Indonesia in a competition. Students with a sickness excuse are obliged to submit an application for supplementary exam signed by their parents/guardian and a medical certificate from a doctor or hospital that treats them; students with grievance or death in the family (death of the father, mother, older or younger siblings) are obliged to submit an application for supplementary exam signed by their parents/guardian; students representing Universitas Indonesia in the competition are obliged to submit a Letter of Assignment/Letter of Reference stating the competition in which they represent UI. The supplementary exam can only be taken with written consent from the Vice Dean for Academic, Research, and Student Affairs of Faculty of Engineering Universitas Indonesia.

Credit Transfer

Credit transfer is a recognition process of the number of credits a student may obtain from a university after an evaluation process by a Credit Transfer Team in each Faculty/ Department in the University. Students who have registered and studied at an undergraduate study program or other equivalent education programs, whether in Universitas Indonesia or any other universities or through a student exchange or study abroad program, may apply for a credit transfer, provided that: (i) the transferred credits contain the same material as the courses listed in the curriculum for the Undergraduate Program in FTUI, (ii) the academic record must date back not more than 5 years from the credit transfer application date, (iii) if the academic record is obtained from a university other than Universitas Indonesia, the university should have at least a 'B' accreditation from the National Accreditation Board for Higher Education or other international accrediting agencies. The maximum academic load that can be transferred in the Undergraduate Program is 50% of the total academic load that a student is required to complete in accordance with the curriculum of the Study Program he/ she is currently studying in. The courses transferred will be indicated with a 'TK' mark in the academic transcript.

The credit transfer procedures are as follows: (i) The student submits a letter requesting credit transfer to the Head of the designated Department; (ii) The Head of Department will form a team to recommend which courses the student has previously taken can be transferred; (iii) The recommendation will be sent to the Dean of FTUI; (iv) The Dean of FTUI will issue a Credit Transfer Decree; and (v) The Faculty's Center of Administration will assign a 'TK' mark to all the relevant courses in the student's SIAK NG account.

Credit Transfer for Parallel Class Students of Diploma Graduates

As of 2011, all Extension Programs in FTUI are merged into Parallel Classes in the Undergraduate Program. For diploma graduates registered as students in these Parallel Classes, credits obtained from the previous diploma program will be transferred in blocks of credits equivalent to the number of the first and second semester credits in their study program. Students begin their study in the third semester by taking a full academic load according to the package provided for the third semester. Afterward, they can take credits according to their SGPA in the following semester.

Study Abroad

There are many opportunities available for undergraduate students, both from Regular and Parallel programs to participate in Student Exchange programs abroad, such as in Japan, Korea, Taiwan, Singapore, and many other countries. Student exchange programs generally last for 1-2 semesters and are supported with a full scholarship. Information on Student Exchange program can be obtained from the Universitas Indonesia's International Office, PAU Building 1st floor. Courses taken during the study exchange program are transferrable when they return to Universitas Indonesia. Thus, students are still able to graduate on time.

In addition, Undergraduate students can participate in Double Degree 2+2 International Undergraduate program with FTUI's partner universities. Students participating in this program will spend the last two years studying at the partner university abroad, and he will earn two degrees once he graduates. However, this Double Degree program offers no scholarships. Thus, participating students should ensure their availability of funds. Students participating in classes outside of the university (in the form of Student Exchange, International Undergraduate Dual Degree Program, Sandwich Program, Joint Degree Program, or other university acknowledge program) for at least one semester will be given an "overseas" or study outside of the university status. Before leaving to continue their study overseas, students must ensure that their status in SIAK NG has been change to "overseas", and they are obliged to make payment to Universitas Indonesia in the amount stated in the applied Rector's Decree of "overseas" academic fee. Period of study abroad, either on the Student Exchange program and the Double Degree, is counted as part of the whole study period. The result or grades obtained from this program will not be calculated in determining their GPA and will be given a letter grade of TK in their transcript.

Fast Track (Undergraduate – Master Program)

FTUI students, Regular, Parallel, or International Undergraduate Program, with brilliant academic achievements can participate in the Fast Track program. In this program, FTUI's undergraduate students in semesters 7 & 8 are allowed to take several Master's program courses. Courses that can be taken and other requirements are specified by the Study Program in a way that the students can directly pursue a Master program in FTUI and complete the program in 1 year. Thus, the total time needed to complete both undergraduate and master programs is 5 years or 10 (ten) semesters.

The Academic load for the Fast Track Program curriculum is as follow:

1. For the undergraduate program is 144 (one hundred and forty four) credits, including 16-22 credits of elective subjects taken from the main competence subjects of the Master Program.
2. For the Master Program is 40-44 credits including the 16-22 credits from subjects mentioned in point an above and are acknowledge through credit transfer.

If a student is unable to complete his/her Undergraduate Program in 8 (eight) semesters, then the student will be deemed as unable to complete the Fast Track program, making all the subjects of the Master Program he/she has taken will be considered as elective subjects in their completion of the Undergraduate Program and cannot be acknowledged as part of their credit towards continuing to the Master Program.

Requirements and Procedure for Fast Track Registration

Undergraduate students who are interested in participating in the Fast Track Program must fulfill the following requirements:

1. Have a minimum GPA of 3.50 with a total of 120 credits (until 6th semester).
2. Have a minimum Institutional TOEFL/EPT score of 500 (students may use the score from the EPT test they took as a new student in FTUI)
3. Have a high motivation for research

Procedure for Fast Track Program:

1. Fast Track Program is open for all FTUI undergraduate study programs which have the same specialization with the Master programs (for undergraduate study programs that have specialization).
2. Students who are interested in participating in the Fast Track Program are required to fill out the Registration Form.
3. The Fast Track Registration Forms will be evaluated by a team headed by the Head of Department.
4. If the student's application to participate in the Fast Track scheme is approved, they are required to counsel with his/her academic advisor for the finalization of his/her Undergraduate (S1) and Master (S2) Study Plan Form. The student's Study Plan Form for semester 7 and 8, especially for the undergraduate Elective Course selection must be in accordance with the Compulsory and Elective Courses in their respective Master study program in line with their specialization.
5. Undergraduate thesis and thesis of the student are expected to be of continuous research to maximize knowledge, experience and quality research result.
6. The funds for the Fast Track Program will be borne entirely by the student.

Registration Form for the Fast Track Program for each running Academic Year may be submitted to each Department Secretariat on March each year at the latest.

Fast Track (Undergraduate – Doctoral Program)

Fast Track (Undergraduate – Doctoral Program) is an educational program organized by the University to accelerate students who have an excellent academic performance to complete their studies in the Undergraduate Program and Doctoral program in the same study field at the maximum of 12 (twelve) semesters.

Merdeka Belajar Kampus Merdeka Program

Merdeka Belajar Kampus Merdeka Program is a policy of the Minister of Education and Culture, which aims to encourage students to master various sciences useful for entering the world of work. Merdeka Campus provides an opportunity for students to choose freely several courses they will take. The implementation of Merdeka Belajar – Kampus Merdeka Program in the curriculum starting on 2O2O/2021 Academic Year. The Merdeka Belajar – Kampus Merdeka Program is the right for all undergraduate study programs.

Fulfillment of time and study load for undergraduate students or applied undergraduate programs can be implemented by:

a. follow the entire learning process in the study program to the period and study load; or
b. follow the study program's learning process to fulfill part of the time and learning load, and perform the rest learning process outside the study program.

The student may apply for the following elective courses scheme:

a. Fast-Tack program with a minimum of 24 (twenty-four) and a maximum of 54 (fifty-four) credits of choice focused on elective courses and postgraduate level courses at the same field of science as the field of science at the bachelor level.
b. Major-Minor Program with a minimum of 24 (twenty-four) and a maximum of 54 (fifty-four) credits the choice is focused on one different Study Program (across Study Programs/cross faculties/cross clumps of knowledge).
c. Double Major Program with a minimum of 24 (twenty-four) and a maximum of 54 (fifty-four) credits the choice is focused on one different Study Program (across Study Programs/cross faculties/cross disciplines) plus the rest of the Mandatory courses in the second Study Program to fulfill the minimum Expected Learning Outcome of the second study program.
d. Independent study Choice with a maximum of 54 (fifty-four) Optional credits are used for outside learning activities study program as stated in the Policy Merdeka Learning - Merdeka Campus.
e. The selection of the selected subject application scheme is consulted with the Study Program.

The form of learning activities that can be carried out outside the Study program include:

a. Student Exchange
b. Internship/Work Practice
c. Teaching assistant in education unit
d. Research
e. Humanity project Proyek
f. Entrepreneurial activities
g. Independent Study/Project
h. Building a Thematic Real Work Village/Lecture

The number of hours of learning activities is 45 Hours per week for one credit. Implementation of activities must be accompanied by lecturers advisor. The conversion of activities to credits will be carried out by faculty evaluators and verifiers, based on the number of hours and type/form of activities. The evaluator is a lecturer in the study program from the student or other Study Programs in the Faculty assigned to assist and monitor student activities. Verificators are officials at the Faculty level who are responsible for Education and/or Student Affairs in charge of perform verification, assign weighting, and propose assessment of student performance in student activities.

Administrative and Academic Registration

Academic Calendar

Administrative and academic schedules in FTUI are set in accordance with the administrative and academic schedules in Universitas Indonesia as follows:

Term 1

- **Administrative registration in Universitas Indonesia**
  July - August
- **Academic registration in Universitas Indonesia**
  August
- **Course period**
  August – January
- **Mid-semester examination**
  October
- **End of Semester Examination**
  December - January
- **Deadline for grade assignment in SIAK-NG**
  January
- **Departmental Judicium**
  1st: October
  2nd: January
- **Faculty Yudicium**
  1st: November
  2nd: January
- **Graduation**
  February

Term 2

- **Administrative registration in FTUI**
  January - February
- **Academic registration in FTUI**
  January - February
- **Course Period and examination**
  February - May
- **Mid-semester examination**
  March - April
- **End of Semester Examination**
  May
- **Graduation**
  August

Short Semester

- **Administrative Registration**
  June
- **Academic Registration**
  May - June
- **Course period**
  June - August
- **Mid-semester Examination**
  July
- **End of Semester Examination**
  August

Note:

*) Schedules are subject to change

Note:

1. Short Semester course period is held for 8 weeks, including mid-semester and final semester examinations.
2. 2 credit courses consist of two 2-hour contact per week, 3 credit courses consist of three times 2-hour contact per week, 4 credit subject consist of four times 2-hour contact per week.
3. For regular undergraduate program: Faculty Basic Courses (Physics, Mathematics and Chemistry) are only available for students who wish to retake the course and have attended required lab activities.
4. A student can take up to a maximum of 12 credits during the short semester.
5. Courses offered are determined by the Department.
6. If the number of students registered for a certain course in the Short Semester does not meet the minimum requirement, then the course will be canceled.
7. Short semester's tuition fee is not included in the normal tuition fee (BOP) and is calculated by the number of credits taken during the short term. Tuition fee for each credit is determined by FTUI.
8. Payment for short semester courses must be made before the payment period is closed. Otherwise, the student's name will be automatically removed and the student is no longer considered as a participant in the short semester.

Registration and Course Guidelines

Before administrative registration takes place, FTUI publishes an academic calendar for one semester listing schedules for courses, mid-term, final-term examinations and other academic activities. The academic calendar and course schedule could be accessed at http://www.eng.ui.ac.id, and SIAK NG.

Administrative Registration

Administrative Registration includes payments of tuition fee and admission fee. Students are responsible for paying fees by the payment deadline. Students who do not complete the registration process by the payment dead line will not be registered at that particular semester will be included toward student's allowed length of study. A 50% penalty will be imposed to students who do not make payment on time. Administrative registration are done by paying the tuition fee through the host-to-host system by the ATM (Automated Teller Machine) or bank teller of banks in cooperation with the Universitas Indonesia.

Academic Registration

Students should do online academic registration; consult with his/her Academic Advisor for approval and signing the Study Plan Form or Formulir Rencana Studi (FRS) during the academic registration period. The main duties of Academic Advisor are:

- Helping and directing students in their Study Plan Form particularly in selecting courses and in solving their academic problems
- Monitoring and evaluating student's academic performance during their period of study.

Students should login to https://academic.ui.ac.id using username and password provided by the Office of Direktorat Sistem & Teknologi Informasi (DSTI) UI. Students could get their username and password at PPMT (Pusat Pelayanan Mahasiswa Terpadu) building. Students could also download course schedules and academic calendar from the website.

After completing the online FRS, students should print the form (3 copies) and meet their PA to discuss, verify and validate the courses taken. Students have to check their FRS after registration period to ensure that the courses taken are correct. Fines will be levied to students for late administrative and academic registration, as per the university or the faculty regulation.

Sanctions

1. Students who do not carry out the administrative registration will receive inactive status as a student in the current semester, which is included as their length of study.
2. Students who do not carry out academic registration are not followed to take part in the academic activities in the relevant semester, which is counted towards their length of study
3. Students who are not active as referred to in points (1) are not charged with tuition.
4. Students who do not carry out the registration and administration of academic registration 2 (two) consecutive semesters, expressed as a university student resigned without notice from the university.

Exception Administrative Registration

When non-active students, by any reason, intend to maintain their status as active students, they have to follow the procedure of administrative registration:

- The students are required to obtain the approval of FTUI by filling out a form available at PAF (Pusat Administrasi Fakultas/Faculty Administrative Center).
- The students must come to the Directorate of Finance UI to obtain the approval for paying the tuition fee after paying the penalty 50% from the tuition fee on the relevant semester.
- The approval will be used by the students for paying the tuition fee manually.
- The students must give the copy of the payment record to the Directorate of Finance UI for verification.

Prerequisite Courses

These courses can only be taken if a student is currently taking or has previously taken and passed the prerequisite course with sufficient grade [not T].

Requirements for Transfer to Partner Universities in Australia for Double Degree Program

Minimum requirement of GPA and English before transferring to Partner University is listed in Table 2.3. Eligible students can continue their study to partner universities in Australia if they fulfill the following requirements:

1. Achieve the minimum GPA as required at the end fourth semester for the 2+2 program;
2. Have passed all required subjects as listed in the Study Program curriculum with minimum C with a total of passed credits consistent with the total number of credits listed in the Study Program curriculum for semester 1-4.
3. Achieve the minimum IELTS or TOEFL scores as required.
4. If their GPA is less than required, the students must stay at UI and repeat some subjects to improve their GPA, while administratively and academically registered at FTUI.
5. If their GPA meets minimum requirement, but IELTS or TOEFL scores less than minimum requirement, they are suggested to improve their IELTS or TOEFL score in Indonesia and maintain administrative registration at FTUI. Other choice is to take English for Academic Purposes (EAP) at the partner university. Information on duration and schedule of EAP can be found at the partner university's website.

English Language Requirements for Undergraduate International Program Single Degree

Students of the Undergraduate International Program Single Degree are required to obtain an English certificate in IELTS (International English Language Testing System) or TOEFL iBT (Test of English as a Foreign Language – internet Based Test) with the following minimum score:

Table 2.3. Minimum requirement of GPA and IELTS or TOEFL for transfer to the Partner Universities

Partner University	Minimum GPA	Minimum IELTS / TOEFL
Queensland Univ. of Technology	3.0	IELTS minimum 6.5 with no band lower than 6 TOEFL iBT in accordance to partner university's requirement
Curtin University		
The Univ. of Queensland		
The Univ. of Sydney		
Monash University	3.2	

Type of Test	Overall Minimum Score	Additional Requirements
IELTS	6.0	No bands lower than 5.5
TOEFL iBT	75	No bands lower than 17

This English Language Certificate is one of the requirements before they may proceed to have their Undergraduate Thesis/ Final Project Exam.

1. Student choose a Partner University • Find out list of UI's Partner Universities • Information on Study Abroad/ Student Exchange Information from International Office UI through http://international.ui.ac.id
2. Student contacted the selected partner University for Information on: • List of subjects offered and course description • List of requirements/documents needed. • Application and Tuition Fees. • Other Documents needed.
3. Student consulted their Academic Guidance Counselor or the Vice Head of Department to determine the subjects they will take in Partner University that can be credit transferred upon their return.
4. The Head of Department issued a Letter addressed to the Vice Dean stating: • Name and Student ID of student participating in the Study Abroad/Student Exchange Program • Name of Partner University and length of study of said program • List of subjects that the students will take at Partner University.
5. The Vice Dean will assigned the Associate Dean for Academic and Head of PAF to process the student's status to "overseas" or "student exchange and issued a Reference Letter and Academic Transcript for the student.
6. Student prepare the documents needed for their Study Abroad/ Student Exchange: • Application Form • IELTS/TOEFL iBT • Other language requirement • Reference Letter and Academic Transcript from the Faculty.
7. Student sends their application documents to Partnery University.
8. Student receives Letter of Offer dan Letter of Acceptance from Partner University.
9. Student makes payment and signed the Letter of Offer
10. Student applies for Student Visa to the Country where the Partner University is located.
11. Departure to Partner University

Procedure for Study Abroad/ Student Exchange to Partner University for Undergraduate International Program Single Degree.

Graduate Predicate

Students are considered to have passed the Undergraduate Program and will earn a Bachelor's Degree (S.T. or S.Ars.) if they are registered as an active student in Universitas Indonesia during said semester, both administratively and academically; have passed all the compulsory courses and acquired a minimum of 144 credits in accordance with the applicable curriculum with 'C' as the lowest grade and completed all 8-semester scheduled academic load within 8-12 semesters; have completed all administrative obligations, including returning all borrowed library and laboratory collections; and have completed all obligations within their study period and/or all assignments given in accordance with the curriculum of the Study Program (including revising Final Project) with a GPA of ≥ 2.00 (two point zero). Honors predicate for a graduate is determined by the student's CGPA as follows: Cum Laude (3.51–4.00), Very Satisfactory (3.01–3.50), and Satisfactory (2.76–3.00). For an undergraduate student to graduate Cum Laude, he/she must finish his/her study within 8 (eight) semesters with minimum GPA 3,51 and without retaking any courses.

Students are considered to have passed the Master Program and will earn a Master of Engineering or Master of Architecture Degree if they have passed all the required 40–44 credits; achieve a ≥ 3.00 GPA with 'C' as the lowest grade; do not exceed the maximum study period; and have met all administrative requirements. The honors predicate for a graduate is determined by the student's CGPA as follows: Cum Laude (3.76–4.00), Very Satisfactory (3.51–3.75), and Satisfactory (3.00–3.50). For a Master Program student to graduate Cum Laude, his/her length of study must not exceed 4 (four) semesters with minimum GPA 3,76 and without retaking any courses.

Students are considered to have passed the Doctoral Program and will earn a Doctoral Degree if they have passed all the required 50 credits; achieve a minimum GPA of 3.00 with minimum 'C' for in-class courses and minimum 'B' for research courses; do not exceed the maximum study period; and have met all administrative requirements. Honors predicate for a graduate is determined by the student's CGPA as follows: Cum Laude (3.76–4.00), Very Satisfactory (3.51–3.75), and Satisfactory (3.00–3.50). For a Doctoral Program student to graduate Cum Laude, his/her length of study must not exceed 8 (eight) semesters without retaking any courses or academic leave (except for a student with outstanding achievement based on the Promoter and examiner team's judgment, the length of his/ her study must not exceed 10 (ten) semesters). The mark 'BS' is not counted as course repetition. If a student's GPA is within the 3.76–4.00 range but he/she fails to meet the other requirements, he/she will be awarded a 'Very Satisfactory' predicate.

Academic Performance Evaluation and Dropout Criteria

Undergraduate Program

The university also requires that students maintain satisfactory academic performance during their study at FTUI and meet the following evaluation criteria to be able to continue their studies:

- Attain at least 24 credits with a minimum of C at the end of their second semester;
- Attain at least 48 credits with a minimum of C at the end of their fourth semester;
- Attain at least 72 credits with a minimum of C at the end of their sixth semester;
- Attain at least 96 credits with a minimum of C at the end of their eight semester;
- Attain at least 120 credits with a minimum of C at the end of their tenth semester;
- Attain all required credit with a minimum of C at the end of their twelfth semester;

Or:

- Have the following issues: have an inactive status (empty) for two semesters in a row, thus being declared as "resign" automatically from the status of Universitas Indonesia's student by the Rector's decree on Status Determination.

- It was proven to be in violation of rules or regulations that caused the student to lose his right as FTUI student.
- Deemed unfit to continue their study based on consideration from a team of Medical Doctors appointed by the Head of the University.

Students who still maintain satisfactory academic performance and meet the evaluation criteria to continue their study but would like to resign on their own free will may submit a written application to the Vice Dean with a copy to the Head of the Department.

Master's Program

The Maximum length of study to earn a Master Degree in FTUI is at the latest 6 (six) semesters, starting from registration time to graduation. This provision also applies to students who enroll in the FTUI Master program with a "probation" status. Students will lose their right to continue the study (dropping out) if:

- Students fail to achieve a 3.00 GPA of at least 9 passed credits (for regular Master Program student) or 12-14 passed credits (for non-regular Master Program student) at the end of the second semesters;
- In the end of the study period evaluation, students fail to achieve the following graduation requirements: registered as an active student in Universitas Indonesia during said semester both administratively and academically; not exceeding the maximum length of study; completed all administrative obligation including the return of all borrowed library and laboratory collection; and complete all obligation of their study period and/or all assignments given in accordance to the curriculum of the Study Program (including revised Final Project) with a GPA ≥ 3,00 (three point zero).
- Students who do not register academically and administratively for two consecutive semesters.
- Proven to be in violation of rules or regulations that caused the student to lose his right as FTUI students.
- Deemed unfit to continue their study based on consideration from a team of Doctors appointed by the Head of the University.

Student who still maintain satisfactory academic performance and meet the evaluation criteria to continue his study but would like to resign on his own free will may submit a written application to the Vice Dean with a copy to the Head of the Department.

Doctoral Program

The Maximum length of study to earn a Doctoral degree in FTUI is 10 (ten) semesters, starting from registration to graduation. **Students of the Doctoral Program (Class and Research)** will lose their right to continue to study (dropping out) if:

- Students do not register academically and administratively for two consecutive semesters, thus automatically being considered to have resigned from UI.
- Students fail to obtain a minimum of 'B' for their research proposal examination or a similar exam at the end of their fourth semester.
- Students fail to complete a minimum of 50% of their research based on the judgment of the Promoter Team by the end of their sixth semester.
- Students fail to complete a minimum of 75% of their research based on the judgment of the Promoter Team by the end of their eighth semester.
- At the end of the study period (ten semesters), students fail to complete 4 points above.
- Students fail to do the following by the end of their study period of ten semesters: producing 1 (one) scientific paper based on research for their dissertation as the main author with an option to work with the Promoter Team as their co-writer that has been accepted to be published in an indexed international journal (8 credits); submitting proof of compliance with the foregoing requirement as part of the requirements for promotion exam, and submitting 1 (one) dissertation and participating in a promotion exam as the final step of the Doctoral Program (6-8 credits).
- Students exceed the maximum length of study (10 semesters).
- Students are proven to be in violation of rules or regulations that causes the students to lose their rights as an FTUI student.

Student who still maintain satisfactory academic performance and meet the evaluation criteria to continue his study but would like to resign on his own may submit a written application to the Dean with a copy to the Head of the Department.

Students of the Doctoral Program (Research) will lose their right to continue to study (dropping out) if:

- Students do not register academically and administratively for two consecutive semesters, thus automatically being considered to have resigned from UI.
- Students fail to obtain a minimum of 'B' for their research proposal examination or a similar exam at the end of their fourth semester.
- Students fail to complete a minimum of 50% of their research based on the judgment of the Promoter Team by the end of their sixth semester.
- Students fail to complete a minimum of 75% of their research based on the judgment of the Promoter Team by the end of their eighth semester.
- At the end of the study period (ten semesters), students fail to complete 4 points above.
- Students fail to do the following by the end of their study period of ten semesters: producing 1 (one) scientific paper based on research for their dissertation as the main writer that is presented at an international scientific conference and published in the proceedings as a full paper (6 credits); producing 1 (one) scientific paper based on research for their dissertation as the main writer with an option to work with the Promoter Team as their co-writer that has been accepted to be published in an indexed international journal (8 credits); submitting 1 (one) scientific paper that has been accepted to be published in a nationally accredited journal; submitting proof of compliance with the foregoing requirement as part of the requirements for promotion exam; and submitting 1 (one) dissertation and participating in a promotion exam as the final step of the Doctoral Program (6-8 credits).
- Students exceed the maximum length of study (10 semesters).
- Students are proven to be in violation of rules or regulations that causes the students to lose their rights as an FTUI student.

Student who still maintain satisfactory academic performance and meet the evaluation criteria to continue his study but would like to resign on his own may submit a written application to the Dean with a copy to the Head of the Department.

Academic Leave

Students who wish to be away from their academic endeavors at FTUI for one to two semesters, but intend to return to FTUI are eligible for an academic leave of absence. Leave of absence can only be given to a student who has studied at FTUI for at least two semesters, unless under specific circumstances. Academic leave for special circumstances is an academic leave that is given to a student for unavoidable reasons, such as: carrying out state task, undertaking university task, or undergoing medical treatment, which prohibit the said student from participating in academic activities. Academic leave is not counted as part of the length of study.

Procedures of Academic Leave

1. To apply for academic leave, a student must write a letter requesting for academic leave to the Head of Department. Head of Department will give recommendation to Vice Dean based on the student request before the beginning of the administrative registration period of the relevant semester.
2. If the academic leave is approved by the Vice Dean, PAF will change the status of the student to 'academic leave' before the beginning of the administrative registration period of the relevant semester, and the amount of tuition will be automatically changed.
3. The student must pay 25% of tuition during the period of administrative registration of the intended semester.
4. If the student has been granted an academic leave but fails to pay the required tuition during the registration period, the academic leave will be canceled, and the student's status will change to 'inactive' (empty).
5. In the situation as stated above, if the student still insists on making payment after the registration period has passed, the student will be charged a late administrative registration fee in the amount stated in the Rector's Regulation on Academic Fees.
6. If the student fails to pay during the prescribed period of administrative registration, Exceptional Administrative Registration will apply.
7. If the academic leave is proposed not in accordance with point (1) above, or proposed after the semester starts, the student must pay the full amount (100%) of tuition.

Faculty and Department Judiciums

Judicium is a meeting held at both the Faculty and the Department level to decide whether a student has fulfill all academic requirements and may graduate and earn a degree in engineering based on the Department/Faculty Evaluation.

Semester Grade Transcript, Diploma and Academic Transcripts

FTUI Central Administration Office is responsible for issuing Semester Grade Transcript, Diploma and Academic Transcript for all FTUI's graduates. Student Academic History is issued on student's request, while the diploma and academic transcripts are issued only once at the time of the student's graduation. Student Academic History and Academic Transcript contain the names, course codes and grades of all courses that the student have taken during their study period. Also included is the student's Grade Point Average (GPA) which is calculated based on all courses' grades. Diplomas and Academic Transcripts will be handed to all graduates no later than 2 (two) months from the date of graduation.

The Semester Academic Transcript (DNS) gives the information on the student's identity (name, student ID and highest education level), Academic Advisor, Faculty, Study Program, Specialty, Education Level, Subject Code, Subject Title, Credit, Letter Grade, Semester GPA, and GPA. The Semester Academic Transcript can be issued in hard copy form on a student request as required. A valid DNS is signed by the academic administration official in the Faculty level.

Academic Record chronologically lists all academic activities of a student since the FRS time registered as a student until no longer registered, either due to graduation, expulsion, or resignation. The academic status of a student for each semester is recorded in the Academic Record. The Academic Record is also used as a source of information for the student, Academic Advisor, and Study Program to help the student to achieve success in their study and is issued as required on the student's request and validated by the Vice Dean of the Faculty.

Academic Transcript is given to students that have been declared to fulfill all requirements to graduate from a Study Program in a faculty meeting and contains information on a student identity (name, student ID, place and date of birth), previous education, education level, study program, specialty, list and code number of subjects, letter grade, number of required credits, number of obtained credits, GPA, title of the student's Final Project, diploma number and year of graduation. All subjects taken by the student, including repeated subjects and transfer credit subjects, are included in the Academic Transcript which is issued in two languages, Bahasa Indonesia and English. The Academic Transcript will be given to students with no outstanding tuition fees.

Diploma is given to a student who has been verified in a faculty members meeting to complete all requirements to graduate from a Study Program. Diploma contains information on the personal identity of the diploma holder (name, place and date of birth), academic title, name and signature of the Rector and Dean, issuance date of diploma, date of graduation, student ID, diploma number and signature and photo of the diploma holder. In the event that the diploma is lost or damaged, the diploma holder may request another copy of the diploma. Dean/ Vice Dean/ Director of Academic on behalf of the Rector may signed to validate a copy of diploma. Diploma will be given to students with no outstanding tuition fees.

Offenses and Sanctions

In any courses, no student shall engage in any form of unethical or improper conducts, including but not limited to examination offenses, such as:

1. Utilizing unauthorized materials/notes to enhance performance during on examination.
2. Attempting to observe the work of another student.
3. Taking an examination for another person, or permitting someone else to do so.
4. Collaborating improperly by joint effort on discussion in anyway expressly prohibited by lecturer.
5. When incidents, as enumerated above occurs, the following sanctions may be imposed (as per FTUI regulation):
   - The student may be assigned E for the subject in question
   - The student may be suspended for one semester
   - The student may be dismissed or expelled by FTUI

- If necessary, a meeting of Panitia Penyelesaian Pelanggaran Tata Tertib (Offence Settlement Committee) (PT32) may be held.

Academic Sanction for Perpetrators of Academic Cheating In Exams

1. Academic sanction in the form of the revocation of the said exam (E grade) for the student caught or proven committing academic offence in the examination process, such as working with any other student, copying any other student's work or giving answer to any other student;
2. Academic sanction in the form of study period revocation (for all subjects) for the said semester for the student caught or proven committing academic offence in examination process such as opening books, notes or any other equipment prepared beforehand;
3. Academic sanction in the form of revocation of study period for the said semester and one semester suspension for the student caught or proven committing academic offence in the examination process due to collaborating with any third party outside of the examination room;
4. Academic sanction in the form of expulsion from the Faculty of Engineering, Universitas Indonesia, for the student caught or proven committing academic offence in the examination process by substituting any other examinee or by having someone else to take their place;
5. Academic sanction in the form of expulsion from the Faculty of Engineering, Universitas Indonesia, for the student caught or proven committing academic offence in the examination process for planning and carrying out the plan to help any other examinee;
6. Other academic offence will be handled through a hearing by the Offence Settlement Committee (Panitia Penyelesaian Pelanggaran Tata Tertib (P3T2)), Faculty of Engineering, Universitas Indonesia;
7. Student is entitled to submit an appeal to the Faculty Academic Senate with the help of their Academic Advisor and the Vice Dean for Academic, Research, and Student Affairs, Faculty of Engineering, Universitas Indonesia..

Academic Sanction on Plagiarism and Act of Fraud in the Completion of Final Project

Plagiarism is an act of stealing ideas or thought already available in written and/or someone else's writing and used them as if it is our own ideas, thoughts and/ or writing thus causing harm/loss to the original owner both material or non material, this plagiarism can be in the form of using a word, phrase, sentence, paragraph, or even a chapter of someone else's writing or book, without stating the source. Included in this is the auto plagiarism.

Auto Plagiarisme is an act of using an idea or thought repeatedly in writing or using someone's own writing in parts or whole without stating the origin published source as if those ideas or thoughts are a new idea, thought and/or writing.

Plagiarism criteria used as a based to decide a sanction focuses on the amount of idea or phrase stolen and how similar the writing in phrase, sentence, paragraph, section, chapter, and the writing as a whole. A work can be considered plagiarism if based on the verification result on the writing contained a similarity level of 35% or more with the original work. To prevent plagiarism, student is obligated to check their final work using software of anti plagiarism provided by the Faculty or University before submitting their work to their advisor/promoter/co-promoter. If such software is unavailable, student is required to check existing list of research in connection to the topic of their research and state such research in their reference of research. Student caught and proven of committing plagiarism is entitled to an appeal tried in the Study Program level to the Faculty which the Faculty will later passed on to the university through the P3T2 to be verified and processed.

In case of an active student, early sanction can be in the form of delaying the final project examination or delaying the graduation status for student who has been declared passing the final project examination. Student that has been declared as a graduate but have not received their diploma, with the approval of the Rector, the Dean may hold said student diploma while await the Rector's final decision. Academic sanction on plagiarism for active student is established through the Dean's decree based on the proposal by the Head of the Study Program or recommendation from the Faculty in one month at the latest since the date of the proposal letter was accepted by the Dean. For graduate student is established through the Rector's Decree based on the P3T2 recommendation. The heaviest academic sanction given can be in the form of cancellation of the student final project (for active student) with the obligation to write a new final project with new topic, while for graduate student the sanction is in the form of revocation of academic titles.

The act of fraud in the writing of Final Project, Essay as Exam Substitute, or Assignment, includes the usage of other person's service/ replacement/ consultant/ or other service to complete assignments in the name of said student and other manipulative act of fraud. This act does not include the usage of service for data collecting, survey, and data processing for the completion of final project of student. Sanction given to the perpetrator of said act of fraud in the completion of final project is established throught the Dean's decree issued in one month at the latest since the proposal letter from the Head of Study Program is received by the Dean. The heaviest academic sanction given can be in the form of cancellation of the student final project (for active student) with the obligation to write a new final project with new topic, while for graduate student the sanction is in the form of revocation of academic titles. Active students who consciously act as a ghost writer in writing the final works for other students will be given the equivalent of student academic sanction given to the perpetrators of acts of fraud.

Academic Regulation Of The Universitas Indonesia

List of Academic Regulations at Universitas Indonesia can be accessed via http://respository.ui.ac. id. Below is a list of Decrees that functioned as reference for education program at Universitas Indonesia

General:

1. Decree of the Board of Trustees Universitas Indonesia Number: 008/SK/MWA-UI/2004 on the Amendment of Board of Trustees' Decree Number: 005/SK/MWA-UI/2004 on the Code of conduct on Campus Life in Universitas Indonesia

Education

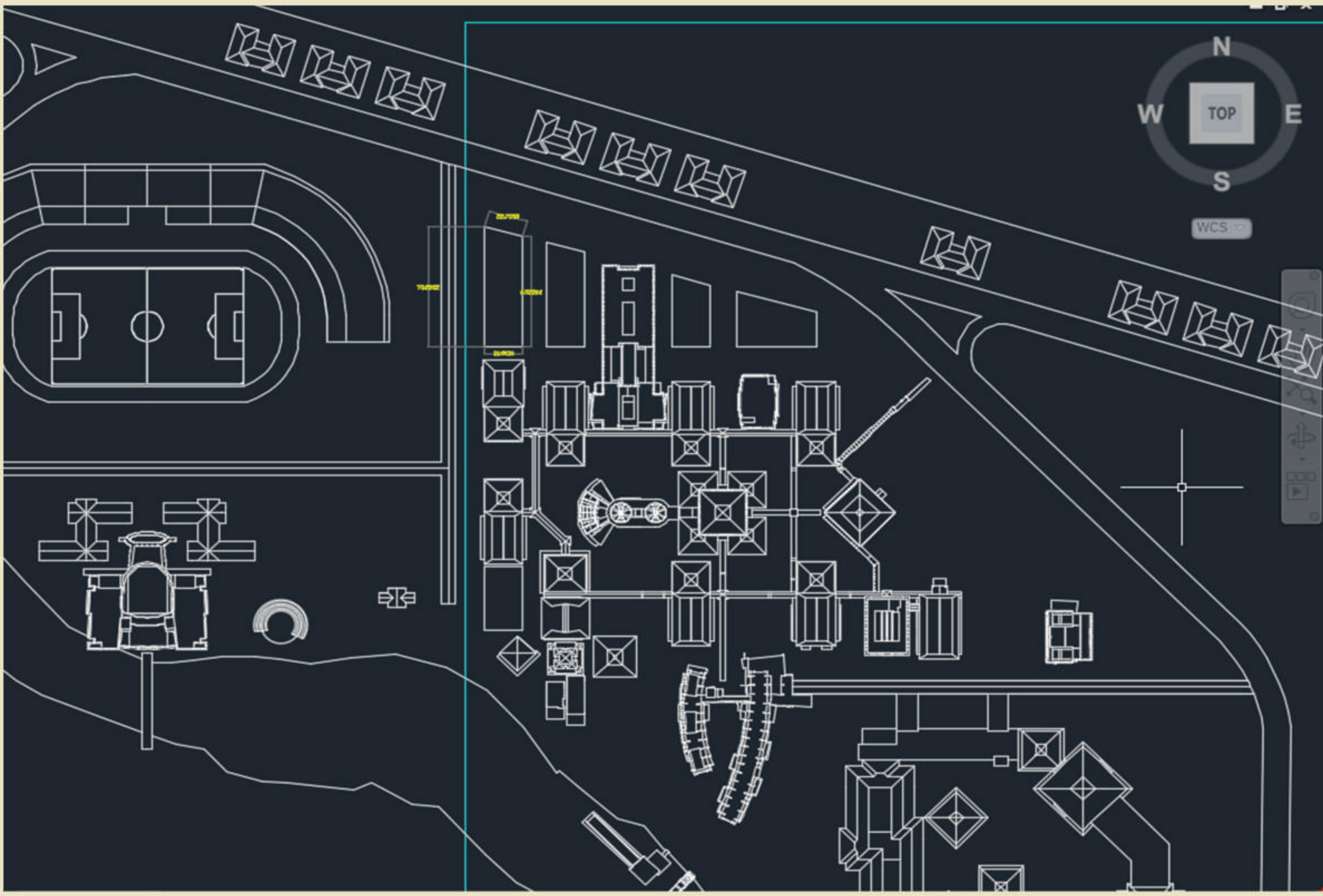
1. Decree of the Rector Universitas Indonesia Number: 285/SK/R/UI/2003 on the Implementation Guidelines for Cross-Faculty Lectures in Universitas Indonesia
2. Decree of the Board of Trustees Universitas Indonesia Number: 006/MWA-UI/2004 on the Universitas Indonesia's Academic Curriculum
3. Decree of the Rector of Universitas Indonesia Number: 491/SK/R/UI/2004 on Universitas Indonesia Education Activities Conclusion Regulations
4. Decree of the Board of Trustees Universitas Indonesia Number: 001/TAP/MWA-UI/2005 on the Establishment of Academic Degrees in the Universitas Indonesia.
5. Decree of the Board of Trustees Universitas Indonesia Number 003/TAP/MWA-UI/2005 on General Guidelines for Implementation on Universitas Indonesia's Professional Programs
6. Regulation of the Board of Trustees Universitas Indonesia Number: 006/Peraturan/MWA-UI/2005 on Student Learning Outcomes Evaluation at Universitas Indonesia
7. Regulation of the Board of Trustees Universitas Indonesia Number: 007/Peraturan/MWA-UI/2005 on Academic Education Implementation Norms in Universitas Indonesia
8. Regulation of the Board of Trustees Universitas Indonesia Number: 008/Peraturan/MWA-UI/2005 on Professional Education Curriculum Norms in Universitas Indonesia
9. Decree of the Rector of Universitas Indonesia Number: 838/SK/R/UI/2006 on Administration of Universitas Indonesia Student's Learning Outcomes
10. Decree of the Rector of Universitas Indonesia Number: 012/SK/R/UI/2007 on Implementation of the of Students Learning Activity in Universitas Indonesia
11. Decree of the Rector of Universitas Indonesia Number: 450/SK/R/UI/2008 on the Implementation of E-Learning in the University Indonesia
12. Decree of the Dean of Faculty of Engineering Universitas Indonesia Number: 3 year 2019 on the English Requirements for Undergraduate International Program Single Degree and Double Degree Faculty of Engineering Universitas Indonesia.
13. Decree of the Rector of Universitas Indonesia Number : 16 year 2020 on the Implementation of Undergraduate Program in Universitas Indonesia
14. Decree of the Rector of Universitas Indonesia Number : 5 year 2021 on the Implementation of Master Program in Universitas Indonesia
15. Decree of the Rector of Universitas Indonesia Number : 8 year 2021 on the Implementation of Doctoral Program in Universitas Indonesia
16. Decree of the Dean of Faculty of Engineering Universitas Indonesia Number: 622/D/SK/FTUI/IX/2016 on Academic Sanction for Academic Fraud Perpetrator in Faculty of Engineering Universitas Indonesia.
17. Decree of the Dean of Faculty of Engineering Universitas Indonesia Number: 623/D/SK/FTUI/IX/2016 on General Regulation on Supplementary Exam for Mid Term and Final Examination in Faculty of Engineering Universitas Indonesia.
18. Decree of the Dean of Faculty of Engineering Universitas Indonesia Number: 624/D/SK/FTUI/IX/2016 on Academic Sanction for Plagiarism and Act of Fraud in the Completion of Final Project in Faculty of Engineering Universitas Indonesia.
19. Decree of the Dean of Faculty of Engineering Universitas Indonesia Number : 2 year 2022 on the Scientific Publication Assessment Guide for Master Program and Doctoral Program in Faculty of Engineering Universitas Indonesia.
20. Decree of the Dean of Faculty of Engineering Universitas Indonesia Number : 703 year 2016 ont the Credit Transfer

Research

1. Decree of the Board of Trustees Universitas Indonesia Number 002/SK/MWA-UI/2008 on University's Research Norms
2. Decree of the Board of Trustees Universitas Indonesia Number 003/SK/MWA-UI/2008 on Research Policy at Universitas Indonesia
3. Decree of the Board of Trustees Universitas Indonesia Number 009/SK/MWA-UI/2008 on amendment of the Decree of the Board of Trustees of Universitas Indonesia Number 003/MWA-UI/2008 on Research Policy in Universitas Indonesia

CHAPTER 3

Facilities and Campus Life



Facilities and Campus Life

New Facilities Available in FTUI

1. All classrooms in S building are now having one special chair for each classroom dedicated to left handed students.
2. FTUI has renovated the S405 classroom into a specially design discussion room for students to learn and discuss in groups in the implementation of Student-Centered Learning (SCL). This renovation is partly funded by USAID through their PEER Science research program by providing chairs, computer screen for each discussion group, wireless LCD projector and documented camera. The renovation is completed by the start of the Odd Semester of 2015. The class room will be able to accommodate up to 80 students in groups discussion form as in problem-based learning (PBL) or Collaborative Learning (CL) and up to 100 students in class room form
3. Online Electricity Metering and Monitoring System now help FTUI in monitoring electricity usage of each building and their characteristic. www.ee.ui.ac.id/power; www.eng.ui.ac.id/power
4. Offline Water Metering and Monitoring System prepare FTUI in determining the water usage of each building and help plan the creation of rain water well within the faculty.
5. Smoking is prohibited throughout most of the faculty areas. However, the new and vastly improved Smoking Shelter is now available in the student's cafeteria area and in front of the S Building.
6. Smart class rooms are built with concepts that have various advanced features to support various learning models. Equipped with a modular table that can be arranged according to lecture mode, as well as an interactive smart board that has advanced features. During the lecture, the system will automatically record the lecture activities and the results can be used by students. Recordings and discussion results during lectures in the smart class room can be accessed by students through the learning management system channel.
7. Integrated - Creatice Engineering Learning Laboratofy (i-CELL) is prepared to support the change in te educational process from Teaching Approach to Learning Approach which makes students the focus. i-CELL is also one of the answers to the demands of the Industrial Revolution 4.0. This building carries smart and green building technology that is environmentally friendly, equipped with sophisticated IT systems to support effective and efficient research and practicum activities. The construction of the i-CELL and Workshop building is an effort of FTUI to create and unite research and education laboratories that are integrated, comfortable, modern, and make it easier to conduct interdisciplinary research at FTUI.

Integrated Students Service Building (PPMT)

This building is located at the left of the Rector building with the one door policy in serving the registration process of all Universitas Indonesia students, whether they are vocational, undergraduate, undergraduate extension, master, doctoral, specialist, and professional students. This building consists of three divisions: PPSI division, Student Affairs division, and Academic division.

Faculty Administration Center

Academic administrative services for all academic programs in FTUI are managed by PAF. The services provided for students include academic records, change of grades from lecturers, testamur and academic transcripts, registration, absence of leave, enrollments and letter of reference letter. The working hour is at 08.00 to 18.00 from Monday to Friday, at PAF building.

University Central Library

Location : Kampus UI Depok

Service hours of UI Central Library

Monday - Friday	08.30 - 19.00 WIB
Saturday & Sunday	08.30 - 15.00 WIB
Holly Month of Ramadhan	08.30 - 15.00 WIB

Membership:

Students, lecturers, researchers and employee of the Universitas Indonesia are entitled for membership of the central library with the following requirements:

1. Provide the latest semester payment proof or the latest study card (IRS) or certification letter from any faculty, unit or department within the Universitas Indonesia.
2. Provide a 2x3 photo (one)
3. Provide a cover letter from the faculty (for lecturers)

Lending Procedures:

1. General text books can be borrowed for two weeks (max. 3 books) by showing your Student Card. Borrowed books need to be stamped.
2. Reference books, magazines, newspaper and thesis can only be read on the spot or photocopied.
3. Dissertation and thesis can only be photocopied as many as 10 pages.

UI Central Library Services

Reference Service

This service is provided to help the UI civitas academica in searching information, especially for students who are working on their final assignment or research. Information search request may be submitted in person or via email (reflib@ui.ac.id).

Information Package

Information package is a form of service in the form of certain topics of information packages. Each package consists of several articles and their annotation in accordance to the selected topic. Each article can be obtained by contacting the reference division first (reflib@ui.ac.id) or by direct phone request (+6221-7270751).

Information Search Training

The information search training consists of several packages. They are: basic and advance package. This training is provided to help improve the information skill of library visitors and members. This service is available to all university members, especially new students and students who are in their final year. Request for training can be submitted directly or through the email perpusui@ui.ac.id

Circulation (Borrowing Books)

The circulation services are located in level 1 The library's collection of reference books, thesis, dissertation, research reports and UI-ana can only be read on the spot at the UI Central Library.

UI Central Library Facilities

OPAC (Online Public Access Catalog)

OPAC is a tool to search the information regarding the available collection of the library by using a terminal computer. OPAC computers are available on every floor of the library.

Internet Access

Internet access connection at the UI central library uses the integrated network (JUITA – Jaringan Terpadu) and can also be accessed by using the UI Hotspot. Internet service is also available at the first floor of the central library. Also available are computers with internet access for the usage of library visitors and members.

Computer, Scanner and Data Backup

Students are allowed to use the provided computers to work on their assignments, picture/photo scanning and to burn the result of their information search to a CD.

Photocopy

A photocopy machine is available at the UI Central Library

Discussion, Class and Seminar Rooms

Discussion, Class and Seminar rooms are available for students' needs and for classes.

Special Study Rooms

Special study rooms are available and can be used by all university members. These rooms are equipped with a desk, filing cabinet and internet access.

Locker

250 lockers are available for UI Central Library Members.

Computer Sciences & Network

Directorate of Information System Development and Service (PPSI) are responsible for the programmed computer network system designed to help fulfill the students and lecturers needs in computer usage (from academic activities such as programming to internet usage) through the Integrated UI network (JUITA).

Requirements for using the JUITA:

- Registered as a UI student
- Fill out registration form with a reference from the Associate Dean for Students Affairs/ Head of Study Program/Academic Counselor of the student.

Place of Registration:

- Depok (Integrated Student Service Center Building)
- Salemba (PUSILKOM Building)

Hotline Service

Users who are experiencing problems in the use of this facility can report or request the help of the Computer Technical Unit through the following PPSI hotline service:

Phone : +6221-7863419

Email : support@ui.ac.id

Web Site : http/cso.ui.ac.id

Office Hours : Monday – Friday (09.00 - 16.00)

Puskom Services at FTUI

Puskom (Pusat Komputer) provides services related to education and information technology development for students and academic/non-academic staff. The office is located at 2nd floor of GK Building at FTUI, Depok Campus. Main duties of Puskom is to provide education facilities for students, learning and research facilities for lecturers, and services for education administration, students and personnel. Puskom also provides connection services to internet and local area network at the Faculty and the University. Internet can be accessed at all area of FTUI. This facility can be used by students as well as faculties. All computer networks have been connected by fiber optic cables for inter-building and copper cable in the buildings with capacity of 100 Mbps. Besides providing local networks, Puskom also controls 7 computer servers with redundancy backup to minimize troubles in academic and research services. Computers are also available for students at various locations at FTUI i.e. computer laboratory at 2nd floor of GK Building, as well as at FTUI building at Salemba Campus. The service hour is 09.00 to 16.00 from Monday to Friday. For further information please contact Puskom at GK Building, 2nd floor, tel. 021-7863508, 021-2720011 ext. 64, or send email to puskom@eng.ui.ac.id.

Student Welfare

Universitas Indonesia Mosques

- The Ukhuwah Islamiyah (UI) Mosque Depok located in the UI Depok Campus. Established on 28 January 1987 for the Friday prayer with Prof. H. Moh. Daud Ali, SH as khatib (preacher). This mosque was named Ukhuwah Islamiyah for within this mosque is fostered the Islamic brotherhood within the campus as well as the unity and brotherhood of Moslem from within and outside of campus area.
- The Arif Rahman Hakim (ARH) Mosque Salemba is located in the UI Salemba Campus. Established on 10 November 1967, 27 Rajab 1387 H. Based on the UI Rector Decree dated 16 August 1966, a development committee was established and consist of students. The vision of this mosque is to be the center of Islam education in the campus and produces modern Moslems (equipped with faith and knowledge) that can implement the teachings of Islam and help solve religious problems.

Teksas Bridge

The Teksas Bridge is a linkage bridge between two faculties in the UI Depok campus, the Faculty of Engineering and the Faculty of Humanities. These two faculties are separated by an 80 meters lake. The Teksas Bridge is hoped to serve as:

- As a connection bridge and "Landmark"
- As a research object for steel application product
- As a promotional tool on "Aesthetics Steel"

The concept of this bridge aims towards two approach:

- The side of the bridge on the Faculty of Engineering UI reflects a powerful and masculine character symbolized with a "Sail" shaped Pylon Bridge soaring to the sky as a symbol of "LINGGA".

- The side of the bridge on the Faculty of Humanities UI reflects a flexible and feminine character symbolized with a "Hole Gate" shaped Pylon Bridge as a symbol of "YONI".

Campus Bus

To serve the transportation needs of students within the campus, Universitas Indonesia provides 20 campus busses. These busses will serve inside campus routes from these times: 07.00-21.00 (Monday-Friday) and 07.00-14.00 (Saturday). These yellow campus busses have two different routes:

- **Blue** :
UI Dormitory, Gerbatama, UI Train Station, Faculty of Psychology, Faculty of Social and Political Science, Faculty of Humanities, Faculty of Economics, Faculty of Engineering, KuKel, Student Center Building, Faculty of Mathematic and Natural Sciences, Faculty of Public Health, Balairung, UI Mosque, and Faculty of Law.
- **Red** :
UI Dormitory, Gerbatama, UI Trains Station, Faculty of Law, UI Mosque, Balairung, Faculty of Public Health, Faculty of Mathematic and Natural Sciences, Student Center Building, KuKel, Faculty of Engineering, Faculty of Economics, Faculty of Humanities, Faculty of Social and Political Science, and Faculty of Psychology.

Executive Bus

In order to provide transportation service, especially outside campus transportation, Universitas Indonesia provides Air Conditioned and Non-Air Conditioned busses for rent. These busses are available for various types of activity, such as: UI student organization activities, academic support activities, and many more.

Rental Procedures:

- Written rental request is submitted to:
Directorate of Student Affairs
Integrated Student Service Center
Building, Kampus UI Depok
Phone : +6221-7867222 (Operator)
Fax : +6221-7863453
- Payment should be made, at the very latest, one week before the date of use via BNI Bank, Kampus UI Depok Branch, and Account Number: 1273000024 under the name of Universitas Indonesia.
- Proof of payment must be submitted to the Directorate of Student Affairs. Cancellation done 3 (three) days before the date of use will be charge a 10% cancellation fee from the paid rent. Cancellation on the date of use will be charge a 30% cancellation fee from the paid rent.

Student Welfare and Facility Building (GKFM) / University Health Center

Address : Kampus UI Depok

Phone : +6221-78881019

This building is located in front of the Faculty of Engineering in UI Campus Depok. GKFM / University Health Center Building was built to better serve several important needs of the students, such as:

Polyclinic Unit

Provide a free health service to all students of the Universitas Indonesia. Students only need to provide their Student ID card to process their membership card for future medical record to receive this service. There are several services available:

1. Public Health Service
2. Dental Health Service

Service Hours:

Monday – Thursday : 08.00 - 12.30
and 14.00 - 19.00

Friday : 08.00 - 11.00
and 14.00 - 19.00

Saturday : 08.00 - 12.00

Note:

Aside from the above mentioned facilities for students which are funded by the Students Welfare and Facility Fund, GKFM in UI Depok Campus also provide facilities for blood chemistry examinations, x-ray, and cardiac examination for university members with affordable prices.

Pharmacy

The pharmacy provides free medicine for 3 (three) days for UI students who seek treatments in the Polyclinic unit. The pharmacy also provides various other medicines for first aid needs for general public purchase.

UI Student Counseling and Guidance (BKM)

In providing service in the mental welfare of the UI students, the Student Counseling and Guidance is a place where UI students can receive psychological help in dealing with academic, personal or family problems. These psychological help are given in the form of counseling and guidance. Guidance service is the provision of information (to an individual or group) with the purpose of making sure that students are able to learn and build an optimal social relationship. Counseling service is the process of giving help to students and support student in finding a way to solve his problem. Here, a counselor functions as a facilitator.

Services in the UI Student Counseling and Guidance

The routine services provided by the BKM UI are counseling and guidance services daily which are done at:

Service Time : Monday – Friday

Service Hours : 09.00 – 15.00

Place : Student Welfare Center

2nd floor, Student Welfare & Facility Center Building

UI Campus Depok Phone : +6221-96384797

BKM UI staff of counselors consists of psychologies, psychiatrists, and academic counselors.

Problems handled by BKM UI

Generally, the problems handled by the BKM UI consist of academic, personal, family, and social problems.

BKM UI's other services:

- Online counseling
- Peer counseling training
- Counseling training for counselor lecturers and BKM management in the faculty level.
- Coordinate meeting between BKM in the university

and faculty level.
- Personality development training
- Group therapy

UI Salemba Polyclinic

For students in the UI Salemba Campus, the university also provides similar health service in the polyclinic for public health service. Service time : Monday – Friday: 08.00 – 12.00 and 14.00 – 18.00

Smart Classroom

FTUI in collaboration with Kapal Api Group build smart classroom. This is in line with FTUI's vision to implement IT technology that changes the teaching process at FT UI from teaching to student-focused learning. Smart class rooms are built with concepts that have various advanced features to support various learning models. Equipped with a modular table that can be arranged according to lecture mode, as well as an interactive smart board that has advanced features. During the lecture, the system will automatically record the lecture activities and the results can be used by students. Recordings and discussion results during lectures in the smart class room can be accessed by students through the learning management system channel.

Integrated - Creative Engineering Learning Laboratory (i-CELL)

2020 became a new milestone for the Faculty of Engineering, University of Indonesia (FTUI). This is related to the completion of the construction of the FTUI integrated - Creative Engineering Learning Laboratory (i-CELL) and Workshop building as the latest laboratory facility that integrates various practicum activities from all departments. i-CELL is an embodiment of FTUI's mission of providing Cutting Edge Engineering Education and conducting applied-based engineering research (Applied Engineering Research). i-CELL is prepared to support the change in the educational process from Teaching Approach to Learning Approach which makes students the focus. i-CELL is also one of the answers to the demands of the Industrial Revolution 4.0.

The integrated - Creative Engineering Learning Laboratory and Workshop building consists of 8 floors and 1 rooftop laboratory with a total building area of 8,410 square meters. This building carries smart and green building technology that is environmentally friendly, equipped with sophisticated IT systems to support effective and efficient research and practicum activities. The concept of green building is applied by designing buildings so that lighting, air circulation, and water are utilized optimally to reduce energy and water consumption.

The construction of the i-Cell and Workshop building is an effort of FTUI to create and unite research and education laboratories that are integrated, comfortable, modern, and make it easier to conduct interdisciplinary research at FTUI. This is done to answer the challenges in the field of science and technology in the future. Especially in increasing the number and quality of research, as well as efforts to realize UI as a World Class Research University.

Student Dormitory

Location : UI Campus, Depok

Phone/Fax : +6221- 7874414 /
+6221-7874271

Capacity : 594 rooms for male students housing, 656 rooms for female students housing (including the VIP – AC rooms)

Facility : TV, cafetaria, public pay phone, public internet shops, computer rental

UI Wismarini Student Dormitory

Location : Jl. Otto Iskandar Dinata No. 38, East Jakarta, Indonesia

Phone/Fax : +6221-8195058

Capacity : 72 rooms for male students housing, 111 rooms for female students housing

Facility : Badminton court, TV, cafeteria, Table Tennis

The UI Wismarini student dormitory is provided to students from the Salemba Campus (Faculty of Medicine & Faculty of Dentistry).

Facility

- Standard housing facility: Bed, table, chair, wardrobe, shoe rack, lamp, bathroom, wash basin.
- Technology facility: Public pay phone shops, public internet shop, photocopy
- Public facility: Cafeteria, praying room, laundry service, sport facility, car/motorcycle parking areas, minimart, dormitory market

Room Specification

- Standard room: Standard bed, table, chair, bookcase, wardrobe, shoe rack, lamp, outdoor bathroom, non AC.
- Standard plus room: Standard bed, table, chair, book case, wardrobe, shoe rack, lamp, outdoor bathroom, air conditioned.
- Bungur and Melati room: Spring bed mattress, table, chair, indoor bathroom, wash basin, small kitchen, living room, air conditioned.
- VIP room: Spring bed mattress, table, chair, indoor bathroom, wash basin, small kitchen, living room, air conditioned.

Other information

- UI Depok dormitory has their own set of rules and regulations which must be obeyed by all dormitory residents as an attempt to create conducive environment for dormitory residents and as an attempt to maintain harmony among the various elements of the UI Depok dormitory residents.
- Each undergraduate student residents of the UI Depok dormitory are entitled to live in the dormitory for one year (semesters 1 and 2).
- Residents will be charged for every electronic device which they brought to their dormitory rooms.
- For further information, please contact UI Dormitory secretariat at +6221-78744144 or by clicking http://asrama.ui.edu.

Registration Process Flow Chart for UI Dormitory

Step 1: Joint Academic Registration where students will receive their student ID number (NPM). Students will then be asked to fill out registration form and enclose: (1) a copy of ID card (2) a copy of academic registration proof (3) a copy of acceptance letter (4) 3x4 photographs (5) a letter of statement on impoverished condition (6) not a smoker statement

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Step 2: acquire a recommendation from the Faculty's Associate Dean for Students Affair --> submit the form package + recommendation --> considered entitled to a room in the dormitory: No --> STOP; Yes --> continue to the next step

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Step 3: Make a registration at the UI Depok dormitory by submitting the form package + recommendation, pay the first month rent + security deposit at the dormitory counter.

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Step 4: Accepted as dormitory resident for two semesters. Submit proof of payment and receive the room key.

Wisma Makara

Phone : +6221-78883670, 78883671

Reservation : +6221-78883672

E-mail : info@makara.cso.ui.ac.id

Website : http://www.wismamakara.com

Wisma Makara, located within the UI Depok campus, is a choice of accommodation for the Southern Jakarta and Depok area. This hotel is very suitable for seminar, training, workshop activities. Surrounded by rubber trees and a lake; the hotel's cool, calm, and beautiful atmosphere provides the perfect background for your various activities. The hotel's tranquility also makes it very suitable for those of you who need tranquility to work and rest.

Available facilities:

- 70 fully furnished rooms (AC, TV, refrigerator)
- Restaurant
- Swimming Pool
- Coffee Shop
- Meeting room (up to 100 person capacity)
- Pay phone shop and internet shop
- Photocopy
- Ballroom (with 800 person capacity)
- Parking area

UI Student Activity Center (PUSGIWA)

Location : UI Campus Depok

Phone : +6221-7270201

Pusgiwa UI is a place for various student activities in Universitas Indonesia. Here we can find secretariat offices of various UI student organizations. Pusgiwa also provides many facilities for students' acitivites such as an 300-400 person auditorium.

UI Students Hall

Location : UI Salemba Campus

Capacity : 300 People

Phone : +6221-31901355/56

The UI Salemba Student Hall is one of the facilities in UI under the management of Directorate of Student Affairs and Alumni Relation. This hall is often used for various activities such as meetings, seminars, workshops, and many more. The hall is available for use by the university members and public.

Sport Facilities

A. Stadium

- Football field
- Triple Jump Field
- Athletic Field

B. In Door (Gymnasium)

- Badminton court
- Volleyball court
- Basketball court

C. Out Door

- Hockey field
- Basketball court (3 lines)
- Badminton court (1 line)

D. SOR (Sarana Olahraga) Zona 1

- Futsal
- Basket
- Volley

Permit form or letter for the use of UI Student Activity Center (Pusgiwa), UI Student Hall, and Sport Facilities must be submitted to the Directorate of Student Affairs and Alumni Relation UI located at the Student Activity Center Building, UI Campus Depok.

Phone : +6221-7866403, 7863453

Fax : +6221-7863453

at FTUI, several sport facilities are available: basket ball court, futsal court and climbing wall.

Bike to Campus

As a proof to Universitas Indonesia's commitment in implementing the "Go Green" program, UI has provided free bicycles as a mean of transportation within the campus area. Started in 2008, this program establishes collaboration with the Bike to Work and Polygon, making UI the first campus in Indonesia with their own Bike to Campus program.

These bicycles, which colors and and form are specially design for UI, are single seat bicycles. By July 2009, there are around 300 units of bicycle available for use and will continue to be added in accordance with the campus development or demand.

How to Borrow:

1. Students simply showed their student ID card (KTM) to officer in charge of each bike shelter.
2. Campus bicycle can only be use on the available bicycle track. It is forbidden to ride them outside of the available track or to take them outside of campus area.
3. Each bicycle is equipped with a trunk with a maximum capacity of 10 kg and is not to be use as a passenger space.
4. Borrowed bicycle is the responsibility of each student until it is returned to the officer in charge of each bike shelter.
5. Students may return the borrowed bicycle at the nearest bike shelter by showing their student ID card (KTM) to the officer of said shelter.

Service time for Bike to Campus is Monday to Friday, 08.00 – 17.00. For usage outside of service day and time, interested party must coordinate in accordance to the existing regulation.

A few points worth noting in cycling:

Once you've received your borrowed bicycle from the shelter officer, please do the following:

1. Make sure that your bicycle are in good order and function well.
2. Make sure that you have both hand on the bicycle handle, put your books/bags on the provided space.
3. Arrange your seat in accordance to your height, the height of your seat determines your comfort in cycling.
4. Each bicycle has three shifter levels, use them in accordance.
5. Ride the bicycle on the provided track, stay at the left side of the track when passing other bicycle.
6. Pay special care to motorcycles at each crossing.
7. Pay special attention to cycling safety.

Student Organization

Students are a nation's agent of change in making changes towards a fair and prosper independent society. Their power in fighting and struggling toward that goal must always be balanced with moral power as future asset in their fight in realizing the country's objectives. Thus, students need a vessel where all of their independent, family oriented, scientific, society oriented, and open activities can be accommodated. In Universitas Indonesia, this vessel is called Universitas Indonesia Student Society Association (Ikatan Keluarga Mahasiswa Universitas Indonesia – IKM UI).

IKM UI is a formal and legal organization which is the parent organization for all student activities in Universitas Indonesia. IKM UI adopts constitutional values adapted with the need of student lives. Sovereignty of IKM UI lies in the hand of the students and is fully implemented according to Laws and Constitution of IKM UI. The members of IKM UI are registered students in the Universitas Indonesia, consisting of active and regular members. Active members are IKM UI members that have followed active member admission procedures and received recommendation from the faculty. Regular members are IKM UI members that are not registered within the active membership of IKM UI. The symbol of the Universitas Indonesia Student Society Association (IKM UI) is the Makara of Universitas Indonesia with the wording IKATAN KELUARGA MAHASISWA UNIVERSITAS INDONESIA in black.

Student organizations that are incorporated within the IKM UI are:

1. Students Forum
2. Students Representative Council
3. Student Executive Body
4. Financial Audit Agency
5. Student Court
6. Student Element of the Board of Trustees
7. Autonomous Body of the Student Activity Unit
8. Semi Autonomous Body of the Student Activity Unit

Students Representative Council (Dewan Perwakilan Mahasiswa - DPM)

Students Representative Council is the high level body within the Universitas Indonesia Student Society Association (IKM UI) which possesses a legislative power. Members of the DPM UI consist of independent members from each faculties and representatives of legislative bodies of each faculty. Independent members are voted through a general election, while there can only be one representative from each faculty's legislative body. Membership of DPM UI is inaugurated by a student forum decree. Term of office for members of the DPM UI is one year and ended simultaneously with the inauguration of the new members of the DPM. The requirements for becoming a member of the DPM UI are regulated within the IKM UI laws. DPM UI has the authority in term of legislative, supervision, and assessment of Students Representative Council's (BEM UI) Work Accountability Report, jurisdiction, facility, and designing the admission mechanism and follow up on financial budget plan of each student organizations within the Universitas Indonesia for each period of management. Members of the DPM UI are entitled to interpellation right, voting right, and the right to convey suggestion and express their opinions.

Secretariat : Student Activity Center

Building (Pusgiwa), 2nd floor

Phone :+6221-94629107,

+6285717884964

Students Representative Council (Badan Eksekutif Mahasiswa - BEM)

Universitas Indonesia Students Representative Council is a student organization within the university level with the executive power. Term of office for UI Students Representative Council is one year, from January to December each year. Chairman and Vice Chairman of BEM UI are elected as a couple directly by members of the IKM UI in a Universitas Indonesia General Election. The elected Chairman and Vice Chairman of BEM UI are later officially inaugurated with a Student Forum Decree. Function and authority of BEM UI are, among other: advocate students in issues relating to funds and facilities at the university level; addressing the external politic policy of IKM UI; serve and coordinate with the Universitas Indonesia Autonomy Body of UKM UI, faculty's executive body, and student element of the Board of Trustees. BEM UI Board of Administrators is elected based on open and close recruitment mechanism.

Student Activity Unit (Unit Kegiatan Mahasiswa - UKM)

Student Activity Unit of Universitas Indonesia (UKM-UI) is a place of student activities and creations in the Universitas Indonesia in one area of specialization, talent and religious services at the university level. The Student Activity Unit consists of the Autonomy and Semi Autonomy Bodies. Universitas Indonesia UKM Autonomy Body is a UKM in the university level which is deemed qualified and valid by the decree of the Student Forum into an autonomic UKM UI Autonomy Body. While the Universitas Indonesia UKM Semi Autonomy Body is a place of student activities and creations in the Universitas Indonesia in one area of specialization, talent and religious services at the university level under the coordination of the Students Representative Council.

a. Art

1. Krida Budaya Dance League
2. Madah Bahana Marching Band
3. Mahawarditra Philharmonic
4. Paragita Choir
5. Student Theater

b. Sport

1. Badminton
2. Hockey
3. Tennis
4. Soccer
5. Basket Ball
6. Swimming
7. Volley Ball
8. Softball
9. Bridge
10. Futsal
11. Dance Sport
12. Cricket
13. Table Tennis

c. Martial Art

1. Taekwondo
2. Merpati Putih
3. Aikido
4. Wushu

d. Religious Groups

1. Moslem Student Society (Nuansa Islam Mahasiswa - SALAM)
2. Catholic Student Society (Keluarga Mahasiswa Katolik - KMK)
3. Oikumene Civitas Academica Society (Persekutuan Oikumene Sivitas Akademika - POSA)
4. Buddhist Student Society (Keluarga Mahasiswa Budhis)
5. Hindu Student Society (Keluarga Mahasiswa Hindu)

e. Academic Group

1. Eka Prasetya Student Study Group (KSM EP)
2. English Debating Society (EDS)

f. Entrepreneurship

1. Student Voice
2. CEDS

3. Student Radio (RTC UI FM) 107,9 FM

g. Others

1. Wira Makara (Student Regiment)
2. Students' Mountaineering Club (Mapala)

Career Development Center

Career Development Center is a center with the aim of preparing UI graduates to have more skill and higher level of competitiveness and at the same time channeled UI graduates to the working world. CDC is located in the Student Center Building.

Phone/Fax : +6221-70880577/78881021

Email : cdc-ui@ui.ac.id

FTUI also has a CDC, located at 3rd floor of Engineering Center (EC) Building.

Phone : +6221-78880766

National Student Science Week

The National Student Science Week (Pekan Ilmiah Mahasiswa Nasional - PIMNAS) is a prestigious event for all Universities in Indonesia organized by the Directorate General of Higher Education (DIKTI). The Adikarta Kertawidaya trophy is the award contested at the PIMNAS. PIMNAS is an opportunity to channel the creativity, education and community service of the society in a Student Activities Program. Below is some of the Student Activities Program being contested within the National Student Science Week.

Student Creativity Program – Research (PKM-P)

This program is a research program that aimed to identify the determinants of the quality of the product, find a causal relationship between two or more factors, experimented with a form or equipment, to establish the method of learning, conduct an inventory of resources, modifying existing products, identify the chemical compounds in the plants, testing the efficacy of plant extracts, formulate marketing techniques, a health survey of street children, teaching methods Balinese script in elementary school students, the rate of economic growth in the craft center of Kasongan, superstition factor that characterizes the behavior of the Javanese community and other activities that have such a purpose.

Student Creativity Program - Technology Application (PKM-T)

This program is a technology assistance program (quality of raw materials, prototypes, models, equipment or production processes, waste management, and quality assurance systems and many other) or other micro-or small-scale industries (home industries, small traders or cooperation) as needed by the potential partners in the program. PKMT require students to exchange ideas with their partner in the program first, because the product is a solution of a problem which the PKMT partner prioritizes. Thus, in the proposed program, the student must attach a Statement of Willingness to Work Together with Partner on a paper with Rp. 6000, - seal.

Student Creativity Program – Entrepreneurship (PKM-K)

This program is the where students develop their skills in entrepreneurship and is a profit oriented program. Business commodities produced can be in the form of goods or services which in turn are one of the basic capital students will need in entrepreneurship and to enter the market.

Student Creativity Program – Community Service (PKM-M)

This program is an assistance program in science, technology, and arts in an effort to increase performance, build business skills, structuring and improving the environment, strengthening community institutions, the socialization of rational drug use, exposure to and understanding aspects of customary law, relief efforts on illiterates in the society and other community programs both for formal and non-formal societies.

Student Creativity Program - Writing Scientific Articles (PKM - AI)

This program is a program of writing a scientific article which originated from student activities in education, research, or community service which the student has done himself (case studies, field practice, community development work, student creativity program, internships, and many other).

Student Creativity Program – Written Concept (PKM - GT)

This program is a program of writing a scientific article that originated from ideas or concepts from a group of students. This written idea refers to an actual problem that can be found in the community and require a smart and realistic solution. In each area these programs are subdivided into seven groups of fields of science, namely:

1. Health field, including: Pharmacy, Nutrition, Obstetrics, Medicine, Dentistry, Nursing, Public Health, and Psychology.
2. Agricultural field, include: Veterinary Medicine, Forestry, Maritime, Fisheries, Agriculture, Animal Husbandry, and Agricultural Technology.
3. Mathematic and Natural Sciences field, including: Astronomy, Biology, Geography, Physics, Chemistry, and Mathematics.
4. Technology and Engineering field, including: Information Technology, Engineering, and Agricultural Technology.
5. Social Economy field, including: Agribusiness (Agriculture), Economic, Social and Political Sciences.
6. Humanities field, including: Religion, Language, Philosophy, Literature, and Art.
7. Education field, including: Education Sciences study program under the Faculty of Education.

Submission deadline for PKM-K, PKM-M, and PKM-P proposals are in October of each year, while deadline proposals for PKM-GT and PKM-AI are in March of each year. Almost all of these areas can be followed by students in 12 faculties at UI. PIMNAS is a means to prove the existence of UI as a research university in Indonesia. Win the Adikarta Kertawidya trophy and show the existence of UI as the Research Campus.

For further information :

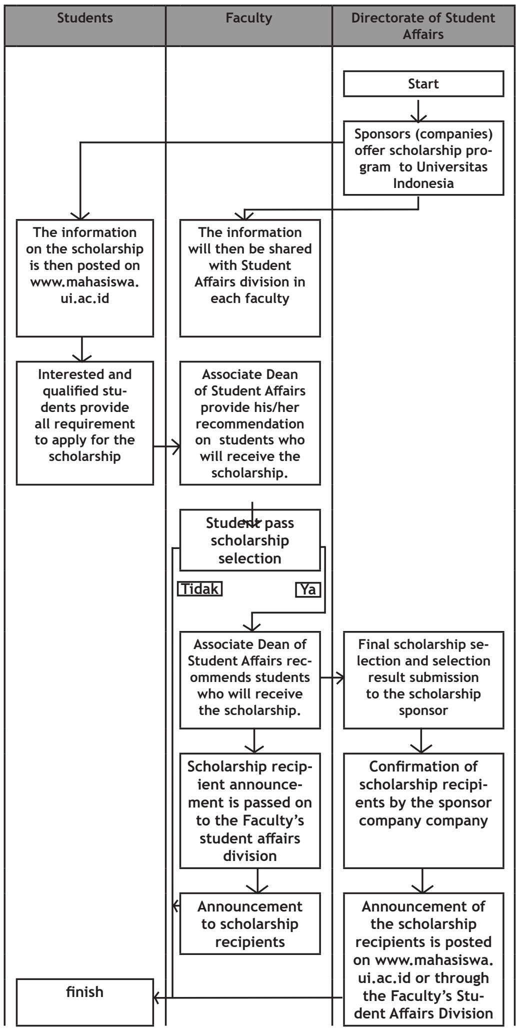
http://bem.ui.ac.id/

http://mahasiswa.ui.ac.id/info-pkm-2010.html

Scholarship

Universitas Indonesia currently manages approximately 71 scholarships both from the government and the private sector. Information about scholarships can be obtained at the Student Affairs Division of each faculty or through the website of the Directorate of Student Affairs at www.mahasiswa.ui.ac.id.

Flowchart of Scholarship Application



There are two types of scholarship in UI:

- UI Scholarship
- Donor/Sponsor Scholarship

General requirement procedure for scholarship application from Donor/Sponsor:

- Submit application through the Faculty Head with a recommendation from the Associate Dean of Student Affairs.
- Submit a photocopy of academic transcript stating a GPA corresponding with the requirement given by the donor/sponsor.
- Not a smoker.
- Is not a receiver of similar other scholarship.
- Other requirements as stated by the Donor/Sponsor.

List of Name of Scholarship Donor/Sponsor For Universitas Indonesia Students

1. Bank BNI 46
2. Bank Central Asia
3. Bank Indonesia
4. Bank KEB Indonesia
5. Bank Lippo
6. Bank Mandiri
   - Bank Mandiri
   - Bank Mandiri Prestasi
7. Bank Mayapada
8. Bank Niaga
9. Bank Permata
10. Bank Tabungan Negara
11. Student Special Aid
    - Special Aid for Undergraduate Program Student
    - Special Aid for Vocational Program Student
12. BAZNAS
13. West Java Scholarship
14. BMU Scholarship
15. CIMB Niaga Excellent Scholarship
16. DKI Jakarta Scholarship
    - Jakarta Achievement Scholarship
    - Jakarta Thesis Scholarship
17. BPMIGAS
18. BRI
19. BUMN
20. DIKNAS
    - Diknas (Excellent Activist Scholarship)
    - Diknas (Excellent Master Scholarship)
    - Diknas (Super Excellent Scholarship)
21. Diknas 1 (BBM)
22. Diknas 2 (PPA)
23. Eka 2007 - 2008
24. Eka 2008 - 2009
25. Eka CIpta (Uang Buku)
26. Exxon MOBIL (For Students from Aceh)
27. Exxon MOBIL (For Students from Aceh) Thesis
28. Indosat
29. Karya Salemba 4 (KS 4)
30. KORINDO
31. LGE
32. MARUBENI
33. MC.DERMONT
34. Part Time Job
35. Posco (Thesis Aid)
36. PPA/BBM Angkatan 2009
    - PPA/BBM DIII
    - PPA/BBM S1
37. PPE
38. PT. BUMA Apparel Industry
39. PT. Coca Cola
40. PT. Indocement
41. PT. Accenture
42. PT. Sun Life Indonesia
43. PT. Thiess
44. Qatar Charity

45. Recapital
46. Rotary Club Jakarta Sudirman
47. Salim
48. Sariboga
49. Shell (Extention Scheme)
50. Shell (New Scheme)
51. Sime Darby
52. Sumitomo Bank (Supportive Scholarship)
53. Sumitomo Bank (Full Scholarship)
54. Sumitomo Corporation Scholarship
55. Supersemar
56. Tanoto
57. Tanoto S2
58. Total E & P
59. TPSDP (DIKTI)
60. UFJ Foundation / Mitsubishi
61. Unilever
62. Y. Asahi Glass (YAGI)
63. Y. Toyota (REGULER)
64. Yayasan IJARI
65. Yayasan Goodwill Internasional
66. YAYASAN TIFICO
67. YKPP - Pertamina
    - YKPP - Pertamina (Living Allowance)
    - YKPP - Pertamina (Tuition Fee)

Insurance

Each student enrolled in Universitas Indonesia for each running semester (participate in academic activities) will also be registered as an insurance member of PT. Asuransi Jasa Raharja.

For these insured students, they are allowed to submit an insurance claim in accordance with the following provisions:

- Accidents included within the insurance claim are accidents which occurred during the student's journey from home to UI campus to participate in academic and extracurricular activities whether it is within or outside of Campus area and with the UI/Faculty's Management's knowledge and permission.
- Compensation on claim regarding students' accident is only applicable to those who have paid the DKFM fee for the semester.
- In the event of an accident, student must report the accident no later than 3x24 hours to the office of the Universitas Indonesia Directorate of Student Affairs Sub Directorate of Student Welfare Services or the nearest PT Jasa Raharja Office Branch.
- If after 180 (one hundred and eighty) days, the accident is not reported, insurance compensation shall be canceled.
- Compensation claim (for victims suffering from injuries) must be submitted by attaching the original and valid receipt from doctor/hospital/clinic that treated the student's injuries.
- Non-medical care or treatment is not compensable.
- Students may send their inquiries regarding any matter that are not listed here directly to the Universitas Indonesia Head of Student Welfare Sub Directorate at the Central Administration Building, Universitas Indonesia Campus, Depok.

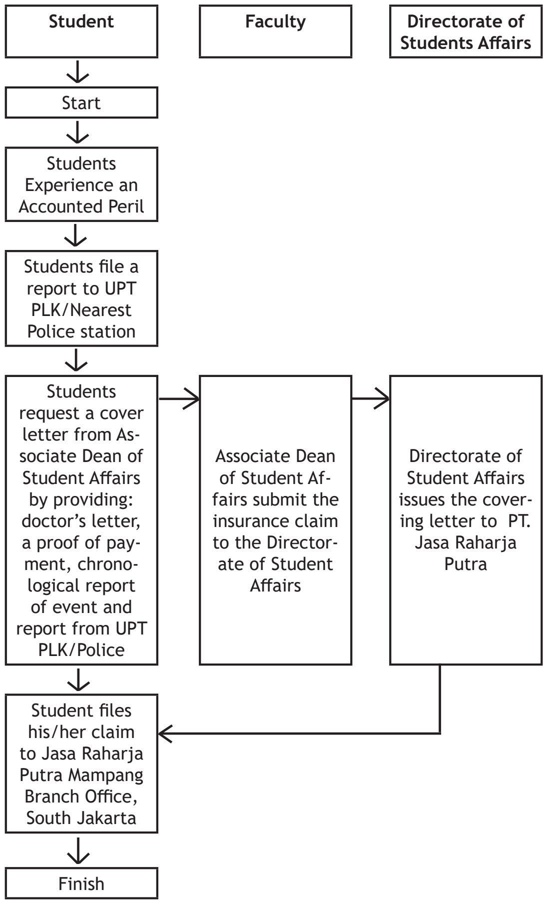
Cause	Condition	Required Document
Train Accident	Injured	1. A notification letter from the Faculty's Associate Dean of Student Affairs to the Directorate of Students Affairs.
		2. Accident Report issued by the police
		3. Treatment report from the attending doctor
		4. Original receipt from the hospital or the attending physician
	Death	1. A notification letter from the Faculty's Associate Dean of Student Affairs to the Directorate of Students Affairs.
		2. Accident Report issued by the police
		3. Accident Report from Polsuska (PT. KAI)
		4. Autopsy report from the hospital
		5. Death Certificate
		6. A copy of the victim's birth certificate
		7. A copy of Family Card
		8. Heir certificate letter from the local district office.
Road Accident	Injured	1. A notification letter from the Faculty's Associate Dean of Student Affairs to the Directorate of Students Affairs.
		2. Accident Report issued by the police
		3. Treatment report from the attending doctor
		4. Original receipt from the hospital or the attending physician and the pharmacy
	Death	1. A notification letter from the Faculty's Associate Dean of Student Affairs to the Directorate of Students Affairs.
		2. Accident Report issued by the police
		3. Accident Report from Transportation Agency
		4. Autopsy report from the hospital
		5. Death Certificate
		6. A copy of the victim's birth certificate
		7. A copy of Family Card
		8. Heir certificate letter from the local district office.

Compensation Receivable from the Insurance Claim *)

- **Death due to an accident :**
  Rp. 5.000.000, -
- **Permanent disability due to accident** :
  Rp. 10.000.000, -
- **Care / medical Treatment due to accident (maximum payment) :**
  Rp. 3.500.000, -

*) Subject about to change without notice

Insurance Claims Process



General Information

Post Office, Depok Campus

The Depok Campus Post Office offers postage stamp sales, special delivery mail delivery, registered mail, parcel post, money orders, checks and postal giro and savings services such as Batara.

Address: Ground Floor Integrated Student Services Center (PPMT) Building, UI ,Depok Campus, 16424

Important Phone Numbers

UI Campus Salemba

Phone : +6221-330343, 3303455

Fax : +6221-330343

UI Campus Depok

Phone : +6221-7270020, 7270021, 7270022, 7270023, 7863460

Firefighters : 116

SAR : 55 021

Ambulance

RSCM : 118

Accidents : 119, 334 130

Police (on duty) : 525011

Police station

Central Jakarta : 3909922

North Jakarta : 491 017

South Jakarta : 7206011

West Jakarta : 5482371

East Jakarta : 8191478

Depok : 7520014

International Journal of Technology

International Journal of Technology (IJTech) is bi-annual international referred journal with the objectives to explore, develop, and elucidate the knowledge of engineering design and technology, to keep practitioners and researchers informed on current issues and best practices, as well as serving as a platform for the exchange of ideas, knowledge, and expertise among technology researchers and practitioners.

International Journal of Technology provides an opportunity to share detailed insights from different understandings and practices associated with technology. It provides an international forum for cross-disciplinary exchange of insights and ideas regarding value and practices for dissemination. International Journal of Technology will publish your work to international society of practitioners and researchers with interest in technology design and development from a wide variety of sectors.

Website: www.ijtech.eng.ui.ac.id

Quality in Research (QiR) Conference

QiR Conference is a bi-annual international conference organized by FTUI since 1998. The 16th QiR was held in Padang, West Sumatera from 22 – 24 July 2019. This conference provide a chance for students, be it undergraduate, master or doctoral program students, to present their research findings in front of an international audience. The 17th QiR will be held in October 2023. For more detail information on Qir, please visit: http://qir.eng.ui.ac.id.

International Office

International Office is the university division dedicated to support the internationalization goals of the university and to handle international mobility involving the university and the international civitas academica. Their goal is to assist the international students and scholars handle their academic-related matters at Universitas Indonesia and to bridge Universitas Indonesia's civitas academica with overseas universities. Universitas Indonesia has a worldwide cooperation with various universities all over the world. These cooperations include not only academic but also research collaborations, giving the international access and exposure to its entire proud member.

The International Office of Universitas Indonesia provides various services such as: Bilateral Cooperation (University to University Cooperation), Regional Cooperation (International Associations & International Forums), Government to Government Cooperation (G to G), International Learning and Teaching, Student Exchange, Double Degree, Sandwich Program, Visiting Scholars, Study abroad, Scholarship Opportunities, International Research and Research Training, International Knowledge Transfer; are some of the services provided by the International Office. These opportunities are open for all university members from lecturers to students, be it in their Bachelor, Master or Ph.D program. Students can benefit from these programs in experiencing a once in a life time chance to study and understand different academic cultures in the world.

For further information, please contact:

Central Administration Building

1st Floor, Universitas Indonesia

Kampus Depok, Jawa Barat 16424

Phone/fax : +62 21 – 7888 0139

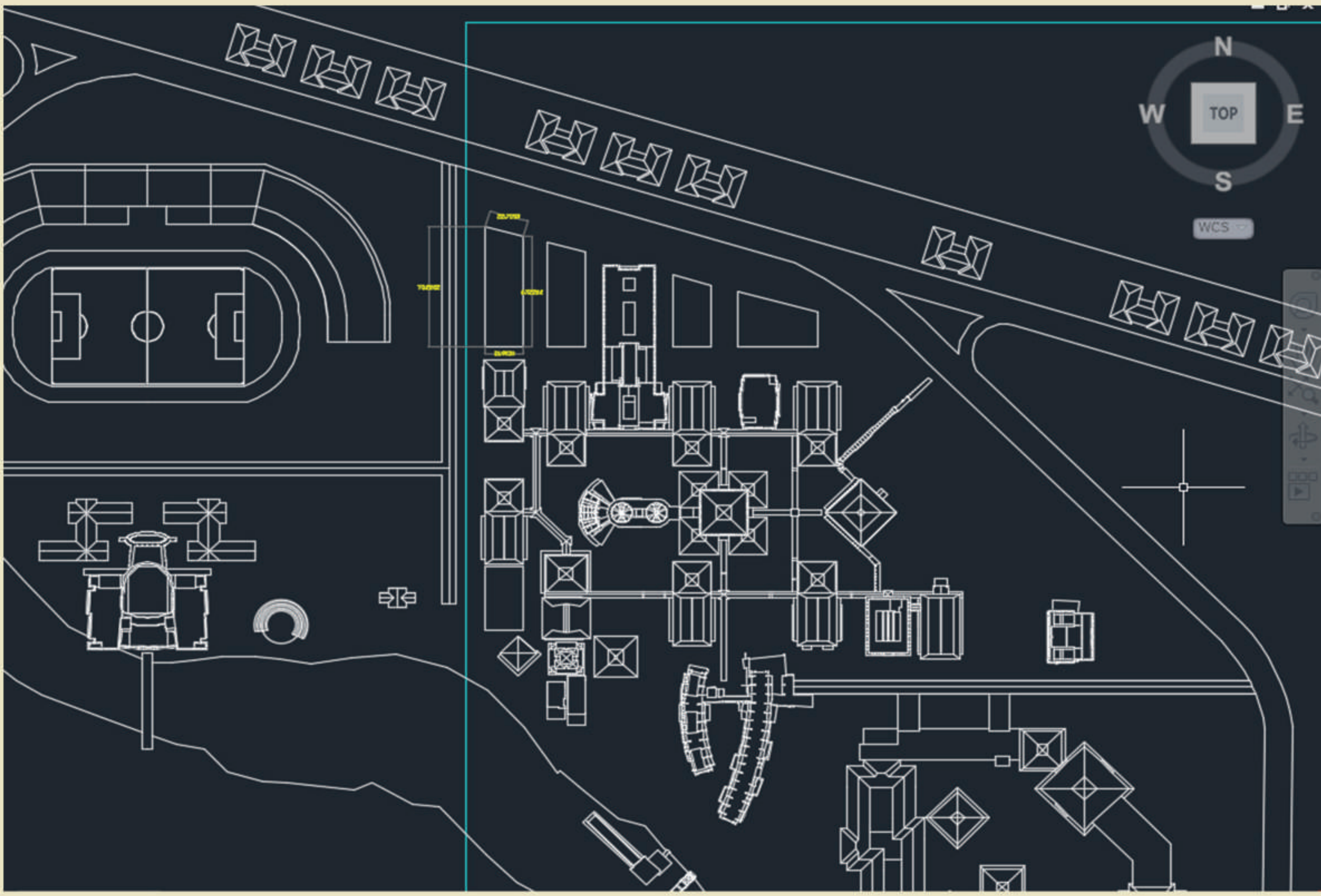
Email : intofui@yahoo.com, io-ui@ui.ac.id

Milist : internationaloffice@yahoogroups.com

Twitter : @intofui

CHAPTER 4

Undergraduate Program



Undergraduate Program in Civil Engineering

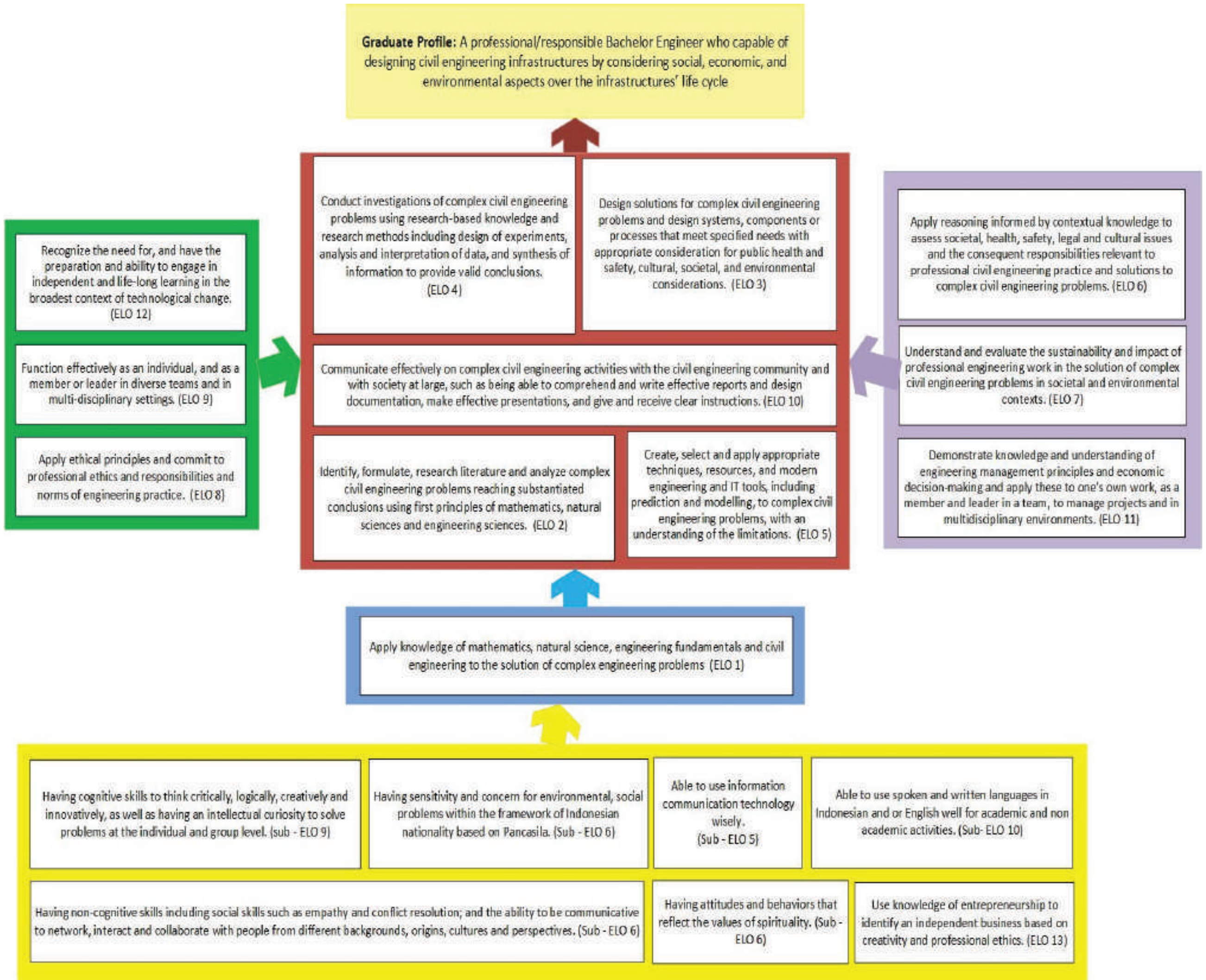
Program Specification

1.	**Awarding Institution**	Universitas Indonesia Double Degree: Universitas Indonesia and partner university	
2.	**Teaching Institution**	Universitas Indonesia Double Degree: Universitas Indonesia and partner university	
3.	**Faculty**	Engineering	
4.	**Programme Tittle**	Undergraduate Program in Civil Engineering	
5.	**Vision and Misson**	Vision of Civil Engineering Study Programme To become a center of knowledge and technology in Civil Engineering and Environmental Engineering and to play an important role in global market Mission of Civil Engineering Study Programme 1. To improve the quality of graduates in mastering Civil and Environmental Engineering knowledge with solid foundation, and to provide them with internationally standardized environmental insight 2. To actively contribute ideas through research including direct involvement in community service that is oriented to the development of facilities and infrastructure in the Civil and Environmental Engineering discipline, as well as reflecting upon the balanced relationships between human beings and nature. 3. To shape and build students that can demonstrate strong leadership and independent personality, along with the ability to socialize, communication effectively and uphold profession ethics.	
6.	**Class**	Regular, Parallel, and International	
7.	**Final Award**	Sarjana Teknik (S.T) Double Degree: Sarjana Teknik (S.T) and Bachelor of Engineering (B.Eng)	
8.	**Accreditation / Recognition**	BAN-PT: Excellent - accredited AUN-QA IABEE	
9.	**Language(s) of Instruction**	Bahasa Indonesia and English	
10.	**Study Scheme (Full Time / Part Time)**	Full Time	
11.	**Entry Requirements**	High school /equivalent, or D3 / Polytechnique / equivalent, AND pass the entrance exam.	
12.	**Study Duration**	Designed for 4 years	
	Type of Semester	Number of Semester	Number of weeks / semester
	Regular	8	16
	Short (optional)	3	8
13.	**Aims of The Programme** 1. Able to design environmentally friendly infrastructure professionally and based on reliable economic analysis; 2. Able to communicate and coordinate effectively; and 3. Have an adaptive attitude and open to the dynamics of science		
14.	**Graduate Profiles:** A professional/responsible Bachelor Engineer who are capable of designing and building civil engineering infrastructures by considering social, economic, and environmental aspects over the infrastructures' life cycle.		

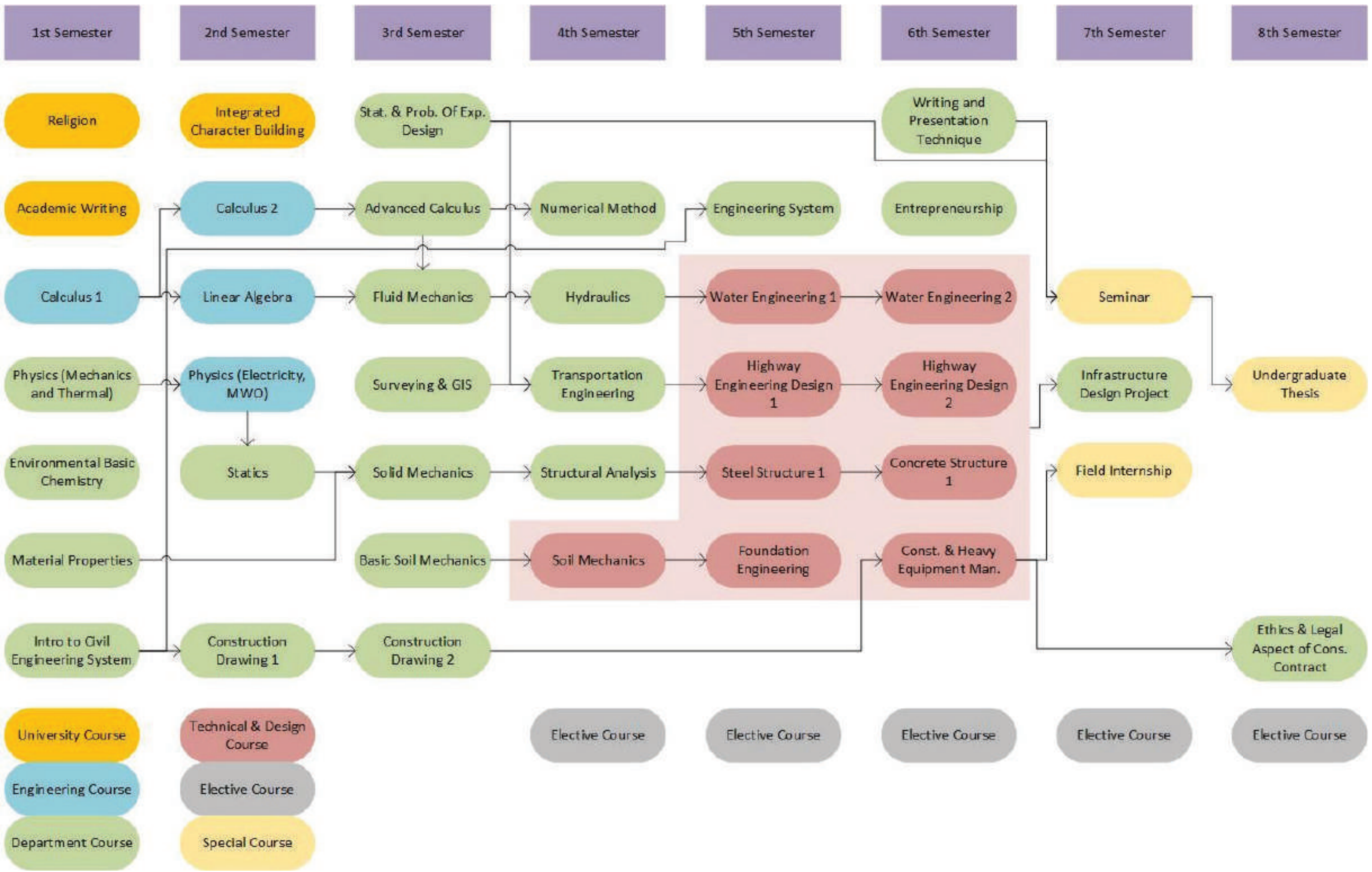
15.	Expected Learning Outcomes: 1. Apply knowledge of mathematics, natural science, engineering fundamentals and civil engineering to the solution of complex engineering problems. 2. Identify, formulate, research literature and analyze complex civil engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences. 3. Design solutions for complex civil engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations. 4. Conduct investigations of complex civil engineering problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions. 5. Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex civil engineering problems, with an understanding of the limitations. 6. Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional civil engineering practice and solutions to complex civil engineering problems. 7. Understand and evaluate the sustainability and impact of professional engineering work in the solution of complex civil engineering problems in societal and environmental contexts. 8. Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice. 9. Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings. 10. Communicate effectively on complex civil engineering activities with the civil engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. 11. Demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. 12. Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. 13. Apply knowledge of entrepreneurship to identify an independent business based on creativity and professional ethics.
16.	**Classification of Subjects**

No.	Classification	Credit Hours (SKS)	Percentage
i	**University General Subjects**	**9**	**6 %**
ii	**Basic Engineering Subjects**	**13**	**9 %**
iii	**Core Subjects**	**88**	**61 %**
iv	**Elective Subjects**	**26**	**18 %**
v	**Industrial Attachment, Seminar, Undergraduate Thesis, Project**	**8**	**6%**
	Total	**144**	**100 %**
	Total Credit Hours to Graduate		**144 SKS**

Learning Outcomes



Flow Diagram of Subjects Undergraduate Program on Civil Engineering



Course Structure of Undergraduate Program in Civil Engineering (Regular/ Parallel)

Code	Subject	SKS
	1st Semester	
UIGE 600 004	Religion	2
UIGE 600 003	Academic Writing	2
ENGE 600 001	Calculus 1	3
ENCV 601 001	Physics (Mechanics and Thermal)	4
ENCV 601 002	Environmental Basic Chemistry	3
ENCV 601 003	Intro to Civil Engineering System	3
ENCV 601 004	Material Properties	3
	Sub-Total	**20**
	2nd Semester	
UIGE 600 006	Integrated Charater Building	5
ENGE 600 002	Calculus 2	3
ENGE 600 007	Physics (Electricity, MWO)	3
ENGE 600 004	Linear Algebra	4
ENCV 602 001	Construction Drawing 1	2
ENCV 602 002	Statics	3
	Sub-Total	**20**
	3rd Semester	
ENCV 603 001	Construction Drawing 2	3
ENCV 603 002	Solid Mechanics	4
ENCV 603 003	Fluid Mechanics	3
ENCV 603 004	Statistics and Probabilistic of Experimental Design	2
ENCV 603 005	Basic Soil Mechanics	3
ENCV 603 006	Surveying & Geospatial Information Systems	2
ENCV 603 007	Advanced Calculus	3
	Sub Total	**20**
	4th Semester	
ENCV 604 001	Soil Mechanics	3
ENCV 604 002	Hydraulics	3
ENCV 604 003	Structural Analysis	4
ENCV 604 004	Numerical Method	2
ENCV 604 005	Transportation Engineering	3
	Elective Course	5
	Sub-Total	**20**
	5th Semester	
ENCV 605 001	Foundation Engineering	3
ENCV 605 002	Engineering System	2
ENCV 605 003	Highway Engineering Design 1	4
ENCV 605 004	Steel Structure 1	3
ENCV 605 005	Water Engineering 1	3
	Elective Course	5
	Sub-Total	**20**
	6th Semester	
ENCV 606 001	Concrete Structure 1	3
ENCV 606 002	Construction & Heavy Equipment Management	4
ENCV 606 003	Highway Engineering Design 2	2
ENCV 606 004	Writing and Presentation Technique	2
ENCV 606 006	Water Engineering 2	3
	Elective Course	9
	Sub Total	**19**
	7th Semester	
ENCV 600 100	Field Internship	3
ENCV 607 001	Infrastucture Des ign Project	4
	Elective Courses	7
	Sub Total	**14**
	8th Semester	
ENCV 600 200	Undergraduate Thesis	5
ENCV 608 001	Ethics and Aspects in Construction Contract Laws	2
	Elective Courses	4
	Sub Total	**11**
	Total	**144**

Electives Course

Code	Elective Courses	SKS
	4th Semester	
ENCV 604 101	Application of the FEM with Program Package Software	3
ENCV 600 300	Internship A	2
ENCV 600 011	Engineering Economics	3
Code	**5th Semester**	**SKS**
ENCV 605 102	Cold Formed Steel Structure	2
ENCV 605 301	Airport Planning	2
ENCV 600 012	HSE Protection	2
Code	**6th Semester**	**SKS**
ENCV 600 400	Internship B	3
ENCV 606 103	Steel Structure 2	3
ENCV 606 201	Introduction to Geotechnical Investigation	2
ENCV 606 302	Railroad Transportation	2
ENCV 606 303	Transportation and Environment	3
ENCV 606 005	Entrepreneurship	2
Code	**7th Semester**	**SKS**
ENCV 607 104	Concrete Structure 2	3
ENCV 607 202	Geotechnical Construction Method	2
ENCV 607 304	Port Planning	3
ENCV 607 401	Coastal Engineering	3
ENCV 607 402	River Engineering	2
ENCV 607 501	Introduction to Stakeholders and Project Communications	2
ENCV 607 502	Introduction to Management System of HSE	2
ENCV 600 600	Special Topic of Research Collaboration	3
ENCV 600 200	Student Affairs	1
Code	**8th Semester**	**SKS**
ENCV 608 403	Stormwater management	2
ENCV 608 404	Water Resources Infrastructure	2
ENCV 608 503	Introduction to Quality & Risk Management	2
ENCV 608 504	Introduction to Procurement Management & Contract Administration and Claim	2

Minor Course

Structural Engineering Courses		
Code	**Course**	**SKS**
ENCV 601 004	Material Properties	2
ENCV 602 002	Statics	3
ENCV 603 002	Solid Mechanics	4
ENCV 604 101	Application of the FEM with Program Package Software	3
ENCV 605 004	Steel Structure 1	3
ENCV 606 001	Concrete Structure 1	3

Geotechnical Engineering Courses		
Code	**Course**	**SKS**
ENCV 602 002	Statics	3
ENCV 603 002	Solid Mechanics	4
ENCV 603 005	Basic Soil Mechanics	3
ENCV 604 001	Soil Mechanics	3
ENCV 605 001	Foundation Engineering	3
	Geotechnical Elective Course	2-3
Construction Management Engineering Courses		
Code	**Course**	**SKS**
ENCV 602 001	Construction Drawing 1	2
ENCV 603 001	Construction Drawing 2	3
ENCV 606 002	Construction & Heavy Equipment Management	4
ENCV 608 001	Ethics and Aspects in Construction Contract Laws	2
ENCV 607 501	Introduction to Stakeholders and Project Communications	3
ENCV 608 503	Introduction to Quality & Risk Management	3
Water Resource Engineering Courses		
Code	**Course**	**SKS**
ENCV 603 003	Fluid Mechanics	3
ENCV 604 002	Hydraulics	3
ENCV 605 005	Water Engineering 1	3
ENCV 606 006	Water Engineering 2	3
ENCV 801 402	Hydrological Engineering	3
ENCV 608 404	Water Resources Infrastructure	3
Transportation Engineering Courses		
Code	**Course**	**SKS**
ENCV 603 006	Surveying & GIS	2
ENCV 604 005	Transportation Engineering	3
ENCV 606 303	Transportation & Environment	2
ENCV 605 301	Airport Planning	2
ENCV 803 502	Public Transportation Planning	3
ENCV 803 508	Logistics Transportation	3

Transition Policy from the 2016 to the 2020 Curriculum

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2. For class 2019 and above will follow this transition rules.
3. The enforcement of the transitional period is one year. During this transition period, if a course in curriculum 2020 is in odd semester while in previous curriculum in even semester (vice versa), then this course can be held (if necessary) in both semesters.
4. For students who have not passed the compulsory courses in curriculum 2016, are required to take the same course or equivalent in curriculum 2020. Equivalence courses can be seen in the table below. All courses in the curriculum 2016 that are not listed in equivalence table have not changed, both in names and credits.
5. When there is a change in the course credits, then the number of graduation credits counted in, is the number of credits when it was taken. The same or equivalent courses when are equated with different credits, if retaken, or just taken will be acknowledged under a new name and credits. (see course equivalence table).
6. When a compulsory subject in the curriculum 2016 is deleted and there is no equivalence in the curriculum 2020 then:
7. For students who have passed these subjects, the credits that are achieved will be counted in the calculation of graduation 144 credits.For students who did not pass these courses, they can take new compulsory courses or choose elective subjects in the curriculum 2020 to complete 144 credits.

Equalizing the 2016 Curriculum Subjects and the 2020 Curriculum for Civil Engineering Undergraduate

No	Name of Courses in Curriculum 2016	Credits 2016	Name of Courses in Curriculum 2020	Credits 2020	Remarks
1	Integrated Character Building - A (MPKT A)	6	Integrated Character Building (MPKT)	5	Those who have not pass MPKT-A and MPKT-B can enroll in MPKT Those who have not pass one of MPKT-A or MPKT-B; do not have to retake MPKT
2	Integrated Character Building - B (MPKT B)	6			
3	Olahraga / Seni	1	None		Those who have not pass; see transition rule #6
4	Agama	2	Religion	2	The change of teaching learning method; (refer to course plan / syllabus)
5	Bahasa Inggris	3	Bahasa Inggris	2	
6	Physics - Mechanics and Thermal	3	Physics - Mechanics and Thermodynamics	4	The change of course name
7	Physics - Mechanics and Thermal Lab	1	None	-	Those who have not pass the laboratory courses are suggested to enroll in one of new compulsory courses of Curriculum 2020
8	Physics - Electricity, MWO Lab	1	None	-	
9	Basic Chemistry	2	Environmental Basic Chemistry	2	Those who have not pass one of Basic Chemistry or Advanced Chemistry should enroll in Environment Basic Chemistry
10	Advanced Chemistry	2		2	
11	Construction Drawing	2	Construction Drawing 1	2	The change of course name
12	Surveying	3	Surveying & Geospatial Information System	2	The change of course name & credits
13	Statics	4	Statiics	3	The change of course credit

14	Statistic & Probabilistic	2	Statistic & Probabilistic Experiments	2	The change of course name
15	Building Construction	3	Construction Drawing 2	3	The change of course name
16	Structural Analysis	3	Structural Analysis	4	The change of course credit
17	Road Geometric Design	3	Highway Engineering Design 1	4	Those who have not pass one of Road Geometric Design or Pavement Engineering should enroll in both Highway Engineering 1 and 2
18	Pavement Design	3	Highway Engineering Design 2	2	
19	Construction Management	2	Construction & Heavy Equipment Management	4	Those who have not pass one of Construction Management or Construction Methods & Equipments should enroll in Construction & Heavy Equipment Management
20	Construction Methods & Equipments	2			
21	Capstone Project	3	Infrastructure Design Project	4	The change of course name & credits
22	Internship	3	Field Internship	3	The change of prequisite
23	Seminar	1	Seminar	1	
24	Final Project	4	Final Project	4	
25	-		Student Activity	1	New courses, compulsory for batch 2018 onward
26	-		Civil Engineering System	2	
27	-		Effective Communication	2	
28	-		Internship A Internship B	2/3	New elective courses

Course Structure International Undergraduate Program on Civil Engineering

Code	Subject	SKS
	1st Semester	
UIGE 600 003	Academic Writing	2
ENGE 610 001	Calculus 1	3
ENCV 611 001	Physics (Mechanics and Thermal)	4
ENCV 611 002	Statics	3
ENCV 611 003	Construction Drawing 1	2
ENCV 611 004	Material Properties	3
ENCV 611 005	Intro to Civil Engineering System	3
	Sub Total	**20**
	2nd Semester	
ENGE 610 002	Calculus 2	3
ENGE 610 007	Physics (Electricity, MWO)	3
ENGE 610 004	Linear Algebra	4
ENCV 612 001	Basic Soil Mechanics	3
ENCV 612 002	Construction Drawing 2	3
ENCV 612 003	Solid Mechanics	4
	Sub Total	**20**
	3rd Semester	
ENCV 613 001	Statistics and Probabilistic of Experimental Design	2
ENCV 613 002	Advanced Calculus	3
ENCV 613 003	Environmental Basic Chemistry	3
ENCV 613 004	Soil Mechanics	3
ENCV 613 005	Fluid Mechanics	3
ENCV 613 006	Surveying & Geospatial Information Systems	2
ENCV 613 007	Structural Analysis	4
	Sub Total	**20**
	4thSemester	
ENCV 614 001	Engineering System	2
ENCV 614 002	Transportation Engineering	3
ENCV 614 003	Steel Structure 1	3
ENCV 614 004	Hydraulics	3
ENCV 614 005	Numerical Method	2
ENCV 614 006	Foundation Engineering	3
	Elective Courses	**3**
	Sub Total	**19**
	5th Semester	
UIGE 600 004	Religion	2
ENCV 615 001	Highway Engineering Design 1	4
ENCV 615 002	Water Engineering 1	3
ENCV 615 003	Construction & Heavy Equip-ment Management	4
ENCV 615 004	Concrete Structure 1	3
	Elective Courses	**4**
	Sub Total	**20**
	6th Semester	
UIGE 600 006	Integrated Charater Building	5
ENCV 616 001	Water Engineering 2	3
ENCV 616 002	Writing and Presentation Technique	2
ENCV 616 003	Highway Engineering Design 2	2
ENCV 616 004	Ethics and Legal Aspect of Construction Contract	2
ENCV 616 005	Infrastructure Design Project	4
	Sub Total	**18**
	7th Semester	
ENCV 610 100	Field Internship	3
	Elective Course	10
	Sub Total	**13**
	8th Semester	
ENCV 610 300	Final Project	5
	Elective Course	9
	Total	**14**
	Total	**144**

Electives Course

Code	Elective Courses	SKS
	Odd Semester	
ENCV 617 101	Cold Formed Steel Structure	2
ENCV 617 102	Concrete Structure 2	3
ENCV 617 201	Geotechnical Construction Method	2
ENCV 617 301	Airport Planning	2
ENCV 617 302	Port Planning	3
ENCV 617 401	Coastal Engineering	3
ENCV 617 402	River Engineering	2
ENCV 617 501	Introduction to Stakeholders and Project Communications	2
ENCV 617 502	Introduction to Management System of HSE	2
ENCV 610 200	Service Learning	1
ENCV 610 400	Internship A	2
ENCV 610 500	Special Topic of Research Collaboration	3
ENGE 610 012	HSE Protection	2
ENCV 615 005	Entrepreneurship	2
	Even Semester	
ENCV 618 103	Application of the FEM with Program Package Software	3
ENCV 618 104	Steel Structure 2	3
ENCV 618 303	Railroad Transportation	2
ENCV 618 304	Transportation and Environment	3
ENCV 618 403	Stormwater management	2
ENCV 618 404	Water Resources Infrastructure	2
ENCV 618 503	Introduction to Quality & Risk Management	2

ENCV 618 504	Introduction to Procurement Management & Contract Administration and Claim	2
ENCV 610 600	Internship B	3
ENCV 610 011	Engineering Economics	3

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a. For students who have passed these subjects, the credits that are achieved will be counted in the calculation of graduation 144 credits.

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2	Integrated Character Building - B (MPKT B)	6	Integrated Character Building (MPKT)	5	Those who have not pass one of MPKT-A or MPKT-B; do not have to retake MPKT
3	Olahraga / Seni	1	None		Those who have not pass; see transition rule #6
4	Agama	2	Religion	2	The change of teaching learning method; (refer to course plan / syllabus)
5	Bahasa Inggris	3	Bahasa Inggris	2	
6	Physics - Mechanics and Thermal	3	Physics - Mechanics and Thermodynamics	4	The change of course name
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8	Physics - Electricity, MWO Lab	1	None	-	
9	Basic Chemistry	2	Environmental Basic Chemistry	2	Those who have not pass one of Basic Chemistry or Advanced Chemistry should enroll in Environment Basic Chemistry
10	Advanced Chemistry	2		2	

11	Construction Drawing	2	Construction Drawing 1	2	The change of course name
12	Surveying	3	Surveying & Geospatial Information System	2	The change of course name & credits
13	Statics	4	Statiics	3	The change of course credit
14	Statistic & Probabilistic	2	Statistic & Probabilistic	2	The change of course name
15	Building Construction	3	Construction Drawing 2	3	The change of course name
16	Structural Analysis	3	Structural Analysis	4	The change of course credit
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20	Construction Methods & Equipments	2			
21	Capstone Project	3	Infrastructure Design Project	4	The change of course name & credits
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23	Seminar	1	Seminar	1	
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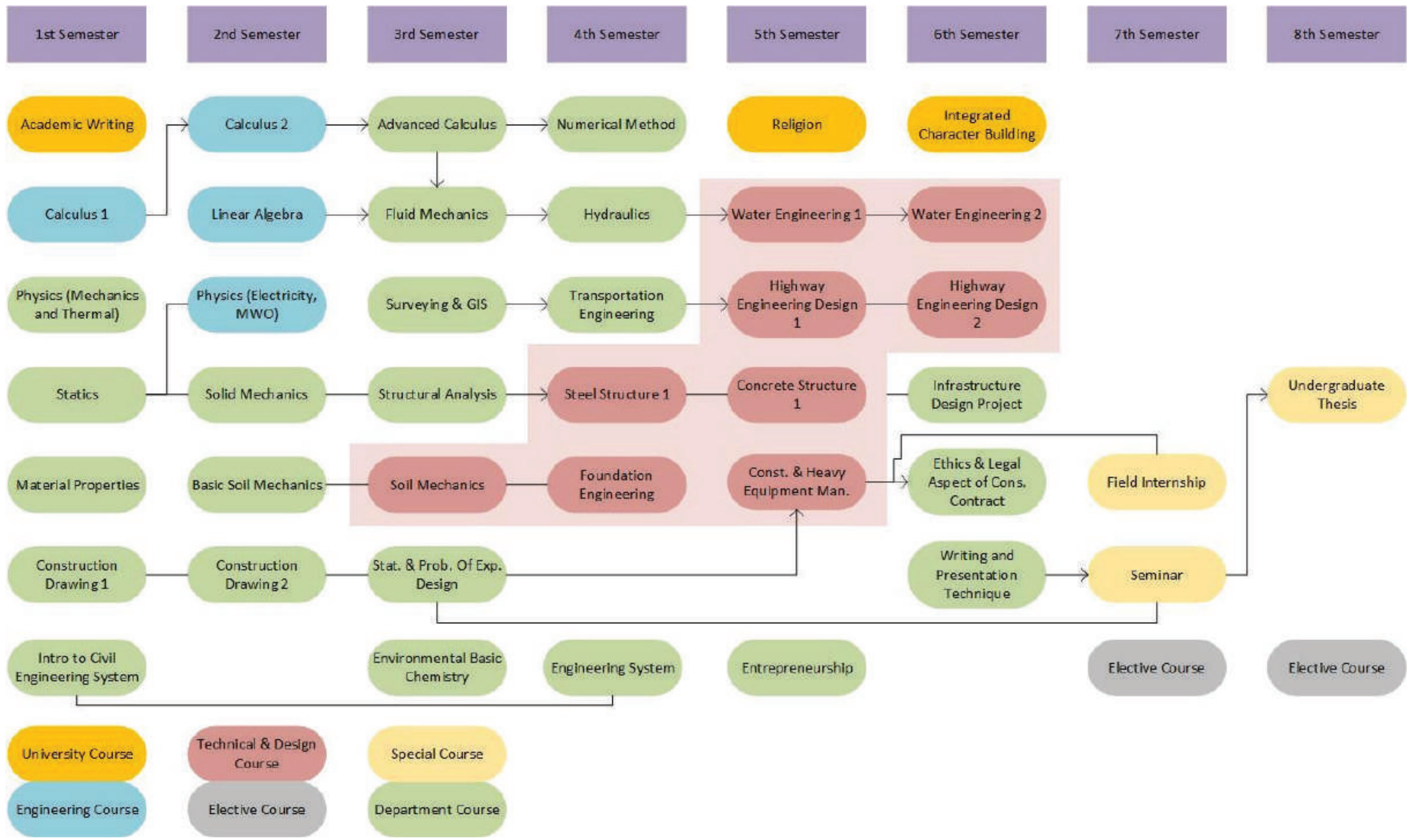
26	-		Civil Engineering System	2	
27	-		Effective Communication	2	
28	-		Internship A Internship B	2/3	New elective courses

Flow Diagram of Subjects – International Undergraduate Program on Civil Engineering



Course Sylabus of University Subjects

INTEGRATED CHARACTER BUILDING

UIGE6000061/UIGE6100061
5 credits

Syllabus :

The Integrated Character Building is part of the Higher Education Personality Development Lecture which is held for students which contains elements of the internalization of basic life values, interaction/relationship skills, nationality and academic skills as the basis for student personality to carry out learning according to scientific disciplines.

MPKT is carried out in the form of a series of learning activities outside the formal class. activities carried out include participation in lectures/seminars, internships, field work practices, social work, sports and/or arts activities and other forms of activities that have the main goal of equipping students with soft skills and proven by portfolio documents. The form of this learning activity is different from the MPKT courses that have been carried out at the previous UI.

The material provided at MPKT aims to form a human thinking pattern with values and morals to create a human personality by having critical, logical, creative, innovative thinking, and having intellectual curiosity and an entrepreneurial spirit. The material provided includes 9 UI values, national, state and citizen values based on Pancasila. Solving problems in science, technology, health, and humans as natural managers by using reasoning and utilizing Information and Communication Technology (ICT) to achieve the final objectives of this module.

Lecture activities are carried out using an online student-centered learning (SCL) approach which can use the following methods: experiential learning (EL), collaborative learning (CL), problem-based learning (PBL), question-based learning, and project based learning. The use of these various methods is carried out through group discussion activities, independent assignment exercises, presentations, writing papers in Indonesian and interactive discussions in online discussion forums. The language of instruction in this lecture is Indonesian.

Graduate Learning Outcomes :

- CPL 1: Able to use spoken and written language in Indonesian and English both for academic and non-academic activities (C3, A5)
- CPL 2: Have integrity and are able to think critically, creatively, and innovatively and have intellectual curiosity to solve problems at the individual and group level (C4, A3)
- CPL 3: Able to provide alternative solutions to various problems that arise in the community, nation, and country (C4, A2)
- CPL 4: Able to take advantage of information communication technology (C3)
- CPL 5: Able to identify various entrepreneurial efforts characterized by innovation and independence based on ethics (C2, A5)

Course Learning Outcomes :

- CPMK 1: After completing this course, students are able to apply self-regulated learning characteristically in studying critically, logically, creatively, innovatively through analysis of societal problems, nation, state, and Pancasila ideology based on self-understanding as individuals and members. the community by using good and correct Indonesian and the latest information and communication technology (C4, A4)
- CPMK 2: Able to identify various entrepreneurial efforts characterized by innovation and independence based on ethics (C2, A5)
- CPMK 3: After completing this course, students are able to apply self-regulated learning characteristically in pursuing integrated and comprehensive knowledge through analysis of science problems, technology based on the role of nature manager by using good and correct Indonesian and information technology and current communications. (C4, A4)
- CPMK 4: After completing this course, students are able to plan creative activities to solve problems in society and the world of work/industry by showing creativity, critical thinking, collaborative self-discipline using good and correct Indonesian as well as the latest information and communication technology (C5, A5)

Prerequisite : -

ACADEMIC WRITING

UIGE610002
2 credits
The Objectives :

To activate students, English so that they will be able to communicate effectively in English;

To enable students to develop the learning strategies and study skills needed to finish their study successfully and o continue learning on their own after taking the MPK program (to develop independent learners)

Main Competencies :

- Listen to, understand and take notes of key information in academic lectures of between 5-10 minutes length;
- Improve their listening skills through various listening materials and procedures;
- Speak confidently, ask questions in and contribute to small group discussions;
- Use different reading strategies needed to the effective readers;
- Improve their reading skills through extensive reading material;
- Develop skills in connecting ideas using appropriate transitions and conjunctions;
- Work as part of a group to prepare and deliver a 25-minute presentation on an academic topic using appropriate organization, language and visual aids;
- Write a summary of a short academic article;
- Write an expository paragraph;
- Write a short essay.

Learning Method : Active learning, Contextual language learning, small group discussion.

Prerequisite :

1. Students Learning Orientation/Orientasi Belajar Mahasiswa (OBM)

ENGLISH

UIGE600003
2 credits

Learning Objectives :

After attending this subject, students are expected to capable of use English to support the study in university and improve language learning independently.

Syllabus :

Study Skills : (Becoming an active learner, Vocabulary Building: word formation and using the dictionary Listening strategies Extensive reading) Grammar: (Revision of Basic grammar Types of sentences Adjective clauses, Adverb clauses Noun clauses, Reduced clauses) Reading: (Reading skills: skimming, scanning, main idea, supporting ideas, Note-taking Reading popular science arti-cle, Reading an academic text) Listening: (Listening to short conversations, Listening to a lecture and notetaking, Listening to a news broadcast, Listening to a short story) Speaking: (Participating in discussions and meetings, Giving a presentation) Writing: (Writing a summary of a short article Describing graphs and tables, Writing an academic paragraph, Writing a basic academic essay (5 paragraphs).

ISLAMIC STUDIES

UIGE6000010/UIGE610005
2 credits
General Instructional Objectives :

The cultivation of students who have concern for social, na-tional and countrys issues based on Islamic values which is applied in the development of science through intellectual skills.

Learning Objectives :

Course participants are expected to do the following when faced with a problem or issue which they must solve :

1. Analyze the problem based on the Islamic values they adopted;
2. Analyze the problem by implementing active learning stages;
3. Discuss and express their thoughts and ideas by using proper and correct Indonesian language in discussion and academic writing.

Syllabus :

Islam history: the meaning of Islam, the characteristic of Islam, the sources of Islamic teachings, Muhammad SAW as prophet and history figure, introduction of Islam in Indonesia, the teaching essence of Islam: the basic principle of Islam teachings, the unity of Allah, worship prac-tice in live, eschatology and work ethics, human's basic rights and obligation, social structure in Islam: sakinah mawaddah and ramhah family, the social implication of family life, Mosque and the development of Islam, zakat and the economic empowerment of the people, Islam society, Science: reason and revelation in Islam, Islam's motivation in development of science, science characteristics, source of knowledge, IDI (each Faculty and Department/Study Program).

CATHOLIC STUDIES

UIGE6000011/UIGE610006
2 credits
General Instructional Objectives :

To help deliver students as intellectual capital in implementing lifelong learning process to become scientists with mature personality who uphold humanity and life.

Be scholars who believe in God according to the teachings of Jesus Christ by continuing to be responsible of his faith in life in church and society.

Syllabus :

Almighty God and the God teachings; Man, Morals, science technology and art; harmony between religions; Society, Culture, Politics, Law: the substance of theses studies will be addressed by integrating the four dimensions of the teachings of the Catholic faith: the personal dimension, the dimension of Jesus Christ, the dimension of the Church, and Community dimension. Dimensions are implemented in the following themes: People, Religion, Jesus Christ, the Church, and Faith in the society.

CHRISTIAN STUDIES

UIGE6000012/UIGE610007
2 credits
General Instructional Objectives :

Cultivating students with comprehensive Christian knowledge and teaching in the midst of the struggle and the fight of the nation while also discussing the student's participation in line with the study to help improve and build our country.

Learning Objectives :

Course participants are expected to do the following when faced with a problem or issue which they must solve:

1. Analyze the problem based on the Christian values
2. Analyze the problem by implementing active learning stages
3. Discuss the problem by using proper and correct Indonesian language

Syllabus :

History (Historical terms): Status of the Bible, the existence of God and Morality, Christ the Savior, the Holy Spirit as existence reformer and outlook on the world: Faith and Knowledge of Science, Church and service, Ecclesiology, Spiritual and enforcement of Christian Human Rights and the world of ethics: Christian Ethics, Christian and worship, Christianity and politics, Christian love and social reality: Christian Organizations, Students and Service, Christian and expectations.

HINDU STUDIES

UIGE6000013/UIGE610008
2 credits

Syllabus :

Hindu religion, Hindu history), Source and scope of Hinduism (the Veda as the source of Hindu religion teachings, the scope of the teachings in Hindu religion), The concept of the God (Brahman) according to the Veda, the Path to Brahman (Catur Marga Yoga, Mantra and Japa), Human Nature (The purpose of human life, Human's duties, obligations, and responsibilities both individually or collectively), Ethics and morality (Principles teaching, self-control), in-depth understanding of the scripture (deep understanding of the Bhagawadgita, deep understanding of the Sarasamuschaya), The Role of Hinduism in science, technology, and art (Hinduism benefits in science and technology in accordance with each department, benefit / the role of Hinduism in the arts), Cohesion and community's prosperity /independence (Benefits of unity in the religious plurality, independent community (kerthajagathita) as a common goal, Tri Pitakarana), Culture as an expression of Hindu religious practice, Contribution to the Hindu religion teachings in the political life of nation and country, laws and

the enforcement of justice, Awareness of and obeying the Rita / Dharma.

BUDDHIST STUDIES
UIGE6000014/UIGE610009
2 credits

Syllabus :

Almighty God and the God Study (Faith and piety, Divine Philosophy/Theology), Human (Human Nature, Human Dignity, Human Responsibility), Moral (Implementation of Faith and Piety in everyday life), Science, Technology and Art (Faith, Science and Charity as a unity, the Obligation to study and practice what you are taught, Responsibility for nature and environment), harmony between religion (religion is a blessing for all mankind, the essence of the religious plurality and togetherness), community (the role of religious society in creating a prosperous independent society, the responsibility of religious society in the realization of human rights and democracy), Culture (the responsibility of religious society in the realization of critical thinking (academic), work hard and fair), Politics (Religion contribution in the political life of nation and country), Law (Raise awareness to obey and follow God's law, the role of religion in the formulation and enforcement of law, the function of religion in the legal profession).

KONG HU CU STUDY
UIGE6000015/UIGE610010
2 credits

Syllabus of Faculty Subjects

CALCULUS 1
ENGE600001/ENGE610001
3 credits
Course Learning Outcomes:

Able to use the basic concepts of calculus related to -a function of one variable, the derivative and integration of the function of one variable in order to solve its applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, basic engineering, and engineering specialization to be used in solving complex engineering problems.

Syllabus :
Introduction, Functions and Limits, The Derivative, Applications of the Derivative, The Definite Integral, Applications of The Definte Integral, Transcendental Functions, Techniques of Integration, Indeterminate Forms and Improper Integrals.

Prerequisite: None

Textbooks:

Main reference:
D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., Pearson, Prentice Hall, 2007.

Additional eferences:
1. George B. Thomas Jr., Thomas' Calculus Early Transcendental, 12th ed., Addison–Wesley Pearson, 2009.
2. Howard Anton, Calculus, 10th ed., John Wiley and Sons, 2012.

CALCULUS 2
ENGE600002/ENGE610002
3 SKS
Course Learning Outcomes:

Students are able to use the concepts of sequences, series, conic sections, and the basic concepts of calculus which involve the function of two or three variables to solve their applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :
Infinite sequences and infinite series, Test for convergence of positive series and alternating series, Power series and operation on operations, Taylor and MacLaurin series, Conic sections , Calculus in polar coordinates, Derivatives, limits, and continuity of multi-variables functions, Directional derivatives and gradients, Chain Rule, Tangent planes and Approximations, Lagrange multipliers. Double integrals in Cartesian coordinates and polar coordinates, triple integrals in Cartesian coordinates, cylindrical coordinates and spherical coordinates, Applications of double and triple Integral.

Prerequisite: Calculus 1

Textbooks:
1. D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., PEARSON, Prentice Hall, 2007.
2. Thomas, Calculus Thirteenth Edition Volume 2, Erlangga, 2019.

CALCULUS
ENGE600003/ENGE610003
4 SKS
Course Learning Outcomes:

Students are able to use the basic concepts of calculus involving functions of one to three variables to solve their applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :

Introduction, Functions and Limits, Derivatives, Derived Applications, Indeterminate Integral, Integral Applications, Infinite Row, and Series. Derivatives with many variables, Duplicate Integral (2 and 3), Duplicate Integral Application.

Prerequisite: None

Textbooks:

Main :

D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., Pearson, Prentice Hall, 2007.

George B. Thomas Jr., Thomas' Calculus Early Transcendental, 12th ed., Addison – Wesley Pearson, 2009.

LINEAR ALGEBRA
ENGE600004/ENGE610004
4 SKS
Course Learning Outcomes:

Students are able to calculate linear system problems to solve engineering problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :

Linear Systems and matrix equations, Determinants, Euclid vector spaces, Common vector spaces, eigenvalues and eigenvectors, inner product spaces, Diagonalization and General Linear Transformation.

Prerequisite: None

Textbooks:
1. Elementary Linear Algebra, Howard Anton & Chris Rorres, 11th edition, 2014
2. Gilbert Strang, Introduction to linear algebra 3rd edition Wellesley Cambridge Press, 2003

MECHANICAL AND HEAT PHYSICS

ENGE600005 / ENGE610005
3 credits
Course Learning Outcomes:

Able to explain the basic concepts of mechanics and thermodynamics, and be able to apply them to understand natural phenomena and human engineering, including their applications.

Graduate Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus:

Units, Magnitudes and Vectors, Motion Along Straight Lines, Motion in Two and Three Dimensions, Newton's Laws of Motion, Applications of Newton's Laws, Kinetic Energy, and Work, Potential Energy and Energy Conservation, Center of Mass, Linear Momentum, Rotation, Rolling Motion, Torque, Angular Momentum, Oscillation, Mechanical and Sound Waves, Gravity, Statics and Elasticity, Fluid Mechanics, Temperature, Heat, Law I Thermodynamics, Ideal Gas and Kinetic Theory of Gas, Heat Engine, Entropy, and Law II Thermodynamics.

Prerequisite: none

Textbooks:
1. Halliday, Resnick, and Walker, Principles of Physics 10th Edition, Wiley, 2014.
2. Serway Jewett, Physics for Scientists and Engineers 9th Edition, Thomson Brooks / Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008

ELECTRICAL MAGNETIC, OPTICAL AND WAVE PHYSICS

ENGE600007 / ENGE610007
3 credits
Course Learning Outcomes:

Students are able to apply the basic concepts of electrical physics, magnetism, waves, and optics to solve problems in the engineering field.

Graduate Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus:

Unit, Magnitude, Vector, Electric Charge, Electric Field, Gauss Law, Electric Potential, Capacitance, Electric Current, Resistance, Direct Current, Magnetic Field Due to Electric Current, Magnetic Field Source, Induced GGL, Inductance, Alternating Current, Electromagnetic Waves, Light Properties and Propagation, Optical Geometry.

Prerequisite: none

Textbooks :
1. Halliday, Resnick, and Walker, Principles of Physics 9th Edition, Wiley, 2011.
2. Serway Jewett, Physics for Scientists and Engineers 9th Edition, Thomson Brooks / Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008.

BASIC CHEMISTRY

ENGE600009 / ENGE610009
2 credits
Course Learning Outcomes:

Students are able to analyze the principe of basic chemistry for application in engineering.

Graduates' Learning Outcomes:

Able to apply mathematics, science, and basic engineering to be used in solving complex engineering problems.

Syllabus:

Material and measurements, atoms, molecules and ions, stochiometry, water phase reactions and solution stochiometry, thermochemistry, chemical equilibrium, acid and base equilibrium, electrochemistry, chemical kinetics, and chemical applications.

Prerequisite: none

Textbooks :
1. Ralph H. Petrucci, General Chemistry: Principles and Modern Applications, 8th Ed. Prentice Hall Inc., New York, 2001.
2. John McMurry, Robert C. Fay, Chemistry (3rd ed.), Prentice Hall, 2001.
3. Raymond Chang, Williams College, Chemistry (7th ed.), McGraw-Hill, 2003.

ENGINEERING ECONOMY

ENGE600011 / ENGE610011
3 credits
Course Learning Outcomes:

Students are able to analyze the economic and financial feasibility of making economic practice decisions.

Graduate Learning Outcomes:

Able to apply the principles of technical management and decision making based on economic considerations, in individual and group, as well as in project management.

Syllabus:

Introduction to Engineering Economics, Time Value of Money, Combining Factors, Interest Rates, Money Worth Analysis, Rate of Return Analysis, Effects of Inflation, Benefit Cost & Break-Even Point Analysis, Sensitivity Analysis, Depreciation, Tax Analysis, Cost Estimation & Allocation, Capital Budgeting & Replacement Analysis.

Prerequisite:
1. Civil Engineering : -
2. Environmental Engineering : -
3. Naval Engineering : -
4. Industrial Engineering : must pass the introductory Economic course and have completed 38 credits
5. Chemical Engineering : -
6. Bioprocess Engineering : -

Textbooks:
1. Blank, Leland and Tarquin, Anthony. 2018. Engineering Economy 8th Ed. McGraw Hill.

2. Park, Chan S. 2016. Contemporary Engineering Economics 6th Ed. Pearson. Upper Saddle River.
3. White, Case and Pratt. 2012. Principles of Engineering Economic Analysis 6th ed. John Wiley and Sons.

STATISTICS AND PROBABILISTICS
ENGE600010 / ENGE610010
2 credits
Course Learning Outcomes:

Students are able to handle quantitative data/information starting from the descriptive stage (collection, organization, and presentation) to the inductive stage, which includes forecasting and drawing conclusions based on the relationship between variables for decision making.

Graduate Learning Outcomes:
1. Apply descriptive statistics and probability theory to data processing and serving
2. Apply probability distribution to data processing and serving
3. Apply the principles of sampling and estimation for decision making
4. Apply hypothesis test samples for decision making

Syllabus:

Introduction to Statistics for Engineering Studies, Probability Theory, Dasar Basic concepts and definitions, Distribution Probability, Sampling, Estimation, Hypothesis testing, Hypothesis test 1 sample at an average value, Regression

Prerequisite: none

Textbooks :
1. Harinaldi, Basic Principles of Statistical Engineering and Science, Erlangga, 2004
2. Montgomery, DC., And Runger, GC., Applied Statistics and Probability for Engineers, John Wiley Sons, 2002

HSE PROTECTION
ENGE600012 / ENGE610012
2 credits
Course Learning Outcomes:

Upon completion of this subject students are expected to be able to carried out hazard identification, and characterization, to propose appropriate methods for risk reduction and mitigation, and to design safety management system. The student is also expected to improve their awareness on industrial safety and health, and understanding on safety regulation framework and standards as well as environmental program.

Graduate Learning Outcomes:
1. Students are expected to understand safety, health and environmental aspect as an integral part of fundamental principal in engineering code of ethics.
2. Students are expected to be able to carry out process of risk assessments by considering risk factors in the impact of hazards on people, facilities, and the surrounding community and environemt.
3. Students are expected to understand the regulatory framework and standard related to the stages of life cycle of machine, building structure, construction, and process.
4. Students are able to design and propose an effective hazard communication, management and engineering control, and risk mitigation through an engineering assignment project.
5. Students are able to identify the knowledge required to perform risk assesment, investigation and design improvement through a multidisiplinary case of incident and accident.

Syllabus:

Introduction to SHE Regulation and Standards, SHE Perception (Risk and Environment), Identification, Assessment and Management, Construction, machinery and Noise hazards, Process safety hazard and analysis technique, Fire and explosion hazard, Electrical hazard, Toxicology in the Workplace, Ergonomy Aspect, Hazard communication to employees, Environmental Protection, Case studies, Safety Health and Environment audits.

Prerequisite: none

Textbooks :
1. Charles A. Wentz, Safety, Health and Environmental Protection, McGraw Hill, 1998.
2. Asfahl, C.R., Rieske, D. W., Sixth Edition Industrial Safety and Health Management, Pearson Education, Inc., 2010.
3. United Kingdom - Health and Safety Executive, http://www.hse.gov.uk/
4. National laws and regulations related to the K3 Management System and the Environment.
5. Related Journal (http://www.journals.elsevier.com/safety-science/) etc, related standards and publications.

Course Syllabus of Undergraduate Program on Civil Engineering

Mechanics and Thermal Physics
ENCV 601 001
4 Credits
Expected Learning Outcomes :

CLO 1 (Engineering Knowledge)

Course Learning Outcomes :

Be able to apply the concepts of physics, mechanics and thermodynamics as an effort to understand natural phenomena and human engineering, including engineering application (CLO 1)

Learning Experiences :

Interactive lectures, individual assignments, and tutorials.

Syllabus :

Magnitude, kinematics of a point particle, mechanics of rigid bodies, the law of conservation of linear momentum and energy, harmonic motion, gravity, kinematics and dynamics of rigid bodies, basic concepts (pressure, thermodynamic system, state system, temperature), expansion, energy equilibrium (thermal state equations) , heat transfer, ideal gas, first law of thermodynamics, enthalpy and entropy, application of first law of thermodynamics for open and closed systems, second law of thermodynamics, kinetic theory of ideal gases, building ventilation systems, building insulation systems, building cooling systems and central air.

Prerequisites : -

Text Book References :
1. Halliday, Resnick, dan Walker, Principles of Physics 9th Edition, Wiley, 2011.
2. Serway Jewett, Physics for Scientists and Engineers 9th Edition, Thomson Brooks/Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008
4. Cengel, Y, Thermodynamics: An Engineering Approach 8th Edition, McGraw-Hill Education, 2014
5. Ganijanti AS, Mekanika,Penerbit Salemba Teknik, 2000.
6. Tipler PA, Fisika I, ed III, terjemahan Lea Prasetio, Penerbit Erlangga, 1998.

Environmental Basic Chemistry

ENCV 601 002
2 Credits

Expected Learaning Outcomes :
CLO 1 (Engineering Knowledge)

CLO 7 (Environment and Suistanibility)
Course Learning Outcomes :

1. Be able to identify chemical processes that occur in the Civil Engineering construction cycle and analyse its effects on the environment (CLO 1)
2. Be able to identify basic theories of chemistry related to the concepts and principles of built environment sustainability (CLO 7)

Learning Experiences :

1. Interactive lectures
2. Case study in analysing chemical phenomena occurred in the lifecycle of civil engineering buildings.

Syllabus :

Table Periodic; Stoichiometry: Calculation with Chemical; Chemical Reaction in Solution and Stoichiometry Solution; Thermochemistry; Chemical Equilibrium; Acid and Base; Electrochemistry; Spontaneity of reactions (concept of irregularity, enthalpy, entropy, Gibbs free energy, Arrhenius equation), spontaneous and non-spontaneous reactions (effect of temperature, concentration and energy on spontaneity, cement production processes), steel production processes (mining and mineral purification, iron extraction from minerals, steel production), chemical weathering of building materials (causes and mechanisms of acid rain formation, ettringite formation and characteristics, ettringite effects on building strength, reaction of metals with acids, impact of acid raid on metals, aggressive and corrosive environments, examples of methods of materials protection), civil engineering life cycle concept (life cycle concept, production processes, transportation, constructions, operations and end of life of civil engineering building), impact of cement production processes and steel on increased air pollution (by-product of cement production processes, by-product of steel production processes, the contribution of cement industry and steel to CO2 and particulate levels in the air), pollution due to the life cycle of civil engineering building (air, water, and soil pollution from construction processes and operation of civil engineering buildings).

Prerequisites : -

Text Book References :

1. Brown and Holme, 2011, Chemistry for Engineering Students 2nd edition
2. Rainer Remus, Miguel A. Aguado-Monsonet, Serge Roudier and Luis Delgado Sanch, 2013, Best Available Techniques (BAT) Reference Document for Iron and Steel Production, JRC REFERENCE REPORT EU EU Commission
3. COLIN BAIRD, MICHAEL CANN, 2008, Environmental Chemistry 4th edition, W. H. Freeman
4. Moncmanová, 2007, Environmental Deterioration of Materials, WIT Press
5. Frauke Schorcht, Ioanna Kourti, Bianca Maria Scalet, Serge Roudier, Luis Delgano Sancho, 2013, Best Available Techniques (BAT) Reference Document for Cement, Lime and Magnesium Oxide, JRC REFERENCE REPORT EU EU Commission
6. Building and Environment, Elsevier
7. Georgia Institute of Technology, 2010, AIA Guide to Building Life Cycle Assessment in Practice, The American Institute of Architects
8. Georgia Institute of Technology, 2010, AIA Guide to Building Life Cycle Assessment in Practice, The American Institute of Architects

Introduction to Civil Engineering System

ENCV 601 003
3 Credits
Expected Learning Outcomes :

CLO 2 (Problem Analysis),

CLO 6 (Engineer and Society),

CLO 9 (Team Work),

CLO 10 (Communication)

Course Learning Outcomes (CLO) :

1. Be able to analyse problems related to Civil Engineering and the surrounding environment (CLO 1)
2. Be able to analyse problems in society related to Civil Engineering and propose solutions (CLO 2)
3. Be able to work in teams in analysing Civil Engineering problems in society (CLO 9)
4. Be able to use appropriate and correct Indonesian in expressing opinions and ideas (CLO 10)

Learning Experiences :

1. Using problem-based learning (PBL) method in analysing problems within the scope of Civil Engineering.
2. Conducting a field survey to dig deeper into the analysed problems.
3. Presenting the results and proposing simple solutions in the form of posters.

Syllabus :

Introduction to the system and scope of work of Civil Engineering: General description of the scope of the Civil Engineering system and work, an overview of the sub-expertise of Transportation Engineering, Geotechnical Engineering, Water Resources Management, Environmental Engineering, Structural Engineering and Construction Management; Components and functions of Civil Engineering buildings / infrastructure: Physical and non-physical components of Civil Engineering buildings / infrastructure, Functions of physical and non-physical components of Civil Engineering buildings / infrastructure; The role of the Civil Engineering undergraduate: The role of the Civil Engineering undergraduate in the field of expertise of Transportation Engineering, Geotechnical Engineering, Water Resources Management, Environmental Engineering, Structural Engineering and Construction Management, The linkage of the scope of work between areas of expertise.

Prerequisites : -

Text Book References : -

Material Properties

ENCV 601 004
3 Credits
Expected Learning Outcomes :

CLO 1 (Engineering Knowledge)

CLO 4 (Experiment)

Course Learning Outcomes (CLO) :

1. Be able to identify the properties of materials used in Civil Engineering. (CLO 1)
2. Be able to conduct experiments in the laboratory and analyse the results. (CLO 4)

Learning Experiences :

1. Interactive lectures
2. Conducting experiments on concrete mix designs and cement
3. Observing the simulation of steel reinforcement tensile tests.
4. Conducting experiments on asphalt materials

Syllabus :

Particulate Materials, Aggregates, Portland Cement and Portland Cement Concrete, Structural steel, Asphalt cement and asphalt concrete, wood, bricks, polymers, consideration of environmental aspects in material selection, response of materials to loads, melting and fracture; Rheology of fluids and solids; Fatigue.

Prerequisites : -

Text Book References :
1. S. Young, Sidney, The Science and Technology of Civil Engineering Materials, Prentice-Hall International Inc., 1998
2. Shan Somayaji, 2001, Civil Engineering Materials, Prentice Hall.
3. Robert D Kerbs, Richad D Walker, (1971) Highway Materials, Mc Graw-Hill
4. A.M Neville; Properties of Concrete

Construction Drawing 1
ENCV 602 001
2 Credits

Expected Learning Outcomes :

CLO 9 (Teamwork)

CLO 10 (Communication)

Course Learning Outcomes (CLO) :

1. Be able to work in teams in identifying specifications for simple healthy house building. (CLO 9)
2. Be able to draw a 1-storey house in accordance with engineering drawing principles (CLO 10)

Learning Experiences :

1. Interactive lectures
2. Individual assignments to draw building components
3. Conducting a field survey to identify the components of a healthy / unhealthy house building
4. Drawing the healthy / unhealthy house building on a working drawing in accordance with engineering drawing principles.

Syllabus :

Introduction to drawing techniques, functions and benefits of drawing in the design process; introduction of drawing equipment, drawing paper format, image header, image standard recognition, lettering, image captions (leader), image scale; geometric construction; pictorial projection; orthogonal projection; cross-sectional drawings and buildings; detailed drawings of buildings; wooden and light steel roof construction drawings; construction drawings of beams, columns and river stone foundations; Electrical Installation drawings and plumbing drawings. Introduction to external, internal and physical aspects, techniques and the relationship between space / function activities for designing a simple healthy house building. Introduction of standards and regulations for healthy house building.

Prerequisites : -

Text Book References :
1. Neufret, Ernst, Data Arsitek Jilid 1 dan 2, Penerbit Erlangga, Jakarta, 1989
2. Subarkah, Imam, Konstruksi Bangunan Gedung, Penerbit Idea Dharma, Bandung, 1988
3. Sugiharjo, R., Gambar-Gambar Dasar Ilmu Bangunan, Penerbit R. Sugihardjo
4. Giesecke, F. E., et al. (1997). Technical Drawing, Tenth Edition, Prentice Hall Publishing,

Statics
ENCV 602 002
3 Credits

Expected Learning Outcomes :

CLO1 (Engineering Knowledge)

Course Learning Outcomes (CLO) :

Be able to apply Newton's Laws in calculating reactions and forces in certain static structures (CLO 1)

Learning Experiences :

1. Interactive lectures and combined with flip classrooms on the topic of influence lines
2. Conducting individual assignments in a structured and scheduled manner.
3. Discussing in groups in a structured and scheduled manner.

Syllabus :

Particle statics; Rigid object; Rigid body equilibrium; Trusses structures analysis by joint and section methods; Forces in beam, portal and joint structures (gerbers); Influence lines on certain statistical structures due to moving loads.

Prerequisites : Mechanics & Thermal Physics

Text Book References :
1. Hibbeler, R.C., Engineering Mechanics Statics, Thirteenth Edition, Pearson, 2013
2. Hibbeler, R.C., Structural Analysis, Eighth Edition, Prentice Hall, 2012
3. Andrew Pytel ; Jaan Kiusalaas, Engineering Mechanics : Statics:, 3rd edition, The Pennsylvania State University, 2010

Construction Drawing 2
ENCV 603 001
3 Credits

Expected Learning Outcomes :

CLO 5 (Modern Tool Usage)

CLO 10 (Communication)

Course Learning Outcomes (CLO) :

1. Be able to use an AutoCAD software in drawing Civil Engineering building structures (CLO 5)
2. Be able to draw a 2-storeys civil engineering building structures or more in accordance with engineering drawing principles (CLO 10)

Learning Experiences :

1. Interactive lectures
2. Conducting a survey of existing building, identifying architectural and structural components.
3. Drawing "the structural drawing" of the surveyed building.
4. Attending an AutoCAD course organized by IMS.

Syllabus :

1. Reviewing drawing notations: Scale, title, layout; visible/invisible part; center line; grid, as.
2. Reviewing building components in accordance with architectural drawings: practical columns, ring balk, roof truss.
3. Drawing two story reinforced concrete structures building or more: Foundation plan, beam-column plan, roof plan, detail of beam reinforcement, detail of column reinforcement, detail of shallow and deep foundation, detail of beam-column joints, detail of bracing joints.
4. Drawing structural steel industry building: beam-column plan, detail of transversal frames, detail of longitudinal frames, detail of beam-column joints, detail of bracing joints.

Prerequisites : Construction Drawing 1

Text Book References :

1. Neufret, Ernst, Data Arsitek Jilid 1 dan 2, Penerbit Erlangga, Jakarta, 1989
2. Subarkah, Imam, Konstruksi Bangunan Gedung, Penerbit Idea Dharma, Bandung, 1988
3. Sugiharjo, R., Gambar-Gambar Dasar Ilmu Bangunan, Penerbit R. Sugihardjo
4. Tanggoro, Dwi., Utilitas Bangunan, Penerbit Universitas Indonesia, 2000
5. Giesecke, F. E., et al. (1997). Technical Drawing, Tenth Edition, Prentice Hall Publishing.

Solid Mechanics

ENCV 603 002
3 Credits

Expected Learning Outcomes :

CLO 1 (Engineering Knowledge)

Course Learning Outcomes (CLO) :

Be able to apply solid mechanic concepts in calculating stress and deflection occurred in certain static structures (CLO 1)

Learning Experiences :

1. Interactive lectures.
2. Carrying out individual assignments in a structured and scheduled manner.
3. Discussing in groups in a structured and scheduled manner.
4. Conducting experimental simulations in the laboratory.

Syllabus :

Definition of loads and forces acting on solid objects, effects of forces on solid objects, stress on solid objects, shape changes in solid object, properties of shape changes in solid object, elastic and inelastic phases, axial strain, Modulus of Elasticity, Poisson Ratio. Normal stress due to axial force, normal stress due to bending, normal and bending combination, direct and two-way bending stress, core plane (Kern), shear stress due to force in latitude, shear stress due to torsional inner force (torsion). A combination of normal and shear stress. The stress on the inclined plane and main stress. Deflection of certain static beam, frame and truss structures due to external loads using the elastic deflection line differential equation method, the moment plane area method with an equivalent beam, the energy method (unit load). Analysis of simple indeterminate static structures uses the principle of consistent deformation.

Prerequisites : Statics (pass)

Text Book References :

1. Hibbeler, R.C., Mechanics of Materials, 8/e, Pearson, 2011
2. Beer, F. and Johnston, P., Mechanics of Materials, 6/e. Mc Graw Hill, 2011
3. Egor P. Popov (Author), Engineering Mechanics of Solids (2nd Edition), Prentice Hall, 1998

Fluid Mechanic

ENCV 603 003
3 Credits

Expected Learning Outcomes :

CLO 1 (Engineering Knowledge)

Course Learning Outcomes (CLO) :

Be able to apply fluid mechanic concepts in calculating the hydrostatic pressure in civil engineering buildings and the dynamic forces caused by the fluid flow (CLO 1)

Learning Experiences :

1. Interactive lectures
2. Scheduled tutorials
3. Conducting experiments in the laboratory

Syllabus :

Basic formulation of motion and object forces that cannot be conceptualized as a unified whole, such as wind and water. Static fluids including the definition of pressure, the formulation of pressure distribution and its application to determine the magnitude of force due to pressure in various civil engineering structures. Fluid flows, starting from the conceptualization of Eulerian motion and its application to the law of conservation of mass, momentum, and energy to calculate the total amount of flow and the resulting dynamic force. The total flow and force are the basis for designing hydraulic buildings in particular or civil buildings in general.

Prerequisites: Calculus 1, Calculus 2, Mechanics & Thermal Physics

Text Book References :

1. Merle C. Potter, David C. Wiggert, Bassem H. Ramadan, Mechanics of Fluids, Fourth Edition, Cengage Learning, 2011
2. Frank M. White, Fluid Mechanics, Fourth Edition, McGraw-Hill, 1998

Statistics and Probabilistic of Experimental Design

ENCV 603 004
2 Credits

Expected Learning Outcomes :

CLO 1 (Engineering Knowledge)

CLO 4 (Experiment)

Course Learning Outcomes (CLO) :

1. Be able to calculate statistical and probabilistic variables needed to analyse data series (CLO 1)

2. Be able to apply statistical and probabilistic concepts in analysing the results of field experiments / measurements (CLO 4)

Learning Experiences :

1. Interactive lectures
2. Using "real data" from experiments to summarise the results
3. Using Ms. Excel to calculate some relevant statistical parameters for interpreting results from experiments or field measurements

Syllabus :

Basic concepts of statistics and probabilistic; Error Analysis and Error Propagation; Analysis of normal distribution; Standard error analysis at appropriate intervals; Estimation of Errors in Derived Quantities; Hypothesis Testing and the t-Test based on ANOVA results; Distribution and consistency test; Analysis of Toolpax data by using Excel to assist the computational process in statistical analysis

Prerequisites : -

Text Books References :

1. Catherine A. Peters, Statistics for Analysis of Experimental Data, Princeton University, 2001
2. Howard J. Seltman, Experimental Design and Analysis, 2018
3. Berthouex, P. M.; L. C. Brown. Statistics for Environmental Engineers. Lewis Publishers, 1994.
4. Bevington, P. R.; D. K. Robinson. Data Reduction and Error Analysis for the Physical Sciences. McGraw-Hill, Inc. 1992.
5. Box, G. E. P.; W. G. Hunter; J. S. Hunter. Statistics for Experimenters: An Introduction to Design, Data Analysis, and Model Building. John Wiley & Sons, 1978

Basic Soil Mechanics

ENCV 603 005
3 Credits

Expected Learning Outcomes :

CLO 1 (Engineering Knowledge)

CLO 4 (Experiment)

Course Learning Outcomes (CLO) :

1. Be able to categorise soil based on USCS and understand physics properties and three phase diagrams of soil (CLO 1)
2. Be able to conduct experiments in the laboratory to determine the characteristics of soil (CLO 4)

Learning Experiences :

1. Interactive lectures
2. Conducting experiments in the laboratory or watching a virtual laboratory to understand the physical properties of soil.

Syllabus :

Engineering Geology and Soil Property; The linkage of geology and geotechnics with civil engineering; Topographic and geomorphological maps; Topography and equipment; How to read and analyse mineralogy, rock types, and stratigraphy, types of minerals forming igneous rocks; Geological structures and types; Identification methods and effects of coating, stocking, faults, non-conformity for construction; Weathering and soil movement; Weathering types, processes, and identifications; Classification process; Geological and geotechnical maps; Topographic base map analysis; Geotechnical and geological map criteria; Soil Properties: Physical characteristics of soil; Soil Classification; Atterberg limit; Soil compaction and CBR test; 1-dimensional flow in soil, groundwater permeability and seepage, flow network; Stress theory and the principle of effective stress; Effective stress reactions due to changes in total stress in fully saturated soils; Soil shear strength; Test the shear strength of soil in the laboratory on clay and sand; Consolidation and consolidation test;

Prerequisites : Material Properties

Text Book References :

1. Burchfiel BC & Foster RJ et .al., "Physical Geology", Charlec E Merril Publishing Co., Colombus Toronto London Sydney, 1986.
2. Blyth, F.G.H. & de Freitas, M.H., "A Geology for Engineers, 7th Ed.". Elsevier. 2005.
3. Craig, R.F., " Soil Mechanics, 7th Ed.", 2007
4. Bowles, J.E., "Physical and Geotechnical Properties of Soils", McGraw-Hill Kogagusha Ltd., 1998.
5. Das, B.M., "Principles of Geotechnical Engineering", Seventh Edition, 2010, PWS Publishing Company, Boston
6. Budu M., "Soil Mechanics and Foundations", Third Edition, 2010, John Wiley& Sons, New York

Surveying & Geospatial Information Systems

ENCV 603 006
2 Credits

Expected Learning Outcomes :

CLO 4 (Experiment)

CLO 5 (Modern Tools)

Course Learning Outcomes (CLO) :

1. Be able to apply statical and probabilistic concepts in analysing the results of surveying measurements. (CLO 4)
2. Be able to use tools (ex: total station) to measure angles and distances and ArcGIS software in mapping of the earth's surface (CLO 5)

Learning Experiences :

1. Interactive lectures
2. Conducting field measurements using theodolite, water pass and total station.
3. Using ArcGIS software in mapping the earth's surface.

Syllabus :

Basics and roles of surveying & GIS in Civil and Environmental Engineering and their applications; Methods & possible errors in distance & angle measurement; Concept mapping and pegging. Geospatial data management in GIS to create custom data and all other data on the desktop; Analysis of geographically oriented spatial data based on certain coordinate systems.

Prerequisites :

Text Book References :

1. ESRI. GIS Solutions for Surveying. ESRI Publishers, 2007.
2. Gopi, S., Sathikumar, R., Madhu, N., Advanced Surveying: Total Station, GIS, and Remote Sensing, Pearson Education, 2008
3. Kavanagh, B. and Slattery, D., 2014. Surveying with Construction Applications 8th ed., Prentice-Hall, Inc.
4. Michael Govorov, Linas Bevainis, Andrius Balčiūnas. Remote Sensing and GIS for Cadastral Surveying, Center

for Cartography at the Faculty of Natural Sciences Vilnius University. 2016.
5. Modul Praktikum Ilmu Ukur Tanah & GIS
6. Nathanson, J., Lanzafama, M. T., Kissam, P., Surveying Fundamental and Practices, 5th Ed., Prentice Hall, 2011

Advanced Calculus

ENCV 603 007
3 Credits

Expected Learning Outcomes :

CLO 1 (Engineering Knowledge)

Course Learning Outcomes (CLO) :

Be able to derive and use the concepts of ordinary differential equation and vector calculus in solving applied problems. (CLO 1)

Learning Experiences :

Interactive lectures

Syllabus :

Introduction to Differential Equations, Definitions and Terminology, Initial-Value Problems, Differential Equations as Mathematical Models, First-Order Differential Equations, Solution Curves without a Solution, Direction Fields, Autonomous First-Order Differential Equations, Separable Equations, Linear Equations, Exact Equations, Solution by Substitutions, A Numerical Method, Linear Models, Nonlinear Models, Modeling with Systems of First-Order Differential Equations.

Higher-Order Differential Equations, Theory of Linear Equations, Initial-Value and Boundary-Value Problems, Homogeneous Equations, Nonhomogeneous Equations, Reduction of Order, Homogeneous Linear Equations with Constant Coefficients, Undetermined Coefficients, Variation of Parameters, Cauchy-Euler Equations, Nonlinear Equations, Linear Models; Initial-Value Problems, Spring/Mass Systems: Free Undamped Motion, Spring/Mass Systems: Free Damped Motion, Spring/Mass Systems: Driven Motion, Series Circuit Analogue, Linear Models : Boundary-Value Problems, Green's Function (Initial-Value and Boundary-Value Problems), Nonlinear Models, Solving Systems of Linear Equations. Vector Functions, Motion on a Curve, Curvature and Components of Acceleration, Partial Derivatives, Directional Derivative, Tangent Planes and Normal Lines, Curl and Divergence, Line Integrals, Independence of the Path, Double Integrals, Double Integrals in Polar Coordinates, Green's Theorem, Surface Integrals, Stokes' Theorem, Triple Integrals, Divergence Theorem, Change of Variables in Multiple Integrals.

Prerequisites : Calculus 1 and Calculus 2

Text Book References :
1. D.G Zill and W.S Wright, Advanced Engineering Mathematics, 5th ed., Jones & Barlett Learning, 2014
2. E. Kreyzig, Advanced Mathematical Engineering, Johnwiley & Son, 5th ed., 2011

Soil Mechanics

ENCV 604 001
3 Credits

Expected Learning Outcomes :

CLO 2 (Problem Analysis),

CLO 3 (Design)

CLO 5 (Modern Tool Usage)

Course Learning Outcomes (CLO) :

1. Be able to analyse slope stability with the limit equilibrium method (CLO 2)
2. Be able to design retaining walls and calculate shallow foundation dimensions (CLO 3)
3. Be able to use GeoStudio software to analyse slope stability (CLO 5)

Learning Experiences :

1. Interactive lectures
2. Watching virtual laboratory videos
3. Using GeoStudio software to analyse slope stability.

Syllabus :

Soil bearing capacity: limit bearing capacity and allowable bearing capacity due to tilting, eccentric loads; Elastic decline and one-dimensional consolidation settlement; Drawing and designing shallow foundations; Seepage through dams; Lateral pressure: Rankine theory and Coulomb theory; Structural design of retaining walls, gravity walls, cantilever walls, cantilever sheet pile walls, sheet pile walls; Slope stability: Slope stability concept, undrained analysis, slice method, introduction to Fellenius method, Bishop method, soil stabilization method, and use of equilibrium method software.

Prerequisites : Basic Soil Mechanics (pass)

Text Book References :
1. Craig, R.F., " Soil Mechanics, 7th Ed.", 2007
2. Bowles, J.E., "Physical and Geotechnical Properties of Soils", McGraw-Hill Kogagusha Ltd., 1998.
3. Das, B.M., "Principles of Geotechnical Engineering", Seventh Edition, 2010, PWS Publishing Company, Boston
4. Budu M., "Soil Mechanics and Foundations", Third Edition, 2010, John Wiley& Sons, New York

Hydraulic

ENCV 604 002
3 Credits

Expected Learning Outcomes :

CLO 1 (Engineering Knowledge)

Course Learning Outcomes (CLO) :

Be able to apply the law of Conservation of Mass, energy, and momentum on a stream media (CLO 1)

Learning Experiences :

1. Interactive lectures
2. Tutorial in a structured and schedule manner

Syllabus :

Hydraulic is an application of the law of mass, energy, and momentum conservation which is applied theoretically in drainage medias generally found in civil engineering world. These drainage media cover flows in pipes (under pressure), and flows in open drainage system (the water surface has atmospheric pressure). Until midterms, awareness is built to obtain the formulation that can be used in designing dimension which basically needed in formulating energy lost. This concept is introduced in designing a piping system. After the midterm, the energy lost concept is continued by applying it to an open drainage system. Due to the incapability of obtaining accuracy just by using the theoretical formulation for energy loss, it is introduced that the application for some of the water structures will be forced to use empirical coefficients.

Prerequisites : Fluid Mechanics, Linear Algebra

Text Book References :
1. Merle C. Potter, David C. Wiggert, Bassem H. Ramadan, Mechanics of Fluids, Fourth Edition, Cengage Learning, 2011.
2. Frank M. White, Fluid Mechanics, Fourth Edition, McGraw-Hill, 1998.

Structure Analysis
ENCV 604 003
4 Credits

Expected Learning Outcomes :

CLO 2 (Problem Analysis)

CLO 5 (Modern Tool Usage)

Course Learning Outcomes (CLO) :

1. Be able to analyse indeterminate static structures with classical methods (three-moment equation, slope deflection and moment distribution) and stiffness methods (CLO 2)
2. Be able to use MATLAB/SAP software to confirm the structural analysis results calculated by stiffness methods (CLO 5)

Learning Experiences :

1. Interactive lectures
2. Carrying out individual assignments in a structured and scheduled manner
3. Conducting experiments to understand moment distribution methods

Syllabus :

Definition of uncertain static vs certain static structures, external indefinite static, Application of the Three Moment Equation method, Slope deflection and moment distribution on continuous beams with various support reaction conditions, fixed frames with single sway, gable frames, symmetrical and asymmetric structures.

Application of the direct stiffness method in cases of 2D truss, continuous beams, frames, joists / grids and composite structures (combined beam-frame, frame-trusses)

Prerequisites : Statics (pass) dan Solid Mechanics

Text Book References :
1. Hibbeler,R.C., Structural Analysis, Prenice Hall, 1998
2. Aslam Kassimali, Structural Analysis, Third Edition, Thomson, 2005
3. Ghali A., A.M. Neville, Structural Analysis : A unified Classical and Matrix Approach, 4th ed., Thompson pub., 1997
4. Marc Hoit, Computer-Assisted Structural Analysis and Modelling, Prentice Hall, Englewood Cliffs, New Jersey, 1995
5. KATILI, Irwan, Metode Elemen Hingga untuk Skeletal, Rajawali Pers, 2008

Numerical Methods
ENCV 604 004
2 Credits

Expected Learning Outcomes :

CLO 1 (Engineering Knowledge)

Course Learning Outcomes (CLO) :

Be able to solve mathematical equations in linear algebra and differential equations numerically (CLO 1)

Learning Experiences :

1. Interactive lectures
2. Using one of available software to analyse linear algebra problems and differential equations

Syllabus :

Basics of programming using MATLAB / PHYTON / VB software, finding the root of the equation (Bracketing Method & Open Method); Linear System (Solving Simultaneous Linear Algebraic Equation, Gauss Elimination, LU-Factorization, Matrix Inversion, Solution by Iteration, Eigenvalues)

Numerical Method in Curve Fitting (Linear Regression & Least Square), Numerical Method in solving: Ordinary Differential Equations (Initial Value Problems, Adaptive Method and Stiff System, Boundary Value Problems)

Prerequisites : Calculus 1, Calculus 2, Advanced Calculus, Linear Algebra

Text Book References :
1. Numerical Methods for Engineers, Steven C. Chapra & Raymond P Canale, 7th edition, 2013
2. Applied Numerical Methods with MATLAB for Engineers and Scientist, 3rd edition, Steven C. Chapra, Mc Graw Hill, 2012
3. KATILI, Irwan, Metode Elemen Hingga untuk Skeletal, Rajawali Pers, 2008

Transportation Engineering
ENCV 604 005
3 Credits

Expected Learning Outcomes :

CLO 2 (Problem Analysis),

CLO 4 (Experiment)

CLO 9 (Teamwork)

Course Learning Outcomes (CLO) :

1. Be able to analyse traffic performance, road and traffic capacity (CLO 2)
2. Be able to apply statistical and probabilistic concepts in analysing traffic survey data (CLO 4)
3. Be able to work in teams in conducting traffic surveys (CLO 9)

Learning Experiences :

1. Interactive lectures
2. Conducting a field survey to calculate the volume of vehicles

Syllabus :

Traffic elements; Interaction of activity systems, network systems, and movement systems; Estimation and prediction of trip generation and attraction using empirical and analogy methods; travel distribution estimation and prediction using growth and synthesis methods; Traffic variables (flow, speed, and density); Greenshield traffic flow model; Measurement method; Road capacity; Simulation-based road performance.

Prerequisites : Statistics and Probabilistic of Experimental Design

Text Book References :
1. AASHTO, Highway Capacity Manual, 2010
2. May, Adolf D.,Traffic Flow Fundamentals. Prentice-Hall, 1990
3. Molugaram, K., Rao, G. S., Statistical Techniques for Transportation Engineering, Butterworth-Heinemann, 2017

4. Pandem, A., Wolshon, B., Traffic Engineering Handbook 7th ed., Wiley, 2016
5. Papacostas, C., Prevedouros, P., Transportation Engineering and Planning 3rd ed., Prentice-Hall, Inc., 2000
6. Washington, S.P., Karlaftis, M.G. and Mannering, F.L. Statistical and Econometric Methods for Transportation Data Analysis. Second Edition, Chapman & Hall/CRC, Boca Raton, FL., 2011

Foundation Engineering

ENCV 605 001
3 Credits
Expected Learning Outcomes :

CLO 2 (Problem Analysis),

CLO 3 (Design),

CLO 10 (Communication)

Course Learning Outcomes (CLO) :

1. Be able to determine the soil parameters of foundation design / retaining wall based on the test results of soil parameter (CLO 2)
2. Be able to design deep foundations and retaining walls (CLO 3)
3. Be able to draw foundation structures in accordance with engineering drawing principles (CLO 10)

Learning Experiences :

Interactive lectures

Syllabus :

Introduction to the types and systems of deep foundations, methods of determining the axial bearing capacity of deep foundations; Methods of determining the lateral bearing capacity of deep foundations; Methods of determining the vertical deformation and lateral deformation of deep foundations; Pile load test method and introduction of deep soil retaining system and types; Methods of calculating the soil retaining system, as well as understanding the required soil parameters; Drawing deep foundation structures; Designing deep foundation based on existing soil parameters.

Prerequisites : Solic Mechanics

Text Book References :
1. Bowles, J.E., "Foundation Analysis and Design, Int. Student Edition", McGraw-Hill, Kogakusha, Ltd., Japan, 1988
2. Coduto D.P., "Foundation Design", Prentice Hall, Inc.,1994
3. Poulos, H.G & Davis, E.H., "Pile Foundation Analysis and Design", John Wiley & Sons, Inc., 1980.
4. Prakash S & Sharma HD., Pile foundation in Engineering Practice, John Wiley $ Sons, 1990
5. Tomlinson M. dan Woodward J., "Pile Design and Construction Practice, 5th Ed.", Taylor & Francis, Oxon, UK., 2007
6. Reese L.C., Isenhower W.M. dan Wang S.-T., "Analysis and Design of Shallow and Deep Foundations", John Wiley & Sons, Inc., Hoboken, USA., 2006.
7. Fleming K., Weltman A., Randolph M., and Elson K., "Piling Engineering, 3rd Ed.", Taylor & Francis, Oxon, UK., 2009

Journal :
1. ASCE, journal of geotechnic and geomechanics
2. Canadian geotechnical journal

Civil Engineering System

ENCV 605 002
2 Credits
Expected Learning Outcomes :

CLO 2 (Problem Analysis)

Course Learning Outcomes (CLO) :

Be able to analyse Civil Engineering problems and quantify parameters associated with linear programming approach (CLO 2)

Learning Experiences :

1. Interactive lectures
2. Conducting a survey to understand more deeply about Civil Engineering problems.

Syllabus :

Roles and functions of civil engineering undergraduates, process of solving engineering problems, systems approach, system characteristics in engineering problems, understanding of problem characteristics, statements of needs, system hierarchy, scopes and boundaries of problems, systems analysis, solution approach, role of modelling, types of modelling, Linear Graph Modelling concepts, Mathematical Modelling Concepts, Optimization Process, Motivation and Freedom of Choices, Purposes, Objectives and Criteria for Optimization, Optimization Methods, Feasibility Studies, Planning Horizons. Time Value of Money, Economic Analysis Methods, Financial Analysis, Decision Problem Elements, Decision Models, Basic Probability, Decision Analysis based on utility value.

Prerequisites : Linear Algebra, Introduction to Civil Engineering System

Text Book References :
1. Dale D Meredith, Kam W Wong, Ronald W Woodhead, Robert H Worthman (1975), Design & Planning of Engineering Systems, Prentice Hall
2. C Jotin Khisty, Jamshid Mohammadi, (2001), Fundamental of System Engineering with Economics, Probability, and Statistics, Prentice Hall
3. M David Burghardt, (1999), Introduction to Engineering Design and Problem Solving, McGraw Hills.

Highway Engineering Design 1

ENCV 605 003
4 Credits
Expected Learning Outcomes :

CLO 3 (Design)

Course Learning Outcomes (CLO) :

Be able to design road geometric components and pavements (CLO 3)

Learning Experiences :

Interactive lectures

Syllabus :

Introduction of Norms, Standards, Procedures and Criteria (NSPK) in connection with the geometric design that applies in Indonesia; Road classification, based on: designation, network system, function, status, road supply specifications; Design and control criteria: namely factors of vehicle, driver, road capacity, safety, environment and economy; Design elements: visibility, alignment (horizontal and vertical), coordination between alignments; Excavation and stockpile analysis; Road cross section elements: road space, traffic lane, shoulder, median, roadside, pedestrian and bicycle facilities; Highway drainage; Street lighting.

Introduction to the history and development of highway design technology; Introduction of Norms, Standards, Procedures and Criteria (NSPK) in connection with road construction, including: type of pavement material, function of each pavement layer, stabilization of the subgrade; Introduction and testing of road pavement materials, design mix and test mix plans, supplemented with practical activities in the laboratory; introduction of asphalt mixing plant (AMP); design criteria and various design methods by empirical and analytical methods, flexible bending pavement design by AASHTO method and component analysis methods (Bina Marga method), gradual construction, and re-construction; rigid pavement design concepts, connection methods; Road maintenance strategies, types of road damage and ways of detection and ways to repair road damage.

Prerequisites : Transportation Engineering; Basic Soil Mechanics

Text Book References :

1. AASHTO, 2007. Maintenance Manual for Roadways and Bridges. 4th Ed.
2. Brockenbrough, R.L., Highway Engineering Handbook 3rd Ed, Mc Graw Hill, 2009
3. BSN (2004) : RSNI Perencanaan Geometrik Jalan Perkotaan
4. Direktorat Jenderal Bina MArga, (2013), Manual Desain Perkerasan Jalan no 02/M/BM/2013, Kementerian Pekerjaan Umum.
5. Direktorat Jendral Bina Marga (1990) : Petunjuk Desain Drainase Permukaan Jalan
6. Direktorat Jendral Bina Marga (1997) : Standar Perencanaan Geometrik Jalan Luar Kota
7. Fwa, T.F., The Handbook of Highway Engineering, Taylor & Fancis Group, 2006
8. Huang, Y., 2004. Pavement Analysis and Design 2nd ed., Prentice-Hall, Inc.

Steel Structure 1

ENCV 605 004
3 Credits

Expected Learning Outcomes :

CLO 2 (Problem Analysis)

CLO 3 (Design)

CLO 9 (Individual and team work)

CLO 10 (Communication)

Course Learning Outcomes (CLO) :

1. Be able to analyse steel structure capacity that experience compression, tensile, bending, shear and to ANAYSE the joint capacity with bolts and welds. (CLO 2)
2. Be able to design trusses structures (bridge or trusses) with steel structures (CLO 3)
3. Be able to work in teams in designing steel structures (CLO 9)
4. Be able to draw steel truss structures or pedestrians in working drawing according to engineering drawing principles and write a clear and organized design report (CLO 10)

Learning Experiences :

1. Interactive lectures
2. Carrying out design assignments related to roof truss structures or pedestrian bridge.

Syllabus :

Simple steel structure system; Types of steel structures; Mechanical Properties; Factors affecting the steel quality, the stress-strain curve of steel, the properties of steel material; Proportion of structural member with LRFD to tensile force, compressive force, bending force, shear force according to applicable standards; Analysis and design of steel structure elements: Tensile bar, compression bar, Elastic bending, Inelastic bending, Bidirectional bending, Shearing, Lateral torsion bending; Analysis and design of steel structure joints; Bolt connection; HTB; Welded joints; Pedestrian bridge design / roof truss.

Prerequisites : Statics, Solid Mechanics, and Drawing Construction 2

Text Book References :

1. Spesifikasi untuk Bangunan Gedung Baja Struktural ; SNI 1729 : 2015
2. Segui,William T., Steel Design,5th edition, 2013
3. Manual of Steel Construction, Load Resistance Factor Design, Structural Members, Spesification & Codes Volume 1
4. Manual of Steel Construction, Load Resistance Factor Design, Structural Members, Spesification & Codes Volume 2
5. Structural Steel Design, Prentice Hall, 2012

Water Engineering 1

ENCV 605 005
3 Credits

Expected Learning Outcomes :

CLO 2 (problem analysis)

CLO 3 (design)

CLO 9 (teamwork)

Course Learning Outcomes (CLO) :

1. Be able to analyse hydrological data (CLO2)
2. Be able to design channels, culverts, spillways and reservoirs/ponds (CLO 3)
3. Be able to work in teams (CLO 9)

Learning Experiences :

Students actively discuss in class in analysing problems of water infrastructure (Problem Based Learning)

Syllabus :

Determine the dimensions of canals, culverts, and overflow reservoirs / retention ponds based on the calculation of flooding plans and open channel hydraulics and determine the dimensions of reservoir / retention pond based on water balance calculation. Learning methods including introductory lectures, individual / group exercises, written quizzes / examinations, primary and secondary data surveys, group discussion, as well as presentation and writing of group assignment. The assignment includes the design of canals, culverts, spillways and reservoirs / retention ponds in a water catchment area (DTA) with an area not exceeding 50 Km2, based on information on topographical maps at 1: 25,000 scale, rainfall data and or in the vicinity of DTA, the survey results of domestic water demand and related regency / municipal social-economic data.

Prerequisites : Hydraulics

Text Book References :

1. Bedient, Philip B. and Huber, Wayne C., 1992. Hydrology and Floodplain Analysis. Second Edition. Addison-Wes-

ley Publishing Company, USA.
2. Chow, Ven Te, 1959. Open-Channel Hydraulics. International Student Edition. McGraw-Hill Kogakusha, Ltd., Tokyo.
3. Chow, Ven Te, Maidment, David R. and Mays, Larry W., 1988. Applied Hydrology. McGraw-Hill Book Company, Singapore.
4. Dewberry, Sidney O. and Rauenzahn, Lisa N., 2008. Land Development Handbook: Planning, Engineering, And Surveying / Dewberry. Third edition. McGraw-Hill, USA. E-Book
5. Mays, Larry W., 1996. Water Resources Handbook. McGraw-Hill, USA.
6. Wanielista, M., Kersten, R. and Eaglin, R., 1997. Hydrology: Water Quantity and Quality Control. Second Edition. John Wiley & Sons, Inc., Canada.
7. Maine Stream Team Program of the Maine Department of Environmental ProtectionStream, 2009. Survey Manual. A CITIZEN'S GUIDE to Basic Watershed, Habitat, and Geomorphology Surveys in Stream and River Watersheds — Volume I.
8. The USDA Natural Resources Conservation Service. How to Read a Topographic Map and Delineate a Watershed. http://www.geo.brown.edu/research/Hydrology/FTP_site_5099-05/Delineate_watersheds_NH_NRCS.pdf

Concrete Structure 1

ENCV 606 001
3 Credits
Expected Learning Outcomes :

CLO 3 (design),

CLO 5 (Modern Tools)

CLO 10 (Communication)

Course Learning Outcomes (CLO) :

1. Be able to design a simple 2-story building using reinforced concrete structures (CLO 3)
2. Be able to use SAP software in analysing a 2-story concrete building structure (CLO 5)
3. Be able to draw a 2-story concrete building according to engineering drawing principles and write a clear and organized design report (CLO 10)

Learning Experiences :

1. Interactive lectures
2. Participating in SAP software training workshop organized by IMS
3. Carrying out design assignments of reinforced concrete structures

Syllabus :

Introduction to design and analysis; system structure: Objectives, design steps; LRFD, reduction factor and permit voltage; Load; and Loading: Load form, type of load; load placement, load distribution, factor; load and combination load; The basic concept of reinforced concrete; The stress and strain properties of concrete and steel; Compressive strength of concrete characteristics; The evolution of concrete compressive strength; The concept of boundary strength, simplification of Whitney stress blocks, balanced collapse; Single reinforcement and double reinforcement analysis on ordinary beams; Reinforcement analysis on the T beam section due to the force in the bending moment; Analysis of shear reinforcement in beam and torsion reinforcement; Analysis of one-way plate reinforcement, two-way plate with moment coefficient method, reinforcement analysis in short columns; Types of local shallow foundations and plans and their depictions; Able to calculate deflection in reinforced concrete structures.

Prerequisites : Construction Drawing 2, Material Properties, Structural Analysis, and Solid Mechanics

Text Book References :

1. Persyaratan Beton Struktural Untuk Bangunan Gedung, SNI 2847 : 2013
2. Beban Minimum Untuk Perancangan Bangunan Gedung Dan Struktur Lain, SNI 1727 : 2013
3. MacGregor, J.G., Reinforced Concrete: Mechanics and design, 6th edition, Pearson, 2012
4. Wahyudi, Syahril A.Rahim, Struktur Beton Bertulang, Penerbit Gramedia, 1997

Construction & Heavy Equipment Management

ENCV 606 002
4 Credits

Expected Learning Outcomes :

CLO 5 (Modern Tool Usage)

CLO 11 (Project Management and Finance)

Course Learning Outcomes (CLO) :

1. Be able to use Ms. Project to develop the planning schedule of construction (CLO 5)
2. Be able to plan construction work and handover of construction projects (CLO 11)

Learning Experiences :

1. Interactive lectures
2. Participating in the MS Project training workshop organised by IMS
3. Carrying out assignments on the work planning of mechanical earthmoving

Syllabus :

An understanding of construction project including: Project Design; Preparation of bidding documents; Contract administration; Construction planning; Methods and implementation of construction; Supervision and control; Material management; Quality management; Project Cost Management; Time Management; Safety, Health and Environment; Resource management and project stakeholders. Understanding of mechanical earthmoving, properties, type and volume of soil, heavy equipment operation, capacity and production cost of heavy equipment, calculating work volume, determining equipment requirements, designing tool combinations to optimize time and costs; calculating the production of heavy equipment, methods of each heavy equipment, how to plan projects. Several ways to calculate the volume of excavation and fill, construction method, calculation of work schedule and associated costs.

Prerequisites : Surveying and Geospatial Information Systems

Text Book References :

1. Kerzner, Harold, Project Management, John Wiley & Sons, Inc., 2006
2. Project Management Institute, A Guide to Project Management Body of Knowledge, 2013
3. European Construction Institute, Total Project Management of Construction Safety, Health and Environment, Thomas Telford, London,1995
4. Clough, R. H., Sears, G. A. and Sears, S. K., Construction Contracting, 7th ed., John Wiley & Sons Inc., New York,

2005
5. Holroyd, T. M., Site Management for Engineers, Thomas Telford, London, 1999
6. Michael T. Callahan, Daniel G. Quakenbush, and James E. Rowing, Construction Planning and Scheduling, McGraw-Hill Inc., New York, 1992.
7. Gould, F. E. Managing the Construction Process (Estimating, Scheduling and Project Control)., Prentice Hall., New Jersey, 1997
8. Halpin, D., W., Construction Management. USA, John Wiley and Sons, Inc., New York, 1998
9. Hendrickson, C., Project Management for Construction. Fundamental Concepts for Owners, Engineer, Architects, and Builders., Prentice Hall, Singapore, 2008
10. Barrie, D. and Paulson B., Professional Construction Management, McGraw Hill, New York, 1992
11. Imam Sugoto. 1980. Mempersiapkan Lapisan Dasar Konstruksi Jilid 1 dan 2. Jakarta: Departemen Pekerjaan Umum.

Highway Engineering Design 2

ENCV 606 003
2 Credits
Expected Learning Outcomes :

CLO 3 (Design),

CLO 5 (Modern Tool Usage),

CLO 10 (Communication)

Course Learning Outcomes (CLO) :

1. Be able to design roads (CLO 3)
2. Be able to use Open Roads software to design roads (CLO 5)
3. Be able to draw geometric and road pavement in accordance with engineering drawing principles (CLO 10)

Learning Experiences :

Interactive lectures

1. Interactive lectures
2. Participating in Open Roads software training workshop organized by IMS
3. Carrying out assignment related to road design

Syllabus :

Inventory of existing conditions; Identification of needs; Highway Design; Basic Design Presentation

Prerequisites : Surveying & Geospatial Information Systems, Highway Engineering Design 1

Text Book References :

1. AASHTO, 2007. Maintenance Manual for Roadways and Bridges. 4th Ed.
2. Brockenbrough, R.L., Highway Engineering Handbook 3rd Ed, Mc Graw Hill, 2009
3. BSN (2004) : RSNI Perencanaan Geometrik Jalan Perkotaan
4. Direktorat Jenderal Bina MArga, (2013), Manual Desain Perkerasan Jalan no 02/M/BM/2013, Kementerian Pekerjaan Umum.
5. Direktorat Jendral Bina Marga (1990) : Petunjuk Desain Drainase Permukaan Jalan
6. Direktorat Jendral Bina Marga (1997) : Standar Perencanaan Geometrik Jalan Luar Kota
7. Fwa, T.F., The Handbook of Highway Engineering, Taylor & Fancis Group, 2006
8. Huang, Y., 2004. Pavement Analysis and Design 2nd ed., Prentice-Hall, Inc.

Writing and Presentation Techniques

ENCV 606 004
2 Credits

Expected Learning Outcomes :

CLO 8 (Ethics)

CLO 10 (Communication)

Course Learning Outcomes (CLO) :

1. Be able to identify ethnical principles and professionalism in communication (CLO 8)
2. Be able to write academic papers, compile presentation documents and present it well to audiences using appropriate Indonesian language (CLO 10)

Learning Experiences :

1. Interactive lecturer
2. Practice writing effective sentences
3. Practice doing scientific writing
4. Practice compiling power points
5. Practice presenting scientific papers
6. Practice compiling CV / motivation letter

Syllabus :

Introduction : the importance of verbal and written communication; Written communication using Indonesian and English; Data presenting in the form of tables, graphs and charts; How to make a good presentation using power points; Preparing a curriculum vitae; Compiling a motivation letter.

Prerequisites : -

Text Book References :

1. Ruiz-Garrido, Miguel. Palmer-Silveira, Juan C., Fortanet-Gomez, Immaculada. English for Professional and Academic Purposes.

Water Engineering 2

ENCV 606 006
3 Credits

Expected Learning Outcomes :

CLO 5 (Modern Tool Usage)

CLO 7 (Environment & Sustainability)

CLO 10 (Communication skill)

Course Learning Outcomes (CLO) :

1. Be able to operate ArcGIS geospatial model to prepare Hec-HMS hydrological model input data (CLO 5)
2. Be able to evaluate the implications of changes in the hypothetical area spatial planning for the magnitude of flooding plan and dimensions of water infrastructure (CLO 7)
3. Be able to present results of analysis or evaluation both in verbal and writing effectively (CLO 10)

Learning Experiences :

Students actively discuss in class analysing water infrastructure problems (Problem Based Learning)

Syllabus :

Utilise a hydrological model assisted by geospatial models to evaluate the implications of changes in spatial planning in a water catchment area (DTA) with an area not exceeding 50 km2, and present the results in the form of systematic written documents and effective oral presentations. The learning method consists of introductory lectures, group discussions inside & outside the classroom, written examinations, as well as oral presentations and writing assignments. The task includes utilizing the ArcGIS geospatial model for the preparation of input data for the WinTR-20 deterministic hydrological model which is used to simulate rainfall-flow relationships that are affected by changes in regional spatial planning. The evaluation focuses on the implications of changes in hypothetical spatial planning for changes in the magnitude of the planned flood which will then affect the dimensions of the related water infrastructure.

Prerequisites : Water Engineering 1, Surveying and Geospatial Information Systems

Text Book References :

1. John E. Gribbin, 2014, Introduction To Hydraulics And Hydrology With Applications For Stormwater Management, Fourth Edition
2. Bedient, Philip B. And Huber, Wayne C., 1992. Hydrology And Floodplain Analysis. Second Edition. Addison-Wesley Publishing Company, Usa.
3. Chow, Ven Te, 1959. Open-Channel Hydraulics. International Student Edition. Mcgraw-Hill Kogakusha, Ltd., Tokyo.
4. Chow, Ven Te, Maidment, David R. And Mays, Larry W., 1988. Applied Hydrology. Mcgraw-Hill Book Company, Singapore.
5. Dewberry, Sidney O. And Rauenzahn, Lisa N., 2008. Land Development Handbook: Planning, Engineering, And Surveying / Dewberry. Third Edition. Mcgraw-Hill, Usa. E-Book
6. Mays, Larry W., 1996. Water Resources Handbook. Mcgraw-Hill, Usa.
7. Wanielista, M., Kersten, R. And Eaglin, R., 1997. Hydrology: Water Quantity And Quality Control. Second Edition. John Wiley & Sons, Inc., Canada.
8. Esri. Gis Solutions For Surveying. Esri Publishers, 2007.
9. Maine Stream Team Program Of The Maine Department Of Environmental Protectionstream, 2009. Survey Manual. A Citizen's Guide To Basic Watershed, Habitat, And Geomorphology Surveys In Stream And River Watersheds — Volume I.
10. The Usda Natural Resources Conservation Service. How To Read A Topographic Map And Delineate A Watershed. http://www.geo.brown.edu/research/Hydrology/FTP_site_5099-05/Delineate_watersheds_NH_NRCS.pdf

Infrastructure Design Project

ENCV 607 001
4 Credits

Expected Learning Outcomes :

CLO 3 (Design),

CLO 7 (Sustainability),

CLO 9 (Teamwork),

CLO 10 (Communication),

CLO 11 (Project and Finance)

Course Learning Outcomes (CLO) :

1. Be able to design civil engineering building structures (CLO 3)
2. Be able to consider sustainability aspect in selecting design alternatives (CLO 7)
3. Be able to work in teams in building design, preparing design reports and DED (CLO 9)
4. Be able to compile design reports, present it in a clear and organized manner and be able to present design results in construction drawings in accordance with engineering drawing principles (CLO 10)
5. Be able to conduct cost studies on infrastructure project based on RKS and DED (CLO 11)

Learning Experiences :

Students actively discuss in class related to design process of civil engineering infrastructure (Problem Based Learning)

Syllabus :

Problem identifications in accordance with social problems or problems in society (Problem-Based Solutions), providing design alternatives and determining possible solutions; Providing planning components related to the scope of work and implementation time in accordance with the alternative design solution chosen; Formulating the main and secondary components of civil engineering building structures; Preparing analysis reports including planning concepts, calculation methods and implementation methods, by applying regulations, manuals and standards; Preparing the specifications for the components of civil engineering construction work in accordance with regulations and technical specifications, calculation of unit prices and "bill of quantity", and details of overall costs; Preparing the planning result reports including technical specifications, calculation of unit prices and "bill of quantity", details of the overall cost of the work, and detailed drawing of the main building components in accordance with technical standards and provisions. Preparing a "blueprint" of the structural calculation results in the form of working drawing that are ready to be implemented by construction stakeholders.

Prerequisites : Construction Drawing 1 (pass), Structural Analysis, Construction & Heavy Equipment Management, Steel Structure.

Text Book References :

1. SNI (standar tata cara perhitungan struktur beton untuk bangunan gedung; standar tata cara perencanaan struktur baja untuk bangunan gedung; standar tata cara perencanaan ketahanan gempa bangunan gedung, dan standar yang dikeluarkan oleh Kementerian PU)
2. ASTM (Amerixan Standar for Testing Material)
3. AISC (American Institute of Steel Construction)
4. The American Concrete Institute' (ACI)
5. ASCE 07-2010 – Minimum Design Load for Building and other structures

Ethics and Legal Aspect of Construction Contract

ENCV 608 001
2 Credits

Expected Learning Outcomes :

CLO 6 (Engineer and Society) dan

CLO 8 (Ethics)

Course Learning Outcomes (CLO) :

1. Be able to apply knowledge related to ethics and construction law in drafting construction contracts (CLO 6)
2. Be able to analyse ethical erros in construction projects and their implications (CLO 8)

Learning Experiences :

1. Interactive lecture
2. Students actively discuss ethical cases in the construction field (Problem Based Learning)

Syllabus :

Understanding ethics and morals; Ethical theories; Professional ethics; Construction business ethics; Ethics towards the environment; Laws and regulations in the construction sector; Legal aspects in construction disputes; Construction contract

Prequisites : -

Text Book References :
1. Mike W. Martin & Roland Schinzinger, Ethics in Engineering, Mc Graw Hill, 2005
2. Chow Kok Fong, Law and Practice of Construction Contracts, Sweet & Maxwell Asia, 2012
3. Nazarkhan Yasin, Kontrak Konstruksi di Indonesia, Gramedia Pustaka Utama, 2014

Special Course

Field Internship
ENCV 600 100
3 Credits

Expected Learning Outcomes :

CLO 8 (Ethics),

CLO 9 (Teamwork),

CLO 10 (Communication)

CLO 11 (Project Management and Finance)

Course Learning Outcomes (CLO) :

1. Be able to write applications of professionalism ethics in construction projects such as quality control, timeliness and work safety (CLO 8)
2. Be able to work in teams to implement and complete a report (CLO 9)
3. Be able to write down observations on a construction project using appropriate Indonesian and present it to the examiners (CLO 10)
4. Be able to write down the application of CM BOK on observed projects in the report (CLO 11)

Learning Experiences :

1. Students in the group conduct field observations on a construction project, observe the complexity of the project and how construction project can be done by implementing CM-BOK (Construction Management Body of Knowledge)
2. Students observe how the decision-making process (problem solving) can be done quickly and accurately.
3. At the end of 200-hour observation, students write a report and present it in front of the examiners.

Syllabus :

Carrying out an internship in a construction project for a minimum of 200 hours; Conducting field observations; Reading a construction drawing; Writing observation report; Describing technical work process, quality control, project management, project specification, engineering drawing and other aspects; Problem solving in construction; Presenting the results of observation.

Prerequisites :

1. Has been doing 6th Semester and taking > 75 credits in accordance with regulation in the Department of Civil Engineering, Universitas Indonesia and or other relevant provisions of Engineering Faculty, Universitas Indonesia.
2. For administrative purposes, students must have passed 60 credits.
3. Students have taken the following courses: Foundation Engineering, Concrete Structure 1, and Construction & Heavy Equipment Management.
4. Fill out the IRS for Special Courses ”Practical Works” and convey the willingness to do the practical work to the course coordinator.
5. Students have to select a location for practical work themselves and have made observation at the selected location
6. Students must fill out and submit the registration form to the administration staffs of Civil Engineering department.

Final Project/Bachelor Thesis
ENCV 600 300
5 Credits

Expected Learning Outcomes :

CLO 4 (Experiment), dan

CLO 8 (Ethics),

CLO 10 (Communication)

CLO 12 (Lifelong Learning)

Course Learning Outcomes (CLO) :

1. Be able to investigate problems, design research methodologies, conduct research and analyse results. (CLO 4)
2. Be able to apply ethics in conducting research as proven by scientific writing report having a maximum similarity test of 30% (CLO 8)
3. Be able to write a research report appropriately using Indonesian and present it clearly to the examiners (CLO 10)
4. Be able to work independently and complete research work within the specified time (CLO 12)

Learning Experiences :

Students are encouraged to carry out research independently under the supervision of lecturers, write a research report and present it clearly to the examiners.

Syllabus :

Problem formulation, literature study, conducting research, data analysis, result interpretation, writing and presenting research report.

Prerequisites : Has completed 114 credits with a GPA>=2.00 and without E grade

Elective Course

Entrepreneurship
ENCV 606 005
2 Credits

Expected Learning Outcomes :

CLO 9 (Teamwork)

CLO 10 (Communication)

CLO 13 (Entrepreneurship)

Course Learning Outcomes (CLO) :

1. Be able to work in teams to conceive business ideas (CLO 9)
2. Be able to effectively present the innovative ideas to general public (CLO 10)
3. Be able to come up with entrepreneurial ideas in the field of Civil Engineering (CLO 13)

Learning Experiences :

1. Listening to the alumni stories who have successfully create a business in construction area or who secure high position in a construction company
2. Discussing in teams to explore business prospects in the field of Civil Engineering
3. Presenting business ideas to potential investors / customers

Syllabus :

The problems and needs of various stakeholders in the field of Civil Engineering, General entrepreneurial opportunities to solve Civil Engineering problems, definitions of entrepreneurship, actions, plans and challenges of business people, actions, plans and challenges of academics and observers, Business model canvas concepts, general company profiles, profiles customers in general, Cost and Turnover, Identification of differences and similarities between BMC components, Assessment of the advantages and disadvantages of each BMC component, Various environmental engineering products and services, Definition of product value, Human needs, Customer segments, Various customer profiles, excavating customer profiles, excavating customer profiles, identifying differences and similarities between VPC components, assessing the advantages and disadvantages of each VPC component.

Prerequisites : Engineering Economics

Textbooks : -

Service Learning

ENCV 600 300
1 Credits

Expected Learning Outcomes (CLO):

CLO 12 (Lifelong Learning)

Course Learning Outcomes (CLO):

Be able to independently allocate time to actively involved in student activities without disrupting academic activities as indicated by the achievement of activity points (CLO 12)

Learning Experiences:

Being actively involved in various student activities

Syllabus :

Students take part in activities outside the Civil Engineering curriculum. For each activity that is followed, the equivalent will be calculated in the form of points (scores). Students must achieve a minimum point according to the implementation instructions issued by the department.

Prerequisites :

Students can claim 1 credit for this course after reaching the minimum number of points stipulated. (see the Student Affairs Manual of the Department of Civil Engineering, 2020 Curriculum, authorized by the Department).

Civil Engineering Fast-Track Curriculum (Undergraduate and Graduate)

Code	Subject	SKS
	1st Semester	
	Religion	2
	Academic Writing	**2**
ENGE 600 001	Calculus 1	3
ENCV 601 001	Physics (Mechanics and Thermal)	4
ENCV 601 002	Environmental Basic Chemistry	**3**
ENCV 601 003	Intro to Civil Engineering System	3
ENCV 601 004	Material Properties	3
	Sub Total	**20**
	2nd Semester	
	Integrated Character Building	5
ENGE 600 002	Calculus 2	3
ENGE 600 007	Physics (Electricity, MWO)	3
ENGE 600 004	Linear Algebra	4
ENCV 602 001	Construction Drawing 1	2
ENCV 602 002	Statics	3
	Sub Total	**20**
	3rd Semester	
ENCV 603 001	Construction Drawing 2	3
ENCV 603 002	Solid Mechanics	4
ENCV 603 003	Fluid Mechanics	3
ENCV 603 004	Statistics and Probabilistic of Experimental Design	2
ENCV 603 005	Basic Soil Mechanics	3
ENCV 603 006	Surveying & Geospatial Information Systems	2
ENCV 603 007	Advanced Calculus	3
	Sub Total	**20**
	4thSemester	
ENGE 600 011	Engineering Economics	3
ENCV 604 001	Soil Mechanics	3
ENCV 604 002	Hydraulics	3
ENCV 604 003	Structural Analysis	4
ENCV 604 004	Numerical Method	2
ENCV 604 005	Transportation Engineering	3
	Elective Courses	**9**
	Sub Total	**20**
	5th Semester	
ENGE 600 012	HSE Protection	2
ENCV 605 001	Foundation Engineering	3
ENCV 605 002	Engineering System	2
ENCV 605 003	Highway Engineering Design 1	4
ENCV 605 004	Steel Structure 1	3
ENCV 605 005	Water Engineering 1	3
	Elective Courses	**9**

	Sub Total	**20**
	6th Semester	
ENCV 606 001	Concrete Structure 1	3
ENCV 606 002	Construction & Heavy Equipment Management	4
ENCV 606 003	Highway Engineering Design 2	2
ENCV 606 004	Effective Communication	2
ENCV 606 005	Entrepreneurship	**2**
ENCV 606 006	Water Engineering 2	3
	Elective Course	3
	Sub Total	**19**
	7th Semester	
ENCV 600 100	Field Internship	3
ENCV 600 300	Service Learning	1
ENCV 607 001	Infrastructure Design Project	4
ENCV 801 101	Applied Mathematics (S2)	3
ENCV 801 102	Value and System Engineering (S2)	3
	Mandatory Specialization Course S2	3
	Sub Total	**17**
	8th Semester	
ENCV 608 001	Ethics and Legal Aspect of Construction Contract	2
ENCV 802 103	Research Methodology	3
ENCV 800 104	Pra Master Thesis	4
	Mandatory Specialization Course S2	3
	Sub Total	**12**
	9thSemester	
ENCV 800 105	Master Thesis	4
	Mandatory/Elective Specialization Course S2	3
	Mandatory/Elective Specialization Course S2	3
	Sub Total	**15**
	10th Semester	
ENCV 800 106	Scientific Pub;lication	2
	Mandatory/Elective Specialization Course S2	3
	Mandatory/Elective Specialization Course S2	3
	Mandatory/Elective Specialization Course S2	3
	Sub Total	**10**

Undergraduate Program in Environmental Engineering

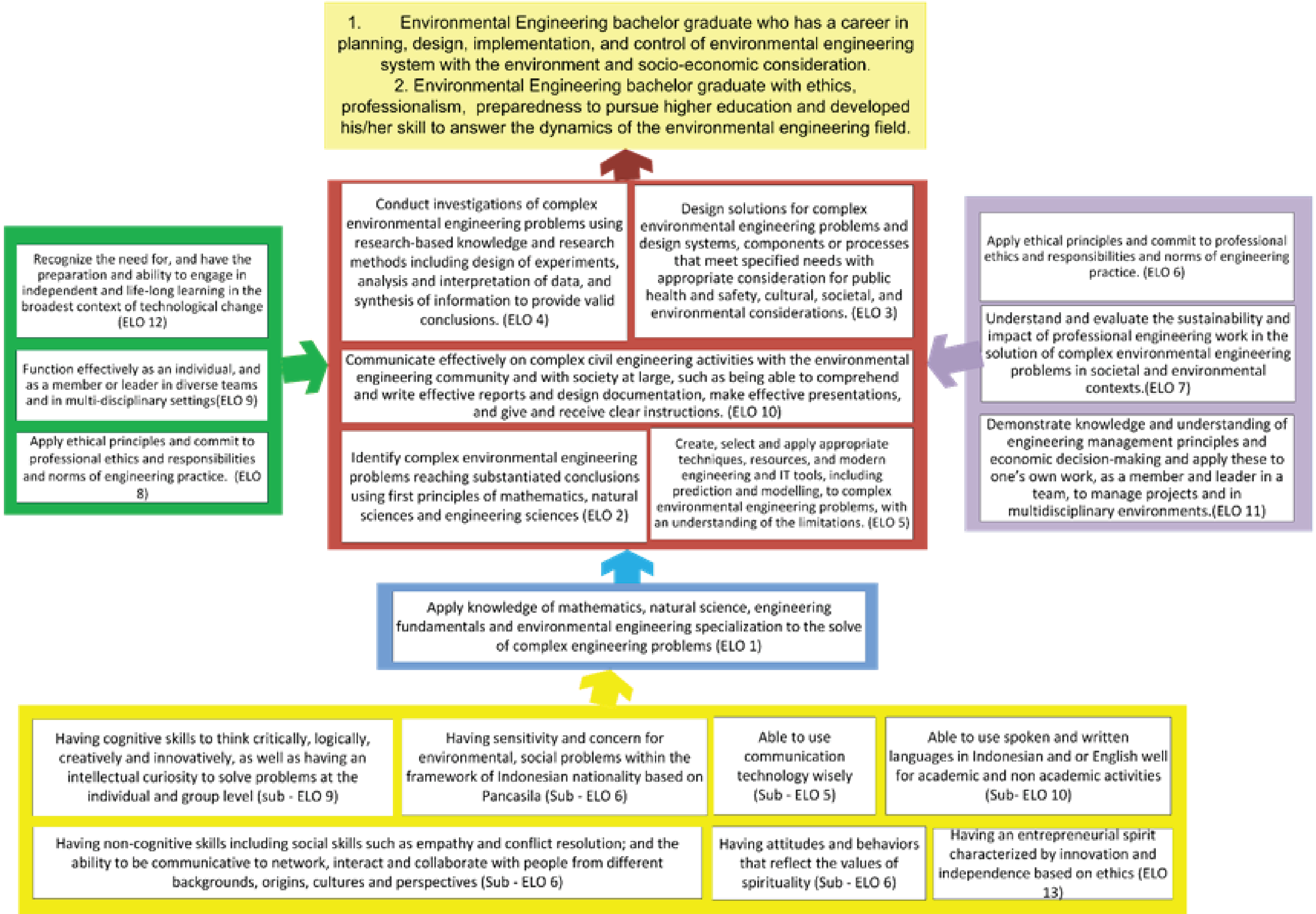
Program Specification

1.	**Awarding Institution**	Universitas Indonesia	
2.	**Teaching Institution**	Universitas Indonesia	
3.	**Faculty**	Engineering	
4.	**Programme Tittle**	Undergraduate Program in Environmental Engineering	
5.	**Vision and Misson**	The Vision: "As an exceptional center for science and technology in the field of environmental engineering that contributes to the global market" The Mission: a. Produce graduates who mastered the technique of the environment with the underlying technology of basic civil and environmental engineering and a robust international standard. b. Actively contribute ideas to society through research and development of environmental engineering facilities and infrastructure, considering the harmonious relationship between humans and nature. c. Develop students to have leadership skills, independence, sociable, communicative, and upholds professional ethics.	
6.	**Class**	Regular and Parallel	
7.	**Final Award**	Sarjana Teknik (S.T)	
8.	**Accreditation / Recognition**	National Accreditation: Excellent accreditation from BAN – PT: International accreditation from IABEE and AUN-QA	
9.	**Language(s) of Instruction**	Bahasa Indonesia	
10.	**Study Scheme (Full Time / Part Time)**	Full Time	
11.	**Entry Requirements**	High school /equivalent, or D3 / Polytechnique / equivalent, AND pass the entrance exam.	
12.	**Study Duration**	Designed for 4 years	
	Type of Semester	Number of Semester	Number of weeks / semester
	Regular	8	16
	Short (optional)	3	8
13.	T**he aims of the programme** is produce environmental engineering bachelor graduate that protects the environment, through the design, implementation, and control in the areas of : 1. Drinking Water Supply. 2. Wastewater management and solid waste management (Hazardous and Non-Hazardous) 3. Drainage 4. Environmental Sanitation 5. Water Resource 6. Air Pollution 7. Pollution Prevention 8. Environmental Impact Assessment		
14.	**Profile of Graduates** 1. Environmental Engineering bachelor graduate who has a career in planning, design, implementation, and control of environmental engineering system with the environment and socio-economic consideration. 2. Environmental Engineering bachelor graduate with ethics, professionalism, preparedness to pursue higher education and developed his/her skill to answer the dynamics of the environmental engineering field.		

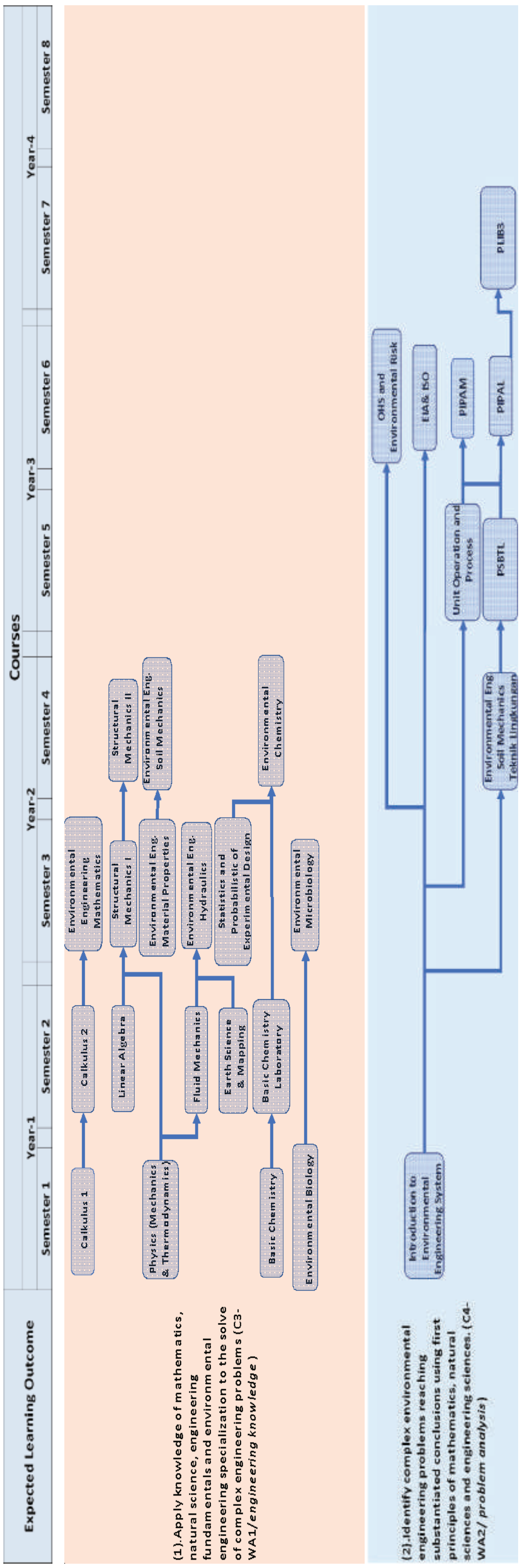
15.	**Expected Learning Outcomes (ELO):**
	1. Apply knowledge of mathematics, natural science, engineering fundamentals and environmental engineering specialization to the solve of complex engineering problems (C3-WA1/engineering knowledge) 2. Identify complex environmental engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences. (C4-WA2/problem analysis) 3. Design solutions for complex environmental engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations. (C5-WA3/design or development of solutions) 4. Conduct investigations of complex environmental engineering problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions. (C4-WA4/investigation) 5. Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex environmental engineering problems, with an understanding of the limitations. (P3-WA5/modern tool usage) 6. Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional civil engineering practice and solutions to complex environmental engineering problems.(C3-WA6/the engineer and society) 7. Understand and evaluate the sustainability and impact of professional engineering work in the solution of complex environmental engineering problems in societal and environmental contexts. (C3-WA7/environment and sustainability) 8. Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice. (A4-WA8/ethics) 9. Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings. (P3-WA9/individual and team work) 10. Communicate effectively on complex civil engineering activities with the environmental engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. (C3, P3/WA10 communication) 11. Demonstrate knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. (C3-WA11/project management and finance) 12. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. (C3-WA12/lifelong learning) 13. Use knowledge of entrepreneurship to identify an independent business based on creativity and professional ethics. (C3-UI-E)

16.	**Classification of Subjects**		
No.	**Classification**	**Credit Hours (SKS)**	**Percentage**
i	**University General Subjects**	**9**	**6,25 %**
ii	**Basic Engineering Subjects**	**12**	**8,33 %**
iii	**Core Subjects**	**88**	**61,11 %**
iv	**Electives**	**26**	**18,06 %**
v	**Industrial Attachment, Seminar, Undergraduate Thesis**	**9**	**6,25 %**
	Total	**144**	**100 %**
	Total Credit Hours to Graduate		**144 SKS**

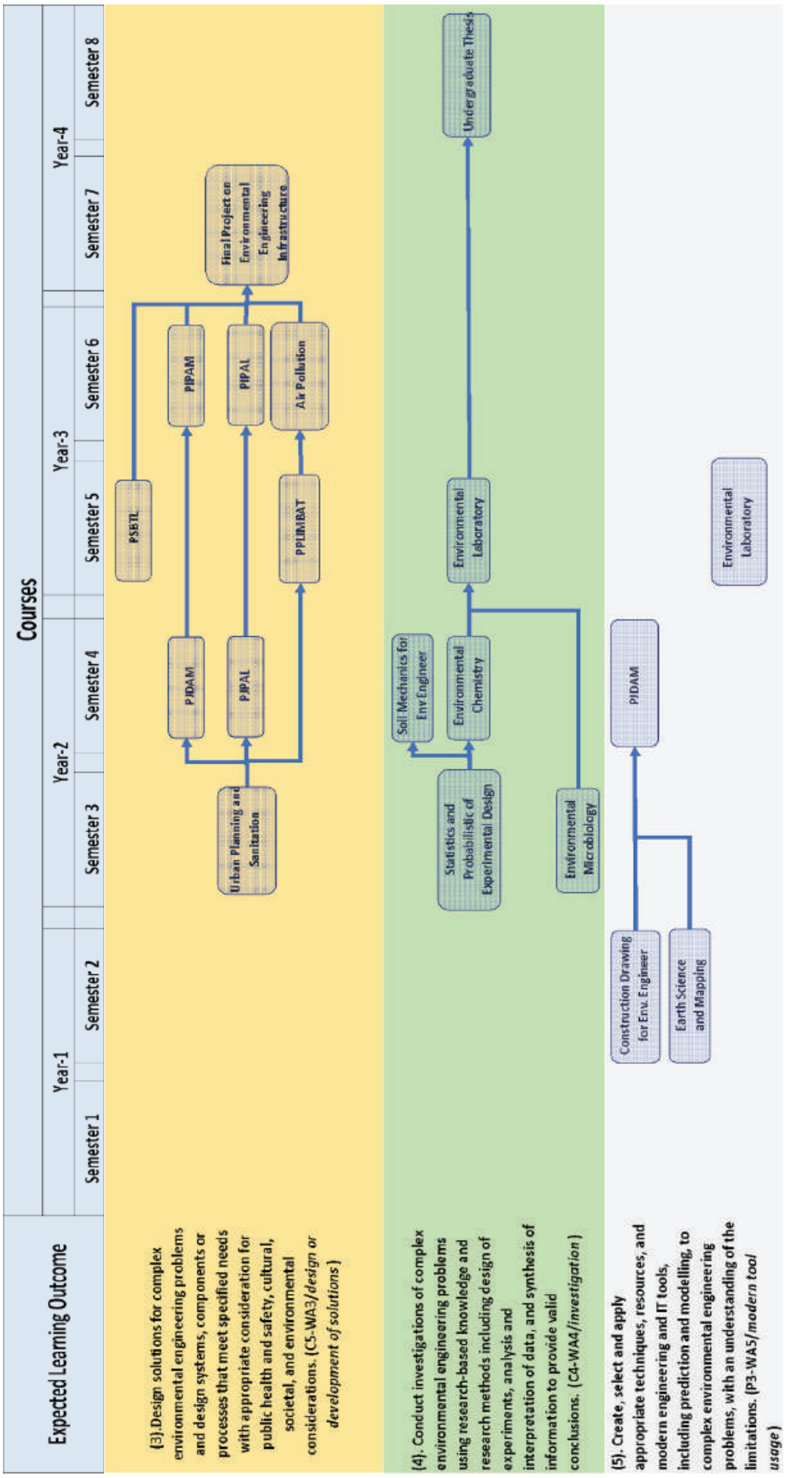
Learning Outcome



Flow Diagram Of Subject to Reach ELO in Environmental Engineering Undergraduate Programme



PSBTL: Structural Design for Environmental Engineering Infrastructure	PIPAL: Domestic Wastewater Treatment Plant Design
EIA & ISO: Environmental Impact Assessment & ISO	PJPAL: Wastewater Collection System Design
PIPAM: Water Treatment Plant Design	PLIB3: Hazardous dan Industrial Waste Treatment
PJDAM: Drinking Water Distribution System Design	PPLIMBAT: Integrated Solid Waste Management Planning
OHS and Environmental Risk : Occupational Health and Safety and Environmental Risk	



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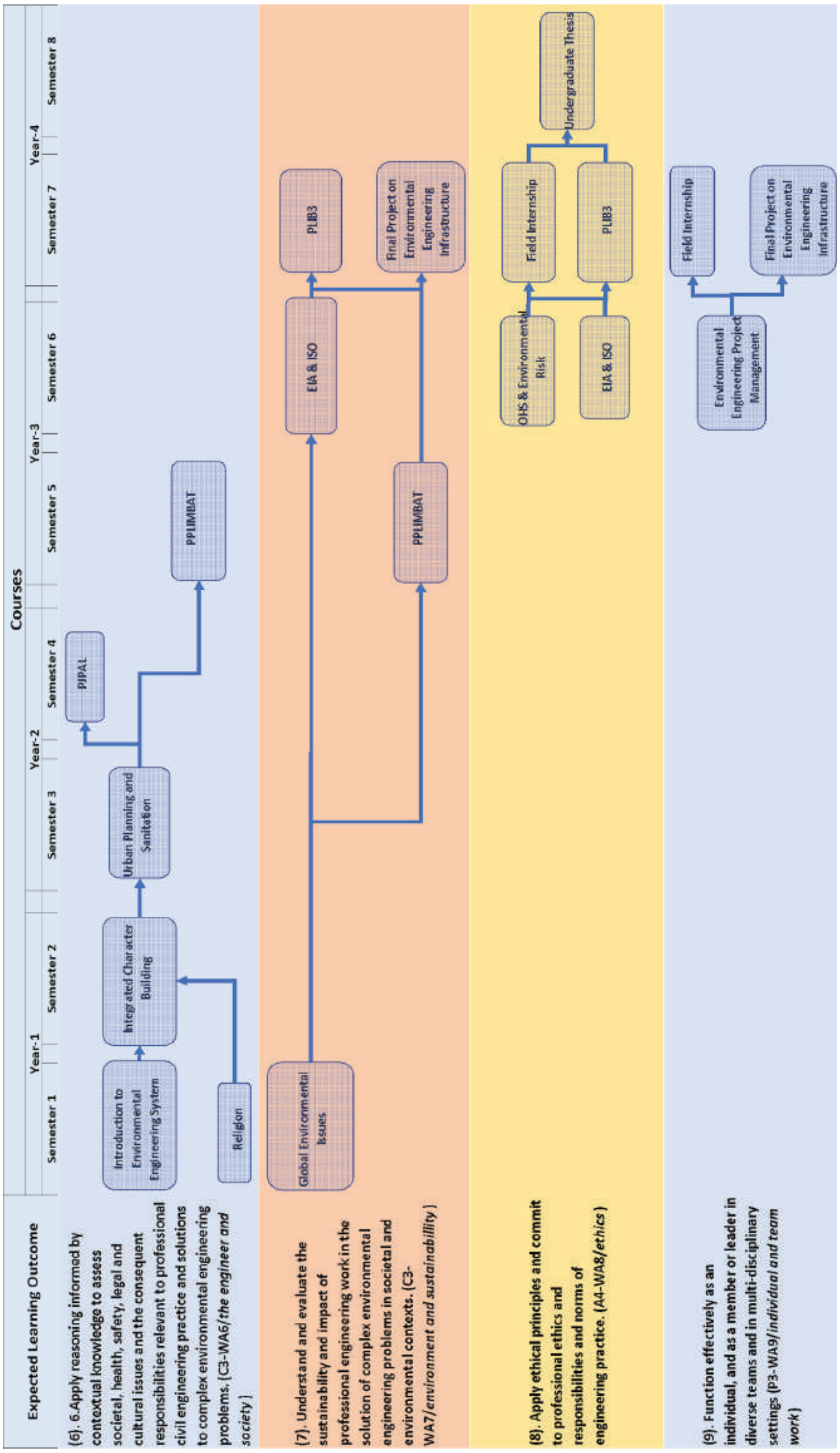

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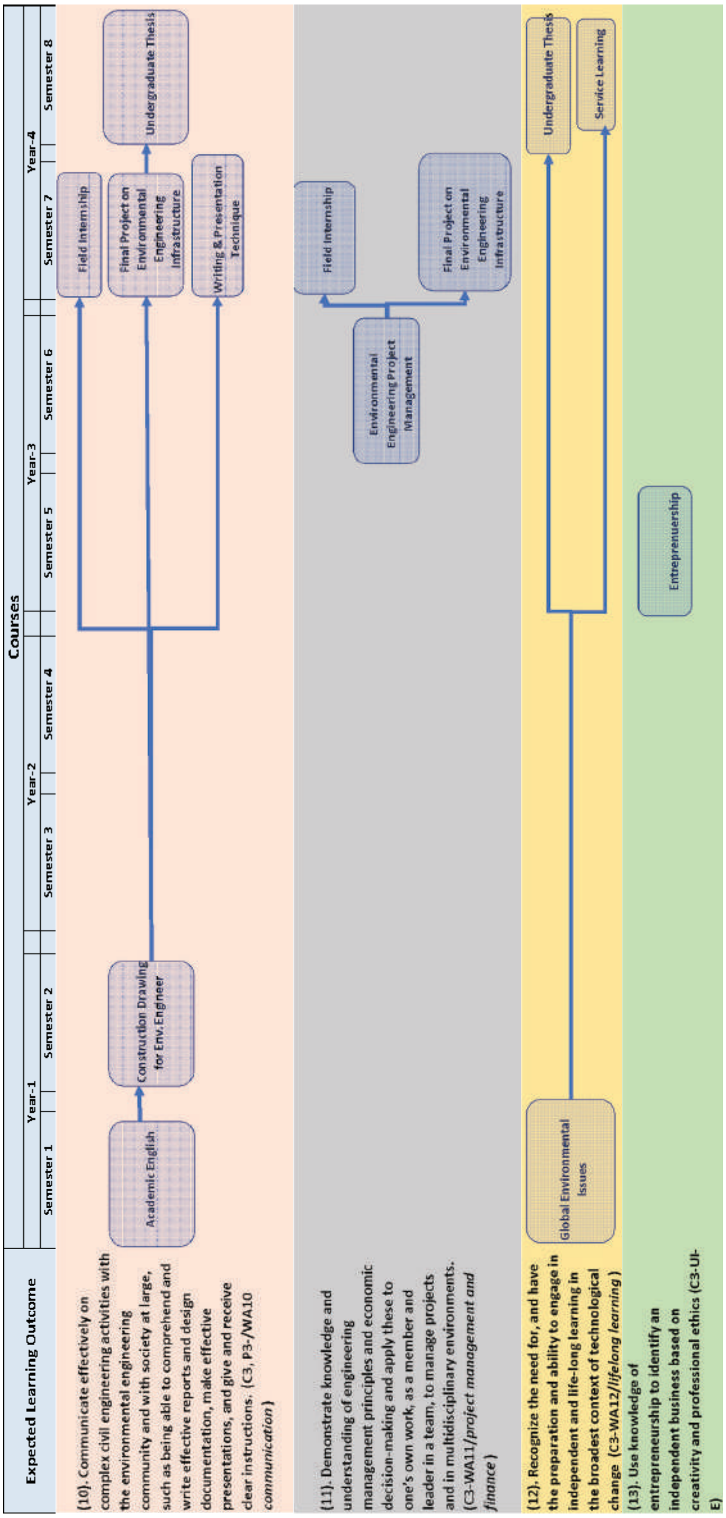

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OHS and Environmental Risk : Occupational Health and Safety and Environmental Risk	

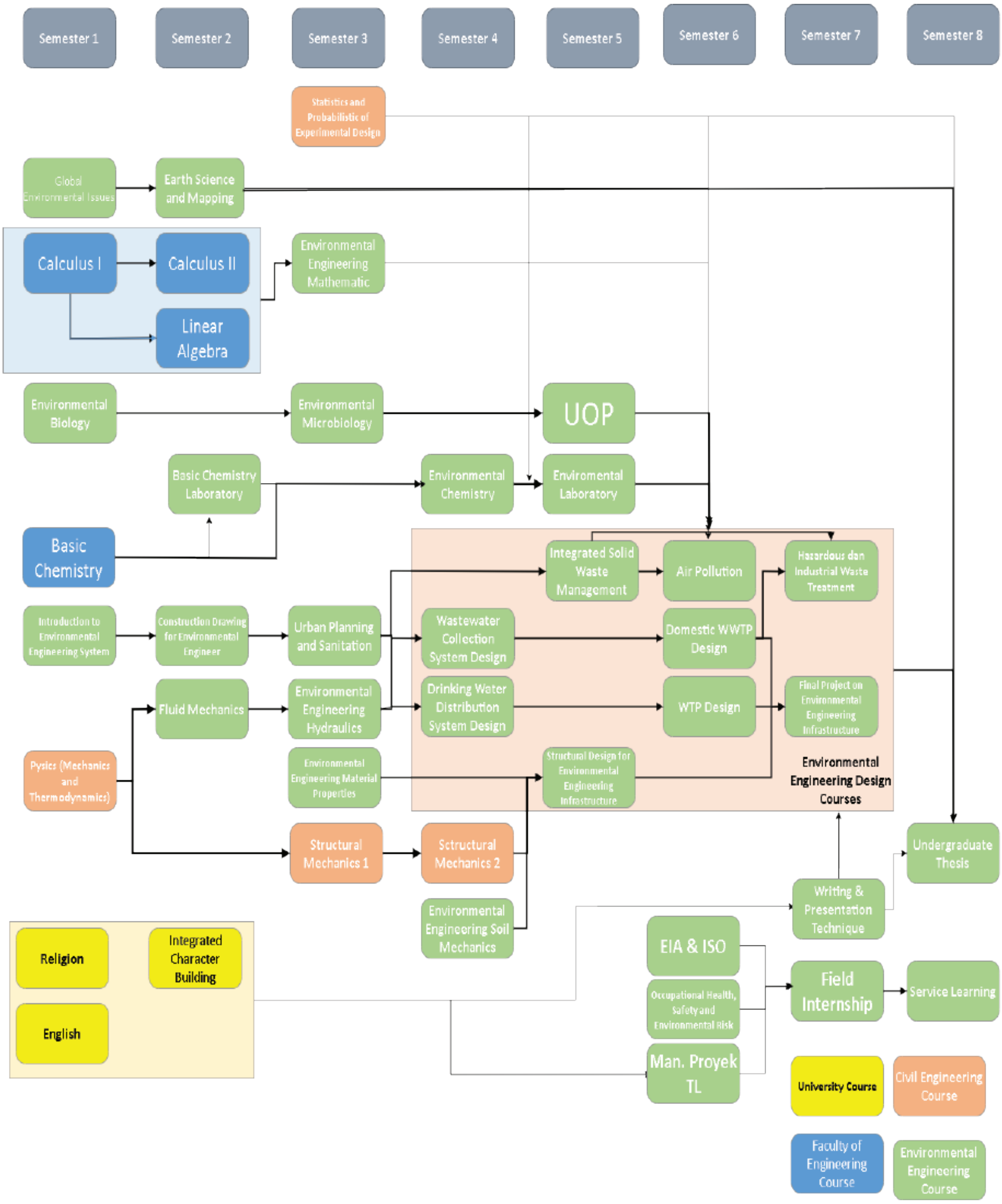
Code	Course	SKS	ELO													Total Assessment
			Engineering Knowledge	Problem Analysis	Design	Experiments	Modern Tools	Engineer and Society	Sustainability	Ethics	Individual and Teamwork	Communication	Project Management	Lifelong	(UI-e)	
			1	2	3	4	5	6	7	8	9	10	11	12	13	
Semester 1		20														
UIGE 600 003	Academic English	2										O				1
UIGE 600 004	Religion	2						O								1
ENGE 600 001	Calculus 1	3	O													1
ENGE 600 009	Basic Chemistry	2	O													1
ENCV 601 001	Physics (Mechanics and Thermodynamics)	4	O													1
ENEV 601 001	Introduction to Environmental Engineering System	3		O				O								2
ENEV 601 002	Global Environmental Issues	2							O					O		2
ENEV 601 003	Environmental Biology	2	O													1
Semester 2		20														
UIGE 600 006	Integrated Character Building	5	O													1
ENGE 600 002	Calculus 2	3	O													1
ENGE 600 004	Linear Algebra	4	O													1
ENCV 603 003	Fluid Mechanics	3	O													1
ENEV 602 001	Earth Science and Mapping	2	O				O									2
ENEV 602 002	Construction Drawing for Environmental Engineer	2					O					O				2
ENEV 602 003	Basic Environmental Chemistry	1	O													1

Code	Course	SKS	ELO													Total Assessment
			Engineering Knowledge	Problem Analysis	Design	Experiments	Modern Tools	Engineer and Society	Sustainability	Ethics	Individual and Teamwork	Communication	Project Management	Lifelong	(UI-e)	
			1	2	3	4	5	6	7	8	9	10	11	12	13	
Semester 3		18														
ENCV 603 004	Statistics and Probabilistic of Experimental Design	2	O			O										2
ENEV 603 001	Environmental Engineering Mathematic	3	O													1
ENEV 603 002	Environmental Microbiology	3	O			O										2
ENEV 603 003	Environmental Engineering Material Properties	2	O													1
ENEV 603 004	Environmental Hydraulics	3	O													1
ENEV 603 005	Structural Mechanics I	2	O													1
ENEV 603 006	Urban Planning and Sanitation	3			O			O								2
Semester 4		18														
ENEV 604 001	Structural Mechanics II	2	O													1
ENEV 604 002	Drinking Water Distribution System Design	2			O		O									2
ENEV 604 003	Soil Mechanics for Environmental Engineer	3	O	O		O										3
ENEV 604 004	Environmental Chemistry	3	O			O										2
ENEV 604 005	Wastewater Collection System Design	2			O			O								2
ENGE 600 011	Engineering Economy	3											O			1
	Elective/Minor	3														0

Code	Course	SKS	ELO													Total Asessment
			Engineering Knowledge	Problem Analysis	Design	Experiments	Modern Tools	Engineer and Society	Sustainability	Ethics	Individual and Teamwork	Communication	Project Management	Lifelong	(UI-e)	
			1	2	3	4	5	6	7	8	9	10	11	12	13	
Semester 5		20														
ENEV 605 103	Entrepreneurship	2						O							O	2
ENEV 605 002	Unit Operation and Process	4		O												1
ENEV 605 003	Environmental Laboratory	3				O	O									2
ENEV 605 004	Integrated Solid Waste Management Planning	3			O			O	O							3
ENEV 605 005	Structural Design for Environmental Engineering Infrastructure	3		O	O											2
	Elective/Minor	7														0
Semester 6		20														
ENEV 606 001	Occupational Health, Safety and Environmental Risk	2		O						O						2
ENEV 606 002	Environmental Impact Assessment and ISO	3		O					O	O						3
ENEV 606 003	Environmental Engineering Project Management	3									O		O			2
ENEV 606 004	Water Treatment Plant Design	3		O	O											2
ENEV 606 005	Domestic Wastewater Treatment Plant Design	3		O	O											2
ENEV 606 006	Air Pollution	3			O											1
	Elective/Minor	3														0

Code	Course	SKS	ELO													Total Asessment
			Engineering Knowledge	Problem Analysis	Design	Experiments	Modern Tools	Engineer and Society	Sustainability	Ethics	Individual and Teamwork	Communication	Project Management	Lifelong	(UI-e)	
			1	2	3	4	5	6	7	8	9	10	11	12	13	
Semester 7		15														
ENEV 600 100	Field Internship	3								O	O	O	O			4
ENEV 607 001	Final Project on Environmental Engineering Infrastructure	4			O						O	O	O			4
ENEV 607 002	Hazardous dan Industrial Waste Treatment	3		O					O	O						3
ENEV 603 007	Writing and Presentation Technique	2										O				1
	Elective/Minor	3														0
Semester 8		13														
ENEV 600 300	Service Learning	1												O		1
ENEV 600 400	Undergraduate Thesis	5				O				O		O		O		4
	Elective/Minor	7														0
	Total	144														79.000
	Number of Course assesed by each ELO		19	9	9	6	4	6	4	5	3	6	4	3	1	79

Flow Diagram of Subjects in Environmental Engineering Undergraduate Programme



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PJDAM: Drinking Water Distribution System Design	PPLIMBAT: Integrated Solid Waste Management Planning
OHS and Environmental Risk : Occupational Health and Safety and Environmental Risk	

Course Structure Undergraduate Program Environmental Engineering

Code	Subject	SKS
	1st Semester	
UIGE 600 003	Academic English	2
UIGE 600 004	Religion	2
ENGE 600 001	Calculus 1	3
ENGE 600 009	Basic Chemistry	2
ENCV 601 001	Physics (Mechanics and Thermodynamics)	4
ENEV 601 001	Introduction to Environmental Engineering System	3
ENEV 601 002	Global Environmental Issues	**2**
ENEV 601 003	Environmental Biology	**2**
	Sub Total	**20**
	2nd Semester	
UIGE 600 006	Integrated Character Building	5
ENGE 600 002	Calculus 2	3
ENGE 600 004	Linear Algebra	4
ENCV 603 003	Fluid Mechanics	3
ENEV 602 001	Earth Science and Mapping	2
ENEV 602 002	Construction Drawing for Environmental Engineer	2
ENEV 602 003	Basic Environmental Chemistry	1
	Sub Total	**20**
	3rd Semester	
ENCV 603 004	Statistics and Probabilistic of Experimental Design	2
ENEV 603 001	Environmental Engineering Mathematic	3
ENEV 603 002	Environmental Microbiology	3
ENEV 603 003	Environmental Engineering Material Properties	2
ENEV 603 004	Environmental Hydraulics	3
ENEV 603 005	Structural Mechanics I	2
ENEV 603 006	Urban Planning and Sanitation	3
	Sub Total	**18**
	4th Semester	
ENEV 604 001	Structural Mechanics II	2
ENEV 604 002	Drinking Water Distribution System Design	2
ENEV 604 003	Soil Mechanics for Environmental Engineer	3
ENEV 604 004	Environmental Chemistry	3
ENEV 604 005	Wastewater Collection System Design	2
	Elective/Minor	6
	Sub Total	**18**
	5th Semester	
ENEV 605 002	Unit Operation and Process	4
ENEV 605 003	Environmental Laboratory	3
ENEV 605 004	Integrated Solid Waste Management Planning	3
ENEV 605 005	Structural Design for Environmental Engineering Infrastructure	3
	Elective/Minor	7
	Sub Total	**20**
	6th Semester	
ENEV 606 001	Occupational Health, Safety and Environmental Risk	2
ENEV 606 002	Environmental Impact Assessment and ISO	3
ENEV 606 003	Environmental Engineering Project Management	3
ENEV 606 004	Water Treatment Plant Design	3
ENEV 606 005	Domestic Wastewater Treatment Plant Design	3
ENEV 606 006	Air Pollution	3
	Elective/Minor	3
	Sub Total	**20**
	7th Semester	
ENEV 600 100	Field Internship	3
ENEV 607 001	Final Project on Environmental Engineering Infrastructure	4
ENEV 607 002	Hazardous and Industrial Waste Treatment	3
ENEV 607 003	Writing and Presentation Technique	2
	Elective/Minor	3
	Sub Total	**15**
	8th Semester	
ENEV 600 300	Service Learning	1
ENEV 600 400	Undergraduate Thesis	5
	Elective/Minor	7
	Sub Total	**13**
	Total	**144**

Electives Subject in Environmental Engineering Undergraduate Programme

Code	Subject	SKS
	4th Semester	
ENEV 604 101	Applied Sanitation	3
ENEV 600 011	Engineering Economics	3
ENEV 600 500	Internship A	2
	5th Semester	
ENEV 605 102	Introduction to Environmental Economics	3
ENEV 605 103	Entrepreneurship	**2**
ENEV 605 104	Environmental Modelling	**2**
	6th Semester	
ENEV 606 105	Environmental System Analysis	3
ENEV 600 600	Internship B	3

	7th Semester	
ENEV 607 106	Monitoring and Optimation of Water Treatment Plant	3
ENEV 607 107	Emerging Topics on Environmental Engineering	3
ENEV 600 700	Special Topic of Research Collaboration	3
	8th Semester	
ENEV 608 108	Sludge processing and Valorization	3
ENEV 608 109	Polution Prevention	3

Environmental Engineering Undergraduate Minor Curriculum

Code	Environmental Engineering Minor	SKS
ENEV 601 001	Introduction to Environmental Engineering System	3
ENEV 603 006	Urban Planning and Sanitation	3
ENEV 606 002	Environmental Impact Assessment and ISO	3
ENEV 606 006	Air Pollution	3
ENEV 607 002	Hazardous and Industrial Waste Treatment	3
ENEV 608 109	Pollution Prevention	3
	Total	**18**

Transition Policy from the 2016 to the 2020 Curriculum

1. New curriculum 2020 will be applied effectively from Odd Semester 2020/2021. In principle, after curriculum 2020 is implemented, then only courses from this new curriculum will be opened.
2. For class 2019 and above will follow this transition rules
3. The enforcement of the transitional period is one year. During this transition period, if a course in curriculum 2020 is in odd semester while in previous curriculum in even semester (vice versa), then this course can be held (if necessary) in both semesters.
4. For students who have not passed the compulsory courses in curriculum 2016, are required to take the same course or equivalent in curriculum 2020. Equivalence courses can be seen in the table below. All courses in the curriculum 2016 that are not listed in equivalence table have not changed, both in names and credits.
5. When there is a change in the course credits, then the number of graduation credits counted in, is the number of credits when it was taken. The same or equivalent courses when are equated with different credits, if retaken, or just taken will be acknowledged under a new name and credits. (see course equivalence table).
6. When a compulsory subject in the curriculum 2016 is deleted and there is no equivalence in the curriculum 2020 then:For students who have passed these subjects, the credits that are achieved will be counted in the calculation of graduation 144 credits. For students who did not pass these courses, they can take new compulsory courses or choose elective subjects in the curriculum 2020 to complete 144 credits.
7. The shortage of credits due to curriculum changes can be covered by taking new compulsory courses in the 2020 curriculum as stated in the equivalence of courses. The excess of credits due to curriculum changes has an impact on reducing the obligation of credits for elective courses.
8. If there is a change in the credit of a course, the number of credits taken into account in graduation is the number of credits at the time the course is taken. The same subject or equivalent with different credits weights, if repeated or newly taken will be listed with a new name and calculated with the new credit weight.
9. The new mandatory courses in the 2020 curriculum such as Practicum of Basic Chemistry, Environmental Biology, and Student Affairs are elective courses for the 2019 class, 2018 and before and become a compulsory MK for the 2020 class and after.
10. The new mandatory courses in the 2020 curriculum such as Practicum of Basic Chemistry, Environmental Biology, and Student Affairs are elective courses for the 2019 class, 2018 and before and become a compulsory MK for the 2020 class and after
11. It should be noted for the following courses managed by the University:

a. Students who have passed one of the MPKT A (6 credits) or MPKT B (6 credits) courses in the 2016 Curriculum are not required to take the MPKT MK (5 credits) in the 2020 Curriculum.

b. Students who have not passed or have not taken the MK Sports/Arts (2 credits) are required to take the MK Option/Minor.

c. Students who have not passed or have not taken the English Constitutional Court (3 credits) are required to take the English Constitutional Court (2 credits) in the 2020 Curriculum.

12. It should be noted for the following courses managed by the faculty:

a. Students who have not passed or have not taken the MK Calculus (4 credits), are required to repeat the MK Calculus course (4 credits) organized by the Study Program within the FTUI environment.

b. Students who have not passed or have not taken the MK Physics of Mechanics and Heat (3 credits), are required to take Physics of Mechanics and Thermodynamics (4 credits) in the 2020 Curriculum.

c. Students who have not passed or have not taken the Basic Physics Practicum 1 (1 credit) in the 2016 curriculum, are not required to take the MK in the 2020 curriculum. To meet the shortage of credits, they can take the Mandatory MK Study Programs in the 2020 Curriculum

d. Students who have not passed or have not taken the MGO Electrical Physics MK (3 credits) in the 2016 curriculum are required to take the compulsory MK Study Program in the 2020 curriculum which is equivalent, namely Environmental Biology (2 credits) To meet the shortage of credits, they can take the compulsory MK Study Program in the 2020 curriculum.

e. For students who have not passed or have not taken the MK Electrical Physics Practicum (1 credit) are not required to take the MK in the 2020 curriculum. To meet the shortage of credits, they can take the Mandatory MK Study Programs in the 2020 Curriculum

f. Students who have not passed or have not taken the MK Statistics & Probability 2016 curriculum are required to take the MK Compulsory Study Program which is equivalent to the MK Statistics and Probabilistic Experiments curriculum 2020

g. Students who have not graduated or have not taken the K3LL MK (2 credits) in the 2016 curriculum are required to take the equivalent Study Program Compulsory MK, namely the K3 MK and Environmental Risk (2 credits) in the 2020 Curriculum.

h. Students who have not graduated or have not taken the MK Basic Chemistry (2 credits) in the 2016 curriculum are required to take the compulsory MK Study Programs in the 2020 curriculum which are equivalent, namely the MK Basic Chemistry (2 credits) and the Basic Chemistry Practicum Court (1 credit) in the 2020 curriculum.

13. It should be noted for the following courses managed by the Study Program:

a. Students who have not passed or have not taken the Constitutional Court of Construction Drawing (2 credits) or the Constitutional Court of Building Construction (2 credits) in the 2016 curriculum are required to take the Constitutional Court of Environmental Engineering Construction (2 credits) curriculum 2020. To meet the shortage of credits, students can take the Mandatory Court of Study Program in the 2020 Curriculum.

b. Students who have not passed or have not taken the MK Advanced Calculus (3 credits) 2016 curriculum are required to take the MK Mathematics Environmental Engineering (3 credits) curriculum 2020.

c. Students who have not passed or have not taken the MK in Soil Surveying (3 credits) in the 2016 curriculum are required to take the MK in Earth and Mapping (2 credits) in the 2020 curriculum. To meet the shortage of credits, students can take the Mandatory MK in the 2020 Curriculum.

d. Students who have not passed or have not taken the Material Property Theory (2 credits) 2016 curriculum are required to take the Environmental Engineering Material Property Constitutional Court (2 credits) in the 2020 curriculum.

e. Students who have not passed or have not taken the MK Structural Mechanics (3 credits) in the 2016 curriculum are required to take the MK Structural Mechanics I (2 credits) curriculum 2020. To meet the shortage of SKS students can take the Mandatory MK in the 2020 Curriculum.

f. Students who have not passed or have not taken the Basic Soil Mechanics Court (3 credits) in the 2016 curriculum are required to take the Environmental Engineering Soil Mechanics Court (3 credits) in the 2020 curriculum.

g. Students who have not passed or have not taken the MK in Solid Mechanics (3 credits) in the 2016 curriculum are required to take the MK in Structural Mechanics II (2 credits) in the 2020 curriculum. To meet the shortage of credits, students can take the Mandatory MK in the 2020 Curriculum.

h. Students who have not passed or have not taken the MK Environmental Microbiology (2 credits) in the 2016 curriculum are required to take the MK Environmental Microbiology (3 credits) in the 2020 curriculum.

i. Students who have not passed or have not taken the TL Network Design Court (3 credits) in the 2016 curriculum are required to take the Wastewater Collection Network Design Court (2 credits) and Drinking Water Distribution Network Design (2 credits) in the 2020 curriculum.

j. Students who have not passed or have not taken the TL Building Structure Design Court (3 credits) in the 2016 curriculum are required to take the Environmental Engineering Building Structure Design Court (3 credits) in the 2020 curriculum.

k. Students who have not passed or have not taken the MK in Design of Water Treatment Plants (3 credits) in the 2016 curriculum are required to take the MK in the Design of Drinking Water Treatment Plants (3 SKS) in the 2020 curriculum.

l. Students who have not passed or have not taken the Constitutional Court in Designing Domestic Sewage Treatment Buildings (3 credits) in the 2016 curriculum are required to take the Constitutional Court of Planning for Domestic Wastewater Treatment Plants (3 credits) in the 2020 curriculum.

m. Students who have not met the number of Mandatory MK credits can take the New Mandatory MK in the 2020 Curriculum

Equalizing the 2016 Curriculum Subjects and the 2020 Curriculum for Civil Engineering Undergraduate

No	Name of Courses in Curriculum 2016	Credits 2016	Name of Courses in Curriculum 2020	Credits 2020	Remarks
1	Physics - Mechanics and Thermal	3	Physics - Mechanics and Thermo-dynamics	4	New courses are mandatory for the study program. The number of credits is reduced. Merger of two courses, Exception for 2019; 2018; 2017 during transition
2	Thermodynamics	2			
3	Praktikum Fisika Dasar	1	None	-	
4	Academic English	3	Academic English	2	The change of course credit
5	Integrated Character Building A	6	Integrated Character Building	5	The change of course name & credits
6	Integrated Character Building B	6			
7	Olahraga/ Seni	1	None	1	None
8	Religion	2	Religion		The change of position form even to odd
9	Physics - Electricity, MWO	3	Environmental Biology	2	New courses are mandatory for the study program
10	Physics - Electricity, MWO Lab	1	None	-	
11	Basic Chemistry	2	Basic Chemistry	2	The change of position (semester 3 become semester 1) and New courses are mandatory
12			Basic Chemistry Lab	1	
13	Statistic & Probabilistic	2	Statistik & Probabilistik Eksperimen	2	The course become study programme mandatory course; The change of course name.
14	Advanced Calculus	3	Environmental Engineering Mathematic	3	The change of course name
15	Occupational Health, Safety and Environmental Risk	2	Occupational Health, Safety and Environmental Risk	2	The course become study programme mandatory course; The change of course name.
16	Construction Drawing	2	Construction Drawing for Environmental Engineer	2	The new courses of the study program replace these courses and change credit
17	Construction Building	2		2	
18	Surveying	3	Earth Science and Mapping	2	The new courses of the study program replace these courses and change credit
19	Theory of Material Property	2	Environmental Engineering Material Properties	2	The change of course name
20	Structural Mechanics	3	Structural Mechanics I	2	The change of course name and change of credits

21	Fluid Mechanics	3	Fluid Mechanics	3	The change of course position form odd to even
22	Basic Soil Mechanics	3	Soil Environment for Environmental Engineer	3	The change of course name
23	Soil Mechanics	3	Structural Mechanics II	2	The change of course name and change of credits
24	Environmental Hydraulics	3	Environmental Hydraulics	3	The change of course position form even (semester 4) to odd (semester 3)
25	Global Envinronmental Issues	2	Global Envinronmental Issues	2	The change of course position from evenp(semester 4) to odd (semester 1)
26	Environmental Microbiology	2	Environmental Microbiology	3	The change of course position form even (semester 4) to odd (semester 3)
27	Urban Planning and Sanitation	3	Urban Planning and Sanitation	3	The change of course position form semester 5 to semester 3
28	Water Supply Sewerage Network Design	3	Wastewater Collection System Design	2	The new course that split from Water Supply and Sewerage Network Design course. The total credits increase. The change of course position form odd (semester 5) to even (semester 4)
29			Drinking Water Distribution System Design	2	
30	Structural Design of Environmental Engineering Facilities	3	Structural Design for Environ-mental Engineering Infrastructure	3	The change of course name
31	Water Treatment Design	3	Water Treatment Plant Design	3	The change of course name
32	Domestic Waste Water Treatment Design	3	Domestic Waste Water Treatment Plant Design	3	The change of course name
33	Air Pollution	3	Air Pollution	3	The change of course position from odd (semester 7) to even (semester 6)
34	Research Methodology & Proposal	2	Undergraduate Thesis	5	The new course of the study program replaces the course.
35	Final Project	4			Increase the number of credits
36	-	-	Final Project on Environmental Engineerin Infrastructure	4	New courses are mandatory for the study program
37	-	-	Service Learning	1	New courses are mandatory for the study program
38	-		Writing and Presentation Technique	2	New courses are mandatory for the study program

Course Syllabus of University Subjects

INTEGRATED CHARACTER BUILDING

UIGE6000061/UIGE6100061
5 credits

Syllabus :

The Integrated Character Building is part of the Higher Education Personality Development Lecture which is held for students which contains elements of the internalization of basic life values, interaction/relationship skills, nationality and academic skills as the basis for student personality to carry out learning according to scientific disciplines.

MPKT is carried out in the form of a series of learning activities outside the formal class. activities carried out include participation in lectures/seminars, internships, field work practices, social work, sports and/or arts activities and other forms of activities that have the main goal of equipping students with soft skills and proven by portfolio documents. The form of this learning activity is different from the MPKT courses that have been carried out at the previous UI.

The material provided at MPKT aims to form a human thinking pattern with values and morals to create a human personality by having critical, logical, creative, innovative thinking, and having intellectual curiosity and an entrepreneurial spirit. The material provided includes 9 UI values, national, state and citizen values based on Pancasila. Solving problems in science, technology, health, and humans as natural managers by using reasoning and utilizing Information and Communication Technology (ICT) to achieve the final objectives of this module.

Lecture activities are carried out using an online student-centered learning (SCL) approach which can use the following methods: experiential learning (EL), collaborative learning (CL), problem-based learning (PBL), question-based learning, and project based learning. The use of these various methods is carried out through group discussion activities, independent assignment exercises, presentations, writing papers in Indonesian and interactive discussions in online discussion forums. The language of instruction in this lecture is Indonesian.

Graduate Learning Outcomes :

- CPL 1: Able to use spoken and written language in Indonesian and English both for academic and non-academic activities (C3, A5)
- CPL 2: Have integrity and are able to think critically, creatively, and innovatively and have intellectual curiosity to solve problems at the individual and group level (C4, A3)
- CPL 3: Able to provide alternative solutions to various problems that arise in the community, nation, and country (C4, A2)
- CPL 4: Able to take advantage of information communication technology (C3)
- CPL 5: Able to identify various entrepreneurial efforts characterized by innovation and independence based on ethics (C2, A5)

Course Learning Outcomes :

- CPMK 1: After completing this course, students are able to apply self-regulated learning characteristically in studying critically, logically, creatively, innovatively through analysis of societal problems, nation, state, and Pancasila ideology based on self-understanding as individuals and members. the community by using good and correct Indonesian and the latest information and communication technology (C4, A4)
- CPMK 2: Able to identify various entrepreneurial efforts characterized by innovation and independence based on ethics (C2, A5)
- CPMK 3: After completing this course, students are able to apply self-regulated learning characteristically in pursuing integrated and comprehensive knowledge through analysis of science problems, technology based on the role of nature manager by using good and correct Indonesian and information technology and current communications. (C4, A4)
- CPMK 4: After completing this course, students are able to plan creative activities to solve problems in society and the world of work/industry by showing creativity, critical thinking, collaborative self-discipline using good and correct Indonesian as well as the latest information and communication technology (C5, A5)

Prerequisite : -

ACADEMIC WRITING

UIGE610002
2 credits
The Objectives :

To activate students, English so that they will be able to communicate effectively in English;

To enable students to develop the learning strategies and study skills needed to finish their study successfully and o continue learning on their own after taking the MPK program (to develop independent learners)

Main Competencies :

- Listen to, understand and take notes of key information in academic lectures of between 5-10 minutes length;
- Improve their listening skills through various listening materials and procedures;
- Speak confidently, ask questions in and contribute to small group discussions;
- Use different reading strategies needed to the effective readers;
- Improve their reading skills through extensive reading material;
- Develop skills in connecting ideas using appropriate transitions and conjunctions;
- Work as part of a group to prepare and deliver a 25-minute presentation on an academic topic using appropriate organization, language and visual aids;
- Write a summary of a short academic article;
- Write an expository paragraph;
- Write a short essay.

Learning Method : Active learning, Contextual language learning, small group discussion.

Prerequisite :

1. Students Learning Orientation/Orientasi Belajar Mahasiswa (OBM)

ENGLISH

UIGE600003
2 credits

Learning Objectives :

After attending this subject, students are expected to capable of use English to support the study in university and improve language learning independently.

Syllabus :

Study Skills : (Becoming an active learner, Vocabulary Building: word formation and using the dictionary Listening strategies Extensive reading) Grammar: (Revision of Basic grammar Types of sentences Adjective clauses, Adverb clauses Noun clauses, Reduced clauses) Reading: (Reading skills: skimming, scanning, main idea, supporting ideas, Note-taking Reading popular science arti-cle, Reading an academic text) Listening: (Listening to short conversations, Listening to a lecture and notetaking, Listening to a news broadcast, Listening to a short story) Speaking: (Participating in discussions and meetings, Giving a presentation) Writing: (Writing a summary of a short article Describing graphs and tables, Writing an academic paragraph, Writing a basic academic essay (5 paragraphs).

ISLAMIC STUDIES

UIGE6000010/UIGE610005
2 credits
General Instructional Objectives :

The cultivation of students who have concern for social, na-tional and countrys issues based on Islamic values which is applied in the development of science through intellectual skills.

Learning Objectives :

Course participants are expected to do the following when faced with a problem or issue which they must solve :

1. Analyze the problem based on the Islamic values they adopted;
2. Analyze the problem by implementing active learning stages;
3. Discuss and express their thoughts and ideas by using proper and correct Indonesian language in discussion and academic writing.

Syllabus :

Islam history: the meaning of Islam, the characteristic of Islam, the sources of Islamic teachings, Muhammad SAW as prophet and history figure, introduction of Islam in Indonesia, the teaching essence of Islam: the basic principle of Islam teachings, the unity of Allah, worship prac-tice in live, eschatology and work ethics, human's basic rights and obligation, social structure in Islam: sakinah mawaddah and ramhah family, the social implication of family life, Mosque and the development of Islam, zakat and the economic empowerment of the people, Islam society, Science: reason and revelation in Islam, Islam's motivation in development of science, science characteristics, source of knowledge, IDI (each Faculty and Department/Study Program).

CATHOLIC STUDIES

UIGE6000011/UIGE610006
2 credits
General Instructional Objectives :

To help deliver students as intellectual capital in implementing lifelong learning process to become scientists with mature personality who uphold humanity and life.

Be scholars who believe in God according to the teachings of Jesus Christ by continuing to be responsible of his faith in life in church and society.

Syllabus :

Almighty God and the God teachings; Man, Morals, science technology and art; harmony between religions; Society, Culture, Politics, Law: the substance of theses studies will be addressed by integrating the four dimensions of the teachings of the Catholic faith: the personal dimension, the dimension of Jesus Christ, the dimension of the Church, and Community dimension. Dimensions are implemented in the following themes: People, Religion, Jesus Christ, the Church, and Faith in the society.

CHRISTIAN STUDIES

UIGE6000012/UIGE610007
2 credits
General Instructional Objectives :

Cultivating students with comprehensive Christian knowledge and teaching in the midst of the struggle and the fight of the nation while also discussing the student's participation in line with the study to help improve and build our country.

Learning Objectives :

Course participants are expected to do the following when faced with a problem or issue which they must solve:

1. Analyze the problem based on the Christian values
2. Analyze the problem by implementing active learning stages
3. Discuss the problem by using proper and correct Indonesian language

Syllabus :

History (Historical terms): Status of the Bible, the existence of God and Morality, Christ the Savior, the Holy Spirit as existence reformer and outlook on the world: Faith and Knowledge of Science, Church and service, Ecclesiology, Spiritual and enforcement of Christian Human Rights and the world of ethics: Christian Ethics, Christian and worship, Christianity and politics, Christian love and social reality: Christian Organizations, Students and Service, Christian and expectations.

HINDU STUDIES

UIGE6000013/UIGE610008
2 credits

Syllabus :

Hindu religion, Hindu history), Source and scope of Hinduism (the Veda as the source of Hindu religion teachings, the scope of the teachings in Hindu religion), The concept of the God (Brahman) according to the Veda, the Path to Brahman (Catur Marga Yoga, Mantra and Japa), Human Nature (The purpose of human life, Human's duties, obligations, and responsibilities both individually or collectively), Ethics and morality (Principles teaching, self-control), in-depth understanding of the scripture (deep understanding of the Bhagawadgita, deep understanding of the Sarasamuschaya), The Role of Hinduism in science, technology, and art (Hinduism benefits in science and technology in accordance with each department, benefit / the role of Hinduism in the arts), Cohesion and community's prosperity /independence (Benefits of unity in the religious plurality, independent community (kerthajagathita) as a common goal, Tri Pitakarana), Culture as an expression of Hindu religious practice, Contribution to the Hindu religion teachings in the political life of nation and country, laws and

the enforcement of justice, Awareness of and obeying the Rita / Dharma.

BUDDHIST STUDIES
UIGE6000014/UIGE610009
2 credits

Syllabus :

Almighty God and the God Study (Faith and piety, Divine Philosophy/Theology), Human (Human Nature, Human Dignity, Human Responsibility), Moral (Implementation of Faith and Piety in everyday life), Science, Technology and Art (Faith, Science and Charity as a unity, the Obligation to study and practice what you are taught, Responsibility for nature and environment), harmony between religion (religion is a blessing for all mankind, the essence of the religious plurality and togetherness), community (the role of religious society in creating a prosperous independent society, the responsibility of religious society in the realization of human rights and democracy), Culture (the responsibility of religious society in the realization of critical thinking (academic), work hard and fair), Politics (Religion contribution in the political life of nation and country), Law (Raise awareness to obey and follow God's law, the role of religion in the formulation and enforcement of law, the function of religion in the legal profession).

KONG HU CU STUDY
UIGE6000015/UIGE610010
2 credits

Syllabus Of Faculty Subjects

CALCULUS 1
ENGE600001/ENGE610001
3 credits
Course Learning Outcomes:

Able to use the basic concepts of calculus related to -a function of one variable, the derivative and integration of the function of one variable in order to solve its applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, basic engineering, and engineering specialization to be used in solving complex engineering problems.

Syllabus :
Introduction, Functions and Limits, The Derivative, Applications of the Derivative, The Definite Integral, Applications of The Definte Integral, Transcendental Functions, Techniques of Integration, Indeterminate Forms and Improper Integrals.

Prerequisite: None

Textbooks:

Main reference:
D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., Pearson, Prentice Hall, 2007.

Additional eferences:
1. George B. Thomas Jr., Thomas' Calculus Early Transcendental, 12th ed., Addison–Wesley Pearson, 2009.
2. Howard Anton, Calculus, 10th ed., John Wiley and Sons, 2012.

CALCULUS 2
ENGE600002/ENGE610002
3 SKS
Course Learning Outcomes:
Students are able to use the concepts of sequences, series, conic sections, and the basic concepts of calculus which involve the function of two or three variables to solve their applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :

Infinite sequences and infinite series, Test for convergence of positive series and alternating series, Power series and operation on operations, Taylor and MacLaurin series, Conic sections , Calculus in polar coordinates, Derivatives, limits, and continuity of multi-variables functions, Directional derivatives and gradients, Chain Rule, Tangent planes and Approximations, Lagrange multipliers. Double integrals in Cartesian coordinates and polar coordinates, triple integrals in Cartesian coordinates, cylindrical coordinates and spherical coordinates, Applications of double and triple Integral.

Prerequisite: Calculus 1

Textbooks:
1. D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., PEARSON, Prentice Hall, 2007.
2. Thomas, Calculus Thirteenth Edition Volume 2, Erlangga, 2019.

CALCULUS
ENGE600003/ENGE610003
4 SKS
Course Learning Outcomes:

Students are able to use the basic concepts of calculus involving functions of one to three variables to solve their applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :

Introduction, Functions and Limits, Derivatives, Derived Applications, Indeterminate Integral, Integral Applications, Infinite Row, and Series. Derivatives with many variables, Duplicate Integral (2 and 3), Duplicate Integral Application.

Prerequisite: None

Textbooks:

Main :
D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., Pearson, Prentice Hall, 2007.

George B. Thomas Jr., Thomas' Calculus Early Transcendental, 12th ed., Addison – Wesley Pearson, 2009.

LINEAR ALGEBRA
ENGE600004/ENGE610004
4 SKS
Course Learning Outcomes:
Students are able to calculate linear system problems to solve engineering problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :

Linear Systems and matrix equations, Determinants, Euclid

vector spaces, Common vector spaces, eigenvalues and eigenvectors, inner product spaces, Diagonalization and General Linear Transformation.

Prerequisite: None

Textbooks:
1. Elementary Linear Algebra, Howard Anton & Chris Rorres, 11th edition, 2014
2. Gilbert Strang, Introduction to linear algebra 3rd edition Wellesley Cambridge Press, 2003

MECHANICAL AND HEAT PHYSICS
ENGE600005 / ENGE610005
3 credits
Course Learning Outcomes:

Able to explain the basic concepts of mechanics and thermodynamics, and be able to apply them to understand natural phenomena and human engineering, including their applications.

Graduate Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus:

Units, Magnitudes and Vectors, Motion Along Straight Lines, Motion in Two and Three Dimensions, Newton's Laws of Motion, Applications of Newton's Laws, Kinetic Energy, and Work, Potential Energy and Energy Conservation, Center of Mass, Linear Momentum, Rotation, Rolling Motion, Torque, Angular Momentum, Oscillation, Mechanical and Sound Waves, Gravity, Statics and Elasticity, Fluid Mechanics, Temperature, Heat, Law I Thermodynamics, Ideal Gas and Kinetic Theory of Gas, Heat Engine, Entropy, and Law II Thermodynamics.

Prerequisite: none

Textbooks:
1. Halliday, Resnick, and Walker, Principles of Physics 10th Edition, Wiley, 2014.
2. Serway Jewett, Physics for Scientists and Engineers 9th Edition, Thomson Brooks / Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008

ELECTRICAL MAGNETIC, OPTICAL AND WAVE PHYSICS
ENGE600007 / ENGE610007
3 credits
Course Learning Outcomes:

Students are able to apply the basic concepts of electrical physics, magnetism, waves, and optics to solve problems in the engineering field.

Graduate Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus:

Unit, Magnitude, Vector, Electric Charge, Electric Field, Gauss Law, Electric Potential, Capacitance, Electric Current, Resistance, Direct Current, Magnetic Field Due to Electric Current, Magnetic Field Source, Induced GGL, Inductance, Alternating Current, Electromagnetic Waves, Light Properties and Propagation, Optical Geometry.

Prerequisite: none

Textbooks :
1. Halliday, Resnick, and Walker, Principles of Physics 9th Edition, Wiley, 2011.
2. Serway Jewett, Physics for Scientists and Engineers 9th Edition, Thomson Brooks / Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008.

BASIC CHEMISTRY
ENGE600009 / ENGE610009
2 credits
Course Learning Outcomes:

Students are able to analyze the principe of basic chemistry for application in engineering.

Graduates' Learning Outcomes:

Able to apply mathematics, science, and basic engineering to be used in solving complex engineering problems.

Syllabus:

Material and measurements, atoms, molecules and ions, stochiometry, water phase reactions and solution stochiometry, thermochemistry, chemical equilibrium, acid and base equilibrium, electrochemistry, chemical kinetics, and chemical applications.

Prerequisite: none

Textbooks :
1. Ralph H. Petrucci, General Chemistry: Principles and Modern Applications, 8th Ed. Prentice Hall Inc., New York, 2001.
2. John McMurry, Robert C. Fay, Chemistry (3rd ed.), Prentice Hall, 2001.
3. Raymond Chang, Williams College, Chemistry (7th ed.), McGraw-Hill, 2003.

ENGINEERING ECONOMY
ENGE600011 / ENGE610011
3 credits
Course Learning Outcomes:

Students are able to analyze the economic and financial feasibility of making economic practice decisions.

Graduate Learning Outcomes:

Able to apply the principles of technical management and decision making based on economic considerations, in individual and group, as well as in project management.

Syllabus:

Introduction to Engineering Economics, Time Value of Money, Combining Factors, Interest Rates, Money Worth Analysis, Rate of Return Analysis, Effects of Inflation, Benefit Cost & Break-Even Point Analysis, Sensitivity Analysis, Depreciation, Tax Analysis, Cost Estimation & Allocation, Capital Budgeting & Replacement Analysis.

Prerequisite:
1. Civil Engineering : -
2. Environmental Engineering : -
3. Naval Engineering : -
4. Industrial Engineering : must pass the introductory Economic course and have completed 38 credits
5. Chemical Engineering : -
6. Bioprocess Engineering : -

Textbooks:
1. Blank, Leland and Tarquin, Anthony. 2018. Engineering

Economy 8th Ed. McGraw Hill.
2. Park, Chan S. 2016. Contemporary Engineering Economics 6th Ed. Pearson. Upper Saddle River.
3. White, Case and Pratt. 2012. Principles of Engineering Economic Analysis 6th ed. John Wiley and Sons.

STATISTICS AND PROBABILISTICS
ENGE600010 / ENGE610010
2 credits
Course Learning Outcomes:

Students are able to handle quantitative data/information starting from the descriptive stage (collection, organization, and presentation) to the inductive stage, which includes forecasting and drawing conclusions based on the relationship between variables for decision making.

Graduate Learning Outcomes:
1. Apply descriptive statistics and probability theory to data processing and serving
2. Apply probability distribution to data processing and serving
3. Apply the principles of sampling and estimation for decision making
4. Apply hypothesis test samples for decision making

Syllabus:

Introduction to Statistics for Engineering Studies, Probability Theory, Dasar Basic concepts and definitions, Distribution Probability, Sampling, Estimation, Hypothesis testing, Hypothesis test 1 sample at an average value, Regression

Prerequisite: none

Textbooks :
1. Harinaldi, Basic Principles of Statistical Engineering and Science, Erlangga, 2004
2. Montgomery, DC., And Runger, GC., Applied Statistics and Probability for Engineers, John Wiley Sons, 2002

HSE PROTECTION
ENGE600012 / ENGE610012
2 credits
Course Learning Outcomes:

Upon completion of this subject students are expected to be able to carried out hazard identification, and characterization, to propose appropriate methods for risk reduction and mitigation, and to design safety management system. The student is also expected to improve their awareness on industrial safety and health, and understanding on safety regulation framework and standards as well as environmental program.

Graduate Learning Outcomes:
1. Students are expected to understand safety, health and environmental aspect as an integral part of fundamental principal in engineering code of ethics.
2. Students are expected to be able to carry out process of risk assessments by considering risk factors in the impact of hazards on people, facilities, and the surrounding community and environemt.
3. Students are expected to understand the regulatory framework and standard related to the stages of life cycle of machine, building structure, construction, and process.
4. Students are able to design and propose an effective hazard communication, management and engineering control, and risk mitigation through an engineering assignment project.
5. Students are able to identify the knowledge required to perform risk assesment, investigation and design improvement through a multidisiplinary case of incident and accident.

Syllabus:

Introduction to SHE Regulation and Standards, SHE Perception (Risk and Environment), Identification, Assessment and Management, Construction, machinery and Noise hazards, Process safety hazard and analysis technique, Fire and explosion hazard, Electrical hazard, Toxicology in the Workplace, Ergonomy Aspect, Hazard communication to employees, Environmental Protection, Case studies, Safety Health and Environment audits.

Prerequisite: none

Textbooks :
1. Charles A. Wentz, Safety, Health and Environmental Protection, McGraw Hill, 1998.
2. Asfahl, C.R., Rieske, D. W., Sixth Edition Industrial Safety and Health Management, Pearson Education, Inc., 2010.
3. United Kingdom - Health and Safety Executive, http://www.hse.gov.uk/
4. National laws and regulations related to the K3 Management System and the Environment.
5. Related Journal (http://www.journals.elsevier.com/safety-science/) etc, related standards and publications.

Syllabus of Undergraduate Program on Environmental Engineering

Physics (Mechanics and Thermodynamics)
ENCV 601 001
4 credits
Expected Learning Outcomes:

ELO 1 Engineering Knowledge

Course Learning Outcomes:

Able to apply fundamental concept and physic mechanics and thermodynamics in solving engineering problem

Learning Experiences:

Syllabus:

Magnitude, point object kinematic, point object mechanics, the law of conservation of linear momentum and energy, harmonic movement, gravitation, kinematics and dynamics of rigid bodies, introduction and concept of thermodynamics (pressure, thermodynamics system, system condition, temperature), expansion, energy equilibirum (isoterm equation), heat trasnfer, noble gas, first law of thermodynamics, enthalpy and enthropy, Hk application. First thermodynamics law in open and closed system, second law of thermodynamics, noble gas kinetic theory, building ventilation system, building insulation system, building cooling system and centralizer air control.

Prerequisite: -

Textbook references :
1. Halliday, Resnick, dan Walker, Principles of Physics 9th Edition, Wiley, 2011.
2. Serway Jewett, Physics for Scientists and Engineers 9th Edition, Thomson Brooks/Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008

Introduction to Environmental Engineering System
ENEV 601 001
2 credits
Expected Learning Outcomes:
ELO 2 Problem Analysis
ELO 6 Engineer and Society

Course Learning Outcomes:

Explain environmental engineering and its sub-specialization scope of work through teamwork skills and deliver a verbal and written report about environmental engineering works.

Learning Experiences:

Syllabus:

Understanding of ecology, ecosystems, natural resources, vegetation and tropical forests, ecosystem waters, dams, agricultural, land use management, climate change, element, energy, life, life cycle, the hydrologic cycle, water and pollution, management of water resources, water needs, water treatment facility and distribution network, the characteristics of liquid waste, domestic waste water treatment facilities and collecting ducts, solid waste and hazardous waste, air emissions, soil and water contamination by sewage, renewable and nonrenewable natural resources, regulations.

Physical and non-physical components in Environmental Engineering System; interconnecting scope of work amongst sub-specialization in environmental engineering; technical and non-technical (law, social, economic, and health) aspect in engineering infrastructure system, environmental engineering and its sub-specialization scope of work; role of environmetal engineer.

Prerequisites: -

Text Book References :

1. Danny Reible, CRC Press, 14 Des 2017, Fundamentals of Environmental Engineering
2. Mackenzie L Davis, Susan J Masten, McGraw-Hill Education, Mar 11, 2019, Loose Leaf for Principles of Environmental Engineering and Science

Global Environmental Issues

ENEV 601 002
2 credits
Expected Learning Outcomes:
ELO 7 Sustainability
ELO 12 Lifelong Learning

Course Learning Outcomes:

Students can relate the (C3) concepts and knowledge of environmental science to investigate (C3), criticized (A3) and demonstrating (P2) causes, effects and solutions of the existing contemporary global environmental problems

Learning Experiences:

Syllabus:

Abiotic environment problems and decrease of resilience of various spatial and temporal scales, (concept of D-P-S-I-R, climate change, water, air and land pollution, scarcity of Natural Resources, Probability and statistics in environmental science, Resilienc); Ecosystems and living beings (Recycling of energy and water, the food chain, biodiversity, nutrient cycle in nature, the main ecosystems of the earth, Sustainability); The harmful effects of environmental problems on society, the economy, and the environment particularly which is irreversible (System thinking, State shift and irreversibility, health impacts, economic impacts, the impact of welfare); Anthropocene era and the concept of sustainable development (population, changes in land use, consumption, economy and development, Nexus Water-Energy-Food, Three pillars of sustainability); Solutions to environmental problems (L-C-A, Greenwashing, Geo-Engineering, End-of-pipe vs closed loop, Reflexive Engineer, Sustainable Consumption and Production, Resiliency)

Prerequisites: Integrated Character Building Course

Text Book References :

1. Berg, Linda R. 2013. Visualizing Environmental Science 4th Edition. Wiley.
2. Easton, Thomas. 2013. Taking Sides: Clashing Views on Environmental Issues 15th Edition. McGraw-Hill/Dushkin.
3. Hardisty, Paul E. 2010. Environmental and Economic Sustainability 1st Edition. CRC Press.
4. Harris, Frances. 2012. Global Environmental Issues 2nd edition. Wiley Blackwell
5. The Worldwatch Institute & Erik Assdourian. 2013. State of The World 2013: Is Sustainable Still Possible? 1st Edition. Island Press.

Environmental Biology

ENEV 601 003
2 credits
Expected Learning Outcomes:

ELO 1 Engineering Knowledge

Course Learning Outcomes:

Able to explain the function of biological component in the ecosystem including the environmental quality and support **(C2)**

Learning Experiences:

Syllabus :

Structure and impact of biogeochemistry cycles, energy transformation in every trophic level, interaction between biotic and abiotic factor in the environment, principle of biodiversity and biological conservation, Anthropocene impact on the environment, environmental hazard and risk and its socio-economic consequences.

Prerequisites:

Textbook References:

Withgott, J and Laposata, M. 2018. Essential Environment: The Science Behind the Stories 6th. Pearson Publications.

Fluids Mechanics

ENCV 603 003
3 credits
Expected Learning Outcomes:

ELO 1 Engineering Knowledge

Course Learning Outcomes:

Students are able to understand the fluid characteristics, concept of hydraulic pressure and forces on static and dynamic fluid and apply the basic equation to calculate the hydraulic pressure and forces on static and dynamic fluid.

Learning Experiences:

Syllabus:

a) The characteristics of the fluid, liquid and gaseous fluids, dimensions and units; (b) Types of flow; laminar, transitional, turbulent; (c) Concept of hydraulic pressure and forces on static and dynamic fluid; the pressure at a point, the pressure on a flat plane, the pressure on the curved area, the pressure of fluid in container undertake linear acceleration, and the pressure of fluid in rotating cylinder; (d) The buoyancy and stability of an object, metacentrum of floating objects; (e) The basic equations of the hydraulic pressure and forces on static and dynamic fluid (Bernoulli, Law of Continuity, Energy, and Momentum), to be applied on Environmental Engineering building structure.

Prerequisite:
Physics (Mechanics and Thermodynamics), Calculus

Text Book Reference:
1. Fundamentals of Fluid Mechanics, 7th Edition. Bruce R. Munson, Bruce R. Munson, Alric P. Rothmayer, Alric P. Rothmayer, Theodore H. Okiishi, Theodore H. Okiishi, Wade W. Huebsch, Wade W. Huebsch, ©2013
2. Fluid Mechanics, 7th Edition SI Version. Bruce R. Munson, Theodore H. Okiishi, Wade W. Huebsch, Alric P. Rothmayer. ISBN: 978-1-118-31867-6, 792 pages. January 2013, ©2013
3. Engineering Fluid Mechanics, 10th Edition SI Version. Donald F. Elger, Barbara C. Williams, Clayton T. Crowe, John A. Roberson. ISBN: 978-1-118-31875-1, 696 pages. June 2013, ©2013
4. Fluid Mechanics, 9th Edition SI Version. Robert W. Fox, Alan T. McDonald, Philip J. Pritchard, John W. Mitchell. ISBN: 978-1-118-96127-8, 680 pages. September 2015, ©2015

Earth Science and Mapping

ENEV 602 001
2 credits

Expected Learning Outcomes (CLO):
ELO 1 Engineering knowledge
ELO 5 Modern Tools

Course Learning Outcomes :

Explain the fundamental concept of earth science and geography and have geographic technical skills through GIS (Geographic Information System). Therefore students can process and analyze data in the form of an earth surface model that can be manipulated, modeled, and analyzed by text, spatial, and the combination of both as required.

Syllabus :

Introduction to earth science, earth surface mapping, atmosphere, ocean and climate, climate change, biogeochemistry cycles. Concept and theory of geomatics science including determining position, photogrammetry, remote sensing, geographic information system (component function in GIS and GIS spatial model), cartography and surveying concept.

Prerequisite: -

Text Book References:
1. de Blij, H.J., Physical Geography of the Global Environment, John Wiley and Sons, 1996
2. Michael,etc,1996, GIS & Environmental Modelling : Progress & Research Issues, GIS World Books, Fort Collins,USA

Construction Drawing for Environmental Engineering

ENEV 602 002
2 credits
Expected Learning Outcomes:
ELO 5 Modern Tools
ELO10 Communication.

Course Learning Outcomes:

Able to understand and draws environmental engineering construction drawing in accordance of applicable standard

Learning Experiences:

Syllabus:

Types and function of construction drawing; engineering drawing standard; introduction to drawing tools; CAD basics; scale; line type; material and drawing notation; lettering and dimensioning; geometric construction; pictorial projection; orthogonal projection; section view drawing; details of the building drawing; drawing of building structural element; drawing of sanitation, piping and its accessory; drawing of unit operation and process; hydraulic profile drawing; example of engineering drawing; survey and observation of case study.

Prerequisites:

Textbook References:
K. Rathnam. (2017). A First Course in Engineering Drawing. Springer Nature Singapore Pte Ltd. 2018. ISBN 978-981-10-5357-3

Basic Chemistry Laboratory

ENEV 602 003
1 credits
Expected Learning Outcomes:

ELO 1 Engineering Knowledge

Course Learning Outcomes:

1. Students are able report initial theory for each laboratory experiments module.
2. Student are able to conduct experiments in laboratory.
3. Student are able to process and analyze the laboratory experiment data and submit final report explaining the phenomenon during the laboratory experiment.

Learning Experiences:

Syllabus:

General techniques and safety aspect in chemistry laboratory, physical and chemical characteristic, chemical reaction and stoichiometry, chemical kinetics, chemical equilibrium and acid-base reaction, redox reaction, and electrochemical cells, organic substance.

Prerequisites: -

Text Book References:
1. Fessenden, translation: A. Hadiyana Pujatmaka, Organic Chemistry, Second edition 1986 grants.
2. Morrison, RT and Boyd, RN, Organic Chemistry, 6th ed., Prentice Hall 1998.
3. Vogel, Practical Organic Chemistry.
4. TGP majors, Organic Chemistry Lab Instructions diktat (Basic Chemistry and Organic Chemistry Guide, Department of Chemical Engineering , FTUI).
5. Moran, L. dan Masciangioli, T.Safety and Security of Chemical Lab, the National Academies Press, 2010.
6. Brown, T.L., H. E. LeMay and B.E. Bursten, Chemistry, ed. 8, Prentice Hall, 2000.
7. Vogel, Anorganic Qualitative Analyze, PT. Kalman Media Pustaka, 1985.
8. Raymond Chang, Williams College, Chemistry (7th Ed.), McGraw-Hill, 2003.

Statistics and Probabilistic of Experimental Design

ENCV 603 004
2 credits
Expected Learning Outcomes:
ELO 1 Engineering Knowledge
ELO 4 Experiment

Course Learning Outcomes:
1. Student able to identify data requirement, and appy valid experimental data in accordance of statistic and probabilistic concept
2. Student able to utilize and apply excel to analyse experimental and report the analysis result.

Learning Experiences:

Syllabus:

Basic concept of statistic and probabilistic, error analysis and error propagation; normal distribution analysis; standard error analysis; estimation of errors in derived quantities; hypothesis testing and the t-test based on ANOVA result; distrubtion and consistency test; analysis using excel toolpax; multiple regression; Classical Assumption test; probabilistic theory.

Prerequisites:

Textbook References:

1. Catherine A. Peters, Statistics for Analysis of Experimental Data, Princeton University, 2001
2. Howard J. Seltman, Experimental Design and Analysis, 2018
3. Berthouex, P. M.; L. C. Brown. Statistics for Environmental Engineers. Lewis Publishers, 1994.
4. Bevington, P. R.; D. K. Robinson. Data Reduction and Error Analysis for the Physical Sciences. McGraw-Hill, Inc. 1992.
5. Box, G. E. P.; W. G. Hunter; J. S. Hunter. Statistics for Experimenters: An Introduction to Design, Data Analysis, and Model Building. John Wiley & Sons, 1978

Environmental Engineering Mathematic

ENEV 603 001
3 credits
Expected Learning Outcomes (CLO):

ELO 1 Engineering knowledge

Course Learning Outcomes (CLO):

Able to apply basic calculus concepts to solve environmental engineering problems using analytical and numerical solutions of ordinary differential equations **(C3)**

Learning Experiences:

Syllabus:

Introduction to Differential Equations, Definitions and Terminology, Initial-Value Problems, Differential Equations as Mathematical Models**,** Analytical solution for first order Differential Equation (Separable Equations, Linear Equations, Exact Equations, Solution by Substitutions, Linear Models, Nonlinear Models, Cauchy-Euler Equations, Modeling with Systems of First-Order Differential Equations), Analytical solution for Higher-Order Differential Equations (Homogeneous Equations, Nonhomogeneous Equations, Reduction of Order, Homogeneous Linear Equations with Constant Coefficients, Undetermined Coefficients, Variation of Parameters, Nonlinear Equations). Numerical solution for Ordinary Differential Equation (Euleur Method, Heun Method, Runge Kutta Method, Stiffness and Multistep), Boundary value and eigenvalue problem, Introduction to Matlab.

Prerequisites:
Calculus 1, Calculus 2

Textbook References:

1. Charles Prochaska and Louis Theodore, Introduction to Mathematical Methods for Environmental Engineers and Scientists. Wiley, 2018
2. E. Kreyzig, Advanced Mathematical Engineering, John-wiley & Son, 5^{th} ed., 2011
3. Numerical Methods for Engineers, Steven C. Chapra & Raymond P Canale, 7th edition, 2013

Environmental Microbiology

ENEV 603 002
3 credits
Expected Learning Outcomes (CLO):
ELO 1 Engineering Knowledge
ELO 4 Experiments

Course Learning Outcomes (CLO):

1. Able to explain the microbiological system and its relation to growth, the spreading, and the habitat.
2. Able to conduct microbial test from water and air sample.

Learning Experiences:

Syllabus:

The basic concepts of microbiology (Introduction of environmental microbiology, microorganisms found in the environment, diversity of microorganisms and their interaction at natural ecosystem); Nutrition for microorganisms; Bacterial growth; Environmental microorganism (Earth environments, Aero microbiology, Aquatic environments, Extreme environments); environmental sampling and testing; microbial diversity and its interaction in natural ecosystem; waterborne and foodborne pathogen (pathogen environmental transmission); wastewater biological treatment; Urban microbiology (domestic and outdoor microbiology); microbial emerging global issues in the Anthropocene era. Microorganism indicator, microbes enumeration using TPC and gram coloring method, microbes culturing method; water quality test using MTF method; sampling and testing of bioaerosol (bacteria and fungi)

Prerequisite:

Introduction to Environmental Engineering System

Textbook References:

1. Ian L.P., Charles P.G., Terry J.G. 2015. Environmental Microbiology, 3rd ed. Elsevier. Amsterdam.
2. Johnson, T.R., Case, C.L. 2010. Laboratory Experiments in Microbiology. Benjamin Cummings. Pearson. San Fransisco
3. Novita, E., Gusniani, I., G.B.Andari, Pipit Fitriah. 2019. Modul Praktikum Mikrobiologi Lingkungan. Laboratorium Teknik Lingkungan-Departemen Teknik Sipil FT-UI. Depok
4. Willey, J.M., Sherwood, L.M., Woolverton, C.J. 2008. Microbiology. 7th. Edition. Mc Graw Hill, Boston.

Environmental Engineering Material Properties

ENEV 603 003
2 credits
Expected Learning Outcomes (CLO):

ELO 2 Problem Analysis

Course Learning Outcomes (CLO):

Able to explain the various physical properties and chemical properties of materials used for water treatment systems, waste management systems, and environmental engineering buildings

Learning Experiences:

Syllabus:

Properties of construction materials (aggregate, cement, concrete, steel, and polymer); the concept of tension-strain; material for unit operation and process (water, adsorbent, membrane, catalyst); concrete mix design (concrete mix composition, curing, strong concrete press, slump test, etc); material characterization theory (particle size distribution, morphology, elemental and crystalline composition, surface area and pore volume, phpzc, etc.).

Prerequisites: -

Textbook References:

1. A. M. Neville. Properties of Concrete. 5th Edition. Pearson.

2. Nagaratnam Sivakugan, Carthigesu T. Gnanendran, Rabin Tuladhar, M. Bobby Kannan. (2017). Civil Engineering Materials. CL Engineering. ISBN: 1305386647
3. Surender Kumar Sharma. (2018). Handbook of Materials Characterization-Springer International Publishing. Springer International Publishing. ISBN 978-3-319-92954-5

Environmental Hydraulics
ENEV 603 004
3 credits
Expected Learning Outcomes (CLO):

ELO 1 Engineering Knowledge

Course Learning Outcomes (CLO):

Able to understand the basic concepts of the behavior of water flow in open channels and closed conduits, understand the functions of the water buildings and measuring the flow rate, and able to calculate the flow rate in open channels and closed conduits, calculate the energy loss, and mathematically describe the flow and pressure distribution within a pipe network.

Syllabus:

a) the concept of hydraulics in open-channel flow and closed-conduits flow; (b) Flow in open channel; basic equation, minor and major losses; (c) Flow in pipe network; the use of concept of HGL (Hydraulic Grade Line) and EGL (Energy Grade Line), Bernoulli equation, Hardy-cross method for calculating flow distribution in a pipe network: series, parallel, and branching; (d) The concept of energy (specific energy and critical energy), the type of flow; steady, unsteady, uniform, non-uniform; (e) Various primary water buildings; weir, intake building, distribution channel, flow or discharge measuring tools/gauges; Chipoleti-weir, Parshall-flume, V-notch weir, loggers, etc.

Prerequisite: Fluid Mechanics

Textbook References:
1. Fundamentals of Hydraulic Engineering Systems (4th Edition), Houghtalen, Robert J.; Akan, A. Osman; Hwang, Ned H. C., Publisher: Prentice Hall, 2009. ISBN 10: 0136016383 ISBN 13: 9780136016380
2. Hydraulics in Civil and Environmental Engineering, 5th edition. Andrew Chadwick, John Morfett, Martin Borthwick. Publisher: CRC Press ISBN: 978-1-118-31875-1, 648 pages. © February 21, 2013

Structural Mechanics 1
ENEV 603 005
2 credits
Expected Learning Outcomes (CLO):

ELO 1 Engineering knowledge

Course Learning Outcomes (CLO):

Students are able to apply the concept of equilibrium in calculating and analyzing the response of a rigid body due to force that works on specific simple static structures such as beam beams, rod frame, portals, three-joint arch, and Gerber structure..

Learning Experiences:

Syllabus:

Statics of particle; rigid body; equilibrium of rigid body; action-reaction; structural analysis of two trusses with point equilibrium method; Structural analysis of beam on two points, cantilever beam, Gerber Beam, portal, three joint Portal, Gerber structure and frame structure

Prerequisites:
Physics (Mechanics and Thermodynamics), Calculus 1 and Calculus 2

Textbook References:
1. Hibbeler, R.C., Engineering Mechanics Statics, Thirteenth Edition, Pearson, 2013
2. Hibbeler, R.C., Structural Analysis, Eighth Edition, Prentice Hall, 2012

Urban Planning and Sanitation
ENEV 603 006
3 credits
Expected Learning Outcomes (CLO):
ELO 3 Design
ELO 6 Engineering and Society

Course Learning Outcomes (CLO):
1. Able to explain the role of environmental engineer in setting up the infrastructure needed in an urban area and apply that knowledge in the planning, monitoring, and implementation of the regional arrangement.
2. Able to describe the components of urban sanitation technology and apply that knowledge in the planning, monitoring, and implementation to create an environmentally sustainable region

Learning Experiences:

Syllabus:

Definition and function of urban planning; urban development model; Primary factor in urban planning ; Spatial policy and urban area planning; green and sustainable city concept; Population aspect in urban planning; urban facilities and infrastructure; Sanitation and the components of urban sanitation; Sustainable sanitation; urban sanitation policy; Master plan for solid waste management, drinking water supply system, wastewater management, and urban drainage system. Public health and control of vector-borne disease; local sanitation system and technology.

Prerequisites:
Introduction to Environmental Engineering System

Textbook References:
1. (Kurt W. Bauer 2009). City Planning for Civil Engineers, Environmental Engineers, and Surveyors. CRC Press.
2. J.A. Salvato, N.L. Nemerow, F.J. Ahardy. (2003). Environmental Engineering, 5th ed. John Wiley & Sons Inc. New Jersey.
3. IHP-UNESCO, GTZ. (2006). Concept for Ecologically Sustainable Sanitation in Formal and Continuing Education. Paris.
4. Standards, Technical Guidelines, SNI and related regulations

Structural Mechanics 2
ENEV 604 001
2 credits
Expected Learning Outcomes (CLO):

ELO 1 Engineering knowledge

Course Learning Outcomes (CLO):

Students able to analyze tension, shape changes because of working forces on various shape of certain static structure with the variation side sections and type of materials.

Learning Experiences:

Syllabus :

The meaning of loads and forces working on a solid object, effect of forces to a solid object, stresses on a solid object, shape deformation of a solid object, characteristics of shape deformation of a solid object, elastic and inelastic phases, axial strain, Modulus of Elasticity, Poisson Ratio. Section Properties, area, center of gravity, cross-axis system, maximum moment of inertia of a section, minimum moment of inertia of a section, radius of gyration, symmetric section, asymmetric section. Normal stress due to axial internal forces, normal stress due to flexure, combination of normal stress and flexure, one way and two-way flexural stress, core area (Kern), shear stress due to transversal internal forces, shear stress due to torsion internal forces. Combination of normal and shear stresses. Deflection of beam, portal, and trusses of statically determined structure caused by external forces using energy/unit load method.

Prerequisite: Statics

Textbook References:
1. Hibbeler, R.C., Mechanics of Materials, 9/e, Pearson, 2014
2. Egor P. Popov (Author), Engineering Mechanics of Solids (2nd Edition), Prentice Hall, 1998
3. Beer, F. and Johnston, P., Mechanics of Materials, 6/e. Mc Graw Hill, 2011
4. Gere, J.M. and Timoshenko, S.P. (1997). Mechanics of Materials, 4th ed., PWS Publishing Co., Boston, Mass.
5. Vable, M., Mechanics of Materials, http://www.me.mtu.edu/~mavable/MoM2nd.htm
6. JAMES M. GERE , MEKANIKA BAHAN 1 ed.4, Penerbit Erlangga, Kode Buku: 37-01-010-6 Tahun: 2000
7. JAMES M. GERE , MEKANIKA BAHAN 2 ed.4, Penerbit Erlangga, Kode Buku: 37-01-010-7 Tahun: 2002

Drinking Water Distribution System Design

ENEV 604 002
2 credits
Expected Learning Outcomes (CLO):
ELO 3 Design;
ELO 5 Modern Tools.

Course Learning Outcomes (CLO):

Able to apply the principles of hydraulics and design criteria in designing the drinking water distribution system layout, its pipe dimensions and including operational and maintenance aspects.

Learning Experiences:

Syllabus:

hydrological cycles; water balance; components of drinking water supply system; gravitation and pump flow system; type of pipeline distribution system (branch, grid, arterial loop); service unit (home connection, general hydrant); pipe material alternative; analysis of a piping loop with hardy-cross method; calculation of pipe diameter; accessories in distribution pipelines; water pressure and pressure lost; distribution reservoir; analysis with epanet software; installation and pipeline connections; pipeline monitoring and repair.

Prerequisite:

Environmental Engineering Hydraulics; Urban Planning and Sanitation

Textbook References:
1. Fair, Geyer and Okun. (2011). Water Supply and Wastewater Removal 3rd edition. John Wiley & Sons, Inc.
2. Hydrology and Floodplain Analysis, 5th Edition. Philip B. Bedient, Wayne C. Huber, Baxter E. Vieux. Publisher: Prentice Hall ISBN-10: 0132567962, 816 pages. © February 25, 2012
3. Introduction to Hydrology. Warren Viessman, Gary L. Lewis., Pearson Education, 2012.

Soil Mechanics for Environmental Engineer

ENEV 604 003
3 credits
Expected Learning Outcomes (CLO):
ELO 1 Engineering Knowledge
ELO 2 Problem Analysis
ELO 4 Experiments

Course Learning Outcomes (CLO):

Students is able to explain the basic understanding of geology and able to explain the physical properties of soil and its parameters which covers its application in environmental engineering

Learning Experiences:

Syllabus :

Engineering geology and soil properties; definition of geological sciences, geoengineering with other disciplines/civil engineering; Topographical and geomorphological maps; How to read and analyze mineralogy, rock type, and stratigraphy, geological structure and its type; identification and influence plating, Croar, fault, misalignment for construction; Weathering and ground movements; Introduction of type, process, and identification of weathering; Explanation of classification process; Geological and geotechnical maps; Analysis of topographic base maps; Geotechnical geological map criteria; Property Land: Ground as a 3 phase material; Physical characteristics of soil; Classification of land; Atterberg limit; Soil compaction theory and CBR test; 1 dimensional flow in soil, permeability and introduction of groundwater seepage, flow tissue; Voltage theory and effective voltage principle; Effective voltage reaction due to total voltage change in the perfect saturated soil; Ground shear strength theory; Vigorous test of sliding soil in the laboratory on clay and sand; Consolidation theory and consolidation test; Ground support: The carrying power of the limit and the carrying capacity of permits due to tilt, eccentric loads; Elastic decline and decreased one-dimensional consolidation; Drawing a shallow foundation design; leaks through the dam; Distribution of ground voltage: Point load, line load, field path, Circle field, square field with Fadum and Newmark theory

Prerequisite: Environmental Engineering Material Properties

Textbook References:
1. Burchfiel BC & Foster RJ et .al., “Physical Geology”, Charlec E Merril Publishing Co., Colombus Toronto London Sydney, 1986.
2. Blyth, F.G.H. & de Freitas, M.H., “A Geology for Engineers, 7th Ed.”. Elsevier. 2005.
3. Craig, R.F., “ Soil Mechanics, 7th Ed.”, 2007
4. Bowles, J.E., “Physical and Geotechnical Properties of Soils”, McGraw-Hill Kogagusha Ltd., 1998.
5. Das, B.M., “Principles of Geotechnical Engineering”, Seventh edition, 2010, PWS Publishing Company, Boston
6. Budu M., “Soil Mechanics and Foundations”, Third Edition, 2010, John Wiley & Sons, New York

Environmental Chemistry

ENEV 604 004
3 credits
Expected Learning Outcomes (CLO):
ELO 1 Engineering Knowledge
ELO 4 Experiments

Course Learning Outcomes (CLO):

Students are able to explain the chemical factor of the environment that causes pollution and can conduct parameter testing for drinking water/waste quality

Learning Experiences:

Syllabus:

Raw water characteristics; Water Source and its function; body of water properties; Drinking water and water body quality standard; The chemical properties of the water body(physical, chemical); Microorganism as catalyst in water environmental chemistry; aquatic life; chemical substance in water body; Water pollution; Water parameters (acidity, alkalinity, hardness, turbidity, color, pH, Nitrogen, sulphate, colloidal and solid, iron and manganese, dissolved oxygen, BOD and COD, Fluoride and chlorine and residual chlorine).

Prerequisite: Basic Chemistry

Textbook References:
1. Manahan, S.E. (2005). Environmental Chemistry. Washington: CRC.
2. Sawyer, McCarty, and Parkin. (2003). Chemistry for Environmental Engineering and Science. Singapore: McGrawHill

Wastewater Collection System Design

ENEV 604 005
2 credits
Expected Learning Outcomes (CLO):
ELO 3 Design
ELO 6 Engineering and Society

Course Learning Outcomes (CLO):

Students are able to apply the principles of hydraulics and design criteria for the layout and dimensions of drainage channels and waste water pipes and their operational and maintenance aspects.

Learning Experiences:

Syllabus:

Hydrological cycles; water catchment area; Determination of the average rainfall from an area, rain plan with the distribution method, extreme; Intensity-duration curve determination of the rainy frequency of a region; The calculation of flood discharge plans for various retimes; Planning of drainage channel dimensions; Waste water collection system; Design criteria; Planning a network layout; Pipe Material; Design of waste water pipe dimensions; Pipe Accessories (turns, branches, valves, etc.); Support Infrastructure (pumps, manholes, siphon, interceptors, detensions tank, overflow, etc.); Pipe fitting method; Operational-Maintenance-Troubleshooting.

Prequisite: Environmental engineering hydraulics; urban planning and sanitation

Textbook References:
1. Introduction to Hydrology. Warren Viessman, Gary L. Lewis., Pearson Education, 2012.
2. Hydrology and Floodplain Analysis, 5th Edition. Philip B. Bedient, Wayne C. Huber, Baxter E. Vieux. Publisher: Prentice Hall ISBN-10: 0132567962, 816 pages. © February 25, 2012
3. Fair, Geyer and Okun. (2011). Water Supply and Wastewater Removal 3rd edition. John Wiley & Sons, Inc.

Unit Operation and Process

ENEV 605 002
4 credits
Expected Learning Outcomes (CLO):

ELO 2 Problem Analysis

Course Learning Outcomes (CLO):

Students are able to explain unit operations and unit processes used in water treatment and waste water, using the basic principles of engineering calculations for the deterimining processes of physics, chemistry, and biology.

Learning Experiences:

Syllabus:

Unit operations and processes based on the principle (physical processing, chemical, biology), classification level of water treatment plantl; the concept of balanced mass, flow model, and reactor; unit operation and process for oxygen transfer and mixing; unit operations and process of preliminary treatment in the process of water treatment and waste water; process and operation of the coagulation process and Flocculation; an operating unit of the separation of solid particles in the water treatment and waste water (sedimentation); an operating unit of the separation of solid particles through the porous media (filtration); biological processes for waste water treatment using suspended growth method, Stabilization Ponds and aerated Lagoons;); biological processes for waste water treatment using suspended growth method; unit operation and process in N and P removal; processing unit for organic sludge, chemical sludge; sludge from water treatment process; basic principle of adsorption, ion exchange and membrane.

Prerequisite:
Environmental Chemistry; Environmental Microbiology

Textbook Reference:
1. Rich, Linvil G : " Unit Operation for Sanitary Engineering"Management, McGraw Hill
2. Tom D. Reynolds and Paul Richards, Unit Operations and Process in Environmental Engineering Pws Series in Engineering; 1997

Environmental Laboratory

ENEV 605 003
3 credits
Expected Learning Outcomes (CLO):
ELO 4 Experiments
ELO 5 Modern Tools

Course Learning Outcomes (CLO):
1. Student are able to perform environmental sampling and analyze the result.
2. Student are able to apply the unit operation and process principle in operating the lab scale unit of water and wastewater treatment.
3. Student have the information about various modern laboratory equipment for testing the environmental sample

Syllabus:

The composition and characteristics of food waste and its impact to the environment; Food waste Sampling; Experimental design and data analysis; Sampling water in various water bodies; discrete process of particle sedimentation and flocculation; Chlorination process and chlorine dosing determination in water treatment; Modelling of biological processes, and the utilization of modern analytical equipment such as GC and AAS.

Prerequisite:

Basic Chemistry, Environmental Chemistry

Textbook References:
1. Sawyer, McCarty, and Parkin. (2003). Chemistry for Environmental Engineering and Science. Singapore: McGraw-Hill
2. Douglas C. Montgomery. 1976. Design and Analysis of Experiments.Wiley

Integrated Solid Waste Management Planning

ENEV 605 004
3 credits
Expected Learning Outcomes (CLO):
ELO 3 Design
ELO 6 Engineering and Society
ELO 7 Sustainability

Course Learning Outcomes (CLO):

Students are able to plan a solid waste management system in engineering aspects starting from the waste sources to the final processing plant.

Learning Experiences:

Syllabus:

General solid waste management system and its functional elements; Solid waste management system in Indonesia, policies and laws, related regulations; classification of domestic solid waste based on source, type and composition; Physical, chemical and biological characteristics of domestic solid waste; applicable physical, chemical, and biological transformation process; Source, type and charateristic hazardous solid waste in domestic solid waste; measurement methods for domestic solid waste generation from various sources and the estimation for its generation; solid waste handling at the source; Solid waste collection methods; Separation, processing and transformation of solid waste; Transfer and transport of solid waste in the technique of collecting operations; Method of discharge of solid waste and predict land use; Plan a city integrated solid waste handling system.

Prerequisite:

Textbook Reference:

1. Flintoff FF., 1983, Management of Solid Wastes in Developing Countries.
2. Tchobanoglous, 1977, Engineering Principles and Management Issues.
3. Tchobanoglouss, 1993, Integrated Solid Waste Management.
4. Wentz, 1989, Hazardous Waste Management.

Structural Design for Environmental Engineering Infrastructure

ENEV 605 005
3 credits
Expected Learning Outcomes (CLO):
ELO 2 Problem Analysis
ELO 3 Design

Course Learning Outcomes (CLO):

Able to apply design criteria in calculating and analyzing dimension for environmental engineering infrastructure and its maintenance.

Learning Experiences:

Syllabus:

Role of building structure science in design process of environmental engineering infrastructure; Explaining the various buildings of environmental engineering; Explaining the objectives, the process of structural design and various planning methods; Explaining the form, type, placement, distribution, factors and combinations of loading in the planning of reinforced concrete for building environmental engineering; Explaining the aspects and parameters of reinforced concrete planning for environmental engineering infrastructure; Explaining the material properties and the mechanics of reinforced concrete cross-section, the elastic concept and boundary strength, the simplification of the Whitney tension block and the balanced collapse; Analyzing and designing square reinforced concrete beams, with single and double reinforcement and T cross-section beams with against bending and sliding; Analyzing and designing the reinforcement for one-way and two-way plates; Analyzing the strength of both short and slim columns as well as structural walls against bending and axial force; Understand the structure of reinforced concrete square tank and circular tank for building environmental engineering; Water-resistant aspect in buildings; Aspect of durability; Reinforced concrete degradation mechanism; Prevention of reinforced concrete corrosion; Repair of reinforced concrete structures;

Prerequisite:

Environmental Engineering Material Properties, Structural Mechanic 1, Structural Mechanics 2

Textbook References:

1. Persyaratan beton struktural untuk bangunan gedung, SNI 2847:2013, Badan Standarisai nasional
2. Mac Gregor, J.G, *Reinforced Concrete: Mechanics and Design*, 6th .edition, Prentice-Hall, 2012.
3. *Code Requirements for Environmental Engineering Concrete Structures and Commentary*, ACI 350-06, American Concrete Institute, 2006, Farmington Hill
4. Beban miminum untuk perancangan gedung dan struktur lainnya, SNI 1727:2013, BSN 2013.
5. Wahyudi & Syahril A.R., *Struktur Beton Bertulang*, Gramedia, 1997.
6. John F. Seidensticker, Edward S. Hoffman, *Sanitary Structures – Tanks and Reservoirs*, Chapter 18 Handbook Concrete Engineering, Second Edition, Edited by Mark Fintel, Van Nostrand Reinhold Company Inc, 1985.
7. Rectangular Concrete Tanks, Concrete Information IS003.03D, Portland Cement Association, 1969, Revised 1981.
8. Underground Concrete Tanks, Concrete Information Sheet IS071.03D, Portland Cement Association.
9. Circular Concrete Tanks without Prestressing, ISBN 0-89312-125-8, Portland Cement Association,1993
10. El-Reedy, M. A. (2018). Steel-Reinforced Concrete Structures: Assessment and Repair of Corrosion, 2nd edition. CRC Press: Taylor & Francis Group.

Occupational Health, Safety and Environmental Risk

ENEV 606 001
2 credits
Expected Learning Outcomes (CLO):
ELO 2 Problem Analysis
ELO 9 Individual and Teamwork

Course Learning Outcomes (CLO):

Student able to explain the risk and hazard of environmental pollutant in water, air, soil and workplace environment towards human safety and health and able to describe the appropriate protection method when faced environmental health and safety issue.

Learning Experiences:

Syllabus:

Water, soil, and air pollutant, introduction to environmental toxicology, environmental risk analysis, Introduction to occupational health and safety, hazard and safety in industrial solvent usage, industrial dust and debris hazard and safety, hazard and safety of noise, radiation safety, ergonomic, evaluation for occupational health and safety, occupational health and safety and environment management system,

Prerequisite: -

Textbook References:
1. Hemond, H. and Fechner, E.J., 1999. Chemical Fate and Transport in the Environment 2nd Edition
2. Frank M. Dunnivant, Elliot Anders. 2006. A basic introduction to pollutant fate and transport: an integrated approach with chemistry, modeling, risk assessment, and environmental legislation
3. Wentz, Charles A. Safety, Health, and Environmental Protection, Boston; McGraw-Hill Book Co, 1998.

Environmental Impact Assessment and ISO
ENEV 606 002
3 credits
Expected Learning Outcomes (CLO):
ELO 2 Problem Analysis
ELO 7 Sustainability
ELO 8 Ethics

Course Learning Outcomes (CLO):

Students are able to apply EIA method and ISO 14000:1 as parts of environmental management as well as aninputs for safeguards for human and natural resources

Learning Experiences:

Syllabus:

Background and policy regarding environmental management in Indonesia; definition, purpose & benefit of EIA; environmental law and EIA regulation; EIA procedure; filtering procedure; EIA document components ; project description; initial environmental condition; Societal involvement result; the potential environmental impact on specific activities; procedure and method for identifying & evaluating environmental impact; area boundary and time frame; data collection method and analysis; forecasting method for potential impact; holistic evaluation methods for environmental impact; EIA & RKL-RPL document structure and components; history, definition, purpose and function of ISO 14000:1; ISO 14000:1 (clausal 1-10) standard structure.

Prerequisite:

Textbook References:
1. Canter, L.W., *Environmental Impact Assesment*, New York, McGraw-Hill, 1996.
2. Richard K. Morgan, Environmental Impact Assessment: A Methodological Perspective, Boston, Kluwer Academic Publisher, 1998.
3. SNI ISO 14001:2015 Sistem Manajemen Lingkungan – Persyaratan & Panduan Untuk Penggunaan, 2015.
4. Soemarwoto, Otto., Analisis Mengenai Dampak Lingkungan, Yogyakarta, Gadjah Mada University Press, 2007.
5. Suratmo F. Gunarwan, *Analisis Mengenai Dampak Lingkungan*, Yogyakarta, Gajah Mada University Press, 2007.

Environmental Engineering Project Management
ENEV 606 003
3 credits
Expected Learning Outcomes (CLO):
ELO 9 Individual and Teamwork
ELO 10 Communication
ELO 11 Project Management

Course Learning Outcomes (CLO):
1. Able to select and plan project management from project initiation to project implementation and hand over works
2. Able to communicate and work in team
3. Able to deliver ideas verbally and written report

Learning Experiences:

Syllabus:

Project: environmental infrastructure, project initiation: project selection, Planning project: major activities and supporting activities; Implementation of the project: plan implementation, quality assurance, Healt, safety and environmental management, material procurement processes, equipment and services; Control of the project: project performance reporting, control activities, time, cost and quality; Closure of the project: the introduction of asset management / infrastructure

Prerequisite:

Textbook References:
1. Blank, L and Tarquin, A., Engineering Economy, McGraw-Hill, New York, 2002
2. Duffield, C.F and Trigunarsyah, B., Manajemen Proyek – dari Konsepsi sampai Penyelesaian, Engineering Education Australia, Melbourne, 1999
3. Europen Construction Institute, Total Project Management of Construction Safety, Health and Enviornment, Thoman Telford, London, 1995
4. Halpin, D, W and Woodhead, R.W., Costruction Management, 2nd ed., John Wiley & Sons Inc., New York, 1998
5. Project Management Institute, A Guide to the Project Management Body of Knowledge (PMBOK®Guide). PMI, USA 2000
6. Project Management Institute, A Guide to the Project Management Body of Knowledge (PMBOK®Guide). PMI, USA 2013
7. Slough, R.H., Sears, G.A. and Sears, S.K., Construction Project Management, 4th ed., John Wiley & Sons Inc., New York, 2000

Water Treatment Plant Design
ENEV 606 004
3 credits
Expected Learning Outcomes (CLO):
ELO 2 Problem Analysis
ELO 3 Design

Course Learning Outcomes (CLO):
1. Able to analyze raw water characteristic, water quality regulation, as well as technical and non-technical considerations to determine the type of water intake, water transmission and drinking water treatment system for a region or a city
2. Able to determine the design parameter, detail the component, dan calculate the dimension of water treatment unit based on technical and non-technical considerations.

Learning Experiences:

Syllabus:

Water supply systems and their components, raw water resource and its utilization, raw water and drinking water standard quality, selecting water resource; water catchments and water transmission and equipment, water treatment, physical treatment, chemicals treatment, reservoir, equipments of another installation, layout, hydraulic profile

Prerequisite:

Unit Operation and Process, Environmental Engineering Hydraulics, Urban Planningn and Sanitation

Textbook References:
1. Cheremisinof. Handbook of Water and Waste Water Technology, 1995
2. Water and Wastewater Technology, Mark J. Hammer, 1996
3. Water Supply and Sewerage, Terence J. Mc.Ghee, 1991

4. Water Treatment Principles and design, J. M. Montgomery, 1985
5. Water Works Enginering, Planning, Design & Operation , Syed R. Qasim, 2000

Domestic Wastewater Treatment Plant Design

ENEV 606 005
3 credits
Expected Learning Outcomes (CLO):
ELO 2 Problem Analysis
ELO 3 Design

Course Learning Outcomes (CLO):

1. Able to analyze wastewater characteristic, water quality standard and regulation, as well as technical and non-technical considerations to determine the wastewater treatment system for a region or a city.
2. Able to determine the design parameter, detail the component, dan calculate the dimension of wasterwater treatment unit based on technical and non-technical considerations.

Learning Experiences:

Syllabus:

Problems and challenges of wastewater management; Sources and characteristics of wastewater; Environmental quality standards; Local and centralized systems; Alternative treatment; Processing level; removal efficiency; Non-technical aspects and environmental impacts of WWTP; Selection of process; Design criteria; filtration; equalization; sand filtration and sedimentation; Suspended Growth Aerobic Treatment; Attached Growth Aerobic Treatment; Anaerobic Treatment; disinfection; sludge processing; layout, hydraulic profile.

Prerequisite:
Unit Operation and Process, Environmental Engineering Hydraulics, Urban Planning and Sanitation

Textbook References:
1. Metcalf and Eddy, Wastewater Engineering Treatment and Disposal, Reuse, Singapore, McGraw-Hill Inc, 2004.
2. Qasim, Syed R. Zhu, Guang. (2017). Wastewater Treatment and Reuse, Theory and Design Examples, Volume 1 Principles and Basic Treatment. CRC Press

Air Pollution

ENEV 606 006
3 credits
Expected Learning Outcomes (CLO):

ELO 2 Problem Analysis

Course Learning Outcomes (CLO):
1. Able to explain source, type and impact of air pollution and related air pollution policy
2. Able to explain meteorology factor and air pollution mechanism
3. Able to analyze appropriate technology for air pollution control
4. Able to examine gas and particulate pollutant from air

Learning Experiences:

Syllabus:

History of air pollution; standard and regulation about air pollution; air pollution impact; meteorology factor and air pollution mechanism; sulfur oxide; nitrogen oxide; particulate; volatile organic compounds; waste inventory and case study; indoor air pollutants; particulate and gas practicum; gas and particulate pollution control.

Prerequisite:
Environmental Laboratory; Domestic wastewater treatment

Textbook References:
1. Vallero, D.2008. Fundamentals of Air Pollution. Fourth Edition.Ap: USA.
2. De Nevers, N. 2000. Air Pollution Control Engineering. McGraw Hill: USA

Final Project on Environmental Engineering Infrastructure

ENEV 607 001
4 credits
Expected Learning Outcomes (CLO):
ELO 3 Design
ELO 9 Individual and Team Works
ELO 10 Communication
ELO 11 Project Management

Course Learning Outcomes (CLO):

Able to design a sustainable environmental engineering buildings/infrastructure and present it in the form of tender documents which include: i) detailed technical design drawings, ii) requirements work plans, iii) cost budget plans, and iv) other supporting documents and able to present these designs to the examiner.

Learning Experiences:

Syllabus:

Problem identification in accordance to the project terms of reference; negotiation for the planning component related to the scope of work and the scheduling; Formulation for the primary and secondary components of the environmental engineering building structure for analysis; Iteration of alternative solutions and decision making; Report of the study includes the planning concept, calculation methods, and implementation methods, by applying regulations, manuals and standards; Final report of the proposal including technical specifications, unit price calculations, details of the overall cost of work, and detail engineering drawings of the primary components and other supporting documents such as monitoring plans, maintenance to produce a sustainable building life cycle.

Prerequisite:
Student should have taken these courses: Structural Design for Environmental Engineering Infrastructure, Engineering Economics, Water Treatment Plant Design, Domestic Wastewater Treatment Plant

Textbook References:
1. Clive L Dym, Patrick Little, Elizabeth Orwin. (2014). Engineering Design, A Project-Based Instroduction 4th Edition. John Wiley & Sons, Inc.
2. SNI and other related national and international standard.

Hazardous dan Industrial Waste Treatment

ENEV 607 002
3 credits
Expected Learning Outcomes (CLO):
ELO 2 Problem Analysis
ELO 7 Sustainability
ELO 8 Ethics

Course Learning Outcomes (CLO):

Students are expected to implement processes and technology of industrial waste treatment within the framework of environmental pollution control and environmental work

Learning Experiences:

Syllabus :

Global Agenda 21 and Indonesia Agenda 21 in sustainable development especially in waste management; Policy and regulation regarding environmental management in industry; environmental support concept and environmental components in industrial waste management; source, type, and characteristic of industrial waste based on raw material, processs, and the product utilization; pollution impact (pollutant in form liquid, solid and gas), vibration and noise toward human health and the environment; pollution prevention and minimizing the industrial waste; process and technology for wastewater, solid waste and air pollution; case study in industrial waste management.

Prerequisite:

Textbook References:

1. La Grega (1994), 'Hazardous Waste Management' ERM, England
2. Nemerow (1992),'Industrial and Hazardous Waste Pollution Control', McGraw-Hll, Singapore
3. W.W. Eckenfelder (1989),'Industrial Water Polluiton Control', McGraw-Hill, Singapore

Writing and Presentation Technique

ENEV 607 003
2 credits

Expected Learning Outcomes (CLO):

ELO10 Communication.

Course Learning Outcomes (CLO):

1. Student are able to communicate effectively within the scope of academic activities such as reporting the result of field internship, research proposal and undergraduate thesis
2. Student able to present ideas when it is required using correct Bahasa Indonesia grammar in verbal presentation and written report
3. Student are able to prepare his/her curriculum vitae and motivation letter for job seeking purposes, scholarship, and/or pursuing higher education

Learning Experiences:

Syllabus:

Introduction: the importance of verbal and written communication; written communication using proper Bahasa Indonesia and English; data visualization using table, graph and chart; how to create a good presentation using power point; preparing a curriculum vitae; writing motivation letter

Prequisites: -

Textbooks:

Ruiz-Garrido, Miguel. Palmer-Silveira, Juan C., Fortanet-Gomez, Immaculada. English for Professional and Academic Purposes.

Field Internship

ENEV600 100
3 credits
Expected Learning Outcomes (CLO):
ELO 8 Ethics
ELO 9 Individual and Teamwork
ELO10 Communication
ELO 11 Project Management

Course Learning Outcomes (CLO):

Students are able to describe civil and environmental engineering job/project at internship site, identify problems, conduct analysis and possible solution, and reporting in written document which will be defended in front of examiner team.

Learning Experiences:

Syllabus:

Specify the work object to be studied and poured in the proposal; To perform an internship in a place that has been approved and in accordance with its interests; Learn and describe technical work processes, quality control, project management, project specifications, engineering drawings, and other aspects; technical problem identification at internship workplace, quality control, project management, project specification; engineering drawing and other aspects; problem analysis on every project stage; identify possible solution for ever project stage; final report describe the project; Problem Solving

Prerequisite:

1. Student is at Semester VI and have obtained > 75 SKS in accordance to Department of Civil Engineering regulation and/or Faculty of Engineering Universitas Indonesia regulation.
2. Have filled in IRS for Field Internship and have submit the field internship request to the Field Internship Coordinator at Department of Civil Engineering.
3. Student should have chosen prospective project or internship workplace.
4. Student should filled in and submit the field internship registration form to The Secretariat of Department of Civil Engineering

Textbooks:

Undergraduate Thesis

ENEV 600 400
5 credits
Expected Learning Outcomes (CLO):
ELO 4 Experiment
ELO 8 Ethics
ELO 10 Communication
ELO 12 Lifelong Learning

Course Learning Outcomes (CLO):

Student are able to chose an appropriate methods for the research, appropriately conduct research, write the thesis using a correct grammar and present the result in a scientific report and an oral presentation.

Learning Experiences:

Syllabus:

Problem formulation, study literature, research, data analysis, result interpretation, report writing and oral presentation.

Prerequisite: -

Textbook References:

ELECTIVE COURSE IN ENVIRONMENTAL ENGINEERING UNDERGRADUATE PROGRAMME

Elective Course in Environmental Engineering Undergraduate Programme

Service Learning

ENEV 600 300
1 credits
Expected Learning Outcomes (CLO):

ELO 12 Lifelong Learning

Course Learning Outcomes (CLO):

Able in indepedently managing time while being active participating extracurricular activities such as ; competition; seminar (national and international); social works; student organization; event organizer; etc. Actively participating in extracurricular activities will develop independency, critical thinking, social sensitivity, ability to work underpressure, and profesionalism.

Learning Experiences:

Syllabus :

Student participate extracurricular activities. The participation of each activity will be calculated of its equivalent point (score). Each student should obtain specific point (score) in accordance to the environmental engineering programme.

Prerequisite:

Student can claim the credit after obtaining certain minimum points.

Textbook References:

Term of Reference for Service-Learning Course in Curriculum of Department of Civil Engineering 2020

Applied Sanitation

ENEV 604 101
3 credits
Expected Learning Outcomes (CLO):

ELO 3 – Design

Course Learning Outcomes (CLO):

Able to analyze the applied sanitation needs in slum area with contextual consideration of social problem, health problem, safety problem, and in accordance to the local law and tradition.

Learning Experiences:

Syllabus:

Introduction to the development of clean water access and sanitation, basic concept, sanitation for the rich and the poor, global clean water and sanitation. Utility approach for the poor and slum dwellers in Indonesia. Water, sanitation, and disease related to sanitation. Funding for clean water access and sanitation. Decentralized water treatment and storage. On-site sanitation system. WWTP, Sanimas and Pamsimas Programme. Case study : Sanitation for slum area project.

Prerequisite:
Currently take or have taken course: Urban Planning and Sanitation

Textbook References:
1. Appropriate Technology for Water Supply and Sanitation, A.K.M. Nurul Islam and Hidetoshi Kitawaki (1996)
2. Progress on drinking-water and sanitation : special focus on sanitation, WHO/Unicef (2008)
3. Sustainable Water and Sanitation Services The Life-Cycle Cost Approach to Planning and Management, Routledge Taylor Francis (2013)

Internship A

ENEV 600 500
1 credits
Expected Learning Outcomes (CLO):

ELO 9 Individual and Team Work

Course Learning Outcomes (CLO):

Student are able to execute the delegated task by the internship supervisor professionally and able to show positive attitude in the workplace.

Learning Experiences:

Syllabus :
1. Able to accept input and instruction from supervisor or colleague
2. Able to accurately report and execute the delegated task
3. Able to finish the task on schedule
4. Able to adapt to the vision, mission and culture at the workplace
5. Have positive attitude towards the delegated task and with the colleague
6. Have initiative attitude
7. Be on time at the workplace
8. Participate in workplace activities in accordance to workplace ethics and cultures

Prerequisite: -

Textbook References :

Introduction to Environmental Economics

ENEV 605 102
3 credits
Expected Learning Outcomes (CLO):

ELO 11 Project Management

Course Learning Outcomes (CLO):
1. Able to describe how environmental problem can be explained and analyzed using economic theory approach
2. Able to communicate and work in team on how pollution in economic activities can be abated.

Learning Experiences:

Syllabus:

Definition of environmental economics, environment as raw material, environment and sustainable development, economic system and environmental function, types and source of pollution and pollution control, environmental valutation, policy instrument in environmental protection.

Textbook References: -
1. Ekonomi Lingkungan, 2000. Drs. Suparmoko. M.A., Ph.D, Maria R. Suparmoko, S.E.,M.A.
2. Ekonomika Pembangunan, 2002. Drs. Irawan, M.B.A., Drs. M. Suparmoko, M.A., Ph.D.
3. Natural Resource and Environmental Economics, 2011. Perman, R.,Y. Ma., J. McGilvray, and M. Common

Entrepreneurship

ENEV 606 005
2 credits
Expected Learning Outcomes (CLO):
ELO 6 Engineering and Society
ELO 13 Entrepreneurship

Course Learning Outcomes (CLO):

Students are able to explain the comparison of various entrepreneurial activity of civil / environmental engineering characterized by innovation and self-reliance based on ethics and able to communicate visually and verbally

Learning Experiences:

Syllabus:

Introductions and overview of entrepreneurship (definition of entrepreneurship; Entrepreneurship in environmental engineering field; Identify environmental issues as an entrepreneurial opportunity), Design Thinking concept and Value Preposition Canvas (Introduction to Design Thinking and Value Preposition Canvas; Identify problems related to the environmental engineering for potential customers; Identify VPC components for potential customers; Identification of present environmental engineering solutions in Indonesia), Business model canvas Concept (Introduction of Business model canvas; Potential business plan; Expenditure and income in the business plan; Definitions of resources, activities, and partners in a business plan; Definition of customer segments, relationships and channels in a business plan; Identify differences and similarities between BMC components; Assessment of advantages and disadvantages of each element of BMC)

Prerequisite: Integrated Character Building Course , Introduction to Environmental Engineering System, Urban Planning and Sanitation

Textbook References:

1. Alexander Osterwalder, Yves Pigneur, Gregory Bernarda, Alan Smith, John Wiley & Sons, 28 Jan 2015, Value Proposition Design: How to Create Products and Services Customers Want
2. Alexander Osterwalder; Yves Pigneur, Hoboken, N.J. : Wiley, ©2010, Business model generation : a handbook for visionaries, game changers, and challengers

Environmental Modelling
ENEV 605 104
2 credits
Expected Learning Outcomes (CLO):
ELO 2 Problem Analysis
ELO 5 Modern Tool

Course Learning Outcomes (CLO):

1. Students are able to explain ekokinetika polluters in the water environment (C2)
2. Students are able to simulate the process of pollutant fate and transport in a single-dimensional environment using the advanced calculus basis, fluid mechanics and environmental chemistry (C3)

Learning Experiences:

Syllabus:

Introduction to environmental modeling, the pollutant mass equilibrium principle in controlled volumes, advection and diffusion processes, pollutants reaction in the environment, the general solutions for pollutants dynamics in the environment, characterization of pollutants, specific solutions to the pollutant dynamics in the environment, numerical solutions of pollutants in the environment, environmental modeling applications.

Prerequisite:

Textbook References:

Steven C. Chapra, 1997, Surface Water-Quality Modeling. Waveland Press. Inc.

Environmental System Analysis
ENEV 606 105
3 credits
Expected Learning Outcomes (CLO):

ELO 2 Problem Analysis

Course Learning Outcomes (CLO):
1. Able to explain basic principle of environment as a system with the interaction between its component (social, natural, and artificial)
2. Able to simulate the amount, the concentration, the level of hazard and impact of pollutant in the environment

Learning Experiences:

Syllabus :

Definition of environmental system with its subsystem (natural, artificial, and social); the dynamics of environmental system (the principle of environmental sciences: interaction, interdependency, diversity, harmony, and continuity). Physical dynamics of environmental system (matter and energy cycles, hydrology cycles, food cycles, and disturbance caused by environmental pollution)l; Physical environmental management model (factor determination, media and physical component interaction); Social system management model (conflict management and environmental mediation); Physical case study and social case study.

Prerequisite: -

Textbook References:
1. Tyller Miller, Living in The Environment, McGraw-Hill, Singapore, 1994
2. Amy, The Polities of Environmental Mediation, Columbia University Press, 1987
3. Fisher dkk, Mengelola Konflik Ketrampilan dan Strategi Untuk Bertindak, The British Council, Jakarta, 2000

Internship B
ENEV 600 600
3 credits
Expected Learning Outcomes (CLO):

ELO 9 Individual and Team Work

Course Learning Outcomes (CLO):

Student are able to execute the delegated task by the internship supervisor professionally and able to show positive attitude in the workplace.

Learning Experiences:

Syllabus :
1. Able to accept input and instruction from supervisor or colleague
2. Able to accurately report and execute the delegated task
3. Able to finish the task on schedule
4. Able to adapt to the vision, mission and culture at the workplace
5. Have positive attitude towards the delegated task and with the colleague
6. Have initiative attitude
7. Be on time at the workplace
8. Participate in workplace activities in accordance to workplace ethics and cultures

Prerequisite: -

Textbook References :

Monitoring and Optimation of Water Treatment Plant
ENEV 607 106
2 credits
Expected Learning Outcomes (CLO):

ELO 4 Design.

Course Learning Outcomes (CLO):

Able to evaluate to performance of a water treatment plant based on treatment efficiency, criteria design, operation and maintenances and able to provide technical recommendation to improve the treatment capacity and its performance.

Learning Experiences:

Syllabus:

Water treatment process overview in WTP; the operational of treatment unit; monitoring the water quality in WTP; typical technical problem occurred in WTP and its troubleshooting; lab scale simulation in evaluating the treatment unit performance; design parameter evaluation; performance and the capacity optimation strategy, case study.

Prerequisite:
Water Treatment Plant Design, Domestic Wastewater Treatment Plant Design

Textbook References:
1. Mackenzie L. Davis. (2010). Water and Wastewater Engineering, Design Principles and Practice. McGraw-Hill Companies. ISBN: 978-0-07-171385-6
2. Warner, E. G. and Pinheiro, R. G. (2001). Upgrading Water Treatment Plants. World Health Organization. ISBN 0-203-34232-1

Emerging Topics on Environmental Engineering
ENEV 607 107
3 credits
Expected Learning Outcomes (CLO):
ELO 10 Communication
ELO 12 Life Long Learning

Course Learning Outcomes (CLO):

1. Able to examine the emergin topics in the system of engineering and examines current topics in systems engineering and environmental infrastructure through industrial and academic guest lectures, case studies and practical projects (C4)
2. Able to relate the latest topics in environmental engineering and infrastructure systems with the basic competencies of environmental engineering that they already have.

Learning Experiences:

Syllabus :

The world is developing rapidly, it provides a better human life but also gives unwanted challenges. Various problem arise that require unconventional approach such as creativity and specific paragdim. In this course, student will learn about emerging issue from environmental engineering perspective. The topic will change during 2020 curriculum in accordance to the current world issues. In the year of 2020/2021, the topic is about the sanitation, clean water, waste water, and solid waste that are related to COVID-19 pandemic. The survival rate of this virus is high in the environment, especially in certain surface such as plastic, paper, sewage and even in fecal matter. This condition increases the possibility that the virus might thrives in domestic solid waste and domestic wastewater generated from the infected area. The waste might be a transmission media to the virus. This course aims to prepare the student in facing the pandemic crisis and able to provide an appropriate response from environmental engineering perspective.

Prerequisite:
Student have takaen 100 SKS

Textbooks References:
Shah, Vishal (Ed.), Emerging Environmental Technologies, Springer (2008).

Sludge processing and Valorization
ENEV 608 108
2 credits
Expected Learning Outcomes (CLO):

ELO 3 Design

Course Learning Outcomes (CLO):

Able to determine the system and its detail of sludge processing in accordance to technical and non-technical aspect and able to express alternative technology for sludge utilization.

Learning Experiences:

Sylllabus:

Background and purpose of sludge processing, source and characteristic of sludge, mass balance analysis, treatment system, primary treatment; sludge thickening; sludge stabilization; sludge conditioning; sludge drying; final disposal; advanced processing; sludge alternative utilization (as adsorbent, construction material, coagulant recovery, etc).

Prerequisite:

Water Treatment Plant Design; Domestic Wastewater Treatment Design;

Textbook References:
1. Qasim, S. R., Zhu, G. (2018). Wastewater treatment and reuse, theory and design examples. Volume 2, Post-treatment, reuse, and disposal. Taylor & Francis Group, LLC. CRC Press. ISBN: 13978-1-138-30094-1
2. SNI dan standar internasional yang terkait

Special Topic of Research Collaboration
ENEV 600 700
3 credits
Expected Learning Outcomes (CLO):

ELO 10 (Communication)

ELO 12 (Life Long Learning)

Course Learning Outcomes (CLO):

Able to apply environmental engineering knowledge to solve complex engineering solve through environmental engineering knowledge through research along with other engineering areas that follow a proper research methodology.

Learning Experiences:

Syllabus:

Conduct literature study, select research methodology, data analysis and interpretation, and draw a valid conclusion

Prerequisite:

Textbook References:

Pollution Prevention
ENEV 608 109
3 credits
Expected Learning Outcomes (CLO):

ELO 6 Engineer and Society

Course Learning Outcomes (CLO):
1. Students are able to explain pollution Prevention method in industry
2. Student are able to evaluate the effectiveness of industrial pollution prevention method

Learning Experiences:

Sylllabus :

ISO 14000:1 concept in the pollution prevention implementation (sustainability concept in pollution prevention policy and implementation, energy and conservation concept, concept of planning, implementation, monitoring, and policy evaluation, value stream mapping), pollution prevention method for every environmental aspect (Pollution prevention in Indonesia and global). The effectiveness of pollution prevention method (The

Overview of pollution prevention effectiveness in industry, industrial waste treatment and recycle, good housekeeping method in industry, Chemical laboratory pollution prevention).

Prerequisite: -

Textbook References :

1. Paul L. Bishop, McGraw-Hill, 2000, Pollution Prevention: Fundamentals and Practice McGraw-Hill series in water resources and environmental engineering
2. Ryan Dupont, Kumar Ganesan, Louis Theodore, CRC Press, 2016, Pollution Prevention: Sustainability, Industrial Ecology, and Green Engineering, Second Edition

Course of Fast Track S1-S2 Environmental Engineering

Code	Subject	SKS
	1st Semester	
	Religion	2
	Academic English	**2**
ENGE 600 001	Calculus 1	3
ENGE 600 009	Basic Chemistry	2
ENCV 601 001	Physics (Mechanics and Thermal)	4
ENEV 601 001	Introduction to Environmental Engineering System	**3**
ENEV 601 002	Global Environmental Issues	2
ENEV 601 003	Basic Chemistry Laboratory	1
	Sub Total	**19**
	2nd Semester	
	Integrated Charater Building	5
ENGE 600 002	Calculus 2	3
ENGE 600 004	Linear Algebra	4
ENCV 603 003	Fluid Mechanics	3
ENEV 602 001	Earth Science and Mapping	2
ENEV 602 002	Construction Drawing for Environmental Engineer	2
ENEV 602 003	Environmental Biology	2
	Sub Total	**21**
	3rd Semester	
ENCV 603 004	Statistics and Probabilistic of Experimental Design	2
ENEV 603 001	Environmental Engineering Mathematic	3
ENEV 603 002	Environmental Microbiology	3
ENEV 603 003	Environmental Engineering Material	2
ENEV 603 004	Environmental Hydraulics	3
ENEV 603 005	Structural Mechanics I	2
ENEV 603 006	Urban Planning and Sanitation	3
ENEV 603 007	Effective Communication	2
	Sub Total	**20**
	4thSemester	
ENGE 600 011	Engineering Economics	3
ENEV 604 001	Structural Mechanics II	2
ENEV 604 002	Drinking Water Distribution System Design	2
ENEV 604 003	Soil Mechanics for Environmental Engineer	3
ENEV 604 004	Environmental Chemistry	3
ENEV 604 005	Wastewater Collection System Design	2
	Elective/ Minor	**3**
	Sub Total	**18**

	5th Semester	
ENCV 606 005	Entrepreneurship	2
ENEV 605 001	Environmental Modelling	2
ENEV 605 002	Unit Operation and Process	4
ENEV 605 003	Environmental Laboratory	3
ENEV 605 004	Integrated Solid Waste Management Planning	3
ENEV 605 005	Structural Design for Environmental Engineering Infrastructure	3
	Elective/ Minor	**3**
	Sub Total	**20**
	6th Semester	
ENEV 606 001	Occupational Health, Safety and Environmental Risk	2
ENEV 606 002	Environmental Impact Assessment and ISO	3
ENEV 606 003	Environmental Engineering Project Management	3
ENEV 606 004	Water Treatment Plant Design	3
ENEV 606 005	Domestic Wastewater Treatment Plant Design	**3**
ENEV 606 006	Air Pollution	3
	Elective/ Minor	3
	Sub Total	**20**
	7th Semester	
ENEV 600 100	Field Internship	3
ENEV 607 001	Final Project on Environmental Engineering Infrastructure	4
ENEV 607 002	Hazardous and Industrial Waste Treatment	3
ENEV 607 003	Writing and Presentation Technique	2
ENEV 801 101	Environmental Data Analysis	3
ENEV 801 102	Environmental Risk Manage-ment	3
	Specialization Compulsary Course S2	3
	Sub Total	**21**
	8th Semester	
ENEV 600 300	Service Learning	1
ENEV 600 400	Undergraduate Thesis	5
ENCV 802 103	Research Method	3
ENEV 802 104	Environmental Engineering Special Topic	3
	Specialization Compulsary Course S2	3
	Sub Total	**15**
	9th Semester	
ENEV 800 104	Pra Thesis	2
	Specialization Compulsary/ Elective Course (S2)	3
	Specialization Compulsary/ Elective Course (S2)	3
	Specialization Compulsary/ Elective Course (S2)	3
	Sub Total	**11**
	10th Semester	
ENCV 800 105	Master Thesis	6
ENCV 800 106	Scientific Pub;lication	2
	Specialization Compulsary/ Elective Course (S2)	3
	Sub Total	**11**

Undergraduate Program in Mechanical Engineering

Program Specification

1.	**Awarding Institution**	Universitas Indonesia Double Degree: Universitas Indonesia and Partner University	
2.	**Teaching Institution**	Universitas Indonesia Double Degree: Universitas Indonesia and Partner University	
3.	**Faculty**	Engineering	
4.	**Study Programme**	Undergraduate Program in Mechanical Engineering	
5.	**Vision and Mission**	VISION As a center of research and education services that excel in mechanical engineering MISSION Carry out research and research-based education for the development of science and technology in the field of mechanical engineering, and conduct research and education that seeks its use to improve the level and quality of people's lives and humanity.	
6.	**Classes**	Regular, Parallel and International	
7.	**Final Award**	Sarjana Teknik (S.T) Double Degree: Sarjana Teknik (S.T) and Bachelor of Engineering (B.Eng)	
8.	**Accreditation / Recognition**	Accreditation of BAN-PT (Excellent) Internasional Assesment from Asean University Network-Quality Assurance (AUN-QA) Accreditation of Indonesia Accreditation Board For Engineering Education (IABEE), General Accreditation.	
9.	**Language(s) of Instruction**	Bahasa Indonesia and English	
10.	**Study Scheme (Full Time / Part Time)**	Full Time	
11,	**Entry Requirements**	High school /equivalent, or D3 / Polytechnique / equivalent, AND pass the entrance exam.	
12.	**Duration for Study**	Designed for 4 years	
	Type of Semester	Number of Semester	Number of weeks / semester
	Regular	8	17
	Short (optional)	3	8
13.	**Aims of the programme:** 1. Producing Mechanical Engineering graduates who meet the specified learning outcomes 2. Contribute to the development of scientific and mechanical technology 3. Contribute to improving the quality of society and industry		
14.	**Profile of Graduates:** Bachelor of Mechanical Engineering who is able to analyze and design energy systems, industrial machinery, building facilities, and the transportation industry in contributing to meeting the goals of sustainable development.		

15.	**Expected Learning Outcomes (ELO):** 1. Able to apply basic knowledge of mathematics, numerical methods, statistical analysis and basic science and information technology. 2. Able to design energy systems, industrial machinery, building facilities, and the transportation industry to meet the expected needs within realistic boundaries, as well as to recognize and / or utilize the potential of local and national resources with global insight. 3. Able to carry out experiments, dig up information and analyze data, report the results of experiments by applying statistical rules. 4. Able to think critically, creatively, and innovatively in identifying, formulating, analyzing and solving mechanical engineering problems. 5. Able to apply modern methods, skills and technical tools needed for engineering practices such as the selection of materials and processes, automation systems, and computer-aided mechanical designs. 6. Able to communicate effectively both visually, in writing and verbally. 7. Able to design, plan, complete and evaluate tasks within the existing constraints. 8. Able to work effectively both individually and in teams across disciplines or across cultures 9. Able to take responsibility and adhere to the ethics of the engineering profession and entrepreneurship which is characterized by innovation and independence. 10. Able to carry out lifelong learning processes including access to knowledge related to relevant contemporary issues.
16.	**Composition of Subjects**

No.	Classification	Credit Hours (SKS)	Percentage
i	**University General Subjects**	**9**	**6,3 %**
ii	**Basic Engineering Subjects**	**20**	**13,9 %**
iii	**Core Subjects**	**81**	**56,3 %**
iv	**Specialization Subjects**	**-**	
v	**Elective Subjects**	**26**	**18,1 %**
vi	**Internship, Seminar, Undergraduate Thesis,**	**8**	**5,6 %**
	Total	**144**	**100 %**
	Total Credit Hours to Graduate		**144 SKS**

Career Prospects

Graduates of this study program can work in various fields such as a) energy systems, b) industrial machinery, c) building facilities, and d) transportation industry, as:

1. Researchers of mechanical elements and systems (mechanical, thermal and fluid systems, materials and production processes)
2. Mechanical systems engineer
3. Managers in the government and private sectors
4. Planners in the process of design, construction, operation and maintenance of machines
5. Civil society motivators and instructors
6. Engineering project inspector
7. Sales & Service Engineers
8. Entrepreneur
9. Adjuster

Curriculum Structure Undergraduate Mechanical Engineering Program

Profile of Graduates

Bachelor of Mechanical Engineering who is able to analyze and design energy systems, industrial machinery, building facilities, and the transportation industry in contributing to meeting the goals of sustainable development.

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(ELO 9) Able to take responsibility and adhere to the ethics of the engineering profession and entrepreneurship which is characterized by innovation and independence.

(ELO 2) Able to design energy systems, industrial machinery, building facilities, and the transportation industry to meet the expected needs within realistic boundaries, as well as to recognize and / or utilize the potential of local and national resources with global insight.

(ELO 10) Able to carry out lifelong learning processes including access to knowledge related to relevant contemporary issues.

(ELO 4) Able to think critically, creatively, and innovatively in identifying, formulating, analyzing and solving mechanical engineering problems.

(ELO 7) Able to design, plan, complete and evaluate tasks within the existing constraints.

↑

(ELO 5) Able to apply modern methods, skills and technical tools needed for engineering practices such as the selection of materials and processes, automation systems, and computer-aided mechanical designs.

(ELO 3) Able to carry out experiments, dig up information and analyze data, report the results of experiments by applying statistical rules.

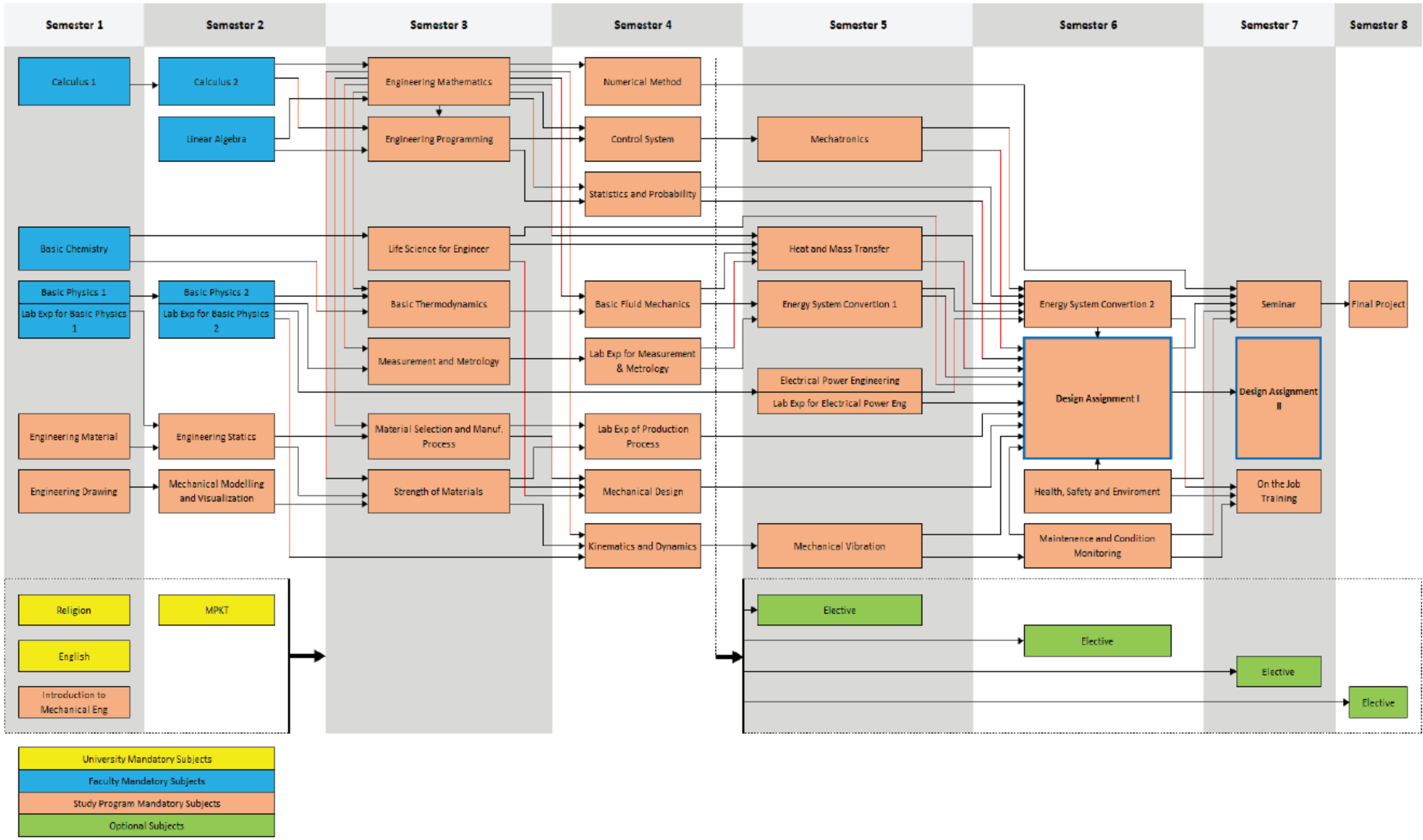
↑

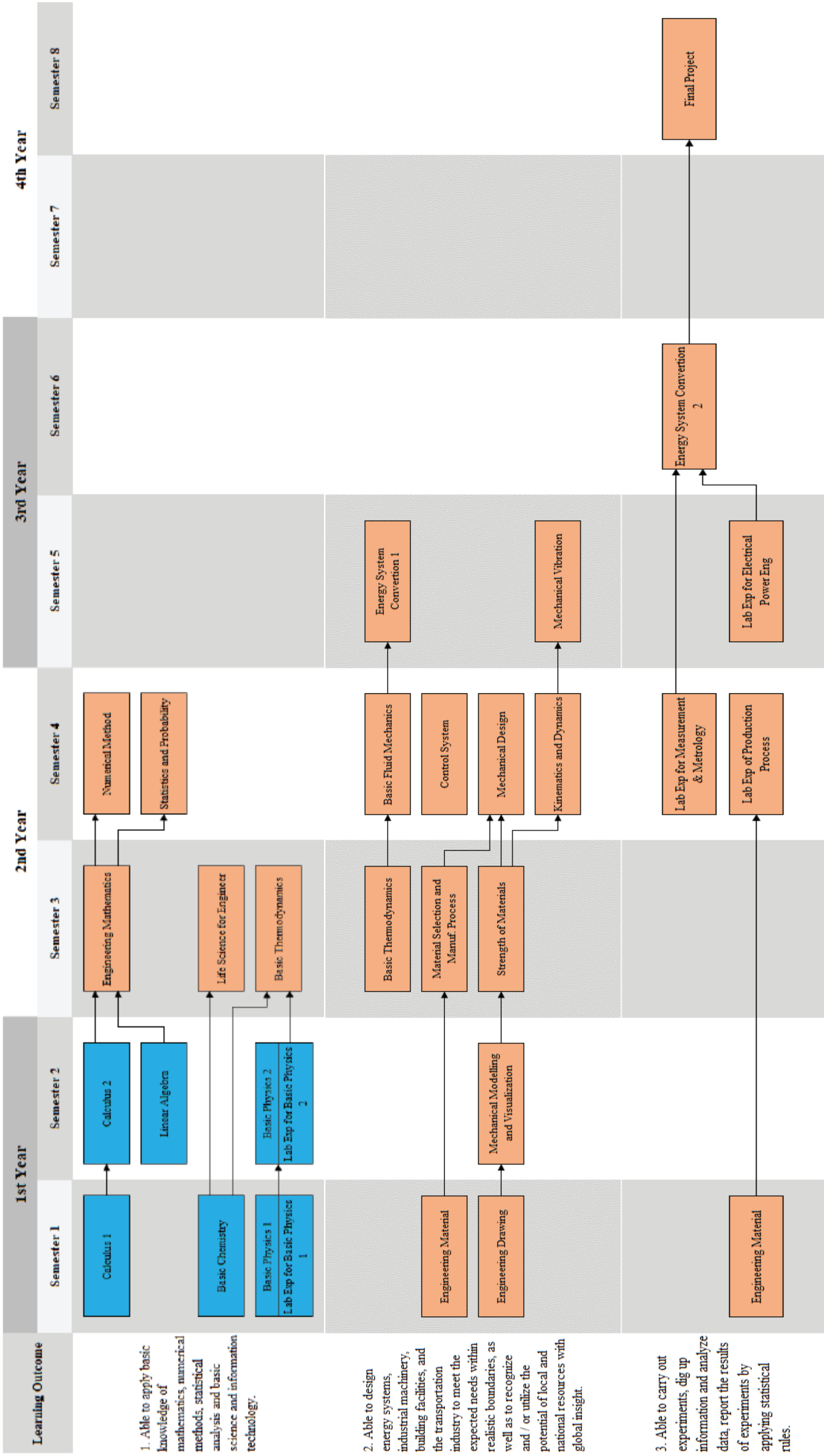
(ELO 6) Able to communicate effectively both visually, in writing and verbally.

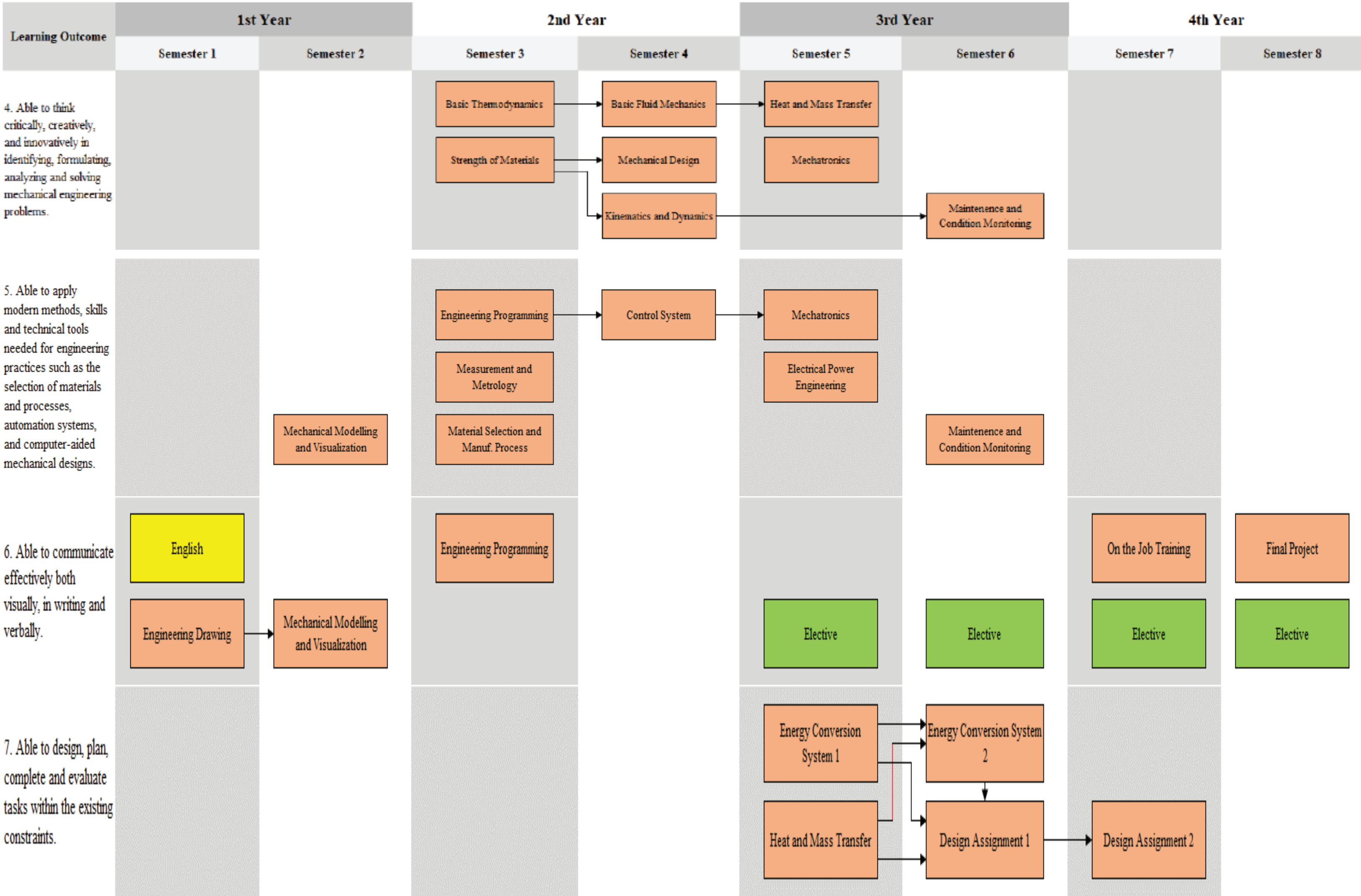
(ELO 1) Able to apply basic knowledge of mathematics, numerical methods, statistical analysis and basic science and information technology.

(ELO 8) Able to work effectively both individually and in teams across disciplines or across cultures.

Course Flow Chart to Achieve Learning Outcomes in the Mechanical Engineering Study Program




Learning Outcome
1st Year
2nd Year
3rd Year
4th Year
Semester 1
Semester 2
Semester 3
Semester 4
Semester 5
Semester 6
Semester 7
Semester 8
1. Able to apply basic knowledge of mathematics, numerical methods, statistical analysis and basic science and information technology.
Calculus 1
Calculus 2
Linear Algebra
Engineering Mathematics
Numerical Method
Statistics and Probability
Basic Chemistry
Life Science for Engineer
Basic Physics 1
Lab Exp for Basic Physics 1
Basic Physics 2
Lab Exp for Basic Physics 2
Basic Thermodynamics
2. Able to design energy systems, industrial machinery, building facilities, and the transportation industry to meet the expected needs within realistic boundaries, as well as to recognize and / or utilize the potential of local and national resources with global insight.
Engineering Material
Engineering Drawing
Mechanical Modelling and Visualization
Basic Thermodynamics
Material Selection and Manuf. Process
Strength of Materials
Basic Fluid Mechanics
Control System
Mechanical Design
Kinematics and Dynamics
Energy System Convertion 1
Mechanical Vibration
3. Able to carry out experiments, dig up information and analyze data, report the results of experiments by applying statistical rules.
Engineering Material
Lab Exp for Measurement & Metrology
Lab Exp of Production Process
Lab Exp for Electrical Power Eng
Energy System Convertion 2
Final Project


Learning Outcome
1st Year
2nd Year
3rd Year
4th Year
Semester 1
Semester 2
Semester 3
Semester 4
Semester 5
Semester 6
Semester 7
Semester 8
4. Able to think critically, creatively, and innovatively in identifying, formulating, analyzing and solving mechanical engineering problems.
Basic Thermodynamics
Strength of Materials
Basic Fluid Mechanics
Mechanical Design
Kinematics and Dynamics
Heat and Mass Transfer
Mechatronics
Maintenence and Condition Monitoring
5. Able to apply modern methods, skills and technical tools needed for engineering practices such as the selection of materials and processes, automation systems, and computer-aided mechanical designs.
Mechanical Modelling and Visualization
Engineering Programming
Measurement and Metrology
Material Selection and Manuf. Process
Control System
Mechatronics
Electrical Power Engineering
Maintenence and Condition Monitoring
6. Able to communicate effectively both visually, in writing and verbally.
English
Engineering Drawing
Mechanical Modelling and Visualization
Engineering Programming
Elective
Elective
On the Job Training
Elective
Final Project
Elective
7. Able to design, plan, complete and evaluate tasks within the existing constraints.
Energy Conversion System 1
Heat and Mass Transfer
Energy Conversion System 2
Design Assignment 1
Design Assignment 2

Learning Outcome	1st Year: Semester 1	1st Year: Semester 2	2nd Year: Semester 3	2nd Year: Semester 4	3rd Year: Semester 5	3rd Year: Semester 6	4th Year: Semester 7	4th Year: Semester 8
8. Able to work effectively both individually and in teams across disciplines or across cultures.	Lab Experiment for Basic Physics 1	Lab Experiment for Basic Physics 2		Lab Exp for Measurement & Metrology Lab Exp of Production Process	Lab Exp for Electrical Power Eng Elective	Design Assignment I Elective	Design Assignment II Seminar	
9. Able to take responsibility and adhere to the ethics of the engineering profession and entrepreneurship which is characterized by innovation and independence.	Religion Introduction to Mechanical Eng.	MPKT				Health, Safety and Enviroment	Internship	
10. Able to carry out lifelong learning processes including access to knowledge related to relevant contemporary issues.		MPKT			Elective	Elective	Elective	Elective

Curriculum Structure of Mechanical Engineering Study Program

Code	Subject	SKS
	1st Semester	
UIGE600004	Religion	2
UIGE600003	English	2
ENME601001	Introduction to Mechanical Engineering	2
ENGE600001	Calculus 1	3
ENGE600005	Basic Physics 1 (Mechanic & Heat)	3
ENGE600006	Laboratory Experiment for Basic Physics 1	1
ENME601002	Engineering Drawing	2
ENME603005	Engineering Material	3
ENGE600009	Basic chemistry	2
	Sub Total	**20**
	2nd Semester	
UIGE600006	Integrated Character Building Subject	5
ENGE600002	Calculus 2	3
ENGE600007	Basic Physics 2 (Electrical, Magnet, Wave, and Optic)	3
ENGE600008	Laboratory Experiment for Basic Physics 2 (Electrical, Magnet, Wave, and Optic)	1
ENGE600004	Linear Algebra	4
ENME602004	Engineering Statics	2
ENME603006	Mechanical Modelling and Visualization	2
	Sub Total	**20**
	3rd Semester	
ENME605015	Measurement and Metrology	2
ENME600013	Engineering Mathematics	4
ENME604010	Material Selection and Manuf. Process	4
ENME603007	Strength of Materials	2
ENME603008	Basic Thermodynamics	4
ENME606024	Life Science for Engineer	2
ENME600017	Engineering Programming	2
	Sub Total	**20**
	4th Semester	
ENME604011	Basic Fluid Mechanics	4
ENME604012	Mechanical Design	4
ENME600016	Numerical Method	2
ENGE600010	Statistics and Probability	2
ENME605019	Control System	2
ENME600009	Kinematics and Dynamics	4
ENME600007	Laboratory Experiment of Production Process	1
ENME600008	Laboratory Experiment for Measurement and Metrology	1
	Sub Total	**20**
	5th Semester	
ENME605017	Heat and Mass Transfer	4
ENME605021	Energy Convertion System 1	4
ENME606025	Mechatronics	4
ENME605014	Mechanical Vibration	2
ENME606023	Electrical Power Engineering	2
ENME600010	Laboratory Experiment for Electrical Power Engineering	1
	Elective (Internship A)	3
	Subtotal	**20**
	6th Semester	
ENME600001	Design Assignment 1 (Conceptual Design)	2
ENME606022	Energy Convertion System 2	4
ENGE600012	Health, Safety and Enviroment	2
ENME606020	Maintenance and Condition Monitoring	3
	Elective (Internship B)	3
	Elective	4
	Subtotal	**18**
	7th Semester	
ENME600002	Design Assignment 2	2
ENME600004	Seminar	1
ENME600003	On the Job Training	2
	Elective	4
	Elective	4
	Subtotal	**13**
	8th Semester	
ENME 600 005	Final Project	5
	Elective	4
	Elective	4
	Subtotal	**13**
	Total	**144**

The list of Elective Courses

Code	Electives Courses, Odd Semester	SKS
ENME803105	Internal Combustion Engine	4
ENME803106	Applied Flow Measurement and Visualization	4
ENME803107	CFD Application	4
ENME801113	Ventilation and Air Conditioning System	4
ENME803115	Clean Room	4
ENME803124	Energy Audit	4
ENME803134	Fire Dynamics and Modelling	4
ENME803145	Composite Product Development	4
ENME803147	Toy Production Design	4
ENME803154	Quality and Production Management System	4
ENME803161	Micro-machining	4
ENME803167	Modern Vehicle Technology	4

ENME803195	Oil and Gas Drilling Equipment	4
ENME803196	Jet and Rocket Propulsion	4
ENME803174	Risk Management	4
ENME601101	Project Management	4
ENME601102	Entrepreneurship	2
ENME601103	Industrial Seminar	2
ENME601108	Internship A (content: Project Management and Entrepreneurship)	3
ENME601104	Special Topic 1	4
ENME601105	Special Topic 2	4
ENME801002	Advanced Engineering Mathematics*	2
ENME802004	Engineering Computation*	2
ENME801101	Advanced Thermodynamics*	4
ENME801102	Advanced Fluid Dynamic and Heat Transfer*	4
ENME802133	Fire and Building Science*	4
ENME801140	Materials and Manufacturing Processes*	4
ENME801141	Product Design and Development Methodolgy*	4
ENME801150	Management of Manufacturing Information System*	4
ENME801151	Manufacturing System and Processes*	4
ENME801163	Vehicle Engineering and Heavy Duty Equipment*	4
ENME801164	Prime Mover and Powertrain System*	4

Code	Electives Courses, Even Semester	SKS
ENME804110	Combustion Engineering	4
ENME804109	Heat and Mass Transfer Engineering	4
ENME804111	Aerodynamics Engineering	4
ENME803108	Refrigeration Engineering	4
ENME804118	Mechanical system for Building	4
ENME802103	Energy System Optimization	4
ENME804138	Fire Safety Analysis	4
ENME804148	Design For Manufacture and Assembly	4
ENME804149	Noise and Vibration Control	4
ENME804155	CAD/CAM	4
ENME804156	Manufacturing Performance Assesment	4
ENME802152	Automation and Robotics	4
ENME804168	Railway Vehicle Engineering	4
ENME804197	Handling and Construction Equipment	4
ENME804198	Aircraft Design and Performance	4
ENME804190	Advanced Welding Engineering	4
ENME804136	Forest and Land Fires	4
ENME803104	Thermal Power Generation	4
ENME803143	Mechanical Failure	4
ENME803153	Machine Vision System	4
ENME601109	Internship B (content: Industrial Seminar and Entrepreneurship)	3
ENME601106	Special Topic 3	4
ENME601107	Special Topic 4	4
ENME802003	Experimental Design*	2
ENME802006	Data Analytics*	2
ENME802131	Fire Protection System*	4
ENME802132	Building Mechanical and Electrical System*	4
ENME802142	Design and Manufacturing Technology Integration*	4
ENME802165	Vehicle Frame and Body Engineering*	4
ENME803166	Vehicle Control System*	4
ENME802181	Maritime Engineering and Management*	4
ENME803182	Ocean Energy*	4

*For Fast-Track Program Only

Transition Policy from the 2016 to the 2020 Curriculum

1. The 2020 curriculum is implemented starting in the Odd Semester 2020/2021. In principle, after the 2016 Curriculum is implemented, only subjects in the 2020 Curriculum will be opened.
2. Class of 2019 and earlier followed the 2020 curriculum with transitional rules.
3. A transitional period of 1 year is applied, namely in the academic year 2020/2021 for subjects that change the implementation semester (from Even to Odd, or vice versa), if necessary, will be opened in both semesters during the transition period (Academic Year 2020 / 2021).
4. For students who have not passed the compulsory subjects in the 2016 Curriculum, are required to take the same or equivalent subjects in the 2020 Curriculum. (Curriculum 2016 courses that are not listed in the Equivalent Table means that they have not changed, both the name and the Credit.
5. If there is a change in the SKS of the course, the number of SKS taken into account in graduation is the number of the SKS at the time the course was taken. Same or equal subjects with different SKS, if repeated or newly taken will be listed with a new name and calculated with new SKS.
6. If the compulsory subjects in the 2016 Curriculum are removed and there is no equivalence in the 2020 Curriculum then for students who have passed these courses, they will still be counted as compulsory subjects in the calculation of passing 144 SKS. Students who have not passed the course can take new compulsory subjects or elective courses in the 2020 Curriculum to complete 144 credits.

Subject Eqivalent Table Mechanical Engineering Study Program

2016			2020		
CODE	SUBJECTS	CREDIT	CODE	SUBJECT	CREDIT
UIGE600003	English	3	UIGE600003	English	2
ENME603005	Engineering Material	2	ENME603005	Engineering Material	3
UIGE600001	MPKT A	6	UIGE600006	MPKT	5
UIGE600002	MPKT B	6		Elective	
UIGE600020-48	Sport / Art	1		Elective	
ENME602003	Engineering Drawing	2		Elective	
			ENME600017	Engineering Programming	2
ENME605020	Control System	4	ENME605020	Control System	2
ENME605021	Energy Convertion and Coservation	2	ENME605021	Energy Convertion System 2	4
ENME600019	Lab Exp for Energy Convertion and Coservation	1			
ENME605018	Fluid System	3	ENME605022	Energy Convertion System 1	4
			ENME601108	Elective, Internship A	3
ENME600006	Industrial Seminar	2	ENME601109	Elective, Internship B	3
ENME803134	Fire Dynamics in Room and Modelling	4	ENME803134	Fire Dynamics and Modelling	4
ENME804138	Evaliation and Fire Protection System Maintenance	4	ENME804138	Fire Safety Analysis	4
ENME804149	Noise and Vibration	4	ENME804149	Noise and Vibration Control	4
ENME804198	Aircraft Stability and Control	4	ENME804198	Aircraft Design and Performance	4
			ENME804136	Forest and Land Fires	4
			ENME601104	Special Topic 1	4
			ENME601105	Special Topic 2	4

Curriculum of International Program In Mechanical Engineering

Code	Subject	SKS
	1st Semester	
ENME611001	Introduction to Mechanical Engineering	2
ENME611002	Engineering Drawing	2
UIGE610002	Academic Writing	2
ENGE610001	Calculus 1	3
ENGE610004	Linear Algebra	4
ENGE610005	Basic Physics 1 (Mechanic & Heat)	3
ENGE610006	Laboratory Experiment for Basic Physics 1	1
ENGE610010	Statistics and Probabilistic	2
	Sub Total	**19**
	2nd Semester	
UIGE610004	Religion	2
ENGE610002	Calculus 2	3
ENGE610007	Basic Physics 2 (Electrical, Magnet, Wave, and Optic)	3
ENGE610008	Laboratory Experiment for Basic Physics 2 (Electrical, Magnet, Wave, and Optic)	1
ENGE610009	Basic chemistry	2
ENME615015	Measurement and Metrology	2
ENME612004	Engineering Statics	2
ENME612005	Engineering Material	3
ENME613006	Mechanical Modelling and Visualization	2
	Sub Total	**20**
	3rd Semester	
ENME610013	Engineering Mathematics	4
ENME613007	Strength of Materials	2
ENME613008	Basic Thermodynamics	4
ENME613010	Material Selection and Manuf. Process	4
ENME606024	Life Science for Engineer	2
ENME610007	Laboratory Experiment of Production Process	1
ENME600008	Laboratory Experiment for Measurement and Metrology	1
ENME600017	Engineering Programming	2
	Sub Total	**20**
	4th Semester	
ENME610016	Numerical Method	2
ENME610009	Kinematics and Dynamics	4
ENME616023	Electrical Power Engineering	2
ENME615017	Heat and Mass Transfer	4
ENME614012	Mechanical Design	4
ENME604011	Basic Fluid Mechanics	4
	Sub Total	**20**
	5th Semester	
UIGE600006	MPKT	5
ENME615014	Mechanical Vibration	2
ENME605021	Energy Convertion System 1	4
ENME616025	Mechatronics	4
ENME605020	Control System	2
	Elective (Internship A)	3
	Sub Total	**20**
	6th Semester	
ENME610001	Design Assignment 1	2
ENME610010	Laboratory Experiment for Electrical Power Engineering	1
ENME606022	Energy Convertion System 2	4
ENGE600012	Health, Safety and Enviroment	2
ENME616020	Maintenence and Condition Monitoring	3
	Elective (Internship B)	3
	Elective	4
	Sub Total	**19**
	7th Semester	
ENME600002	Design Assignment 2	2
ENME600004	Seminar	1
ENME610003	Internship	2
	Elective	4
	Elective	4
	Sub Total	**13**
	8th Semester	
ENME610005	Final Project	5
	Elective	4
	Elective	4
	Sub Total	**13**
	Total	**144**

Course Syllabus of University Subjects

INTEGRATED CHARACTER BUILDING
UIGE6000061/UIGE6100061
5 credits

Syllabus :

The Integrated Character Building is part of the Higher Education Personality Development Lecture which is held for students which contains elements of the internalization of basic life values, interaction/relationship skills, nationality and academic skills as the basis for student personality to carry out learning according to scientific disciplines.

MPKT is carried out in the form of a series of learning activities outside the formal class. activities carried out include participation in lectures/seminars, internships, field work practices, social work, sports and/or arts activities and other forms of activities that have the main goal of equipping students with soft skills and proven by portfolio documents. The form of this learning activity is different from the MPKT courses that have been carried out at the previous UI.

The material provided at MPKT aims to form a human thinking pattern with values and morals to create a human personality by having critical, logical, creative, innovative thinking, and having intellectual curiosity and an entrepreneurial spirit. The material provided includes 9 UI values, national, state and citizen values based on Pancasila. Solving problems in science, technology, health, and humans as natural managers by using reasoning and utilizing Information and Communication Technology (ICT) to achieve the final objectives of this module.

Lecture activities are carried out using an online student-centered learning (SCL) approach which can use the following methods: experiential learning (EL), collaborative learning (CL), problem-based learning (PBL), question-based learning, and project based learning. The use of these various methods is carried out through group discussion activities, independent assignment exercises, presentations, writing papers in Indonesian and interactive discussions in online discussion forums. The language of instruction in this lecture is Indonesian.

Graduate Learning Outcomes :

- CPL 1: Able to use spoken and written language in Indonesian and English both for academic and non-academic activities (C3, A5)
- CPL 2: Have integrity and are able to think critically, creatively, and innovatively and have intellectual curiosity to solve problems at the individual and group level (C4, A3)
- CPL 3: Able to provide alternative solutions to various problems that arise in the community, nation, and country (C4, A2)
- CPL 4: Able to take advantage of information communication technology (C3)
- CPL 5: Able to identify various entrepreneurial efforts characterized by innovation and independence based on ethics (C2, A5)

Course Learning Outcomes :

- CPMK 1: After completing this course, students are able to apply self-regulated learning characteristically in studying critically, logically, creatively, innovatively through analysis of societal problems, nation, state, and Pancasila ideology based on self-understanding as individuals and members. the community by using good and correct Indonesian and the latest information and communication technology (C4, A4)
- CPMK 2: Able to identify various entrepreneurial efforts characterized by innovation and independence based on ethics (C2, A5)
- CPMK 3: After completing this course, students are able to apply self-regulated learning characteristically in pursuing integrated and comprehensive knowledge through analysis of science problems, technology based on the role of nature manager by using good and correct Indonesian and information technology and current communications. (C4, A4)
- CPMK 4: After completing this course, students are able to plan creative activities to solve problems in society and the world of work/industry by showing creativity, critical thinking, collaborative self-discipline using good and correct Indonesian as well as the latest information and communication technology (C5, A5)

Prerequisite : -

ACADEMIC WRITING
UIGE610002
2 credits

The Objectives :

To activate students, English so that they will be able to communicate effectively in English;

To enable students to develop the learning strategies and study skills needed to finish their study successfully and o continue learning on their own after taking the MPK program (to develop independent learners)

Main Competencies :

- Listen to, understand and take notes of key information in academic lectures of between 5-10 minutes length;
- Improve their listening skills through various listening materials and procedures;
- Speak confidently, ask questions in and contribute to small group discussions;
- Use different reading strategies needed to the effective readers;
- Improve their reading skills through extensive reading material;
- Develop skills in connecting ideas using appropriate transitions and conjunctions;
- Work as part of a group to prepare and deliver a 25-minute presentation on an academic topic using appropriate organization, language and visual aids;
- Write a summary of a short academic article;
- Write an expository paragraph;
- Write a short essay.

Learning Method : Active learning, Contextual language learning, small group discussion.

Prerequisite :

1. Students Learning Orientation/Orientasi Belajar Mahasiswa (OBM)

ENGLISH
UIGE600003
2 credits
Learning Objectives :

After attending this subject, students are expected to capable of use English to support the study in university and improve language learning independently.

Syllabus :

Study Skills : (Becoming an active learner, Vocabulary Building: word formation and using the dictionary Listening strategies Extensive reading) Grammar: (Revision of Basic grammar Types of sentences Adjective clauses, Adverb clauses Noun clauses, Reduced clauses) Reading: (Reading skills: skimming, scanning, main idea, supporting ideas, Note-taking Reading popular science arti-cle, Reading an academic text) Listening: (Listening to short conversations, Listening to a lecture and notetaking, Listening to a news broadcast, Listening to a short story) Speaking: (Participating in discussions and meetings, Giving a presentation) Writing: (Writing a summary of a short article Describing graphs and tables, Writing an academic paragraph, Writing a basic academic essay (5 paragraphs).

ISLAMIC STUDIES
UIGE6000010/UIGE610005
2 credits
General Instructional Objectives :

The cultivation of students who have concern for social, na-tional and countrys issues based on Islamic values which is applied in the development of science through intellectual skills.

Learning Objectives :

Course participants are expected to do the following when faced with a problem or issue which they must solve :

1. Analyze the problem based on the Islamic values they adopted;
2. Analyze the problem by implementing active learning stages;
3. Discuss and express their thoughts and ideas by using proper and correct Indonesian language in discussion and academic writing.

Syllabus :

Islam history: the meaning of Islam, the characteristic of Islam, the sources of Islamic teachings, Muhammad SAW as prophet and history figure, introduction of Islam in Indonesia, the teaching essence of Islam: the basic principle of Islam teachings, the unity of Allah, worship prac-tice in live, eschatology and work ethics, human's basic rights and obligation, social structure in Islam: sakinah mawaddah and ramhah family, the social implication of family life, Mosque and the development of Islam, zakat and the economic empowerment of the people, Islam society, Science: reason and revelation in Islam, Islam's motivation in development of science, science characteristics, source of knowledge, IDI (each Faculty and Department/Study Program).

CATHOLIC STUDIES

UIGE6000011/UIGE610006
2 credits
General Instructional Objectives :

To help deliver students as intellectual capital in implementing lifelong learning process to become scientists with mature personality who uphold humanity and life.

Be scholars who believe in God according to the teachings of Jesus Christ by continuing to be responsible of his faith in life in church and society.

Syllabus :

Almighty God and the God teachings; Man, Morals, science technology and art; harmony between religions; Society, Culture, Politics, Law: the substance of theses studies will be addressed by integrating the four dimensions of the teachings of the Catholic faith: the personal dimension, the dimension of Jesus Christ, the dimension of the Church, and Community dimension. Dimensions are implemented in the following themes: People, Religion, Jesus Christ, the Church, and Faith in the society.

CHRISTIAN STUDIES

UIGE6000012/UIGE610007
2 credits
General Instructional Objectives :

Cultivating students with comprehensive Christian knowledge and teaching in the midst of the struggle and the fight of the nation while also discussing the student's participation in line with the study to help improve and build our country.

Learning Objectives :

Course participants are expected to do the following when faced with a problem or issue which they must solve:

1. Analyze the problem based on the Christian values
2. Analyze the problem by implementing active learning stages
3. Discuss the problem by using proper and correct Indonesian language

Syllabus :

History (Historical terms): Status of the Bible, the existence of God and Morality, Christ the Savior, the Holy Spirit as existence reformer and outlook on the world: Faith and Knowledge of Science, Church and service, Ecclesiology, Spiritual and enforcement of Christian Human Rights and the world of ethics: Christian Ethics, Christian and worship, Christianity and politics, Christian love and social reality: Christian Organizations, Students and Service, Christian and expectations.

HINDU STUDIES

UIGE6000013/UIGE610008
2 credits

Syllabus :

Hindu religion, Hindu history), Source and scope of Hinduism (the Veda as the source of Hindu religion teachings, the scope of the teachings in Hindu religion), The concept of the God (Brahman) according to the Veda, the Path to Brahman (Catur Marga Yoga, Mantra and Japa), Human Nature (The purpose of human life, Human's duties, obligations, and responsibilities both individually or collectively), Ethics and morality (Principles teaching, self-control), in-depth understanding of the scripture (deep understanding of the Bhagawadgita, deep understanding of the Sarasamuschaya), The Role of Hinduism in science, technology, and art (Hinduism benefits in science and technology in accordance with each department, benefit / the role of Hinduism in the arts), Cohesion and community's prosperity /independence (Benefits of unity in the religious plurality, independent community (kerthajagathita) as a common goal, Tri Pitakarana), Culture as an expression of Hindu religious practice, Contribution to the Hindu religion teachings in the political life of nation and country, laws and the enforcement of justice, Awareness of and obeying the Rita / Dharma.

BUDDHIST STUDIES

UIGE6000014/UIGE610009
2 credits

Syllabus :

Almighty God and the God Study (Faith and piety, Divine Philosophy/Theology), Human (Human Nature, Human Dignity, Human Responsibility), Moral (Implementation of Faith and Piety in everyday life), Science, Technology and Art (Faith, Science and Charity as a unity, the Obligation to study and practice what you are taught, Responsibility for nature and environment), harmony between religion (religion is a blessing for all mankind, the essence of the religious plurality and togetherness), community (the role of religious society in creating a prosperous independent society, the responsibility of religious society in the realization of human rights and democracy), Culture (the responsibility of religious society in the realization of critical thinking (academic), work hard and fair), Politics (Religion contribution in the political life of nation and country), Law (Raise awareness to obey and follow God's law, the role of religion in the formulation and enforcement of law, the function of religion in the legal profession).

KONG HU CU STUDY
UIGE6000015/UIGE610010
2 credits

Syllabus Of Faculty Subjects

CALCULUS 1
ENGE600001/ENGE610001
3 credits
Course Learning Outcomes:

Able to use the basic concepts of calculus related to -a function of one variable, the derivative and integration of the function of one variable in order to solve its applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, basic engineering, and engineering specialization to be used in solving complex engineering problems.

Syllabus :
Introduction, Functions and Limits, The Derivative, Applications of the Derivative, The Definite Integral, Applications of The Definte Integral, Transcendental Functions, Techniques of Integration, Indeterminate Forms and Improper Integrals.

Prerequisite: None

Textbooks:

Main reference:
D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., Pearson, Prentice Hall, 2007.

Additional eferences:
1. George B. Thomas Jr., Thomas' Calculus Early Transcendental, 12th ed., Addison–Wesley Pearson, 2009.
2. Howard Anton, Calculus, 10th ed., John Wiley and Sons, 2012.

CALCULUS 2
ENGE600002/ENGE610002
3 SKS
Course Learning Outcomes:

Students are able to use the concepts of sequences, series, conic sections, and the basic concepts of calculus which involve the function of two or three variables to solve their applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus: :
Infinite sequences and infinite series, Test for convergence of positive series and alternating series, Power series and operation on operations, Taylor and MacLaurin series, Conic sections , Calculus in polar coordinates, Derivatives, limits, and continuity of multi-variables functions, Directional derivatives and gradients, Chain Rule, Tangent planes and Approximations, Lagrange multipliers. Double integrals in Cartesian coordinates and polar coordinates, triple integrals in Cartesian coordinates, cylindrical coordinates and spherical coordinates, Applications of double and triple Integral.

Prerequisite: Calculus 1

Textbooks:
1. D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., PEARSON, Prentice Hall, 2007.
2. Thomas, Calculus Thirteenth Edition Volume 2, Erlangga, 2019.

CALCULUS
ENGE600003/ENGE610003
4 SKS
Course Learning Outcomes:

Students are able to use the basic concepts of calculus involving functions of one to three variables to solve their applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :

Introduction, Functions and Limits, Derivatives, Derived Applications, Indeterminate Integral, Integral Applications, Infinite Row, and Series. Derivatives with many variables, Duplicate Integral (2 and 3), Duplicate Integral Application.

Prerequisite: None

Textbooks:

Main :
D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., Pearson, Prentice Hall, 2007.

George B. Thomas Jr., Thomas' Calculus Early Transcendental, 12th ed., Addison – Wesley Pearson, 2009.

LINEAR ALGEBRA
ENGE600004/ENGE610004
4 SKS
Course Learning Outcomes:
Students are able to calculate linear system problems to solve engineering problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :

Linear Systems and matrix equations, Determinants, Euclid vector spaces, Common vector spaces, eigenvalues and eigenvectors, inner product spaces, Diagonalization and General Linear Transformation.

Prerequisite: None

Textbooks:
1. Elementary Linear Algebra, Howard Anton & Chris Rorres, 11th edition, 2014
2. Gilbert Strang, Introduction to linear algebra 3rd edition Wellesley Cambridge Press, 2003

MECHANICAL AND HEAT PHYSICS
ENGE600005 / ENGE610005
3 credits
Course Learning Outcomes:

Able to explain the basic concepts of mechanics and thermodynamics, and be able to apply them to understand natural phenomena and human engineering, including their applications.

Graduate Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus:

Units, Magnitudes and Vectors, Motion Along Straight Lines, Motion in Two and Three Dimensions, Newton's Laws of Motion, Applications of Newton's Laws, Kinetic Energy, and Work, Potential Energy and Energy Conservation, Center of Mass, Linear Momentum, Rotation, Rolling Motion, Torque, Angular Momentum, Oscillation, Mechanical and Sound Waves, Gravity, Statics and Elasticity, Fluid Mechanics, Temperature, Heat, Law I Thermodynamics, Ideal Gas and Kinetic Theory of Gas, Heat Engine, Entropy, and Law II Thermodynamics.

Prerequisite: none

Textbooks:
1. Halliday, Resnick, and Walker, Principles of Physics 10th Edition, Wiley, 2014.
2. Serway Jewett, Physics for Scientists and Engineers 9th Edition, Thomson Brooks / Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008

ELECTRICAL MAGNETIC, OPTICAL AND WAVE PHYSICS

ENGE600007 / ENGE610007
3 credits
Course Learning Outcomes:

Students are able to apply the basic concepts of electrical physics, magnetism, waves, and optics to solve problems in the engineering field.

Graduate Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus:

Unit, Magnitude, Vector, Electric Charge, Electric Field, Gauss Law, Electric Potential, Capacitance, Electric Current, Resistance, Direct Current, Magnetic Field Due to Electric Current, Magnetic Field Source, Induced GGL, Inductance, Alternating Current, Electromagnetic Waves, Light Properties and Propagation, Optical Geometry.

Prerequisite: none

Textbooks :
1. Halliday, Resnick, and Walker, Principles of Physics 9th Edition, Wiley, 2011.
2. Serway Jewett, Physics for Scientists and Engineers 9th Edition, Thomson Brooks / Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008.

BASIC CHEMISTRY

ENGE600009 / ENGE610009
2 credits
Course Learning Outcomes:
Students are able to analyze the principe of basic chemistry for application in engineering.

Graduates' Learning Outcomes:
Able to apply mathematics, science, and basic engineering to be used in solving complex engineering problems.

Syllabus:

Material and measurements, atoms, molecules and ions, stochiometry, water phase reactions and solution stochiometry, thermochemistry, chemical equilibrium, acid and base equilibrium, electrochemistry, chemical kinetics, and chemical applications.

Prerequisite: none

Textbooks :
1. Ralph H. Petrucci, General Chemistry: Principles and Modern Applications, 8th Ed. Prentice Hall Inc., New York, 2001.
2. John McMurry, Robert C. Fay, Chemistry (3rd ed.), Prentice Hall, 2001.
3. Raymond Chang, Williams College, Chemistry (7th ed.), McGraw-Hill, 2003.

ENGINEERING ECONOMY

ENGE600011 / ENGE610011
3 credits
Course Learning Outcomes:

Students are able to analyze the economic and financial feasibility of making economic practice decisions.

Graduate Learning Outcomes:

Able to apply the principles of technical management and decision making based on economic considerations, in individual and group, as well as in project management.

Syllabus:

Introduction to Engineering Economics, Time Value of Money, Combining Factors, Interest Rates, Money Worth Analysis, Rate of Return Analysis, Effects of Inflation, Benefit Cost & Break-Even Point Analysis, Sensitivity Analysis, Depreciation, Tax Analysis, Cost Estimation & Allocation, Capital Budgeting & Replacement Analysis.

Prerequisite:
1. Civil Engineering : -
2. Environmental Engineering : -
3. Naval Engineering : -
4. Industrial Engineering : must pass the introductory Economic course and have completed 38 credits
5. Chemical Engineering : -
6. Bioprocess Engineering : -

Textbooks:
1. Blank, Leland and Tarquin, Anthony. 2018. Engineering Economy 8th Ed. McGraw Hill.
2. Park, Chan S. 2016. Contemporary Engineering Economics 6th Ed. Pearson. Upper Saddle River.
3. White, Case and Pratt. 2012. Principles of Engineering Economic Analysis 6th ed. John Wiley and Sons.

STATISTICS AND PROBABILISTICS

ENGE600010 / ENGE610010
2 credits
Course Learning Outcomes:

Students are able to handle quantitative data/information starting from the descriptive stage (collection, organization, and presentation) to the inductive stage, which includes forecasting and drawing conclusions based on the relationship between variables for decision making.

Graduate Learning Outcomes:
1. Apply descriptive statistics and probability theory to data processing and serving
2. Apply probability distribution to data processing and serving
3. Apply the principles of sampling and estimation for decision making
4. Apply hypothesis test samples for decision making

Syllabus:

Introduction to Statistics for Engineering Studies, Probability Theory, Dasar Basic concepts and definitions, Distribution Probability, Sampling, Estimation, Hypothesis testing, Hypothesis test 1 sample at an average value, Regression

Prerequisite: none

Textbooks :
1. Harinaldi, Basic Principles of Statistical Engineering and Science, Erlangga, 2004
2. Montgomery, DC., And Runger, GC., Applied Statistics and Probability for Engineers, John Wiley Sons, 2002

HSE PROTECTION

ENGE600012 / ENGE610012
2 credits
Course Learning Outcomes:

Upon completion of this subject students are expected to be able to carried out hazard identification, and characterization, to propose appropriate methods for risk reduction and mitigation, and to design safety management system. The student is also expected to improve their awareness on industrial safety and health, and understanding on safety regulation framework and standards as well as environmental program.

Graduate Learning Outcomes:
1. Students are expected to understand safety, health and environmental aspect as an integral part of fundamental principal in engineering code of ethics.
2. Students are expected to be able to carry out process of risk assessments by considering risk factors in the impact of hazards on people, facilities, and the surrounding community and environemt.
3. Students are expected to understand the regulatory framework and standard related to the stages of life cycle of machine, building structure, construction, and process.
4. Students are able to design and propose an effective hazard communication, management and engineering control, and risk mitigation through an engineering assignment project.
5. Students are able to identify the knowledge required to perform risk assesment, investigation and design improvement through a multidisiplinary case of incident and accident.

Syllabus:

Introduction to SHE Regulation and Standards, SHE Perception (Risk and Environment), Identification, Assessment and Management, Construction, machinery and Noise hazards, Process safety hazard and analysis technique, Fire and explosion hazard, Electrical hazard, Toxicology in the Workplace, Ergonomy Aspect, Hazard communication to employees, Environmental Protection, Case studies, Safety Health and Environment audits.

Prerequisite: none

Textbooks :
1. Charles A. Wentz, Safety, Health and Environmental Protection, McGraw Hill, 1998.
2. Asfahl, C.R., Rieske, D. W., Sixth Edition Industrial Safety and Health Management, Pearson Education, Inc., 2010.
3. United Kingdom - Health and Safety Executive, http://www.hse.gov.uk/
4. National laws and regulations related to the K3 Management System and the Environment.
5. Related Journal (http://www.journals.elsevier.com/safety-science/) etc, related standards and publications.

Syllabus Mechanical Engineering Study Program

RELIGION

ENME600004
2 credits

Learning Outcome(s):

Provide an understanding of the religious values and see the problems from various aspects of life, so that student care about the social realities they face.

Topic:

Meaning and religion that apply in scientific and theological discourse; History and origins of religion; The main dimensions of religion such as divinity, prophethood, scripture, ritual, salvation, social ethics and eschatology; Socio-religious dimension; Religion and state; Inter-religious relations.

Pre-requisite(s): -

References: Guidebook from UI

ENGLISH

ENME600003
2 credits

Learning Outcome(s):

Able to communicate in English orally and in writing with correct English grammar rules.

Topic:

English grammar, writing and conversation.

Pre-requisite(s): -

References: -

INTRODUCTION TO MECHANICAL ENGINEERING

ENME601001
2 credits
Learning Outcome(s):

To give a description of mechanical engineering knowledge by describing scoupe, field and relation to other knowledges. By this course, student can understand the application and the knowldege of mechanical engineering in every sector.

Topic:

Mechanical engineering field, Mechanical engineering sub-field, mechanical engineering professional ethics; mechanical design, manufacturing process; force, structure and machine; material; fluid mechanics, energy and heat

Pre-requisite(s): -

References:
1. Wickert Jonathan, and Kemper Lewis. An introduction to mechanical engineering. Cengage learning, 2012.
2. Avallone, Eugene A., Theodore Baumeister, and Ali Sadegh. Marks' Standard Handbook For Mechanical Engineers (Standard Handbook for Mechanical Engineers). Mcgraw-Hill Professional, 2006.
3. Grote, Karl-Heinrich, and Erik SCPL. Antonsson. Springer handbook of mechanical engineering. Vol. 10. Springer Science & Business Media, 2009.

ENGINEERING DRAWING

ENME601002
2 credits

Learning Outcome(s):

Course participants are able to transfer geometric component by drawing according to standard draw which is recognized by International Standard Organization (ISO). Students understand the theory and procedure of engineering drawing based on ISO standard. Students are able to read, interpret, and transfer 2D/3D geometric draw from component or construction. Students are able to draw the orthogonal projection based on ISO standard.

Topic:

Illustration: Function and benefit of Engineering Drawing; SAP; Measurement and Evaluation; Introduction to drawing equipment; Basic definition of geometric, paper format, draw regulation, line, field, line configuration, basic geometric form; Visualization geometric: Skew projection and isometric, function and line types, configuration geometric form; Orthogonal Projection: Projection standard, viewing concept, width display principle; Advanced orthogonal projection: Circle region concept, special region concept, trimming concept, display width, refraction.

Pre-requisite(s): -

References:

1. ISO 1101, Technical Drawings, International Organization for Standardization.
2. A.W. Boundy, Engineering Drawing , McGraw-Hill Book Company
3. Colin Simmons & Dennis Maguire, Manual of Engineering Drawing, Edward Arnold
4. Takeshi S. G., Sugiarto Hartanto, Menggambar Mesin, Pradnya Paramita, 1983
5. Warren J. Luzadder, Fundamentals of Engineering Drawing, Prentice-Hall, Inc.
6. Giesecke-Mitchell-Spencer-Hill-Dygdon-Novak, Technical Drawing, Prentice Hall Inc.

ENGINEERING MATERIAL

ENME603005

3 credits

Learning Outcome(s):

Engineering materials are one of the basic knowledge in field of design, especially in mechanical engineering. From the discussion of the behavior of several materials, the students are expected to have the overview about several thing that has to be the concern related to the working process or the specific need. The students are expected to have the basic ability to identify and explain the nature and behavior of materials related to the treatment in working process and specific need.

Topic:

Atomic structure, crystalic material, metal and non metal material, process, phase diagram and solidificatiom, heat treatment process, mechanical behavior of crystalic material, elastic material, plastic deformation, crystal plasticity, method of material mechanical testing, dislocation, strengthening, failure and remaining lifetime of material, introduction to mechanical crack and steel mechanical structure behavior, material structure degradation, corrosion process, corrosion prevention, Oxidation, wear and erotion, concrete material behavior, wood, cement and its structure behavior.

Pre-requisite(s): -

References:

1. Kalpakjian, Manufacturing Engineering and Technology – 6th Ed., Digital Designs- 2006
2. Thomas H. Courtney, Mechanical Behavior of Materials – 2nd Ed, Waveland Press. - 2005
3. R.A. Higgins, Property of Engineering Materials, Edward Arnold - 1994
4. Flinn & Trojan, Engineering Materials and Their Applications, John Wiley & Sons, Inc.- 1995
5. James A. Jacobs & Thomas F. Kilduff, Engineering Material Technology, Prentice- Hall, Inc. - 2004

ENGINEERING STATICS

ENME602004

2 credits

Learning Outcome(s):

To understand the concept of force and force equilibrium in some construction so the student can calculate and analyze the equilibrium of construction by using static equilibrium law.

Topic:

Basic principle of engineering statics/Newton Law. Arrangement and decomposition of force in plane and space. Static equilibrium law. Support and support reaction. Frame construction.

Pre-requisite(s): Introduction to Mechanical Engineering, Engineering Drawing

References:

1. Beer, Ferdinand P, Mechanics for Engineers: STATICS, Mc GrawHill.
2. Hibbeler RC, Mechanics of Materials, 10th ed., Prentice Hall, 2016.
3. Riley, F William, Engineering mechanics: STATICS, John wiley & sons
4. Hamrock, Fundamental of Machine Element, Mc Graw-Hill.
5. Shigley, Joseph Edward, Mechanical Engineering Design, McGrawHill.
6. Kurowski, P.M., Finite Element Analysis for Design Engineers, SAE International, 2004

MECHANICAL VISUALIZATION AND MODELING

ENME603006

2 credits

Learning Outcome(s):

It is expected that students will have the basic ability to effectively describe the information content of a component unit effectively; able to do 2D and 3D modeling and visualization with the help of computers and translate in the form of working drawings that can be used as a guide to the process and can be correctly understood by the parties concerned.

Topic:

Functions and Benefits of Working Drawings in the Design Process and Production Process; Surface Workmanship Quality and Tolerance: Standards & Markings of Workmanship Quality Classification; Standards & Markings of Work Tolerance Classification; Welding Construction, Standards & Marking Types of Camps and Welding Works; Line Chart; 2D and 3D Geometry Representation Methods; Introduction to Modeling Software System Interfaces; 2D and 3D Modeling, Manipulation and Visualization.

Pre-requisite(s):

Engineering Drawing, Introduction of Mechanical Engineering

References:

1. A.W. Boundy, Engineering Drawing, McGraw-Hill Book Company
2. Colin Simmons & Dennis Maguire, Manual of Engineer-

ing Drawing – 4th Ed, Elsevier. 2012.
3. ISO 1101, Mechanical Engineering Drawings, International Organization for Standardization.
4. Takeshi S. G., Sugiarto Hartanto, Menggambar Mesin, Pradnya Paramita, 1983
5. Japanese Industrial Standard, Technical Drawing for Mechanical Engineering, Japanese Standards Association.
6. Warren J. Luzadder, Fundamentals of Engineering Drawing, Prentice-Hall, Inc..

MEASUREMENT AND METROLOGY

ENME605015
2 credits
Learning Outcome(s):

Measurment and Metrology course is knowledge to study the concept of metrology and measurement in industry and the applicaton of metrology and its tools. This course is study the relevance of the theory to the engineering application and manufacturing industry. This course will give the ability to the student to understand the theory and application of engineering measurement and metrology in mechanical engineering application

Topic:

The basic concept of measurement and metrology, measurement terminology and systems, industrial measurement and system terminology, temperature measurement, pressure and flow measurement, force, stress, data acquisition, motion measurement : position, velocity, vibration and acceleration, types of sensors/transducer, transfer function, FFT and filtering, uncertainty analysis, geometric and dimension calibration, room dimention, metrology (length measurement), surface texture, roughnes and roundness, flatness and straightness, angle measurement, introduction to CMM.

Pre-requisite(s): -

References:
1. Busch, Ted, Fundamentals of Dimensional Metrology, 4th Ed, Delmar Publishers
2. Fargo F.T., Curtis, M.A., Handbook of Dimensional Measurement, 5^{th} Ed, Industrial Press. 2013.
3. Slocum, A., Precision Machine Design, SME Press, 1992.
4. Raldi Artono Koestoer, Pengukuran Teknik, Departemen Teknik Mesin FTUI.

ENGINEERING MATHEMATICS

ENME600013
4 CREDITS
Learning Outcome(s):

Complete student's anylitical ability. Students understand and able to use the advances mathematical concepts in order to solve the engineering problems.

Topic:

Introduction to differential equation, 1st order differential equation, 2nd order differential equation, higher order differential equation, vector analysis, vector differential, grad operation, divergence and culr, vector integration, laplace transform, laplace transform to solve the differential equation, fourrier transform, convulsion, numerical method, root of equation, numerical differentiation, numerical integral.

Pre-requisite(s): Calculus, Linear Algebra

References:
1. Croft, A, et.al, Mathematics for Engineers, 3rd Edition, 2008, Prentice Hall
2. Chapra S.C., Canale, Numerical Methods for Engineer, 6th Edition, 2010, Mc Graw Hill
3. Kreyszig, E, Advanced Engineering Mathematics 10th Edition, John Wiley and Sons

MATERIAL SELECTION AND MANUFACTURING PROCESS

ENME604010
4 CREDITS
Learning Outcome(s):

To give the knowledge, understanding and competence about the theory, application method and product manufacturing process technology that consist of: characteristic and how the process work, process constraint, force and energy that needed in process, the effect of the process parameter to the product quality and the relation between process and material to the material characterisc that needed in every process.

Topic:

Manufacturing process and production system, materials in manufactur, theory and method in metal casting, theory and method of bulk formation, theory and method of sheet metal forming, theory and method of powder metallurgy, theory and method of machining/metal cutting process, theory and precess of product surface quality improvement, theory and method of joining, theory and method of prototyping process, characteristic of engineering materials, correlation of material and process characteristic, process parameter control of material, Design of material selection and manufacturing process that related to the market needs (assignment).

Pre-requisite(s): Engineering Materials

References:
1. Ashby, Material selection in Mechanical Design, 4th ed., Butterworrth Heinneman, 2010
2. Ashby, Material selection in Mechanical Engineering, 3rd ed., Butterworth Heinneman, 2005
3. John A. Schey, Introduction to Manufacturing Processes, McGraw Hill, 1999
4. Degarmo, E. Paul, Materials and Processes in Manufacturing, Prentice Hall Int. Inc, 10th edition, 2010
5. Kalpakjian, S, Manufacturing Engineering and Technology, McGraw Hill 7th edition, 2013.
6. Buku Panduan Praktikum Proses Produksi, Departemen Teknik Mesin FTUI

STRENGTH OF MATERIALS

ENME603007
4 credits
Learning Outcome(s):

The aim of this subject is student can calculate and analyze the stress in construction. Student able to solve the defelection and indeterminate statics.

Topic:

Moment and internal force diagram. Characteristics of energy. Deformation, stress & strain. Stress due to normal force, shear, bending moment and torsion. Stress distribution, combination of stress. Deflection/beam deformation. Indeterminate static construction. Column. Energy method. Construction of thin and thick wall, rotating disc.

Pre-requisite(s): Mechanical Drawing, Engineering Statics

References:
1. Timoshenko, Strength of Material, 1965
2. Belyaev, Strength of Material, MIR Publisher, 1979
3. Propov, Mechanic of Material, Prentice Hall, 1976
4. Hibbeler RC, Mechanics of Materials, 10th ed., Prentice Hall, 2016.

5. Riley, F William, Engineering mechanics: STATICS, John wiley & sons
6. Hamrock, Fundamental of Machine Element, Mc Graw-Hill.

BASIC THERMODYNAMICS

ENME603008
4 credits
Learning Outcome(s):
This course introduces the basic concept of thermodynamics and its application in real life and gives the understanding about the design of thermodynamics system.

Topic:
Scope and basic understanding of thermodynamics system, temperature concept, pressure, thermodynamics equilibrium, reversible/irreversible process, zero law of thermodynamics and absolute temperature, first law of thermodynamics, second law of thermodynamics, thermodynamics equation, gas power cycle, gas compressor, combustion engine cycle, internal combustion engine , simple gas turbine cycle, brayton's cycle, stirling's cycle, steam power cycle, refrigeration, carnot's cycle, simple rankine's cycle, rankine's cycle with modification, biner cycle, phsycometrich chart, cooling tower, real gas, real gas equation, enthalpy and entrophy.

Pre-requisite(s): -

References:
1. Michael J. Moran, Howard N. Shapiro, Fundamentals of Engineering Thermodynamics, 8th Edition, Wiley, 2014.
2. Reynolds W.C., Perkins H.C., Engineering Thermodynamics, Mc. G. Hill .
3. Zemansky , Aboot , van Ness, Basic Engineering Thermodynamics, McGraw Hill
4. Kenneth Wark Jr. Thermodynamics , Mc.Graw Hill
5. H.D. Baehr, Termodynamik , Springer Verlag

LIFE SCIENCE FOR ENGINEERS

ENME606024
2 credits
Learning Outcome(s):

This course will study the basic knowledge and introduction to the aspect of life organism that have close relation to mechanical engineering field. The student will get the broad perspective of life science application in mechanical engineering.

Topic:

Introduction to cell, chemical aspect in biology: acid, carbohidrat, lipid, protein, nucleat acid; bioenergy and metabolism: aerobic and anaerobic respiration, photosynthesis; animal control system, termoregulation and homestasis; biomechanics, animal locomotion, scale effect; food and farm; environmental conservation, air, water, life science consideration in mechanical design

Pre-requisite(s): -

References:
1. Alexander, R. McNeill. Principles of animal locomotion. Princeton University Press, 2003.
2. Karp, G. Cell and Molecular Biology, 5th ed., John Wiley and Sons, Inc.
3. Berger, S. et al. Introduction to Bioengineering, Oxford University Press
4. Cunningham, William P., and Mary Ann Cunningham. Principles of environmental science: inquiry & applications. McGraw-Hill, 2011.
5. Cosentino, Carlo, and Declan Bates. Feedback control in systems biology. CRC Press, 2011.
6. Basic Biomechanics, Susan J. Hall, McGraw Hill, USA
7. Biomechanics, Kreighbaum, Barthels, Burgees Publishing, USA
8. Biomechanics in Ergonomics, Shrawan Kumar, Taylor & Francis INC, USA
9. Biomechanics Circulation, Y.C. Fung, Springer, USA
10. Biomechanics Mechanical Properties, Y.C. Fung, Springer, USA
11. Biomechanics of the Upper Limbs, Andris Freivalds, CRC Press, USA
12. Skeletal Tissue Mechanics, Martin,Burr,Sharkey, Springer, USA
13. Biomedical Engineering Principles, David Cooney, Marcel Dekker INC, USA

ENGINEERING PROGRAMMING

ENME600017
2 credits
Learning Outcome(s):

Understanding the basic knowledge of computational and engineering programming, able to make computational and programming techniques simple, able to solve engineering problems with engineering programming.

Topic:

Introduction to programming languages, Basics of algorithms, Basics of computing, Software for computing and programming techniques, Development of computing and programming with case studies

Pre-requisite(s): -

References:

Computer Programming with MATLAB, J. Michael Fitzpatrick, Ákos Lédeczi, Fitzle, 2013

Introduction to Computation and Programming Using Python: With Application to Understanding Data, John V. Guttag, The MIT Press, 2016

BASIC FLUID MECHANICS

ENME604011
4 credits
Learning Outcome(s):

Fluid meachanic are one of the applied mechanical science branch that will be used to investigate, analyse, and learn the nature and the behavior of fluids. Fluid that will be explored could be a moving or stationary fluid. Fluid Mechanics course intends to complement the ability of a student to be able to apply the basic laws of fluid mechanics in practical engineering calculations of fluid mechanics and be able to analyze the behavior of the fluid and developing knowledge in the field of fluid mechanics.

Topic:

Fluid and its nature, fluid statics, the relative balance, concept and basic equations of fluid flow, dynamic of flow, the equation of fluid motion (Newton, Euler, Navierstokes), Basic Equation of Fluid Dynamics (Continiuty, Energy and momentum), dimentional analysist and hydraulic similarity, ideal fluid flow, viscous flow, viscous flow: transition from laminar into turbulent flow, fully developed turbulent flow, flow around submerged objects, general characteristic of outside flow, concept and characteristic of layer in closed flow, measurement and visualization of flow, pressure measurement concept, flow and capacity, flow measurement devices (Pitot tube, Venturi, orifice, Nozzel, HWA, LDV), Flow visualization method.

Pre-requisite(s): -

References:

1. Munson, B.R., Fundamentals of Fluid Mecha-nics 7th Ed, John Wiley & Sons, Inc. 2012
2. Smits, A.J., A, Physical Introduction to Fluid Mechanics, John Wiley & Sons, Inc. 2000
3. Kumar, SCPL.L., Engineering Fluid Mechanics, Eurasia Publishing House Ltd., 2010

MECHANICAL DESIGN

ENME604012
4 credits
Learning Outcome(s):

Give the understanding about the application of engineering mechanic science and material strength in machine element. The students have the basic competence to design the machine element.

Topic:

Basic mechanical design review, design of joint : welding, solder, adhesive bonding, rivet, pin, bolt, nut, thread, axel, shaft, hub, roller & lauch bearing, lubrication, wear and friction, spring, break, fixed and unfixed clutch, chain, belt, basic of gear, straight & tilt bearing, Final Assignment : Design process consist of the understanding of purpose, load and calculation of machine element.

Pre-requisite(s): Mechanical Modelling and Visualization; Strength of Materials

References:

1. Hamrock, Fundamental of Machine Element, 3rd ed, CRC Press, 2013
2. Shigley, Joseph Edward, Mechanical Engineering Design, 10th ed, McGraw-Hill., 2014
3. Sularso, Dasar Perencanaan & Pemilihan Elemen Mesin, Pradnya Paramita, 1994
4. Hibbeler RC, Mechanics of Materials, 10th ed., Prentice Hall, 2016.
5. Riley, F William, Engineering Mechanics: STATICS, John wiley & sons

NUMERICAL METHODS

ENME600016
2 credits
Learning Outcome(s):

The objectives of this course is that the student can understand and able to apply the process and method (algorithm) of engineering numerical method in computer-based computation and to understand the parameters that influence the speed and accuracy of calculation.

Topic:

Introduction to numerical method and programming: simple mathematical modeling, programming and software, structural programming, modular programming, iterative method; Function: function and function value, Taylor and Maclaurin series, approximation and error; Root of equation: graphical method, Bisection method, False-Position method, Newton – Raphson method, Secant method, Bairstow method; Linear algebra equation system: Gauss elimination, Gauss-Jordan elimination, Decomposition and transformed matrices; Curve – Fitting: Least – Square regression, Interpolation; Numerical Integral: Trapezoid method, Simpson method, Double Integral; Differential equation: Finite Divided Difference, Euler method, Runge – Kutta method; Ordinary Diffrential Equation System

Pre-requisite(s): -

References:

1. Chapra, Steven C. and Canale, Raymond P. Numerical Methods for Engineers 6th edition. New York: McGraw-Hill, 2010.
2. Kreyszig, Erwin. Advanced Engineering Mathematics 10th edition. Danvers: John Wiley & Sons, 2011.
3. Sedgewick R., Phillippe F, An Introduction to the Analysis of Algorithms, Addison Wesley.
4. Cheney W., Kincaid D., Numerical Mathematics and Computing, Cole Publishing

CONTROL SYSTEM

ENME605019
4 credits
Learning Outcome(s):

System Control is a science that discusses methods for controlling the value of system parameters, so that it is in accordance with what is desired. The system parameters referred to in this subject are physical quantities, which can be in the form of position, velocity, rotation, acceleration of pressure, flow rate, temperature, and other process variables. This subject aims to make students understand the basics, analysis, design techniques and compensation systems of control systems, and be able to choose the right control system (controller) for a mechanical system.

Topic:

Introduction to Full Systems; Laplace transform; Laplace Transformation; Solution of Ordinary Linear Differential Equation (problem of initial value); Mathematical Modeling I-IV; Full Action: PID Controller, Electronic Controller, Pneumatic Controller and Hydraulic Controller; Analysis of Transient Responses I and II; Analysis of the Root Place of the TKA; Control System Design with the help of the TKA Method; Frequency Response Analysis; Stability Analysis; MATLAB Practicum; Control System Design with the help of Frequency Response; Discrete Time and Z-Transformation Systems; PID Control and Robust Control Introduction; State Spatial Analysis I-II; Control System Design in the State Room; Liapunov Stability Analysis and Optimal Quadratic Control.

Pre-requisite(s): Engineering Mathematics, Basic Physics 1, Basic Physics 2

References:

1. Ogata, Katsuhiko., Modern Control Engineering, 5th ed, Prentice-Hall. 2009.
2. Golnaraghi, F and Kuo, B. C., Automatic Control System, 9th Ed, Wiley, 2010.
3. Francis H, Raven., Automatic Control Engineering, 5th ed. McGraw-Hill,1995.
4. Cheng, David SCPL., Analysis of Linear System, Addison–Wesley P. C., Inc.

KINEMATICS AND DYNAMICS

ENME600009
4 credits
Learning Outcome(s):

Students have the ability to understand the key concept of kinematics and dynamics of mechanical system and capable to analyze the movement, velocity, acceleration force and equilibrium.

Topic:

Vector velocity analysis, free body diagram, linier motion, velocity polygon, 2D motion, rectangular coordinates, N-T and pole, relative motioan and velocity of 2 coincide/relate point, Coriolis acceleration and stiff body kinematics, Inertia Force, Statics, particle system, works, energy, impuls, linear-angular momentum, stiff body motion, works and energy, relative motion, rotating mass balancing and back & forth motion, cam dynamics and Gyroscope.

Pre-requisite(s): Engineering Statics

References:
1. Meriam & Kraige, Engineering Mechanics. 7th ed, Wiley New York. 2012.
2. Holowenko, Dynamics of Machinery, John Wiley, 1995.
3. Beer & Johnston, Mechanics for Engineer, Dynamics, 11th ed. Dynamics, Mc Graw-Hill, 2015.

LABORATORY EXPERIMENT OF PRODUCTION PROCESS

ENME600007
1 CREDITS
Learning Outcome(s):

This subject is a complement to the Manufacturing Process and Material Selection, with a focus on practical aspects. With this subject, students are expected to gain practical skills regarding the product manufacturing process, from the technological aspects to the material.

Topic:

Practicum by using manual machining tools for bench work such as lathe, drill, milling, saws, etc .; welding practicum; rapid prototyping practicum

Pre-requisite(s): Material Selection and Manuf. Process

References:
1. Buku Panduan Praktikum Proses Produksi, Departemen Teknik Mesin FTUI.

LABORATORY EXPERIMENT OF MEASUREMENT AND METROLOGY

ENME600008
1 credits
Learning Outcome(s):

This subject is a complement to Measurement and Metrology, with a focus on aspects of practicum. With this subject, students are expected to get practical knowledge about metrology, various types of sensors and transducers and how to use them in a measurement system.

Topic:

Practicum using metrology measurement tools; practicum use of various types of sensors such as temperature and pressure.

Pre-requisite(s): Measurement and Metrology

References:
1. Busch, Ted, Fundamentals of Dimensional Metrology, 4th Ed, Delmar Publishers
2. Fargo F.T., Curtis, M.A., Handbook of Dimensional Measurement, 3rd Ed, Industrial Press.
3. Slocum, A., Precision Machine Design, SME Press, 1992.
4. Raldi Artono Koestoer, Pengukuran Teknik, Departemen Teknik Mesin FTUI.

HEAT AND MASS TRANSFER

ENME605017

4 CREDITS
Learning Outcome(s):

This course studies about the heat and mass transfer mechanism within a volume control system due to the temperature gradient, this course strictly related to the basic thermodynamics course. The purpose of this course is to develop the understading from the students about several heat and mass transfer mechanism between two systems if the temperature gradient ocure and the students able to calculate the heat transfer rate. The students capable to solve numbers of heat transfer problems using non-dimensional parameter.

Topic:

Fundamental of heat transfer, conduction heat transfer (1 dimentional and 2 dimentional), numerical analysis in conduction heat transfer/unsteady state, forced convection heat transver, free convection heat transfer, boiling and condensation, heat exchanger, radiation, fundamental of mass transfer, steady state molecul diffusion, unsteady state molecul diffusion, convection mass transfer, convection mass transfer correlation, mass transfer apparatus.

Pre-requisite(s): Basic Thermodynamics

References:
1. Frank P Incropere, David P De Witt, Fundamental heat and mass transfer, 7th Ed., Wiley, 2011, New York
2. Holman JP, Heat Transfer, 10th ed, Mc Graw-Hill, 2009.
3. Koestoer, RA, Perpindahan Kalor untuk Mahasiswa Teknik, Salemba Teknika, 2003.
4. Welty R James, Wicks Charless, Wilson Robert, Fundamentals of Momentum, Heat, and Mass Transfer, 6th Ed. Wiley, 2014.
5. Cengel, Yunus, Heat Transfer a Practical Approach, 2nd Ed. Mc Graw Hill, 2003, Singapore.
6. Kreith Frank, Bohn Mark, Principles of Heat Transfer, 7th Ed. CL Engineering, 2010.

ENERGY CONVERTION SYSTEM 1

ENGE605018
4 credits
Learning Outcome(s):

Energy Convertion System 1 is applied science and engineering of basic fluid science which studies the utilization of characteristic, behavior and properties of fluid and its flow behavior in various fluid machines i.e. rotodynamics, reciprocating, hydraulic and pneumatic system. The course is intended to equip student to understand characteristic of turbo fluid machines, hydraulic and pneumatic system and to be able to calculate and design a fluid system.

Topic:

Basic Thermo fluid in a Fluid System; Energy Transfer from Fluid to Rotor; Lagrangian and Eularian Approach; Energy Transfer Components; Impulse and Reaction; Turbo machinery Analysis with Flow; Operational Aspects of Rotodynamic Machinery; Hydraulic Similarities on Fluid Machinery; Reciprocating Machinery: Classification, Main Component and Operating; Discharge and Coefficient Discharge; Work and Power; Basic Hydraulic Machines; Hydraulic Machines; Hydraulic Accumulator; Hydraulic Intensifier, Hydraulic Press; Hydraulic Crane; Hydraulic lift; Pneumatic System: Basic Laws, Pressure Drop Losses, Basic Control Valve of Pneumatic Circuit.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanics

References:

1. Harinaldi, Sistem Fluida
2. Dixon, S.L, Fluid Mechanics and Thermodynamics of Turbomachinery, 7th Edition, Butterworth-Heinemann, 2013
3. Esposito, A., Fluid Power with Application, 7th Edition, Prentice Hall, 2008

4. Mobley, R.K, Fluid Power Dynamics, Newnes Butterworth-Heinemann, 2000
5. Giles, R.V, Fluid Mechanics and Hydraulics, 4th Edition Schaum's Outline Series, Mc-Graw-Hill, 2013

MECHATRONICS

ENME606022
4 credits
Learning Outcome(s):

This course provides the ability to design electrical-mechanical that properly meet the needs of a process specification and a design that given in a laboratory scale with the mechanical, electrical theory and automation control.

Topic:

Mechatronics concept and theory, electronics analog system, electronis analog components, electronics digital system, analog and digital interface, sensors and actuators (electric motor, pneumatic, hydraulic), principles of microprocessor and microcontroller, microcontroller based control system theory, C/C++ programming for electrical-mechanical for control, programmable logic controller (PLC), Laboratory activity.

Pre-requisite(s): Basic Physics 1, Basic Physics 2

References:
1. Smaili A. dan Mrad F., Applied Mechatronics, Oxford University Press, 2007
2. Sabri Cetinkunt, Mechatronics, Wiley, 2006
3. Histand, M.B., & Alciatore, D.G., Introduction to Mechatronics and Measurement System 4th ed, McGraw-Hill, 2011.
4. Fraser, C. dan Milne, J, Electromechanical Engineering, An Introduction, IEEE Press, McGraw-Hill, New York, 1994.
5. Gandjar K, Hand-out Mekatronika, DTMUI, 2007

MECHANICAL VIBRATION

ENME605014
2 credits
Learning Outcome(s):

The students have an understanding of the key points and concepts of the mechanical vibrations of mechanical systems and have the basic competence to analyze the vibration behavior and what parameters can be controlled in order to vibration damping.

Topic:

Fundamental of mechanical vibration in mechanical system, oscillatory motion, free vibration, harmonic vibration, transient vibration, system with 2 degree of freedom and system witih multi degree freedom, lumped parameters system and continue system, Lagrange equation, random and non-linier vibration.

Pre-requisite(s):
Engineering Mathematics, Kinematics and Dynamics

References:
1. Meriam & Kraige. Engineering Mechanics, Dynamics. Wiley New York. 8th ed.2015.
2. Holowenko. Dynamics of Machinery.John Wiley.1995.
3. William T.Thomson. Theory of Vibration with application, 5th Ed. Prentice Hall India.1997.
4. Beer & Johnston. Mechanics for Engineer- Dynamics, 11th ed. Mc-Graw-Hill. 2015.

ELECTRICAL POWER ENGINEERING

ENME606023
2 CREDITS
Learning Outcome(s):

The objective of this course is to give the understanding of basic concept and practical application on electrical power engineering. Student also studies the general understanding of electrical power engineering terms and can work in team effectively.

Topic:

Linear approach and signal analysis; History of development and basic physics of electrical power generationt Electromechanical energy conversion; Single phase and Triple phase Transformator; Three phase generation..

Pre-requisite(s): -

References:
1. J. David Irwin and David V. Kerns, Jr., Introduction to Electrical Engineering, Prentice Hall, 1995.
2. R.D. Shultz and R.A. Smith, Introduction to Electric Power Engineering, John Wiley &Sons, New York, 1988.
3. Zuhal, Dasar Tenaga Listrik dan Elektronika Daya

LABORATORY EXPERIMENT FOR ELECTRICAL POWER ENGINEERING

ENME600010
1 credits
Learning Outcome(s):

The laboratory is intended to introduce electric power basic concept to electrical engineering students : motor and generator includes DC or AC transformator

Topic:

Watt meter, volt meter, amp meter and transformer. Motor & generators DC. Reading of 3 phase circuit power either with balanced or unbalanced load. One and three phase circuit testing for Y & Δ. Power Transformer, solving by using open loop and closed loop circuit test. Autotransformer.

Pre-requisite(s): Electrical Power Engineering

References:
1. J. David Irwin and David V. Kerns, Jr., Introduction to Electrical Engineering, Prentice Hall, 1995.
2. R.D. Shultz and R.A. Smith, Introduction to Electric Power Engineering, John Wiley &Sons, New York, 1988.
3. Zuhal, Dasar Tenaga Listrik dan Elektronika Daya

DESIGN ASSIGNMENT 1

ENME600001
2 credits
Learning Outcome(s):

Student has the ability to design the system and mechanical product using previous knowledge and skill. From this course, student can work in team, communicate, report, present and defend the final project.

Topic:

Fundamental of mechanical design process; team work in design; process planning, understanding the problem and development of engineering specification; Concept Generation, Evaluation and Selection; Product Design Phase; Engineering Economics

Pre-requisite(s):

Mechanical Design, Material Selection and Manufacturing Process

References:
1. David G.Ullman. The mechanical design process, 4th ed. McGraw-Hill. 2009.
2. George Dieter. Engineering Design: A Material and

Processing Approach, 3rd ed. McGraw-Hill. 2000.
3. G.Pahl and W.Beitz. Engineering Design: A Systematic Approach, 3rd ed. Springer. 2007.

ENERGY CONVERTION SYSTEM 2

ENGE606021
4 credits
Learning Outcome(s):

This course discusses about the energy resources, type and classification of energy, energy conversion, energy consumption, basic concept of energy conversion, power resources and classification of energy conversion enginess. The students understand the energy source, type of energy conversion engine, conversion and conservation of energy system, and also capable to perform a basic calculation of energy conversion engine performance and critical consideration of energy conversion.

Topic:

Definition of energy and energy resources, type and energy classification, law and equation in energy conversion, energy profile (resources, reserves and the world's and Indonesia's energy needs), basic concept of energy conversion system, power resources and classification of energy conversion engine, fuel in energy conversion, renewable energy, non-renewable energy, classification of combustion engine, calculation for internal combustion engine performance, steam power plant, fluid machinery, cooling engine classification, thermodynamic cycle of cooling engine, energy conversion method in vehicle, industry and building.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanics, Heat and Mass Transfer

References:

1. Kreith, F, Goswami, DY, Energy Conversion (Mechanical Engineering), CNC Press, 2007
2. Kreith, F, Goswami, DY, Energy management and Conservation Handbook, CNC Press, 2007
3. Patrick, D.R., et.al, Energy Conservation Guidebook, 3rd ed. Fairmont Press 2014
4. Dincer, I., Rosen, Thermal Energy Storage: Systems and Applications 2nd ed, Wiley, 2010
5. Panduan Praktikum Prestasi Mesin Konversi energi, Departemen Teknik Mesin versi 2003. Depok 2003.

MAINTENANCE AND CONDITION MONITORING
ENME606020
3 credits
Learning Outcome(s):

This course gives the understanding and the ability to analyze a system and design a system for maintenance and its procedure to improve the efficiency and reliability within a system. To give the understanding and competence to develop and implementation of vibration monitoring and engine condition so that the mechanical system reach the optimum performance.

Topic:

Quality, Reliability and Maintainability, maintenance system strategy, failure analysis, design of maintenance system and scheduling, maintenance system organization, condition monitoring and condition based maintenance, computer based maintenance system, total productive maintenance (TPM) and its implementation, the effectiveness measurement of total productive maintenance, reliability based maintenance system, planning;measurement and standardization of maintenance work, quality of maintenance system, basic theory of vibration and engine condition, basic of engine condition monitoring, vibration monitoring device in several mechanical systems and engine condition analysis.

Pre-requisite(s): Mechanical Vibration

References:
1. Niebel, B.W., Engineering Maintenance Management, Marcel Dekker, Inc. 1994
2. Higgin, L.R., Maintenance Planning and control, Mc Graw Hill Book Company, 1998
3. Mishra, R.C., and SCPL. Pathak, Maintenance Engineering and Management, PHI, 2004
4. Bruel & Kjaer. Handbook of Vibration & Condition Monitoring

DESIGN ASSIGNMENT 2
ENME600002
2 credits
Learning Outcome(s):

Student have ability to produce the prototype from the previous design in Design Assignment 1. Student can work in team, manage the project and present the final project.

Topic:

Product Generation, Evaluation and Performance; Project Management; Product Evaluation or Mechanical System for Cost, Manufacutring, Assembling etc; Technopreneurship consideration.

Pre-requisite(s): Design Assignment 1

References:
1. David G.Ullman. The mechanical design process, 4th ed. McGraw-Hill. 2009.
2. George Dieter. Engineering Design: A Material and Processing Approach.2000.
3. G.Pahl and W.Beitz. Engineering Design: A Systematic Approach. Springer, 3rd ed. Springer. 2007.

Special Subjects Mechanical Engineering Study Program

SEMINAR
ENME600004
1 credits
Learning Outcome(s):

Student can communicate in verbal or written with final project pjroposal; able to formulate the problems and objectives of the research, conduct theoretical review to formulate the hypothesis, design the research method for empirical proof and present the preliminary result to the supervisor

Topic:

Problem description, basic concept of research with assumption and constraint; making preliminary report, conducting the preparation, literature review and research methodology; present final report with structured report, language, graphical presentation, table etc, reference and clarity.

Pre-requisite(s):

Passed 110 CREDITS and GPA > 2.00 without Grade E

ON THE JOB TRAINING
ENME600003
2 CREDITS
Learning Outcome(s):

The course is intended to provide opportunity for gaining experience in industries and applying mechanical engineering knowledge. Able to perform management tasks and engineering technique according to field of interest.

Topic:

Management and Engineering according to the field of interest. Presentation of internship results and report.

Pre-requisite(s): Passed 95 SKS and GPA > 2.00

FINAL PROJECT
ENME600005
5 CREDITS
Learning Outcome(s):

Students are able to conduct design and analysis the object of system that related to the mechanical engineering field

Topic:

Synthesizing various lectures taken by students to design or to solve engineering problems. Preparing a written report of the synthesis.

Pre-requisite(s): Passed 120 Credits and GPA >= 2.00

Elective Subjects Mechanical Engineering Study Program

INTERNAL COMBUSTION ENGINE
ENME803105
4 credits
Learning Outcome(s):

Student is expected to have competency and expertise in the field of his interest of internal combustion engine working principle and theory and is able to design and do construction calculation.

Topic:

Actual Cycle of Internal Combustion Engine; Fuel System; Ignition and Combustion in Spark Ignition Engine and Compressed Ignition Engine; Some Basic Characteristics and Calculations; Basic Engine Design; Determination of Engine's Main Components; Kinematics and Dynamics Analysis of the Motion; Calculation and Planning of Lubrication and Cooling System.

Pre-requisite(s): Basic Thermodynamics

References:
1. Guzela L, Onder, C., Introduction to Modelling and Control of Internal Combustion Engines, 2nd Edition, Springer, 2014
2. Heywood, J., Internal Combustion Engines Fundamental, McGraw Hill, 2011
3. Taylor, C.F., Internal Combustion Engines, in Theory and Practice, M.I.T Press, England, 1985.
4. Khovakh, M., Motor Vehicle Engines, MIR Publisher, Moscow, 1971.

APPLIED FLOW MEASUREMENT AND VISUALIZATION
ENME803106
4 credits
Learning Outcome(s):

Applied flow diagnostic study measurement and visualization techniques which have wide application both in industry and laboratory. The course give basic competency for the student to be bale to understand various measurement and visualization methods and to design appropriate flow diagnostic system in process installation in industry or experimental set up in a scientific research activities which related to fluid flow.

Topic:

Statistics Diagnostic Flow, Calibration in Flow Measurement; Momentum Sensing Meter (orifice plate, venturi, nozzle meters); Positive Displacement Flow Meter (Nutating Disc, Sliding Vane, Gear meters, etc.); Electromagnetic and Ultrasonic Flow Meters; Compressible Flow Meter (Wet Gas and Wind Anemometer); Principles Local Velocity Measurement in Liquid and Gases; Hot Wire Anemometry; Based Laser Velocimetry (LDV, PIV); Principles of Flow Visualization, Flow Visualization conventional; Shadowgraphs and Schliern Technique; Interferometry Technique; Light Sheet Based Technique ; Image Processing and Computer Assitested Method.

Pre-requisite(s): Basic Fluid Mechanics

References:
1. Yang ,W.J, Handbook of Flow Visualization, Taylor and Francis. 2001
2. Baker, R.C., Flow Measurement Handbook: Industrial Designs, Operating Principles, Performance and Applications, Cambridge University Press, 2005

CFD APPLICATION

ENME803107
4 CREDITS
Learning Outcome(s):

Understanding the basic principles of CFD and having the basic knowledge in applying CFD (Computational Fluid Dynamic)

Topic:

Prediction-rule Principles, Numerical Solutions: Advantages and Disadvantages; Mathematical Description of Physical Phenomena; Basic Nature of Coordinates; Discretization Method; Volume-set Application on Heat Conduction Problem; Convection and Diffusion; Two-Dimension Discretization Equations; Three-Dimension Discretization Method; Special Procedure Needs; Some of Constraints Associated with the Representation of Pressure-gradient Factors, Continuity Equations Representation; Stayered Grid; SIMPLE Algorithm; Revision of SIMPLER algorithm; Final Solutions: Basic Properties of Iterative Numerical Procedures; Sourceterm Linearization, Irregular Geometries, Preparation and Testing a Computer Programs.

Pre-requisite(s): Basic Fluid Mechanics, Engineering Programming

References:
1. Suhas V. Patankar, 1980, Numerical Heat Transfer and Fluid Flow, McGraw Hill.
2. C.A.J. Fletcher, 1996, Computational Techniques for Fluid Dynamics, 2nd edition, Springer Verlag
3. A.D. Gosman et al., 1985, Computer Aided Engineering Heat Transfer dan Fluid Flow, John Wiley & Sons.

VENTILATION AND AIR CONDITIONING SYSTEM
ENME801113
4 CREDITS
Learning Outcome(s):

This subject equips students with an understanding and basic competency in designing an air system with an increasing need for good air quality. Considering lately it is necessary to have more knowledge of the air conditioning system such as aspects of air flow velocity problems in the room, noise, odor, all of which are included in Indoor Air Quality (IAQ). This subject will also be given an understanding of the types of ozone friendly refrigerants including the technical implementation of retroophytic air conditioning systems.

Topic:

This subject equips students with an understanding and basic competency in designing an air system with an increasing need for good air quality. Considering lately it is necessary to have more knowledge of the air conditioning system such as aspects of air flow velocity problems in the room, noise, odor, all of which are included in Indoor Air Quality (IAQ). This subject will also be given an understanding of the types of ozone friendly refrigerants including the technical implementation of retroophytic air conditioning systems.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanics

References:
1. Ronald Howell, Harry J.Sauer, Jr and William J.Coad : Principles of HVAC, ASHRAE 1998.
2. Carrier : Handbook of HVAC
3. ASHRAE Standard
4. Overseas Vocational Training Association Employment Promotion Corporation : Fundamentals of refrigeration and Air Conditioning.

CLEAN ROOM
ENME803115
4 CREDITS
Learning Outcome(s):

Provide an understanding of the basic knowledge of clean room systems and its application in buildings, hospital and pharmaceutical industries. Understanding of the concept of air cleanliness, ventilation and fresh air exchange, application of laminar flow, the air pressure in the chamber and measuring systems, validation and its control.

Topic:

Indoor environment: human psychological and physiological aspects, BEAM IAQ assessment; Air quality: air cleanliness, ambient air quality, rationale for standards; Indoor air pollutants: gaseous pollutants, airborne particulate, VOCs, radon, biological contaminants; Indoor air movement: air flow in confined and unconfined spaces, filtration systems; Instrumentation and measurement techniques; Control measures: improved IAQ by HVAC system design, removal of contaminants.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanics

References:
1. ASHRAE : HVAC Design Manual for Hospitals and Clinics Second Edition, 2013
2. W. Whyte, Clean Room Technology Fundamentals of Design, Testing and Operation, John Wiley & Sons Ltd., 2001
3. John D. Spengler, J.M.Samet, J.F McCarthy, Indoor Air Quality Handbook, McGrawHIll, 2001.

ENERGY AUDIT
ENME803124 –
4 credits
Learning Outcome(s):

This course focuses on the theory, techniques and practices of analyzing energy aspects of building operations and correlating a building envelope's interaction with the mechanical systems. Students will perform a detailed energy audit of a state-of-the-art commercial building design using energy modeling simulation software and develop energy conservation strategies, such as thermal stor- age, that can be applied to heating, cooling, and ventilating equipment to reduce utility bills. Students will apply supporting analytical data to develop operations and maintenance changes designed to improve energy efficiency and reduce operating cost.

Topic:

Energy Auditing Basics, Energy Accounting and Analysis, Understanding the Utility Bill, Energy Economics, Survey Instrumentation, The Building Envelope Audit, The Electrical System Audit, The Heating, Ventilating and Air-Conditioning Audit, Upgrading HVAC Systems for Energy Efficiency Verification of System Performance, Maintenance and Energy Audits, Self-Evaluation Checklists, World-class Energy Assessmeents, and Water Conservation.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanics

References:
1. Albert Thumann, William J. Younger, Terry Niehus, Handbook of Energy Audits, Eighth Edition, The Fairmont Press, 2010.
2. Moncef Krarti, Energy Audit of Building Systems: An Engineering Approach, Second Edition, CRC Press, Taylor & Francis Group, 2010.

FIRE DYNAMICS AND MODELLING
ENME803134
4 credits
Learning Outcome(s):

Sudents understand the various stages of fires and provide basic knowledge methods and techniques applied in the analysis of fire development, and develop students' ability to critically analyze the methods of practical application. This course also aims to improve the ability to understand and analyze the fires model.

Topic:

Introduction to the process of combustion, premixed flame and diffusion flame, ignition and spread of fire, classification of fires and the influence of the geometry of the room. Calorimetry fire: heat release rate, mass loss rate and the relationship between time and heat release rate, the growth of fire in the room, as well as testing methods. The dynamics of the flame: fire plume and flame (flame), a high flame, the flame height correlation.

Pre-requisite(s): Basic Thermodynamics

References:
1. Dougal Dysdale, An Introduction to Fire Dynamics, 3rd Edition, John Wiley and Sons, 2011.
2. James G. Quintiere, Fundamentals of Fire Phenomena, John Wiley & Sons, Ltd ISBN: 0-470-09113-4, 2006
3. Bjorn Karlsson, and James G. Quintiere, "Enclosure Fire Dynamics". CRC Press LLC, 2000.
4. SFPE Handbook of Fire Protection Engineering 5th edition, Springer, 2016
5. Thierry POINSOT, Denis VEYNANTE, Theoretical and Numerical Combustion.
6. Jurnal dan standar terkait.

COMPOSITE PRODUCT DEVELOPMENT
ENME803145
4 credits
Learning Outcome(s):

Provide expertise and competence to students in the field of designing and manufacturing of parts / mechanical construction using composite materials. This course provides an understanding of composite materials, including the characteristics, testing, manufacturing process, and special applications in the engineering field.

Topic:

Composite Type, Material, Properties, Mechanics; Knowledge and Characteristics of Fiber Composite, Strength, Hardness, and the composite thermal expansion; Theory of Combination Fiber and Matrix; Matrix Composite Characterization; Laminar Theory On Axis and Off Axis; Composite Product Design, Composite Fabrication Technique ; Testing Method; Future Applications.

Pre-requisite(s): Engineering Materials, Mechanical Design

References:
1. Brent Strong, Fundamentals Of Composites Manufacturing: Materials, Methods and Applications - Technology & Engineering – 2007
2. By Daniel Gay, Suong V . Hoa, Stephen W. TsaiTranslated by Stephen W Tsai Contributor Suong V. Hoa, Stephen W. Tsai, Composite materials: Design and application, 2nd : CRC Press 2007
3. Soemardi,T.P. Diktat Mekanika komposit, Fabrikasi dan Testing. FTUI.2003.
4. Composites ASM handbook No 21

DESIGN AND DEVELOPMENT OF EDUCATIONAL PRODUCTS

ENME803147
4 CREDITS
Learning Outcome(s):

Understand the basics and process of designing and developing educational products in the industry of teaching aids, educational products, and game aids.

Topic:

Brainstorming and expressing ideas and opinions, Innovation and Theme Development, Basics of Toy Product Design, Basic Engineering and Mechanical Design, Basic Theory for Sketching, Sketch Drawing Modeling Process, Design Aesthetics, Manufacturing Theory and Material Selection for Game Props, Basic Theory of Making Prototype, Portfolio Design, Presentation and Idea Pitching.

Pre-requisite(s): Engineering Materials, Mechanical Design

References:
1. Karl Urlich, Steven Eppinger, 2015, Product Design Development Flow, 6th Edition, McGraw Hill.
2. Donald A. Norman, 2005, Emotional Design, 1st Edition, Basic Books.
3. Michael Michalko, 2006, Thinkertoys : A Hanbook of Creative Thinking Techniques, 2nd Edition, Ten Speed Press.

QUALITY AND PRODUCTION MANAGEMENT SYSTEM

ENME803154
4 credits
Learning Outcome(s):

Provide knowledge, understanding and ability to perform management, analysis and improvement of production systems in the manufacturing industry with the principles of efficiency and effectiveness, and able to understand and implement and develop policies and procedures are needed to improve and control the various processes.

Topic :

Introduction to Manufacturing Systems, Manufacturing Principles, Resources, Production Process and Production Organization, Production Lay-Out, Design, Scheduling and Production Process Control; Productive Maintenance, Logistics and Inventory; Engineering Quality, Quality Control, Quality Function Deployment (QFD) , Total Quality Management; Quality Management System (8 Quality Management Principles, International Standard Quality Management System: ISO 9001, ISO 9004, ISO TS 16949, the International Management System Standard: ISO 14001, OHSAS 18001); System And Process Improvement: Cause - Effect Analysis, FMEA (Failure Mode and Effect Analysis), Lean Six Sigma.

Pre-requisite(s): Mechanical Design

References:
1. Hitomi, Katsundo. Manufacturing System Engineering. Taylor & Francis. 2001
2. TQM : A Cross Functional Prespective, Rao, CARR, Dambolena, Kopp, Martin, Rafii, Schlesinger, John Willey, 1996
3. TQM, Text, Cases and Readings, Joel E. Ross, St. Lucie Press 100 E. Linton Blvd Suite 403 B Delray Beach, FL 33483

MICROFABRICATION AND PRECISION MANUFACTURING

ENME803161
4 credits
Learning Outcome(s):

of MEMS (micro Electro mechanical system) at this time that has wide application of the biomedic system, sensors and micro-electronic devices (electronic devices). This course giving understanding of manufacturing techniques and basic structure mechanics in a product and also the micro-characterization of the process fabrication conducted in the laboratory. This course provides a basic competency of the principles in the design techniques which control the movement of the size or dimensions in a very small if compared with the size of the object that is designed and produced the correct design and the development machine and a precision mechanism

Topic:

Introduction to Engineering Micro Fabrication; Lithography: The design aspect, macredits making, etching technique (And Wet Etching Dry Etching); Deposisi Engineering: Chemistry and Chemicals; Electroplating, Micromolding, Beam Processing; Microscaling consideration); Transport Processes and Metrology in the micro-scope; Lab Practice and Applications, Philosophy Precision Manufacturing; kinematic concept; Pro and contra Flexures Design; Materials for Precision Components; Self Calibration Concept; Manufacturing Process which is Important in Precision Manufacturing, Precision Instruments; Basic Concept of Tolerance on Dimensions and geometric.

Pre-requisite(s): Engineering Materials, Mechanical Design, Engineering Programming

References:
1. Madou, M.J. Fundamentals of microfabrication: the science of miniaturization, CRC Press, 2002.
2. McGeough, J (Ed.), Micromachining of Engineering Materials, Marcel Dekker, 2002, ISBN 0-8247-0644-7
3. Mainsah, E., Greenwood J.A. and Chetwynd D.G. Metrology and properties of engineering surfaces, Kluwer Academic Publ., 2010
4. Gardner J.W. and Hingle H.T. (Ed.) From Instrumentation to Nanotechnology, Gordon and Breach Science Publishers, 1991, ISBN 2-88124-794-.
5. Korvink J.G. and Greiner A. Semiconductors for Micro- and Nanotechnology – An Introduction for Engineers, WILEY-VCH Verlag GmbH, 2002, ISBN 3-527-30257-3.
6. Mark J. Jackson, Microfabrication and nanomanufactur-

ing. Taylor and Francis, 2006

MODERN VEHICLE TECHNOLOGY

ENME803167
4 credits
Learning Outcome(s):

Students understand the concept of manufacturing technology and control systems on the vehicle so as to: • Analyze the condition of current technological advances to make fundamental changes in vehicle design a sustainable future.

- Design process to create an automatic control system that helps in controlling the vehicle.
- Designing vehicles with electronic control systems that can improve vehicle performance.
- Describes the integration of vehicle control systems and mechanicalelectrical interaction possibilities for the design of future vehicles.

Topic:

Knock control, Linear solenoid idle speed control, Sequential fuel injection, Distributorless ignition, Self-diagnosis for fail-safe operation, Crankshaft angular position measurement for ignition timing, Direct mass air flow sensor, Variable valve phasing, Hybrid Electric Vehicles and Electric Vehicle.

Pre-requisite(s): Engineering Materials, Mechanical Design, Engineering Programming

References:

1. Julian Happian-Smith, " An Introduction to Modern Vehicle Design", Butterworth- Heinemann Linacre House, Jordan Hill, Oxford OX2 8DP, ISBN 07506 5044 3.
2. Heinz Hei s ler, "Advance Vehicle Technology", Society of Automotive Engineers, Inc. ISBN 07680 1071 3.
3. Fuhs, Allen E., "Hybrid vehicles and the future of personal transportation", CRC Press, Taylor & Francis Group, ISBN-13: 978-1-4200-7534-2, ISBN-10: 1-4200- 7534-9.
4. Lino Guzzella and Christopher H. Onder, "Introduction to Modeling and Control of Internal Combustion Engine Systems", Springer-Verlag Berlin Heidelberg, ISBN 978-3-642-10774-0 e-ISBN 978-3-642- 10775-7, DOI 10.1007/978-3-642-10775-7, Library of Congress Control Number: 2009940323.
5. Iqbal Husain, "ELECTRIC and HYBRID VEHICLES Design Fundamentals", CRC PRESS Boca Raton London New York Washington, D.C., ISBN 0-203-00939-8 Master e-book ISBN, International Standard Book Number 0-8493-1466-6 (Print Edition), Library of Congress Card Number 2002041120.
6. Ali Emadi, "Handbook of Automotive Power Electronics and Motor Drives", Taylor & Francis Group, CRC Press is an imprint of Taylor & Francis Group, ISBN 0-8247-2361-9.
7. Nicolas Navet and Françoise Simonot- Lion, "Automotive Embedded Systems Handbook", CRC Press Taylor & Francis Group, 6000 Broken Sound Parkway NW, Suite 300, ISBN-13: 978-0-8493-8026-6, ISBN-10: 0-8493-8026-X
8. Paul Nieuwenhuis and Peter Wells, "The automotive industry and the environment A technical, business and social future", Woodhead Publishing ISBN 1 85573 713 2, CRC Press ISBN 0-8493-2072-0, CRC Press order number: WP2072.
9. Simon Tung, Bernard Kinker, and Mathias Woydt," Automotive Lubricant Testing and Advanced Additive Development", ASTM 100 Barr Harbor Drive PO Box C700, West Conshohocken, PA 19428-2959,ISBN: 978- 0-8031-4505-4.
10. James Larminie, John Lowry, "Electric Vehicle Technology Explained", Oxford Brookes University, Oxford, UK, Acenti Designs Ltd.,UK. ISBN 0-470-85163-5.

OIL AND GAS DRILLING EQUIPMENT

ENME803195
4 credits
Learning Outcome(s):

Provide additional insights regarding the implementation of basic knowledge of engineering competence that is at the core of oil and gas drilling techniques. Competencies expected of graduates capable of developing the engine with value added technical knowledge of oil and gas drilling equipment that is ready to be trained and shaped to be easily and immediately adapt to work without the awkwardness of the world's E / P oil and gas fields in general and in particular oil and gas drilling. Thus it has the advantages of graduates and a wider choice in the real world of work later. Objectives and learning outcomes to be achieved:

1. Enabled students to know the basic tools and their functions and how each is needed in an oil and gas drilling operations.
2. Students capable of explaining the technique of oil and gas drilling operations and its other related aspects such as equipment used, safety issues, safety equipment, emergency and environmental issues.
3. Student s have a pret ty good understanding of the knowledge of drilling equipment and its operation so as to participate in an oil and gas drilling operations with confidence and readiness to increase knowledge and skills later on after graduation.

Topic:

Intro to oil / gas well, oil / gas Exploration, exploitation and production, drilling rig, the terminology, the problem of drilling, drilling fluid, drilling oil and gas in the system, hoisting system equipments, equipments rotating system, circulating system equipments, power system equipments, blowout prevention system equipments, well design, equipments and operations for safety and efficiency, process and equipments for cementing, drilling preparation, drilling operations, drilling and process problems (drill string vibration and whirling, collar failure, etc.) artificial lift methods and equipments, visit to the field of oil and gas drilling.

Pre-requisite(s): Engineering Materials, Mechanical Design

References:

1. Don A. Gorman, Jerry W. Meyer, "Drilling Equipment and Operations", Action Systems Inc., Dallas, Texas – USA.
2. Adam T. Bourgoyne, Martin E. Chenevert, et. al., "Applied Drilling Engineering", Society of Petroleum Engineers, Richarson, Texas – USA.
3. Nguyen J.P., "Drilling-Oil and Gas Field Development Techniques", Institut Français du Pétrole Publication, 1996
4. Kermit E. Brown, "The Technology of Artificial Lift Methods", Volume 2a, Petroleum publishing Co., 1980
5. Amanat U.C., "Oil Well Testing handbook", Elsevier, 2004
6. Amanat U.C., "Gas Well Testing handbook", Elsevier, 2004

JET AND ROCKET PROPULSION

ENME803196
4 CREDITS
Learning Outcome(s):

Students understand the concept of thrust / propulsion related to the resistance of aircraft or flying vehicles. (thrust required); understand the concept and workings of a gas turbine and rocket engine; understand the characteristics of propeller (turboprop), turbofan, and jet (including rocket) propulsion systems on the performance of aircraft or other flying vehicles.

Topics:

The concept of the propulsion system which is influenced by the aerodynamic design of the aircraft (aircraft motion resistance and the 4 main forces of lift, weight, thrust and drag); How gas turbines and rocket engines work; The propulsion characteristics of various types of aircraft propulsion systems, namely, propeller (turboprop), jet and turbofan.

Pre-requisite(s): -

References:
1. J. D. Anderson, Aircraft Performance and Design, McGraw-Hill.
2. Anthony Giampaolo, Gas Turbine Handbook: Principles and Practices, The Fairmont Press.
3. D. P. Mishra, Fundamentals of Rocket Propulsion, CRC Press.
4. Rolls Royce, The Jet Engine, Rolls Royce PLC.

RISK MANAGEMENT
ENME803174
4 credits
Learning Outcome(s):

Fast information flow and the presence of regulatory and supervisory concerns, management requires understanding and measuring risk. Risk management sets standards for combining different information, collecting data, calculating risk measures and creating timely reporting tools for management. This course directs students to understand how complex ricredits on a large scale can be measured and managed.

Topic:

Introduction to risk management, Value at Risk - VaR Risk measures for various asset classes, Monte Carlo Simulation, VaR Validation and Extremes, Regulatory Environment 25 years of risk related regulations, Multifactor models Discussion of multifactor analysis, Review of industry leading risk management systems , Operational Risk and its Basel II requirements.

Pre-requisite(s): -

References:
1. Jorion, Philippe, Value at Risk: The New Benchmark for Managing Financial Risk, 3rd edition, McGraw-Hill, 2007
2. Roger Lowenstein, When Genius Failed, Random House, 2000

PROJECT MANAGEMENT (MK Merdeka)
ENME601101
2 credits
Learning Outcome(s):
Understand project management in engineering in general.

Topic:

Special topics in project management that have not been covered in other subjects.

Pre-requisite(s): -

References: -

ENTREPRENEURSHIP (MK Merdeka)
ENME601102
2 credits
Learning Outcome(s):
Understanding entrepreneurship in general.

Topic:

Special topics in the field of entrepreneurship that have not been covered in other subjects.

Pre-requisite(s): -

References: -

INDUSTRIAL SEMINAR (MK Merdeka)
ENME601103
2 credits
Learning Outcome(s):
Understand the development of the industry and the problems it faces in general.

Topic:
Special topics in the industrial field that have not been covered in other subjects.

Pre-requisite(s): -

References: -

INTERNSHIP A
ENME601108
3 credits
Learning Outcome(s):

Students gain insight and experience activities in industry and the work experiences related to non-engineering aspects.

Topic:

Special topics in the non-engineering industrial sector that have not been covered in other subjects.

Pre-requisite(s): Have undergone a minimum of 4 semesters of lectures, or have obtained a minimum of 72 credits with a GPA> 2.0. Activities carried out by monitoring and evaluation by the Internship Coordinator.

References: -

SPECIAL TOPIC 1
ENME601104
4 credits
Learning Outcome(s):

Students gain insight and experience of activities in national / international competitions, or community, or entrepreneurship, or industry and the work experiences.

Topic:

Special topics in fields that have not been covered in other subjects.

Pre-requisite(s): Have undergone at least 2 semesters of lectures, or have obtained a minimum of 36 credits with a GPA> 2.0. Activities carried out by monitoring and evaluation by the Special Topic Subject Coordinator.

References: -

SPECIAL TOPIC 2
ENME601105
4 credits
Learning Outcome(s):

Students gain insight and experience of activities in national / international competitions, or community, or entrepreneurship, or industry and the work experiences.

Topic:

Special topics in fields that have not been covered in other subjects.

Pre-requisite(s): Have undergone at least 2 semesters of lectures, or have obtained a minimum of 36 credits with a GPA> 2.0. Activities carried out by monitoring and evaluation by the Special Topic Subject Coordinator.

References: -

ADVANCED ENGINEERING MATHEMATICS

ENME802002
2 credits
Learning Outcome(s):

The purpose of this subject is to develop students' analytical skills. Students understand and are able to use advanced engineering mathematical concepts in solving applied engineering problems.

Topic:

Introduction to Differential Equations; Differential Equation Order 1; Differential Equation of Order 2; High Order Differential Equations; Vector Analysis; Differential Vector; Grad, Divergence and Curl Operations; Vector Integral; Laplace transform; Solving Differential Equations using Laplace Transform; Fourier transform; Convolution

Pre-requisite(s): -

References:

1. Chapra, Steven C. and Canale, Raymond P. Numerical Methods for Engineers 6th edition. New York: McGraw-Hill, 2010.
2. Kreyszig, Erwin. Advanced Engineering Mathematics 10th edition. Danvers: John Wiley & Sons, 2011.
3. Sedgewick R., Phillippe F, An Introduction to the Analysis of Algorithms, Addison Wesley.
4. Cheney W., Kincaid D., Numerical Mathematics and Computing, Cole Publishing

ENGINEERING COMPUTATION

ENME802004
2 credits
Learning Outcome(s):

The purpose of this subject is that students know well and be able to apply the processes and methods (algorithms) of calculation (numerical and analytic) engineering in the real computer-based computing world and parameters that affect the speed and accuracy of the calculation results.

Topic:

Numerical Method: Equation roots, Numerical Diffential, Numerical Integral; Partial Differential Equation Solution. Introduction to Computer Applications: Algorithms and Algorithm Analysis; Computational Complexity; Types of Algorithms; Number Optimization and Representation; Overflow and Underflow; Error and Formula Error in Numerical; Root of Eq. Finite Divided Difference Method in calculating Equation Derivation; Numerical Integration; ODE and ODE systems in Computing Applications; Fast Fourier Transform; PDE in Computational Applications: Solutions of Elliptic, Parabolic, and Hyperbolic Equations with Numerical Methods; Application of Elliptic, Parabolic, and Hyperbolic PDE equation techniques; Monte Carlo in Computing Applications.

Pre-requisite(s): -

References:

1. Chapra, Steven C. and Canale, Raymond P. Numerical Methods for Engineers 6th edition. New York: McGraw-Hill, 2010.
2. Kreyszig, Erwin. Advanced Engineering Mathematics 10th edition. Danvers: John Wiley & Sons, 2011.
3. Sedgewick R., Phillippe F, An Introduction to the Analysis of Algorithms, Addison Wesley.
4. Cheney W., Kincaid D., Numerical Mathematics and Computing, Cole Publishing

ADVANCED THERMODYNAMICS

ENME801101
4 credits
Learning Outcome(s):

Provide further understanding of the science of thermodynamics and its applications so that students are able to design and conduct a basic research mapun able to complete the analysis involves the calculation of the thermodynamic system correctly and systematically in order to find the best solution gentang effectiveness of the use of substances and energy, especially in the 'engineering design' by motto: 'Low entropy production', 'high thermal efficiency' and 'low pollution effect'.

Topic:

Basic Thermodynamics and Gas Dynamics, Equilibrium of Thermodynamics System, Thermodynamics properties of System, Thermodyamics of ideal gas mixture, review of chemical thermodynamics, review of chemical kinetics, conservation equation for multicomponent reaction system, pre-mixed laminar flames, method of measuring flame velocity (bunsen burner), flame quenching, flamability limit of premixed laminar flame, gaseous diffusion flame and combustion of single liquid droplet, combustion in compression ignition engine, combustion in spark ignition engine, combustion research in hydrocarbon oxygen mixture, engine research, combustion-generated emission, experimental method : preseure measurement and recording; temperature measurement and recording; combustion photography and flame speed detection; spectrographic method; chemical analysis technique (NDIR, FID, Gaschromatography).

Pre-requisite(s): -

References:

1. Holmann, J.P., Thermodynamics, Intl. Student Edition, McGraw Hill, 2005.
2. Kenneth Wark Jr. Thermodynamics, McGraw Hill, 2003.
3. Francis F. Huang, Engineering Thermodynamics, MaxWell Macmillan Intl. Edition, 2000.
4. H.D. Baehr, Termodynamik, Springer Verlag
5. K. Stephan, Termodynamik, Grundlagen und technishe Anwendung-en, Band 1, Band Springer Verlag.
6. Bejan, Adrian, Advanced Engineering Thermodynamics, Wiley – interscience, 2nd Edition, 1997

ADVANCED FLUID DYNAMICS AND HEAT TRANSFER

ENME801102
4 credits
Learning Outcome(s):

Enhance the ability of students in the study of fluid mechanics in more detail so as to conduct research or the application of science in industrial applications. Studying the mechanism of heat transfer in a control volume due to the existence of the temperature difference and concentration as well as the involvement of one, two or three phases at the tim simultaneously.

Topic:

Viscous flow of Newtonian fluid, membrane boundary flow, Non-Newtonian Fluid Flow, Two-Multi Phase Flow, Particle Displacement Flow, Porous Media and Fluidized Beds, Turbulent Flow and Mixing, Jet, Chimney, Energy and Momentum Equatio, one-two-three dimension conduction heat transfer, heat transfer on extended surface.

Pre-requisite(s): -

References:

1. Frank P Incropere, David P De Witt, Fundamental heat and mass transfer, 5th Ed., John Wiley & Sons, 1996, New York
2. Holman JP, Heat Transfer, 9th, Mc Graw Hill, 2003.
3. Koestoer, RA, Perpindahan Kalor untuk Mahasiswa Teknik, Salemba Teknika, 2003.
4. Welty R James, Wicks Charless, Wilson Robert, Fundamentals of Momentum, Heat, and Mass Transfer, 3rd Ed. John Wiley & Sons, 1996, New York
5. Cengel, Yunus, Heat Transfer a Practical Approach, 2nd Ed. Mc Graw Hill, 2003, Singapore.
6. Kreith Frank, Bohn Mark, Principles of Heat Transfer, 6th Ed. Brooks/cole, 2001, USA
7. Abbott I R, Theory of Wing Section, Dover Publications.
8. Bird R B, Transport Phenomena, John Wiley & Sons.

FIRE AND BUILDING SCIENCE

ENME802133
4 credits
Learning Outcome(s):

Students understand the basic and important parameters in the process of fire (fire), the phenomenon of fire dynamics and fire hazards. Students will also learn the science of fire both for indoors and outdoors. To strengthen understanding of fire science in buildings, students will also study building science, which relates to building requirements, which include safety, health, comfort, and ease of access for normal operating conditions and fire emergencies. The basic phenomenon of fires in nature that propagates to buildings or vice versa (wildland-urban interface or WUI fires) will also be studied in this lecture.

Topic:

Basic laws of aerothermochemistry such as combustion thermodynamics, fluid mechanics, heat transfer, combustion chemical reactions, rate of heat release, calculation of fire dynamics, flame and flame propagation indoors and outdoors. Building sciences relating to the fulfillment of safety, health, comfort, and ease of access requirements both under normal operating conditions and fire emergencies. This lecture course is also equipped with experimental activities in the laboratory to understand ignition behavior, premixed and non-premixed flame phenomena, combustion of solids and liquids, plumes formation, smoke production, flame and flame propagation, and fire dynamics in the room to represent fire conditions building.

Pre-requisite(s): -

References:

1. Drysdale, D., An Introduction to Fire Dynamics, John Wiley & Sons Ltd, 1985.
2. James G. Quintiere, Fundamentals of Fire Phenomena, John Wiley & Sons, Ltd ISBN: 0-470-09113-4, 2006
3. SFPE Handbook of Fire Protection Engineering 5th edition, Springer, 2016
4. Turn, S.R., An Introduction to Combustion 2nd Edition, McGraw-Hill, Inc. 2000.
5. Jens Pohl, Building Science: Concept and Application, Wiley-Blackwell, 2011.
6. Samuel Manzello, Encyclopedia of Wildfires and Wildland-Urban Interface (WUI) Fires, Springer, 2020.
7. Undang-Undang Bangunan Gedung Republik Indonesia, Peraturan terkait, dan SNI.

MATERIAL AND MANUFACTURING PROCESSES

ENME801140
4 credits
Learning Outcome(s):

The course provides understanding and basic competence of theory, application method and product manufacturing processes that covers: working principle, process characteristics, process limitations, work and force due to the process, parameters that affects to the process and the relation of material with the process that needed for certain process.

Topic:

Manufacturing Process and Production Systems; Materials in Manufacturing; Theory and Method of Casting Processes; Theory and Method of Bulk Deformation Processes; Theory and Method of Metal Forming Processes; Theory and Method of Powder Metalurgy Processes; Theory and Method of Material Machining/ Cutting Processes; Theory and Method for Enhancing Manufactured Surface Quality; Theory and Method of Joining Processes; Theory and Method of Prototyping; Engineering Material Characteristics; The Relation between Process Characteristics and Material Characteristics; The Parameter Control of Process for Material; Assignment in Manufacturing Process and Material Selection for Market Needs.

Pre-requisite(s): -

References:

1. Michael Ashby dan Kara Jhonson, Materials and Design: Arts and science in material selection in product design,Butterowrth-Heinemann, 2002
2. Michael Ashby, Material selection in Mechanical Design, Butterworrth Heinneman,2005
3. John A. Schey, Introduction to Manufacturing Processes, McGraw-Hill, 1999
4. Degarmo, E. Paul, Materials and Processes in Manufacturing, Prentice Hall Int. Inc, 8th edition, 2005

PRODUCT DESIGN AND DEVELOPMENT METHODOLOGY

ENME801141
4 credits
Learning Outcome(s):

Provide an understanding and mastery of the theory and methodology of design and product development include: planning, concept development, system design, detailed design, testing and screening, production ramp-up, in a series of factors to consider overall product development.

Topic:

Product Planning: Needs Identification Methods; Product Selection Method (Feasibility Study); Business Specifications: Concept Development and Selection; Aspects of Engineering in Product Development and Manufacturing (Process, Material, Thermal, Durability) Non- Technical Aspects in Product Development and Manufacturing; basic Design for Manufacturing and Assembly; Calculation of Economics of Product Development.

Pre-requisite(s): -

References:

1. Karl T.Ulrich. Product Design and Development, 3rd edition, Mc.Graw Hill 2004.
2. Dieter, G.E., Engineering Design, 3rdedition, Mc.Graw Hill 2000

MANUFACTURING INFORMATION SYSTEM MANAGEMENT

ENME801150
4 credits
Learning Outcome(s):

Provides understanding of the theory, method and application of information technology systems, management, and development of the concept of knowledge-based information systems (Knowledge Management System) and capable to apply in the manufacturing industry.

Topic:

Introduction to Information Systems; State of The Art Utilization Information System; Theory and System Methodology; Database Management Systems; System Design I: Overview functionality, enabling Technology (Automated Solution Assessments Quality, Multi Data Representation, Database Technology and XML); Design System II: (Database Design, Information Input, Output Information); Case Study: Documentation automation and Reporting System for Manufacturing; Introduction Knowledge Base Engineering, Concepts and Methodology in the KBE (System Specialists, Neural Network); KBE application..

Pre-requisite(s): -

References:

1. Raymond McLeod Jr., Strategic information Management: Challenges and Strategies in Managing Information System; 3rd Edition, Butterworth-Heinnemen, 2003.
2. Cortada, James. Total Quality Management, McGraw Hill Book Co.
3. Ake, Kevin et al. Information Technology for Manufacturing: Reducing Costs and Expanding Capabilities, CRC Press, 2003.
4. Cecelja, Franco, Manufacturing Information and Data System: Analysis Design and Practice, Butterworth-Heinnemen, 2001.

MANUFACTURING SYSTEM AND PROCESSES

ENME801151
4 credits
Learning Outcome(s):

Students are expected to know and be able to apply the conventional manufacturing process technology and non-conventional for the manufacture of a product and the parameters which inflence it is devoted to the metal forming processes, machining, rapid prototyping process. In addition, knowing, and understanding the existing production systems in the industry.

Topic:

Materials in Manufacturing: Theory and Method of Casting Process (Metal Casting); Theory and Method of Bulk Formation Processes: Theory and Method of Formation Process Material Sheet (Sheet Metal Forming): Theory and Methods of Powder Metallurgy Process (Powder Metalurgy); Theory and Methods for Machining Processes / Cutting Materials: Theory and Methods of Product Surface Quality Improvement process: Concepts and methods of manufacturing systems.

Pre-requisite(s): -

References:

1. Wagoner R., Chenot J.-L, Fundamentals of Metal Forming, John Wiley & Sons, Inc,2003
2. Degarmo P., Materials and Process in Manufacturing, Prentice Hall, 2004
3. Schey J., Introduction to Manufacturing Process, McGraw-Hill, 2004
4. Thomas E Vollman, Manufacturing Planning and Control, McGraw Hill 1997
5. Stanley B. Gershwin, Manufacturing System Engineering, Prentice Hall, 1993
6. John M. Nicholas, Competitive Manufacturing Management, 1997

VEHICLE ENGINEERING AND HEAVY EQUIPMENT

ENME801163
4 credits
Learning Outcome(s):

This course provides the latest technology from the four-wheeled passenger vehicle, especially with covering all aspects of engineering in a vehicle. Lectures given vehicle engineering with the aim that students have basic competence to do the engineering on the four-wheeled passenger vehicle in particular.

Topic:

Vehicle Kinematics & Dynamics; mover and transmission system; Breaking Systems, Wheel and Suspension; Security System: Active and passive at the time experiencing issues.

Pre-requisite(s): -

References:

1. Bosch Automotive Handbook, Sixth Editions, 2006
2. Gillespie, Thomas D., Fundamentals of Vehicle Dynamics, 2004
3. Hei s ler, Heinz. Advanced Vehicle Technology, 2004
4. Hermann, Hans. SAE Handbook of Automotive Engineering, 2004
5. Miliken, William F., Douglas L. Milliken, Maurice Olley, Chassis Design: Principles and Analysis, 2004
6. Pacejka, Hans B. Tire & Vehicle Dynamics, SAE, 2006

PRIME MOVER AND POWERTRAIN SYSTEM

ENME801164
4 credits
Learning Outcome(s):

Students have the competency and skill in the principles and theory of prime mover including internal combustion motor, electric motor, hybrid motor which are connected to the powertrain system; understand and are able to calculate the construction and design.

Topic:

Combustion motor technology; reciprocating/rotary piston engine; electric motor technology (AC/DC motor); hybrid motor system; serial/parallel hybrid; transmission system: MT, AT, DCT, CVT; battery technology

Pre-requisite(s): -

References:

1. Heywood, J., Internal Combustion Engines Fundamental, McGraw Hill, 1989
2. Khovakh, M., Motor Vehicle Engines, MIR Publisher, Moscow, 1971.
3. Bosch Automotive Handbook, SixthEditions, 2006
4. Gillespie, Thomas D., Fundamentals ofVehicle Dynamics, 2004
5. Heiszler, Heinz. Advanced VehicleTechnology, 2004
6. Hermann, Hans. SAE Handbook ofAutomotive Engineering, 2004

COMBUSTION ENGINEERING

ENME804110
4 CREDITS
Learning Outcome(s):

Combustion Engineering provide basic competency to investigate, analyze and learn about the process of combustion of fuel, and the nature and behavior of flame. The course provides basic understanding to apply the laws of basic aerothermochemistry in the engineering calculation of practical combustion engineering. The student is expected to be able to analyze the combustion behavior of a flame and to develop knowledge in the field of combustion engineering.

Topic:

Important Meaning of Combustion Study; Basic Reaction and Stoikhiometry of Combustion; Gas Fuel (BBG); Liquid Fuel, Solid Fuel; Basic Thermochemistry and Fluid Dynamics of Combustion; Principles of Conservation of Mass and Continuity; Turbulence Premixed Flame Structure; Detonation; Combustion Technology; Fixed-Bed Combustion, Suspension, Fluidized- Bed; Study on Flame and Combustion Technology; Minimum Temperature Self-ignition (Auto/ Self-Ignition); Flammability Limit; Fire spread, Fire Suppression Material, Combustion and the environment.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanic

References:

1. Turn, S.R., An Introduction to Combustion, 3rd Edition, McGraw-Hill, Inc. 2011
2. Borman, G.L., and Ragland, K.W., Combustion Engineering, 2nd Edition, McGraw-Hill, Inc. 2011.
3. Griffi ths, J.F., and Barnard, J.A., Flame and Combustion, 3rd Edition, Blackie Academic and Professional, 1995.
4. Glassman, I., Combustion, 5th Edition, Academic Press, 2014.
5. Warnatz, J., Maas, U., and Dibble R.W., Combustion, 2nd Edition, Springer-Verlag, 1998.

HEAT AND MASS TRANSFER ENGINEERING

ENME804109
4 credits
Learning Outcome(s):

The course objective is to provide understanding of the heat exchangers used in many industrial processes and power plants as the application of heat transfer. This course provides a basic competency to know main heat exchanger types and to understand and able to select suitable heat exchanger type for current applications. Student is also expected to understand basic factors in designing heat exchangers, to estimate size and price and know and choose the type of heat exchanger. Provide basic understanding and various parameters on the drying process so that students can perform calculations and analysis of various drying techniques and their applications. This course also provides the expertise so that students are able to do drying modeling, to design and analyze the system for various materials (solid and solvent) so that the drying process can be suitably selected for particular product.

Topic:

Heat Transfer Review; Type and Application of Heat Exchangers; Practgical Design of Shell and Tube Heat Exchanger (Thermal and Mechanical); Manufacturing Cost Estimation; Heat Exchangers; Operation and Monitoring of Heat Exchangers (Fouling And Vibration); Maintenance of Heat Exchangers; Corrossion on Heat Eschangers; Heat Exchanger Design Software; Presentation and Laboratory Practice of Heat Exchangers. Review Transfer Phenomena (Momentum, Heat and Mass); Drying Principles and Basics; Mathematical Modeling of Drying System; Classification and Selection of Dryer, Post-Harvest Drying and Storage of Grain; Rotary Drying; Vacuum Drying; Fluidized Bed and Spouted Bed Drying; Drum Dryer; Spray Drying, Freeze Drying; Conveyor Drying; Solar Drying; Enrgy Optimization in Drying System; Drying System Design.

Pre-requisite(s):

Heat and Mass Transfer, Basic Fluid Mechanics

References:

1. Frank P Incropere, David P De Witt, Fundamental heat and mass transfer, 7th Ed.,John Wiley & Sons, 2011, New York
2. Holman JP, Heat Transfer, 10th, Mc Graw Hill,2009.
3. Smith Eric, Thermal Design of Heat Exchanger, John Wiley & Sons, 1996, New York
4. Welty R James, Wicks Charless, Wilson Robert, Fundamentals of Momentum, Heat, and Mass Transfer, 6th Ed. John Wiley & Sons, 2014, New York.
5. Cengel, Yunus, Heat Transfer a Practical Approach, 2nd Ed. Mc Graw Hill, 2003,Singapore.
6. Kreith Frank, Bohn Mark, Principles of Heat Transfer, 7th Ed. Brooks/cole, 2010, USA
7. Rohsenow Warren, Hartnett James, Cho Young, Handbooks of Heat Transfer, 3rd Ed., Mc Graw Hill, 1998, New York.

AERODYNAMICS ENGINEERING

ENME804111
4 credits
Learning Outcome(s):

Aerodynamic Engineering is an advanced course of Fluid Mechanics which focusing on aeronautics applications. Through the course students is expected to be able to understand the fundamental principles and basic equations of aerodynamics and to apply them in the process of airfoil design and to understand performance characteristics of the airfoil. Student is able to understand the phenomenon of incompressible flow through the airfoil and finite wings. Student is expected to be able to have an understanding of subsonic and supersonic compressible flow phenomena through aerofoil and other compressible flow phenomena.

Topic:

Introduction on Aerodynamics; Basic and Principle Equations; Incompressible flow; Airfoil Aerodynamics Characteristics; Finite Wings; Incompressible Flow through Airfoil; Incompressible Flow through Finite Wings; Airfoil in Compressible Flow; Wings and Wings-Body Combination in Compressible Flow; Airfoil Design; Double Surface; Vortex Lift; Secondary Flow and Viscous Effect; Other Phenomena in Compressible Flow; Normal Shock Wave; Oblique Shock Wave; Expansion Wave; Supersonic Wave.

Pre-requisite(s):

Basic Thermodynamics, Basic Fluid Mechanics

References:

1. A.M. Kuethe and C.Y. Chow, Foundations of Aerodynamics, 5th Edition, John Wiley & Sons, Inc., 2009.
2. B.W. McCormick, Aerodynamics, Aeronautics, and Flight Mechanics, 6th Edition, John Wiley & Sons,Inc., 2010.
3. J Anderson, Fundamentals of Aerodynamics, 5th Edition, McGraw Hill, 2011.

REFRIGERATION ENGINEERING

ENME803108
4 credits
Learning Outcome(s):

Refrigeration engineering course provides basic competency for the student to be able to do the simulation software to design a cooling system and equipments involved with a very close relationship with the Industrial and engineering users. Hence student will have understanding in design and development of cooling system and ability to evaluate and analyze its performance, especially on clod storage.

Syllabus:

Principles of Refrigeration and Heat Pump, Terminology and Units; Mechanical Vapor Compression Refrigeration Engine; Heat Trasnfer in Refrigeration System; ph Diagram Calculation in Refrigeration Cycle; Refrigeran, Lubricant, Salt and the Environment; Compressors; Condenser and Evaporator; Refrigeration Piping System and Equipments; Automatic Control System and Safety Equipments; Air Properties; Psychrometric and its process; Absorption Refrigeration; Alternative refrigeration Cycles (adsorption, gas compression, and ejector); Display Case, Prefabricated Cold Storage and Cold Storage, Cold Room Calculations.

Pre-requisite(s): Basic Thermodynamics

References:

1. ASHRAE Handbook of Fundamental, ASHRAE Atlanta, 1995.
2. Kuehn, Ramsey and Therkeld, Thermal Environmental Engineering, 3rd Edition, Prentice Hall, 1998.
3. Threkeld,JL., Thermal Environmental Engineering, Prentice Hall.
4. ASHRAE Handbook of Fundamental, ASHRAE Atlanta, 2001
5. ASHRAE Handbook of Refrigeration, ASHRAE, Atlanta, 2002.

MECHANICAL SYSTEM FOR BUILDING

ENME804118
4 credits
Learning Outcome(s):

This subject equips students with basic understanding and competence in designing mechanical systems for buildings that include ventilation and air conditioning systems, plumbing, fire protection, and dirty water treatment.

Topic:

The form of the task of designing the utility system of a multi-storey building.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanics

References:

1. Stein, Benjamin, Reynolds, John S., Grondzik, Walter T., Kwok, Alison G., "Mechanical and Electrical Equipment for Building", John Wiley and Sons, 2006.
2. Gina Barney, "Elevator Traffic Handbook, Theory and Practice", Spon Press, 2003.
3. The American Society of Mechanical Engineers, (ANSI A.17.1-2000), "American National Standard Safety Code for Elevator, Dumbwaiters, Escalators and Moving Walks", ANSI A.17.1-1971

ENERGY SYSTEM OPTIMIZATION

ENME802103
4 credits
Learning Outcome(s):

This course provides an understanding of mathematical modeling, simulation and optimization of energy systems through technical and economical approach. The course is intended to equip student with the ability to understand mathematical model, simulation and optimization of thermal systems.

Topic:

Workable System Design; Economical Evaluation; Determination of Mathematical Equations; Thermal Equipment Modeling; System Simulation; System Optimization: Objective Function, Constraints; Lagrange Multipliers: Lagrange multiplier to complete the optimiza- tion process; Dynamics, Geometric and Linear Programming; Mathematical Model of Thermodynamics Properties; Big System Simulation under Steady Condition; Big Thermal System Simulation; Calculation of Variables in Optimum Conditions.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanics

References:

1. Stoecker, W.F. Design of Thermal System, 3rd Edition, Mc.Graw Hill Book Co, 2011.
2. Boehm,R.F., Design of Analysis of Thermal System, John Wiley&Sons,1987.
3. Yogesh Jaluria, Design and Optimization of Thermal Systems, 2nd Edition, Mc.Graw Hill Book Co, 2007.

FIRE SAFETY ANALYSIS

ENME804138
4 CREDITS
Learning Outcome(s):

Students have comprehensive knowledge of technical analysis related to the design of fire safety systems. These capabilities include the ability to identify and quantify fire ricredits and hazards, provide design options, develop design evaluation concepts, apply fire calculation and modeling methods, determine boundary conditions and constraints in design and analysis. relating to being able to evaluate the performance of a fire protection system and knowing and being able to plan the maintenance of a fire protection system.

Topic:

Development of performance-based fire protection system design, smoke management system design concepts, evacuation time analysis and life-saving facilities, fire safety in buildings, risk management, fire modeling and national and international regulations in the field of Fire Safety Engineering.

Pre-requisite(s): Basic Thermodynamics

References:

1. Dougal Dysdale, An Introduction to Fire Dynamics 3rd Edition, John Wiley and Sons, 2011.
2. SFPE Handbook of Fire Protection Engineering 5th edition, Springer, 2016
3. Rasbach, D.J., et al., Evaluation of Fire Safety, John Wiley and Sons, 2004.
4. A.H. Buchanan, Fire Engineering Design Guide, New Zealand, 2001.
5. SNI, ASTM, NFPA, rules and standards

DESIGN FOR MANUFACTURE AND ASSEMBLY

ENME804148
4 CREDITS
Learning Outcome(s):

Provide knowledge, understanding and competence in the product design process which is considering, including factor and oriented on: material, manufacturing capability and assembling process. Therefore the product is expected to have made ease of manufacture and assembly.

Topic:

Review of the materials selection and processes, product design for manual assembly, design for automated assembly, PCB design for manufacture and assembly, machining process design, injection molding, sheet metal forming processes, die-casting.

Pre-requisite(s): Engineering Materials, Mechanical Design

References:

Boothroyd, Product Design for Manufacture and Assembly 3rd Ed, CRC Press, 2010

NOISE AND VIBRATION CONTROL

ENME804149
4 credits
Learning Outcome(s):

This course provides competency to students to complete the issue of application of vibration on the mechanical structure of the construction, and plate or vessel (vessel), perform the calculation of vibration reducer system design, system and engine holder enhancing of production equipment. Finally students have to make basic vibration measurements; forecasts predicted the damage engine, the vibration analysis of the data signal and the vibration spectrum and carry out machine performance diagnosis based on data analysis of vibration data and other data related

Topic:

Mechanical vibration with Many Degrees Freedom; Vibration on the Structure Construction; Vibration on plate and body shell (Vibration Plate and Shell); Vibration Isolation; Designing Vibration Absorber; Engineering Vibration Measurement; Vibration spectrum analysis; Performance Diagnostic Machine.

Pre-requisite(s) : Mechanical Vibration

References:

1. Jerry H.G., "Mechanical and Structural Vibrations", John Wiley, 2004
2. Demeter G.F., "Mechanical and Structural Vibrations", John Wiley, 1995
3. Kenneth G.M., "Vibration Testing: Theory and practice 2nd ed", Wiley, 2008
4. Werner Soedel, "Vibrations of Shells and Plates", 3rd edition – revised and expanded, Marcel Dekker, INC., 2004
5. Randall R.B., "Frequency Analysis", Brüel & Kjær, 1987
6. Jens T.B., "Mechanical Vibration and Shock Measurement", Brüel & Kjær, 1980

CAD/CAM

ENME804155
4 credits
Learning Outcome(s):

This lecture will discussed about technology of CAD, CAM, Integration of CAD / CAM application in the industry and the emphasis on: the principles modeling and surface curve geometry (Geometric modeling), design of 2D and 3D models with computer assisted. The principle of data exchange between CAD/CAM systems also tool path design using computer for prismatic and sculptured model. Lectures CAD / CAM are provided with the aim that students have the understanding and applying technology of CAD / CAM: starting the process from design to production process with the computers assistance.

Topic:

Overview of CAD / CAM System; Hardware & Software System of CAD / CAM; Interactive Tools and Computer Graphics Concepts, Geometric Modeling: Type & Representation of mathematical model Curve, Surface & Solid ; Data Exchange in CAD / CAM system; Manufacturing Processes: Manufacturing Process Review Type and Parameter Calculation machining, Lab. practice of CAD; CNC Technology; Tool Path Generation Method in the CAM system; Control 'quality of machinery' in the CAM system; Computer Aided Process Planning-CAPP; Postprocessing; Lab. practice of CAM.

Pre-requisite(s): Eengineering Programming

References:

1. Kiswanto G., Handout CAD/CAM, Diktat kuliah, 2004.
2. Choi B. K., Jerard R. B., Sculptured Surface Machining,
3. Zeid, I., CAD/CAM Theory and Practice, McGraw-Hill, 2009.
4. Chang, T. -C., Computer Aided Manufacturing, 3rd ed, Prentice-Hall, 2005.
5. Korem, Y., Computer Control of Manufacturing Systems, McGraw-Hill

MANUFACTURING PERFORMANCE ASSESMENT

ENME804156
4 credits
Learning Outcome(s):

Provide knowledge about the basic concepts of performance assessment of manufacturing industry relating to product performance, process, manufacturing system and its relation to manufacturing excellence. At the end of this course, students are expected to understand the methodologies and assessment tools manufacturing performance and are able to identify, assess and analyze the performance of the manufacturing industry increase.

Topic:

Introduction, Traditional Performance Methodology & Tool: Dupont Financial Performance, Basic Performance Measurement process & tools: Data collection techniques, chart, graph & diagram, Process Improvement methodologies & tools: Process Capability, Measurement System Analysis (MSA), QFD, FMEA, six sigma & lean six sigma, Industry specific/ generic standards & best practices, Manufacturing Maturity model concept & measurements, Case study of Industrial performance Measurement (assignment & evaluation)

Pre-requisite(s): Eengineering Materials, Mechanical Design

References:

1. US Departement of Energy, United Sates of America, Performance Based Management, 2005 Oak Ridge Associated Universities,. "How to Measure Performance, A Hand Book of Techniques and Tools"
2. "World Class Manufacturing Performace Measures"
3. Harold T.Amrine, John A.Ritchey, Prentice Hall International Edition, "Manufacturing Organization and Management"
4. Will Kaydos, Productivity Press Portland Oregon, " Measuring, Managing and Maximizing Performance"

AUTOMATION AND ROBOTICS

ENME802152
4 credits
Learning Outcome(s):
Automation and Robotics course discusses technology and application in the automation industry and the design and control the robot emphasizes: understanding the types of automation systems, particularly in the manufacturing industry and the mechanism, the design and development of automation system that emphasizes the 3 things: reliability, quality and cost and the understanding robot control system. Automation and Robotics Lectures given with the aim that students have an understanding in the implementation of technology Automation and Robotics, especially in the manufacturing industry.

Topic:

Automation System; Classification Type Manufacturing Automation machinery; Actuator; Sensor System; PLC Control System in the Manufacturing Automation machinery; Robotcs: Definitions and Principles of Robot; Spatial Descriptions: Definitions and Principles, Methods and Applications Spatial descriptions; Forward Kinematics: Definition, Principles and The Forward Kinematics; Jacobians: Speed, explicit shape, definition and principle of inverse Kinematics; Dynamic: The form of explicit, Acceleration and inertia; Control system ronbotic: PID control, the Joint Space Control, Operational Control and Space Force Control; Robot Design Assignment.

Pre-requisite(s): Engineering Programming

References:

1. Craig J., Introduction to Robotics 3rd ed, Prentice Hall, 2004.
2. Heath L., Fundamentals of Robotics, Theory and Applications, Prentice Hall, 1985.
3. Koren Y., Robotics for Engineer, McGraw Hill, Intl Edition, 1985.
4. Lentz K. W. Jr., Design of Automatic Machinery, Van Nostrand Reinhold, 1985.
5. Schilling R. J., Mikell P., Fundamentals of Robotics, Analysis and Control, Prentice Hall, 2000.
6. Kiswanto G., Otomasi dan Robotika, Diktat Kuliah Departemen Teknik Mesin, 2004.

RAILWAY VEHICLE ENGINEERING

ENME804168
4 credits
Learning Outcome(s):
Provide the knowledge and design of rail vehicle.

Topic:

Engineering and economic analysis of rail vehicles; body structures and rail vehicles; structural analysis of flat car; coupler analysis; electrical and pressurized water; analysis and modeling of the bogie; axle; wheel; brake and pivot; suspension system and driving quality; dynamic load analysis; fatigue and cracks in rail vehicles; models of rail vehicles and track geometry; modeling components of rolling stock; response rail vehicle on the track tangent; lateral stability of the rail vehicle on the track tangent; response rail vehicle on a curved trajectory; wheel wear; rail vehicle dynamics.

Pre-requisite(s): Engineering Materials, Mechanical Design

References:

Simon Iwnicki, handbook of railway vehicle dynamics, CRC Press, Taylor & Francis Group, 2006.

HANDLING AND CONSTRUCTION EQUIPMENT

ENME804197
4 credits
Learning Outcome(s):

Provide expertise and competence to students in the field of design and development of lifting equipment and construction equipment

Topic:

Introduction and Scope of Construction Equipment; Tractor, Bulldozer, Dump Truck and shovel; Construction Equipment Mechanical Concept; Heavy equipment system: Pneumatic and Hydraulic; Basic Machine-lifting machinery and materials transporter; Cranes, hoist and conveyor; forklift: Moving Walks, Escalators, and Elevators

Pre-requisite(s): Engineering Materials, Mechanical Design

References:

1. ASME. Handbook of Materials Handling.
2. Mc.Guiness. Mechanical and Electrical Equiment for Building.

AIRCRAFT DESIGN AND PERFORMANCE

ENME804198
4 credits
Learning Outcome(s):

Explain aircraft flying techniques, Explain the design concepts of an aircraft, Explain the design stages of an aircraft, Determine aircraft design requirements, Analyze aircraft performance, Analyze the advantages and disadvantages of an aircraft design

Topic:

The evolution of aircraft design, design requirements of an aircraft, aircraft design concepts, aircraft aerodynamics, aircraft propulsion systems, aircraft performance in steady flight conditions, aircraft performance in accelerated flight conditions, aircraft design which includes aspects of aerodynamics and its components, the technique of flying an airplane.

Pre-requisite(s): Engineering Materials, Mechanical Design

References:

1. J. D. Anderson, Aircraft Performance and Design, McGraw-Hill
2. Daniel Raymer, Aircraft Design, American Institute of Aeronautics and Astronautics.
3. Mohammad H. Sadraey, Aircraft Design: A Systems Engineering Approach, Wiley.
4. John P. Fielding, Introduction to Aircraft Design, Cambridge.
5. Egbert Torenbeek, Advanced Aircraft Design: Conceptual Design, Analysis and Optimization of Subsonic Civil Airplanes, Wiley.

ADVANCED WELDING ENGINEERING

ENME804190
4 credits
Learning Outcome(s):

Provide knowledge, understanding of the theories, principles and design as well as the assessment of the quality of welding and welding applications.

Topic:

Introduction, review of welding term and definition, welding process type, standard power source, Oxy-gas welding, Shield Metal Arc Welding (SMAW), Gas Tungsten Arc Welding (GTAW), Gas Metal Arc Welding (GMAW), Submerged Arc Welding (SAW), Flux Cored Arc Welding (FCAW), Resistance welding, Friction Stir Welding, Other welding process: laser, electron beam, plasma, Cutting and other edge preparation processes, surfacing and spraying, Brazing and soldering, Joining processes for plastics, ceramics and composites, Welding metal: Ferrous-based metal, non-ferrous-based metal, Material behavior during welding process, Testing materials and the weld joint, Non Destructive Examination (NDE), DT (Destructive Test), Heat treatment of base materials and welded joints, Basic of welding design, Residual stresses and distortion, Welding Symbol, Behavior of welded structures under different types of loading, Design of welded structures under static and dynamic loading, welding defects, Design of welded pressure equipment, Welding Performance Qualification Record (WPQR), Welding Procedure Specification (WPS), Welding automation.

Pre-requisite(s): Engineering Materials, Mechanical Design

References:

1. Sindo Kou, Welding Metallurgy, 2nd Edition, Wiley, 2002.
2. ASME Section IX, Welding and Brazing Qualifications
3. AWS D1.1., Structural Welding (Steel)
4. Technical Manual TM 5-805-7. Welding Design, Procedures and Inspection Headquarters, Department of the Army.1985
5. Lloyds Register. Welding Procedures, Inspections and Qualifications.

FOREST AND LAND FIRES

ENME804136
4 credits
Learning Outcome(s):

Students have comprehensive knowledge about the understanding of forest fires, land fires, the basic concepts of forest and land fires, factors related to the occurrence of forest and land fires and their prevention and mitigation efforts. In the learning process students will learn various types of vegetation in tropical forests and peat; identify environmental factors such as the availability of fuel capable, weather, topography, and human activity factors that influence ignition, smoldering, flammability, rate of heat release, rate of fire spread, rate of smoke production, and rate of potential fire hazard rating. Students will also learn various methods of early fire detection, calculation of heat release and emissions from forest and land fires, as well as efforts to prevent and handle forest and land fires.

Topic:

Tropical forests and peat in Indonesia, general understanding, types of forests in Indonesia, climatological conditions, and social environment. Statistics of forest fires in Indonesia and the world. Basic concepts and factors related to forest and land fires. Tropical peat in Indonesia, understanding, types, characteristics and hydrological environment. Weather factors, topography, vegetation types, topography and human activity factors in the process of forest and land fires. Characterization of potential, assessment of ricredits and dangers of forest and land fires: (ignition), flammability, rate of heat release, rate of fire spread, rate of production of hazardous fumes and gases, and fire hazard rating. Early detection techniques for fires by remote sensing (satellite imagery) in the form of hot spots, trace particulates, hazardous gas emissions, and haze. Forest and land fire prevention and prevention strategies. Laboratory scale practicum uses an integrated peat fire analyzer available at the Thermodynamics Laboratory to study peat fires propagation rates and the resulting emissions and extinguishing methods.

Pre-requisite(s): Basic Thermodynamics

References:

1. Laslo Pancel and Michael Kohl, Tropical Forestry Handbook, Second Edition, Springer-Verlag, 2016, ISBN 978-642-54600-6.
2. Mitsuru Osaki, Nobuyuki Tsuji, Tropical Peatland System, Springer – Japan, 2016.
3. National Wildfire Coordinating Group, Guide to Wildland Fire Origin and Cause Determination, PMS 412, NFES 1874, 2016.
4. SFPE Handbook of Fire Protection Engineering 5th edition, Springer, 2016
5. Jurnal Ilmiah terkait.

THERMAL POWER GENERATION

ENME803104
4 credits
Learning Outcome(s):

The course objective is to provide an understanding of the basic principles of power generation, and basic competency in the design and development of power generation systems.

Topic:

Industrial Power Plant and Steam System: Boiler, Steam Turbine, Gas Turbine; Cogeneration Engineering, Instrumentation and Main Tools; Performance and Reliability Factors; Economical Aspects, Environmental Aspects: Settings and Prevention.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanics

References:

1. Tyler G. Hicks, Power Plant Evaluation and Design Reference Guide, McGraw Hill, 1986.
2. Sill and Zoner, Steam Turbine Generator Process Control and Diagnostics, Wiley Higher Ed., 1996.
3. Saranavamuttoo et.al, Gas Turbine Theory, 6th Edition, Prentice Hall, 2008.
4. Black and Veath-Power plant engineering , Philips Keameh–Power generation handbook
5. Steam Generators by Babcock Willcock
6. Borman, G.L., and Ragland, K.W., Combustion Engineering, 2nd Edition, McGraw-Hill, Inc. 2011.

MECHANICAL FAILURE

ENME803143
4 credits
Learning Outcome(s):

This course provides an understanding and competence about principles and modes of mechanical failure may occur and should be avoided so that should be considered in the design of mechanical, including buckling, Corrosion, fatigue, creep, melting, fracture, thermal, and wear.

Topic:

Theory and Buckling Mode (Torsional-lateral, Plastic, Dynamic), Theory and Corrosion mode (Metal, Non-Metal, Glass); Corrosion Prevention; Theory and Fatigue Failure Mode; Theory and creep mode; Theory and Melting Mode; Theory and Type of Fracture mode, Theory and the thermal failure mode; Theory and Wear mode; Failure Analysis and Prevention to: Buckling, Corrosion, Fatigue, creep, Melting, Fracture, Thermal, and Wear

Pre-requisite(s): Engineering Materials, Mechanical Design

References:

1. Jack A Collins, Materials Failure in Mechanical Design, Wiley - Interscience, 1993
2. S. Suresh, Fatigue of Materials, Cambridge University Press, 1998
3. M Jansenn, J. Zuidema, Fracture Mechanics, VSSD, 2006
4. Arthur J. McEvily, Metal Failures : Mechanisms, Analysis and Prevention, 2013

MACHINE VISION SYSTEM

ENME803153
4 credits
Learning Outcome(s):

Methods and applications monitoring the production process by using visual-based camera technology, image processing, for the purpose of introducing the feature: product identification, selection and product screening, and quality control. With the completion of this course, students have the ability to apply and develop the visual method of monitoring the production process in the industry for the purpose.

Topic:

Basic Machine Vision Method: Binary Image, Binary Morphology and Gray-Scale, Texture analysis; Identification Method feature; image Processing Method Smart / Intelligent, Image Processing System (Prolog); Control Equipment / Instruments Interface (Instruments, Signal, Protocol, PLC) ; Method Introduction Color image; Machine Vision Applications.

Pre-requisite(s): Engineering Programming

References:

1. J.R. Parker, Algorithms for Image Processing and Computer Vision 2nd ed, Wiley, 2010
2. Butchelor B. G., Whelan P. F.,Intelligent Vision System for Industry, Springer, 2012
3. E.R. Davies, Machine Vision : Theory, Algorithm, Practicalities, Morgan Kauffman, 2004
4. Micheul S, Lawrence O'Gorman, Michael J S Practical Algorithms for Image Analysis : Description, Examples and Code, , Cambride Univ. Press, 2000
5. Rafael Gonzales, et.al, Digital Image Processing using Matlab, McGraw Hill, 2010.
6. A.S. Baskoro, Handout Sistem Machine Vision, Diktat kuliah, 2011.

INTERNSHIP B

ENME601109
3 credits
Learning Outcome(s):

Students gain insight and experience activities in industry and the work experiences related to non-engineering aspects.

Topic:

Special topics in the non-engineering industrial sector that have not been covered in other subjects.

Pre-requisite(s): Have undergone a minimum of 4 semesters of lectures, or have obtained a minimum of 72 credits with a GPA> 2.0. Activities carried out by monitoring and evaluation by the Internship Coordinator.

References: -

SPECIAL TOPIC 3

ENME601106
4 credits
Learning Outcome(s):
Students gain insight and experience of activities in national / international competitions, or community, or entrepreneurship, or industry and the work experiences.

Topic:
Special topics in fields that have not been covered in other subjects.

Pre-requisite(s): Have undergone at least 2 semesters of lectures, or have obtained a minimum of 36 credits with a GPA> 2.0. Activities carried out by monitoring and evaluation by the Special Topic Subject Coordinator.

References: -

SPECIAL TOPIC 4

ENME601107
4 credits
Learning Outcome(s):
Students gain insight and experience of activities in national / international competitions, or community, or entrepreneurship, or industry and the work experiences.

Topic:
Special topics in fields that have not been covered in other subjects.

Pre-requisite(s): Have undergone at least 2 semesters of lectures, or have obtained a minimum of 36 credits with a GPA> 2.0. Activities carried out by monitoring and evaluation by the Special Topic Subject Coordinator.

References: -

EXPERIMENTAL DESIGN

ENME802003
4 credits
Learning Outcome(s):

This course provides knowledge about the methods of planning, implementing and reporting research in the field of engineering so that it is able to apply standard scientific principles in the preparation of the final project in particular as well as in a scientific work that results from research in general. Through this subject, students are expected to be able to manage a study that starts from the planning stage, correctly applies the design and construction procedures of the apparatus, and applies instrumentation and measurement systems, executes and analyzes and interprets the data with appropriate statistical rules. In addition, students are also expected to be able to write scientific texts with good techniques, be able to make a bibliography correctly, find the right reference sources.

Topic:

Introduction: Introduction to Research Design; Approaches to Solving Problems (Problem Solving Approaches); Research Project Planning; Design and Application of Measurement Systems: Measuring System Functional Elements, Measurement System Performance Characteristics, System Accuracy (Uncertainty) Analysis; Design and Construction of Research Apparatus; Experimental Planning; Experiment Execution: Apparatus construction, Debugging apparatus, Datasheet and Logbooks; Data Analysis and Interpretation; Communication Engineering: Principles of Communication of Raw Engineering, Reports, Papers, and Research Results Articles. Introduction to Academic Writing; Rhetoric Analysis on Scientific Manuscripts, Critical Behavior and Arguments on Academic Writing, Techniques for Writing Scientific Manuscripts, Writing Scientific Manuscripts, Peer Review and Revision of Scientific Manuscripts, Finding Sources of Scientific References, Synthesis of Scientific Manuscripts, Delivering papers as a result of learning this course.

Pre-requisite(s): -

References:

1. Montgomery, D.C., Design and Analysis of Experiments, (5th ed.), John Wiley and Sons, Inc., New York, 2001
2. Coleman, H.W., Steele, G.W.Jr., Experimentation and Uncertainty Analysis for Engineers, (2nd ed.), John Wiley and Sons, Inc., New York, 1999
3. Doebelin, E.O., Engineering Experimentation: Planning, Execution, Reporting, McGraw-Hill, Inc., New York, 1995

4. Kirkup, Les., Experimental Method: An Introduction to the Analysis and Presentation of Data, John Wiley and Sons Australia, Ltd., Queensland, 1994
5. Lipson, C, Sheth, N.J., Statistical Design and Analysis of Engineering Experiments, Mc-Graw Hill Kogakusha, Ltd., Tokyo, 1973
6. Ross, V. A Brief Guide to Critical Writing. Philadelphia, PA : Critical Writing Program. 2015.
7. Graff, G., Birkenstein, C. As He Himself Puts It : The Art of Quoting "They Say / I Say" : The Moves That Matter in Academic Writing. New York. 2006
8. Rheingold, H. Net Smart : How To Thrive Online. Cambridge, Mass : MIT Press. 2012.

DATA ANALYTICS

ENME802006
2 credits
Learning Outcome(s):

Know how to identify, collect, and test multivariate data before conducting analysis. Can distinguish statistical analysis techniques available and determine which is most suitable for a particular purpose. Use appropriate techniques in analyzing data and in obtaining statistical summary results to help make management decisions. Verifying the results of the analysis with assumptions that will be considered in the analysis. Apply a variety of techniques to real data sequences using computer applications (eg MS Excel, Origin, Matlab, Tableau) and present the results in appropriate reports that are easily understood by non-statists.

Topic:

Review statistics and probabilities, Factor and Component Design experiments, multiple samples and estimates, Analysis of variance, models and diagnoses, Stepwise and Discriminant Regression, Canonical and Conjoining Analysis, and Non-parametric Statistics.

Pre-requisite(s): -

References:

1. A Modern Introduction to Probability and Statistics: Understanding Why and How by Dekking, Kraaikamp, Lopuhaa, and Meester.
2. Montgomery, D. C., & Runger, G. C. (2010). Applied statistics and probability for engineers. John Wiley & Sons.
3. Härdle, W., A. Werwatz, M. Müller, and S. Sperlich (2004). Nonparametric and Semiparametric Models. Springer.
4. Cox, T. F. (2005). An introduction to multivariate data analysis. London: Hodder Arnold.
5. Hair, Black, Babin, Anderson, and Tatham. Multivariate Data Analysis, 6th Edition. Prentice Hall.

FIRE PROTECTION SYSTEM

ENME802131
4 credits
Learning Outcome(s):

Students are able to understand the fire protection system that is both passive and active.

Topic:

Fire compartmentalization, Passive fire protection strategies, natural ventilation systems for controlling smoke and heat due to fire, fire resistant materials and their installation, integration of automatic fire protection systems for passive fire protection strategies, design of passive fire protection systems, fire modeling for the design of passive protection systems. This course will study various physical and chemical phenomena that are relevant to various hardware and software of a fire protection system such as automatic sprinklers, gas-shaped agents, foam systems and chemical powders. Fire protection installation system complies with applicable standards. Fire resistant material and installation.

Pre-requisite(s): -

References:

1. SFPE Handbook of Fire Protection Engineering 5th edition, Springer, 2016
2. Fire Protection Association, Passive Fire Protection Handbook, 2011
3. Tewarson A, Khan MM (1991) The Role of Active and Passive Fire Protection Techniques in Fire Control,
4. Suppression and Extinguishment. Fire Safety Science 3:1007–1017. doi:10.3801/IAFSS.FSS.3-1007
5. Jurnal dan standar terkait

MECHANICAL AND ELECTRICAL SYSTEM OF BULDING

ENME802131
4 credits
Learning Outcome(s):

Building Mechanical System is a subject that provides specialization and understanding expertise in mechanical systems systems found in modern buildings that are increasingly demanding from the sophistication, efficiency, and use of energy that is more efficient.

Topic:

Building Mechanical Systems in General; Plumbing System: SNI, Calculation, and Dirty Water Treatment; Energy Systems in Buildings; Building Automation System; Fire Fighting Systems: Hydrant and Sprinkler System; Lifts and Escalators: Types of Lifts, Round Trip Time, Handling Capacities, Waiting Time, System Installation and Control; Types of Escalator Types, Applications and Installations.

Pre-requisite(s): Basic Thermodynamics

References:

1. Mechanical System for Building.
2. Handbook of HVAC.
3. ASHRAE Journal
4. NFPA
5. Mechanical Installation in Building.
6. SNI Plambing
7. SNI Hydrant, Sprinkler dan APAR.

DESIGNING AND MANUFACTURING TECHNOLOGY INTEGRATION

ENME802142
4 credits
Learning Outcome(s):

Provide an understanding of competence and capability in designing and manufacturing process by utilizing peracangan / includes latest design and manufacturing system CAD / CAM and reverse engineering and prototype development to improve efficiency and accelerate the production process, reduce errors, improve quality and reduce production costs.

Topic:

System Overview of CAD / CAM; Hardware & Software Systems CAD / CAM: Geometric Modelling: Type a mathematical representation of the model curve, surface and solid 3D modeling methods and manipulation of 3D models; exchange of data within and between sistem-CAD/ CAM; CAD Laboratory Activity; Technology CNC; Tool Path Generation Method-CAM systems;

Control 'quality of machining' (machined surface quality) in the system-CAM: Computer-Aided Process Planning CAPP; postprocessing; Practice CAM: 3D geometry measurements, principles and measurement based Coordinate Measuring Machine (CMM), the method of filtration data, the identification of boundary features, modeling and manipulation of point-based 3D models, 3D models for the modularization of the prototype, prototype and rapidprototyping method, discretization model, principles and application of SLS and SLM.

Pre-requisite(s): -

References:

1. Kunwoo Lee, Principles of CAD / CAM / CAE, Prentice Hall, 2003
2. Gandjar K, Hand out CAD/ CAM, DTMUI, 2007
3. Connie L. Doston, Fundamentals of Dimensional Metrology, Delmar Learning, 2006
4. Ali K. Kamrani. Emad A Nasr, Rapid Prototyping: Theory and Practice, Birkhauser, 2006
5. Patri K. Venivinod, Weyin Ma, Rapid Prototyping: Laser Based and Other Technologies, 2003.

VEHICLE FRAME AND BODY ENGINEERING

ENME802165
4 credits
Learning Outcome(s):

Provides the understanding of several concepts related to design and analysis of vehicle frame such as: A brief understanding in the history of vehicle design development; Understanding the different possible scenarios for vehicle design and interactivity of the process in the design and manufacture of vehicles, as well as various types of vehicle structure and its use.; Understand how the load can be analyzed simply and with the use of computers as well as a simple structural analysis that highlights the processes involved in vehicle structures.; Understanding the basic concepts related to the aerodynamic vehicle body and the basic calculations required in the form of an aerodynamic vehicle design

Topic:

Introduction to Innovation and breakthrough discoveries in the fild of automotive and industrial development of the automotive world today. Understanding the concept of loading on the vehicle structure, various types of chassis, structural analysis with a simple method of surface structure (Simple Structural Surface method) and method of computing the skeletal structure, aerodynamic force, reducing the lift force (drag force reduction), stability and concept of calculation of the vehicle body dynamics computation

Pre-requisite(s): -

References:

1. Heinz Hei s ler, "Advance Vehicle Technology", Society of Automotive Engineers, Inc. ISBN 0 7680 10713.
2. Brian Cantor, Patrick Grant and Colin Johnston, "Automotive Engineering Lightweight, Functional, and Novel Materials", Taylor & Francis Group, 6000 Broken Sound Parkway NW, Suite 300, ISBN 978-0-7503-1001-7.
3. Giancarlo Genta, Lorenzo Morello, "The Automotive Chassis Vol. 1: Components Design", Springer Science+Business Media B.V., ISBN: 978-1-4020-8674-8 e-ISBN: 978-1-4020-8676-2.
4. David A. Crolla, "Automotive Engineering Powertrain, Chassis System and Vehicle Body", Butterworth-Heinemann is an imprint of Elsevier, Linacre House, Jordan Hill, Oxford OX2 8DP, UK ISBN: 978-1-85617-577-7.
5. Nick Tucker and Kevin Lindsey, "An Introduction to Automotive Composite", Rapra Technology Limited, ISBN: 1-85957- 279-0.
6. Jason C. Brown, A. John Robertson, and Stan T. Serpento, "Motor Vehicle Structures: Concepts and Fundamentals", Butterworth-Heinemann Linacre House, Jordan Hill, Oxford OX2 8DP, ISBN 0750651342
7. Liang Yun · Alan Bliault · Johnny Doo, WIG Craft and Ekranoplan, "Ground Effect Craft Technology", ISBN 978-1-4419-0041-8 e-ISBN 978-1-4419-0042-5, DOI 10.1007/978-1-4419-0042-5, Springer New York Dordrecht Heidelberg London.
8. Mat thew Huang, "Vehi c le Crash Mechanics", CRC Press LLC, International Standard Book Number 0-8493-0104-1.
9. Ahmed A. Shabana, Khaled E. Zaazaa and Hiroyuki Sugiyama, "Railroad Vehicle Dynamics a Computational Approach", CRC Press is an imprint of the Taylor & Francis Group, ISBN 978-1-4200-4581-9.

VEHICLE CONTROL SYSTEM

ENME803166
4 credits
Learning Outcome(s):

Students understand the basic features of the vehicle control system that has the ability to: Describes a simple method for the analysis of vehicle suspension systems and components; Describes the vehicle suspension system design requirements and how to achieve it; Analyze the various factors and issues that affect the design of suspension of driving; Understand the mechanics of the vehicle wheel; Describes recent developments in control of the braking system and braking system design and material needs an efficient; Analyze the influence of the steering system characteristics to the vehicle motion

Topic:

Introduction of the role of vehicle suspension systems, factors that affect the design, definitions and terminology in vehicle suspension systems, suspension mobility mechanisms, different types of suspension, kinematics analysis, the analysis center of rotation (roll center analysis), geometric style as well as lateral, suspension components. The basis of the braking system. Regulation, function and terms of use brake system, brake system components and confiurations as well as the kinematics of the braking system. Consideration of adhesion force proportional to the brake system and braking effiiency. Deformation, lateral force and slip angle on the tire when the vehicle is running. Penikungan characteristics (cornering characteristics) according to Fiala theoretical approach to the mathematical model and the effect is due to air pressure in tires.

Pre-requisite(s): -

References:

1. Heinz Heisler, "Advance Vehicle Technology", Society of

Automotive Engineers Inc. ISBN 0 7680 1071 3

2. Giancarlo Genta, Lorenzo Morello, "The Automotive Chassis Vol. 1: Components Design", Springer Science+Business Media B.V., ISBN: 978-1-4020-8674-8 e-ISBN: 978- 1-4020-8676-2.
3. Giancarlo Genta, Lorenzo Morello, "The Automotive Chassis Vol. 1: System Design", Springer Science+Business Media B.V., ISBN: 978-1-4020-8673-1 e-ISBN: 978-1- 4020-8675-5.
4. David A. Crolla, "Automotive Engineering Powertrain, Chassis System and Vehicle Body", Butterworth-Heinemann is an imprint of Elsevier, Linacre House, Jordan Hill, Oxford OX2 8DP, UK ISBN: 978-1-85617-577-7.

MARITIME ENGINEERING AND MANAGEMENT
ENME802181
4 credits
Learning Outcome(s):

This course provides knowledge about technologies for ocean transportation and the application of ocean-based energy sources. This course also aims to equip students with understanding of maritime opportunities that can be developed with the use of technology.

Topic:

Classification of ship based on its function, aspects to consider in ship designing, history of development of off-shore structure, ocean environment, typesof off-shore structure: fixed design and floating design, mooring and anchoring system, force calculation of off-shore structure, FPSO

Pre-requisite(s): -

References:

1. Research Council National Research Council, NEW Mining in the Outer Continental Shelf and in the Deep Ocean, University Press of the Pacific, 2005
2. Arthur H. Johnson, Michael D. Max, William P. Dillon, Natural Gas Hydrate - Arctic Ocean Deepwater Resource Potential, Springer, 2013
3. Khaligh, Alireza and Onar, Omer C., Energy Harvesting: Solar, Wind, and Ocean Energy Conversion Systems, CRC Pr I Llc, 2009

OCEAN ENERGY
ENME803182
4 credits
Learning Outcome(s):

This course provides knowledge about technologies and principles related to the design of renewable ocean energy system

Topic:

Introduction to renewable ocean energy, introduction to wind turbine, tidal system and tidal energy system, OTEC, ocean flows, methods of economic/financial assessment for off-shore renewable energy system, wind energy, momentum theory and the limit of wind power output, tidal flow and its conversion to mechanical energy, description of wave energy sources, instruments of wave energy and instruments for simulation.

Pre-requisite(s): -

References:

1. Twidell, J. and Weir, T., "Renewable Energy Resources. Second Edition", Taylor and Francis Group, 2006.
2. Boyle, G., "Renewable energy power for a sustainable future, Second Edition", Oxford University Press, 2005.
3. Walker J and Jenkins N, "Wind Energy Technology", Wiley Unesco Energy Engineering Series, 1997.
4. Manwell JF, McGowan, JG and Rogers, AL., "Wind Energy explained: Theory, Design and Application", Wiley. 2nd Edition. ISBN0-470-01500-4, 2010
5. Cruz, J., "Ocean Wave Energy: Current Status and Future Perspectives", Springer-Berlin, 2007.
6. Falnes, J., "Ocean Waves and Oscillating Systems: Linear Interactions Including Wave-Energy Extraction", Cambridge University Press, Cambridge, 2002.
7. Baker AC, "Tidal Power", Peter Peregrinus Ltd, 1981.

Curriculum for Fast Track Programme (S1 and S2)

Mechanical Engineering Fast Track Course

Code	Course	SKS
	7th Semester	
ENME600002	Design Assignment II*	2
ENME600004	Seminar*	1
ENME600003	On the Job Training*	2
ENME801001	Applied Engineering Mathematics	2
ENME802004	Engineering Computation	2
	Specialization Course	8
	Sub Total	**17**
	8th Semester	
ENME600005	Final Project*	5
ENME802002	Experiment Design	2
ENME802006	Data Analytics	2
ENME802003	Academic Writing	2
	Specialization Course	8
	Sub Total	**19**
	9th Semester	
ENME800005	Scientific Publication	2
ENME802007	Project Design	2
	Elective Course	4
	Sub Total	**8**
	10th Semester	
ENME800007	Thesis	6
	Elective Course	4
	Sub Total	**10**

*Subjets of S1 program which can not be transfered to S2 program

Bahan Kajian on Mechancial Engineering Study Porgram

Bahan Kajian	Code	Subjects	Credits
Energy Convertion and Conservation System	ENME801101	Basic Thermodynamics	4
	ENME801102	Advanced Fluid Dynamics and Heat Transfer	4
	ENME801113	Ventilation and Air Conditioning System	4
	ENME802103	Energy System Optimization	4
	ENME803104	Thermal Power Generation	4
	ENME803105	Internal Combustion Engine	4
	ENME803106	Applied Flow Measurement and Visualization	4
	ENME803107	CFD Application	4
	ENME803108	Refrigeration Engineering	4
	ENME803182	Ocean Energy	4
	ENME803195	Oil and Gas Drilling Equipment	4
	ENME803196	Jet and Rocket Propulsion	4
	ENME804109	Heat and Mass Transfer Engineering	4
	ENME804110	Combustion Engineering	4
	ENME804111	Aerodynamics Engineering	4
	ENME803124	Energy Audit	4
Mechanical System for Building	ENME803124	Energy Audit	4
	ENME801113	Ventilation and Air Conditioning System	4
	ENME802103	Energy System Optimization	4
	ENME802132	Building Mechanical and Electrical System	4
	ENME803107	CFD Application	4
	ENME803115	Clean Room	4
	ENME804118	Mechanical System for Building	4
	ENME803108	Refrigeration Engineering	4
Fire Safety Technology	ENME803134	Fire Dynamics and Modelling	4
	ENME802131	Fire Protection System	4
	ENME801113	Air Conditioning and Ventilation System	4
	ENME804138	Fire Safety Analysis	4
	ENME804137	Fire Investigation Engineering	4
	ENME804136	Forest and Land Fires	4
	ENME803174	Risk Management	4
	ENME804139	Fire Protection in Industrial Process	4
	ENME803135	Fire Fighting Techniques and Strategies	4
Product Design and Manufacrure	ENME801140	Material and Manufacturing Process	4
	ENME801141	Design Methodology and Product Development	4
	ENME802142	Designing and Manufacturing Technology Integration	4
	ENME803143	Mechanical Failure	4
	ENME801150	Manufacture Information System Management	4
	ENME801151	Manufacture System and Process	4
	ENME803144	Mechanical System Dynamics	4
	ENME803145	Composte Product Development	4
	ENME803146	Finite Element and Multiphysics	4
	ENME803147	Educational Product Design and Development	4
	ENME804148	Design for Manufacture and Assemby	4
	ENME804155	CAD/CAM	4
	ENME804156	Manufacturing Performance Assesment	4
	ENME804197	Handling and Construction Equipment	4

Otomation Technology and Micro-fabrication System	ENME802152	Otomation and Robotics	4
	ENME803153	Machine Vision System	4
	ENME803161	Micro-machining	4
	ENME803154	Quality and Production Management System	4
	ENME804162	Laser Assisted Process	4
	ENME804190	Advanced Welding Engineering	4
Advanced Vehicle Technology	ENME803196	Jet and Rocket Propulsion	4
	ENME803167	Modern Vehicle Technology	4
	ENME801163	Vehicle Engineering and Heavy Duty Equipment	4
	ENME801164	Prime Mover and Powertrain System	4
	ENME802165	Vehicle Frame and Body Engineering	4
	ENME803166	Vehicle Control System	4
	ENME804111	Aerodynamics Engineering	4
	ENME803105	Internal Combustion Engine	4
	ENME804112	Turbomachinery	4
	ENME804119	Accoustics	4
	ENME804149	Noise and Vibration Control	4
	ENME804168	Railway Vehicle Engineering	4

Minor in Mechanical Engineering
Pre-requisite: Mathematics, Physics, Engineering Drawing

Odd Semester			Even Semester		
Code	**Subjects**	**Credits**	**Code**	**Subjects**	**Credits**
Mandatory Subjects, 24 SKS					
ENME603005	Engineering Material	3	ENME602004	Engineering Statics	2
ENME604010	Material Selection and Manuf. Process	4	ENME603006	Mechanical Modelling and Visualization	2
ENME603007	Strength of Materials	2	ENME604011	Basic Fluid Mechanics	4
ENME603008	Basic Thermodynamics	4	ENME606020	Maintenence and Condition Monitoring	3
	Subtotal	13		**Subtotal**	11
Elective, Mechanical Engineering					
ENME605017	Heat and Mass Transfer	4	ENME604012	Perancangan Mekanika	4
ENME605021	Energy System Convertion 1	4	ENME600009	Kinematika dan Dinamika	4
ENME606025	Mechatronics	4	ENME605022	Energy System Convertion 2	4
ENME605014	Mechanical Vibration	2	ENME600001	Design Assignment I (Conceptual design)	2
ENME605015	Measurement and Metrology	2		Elective	4
	Elective	4			
Elective, Fire Safety Engineering					
ENME801113	Air Conditioning and Ventilation System	4	ENME804138	Fire Safety Analysis	4
ENME803134	Fire Dynamics and Modelling	4	ENGE600012	HSE	2
ENME605017	Heat and Mass Transfer	4			

Undergraduate Program in Naval Architecture and Marine Engineering

Program Specification

1.	**Awarding Institution**	Universitas Indonesia	
2.	**Teaching Institution**	Universitas Indonesia	
3.	**Faculty**	Engineering	
4.	**Study Programme**	Undergraduate Program in Naval Architecture and Marine Engineering	
5.	**Vision and Mission**	Vision: To become the center of excellent research and education services in Naval Architecture and Marine Engineering. Mission: To conduct research and research-based education for the development of science and technology in the field of Naval Architecture and Marine Engineering, and to conduct research and education and use it to improve quality life and humanity.	
6.	**Classes**	Regular	
7.	**Final Award**	Sarjana Teknik (S.T)	
8.	**Accreditation / Recognition**	BAN-PT: "A" Accreditated International assessment by Asean University Network-Quality Assurance (AUN-QA)	
9.	**Language(s) of Instruction**	Bahasa Indonesia, English	
10.	**Study Scheme (Full Time / Part Time)**	Full Time	
11,	**Entry Requirements**	High school /equivalent, or D3 / Polytechnique / equivalent, AND pass the entrance exam.	
12.	**Duration for Study**	Designed for 4 years	
	Type of Semester	Number of Semester	Number of weeks / semester
	Regular	8	17
	Short (optional)	3	8
13.	**Aims of the programme:** 1. Provide graduates in Naval Architecture and Marine Engineering with the qualification of expected learning outcomes. 2. Contribute to the development of science and technology in the field of Naval Architecture and Marine Engineering through continuous research. 3. Contribute to improving the quality of society and industry.		
14.	**Profile of Graduates:** Bachelor of Engineering with abilities of analyze and design of ship buildings, marine systems, and marine transportation, with considering an aspect of energy conservation to meet the sustainable development goals.		

15.	**Expected Learning Outcomes (ELO):** 1. Able to apply basic knowledge of mathematics, basic science and information technology needed to achieve competence in the field of Naval Architecture and Marine Engineering. 2. Able to design ship buildings, marine systems, marine transportation, considering the aspect of energy conservation to meet the expected outcomes within realistic boundaries, as well as to recognize and/or utilize local and national potential resources with global insight. 3. Able to carry out experiments, digging information and analyze data, report the results of experiments by applying statistical rules 4. Able to think critically, creatively, and innovatively in identifying, formulating, analyzing and solving shipping technical problems 5. Able to apply modern methods, skills and technical tools needed for engineering practices such as the selection of materials and processes, and the design of computer-aided ships 6. Able communicate effectively both visually, in writing and verbally 7. Able to design, plan, complete and evaluate tasks within the existing constraints 8. Able to work effectively both individually and in teams across disciplines or across cultures 9. Able to take responsibility and adhere to the ethics of the engineering profession and entrepreneurship which is characterized by innovation and independence. 10. Able to carry out the lifelong learning process including access to knowledge related to relevant contemporary issues.
16.	**Composition of Subjects**

No.	Classification	Credit Hours (SKS)	Percentage
i	**University General Subjects**	**9**	**6 %**
ii	**Basic Engineering Subjects**	**20**	**13,9 %**
iii	**Core Subjects**	**81**	**59,6 %**
iv	**Elective Subjects**	**26**	**18,1 %**
v	**Special Subjects (On The Job Training, Seminar, Undergraduate Thesis)**	**8**	**5,6 %**
	Total	**144**	**100 %**
	Total Credit Hours to Graduate		**144 SKS**

Career Prospects

Graduates of Naval Architecture and Marine Engineering study have devoted themselves to various fields such as:

- Engineer at the shipyard
- Superintendent in shipping companies
- Shipping consultant
- Designers in the ship design office
- Appraisers at insurance companies
- Engineers in oil and gas companies
- Analyst at the Ministry of Maritime Affairs and Fisheries
- Analyst at the Ministry of Transportation
- Analysts at the Customs
- Surveyors at classification institutions

Flow Diagram of Expected Learning Outcomes
Undergraduate Program in Naval Architecture and Marine Engineering

Graduate Profile
Bachelor of Engineering with abilities of analyze and design of ship buildings, marine systems, and marine transportation, with considering an aspect of energy conservation to meet the sustainable development goals.

(ELO 8) Able to work effectively both individually and in teams across disciplines or across cultures

(ELO 9) Able to take responsibility and adhere to the ethics of the engineering profession and entrepreneurship which is characterized by innovation and independence.

(ELO 10) Able to carry out the lifelong learning process including access to knowledge related to relevant contemporary issues

(ELO 3) Able to carry out experiments, digging information and analyze data, report the results of experiments by applying statistical rules

(ELO 4) Able to think critically, creatively, and innovatively in identifying, formulating, analyzing and solving shipping technical problems

(ELO 2) Able to design ship buildings, marine systems, marine transportation, considering the aspect of energy conservation to meet the expected outcomes within realistic boundaries, as well as to recognize and/or utilize local and national potential resources with global insight.

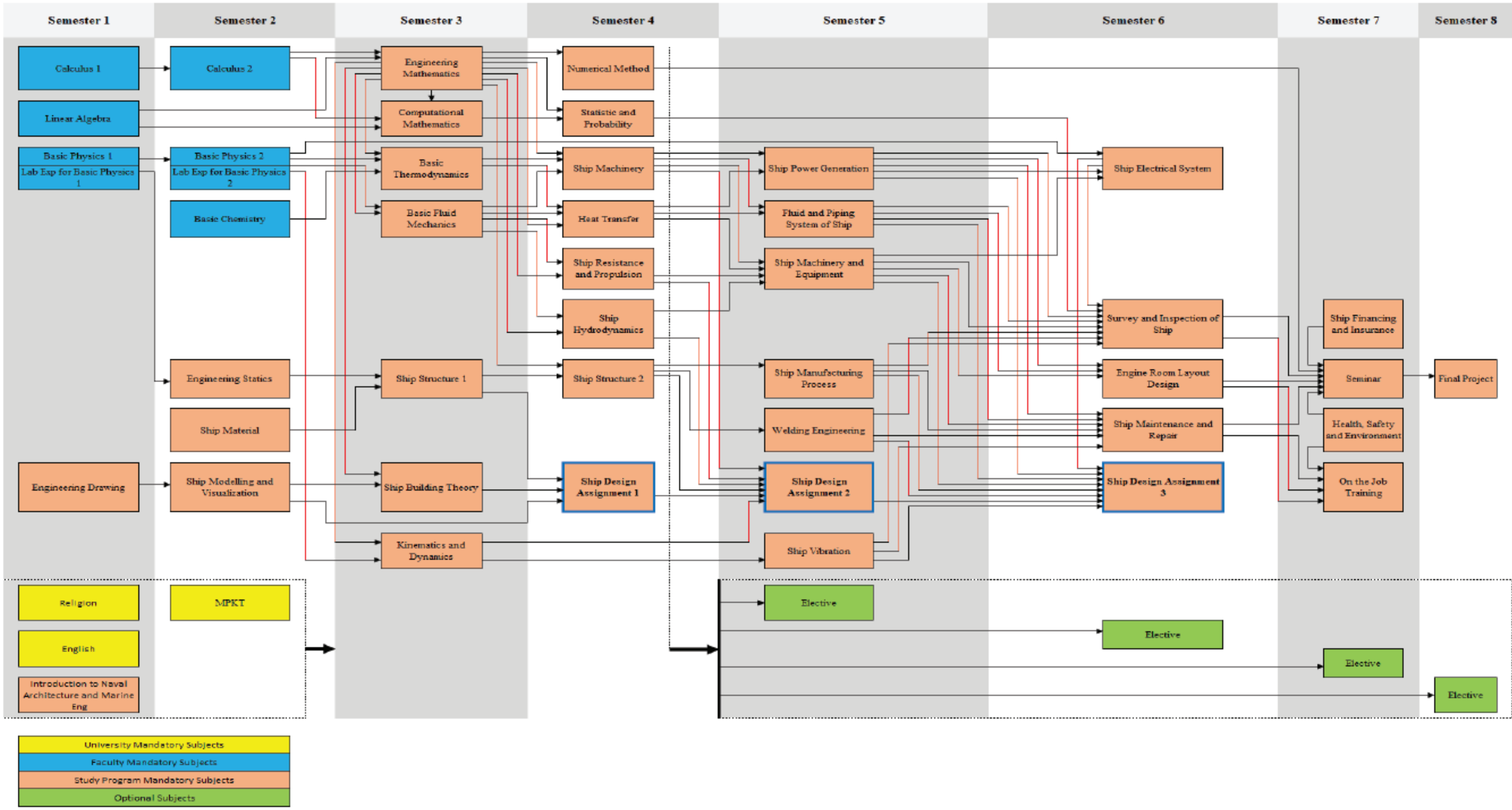
(ELO 5) Able to apply modern methods, skills and technical tools needed for engineering practices such as the selection of materials and processes, and the design of computer-aided ships

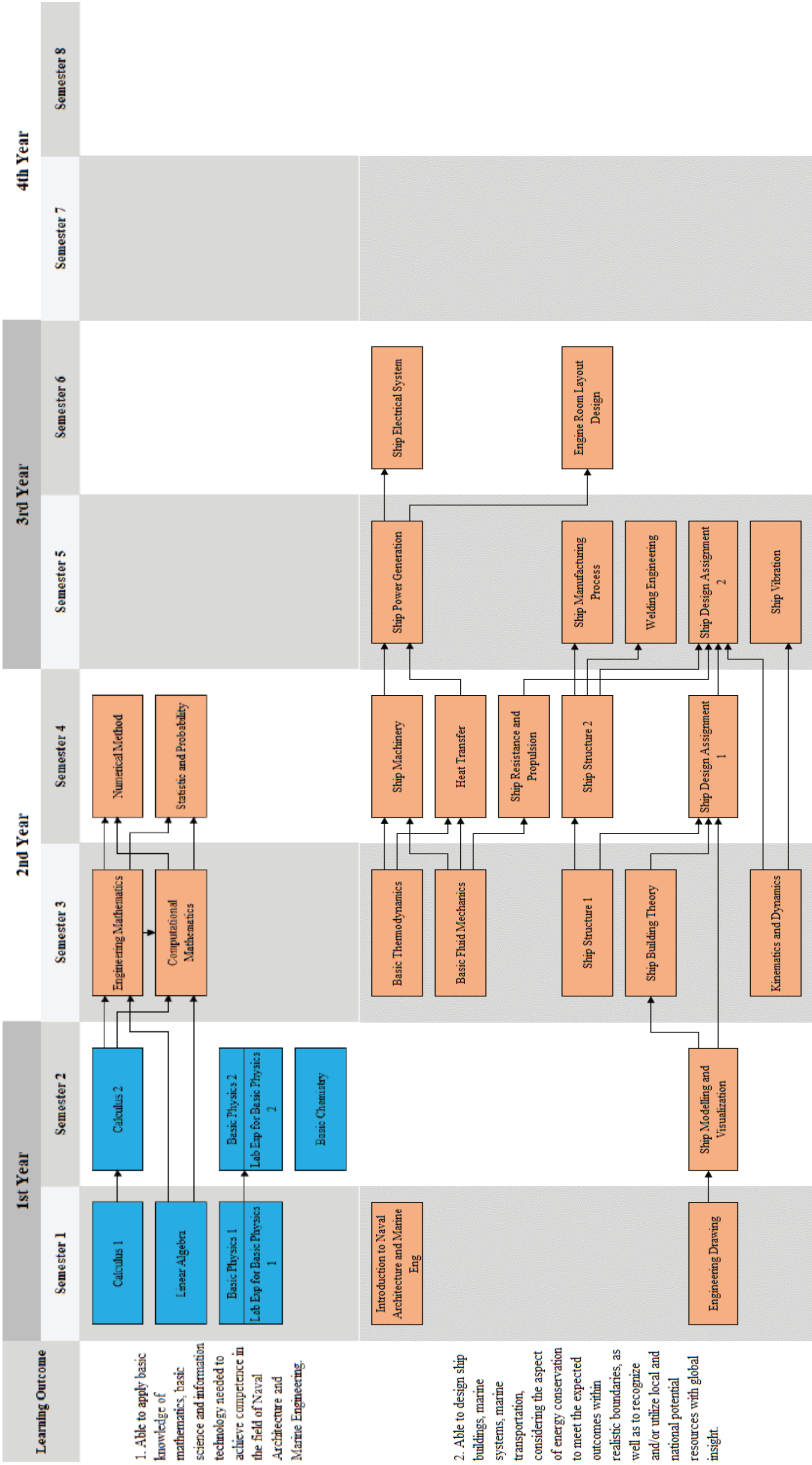
(ELO 7) Able to design, plan, complete and evaluate tasks within the existing constraints

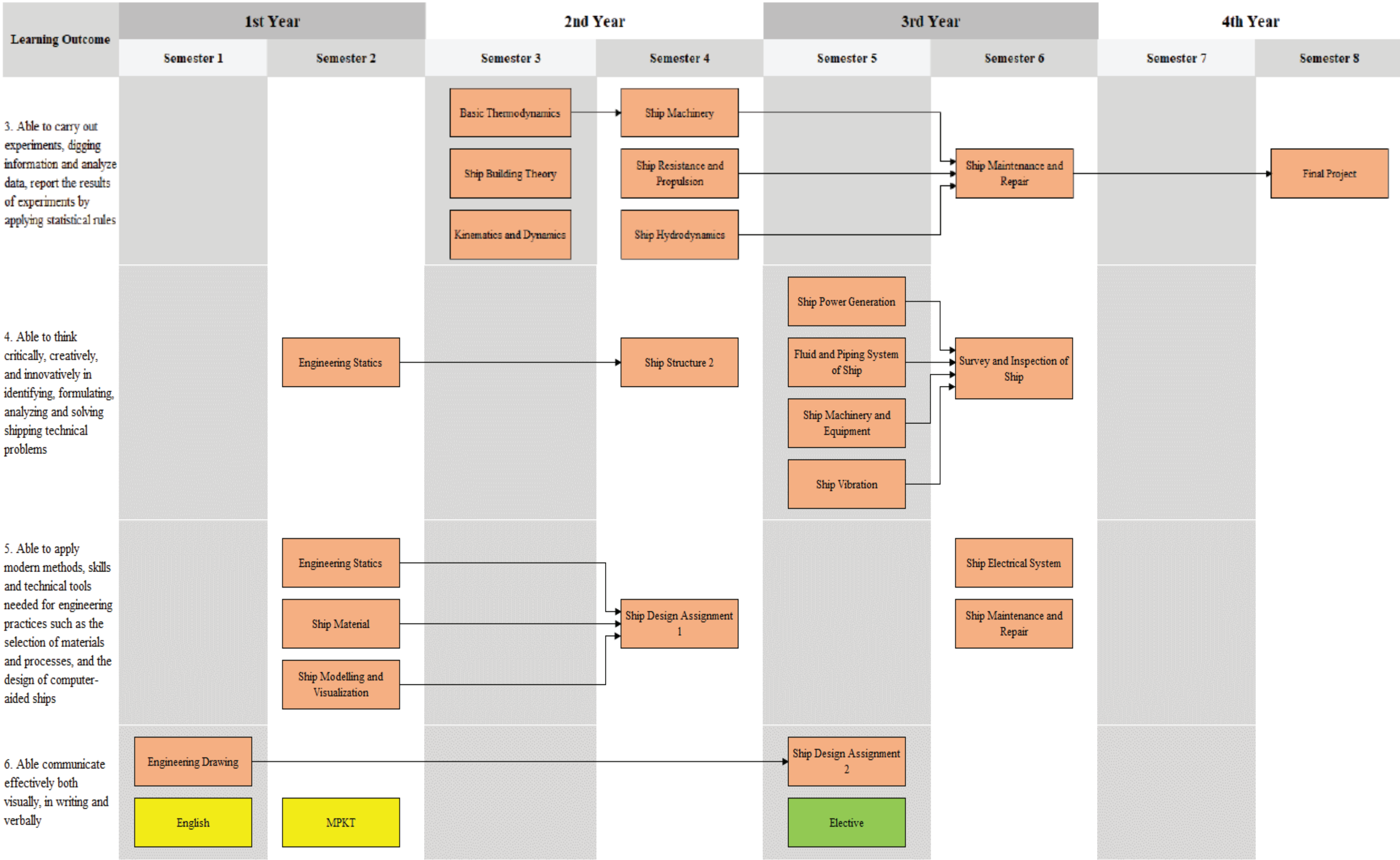
(ELO 1) Able to apply basic knowledge of mathematics, basic science and information technology needed to achieve competence in the field of Naval Architecture and Marine Engineering.

(ELO 6) Able to communicate effectively both visually, in writing and verbally

Flow Diagram of Subject Courses Undergraduate Program in Naval Architecture and Marine Engineering




Learning Outcome
1st Year
2nd Year
3rd Year
4th Year
Semester 1
Semester 2
Semester 3
Semester 4
Semester 5
Semester 6
Semester 7
Semester 8
1. Able to apply basic knowledge of mathematics, basic science and information technology needed to achieve competence in the field of Naval Architecture and Marine Engineering.
2. Able to design ship buildings, marine systems, marine transportation, considering the aspect of energy conservation to meet the expected outcomes within realistic boundaries, as well as to recognize and/or utilize local and national potential resources with global insight.
Calculus 1
Linear Algebra
Basic Physics 1
Lab Exp for Basic Physics 1
Calculus 2
Basic Physics 2
Lab Exp for Basic Physics 2
Basic Chemistry
Engineering Mathematics
Computational Mathematics
Numerical Method
Statistic and Probability
Introduction to Naval Architecture and Marine Eng
Engineering Drawing
Ship Modelling and Visualization
Basic Thermodynamics
Basic Fluid Mechanics
Ship Structure 1
Ship Building Theory
Kinematics and Dynamics
Ship Machinery
Heat Transfer
Ship Resistance and Propulsion
Ship Structure 2
Ship Design Assignment 1
Ship Power Generation
Ship Manufacturing Process
Welding Engineering
Ship Design Assignment 2
Ship Vibration
Ship Electrical System
Engine Room Layout Design


Learning Outcome
1st Year
2nd Year
3rd Year
4th Year
Semester 1
Semester 2
Semester 3
Semester 4
Semester 5
Semester 6
Semester 7
Semester 8
3. Able to carry out experiments, digging information and analyze data, report the results of experiments by applying statistical rules
Basic Thermodynamics
Ship Building Theory
Kinematics and Dynamics
Ship Machinery
Ship Resistance and Propulsion
Ship Hydrodynamics
Ship Maintenance and Repair
Final Project
4. Able to think critically, creatively, and innovatively in identifying, formulating, analyzing and solving shipping technical problems
Engineering Statics
Ship Structure 2
Ship Power Generation
Fluid and Piping System of Ship
Ship Machinery and Equipment
Ship Vibration
Survey and Inspection of Ship
5. Able to apply modern methods, skills and technical tools needed for engineering practices such as the selection of materials and processes, and the design of computer-aided ships
Engineering Statics
Ship Material
Ship Modelling and Visualization
Ship Design Assignment 1
Ship Electrical System
Ship Maintenance and Repair
6. Able communicate effectively both visually, in writing and verbally
Engineering Drawing
English
MPKT
Ship Design Assignment 2
Elective

Learning Outcome	1st Year Semester 1	1st Year Semester 2	2nd Year Semester 3	2nd Year Semester 4	3rd Year Semester 5	3rd Year Semester 6	4th Year Semester 7	4th Year Semester 8
7. Able to design, plan, complete and evaluate tasks within the existing constraints					Elective	Ship Design Assignment 3 Elective	Elective	Elective
8. Able to work effectively both individually and in teams across disciplines or across cultures	Lab Exp for Basic Physics 1	Lab Exp for Basic Physics 2			Ship Manufacturing Process Welding Engineering	Engine Room Layout Design Ship Design Assignment 3 Elective	On the Job Training	
9. Able to take responsibility and adhere to the ethics of the engineering profession and entrepreneurship which is characterized by innovation and independence	Religion Introduction to Naval Architecture and Marine Eng	MPKT			Elective	Elective	Ship Financing and Insurance Health, Safety and Environment	
10. Able to carry out the lifelong learning process including access to knowledge related to relevant contemporary issues		MPKT			Elective	Elective	Seminar Health, Safety and Environment Elective	Final Project Elective

Subject Structure Undergraduate Program in Naval Architecture and Marine Engineering

Code	Subject	SKS
	1st Semester	
UIGE600004	Religion	2
UIGE600003	English	2
ENGE600001	Calculus 1	3
ENGE600005	Basic Physics 1 (Mechanic & Heat)	3
ENGE600006	Laboratory Experiment for Basic Physics 1	1
ENMR601001	Introduction to Naval Architecture and Marine Engineering	2
ENME601002	Engineering Drawing	2
ENGE600004	Linier Algebra	4
	Subtotal	**19**
	2nd Semester	
UIGE600006	MPKT	5
ENGE600009	Basic Chemistry	2
ENGE600002	Calculus 2	3
ENGE600007	Basic Physics 2 (Electrical, Magnet, Wave, and Optic)	3
ENGE600008	Laboratory Experiment for Basic Physics 2	1
ENME602004	Engineering Statics	2
ENMR603003	Ship Material	2
ENMR602002	Ship Modelling and Visualization	2
	Subtotal	**20**
	3rd Semester	
ENME600013	Engineering Matematics	4
ENME603008	Basic Thermodynamics	4
ENMR603004	Ship Building Theory	2
ENMR603005	Ship Structure 1	2
ENME600009	Kinematics and Dynamics	4
ENMR604011	Basic Fluid Mechanics	2
ENME600017	Computational Mathematics	2
	Subtotal	**20**
	4th Semester	
ENMR604005	Heat Transfer	2
ENMR604007	Ship Machinery	2
ENMR604008	Ship Structure 2	2
ENMR604009	Ship Resistance and Propulsion	4
ENMR604010	Ship Hydrodynamics	2
ENME600016	Numeric Method	2
ENGE600010	Statistic and Probability	2
ENMR600001	Ship Design Assignment 1	3
	Subtotal	**19**
	5th Semester	
ENMR606017	Ship Vibration	2
ENMR600002	Ship Design Assignment 2	4
ENMR605011	Fluid and Piping System of Ship	2
ENMR605013	Ship Manufacturing Process	2
ENMR605014	Welding Engineering	2
ENMR606020	Ship Power Generation	2
ENMR606018	Ship Machinery and Equipment	2
	Elective, Internship A	3
	Subtotal	**19**
	6th Semester	
ENMR600003	Ship Design Assignment 3	3
ENMR607023	Survey and Inspection of Ship	2
ENMR605015	Ship Electrical System	3
ENMR605016	Engine Room Layout Design	2
ENMR606021	Ship Maintenance and Repair	2
	Elective, Internship B	3
	Elective	4
	Subtotal	**19**
	7th Semester	
ENMR600005	Seminar	1
ENMR600004	On the Job Training	2
ENMR605012	Ship Financing and Insurance	2
ENME600009	Health, Safety and Environment	2
	Elective	4
	Elective	4
	Subtotal	**15**
	8th Semester	
ENMR600006	Final Project	5
	Elective	4
	Elective	4
	Subtotal	**13**
	Total	**144**

Elective Subjects Undergraduate Program In Naval Architecture And Marine Engineering

Code	Subject	SKS
	Odd Semester	
ENME803183	Marine and Offshore Structure	4
ENME803185	Maritime Law and regulation	4
ENME804192	Supply Chain Technology	4
ENME804193	Cold Storage Technology	4
ENME803184	Marine Transportation and Port Management	4
ENME601108	Internship A (content: Project Management and Entrepreneurship)	4
ENMR601104	Special Topic 1	4
ENME601105	Special Topic 2	4
ENME801002	Advanced Engineering Mathematics*	4
ENME802004	Engineering Computation*	4

ENME801102	Advanced Fluid Dynamics and Heat Transfer*	4
ENME801140	Materials and Manufacturing Processes*	4
	Even Semester	
ENME804186	Special Ship Project	4
ENME804187	Ship Production Optimization	4
ENME804189	Maritime Safety	4
ENME804190	Advanced Welding Engineering	4
ENME804191	Port Operation and Planning	4
ENME802103	Energy Optimization System	4
ENMR607022	Air Conditioning and Refrigeration System of Ship	4
ENME601109	Internship B (content: Industrial Seminar and Entrepreneurship)	4
ENME601106	Special Topic 3	4
ENME601107	Special Topic 4	4
ENME802003	Experimental Design*	4
ENME802006	Data Analytics*	4
ENME802181	Maritime Engineering and Management*	4
ENME803182	Ocean Energy*	4

*For Fast-Track Program Only

Transition Rules

1. The 2020 curriculum is implemented starting in the Odd Semester 2020/2021. In principle, after the 2016 Curriculum is implemented, only subjects in the 2020 Curriculum will be opened.
2. Class of 2019 and previously followed the 2020 curriculum with transitional rules.
3. A transitional period of 1 year, in the academic year 2020/2021, is implemented for subjects where the semester placement changes (from Even to Odd, or vice versa), if necessary, will be opened in both semesters during the transition period (Academic Year 2020 / 2021).
4. For students who have not passed the compulsory subjects in the 2016 Curriculum, are required to take the same or equivalent subjects in the 2020 Curriculum.)
5. If there is a change in the SKS for the course, the number of SKS taken into account in graduation is the number of the SKS at the time the course was taken. Same or equal subjects with different SKS weights, if repeated or newly taken will be listed with a new name and calculated with new SKS weights.
6. If the compulsory subjects in the 2016 Curriculum are removed and there is no equivalence in the 2020 Curriculum then for students who have passed these courses, they will still be counted as compulsory subjects in the calculation of passing 144 SKS. Students who have not passed the course can take new compulsory subjects or elective courses in the 2020 Curriculum to complete 144 credits.

Subject Eqivalent Table Mechanical Engineering Study Program

2016			2020		
CODE	SUBJECTS	CREDIT	CODE	SUBJECT	CREDIT
UIGE600001	MPKT A	6	UIGE600006	MPKT	5
UIGE600002	MPKT B	6		Elective	
UIGE600020-48	Sport / Art	1		Elective	
ENMR606019	Ship Electrical System	2		Elective	
UIGE600003	English	3	UIGE600003	English	2
ENMR602002	Ship Modelling and Visualization	3	ENMR602002	Ship Modelling and Visualization	2
			ENME602004	Engineering Statics	2
			ENME600018	Computational Mathematics	2
ENMR600001	Ship Design Assignment 1	2	ENMR600001	Ship Design Assignment 1	3
ENMR604006	Thermofluids	4	ENMR604011	Basic Fluid Mechanics	2
			ENMR604005	Heat Transfer	2
ENMR605012	Engineering Economic	2	ENMR605012	Ship Financing and Insurance	2
			ENME601108	Internship A	3
ENME600006	Industrial Seminar	2	ENME601109	Internship B	3
ENMR605015	Ship Electrical System	2	ENMR605015	Ship Electrical System	3
ENMR607022	Air Conditioning and Refrigeration System of Ship	4	ENMR607022	Elective, Air Conditioning and Refrigeration System of Ship	4
ENMR604008	Ship Structure 2	4	ENMR604008	Ship Structure 2	2
ENMR606020	Ship Power System	2	ENMR606020	Ship Power Generation	2
ENMR607023	Survey and Inspection of Ship	2	ENMR607023	Survey and Inspection of Ship	4
ENME804187	Ship Production and Management	4	ENME804187	Ship Production Optimization	4
			ENMR601104	Special Topic 1	4
			ENMR601105	Special Topic 2	4
			ENME804192	Supply Chain Technology	4
			ENME804193	Cold Storage Technology	4
			ENME804191	Port Operation and Planning	4

Syllabus Undergraduate Program in Naval Architecture and Marine Engineering

RELIGION
ENME600004
2 credits
Learning Outcome(s) :

Provide an understanding of the religious values and see the problems from various aspects of life, so that student care about the social realities they face.

Topic:

Meaning and religion that apply in scientific and theological discourse; History and origins of religion; The main dimensions of religion such as divinity, prophethood, scripture, ritual, salvation, social ethics and eschatology; Socio-religious dimension; Religion and state; Inter-religious relations.

Pre-requisite(s) : -

References : Guidebook from UI

ENGLISH
ENME600003
2 credits
Learning Outcome(s) :

Able to communicate in English orally and in writing with correct English grammar rules.

Topic:

English grammar, writing and conversation.

Pre-requisite(s) : -

References : -

CALCULUS 1
ENGE600001
3 credits
Learning Outcome(s):

Able to use the basic concepts of calculus related to -a function of one variable, the derivative and integration of the function of one variable in order to solve its applied problems.

Topic :

Introduction, Functions and Limits, The Derivative, Applications of the Derivative, The Definite Integral, Applications of The Definte Integral, Transcendental Functions, Techniques of Integration, Indeterminate Forms and Improper Integrals.

Prerequisite(s): -

References:

D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., Pearson, Prentice Hall, 2007.

Additional eferences:
1. George B. Thomas Jr., Thomas' Calculus Early Transcendental, 12th ed., Addison–Wesley Pearson, 2009.
2. Howard Anton, Calculus, 10th ed., John Wiley and Sons, 2012.

BASIC PHYSICS 1 (MECHANIC & HEAT)
ENGE600005
3 credits
Learning Outcome(s) : -

Topic:

Pre-requisite(s) : -

References : -

LAB EXP FOR BASIC PHYSICS
ENGE600006
1 credits
Learning Outcome(s) :

Able to explain the basic concepts of mechanics and thermodynamics, and be able to apply them in an effort to understand natural phenomena and human engineering, including their applications, be able to apply mathematics, science, and basic engineering and civil engineering specialization to be used in solving complex civil engineering problems.

Topic:

Units, Magnitudes and Vectors, Motion Along Straight Lines, Motion in Two and Three Dimensions, Newton's Laws of Motion, Applications of Newton's Laws, Kinetic Energy and Work, Potential Energy and Energy Conservation, Center of Mass, Linear Momentum, Rotation, Rolling Motion, Torka, Angular Momentum, Oscillation, Mechanical and Sound Waves, Gravity, Statics and Elasticity, Fluid Mechanics, Temperature, Heat, Law I Thermodynamics, Ideal Gas and Kinetic Theory of Gas, Heat Engine, Entropy, and Law II Thermodynamics.

Pre-requisite(s): -

References:

1. Halliday, Resnick, dan Walker, Principles of Physics 10th Edition, Wiley, 2014.
2. Serway Jewett, Physics for Scientists and Engineers 9th Edition, Thomson Brooks/Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008

INTRODUCTION TO MARINE ENGINEERING
ENMR601001
2 credits)
Learning Outcome(s):

Provides basic competence of ship building and structure and the approach to ship designing.

Topic:

History of Ship Building; Types of water bulding: the Classification of Society and the International Agency; Ship Building and Construction; main dimension: Ship Motion; Ship Design Process; Stabil- ity: resistance and Propulsion; Tonnage; Ship building method. Historical of ship machinery, main engines, auxiliary engines, the engine room layout.

Pre-requisite(s): -

References:

1. GM Kok, A.C. Nierich., Bangunan Kapa[, MARTECH
2. D A Taylor, Introduction to Marine Engineering.1996

ENGINEERING DRAWING
ENME601002
2 credits
Learning Outcomes :

Course participants are able to transfer geometric component by drawing according to standard draw which is recognized by International Standard Organization (ISO). Students understand the theory and procedure of engineering drawing based on ISO standard. Students are able to read, interpret, and transfer 2DI3D geometric draw from component or construction. Students are able to draw the orthogonal projection based on ISO standard.

Topic:

Introduction to drawing equipment; Basic definition of geometric, paper format, draw regulation, line, field, line configuration, basic geometric form; Visualization geometric: Skew projection and isometric, function and line types, configuration geometric form; Orthogonal Projection: Projection stan- dard, viewing concept, width display principle; Advanced orthogonal projection: Circle region concept, special region concept, trimming concept, display width, refraction.

Pre-requisite(s) : -

References : -

1. ISO 1101, Technical Drawings, International Organization for Standardization.
2. A.W. Boundy, Engineering Drawing , McGraw-Hill Book Company
3. Colin Simmons & Dennis Maguire, Manual of Engineering Drawing, Edward Arnold
4. Takeshi S. G., Sugiarto Hartanto, Menggambar Mesin, Pradnya Paramita, 1983
5. Warren J. Luzadder, Fundamentals of Engineering Drawing, Prentice-Hall, Inc.
6. Giesecke-Mitchell-Spencer-Hill-Dygdon-Novak, Technical Drawing, Prentice Hall Inc.

LINEAR ALGEBRA

ENGE600004
4 SKS
Course Learning Outcomes:
Students are able to calculate linear system problems to solve engineering problems.

Topic:

Systems of linear and matrix equations, Determinants, Euclid vector spaces, Common vector spaces, eigenvalues and eigenvectors, inner product spaces, Diagonalization and General Linear Transformation.

Pre-requisite(s): -

Textbooks:

1. Elementary Linear Algebra, Howard Anton & Chris Rorres, 11th edition, 2014
2. Gilbert Strang, Introduction to linear algebra 3rd edition Wellesley Cambridge Press, 2003

MPKT

UIGE600006
5 credits
Learning Outcome(s) :

This course aims to develop student participation to increase awareness of social, national, and environmental issues based on faith, piety, character, and academic ethics in the context of developing science and technology.

Topic:

Logic, Philosophy of Science and Pancasila; Morals and Character; Society and Culture in Indonesia

Pre-requisite(s) : -

References : Guidebook from UI

BASIC CHEMISTRY

ENGE600009
2 credits
Learning Outcome(s) :

Students are able to analyze basic chemical principles for application in engineering, Students are able to explain the classification and state of matter, unit and measurement uncertainty, and dimensional analysis of measurement units.

Topic:

Material and measurements, atoms, molecules and ions, stochiometry, water phase reactions and solution stochiometry, thermochemistry, chemical equilibrium, acid and base equilibrium, electrochemistry, chemical kinetics, and chemical applications.

Pre-requisite(s) : -

References :

1. Ralph H. Petrucci, General Chemistry: Principles and Modern Applications, 8th Ed. Prentice Hall Inc, New York, 2001.
2. John McMurry, Robert C. Fay, Chemistry (3rd ed.), Prentice Hall, 2001.
3. Raymond Chang, Williams College, Chemistry (7th ed.), McGraw-Hill, 2003.

CALCULUS 2

ENGE600005
3 credits
Learning Outcome(s) :

Students are able to use the concepts of sequences, series, conic incisional equations and the basic concepts of calculus which involve the function of two or three variables to solve their applied problems, are able to apply mathematics, science, and basic engineering as well as civil engineering specialization to be used in solving civil engineering problems that are complex.

Topic:

Line and series are infinite, Test for convergence of positive series and series of signs, rank series and operations, Taylor and Mc Laurin series, Cone slices, Calculus in polar coordinates, Derivatives, limits and continuity of multi-function functions, Derivative and gradient sequences, Rules chain, tangent plane and surface approximation, Lagrange multiplier method. Double fold integrals in Cartesian coordinates and polar coordinates, Triple fold integrals in Cartesian coordinates, cylindrical coordinates and sphere coordinates, Application double fold and fold integrals 3.

Pre-requisite(s) : Calculus 1

References :

1. D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., PEARSON, Prentice Hall, 2007.
2. Thomas, Kalkulus Edisi Ketiga Belas Jilid 2 , Erlangga, 2019.

BASIC PHYSICS 2 (ELECTRIC, MAGNET, OPTIC AND WAVE)

ENGE600007
3 credits
Learning Outcome(s) : -

Topic:

Pre-requisite(s) : -

References : -

LAB EXP FOR BASIC PHYSICS 2

ENGE600008
1 credits
Learning Outcome(s) :

Students are able to apply the basic concepts of electrical physics, magnetism, waves, and optics to solve problems in the engineering field, Students are able to explain the classification and state of matter, unit and measurement uncertainty, and dimensional analysis of units of measurement.

Topic:

Unit, Magnitude, Vector, Electric Charge, Electric Field, Gauss Law, Electric Potential, Capacitance, Electric Current, Resistance, Direct Current, Magnetic Field Due to Electric Current, Magnetic Field Source, Induced GGL, Inductance, Alternating Current, Electromagnetic Waves , Light Properties and Propagation, Optics Geometry.

Pre-requisite(s) : -

References :

1. Halliday, Resnick, dan Walker, Principles of Physics 9th Edition, Wiley, 2011.
2. Serway Jewett,Physics for Scientists and Engineers 9th Edition, Thomson Brooks/Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008.

ENGINEERING STATICS

ENME602004
2 credits
Learning Outcome(s) :

Understand the concepts of force and force equilibrium in various constructs so that they are able to calculate and analyze construction equilibrium based on the law of static equilibrium

Topic:

Basic principles of structural statics / Newton's Law. Arrangement and decomposition of style in a field and space. Static equilibrium law. Footsteps and footing reactions. Truss construction.

Pre-requisite(s): - None

References: -
1. Beer, Ferdinand P, Mechanics for Engineers: STATICS, Mc GrawHill.
2. RC Hibbeler, Mechanics of Materials, 10th ed., Prentice Hall, 2016.
3. Riley, F William, Engineering mechanics: STATICS, John wiley & sons
4. Hamrock, Fundamental of Machine Element, Mc Graw-Hill.
5. Shigley, Joseph Edward, Mechanical Engineering Design, McGrawHill.
6. Kurowski, P.M., Finite Element Analysis for Design Engineers, SAE International, 2004

SHIP MATERIALS

ENMR603003
3 credits
Learning Outcome(s) : -

Students are expected to understand available material options depending on the operation re- quirement of the ships, encompassing both qualitative and quantitative understanding. Qualita- tive understanding includes properties of materials which are used for ship structure. Quantitative understanding includes calculation of properties of materials which may change due to external influences such as elongation that results from a loading.

Topic:

Types of materials and their applications in industry, properties of materials in various industries such as naval industry, heat treatment, diffusion of materials, phase diagram, dislocation and strengthening mechanism, materials failure, corrosion and degradation of materials, stress-strain diagram, elastic-plastic deformation, compressive deformation, shear stress and torsional stress, material hardness, destructive and non-destructive testing.

Pre-requisite(s): -

References:
1. Callister W. D., Introduction to Material Science and Engineering, John Wiley and sons, 2007
2. Hibbeler R. C., Statics and Machanics of Materials, Prentice Hall, 2004
3. Muckle W., Strength of Ship'ss Structure, Edward Arnold Ltd, 1975.
4. Wessel J. K., Handbook of Advanced Material, John Wiley and sons, 2004

SHIPS VISUALIZATION AND MODELING

ENMR602002
3 credits
Learning Outcome(s):

This subject focus on the procedure of preparing a lines plan drawing that represents the shape of the ship's hull. This subject also provide hands on experience to the student on how ship lines plan is prepared and discuss the characteristics of underwater characteristic of the ship hulls.

Topic:

Drawing Lines Plan; Optimizing the main dimensions and coefficients on ship designs with restric- tions on ship type; Method of Nederlandsche Scheepsbouw Proefstatioen (NSP); Data Form Meth- od; Body Plan & Lines Plan. Interpreting the Hydrostatic Curve; HSC calculations use the Simpson method; Read the calculated hydrostatic curve. Interpreting the Bonjen Curve; Calculating the Bonjean curve; Reading the calculated Bonjean curve. Interpreting Cross Curve; Counting Cross Curve; Read Cross Curve that has been calculated.

Pre-requisite(s): -

References:
1. Tupper E.C., Basic Ship Theory, Butterworth Heinemann, 2001
2. David Watson, Practica[Ship Design.Elsevier Science.1998
3. V. Bertram, H.Schneekluth, Ship design for Efficiency and Economy, Butterworth Heinemann, 1998
4. Tupper E.C. dan W. Muckle, Introduction to Nava[Architecture, Butterworth Heinemann, 1996
5. T.C. Gillmer, Modern Ship Design, US Naval Institute, 1975.
6. Manual Autocad dan Maxsurf 12.02

ENGINEERING MATHEMATICS

ENME600013
4 credits
Learning Outcome(s) :

This course aims to complete student's anylitical ability. Students understand and are able to use the advanced mathematical concepts in order to solve engineering problems.

Topic:

Introduction to differential equation, 1st order differential equation, 2nd order differential equa- tion, higher order differential equation, vector analysis, vector differential, grad operation, diver- gence and curl, vector integration, laplace transform, laplace transform to solve the differential equation, fourrier transform, convulsion, numerical method, root of equation, numerical differ- entiation, numerical integral

Pre-requisite(s): Calculus 2

References:
1. Croft, A, et.al, Mathematics for Engineers, 3rd Edition, 2008, Prentice Hall
2. Chapra S.C., Canale, Numerical Methods for Engineer, 6th Edition, 2010, Mc Graw Hill
3. Kreyszig, E, Advanced Engineering Mathematics 10th Edition, John Wiley and Sons

BASIC THERMODYNAMICS
ENME603008
4 credits
Learning Outcome(s):

This course introduces the basic concept of thermodynamics and its application in real life and gives the understanding about the design of thermodynamics system.

Topic:

Scope and basic understanding of thermodynamics system, temperature concept, pressure, ther- modynamics equilibrium, reversibleIirreversible process, zero law of thermodynamics and abso- lute temperature, first law of thermodynamics, second law of thermodynamics, thermodynamics equation, gas power cycle, gas compressor, combustion engine cycle, internal combustion engine, simple gas turbine cycle, brayton's cycle, stirling's cycle, steam power cycle, refrigeration, car- not's cycle, simple rankine's cycle, rankine's cycle with modification, biner cycle, phsycometric chart, cooling tower, real gas, real gas equation, enthalpy and entrophy.

Pre-requisite(s): Physics (Mechanics and Thermal)

References:
1. Michael J. Moran, Howard N. Shapiro, Fundamentals of Engineering Thermodynamics, 8th Edition, Wiley, 2014.
2. Reynolds W.C., Perkins H.C., Engineering Thermody- namics, Mc. G. Hill .
3. Zemansky , Aboot , van Ness, Basic Engineering Thermo- dynamics, McGraw Hill
4. Kenneth Wark Jr. Thermodynamics , Mc.Graw Hill
5. H.D. Baehr, Termodynamik , Springer Verlag

SHIP BUILDING THEORY
ENMR603004
2 credits
Learning Outcome(s):

Provides an understanding about hydrostatic and dynamic stability calculation

Topic:

Lines Plan calculation and methodology; Bouyancy system; Metasentra, Static Stability: Calcula- tion of hydrostatic curves and cross curves; docking, Ship crashes out, inclining test, ship launch- ing, Wave Theory; Ship Hydrodynamics; Foil shape; Theory of Ship Motion; Plan Steering: Dynamic Stability: Theory of Stationary and Non-Stationary on a Ship Motion; Calculation of Critical Condi- tions Due to shaky ship; Impact loading.

Pre-requisite(s): Ship Visualization and Modelling

References:
1. Bryan Barrass & Dr Derrett, ship stabi[ity for master and mates.2006
2. A.B Brain, Ship hydrostatics and stabi[ity, Butterworth, Heinemann, 2003.
3. Volker Bertram, Practica[ship hydrodynamics, Butter- worth, Heinemann, 2000.
4. Dr C B Barrass, Ship stabi[ity notes & examp[e,3rd edition Butterworth, Heinemann, 2001
5. E.C. Tupper & K.J. Rawson, Basic ship Theory, Butter- worth, Heinemann, 2001.
6. M.A. Talahatu, Hidrodinamika kapal I & II, FTUI. 1998.

SHIP STRUCTURE 1
ENMR603005
2 credits
Learning Outcome(s):

Provides an understanding for calculating transversal and longitudinal constructions, profile and plate selection

Topic:

Stress and strain torsion (torque) and calculation of moment inertia; axial force, shear force and bending moment; Calcula- tion of reaction cross-beam and diagrams, axial and moment diagrams; Analysis of stress and strain fields; Beams Deflection I; Beams Deflection II: Static; column; energy method; cylinder walls thick and thin; theory of plate; analysis of ship structures; longitudinal and transversal strength of ships; calculation of midship strength; Bending and torsion on the Hull Girder; Calculation of Cross Sec- tion, Bending and Buckling on the panels; concept of fatigue.

Pre-requisite(s): -

References:
1. Dr. Yong Bai, Marine Structura[Design. Elsevier Science.2003
2. Tupper E.C., Basic Ship Theory, Butterworth Heinemann, 2001
3. B. Baxter, Naval Architecture Examples and theory, Charles Griffin & Co.
4. Biro Klasifikasi Indonesia
5. Lloyd's Register Rules and Regulations

KINEMATICS AND DYNAMICS
ENME600009
4 credits
Learning Outcome(s):

Students have the ability to understand the key concept of kinematics and dynamics of mechani- cal system and capable to analyze the movement, velocity, acceleration force and equilibrium.

Topic:

Vector velocity analysis, free body diagram, linier motion, velocity polygon, 2D motion, rectan- gular coordinates, N-T and pole, relative motioan and velocity of 2 coincideIrelate point, Coriolis acceleration and stiff body kinematics, Inertia Force, Statics, particle system, works, energy, impuls, linear-angular momentum, stiff body motion, works and energy, relative motion, rotating mass balancing and back & forth motion, cam dynamics and Gyroscope.

Pre-requisite(s): Physics of Mechanics & Heat

Textbooks:
1. Meriam & Kraige, Engineering Mechanics. 7th ed, Wiley New York. 2012.
2. Holowenko, Dynamics of Machinery, John Wiley, 1995.
3. Beer & Johnston, Mechanics for Engineer, Dynamics, 11th ed. Dynamics, Mc Graw-Hill, 2015.

BASIC FLUID MECHANICS
ENMR604011
2 credits
Learning Outcome(s):

Fluid mechanics is a branch of applied mechanics used to investigate, analyze and study the nature and behavior of fluids. The fluid being studied can be a fluid that is moving or stationary.

Topic:

Fluid and its Properties; Fluid Statics; Relative Balance; Basic Concepts and Equations in Fluid Flow; Flow Dynamics: Motion Equations (Newton, Euler, Navierstokes); Basic Equations of Fluid Dynamics (Continuity, Energy and Momentum); Dimensional Analysis and Hydraulic Similarity; Ideal Fluid Flow; Viskos flow; Viskos Flow: Transition from Laminar Flow to Turbulent Flow; Turbulent Flow Full Development; Flow Around Submerged Objects: General Characteristics of Outside Flow.

Pre-requisite(s): -

References:

1. Munson, B.R., Fundamentals of Fluid Mecha-nics 7th Ed, John Wiley & Sons, Inc. 2012
2. Smits, A.J., A, Physical Introduction to Fluid Mechanics, John Wiley & Sons, Inc. 2000
3. Kumar, SCPL.L., Engineering Fluid Mechanics, Eurasia Publishing House Ltd., 2010

COMPUTATIONAL MATHEMATICS

ENME600017
2 credits
Learning Outcome(s):

Understand the basic knowledge of computational and engineering programming, able to make computational and programming techniques simple, able to solve engineering problems with engineering programming.

Topic:

Introduction to programming languages, Basics of algorithms, Basics of computing, Software for computing and programming techniques, Development of computing and programming with case studies

Pre-requisite(s): -

References:

1. Computer Programming with MATLAB, J. Michael Fitzpatrick, Ákos Lédeczi, Fitzle, 2013
2. Introduction to Computation and Programming Using Python: With Application to Understanding Data, John V. Guttag, The MIT Press, 2016

HEAT TRANSFER

ENME604005
2 credits
Learning Outcome(s):

This subject studies the mechanism of heat and mass transfer in a volume control because of differences in temperature and this subject has a close relationship with basic thermodynamics. The aim of this course is for students to be able to understand the various mechanisms of heat and mass energy transfer between two systems, when there is a temperature difference and be able to calculate the rate of heat transfer. Able to solve various problems of heat transfer and mass using dimensionless parameters.

Topic:

Basics of heat transfer; Conduction Heat Transfer (1 Dimension and 2 Dimension); Numerical Analysis of Conduction / Unsteady State Heat Transfer; Forced Convection Heat Transfer; Free convection heat transfer.

Pre-requisite(s): -

References:

1. Frank P Incropere, David P De Witt, Fundamental heat and mass transfer, 7th Ed., Wiley, 2011, New York
2. Holman JP, Heat Transfer, 10th ed, Mc Graw-Hill, 2009.
3. Koestoer, RA, Perpindahan Kalor untuk Mahasiswa Teknik, Salemba Teknika, 2003.
4. Welty R James, Wicks Charless, Wilson Robert, Fundamentals of Momentum, Heat, and Mass Transfer, 6th Ed. Wiley, 2014.
5. Cengel, Yunus, Heat Transfer a Practical Approach, 2nd Ed. Mc Graw Hill, 2003, Singapore.
6. Kreith Frank, Bohn Mark, Principles of Heat Transfer, 7th Ed. CL Engineering, 2010.

SHIP MACHINERY

ENMR604007
2 credits
Learning Outcome(s):

Understanding of types and concept of the main system, supporting system, lubrication system, and refrigeration system of a ship machinery

Topic:

Basic concept of diesel engine, combustion process, four and two stroke engine theory, types of engine, performance of diesel engine, turbo charger, engine ratings, machinery components, supporting system of machines, starting systems, fuel system, lubrication system, refrigeration system, engine propeller matching, experiment for diesel engine performance testing.

Pre-requisite(s): Basic Thermodynamics

References:

D A Taylor, Introduction to Marine Engineering.1996

SHIP STRUCTURE 2

ENMR604008
4 credits
Learning Outcome(s):

Provides knowledge and understanding of the types of construction on the ship structure and competence to design ship structures

Topic:

Bottom Structure: Ship hull and section system; Bulk head and girder; deck, Coaming and super structure: fore peak and after peak construction: Construction of Tankers; Gas Carrier Ship Con- struction: Doors and Windows; Fire Protection; Cabin Construction: Construction of loading and unloading Equipments; Painting and Corrosion Prevention.

Pre-requisite(s): Ship Structure 1

References:

1. D. J. Eyres, Ship Construction, 5th edition. Butterworth-Heinemann. 2011
2. D. Taylor, Merchant Ship Construction, Prentice Hall
3. Biro Klasifikasi Indonesia
4. Lloyd's Register Rules and Regulations

SHIP RESISTANCE AND PROPULSION

ENMR604009
4 credits
Learning Outcome(s):

Provides an understanding for the calculation of ships resistance and propulsion, both theoreti- cally and by using a model

Topic:

Ship force; Ship Resistance Comparative Law; Frictional resistance: wave resistance; pressure resistance: Air resistance; Effect of Ship Shape; Resistance predictions with Model Test; Wake Fric- tion: Thrust reduction; Ship resistance in Bad Weather: The principle of Hydrofoil Ship; coefficient of propulsion; Calculation of Propeller Design with Form Data and Wageningen Graphs..

Pre-requisite(s): -

References:

1. J. P. Ghose, R. P. Gokarn, Basic Ship Propulsion, 2004
2. Dave Gerr, The Propeller Handbook, McGraw-Hill Professional, 2001
3. Sv. Aa. Harva[d, Resistance and Propu[sion of Ships, 1983
4. C. Gallin, Ships and Their Propulsion System, Lohmann & Stolterfoht

SHIP HYDRODYNAMICS

ENMR604010
2 credits
Learning Outcome(s):

Students are expected to understand basic knowledge on ship hydrodynamics, waves, and viscous flow

Topic:

Basic of fluid, hydrostatic pressure, basic of hydrodynamics, theory of linear wave, Bernoulli equa- tion and dynamic pressure, effect of wave force on the body of ship, mass addition, equation for seakeeping, viscous lift and drag, friction and streamline endurance, buff bodies, and Navier Stoke equation.

Pre-requisite(s): - Ship Building Theory

References:

1. White, F. Fluid Mechanics. 5th ed. New York, NY: McGraw-Hill, 2002. ISBN: 9780072831801.
2. Smits, A. J. A Physical Introduction to Fluid Mechanics. New York, NY: John Wiley & Sons, 1999. ISBN: 9780471253495.
3. Bhattacharyya, F. Dynamics of Marine Vehicles. New York, NY: John Wiley & Sons, 1978. ISBN: 9780471072065

NUMERICAL METHOD

ENME600016
2 credits
Learning Outcome(s):

The objective of this course is so that students can understand and apply the process and method (algorithm) for engineering numerical computation based on computer and parameters that affect speed and accuracy of the results.

Topic:

Introduction to numerical method and programming, simple mathematical modeling, program- ming and software, structured programming, modular programming, iterative method, function, Taylor and Maclaurin series, approximation and error, solutions to system of linear equations, Graphical method, bisection method, false-position method, Newton - Raphson method, Secant method, Bairstow method, linear algebra system of equations: Gaussian elimination, Gauss-Jordan elimination, decomposition, matrix transformation, Curve - Fitting: Least - Square regression, Interpolation; Numerical integral: Trapezoidal method, Simpson method, multiple integral; Differential equation: Finite Divided Difference, Euler method, Runge - Kutta method; Ordinary dif- ferential equation

Pre-requisite(s): Calculus 1, Calculus 2 and Engineering Mathematics

References:

1. Chapra, Steven C. and Canale, Raymond P. Numerical Methods for Engineers 6th edition. New York: McGraw-Hill, 2010.
2. Kreyszig, Erwin. Advanced Engineering Mathematics 10th edition. Danvers: John Wiley & Sons, 2011.
3. Sedgewick R., Phillippe F, An Introduction to the Analysis of Algorithms, Addison Wesley.
4. Cheney W., Kincaid D., Numerical Mathematics and Computing, Cole Publishing

STATISTICS AND PROBABILISTICS

ENGE600010 / ENGE610010
2 credits
Learning Outcomes:

Students can handle quantitative data / information starting from the descriptive stage (collection, organization and presentation) to the inductive stage which includes forecasting and drawing conclusions based on the relationship between variables for decision making.

Topic:

Introduction to Statistics for Technical Studies: The role of statistics and their application in engineering, Statistical problem solving methods, Descriptive Statistics, Data collection, data organizing, frequency distribution, graphic presentation, Central tendency measures, dispersion measures, moments, skewness, kurtosis, qualitative data; Probability Theory: Basic concepts and definitions, probabilities, combinations of events, random variables; Probability Distribution: Mathematical model of distribution, continuous and discrete probabilities, probability density functions (PDF), binomial distribution, Poisson distribution, normal distribution (gaussian), chi square distribution; Sampling: The usefulness and advantage of sampling, the distribution of the sampling from the average value, the distribution of the percentage sampling; Estimation: Basic definitions and concepts, Estimating intervals, Estimating average values of populations, Estimating population percentages, Estimating population variances, Determining sample sizes to estimate; Hypothesis testing: General procedures for hypothesis testing; Hypothesis test 1 sample at average value: Hypothesis test 1 sample at variance, Hypothesis test 2 sample at variance, Hypothesis test 2 sample at average value, Hypothesis test 2 sample at percentages, Objectives and procedures ANOVA, sample ANOVA, table ANOVA; Regression: The basic concepts of simple linear regression analysis, Test relations and prediction intervals in linear regression analysis

Pre-requisite(s): none

References:

1. Harinaldi, Basic Principles of Statistical Engineering and Science, Erlangga, 2004
2. Montgomery, DC., And Runger, GC., Applied Statistics and Probability for Engineers, John Wiley Sons, 2002

SHIP DESIGN ASSIGNMENT 1

ENMR600001
3 credits
Learning Outcome(s):

Understanding of ship design procedures and monitoring.

Topic:

Design Analysis (owner requirement based); study literature; initial finding: Displacement, main dimension, and shape of ship, finding power driven; linesplan skecth and monitong of calculation CSA (Curve of Sectional Area); general plan sketch (GA); initial assessment payload and unloading space, stability, hull arise, trim; free and unloading space estimates; watertight bulkhead posi- tioning for passenger ships.

Pre-requisite(s): Ship Building Theory

References:
1. B. Baxter, Teach Yourself Naval Architecture, The English Universities Press. Signifi cant Ships, RINA
2. M.A Talahatu, Teori Merancang Kapal. FTUI 1998.

SHIP VIBRATION
ENMR606017
2 credits
Learning Outcome(s):

Understanding of engine vibration system and vibration source detection

Topic:

Engine vibration system: free vibration, damping, transient vibrations, forced vibrations, vibrations with two degrees of freedom, torsional vibration, lateral and longitudinal in ship propulsion system; Experimental measurement of vibration

Pre-requisite(s): Kinematics and Dynamics

References:
1. L.C. Burrill, Ship vibration: simp[e methods of estimating critica[frequencies, North East Coast Institution of Engineers and Shipbuilders. 1935
2. Meriam & Kraige. Engineering Mechanics. Vol-2, Dynamics. Wiley New York.4th eds.1998.
3. Holowenko. Dynamics of Machinery.John Wiley.1995.
4. William T.Thomson. Theory of Vibration with application. Prentice Hall India.1972.
5. Beer & Johnston.Mechanics for Engineer-Dynamics. Mc-Graw-Hill.1976.

SHIP DESIGN ASSIGNMENT 2
ENMR600002
4 credits
Learning Outcome(s):

Understanding the calculation and monitoring of supporting system for ships designing

Topic:

Ship displacement methode; determine main dimension and coefficient; determine lines plan, hydrostatic calculation, main section plan, profile and bulkhead plan, design of air condirt- ioning system, ship maintenance design, communication devices election, navigate devices election, safety plan

Pre-requisite(s): Ship Design Assignment 1

References:
1. B. Baxter, Teach Yourse[f Nava[Architecture, The English Universities Press. Signifi cant Ships, RINA
2. M.A Talahatu, Teori Merancang Kapal. FTUI 1998.

FLUID AND PIPING SYSTEM OF SHIP
ENMR605011
2 credits
Learning Outcome(s):

Understanding types of fluid system, piping system, and practical aspects on the Ship Construction

Topic:

Positive displacement of fluid engines, hydrolic system,pneumatic power systems. Experimental of water piping system, air piping system, pump impeller, Pelton turbine. Piping systems on ships and marine construction, type of pipe material, pipe fittings, valves, tanks, sea-chest, standards and methods of drawing systems, bilga systems, ballast systems, fire extinguish system,supporting sys- tem (auxiliary motor), fuel system, lubrication system, cooling system, compressed air systems, domestic systems, tanker loading and unloading systems.

Pre-requisite(s): Basic Fluid Mechanics

References:
1. A.Keith Escoe. Piping and Pipeline Assesment Guide. Elsevier Inc. 2006
2. Dixon, S.L, Fluid Mechanics and Thermodynamics of Turbomachinery, 4th Edition, Pergamon Press, 2005
3. Esposito, A., Fluid Power with Application, 5th Edition, Prentice Hall, 2003
4. Mobley, R.K, Fluid Power Dynamics, Newnes Butter-worth-Heinemann, 1999
5. Giles, R.V, Fluid Mechanics and Hydraulics, 2nd Edition Schaum's Outline Series, Mc- Graw- Hill, 1994

SHIP MANUFACTURING PROCESS
ENMR605013
2 credits
Learning Outcome(s):

This course aims to study the ship manufacturing process in general, the process of forming and shaping, the manufacturing of ship's plate, and the machining process.

Topic:

Ship manufacturing process (ship planning & Mouldloft, Sand Blasting & Primer Coating, Keel Lay- ing, Fabrication, Assembly, Erection, Outfitting, Painting, Leakage Test, Launching, Sea Trial, De- livery), Forming and shaping process (Rolling, Forging, Extrusion, Sheet Metal Forming), Manufac- turing of ship's plate (surface roughness, surface treatment, surface coating, surface cleaning), Machining process (machining fundamentals, turning, milling, broaching, sawing, & filing)

Pre-requisite(s): -

References:

Kalpakjian S., Manufacture Engineering and Technology, Pearson Springer, 2009

WELDING ENGINEERING
ENMR605014
2 credits
Learning Outcome(s):
This course aims to study basic knowledges in welding, joining, cutting. Students are expected to achieve the basic competences of welding engineering.

Topic:
Basic knowledge of welding, joining and cutting (Oxy -gas welding dan SMAW, GTAW dan GMAW, SAW, FCAW and friction welding, types of cutting, Brazing, soldering and joining), terminologies and definitions, welding design and its calculations (Weld joint, non destructive test, and destructive test, Heat treatment of base materials and welded joints)

Pre-requisite(s): -

References:
1. Harsono W., T. Okumura, Teknologi Pengelasan Logam, PT Pradnya Paramita Jakarta Cetakan ke-10, 2008.
2. American Welding Society, AWS D1.1ID1.1M:2004, Structural Welding Code - Steel, 19thedi-

SHIP POWER GENERATION
ENMR606020
2 credits
Learning Outcome(s):

Students can understand the principles of power system of the ship, including the current and the future trends.

Topic:

The need for ship power system, current and future trends (fossil fuel, carbon emission, interna- tional regulations, system and consumption of ship energy, efficiency management of ship energy), conventional power system (diesel and biofuel, LNG and CNG, dual-fuel, gas turbine), non- con- ventional power system (nuclear energy, wind energy, solar energy, Organic Rankine Cycle (ORC)), system of electric ship (principles of electric ship, types of electric ship application, hybrid ship)

Pre-requisite(s): Thermofluids

References:
1. K.C. Weston, Energy Conversion, PWS Publisher
2. D.Y. Goswani, F. Kreith, Energy Conversion, CRC Press
3. A.W. Culp, Principle of Energy Conversion, McGraw-Hill

SHIP MACHINERY AND EQUIPMENT
ENMR606018
2 credits
Learning Outcome(s):

Understanding of theory, system, and working principle of ship equipment

Topic:

Anchoring and mooring equipment supplies; loading and unloading equipment; Water-tight win- dows and doors; Ventilation Equipment: Safety Equipment: Equipment Navigation and Communi- cations; Firefighting Equipment: Equipment Ship Steering; Oil Separator Equipment: Pumps and System Installation.

Pre-requisite(s): -

References:
1. H. McGeorge, Marine Auxiliary Machinery, Butterworth Heinemann, 2001.
2. D.A. Taylor, Introduction to Marine Engineering, Butterworth Heinemann, 1996

SHIP DESIGN ASSIGNMENT 3
ENMR600003
3 credits
Learning Outcome(s):

Understanding of calculation and monitoring of ship engine design

Topic:

Engine and tools selection (auxilary engine); electrical load balance; Detailed drawings; Design of Ship Engine Room Layout; transmission system, reduction gear and shafting; Construction of a propeller and propeller maching; ship piping systems for engine and hull; fire extinguishing sys- tem; steering system; ventilation system; calculation, selection and layout of the marine cable; load analysis and design one-line diagram of electrical & Wiring Diagram instalasi including lighting vessels and equipment. Bilga system design and Engine Room Bilga System (Oily-Water Bilge Sys- tem); Design System Reply: Fire System Design: Design of Fuel System: Engine Lubrication System Design: Design of Engine Cooling System: Air Pressure System Design; Domestic Fresh Water System Design Air & Sea; Sanitary Disposal System Design: the design of loading and unloading systems; Ship Electrical Load Analysis: Calculation and selection of the number and capacity of Genset & Shore Connection: the calculation and selection of battery capacity; List Equipment Code

Pre-requisite(s): Ship Design Assignment 2

References:
1. B. Baxter, Teach Yourse[f Nava[Architecture, The English Universities Press. Signifi cant Ships, RINA
2. M.A Talahatu, Teori Merancang Kapal. FTUI 1998.

SHIP SURVEY AND INSPECTION
ENMR607023
4 credits
Learning Outcome(s):

Understanding of types of class survey, statutory approval and ship operation

Topic:

Statutory survey; Class survey; Hull survey; Loadline survey, Inclining experiment; Damage survey; Machinery Installations survey; Electrical & Genset survey; Seatrial procedure.

Pre-requisite(s): -

References:
1. D. Benkovsky, Technology of ship repairing, MIR Publisher.
2. Piero Caridis, Inspection, Repair, and Maintenance of Ship Structures, Witherby & Co.Ltd, 2001
3. Shields S., et.al, Ship Maintenance : A Quantitative Approach, IMARES, 1996
4. Biro Klasifikasi Indonesia
5. Lloyd's Register Rules and Regulations

SHIP ELECTRICAL SYSTEM
ENMR605015
3 credits
Learning Outcome(s):

Understanding of the principles, operations, and applications of electronic systems of ships

Topic:

Basic of electronics: Passive Components: Semiconductors: Electronic Components; Digital Sys- tems; Digital Combinational circuit; Digital Sequential circuit; PLC; Electronics Simple Plan; basic theory of DC circuit: basic theory of AC electrical circuits, working principle of DC motors, Types of MDC; operation of the MDC, the working principle of AC Motor, Various kinds of MAC, MAC opera- tion: principle of generator, voltage drop generator; generator no-load and under load; Parallel generator; Introduction of the application on ship; Electric propulsion and PTO.

Pre-requisite(s): Electrical System of Ships

References:
1. John Bird, Electrical & Electronic Principle and Technology. Jhon Bird.2003
2. John C Payne, The Marine Electronical & Electronics Bible, John Pyne.1993

SHIP MAINTENANCE AND REPAIR
ENMR606021
2 credits
Learning Outcome(s):

Students are able to understand the maintenance and control of ship's engine system.

Topic:

Introduction to reliability system, reliability Fundamental Review of the concept, simple system Network Modelling, Network Modelling System, Introduction to Markov and Monte Carlo Simula- tion, Discrete Markov Chains and Markov

Continuous Process. Public Review: Economic and Reli- ability, Maintenance Strategy. Functions of Manual Maintenance; Parts List and Stock; Preparation of Schedule Maintenance: Maintenance Document Preparation; Engine Room Maintenance, Main- tenance of Inventory: The Role of Engine Builders Tips andTools: Spare-Parts.

Pre-requisite(s): -Engine Room Layout Design, Ship Manufacturing Process

References:

1. D. Benkovsky, Technology of ship repairing, MIR Publisher.
2. Piero Caridis, Inspection, Repair, and Maintenance of Ship Structures, Witherby & Co.Ltd, 2001
3. Shields S., et.al, Ship Maintenance : A Quantitative Approach, IMARES, 1996

SHIP FINANCING AND INSURANCE
ENMR605012
2 credits
Learning Outcome(s):

Students are able to understand the concepts of ship investment financing and maritime insurance as one of the ways of controlling risk and the concept of financing and maritime investment feasibility.

Topic:

Pembiayaan investasi maritime; analisis model pembiayaan; kelayakan investasi suatu projek; asuransi dibidang maritim;

Pre-requisite(s): -

References:

The International Handbook of Shipping Finance: Theory and Practice 1st ed. 2016 Edition by Manolis G. Kavussanos (Editor), Ilias D. Visvikis (Editor)

HEALTH, SAFETY AND ENVIRONMENT
ENGE600012
2 credits
Learning Outcome(s):

Understanding the importance of Occupational Health and Safety and Environmental Protection (K3LL), understanding K3LL regulations and legislation, understanding K3LL management systems, understanding the risks and prevention of work accidents, understanding toxic and dangerous objects and materials and their handling, understanding K3LL tools .

Topic: :
K3LL introduction, K3LL regulations and legislation, K3LL management system, Occupational risk and accident prevention, Toxic and dangerous substances and their handling and handling, K3LL tools

Prerequisite(s): -

References:

Environmental, Safety, and Health Engineering, Gayle Woodside and Dianna Kocurek, Wiley, 2008

Additional eferences:
1. George B. Thomas Jr., Thomas' Calculus Early Transcendental, 12th ed., Addison–Wesley Pearson, 2009.
2. Howard Anton, Calculus, 10th ed., John Wiley and Sons, 2012.

Special Subjects

SEMINAR
ENME600004
1 credits
Learning Objective(s):

Student can communicate in verbal or written with final project pjroposal; able to formulate the problems and objectives of the research, conduct theoretical review to formulate the hypothesis, design the research method for empirical proof and present the preliminary result to the supervisor

Topic:

Problem description, basic concept of research with assumption and constraint; making prelimi- nary report, conducting the preparation, literature review and research methodology; present final report with structured report, language, graphical presentation, table etc, reference and clarity.

Pre-requisite(s): Passed 110 CREDITS and GPA > 2.00 without Grade E

References: -

ON THE JOB TRAINING
ENME600003
2 credits
Learning Objective(s):

The course is intended to provide opportunity for gaining experience in industries and applying mechanical engineering knowledge. Able to perform management tacredits and engineering technique according to field of interest.

Topic:
Management and Engineering according to the field of interest. Presentation of internship results and report

Prerequisite(s): Passed 95 CREDITS and GPA > 2.00

FINAL PROJECT
ENME600005
5 credits
Learning Objective(s):

Students are able to conduct design and analysis the object of system that related to the mechani- cal engineering field

Topic:

Synthesizing various lectures taken by students to design or to solve engineering problems. Preparing a written report of the synthesis.

Prerequisite(s): Passed 128 CREDITS and GPA > 2.00 without Grade E

Electives Subjects

MARINE AND OFFSHORE STRUCTURE
ENME803183
4 credits
Learning Objective(s):

Provide the knowledge, understanding of the theory and principles of building offshore include the type, function, and offshore construction technology and techniques in performing design structure.

Topic:

Types of Offshore; Construction and Offshore Structures; Calculation of Style and Power Offshore: Safety Requirements; Construction Semi-submersible; Single Buoy Mooring; FPSO;

Offshore Main- tenance and Repair.

Prerequisite(s): -

References:
1. Cliff Gerwick, Construction of Marine and Off-shore Structures, CRC Press 1999
2. Subrata Chakrabarti, Handbook of Offshore Engineering, Elsevier Science, 2005
3. Yong Bai, Marine Structural Design, Elsevier Science, 2003

MARITIME LAW AND REGULATION
ENME803185
4 credits
Learning Objective(s):

Provide knowledge and understanding of the laws and regulations on maritime activities both nationally and internationally.

Topic:

Introduction of maritime law; Regulation of Marine Pollution Prevention and Control; SOLAS; Pre- vention of Collisions Regulations; ISM Code; Statutory Rules; Passenger Ship Regulations; Tanker Regulations; Offshore Regulations: Accident Rescue Regulations; Other IMO rules. Accident preven- tion regulations; Risk assessment and analysis.

Pre-requisite(s): -

References:
1. International Convention for the Prevention of Pollution From Ships (MARPOL), International Maritime Organisation Publications
2. International Regulations for Preventing Collisions at Sea (COLREG), International Maritime Organisation Publications
3. International Convention for the Safety of Life at Sea (SOLAS), International Maritime Organ- isation Publications
4. International Safety Management Code (ISM Code) Guide Book, International Maritime Organ- isation Publications
5. Churchil R.R. dan Lowe A.V, The Law of the Sea, MUP 1999

SUPPLY CHAIN TECHNOLOGY
ENME804192
4 credits
Learning Objective(s):

Provides the knowledge and understanding of various management approaches, maritime trans- port and port activities which also include risk factors, safety, and economy.

Topic:

Sea Transport Demand Trend: Marine Transportation Market Research; Inter Mode Transport Sys- tem; System loading and unloading, Types of Sea Transport, Warehousing and Storage Cargo Sys- tems, SystemsAgency, Survey Charge, Corporate Sailing economic calculation, Customs.

Pre-requisite(s): -

References:
1. P. Lorange, Shipping Management, Institution for shipping Research.
2. Patrick Alderton, Reeds Sea Transport : Operation and Management, Adlard Coles, 2008
3. Patrick Alderton, Port Management and Operations,Informa Business Publishing, 2005
4. Svein Kristiansen, Maritime Transportation : Safety management and Risk analysis, Butter- worth-Heinemann, 2004
5. M. Stopford, Maritime Economics, Routledge, 1997
6. House, D.J, Cargo Work for Maritime Operation, Butterworth Heinemann, 2005

CARGO COOLING TECHNOLOGY
ENME804193
4 credits
Learning Objective(s):
Providing knowledge and understanding in the use of cooling and air conditioning equipment circulation technology; cold storage and low temperature logistics.

Topic:
Basic principles for estimating cold storage loads, calculation of cooling capacity for various types of cold storage, and other topics of evaporative cooling, principles for designing low-cost refrigeration bases.

Pre-requisite(s): -

References:
Rao, C.G. Engineering for Storage of Fruits and Vegetables: Cold Storage, Controlled Atmosphere Storage, Modified Atmosphere Storage. Academic Press, 2015, ISBN: 0128033657,9780128033654

SEA AND PORT TRANSPORTATION MANAGEMENT
ENME803184
4 credits
Learning Objective(s) :

Provides knowledge and understanding of various management approaches sea transportation and port activities which also include risk factors, safety, and economy.

Topic :

Sea Transportation Demand Trends; Sea Transportation Market Research; Inter Mode Transportation System; Port Loading and Unloading Systems, Determination of Sea Transportation Types, Cargo Storage and Warehousing Systems, Agency Systems, Cargo Surveys, Shipping Company Economic Calculations, Customs.

Pre-requisite(s): -

References:
1. P. Lorange, Shipping Management, Institution for shipping Research.
2. Patrick Alderton, Reeds Sea Transport : Operation and Management, Adlard Coles, 2008
3. Patrick Alderton, Port Management and Operations,Informa Business Publishing, 2005
4. Svein Kristiansen, Maritime Transportation : Safety management and Risk analysis,
5. Butterworth-Heinemann, 2004
6. M. Stopford, Maritime Economics, Routledge, 1997
7. House, D.J, Cargo Work for Maritime Operation, Butterworth Heinemann, 2005

INTERNSHIP A
ENME601108
3 credits
Learning Outcome(s):
Students gain insight and experience activities in industry and the work experiences related to non-engineering aspects.

Topic:
Special topics in the non-engineering industrial sector that have not been covered in other subjects.

Pre-requisite(s): Have undergone a minimum of 4 semesters of lectures, or have obtained a minimum of 72 credits with a GPA> 2.0. Activities carried out by monitoring and evaluation by the Internship Coordinator.

References: -

SPECIAL TOPIC 1

ENME601104
4 credits
Learning Outcome(s):
Students gain insight and experience of activities in national / international competitions, or community, or entrepreneurship, or industry and the work experiences.

Topic:
Special topics in fields that have not been covered in other subjects.

Pre-requisite(s): Have undergone at least 2 semesters of lectures, or have obtained a minimum of 36 credits with a GPA> 2.0. Activities carried out by monitoring and evaluation by the Special Topic Subject Coordinator.

References: -

SPECIAL TOPIC 2

ENME601105
4 credits
Learning Outcome(s):
Students gain insight and experience of activities in national / international competitions, or community, or entrepreneurship, or industry and the work experiences.

Topic:
Special topics in fields that have not been covered in other subjects.

Pre-requisite(s): Have undergone at least 2 semesters of lectures, or have obtained a minimum of 36 credits with a GPA> 2.0. Activities carried out by monitoring and evaluation by the Special Topic Subject Coordinator.

References: -

ADVANCED ENGINEERING MATHEMATICS

ENME802002
2 credits
Learning Outcome(s):

The purpose of this subject is to develop students' analytical skills. Students understand and are able to use advanced engineering mathematical concepts in solving applied engineering problems.

Topic:

Introduction to Differential Equations; Differential Equation Order 1; Differential Equation of Order 2; High Order Differential Equations; Vector Analysis; Differential Vector; Grad, Divergence and Curl Operations; Vector Integral; Laplace transform; Solving Differential Equations using Laplace Transform; Fourier transform; Convolution

Pre-requisite(s): -

References:

1. Chapra, Steven C. and Canale, Raymond P. Numerical Methods for Engineers 6th edition. New York: McGraw-Hill, 2010.
2. Kreyszig, Erwin. Advanced Engineering Mathematics 10th edition. Danvers: John Wiley & Sons, 2011.
3. Sedgewick R., Phillippe F, An Introduction to the Analysis of Algorithms, Addison Wesley.
4. Cheney W., Kincaid D., Numerical Mathematics and Computing, Cole Publishing

ENGINEERING COMPUTATION

ENME802004
2 credits
Learning Outcome(s):

The purpose of this subject is that students know well and be able to apply the processes and methods (algorithms) of calculation (numerical and analytic) engineering in the real computer-based computing world and parameters that affect the speed and accuracy of the calculation results.

Topic:

Numerical Method: Equation roots, Numerical Diffential, Numerical Integral; Partial Differential Equation Solution. Introduction to Computer Applications: Algorithms and Algorithm Analysis; Computational Complexity; Types of Algorithms; Number Optimization and Representation; Overflow and Underflow; Error and Formula Error in Numerical; Root of Eq. Finite Divided Difference Method in calculating Equation Derivation; Numerical Integration; ODE and ODE systems in Computing Applications; Fast Fourier Transform; PDE in Computational Applications: Solutions of Elliptic, Parabolic, and Hyperbolic Equations with Numerical Methods; Application of Elliptic, Parabolic, and Hyperbolic PDE equation techniques; Monte Carlo in Computing Applications.

Pre-requisite(s): -

References:

1. Chapra, Steven C. and Canale, Raymond P. Numerical Methods for Engineers 6th edition. New York: McGraw-Hill, 2010.
2. Kreyszig, Erwin. Advanced Engineering Mathematics 10th edition. Danvers: John Wiley & Sons, 2011.
3. Sedgewick R., Phillippe F, An Introduction to the Analysis of Algorithms, Addison Wesley.
4. Cheney W., Kincaid D., Numerical Mathematics and Computing, Cole Publishing

ADVANCED FLUID DYNAMICS AND HEAT TRANSFER

ENME801102
4 credits
Learning Outcome(s):

Enhance the ability of students in the study of fluid mechanics in more detail so as to conduct research or the application of science in industrial applications. Studying the mechanism of heat transfer in a control volume due to the existence of the temperature difference and concentration as well as the involvement of one, two or three phases at the tim simultaneously.

Topic:

Viscous flow of Newtonian fluid, membrane boundary flow, Non-Newtonian Fluid Flow, Two-Multi Phase Flow, Particle Displacement Flow, Porous Media and Fluidized Beds, Turbulent Flow and Mixing, Jet, Chimney, Energy and Momentum Equatio, one-two-three dimension conduction heat transfer, heat transfer on extended surface.

Pre-requisite(s): -

References:

1. Frank P Incropere, David P De Witt, Fundamental heat and mass transfer, 5th Ed., John Wiley & Sons, 1996, New York
2. Holman JP, Heat Transfer, 9th, Mc Graw Hill, 2003.
3. Koestoer, RA, Perpindahan Kalor untuk Mahasiswa

Teknik, Salemba Teknika, 2003.

4. Welty R James, Wicks Charless, Wilson Robert, Fundamentals of Momentum, Heat, and Mass Transfer, 3rd Ed. John Wiley & Sons, 1996, New York
5. Cengel, Yunus, Heat Transfer a Practical Approach, 2nd Ed. Mc Graw Hill, 2003, Singapore.
6. Kreith Frank, Bohn Mark, Principles of Heat Transfer, 6th Ed. Brooks/cole, 2001, USA
7. Abbott I R, Theory of Wing Section, Dover Publications.
8. Bird R B, Transport Phenomena, John Wiley & Sons.

MATERIAL AND MANUFACTURING PROCESSES

ENME801140
4 credits
Learning Outcome(s):

The course provides understanding and basic competence of theory, application method and product manufacturing processes that covers: working principle, process characteristics, process limitations, work and force due to the process, parameters that affects to the process and the relation of material with the process that needed for certain process.

Topic:

Manufacturing Process and Production Systems; Materials in Manufacturing; Theory and Method of Casting Processes; Theory and Method of Bulk Deformation Processes; Theory and Method of Metal Forming Processes; Theory and Method of Powder Metalurgy Processes; Theory and Method of Material Machining/ Cutting Processes; Theory and Method for Enhancing Manufactured Surface Quality; Theory and Method of Joining Processes; Theory and Method of Prototyping; Engineering Material Characteristics; The Relation between Process Characteristics and Material Characteristics; The Parameter Control of Process for Material; Assignment in Manufacturing Process and Material Selection for Market Needs.

Pre-requisite(s): -

References:

1. Michael Ashby dan Kara Jhonson, Materials and Design: Arts and science in material selection in product design,Butterowrth-Heinemann, 2002
2. Michael Ashby, Material selection in Mechanical Design, Butterworrth Heinneman,2005
3. John A. Schey, Introduction to Manufacturing Processes, McGraw-Hill, 1999
4. Degarmo, E. Paul, Materials and Processes in Manufacturing, Prentice Hall Int. Inc, 8th edition, 2005

SPECIAL SHIP PROJECT

ENME804186
4 credits
Learning Outcome(s):

Provide the knowledge, understanding of ship design for special purposes.

Topic:

Typology and special ship purposes; Material to special Ship, Design Considerations; Calculation of loading; Calculation of Ship Quantities; Computation Structures: Propulsion Systems; Motion System; Safety and Navigation System; Stability Calculation.

Pre-requisite(s): -

References:

1. Lars Larsson dan Rolf Eliasson, Principles of Yacht Design, International MarineIRagged Moun- tain Press, 2007
2. Dave Gerr, The Elements of Boats Strength, International MarineIRagged Mountain Press, 1999
3. Norman L. Skene, dan Marnard Bray, Elements of Yacht Design, Sheridan house, 2001
4. Steve Killing dan Doug Hunter, Yacht Design Explained : A Sailors Guide to the Principles and Practices of Design, W.W Norton and Company, 1998
5. S. Sleight, Modern Boat Building, Conway Maritime Press.

SHIP PRODUCTION OPTIMIZATION

ENME804187
4 credits
Learning Outcome(s):

Provides knowledge and understanding of the various shipyard management and technique.

Topic:

Shipyard Layout; Ship Process Production; Steel Stock Yard Planning; Crane Calculation: Jamo- rang Calculation At Each Stage Production: Make Work Schedule: Work Break Down Structure; Integrated Hull Outfitting and Painting; Advanced Outfiting; Group Technology Methods for Ship Production; Ship launching; Ship trials.

Pre-requisite(s): -

References:

1. D.J. Eyres, Ship Construction, Butterworth- Heinemann, 2007
2. R.Shenoi, Ship Production Technology, Univ. Of Southampton.
3. National Research Council, Shipbuilding Technology and Education, National Academy Press, 1996

MARITIME SAFETY

ENME804189
4 credits

Learning Outcome(s):

Provides knowledge and understanding of maritime safety through regulations, management and development of maritime transportation technology.

Topic:

SOLAS: general provision, construction, safety equipment, communication radio, safety naviga- tion, freight, management for ship safety, MARPOL Annex I-V, maritime safety, threats from mari- time trading, threats from shipping, evolution of maritime safety, implementation of ISPS code, safety planning.

Pre-requisite(s): -

References:

1. Jones. S. Maritime Security: A practical Guide, the nautical institute 2012
2. Consolidate Edition, MARPOL, International Maritime Organization, 2006
3. Consolidate Edition, SOLAS, International Maritime Organization, 2004

ADVANCED WELDING ENGINEERING

ENME804190
4 credits
Learning Outcome(s):

Provide knowledge, understanding of the theories, principles and design as well as the assessment of the quality of welding and welding applications.

Topic:

Introduction, review of welding term and definition, welding process type, standard power source, Oxy-gas welding, Shield Metal Arc Welding (SMAW), Gas Tungsten Arc Welding (GTAW), Gas Metal Arc Welding (GMAW), Submerged Arc Welding (SAW), Flux Cored Arc Welding (FCAW), Resistance welding, Friction Stir Welding, Other welding process: laser, electron beam, plasma, Cutting and other edge preparation processes, surfacing and spraying, Brazing and soldering, Joining processes for plastics, ceramics and composites, Welding metal: Ferrous-based metal, non-ferrous-based metal, Material behavior during welding process, Testing materials and the weld joint, Non De- structive Examination (NDE), DT (Destructive Test), Heat treatment of base materials and welded joints, Basic of welding design, Residual stresses and distortion, Welding Symbol, Behavior of welded structures under different types of loading, Design of welded structures under static and dynamic loading, welding defects, Design of welded pressure equipment, Welding Performance Qualification Record (WPQR), Welding Procedure Specification (WPS), Welding automation.

Pre-requisite(s): -

References:

1. Sindo Kou, Welding Metallurgy, 2nd Edition, Wiley, 2002.
2. ASME Section IX, Welding and Brazing Qualifications
3. AWS D1.1., Structural Welding (Steel)
4. William A. Bowditch, Welding Fundamentals 5th Edition, Goodheart-Willcox, 2011.
5. Technical Manual TM 5-805-7. Welding Design, Procedures and Inspection Headquarters.
6. Lloyds Register. Welding Procedures, Inspections and Qualifications.

PORT PLANNING AND OPERATIONS

ENME804191
4 credits
Learning Outcome(s):

Port Planning and Operations is a lecture that emphasizes the process of planning the layout and operation of ports in accordance with commodities managed based on the principle of green-port development.

Topic:

Sea transportation: Facilities and commodities, Port functions in maritime transportation, types of ports and sea terminals, stages in port planning, principles of integrated port planning, planning and design of port water areas., Conventional general cargo terminals, Container terminals, Oil & liquid gas terminals, Dry bulk cargo terminals, Green port developments, Conventional general cargo terminals, Container terminals, Oil & liquid gas terminals, Dry bulk cargo terminals, Green port developments.

Pre-requisite(s): -

References:

1. Ligteringen, (1999), Ports and Terminals, Faculty of Civil Engineering and Geosciences Department of Hydraulic and Geotechnic Engineering Section Hydraulic Engineering, Technische Universiteit Delft.
2. Velsink, H., (1994), Ports and Terminals: Planning and Functional Design, Faculty of Civil Engineering Hydraulic Engineering Group, Delft University of Technology.
3. Bose, J.W., (2011), Handbook of Terminal Planning, Springer-Verlag New York

ENERGY SYSTEM OPTIMIZATION

ENME802103
4 credits
Learning Outcome(s):

This course provides an understanding of mathematical modeling, simulation and optimization of energy systems through technical and economical approach. The course is intended to equip student with the ability to understand mathematical model, simulation and optimization of thermal systems.

Topic:

Workable System Design; Economical Evaluation; Determination of Mathematical Equations; Thermal Equipment Modeling; System Simulation; System Optimization: Objective Function, Constraints; Lagrange Multipliers: Lagrange multiplier to complete the optimiza- tion process; Dynamics, Geometric and Linear Programming; Mathematical Model of Thermodynamics Properties; Big System Simulation under Steady Condition; Big Thermal System Simulation; Calculation of Variables in Optimum Conditions.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanics

References:

1. Stoecker, W.F. Design of Thermal System, 3rd Edition, Mc.Graw Hill Book Co, 2011.
2. Boehm,R.F., Design of Analysis of Thermal System, John Wiley&Sons,1987.
3. Yogesh Jaluria, Design and Optimization of Thermal Systems, 2nd Edition, Mc.Graw Hill Book Co, 2007.

SHIP AIR CONDITIONING AND REFRIGERATION SYSTEM

ENMR607022
4 credits
Learning Outcome(s):

Students are able to analyze the design of air conditioning and refrigeration system on the ship

Topic:

Basic principles of refrigeration and air conditioning processes. Diagrams Psikrometri, ducting system design, heating system design, ventilation system design, system design of air conditioning and refrigeration, technical specifications and troubleshooting, ISO standards and the Class

Pre-requisite(s): -

References:

1. James Harbach, Marine Refrigeration and Air Conditioning, Cornell Maritime Press, 2005
2. N. Larsen, Marine Air Conditioning Plant, Butterworth-Heinemann, 2001
3. Jones W.P., Air Conditioning Engineering, Butterworth-Heinemann, 2001

INTERNSHIP B

ENME601109
3 credits
Learning Outcome(s):

Students gain insight and experience activities in industry and the work experiences related to non-engineering aspects.

Topic:

Special topics in the non-engineering industrial sector that have not been covered in other subjects.

Pre-requisite(s): Have undergone a minimum of 4 semesters of lectures, or have obtained a minimum of 72 credits with a

GPA> 2.0. Activities carried out by monitoring and evaluation by the Internship Coordinator.

References: -

SPECIAL TOPIC 3
ENME601106
4 credits
Learning Outcome(s):

Students gain insight and experience of activities in national / international competitions, or community, or entrepreneurship, or industry and the work experiences.

Topic:

Special topics in fields that have not been covered in other subjects.

Pre-requisite(s): Have undergone at least 2 semesters of lectures, or have obtained a minimum of 36 credits with a GPA> 2.0. Activities carried out by monitoring and evaluation by the Special Topic Subject Coordinator.

References: -

SPECIAL TOPIC 4
ENME601107
4 credits
Learning Outcome(s):

Students gain insight and experience of activities in national / international competitions, or community, or entrepreneurship, or industry and the work experiences.

Topic:

Special topics in fields that have not been covered in other subjects.

Pre-requisite(s): Have undergone at least 2 semesters of lectures, or have obtained a minimum of 36 credits with a GPA> 2.0. Activities carried out by monitoring and evaluation by the Special Topic Subject Coordinator.

References: -

EXPERIMENTAL DESIGN
ENME802003
4 credits
Learning Outcome(s):

This course provides knowledge about the methods of planning, implementing and reporting research in the field of engineering so that it is able to apply standard scientific principles in the preparation of the final project in particular as well as in a scientific work that results from research in general. Through this subject, students are expected to be able to manage a study that starts from the planning stage, correctly applies the design and construction procedures of the apparatus, and applies instrumentation and measurement systems, executes and analyzes and interprets the data with appropriate statistical rules. In addition, students are also expected to be able to write scientific texts with good techniques, be able to make a bibliography correctly, find the right reference sources.

Topic:

Introduction: Introduction to Research Design; Approaches to Solving Problems (Problem Solving Approaches); Research Project Planning; Design and Application of Measurement Systems: Measuring System Functional Elements, Measurement System Performance Characteristics, System Accuracy (Uncertainty) Analysis; Design and Construction of Research Apparatus; Experimental Planning; Experiment Execution: Apparatus construction, Debugging apparatus, Datasheet and Logbooks; Data Analysis and Interpretation; Communication Engineering: Principles of Communication of Raw Engineering, Reports, Papers, and Research Results Articles. Introduction to Academic Writing; Rhetoric Analysis on Scientific Manuscripts, Critical Behavior and Arguments on Academic Writing, Techniques for Writing Scientific Manuscripts, Writing Scientific Manuscripts, Peer Review and Revision of Scientific Manuscripts, Finding Sources of Scientific References, Synthesis of Scientific Manuscripts, Delivering papers as a result of learning this course.

Pre-requisite(s): -

References:

1. Montgomery, D.C., Design and Analysis of Experiments, (5th ed.), John Wiley and Sons, Inc., New York, 2001
2. Coleman, H.W., Steele, G.W.Jr., Experimentation and Uncertainty Analysis for Engineers, (2nd ed.), John Wiley and Sons, Inc., New York, 1999
3. Doebelin, E.O., Engineering Experimentation: Planning, Execution, Reporting, McGraw-Hill, Inc., New York, 1995
4. Kirkup, Les., Experimental Method: An Introduction to the Analysis and Presentation of Data, John Wiley and Sons Australia, Ltd., Queensland, 1994
5. Lipson, C, Sheth, N.J., Statistical Design and Analysis of Engineering Experiments, Mc-Graw Hill Kogakusha, Ltd., Tokyo, 1973
6. Ross, V. A Brief Guide to Critical Writing. Philadelphia, PA : Critical Writing Program. 2015.
7. Graff, G., Birkenstein, C. As He Himself Puts It : The Art of Quoting "They Say / I Say" : The Moves That Matter in Academic Writing. New York. 2006
8. Rheingold, H. Net Smart : How To Thrive Online. Cambridge, Mass : MIT Press. 2012.

DATA ANALYTICS
ENME802006
2 credits
Learning Outcome(s):

Know how to identify, collect, and test multivariate data before conducting analysis. Can distinguish statistical analysis techniques available and determine which is most suitable for a particular purpose. Use appropriate techniques in analyzing data and in obtaining statistical summary results to help make management decisions. Verifying the results of the analysis with assumptions that will be considered in the analysis. Apply a variety of techniques to real data sequences using computer applications (eg MS Excel, Origin, Matlab, Tableau) and present the results in appropriate reports that are easily understood by non-statists.

Topic:

Review statistics and probabilities, Factor and Component Design experiments, multiple samples and estimates, Analysis of variance, models and diagnoses, Stepwise and Discriminant Regression, Canonical and Conjoining Analysis, and Non-parametric Statistics.

Pre-requisite(s): -

References:

1. A Modern Introduction to Probability and Statistics: Understanding Why and How by Dekking, Kraaikamp, Lopuhaa, and Meester.
2. Montgomery, D. C., & Runger, G. C. (2010). Applied

statistics and probability for engineers. John Wiley & Sons.

3. Härdle, W., A. Werwatz, M. Müller, and S. Sperlich (2004). Nonparametric and Semiparametric Models. Springer.
4. Cox, T. F. (2005). An introduction to multivariate data analysis. London: Hodder Arnold.
5. Hair, Black, Babin, Anderson, and Tatham. Multivariate Data Analysis, 6th Edition. Prentice Hall.

MARITIME ENGINEERING AND MANAGEMENT

ENME802181
4 credits
Learning Outcome(s):

This course provides knowledge about technologies for ocean transportation and the application of ocean-based energy sources. This course also aims to equip students with understanding of maritime opportunities that can be developed with the use of technology.

Topic:

Classification of ship based on its function, aspects to consider in ship designing, history of development of off-shore structure, ocean environment, typesof off-shore structure: fixed design and floating design, mooring and anchoring system, force calculation of off-shore structure, FPSO

Pre-requisite(s): -

References:

1. Research Council National Research Council, NEW Mining in the Outer Continental Shelf and in the Deep Ocean, University Press of the Pacific, 2005
2. Arthur H. Johnson, Michael D. Max, William P. Dillon, Natural Gas Hydrate - Arctic Ocean Deepwater Resource Potential, Springer, 2013
3. Khaligh, Alireza and Onar, Omer C., Energy Harvesting: Solar, Wind, and Ocean Energy Conversion Systems, CRC Pr I Llc, 2009

OCEAN ENERGY

ENME803182
4 credits
Learning Outcome(s):

This course provides knowledge about technologies and principles related to the design of renewable ocean energy system

Topic:

Introduction to renewable ocean energy, introduction to wind turbine, tidal system and tidal energy system, OTEC, ocean flows, methods of economic/financial assessment for off-shore renewable energy system, wind energy, momentum theory and the limit of wind power output, tidal flow and its conversion to mechanical energy, description of wave energy sources, instruments of wave energy and instruments for simulation.

Pre-requisite(s): -

References:

1. Twidell, J. and Weir, T., "Renewable Energy Resources. Second Edition", Taylor and Francis Group, 2006.
2. Boyle, G., "Renewable energy power for a sustainable future, Second Edition", Oxford University Press, 2005.
3. Walker J and Jenkins N, "Wind Energy Technology", Wiley Unesco Energy Engineering Series, 1997.
4. Manwell JF, McGowan, JG and Rogers, AL., "Wind Energy explained: Theory, Design and Application", Wiley. 2nd Edition. ISBN0-470-01500-4, 2010
5. Cruz, J., "Ocean Wave Energy: Current Status and Future Perspectives", Springer-Berlin, 2007.
6. Falnes, J., "Ocean Waves and Oscillating Systems: Linear Interactions Including Wave-Energy Extraction", Cambridge University Press, Cambridge, 2002.
7. Baker AC, "Tidal Power", Peter Peregrinus Ltd, 1981.

Bahan Kajian on Naval Architecture And Marine Engineering

Bahan Kajian	Code	Subjects	Credits
Ship Design	ENME803183	Offshore Building	4
	ENME804186	Special Ship	4
	ENME804187	Ship Production Optimization	4
	ENME804190	Advanced Welding Engineering	4
	ENME804189	Marine Safety	4
Ship System	ENME804193	Cargo Cooling Technology	4
	ENMR607022	Ship Air Conditioning and Refrigeration	4
Sea Transportation System	ENME804192	Supply Chain Technology	4
	ENME804191	Port Operational and Planning	4
	ENME803185	Marine Law and Regulation	4

Minor in Naval Architecture and Marine Engineering
Pre-requisite: Mathematics, Physics, Engineering Drawing

Odd Semester			Even Semester		
Code	**Subjects**	**Credits**	**Code**	**Subjects**	**Credits**
Mandatory Subjects, 24 SKS					
ENMR601001	Introduction of Naval Architecture and Marine Engineering	2	ENMR602002	Ship Visualization and Modelling	2
ENMR603004	Ship Building Theory	2	ENMR604009	Ship Resistance and Propulsion	4
ENMR605013	Ship Manufacturing Process	2	ENMR604008	Ship Stucture 2	2
ENMR603005	Ship Stucture 1	2	ENMR604007	Ship Engine	2
ENMR606018	Auxiliary Ship Engine	2	ENMR604010	Ship Hidrodynamics	2
			ENMR607023	Ship Survey and Inspection	2
	Subtotal	10		**Subtotal**	14
Elective (Ship Design and Construction)					
ENME803183	Offshore Building	4	ENME804187	Ship Production Optimization	4
			ENME804186	Special Ship	4
Elective (Ship System)					
ENME804193	Cargo Cooling Technology	4	ENMR607022	Ship Air Conditioning and Refrigeration	4
			ENME803182	Ocean Energy	4
Elective (Ship Transportation)					
ENME803185	Marine Law and Regulation	4	ENME804191	Port Operational and Planning	4
ENME804192	Supply Chain Technology	4			

Undergraduate Program in Electrical Engineering

Program Specification

1.	**Awarding Institution**	Universitas Indonesia Double Degree: Universitas Indonesia and partner university	
2.	**Teaching Institution**	Universitas Indonesia Double Degree: Universitas Indonesia and partner university	
3.	**Faculty**	Engineering	
4.	**Program Title**	Undergraduate Program in Electrical Engineering	
5.	**Vision and Mission**	**Vision** "to become a leading study programme that is able to provide the solutions to the problems and challenges at the national and global level" **Mission** The department has defined its mission to 1. Deliver education based on the concept of good university governance to produce graduates who are knowledgeable, internationally minded, and have an entrepreneurial spirit. 2. Organize facilities, funding, and participation in applied research and new findings that can provide solutions to national and global problems. 3. Apply appropriate sciences and technologies in community service activities that meet the needs of the communities and industries.	
6.	**Class**	Regular, Parallel, International	
7.	**Final Award**	Sarjana Teknik (S.T)	
8.	**Accreditation Status**	BAN-PT: A-accredited and AUN-QA International Assessment	
9.	**Language(s) of Instruction**	Bahasa Indonesia and English for International Class	
10.	**Study Scheme (Full Time / Part Time)**	Full Time	
11,	**Entry Requirements**	High school /equivalent or polytechnic/equivalent and pass the entrance exam	
12.	**Duration for Study**	Designed for 4 years	
	Type of Semester	Number of Semester	Number of weeks / semester
	Regular	8	16
	Short (optional)	3	8
13.	**Aims of the programme:** 1. To produce graduates that will have autonomous professional profile as follows: 2. Become a professional graduate who has technical, managerial, and entrepreneurial skills as well as global insight, and as an active learner who follows the latest developments in science and technology in the field of Electrical Engineering. 3. Become a graduate with character, ethics, and care for the environment.		
14.	**Graduate Profiles:** Engineering Graduates that can analyze and design the systems in the field of Electrical Engineering that can provide solutions to problems in society in accordance with professional ethics.		

15. Expected Learning Outcomes:

Electrical Engineering Graduates are expected to have the following learning outcomes:

1. Able to design components, systems, or processes to meet the need for solutions to technical problems within realistic limits, considering aspects, including legal, economic, environmental, social, political, health and safety, as well as their sustainability potential.
2. Able to plan task units within existing limits as part of the process of completing engineering activities.
3. Able to formulate complex engineering problems, and then apply effective methods and tools to solve them.
4. Able to investigate experimental data designed to solve complex problems.
5. Able to identify the need for lifelong learning, including access to knowledge related to relevant current issues.
6. Able to solve complex problems in the field of electrical engineering by applying modern engineering methods, skills, and tools as well as information technology.
7. Able to apply knowledge of mathematics, physics, information communication technology (ICT) and engineering to solve complex problems in the field of electrical engineering.
8. Able to communicate effectively both orally and in writing.
9. Able to play an effective role in a multi-disciplinary team, with integrity, critical thinking, creative, innovative to achieve individual and collective goals.
10. Able to be responsible to the community and fulfill professional ethics in carrying out engineering activities.

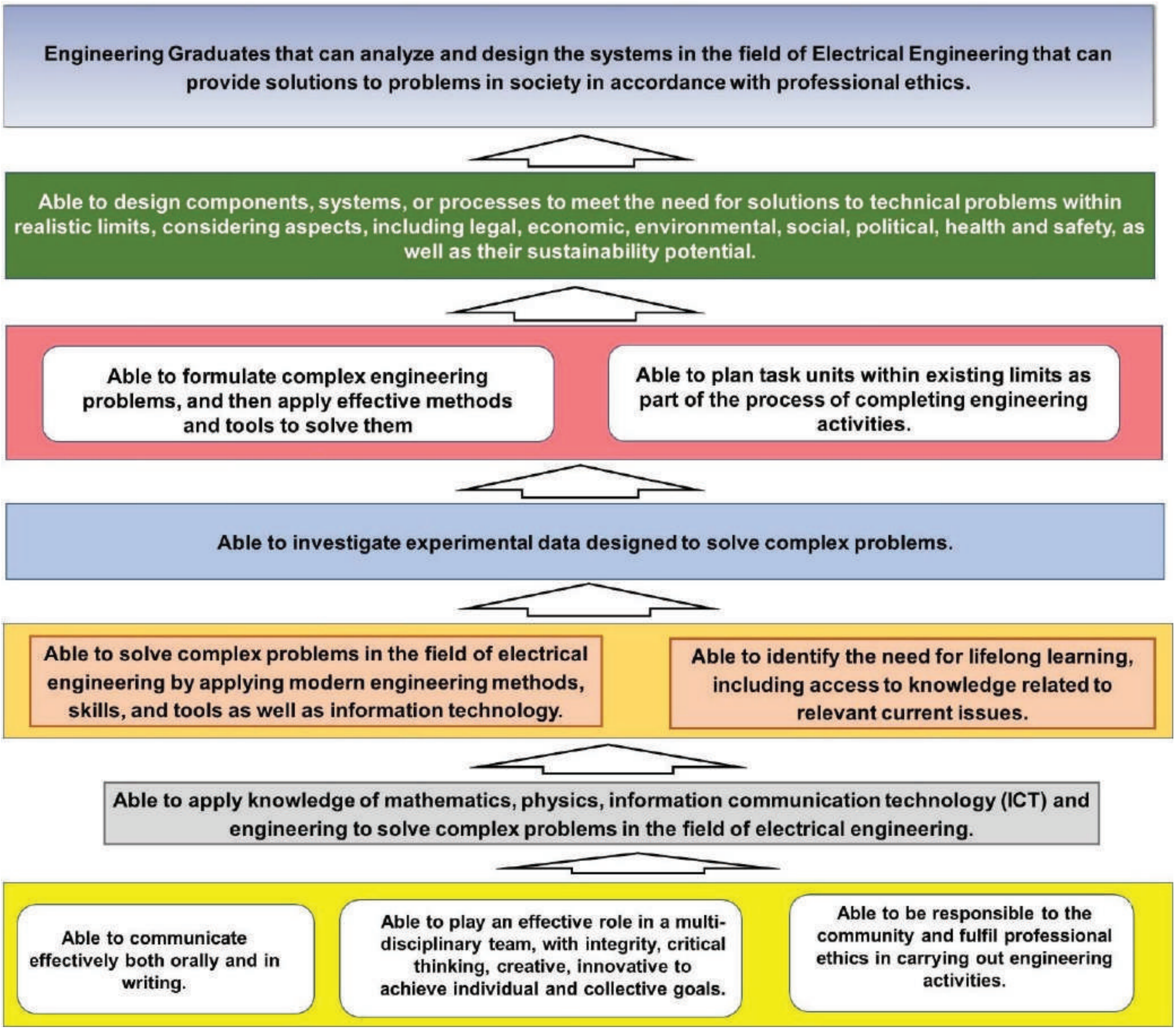
16. Composition of Subjects

No.	Classification	Credit Hours (SKS)	Percentage
i	University General Subjects	9	6,3%
ii	Faculty Subjects	18	12,5%
iii	Core Subjects	88	61,1%
iv	Elective Subjects	29	20,1
	Total	144	100 %
	Total Credit Hours to Graduate		144 SKS

Career Prospects

Graduates of this study program can work in various types of companies such as the electric power industry, telecommunications and information technology, electronics, oil and gas, education, government, health industry, banking, and other related industries.

LEARNING OUTCOMES



Learning Outcome Matrix of Mandatory Subjects

Kode	Course	Credit	Sem	10	9	8	7	6	5	4	3	2	1
UIGE600010-15	Religion	2	1		X								
UIGE600003	English	2	1				X						
ENGE600003	Calculus	4	1			X							
ENGE600004	Linear Algebra	4	1			X							
ENGE600007	Physics of Electricity, Magnetism, Optics, and Waves	3	1			X							
ENGE600008	Physics of Electricity, Magnetism, Optics, and Waves Laboratory	1	1			X							
ENEE601001	Introduction to Electrical Engineering	2	1		X		X		X				
UIGE600001	Integrated Characteristic Building	5	2		X		X		X				
ENGE600005	Physics of Mechanics and Heats	3	2			X							
ENGE600006	Laboratory of Mechanics and Heats Physics	1	2			X							
ENEE602002	Probability and Statistics	4	2			X							
ENEE602003	Electric Circuit 1	3	2			X		X					
ENEE602004	Vector Analysis and Complex Variable	2	2			X							
ENEE602005	Fundamentals of Digital System and Laboratory	3	2			X		X					
ENEE603006	Electric Circuit 2	3	3			X		X					
ENEE603007	Electric Circuit Laboratory	1	3			X		X					
ENEE603008	Engineering Mathematics	4	3			X							
ENEE603009	Physics of Semiconductor	2	3			X							
ENEE603010	Advanced Linear Algebra	2	3			X							
ENEE603011	Electromagnetics	4	3			X		X					
ENEE603012	Electric Measurements	2	3			X		X					
ENEE603013	Electric Measurement Laboratory	1	3			X		X					
ENEE603014	Basic Computer and Laboratory	3	3			X		X					
ENEE604015	Electronic Circuits 1	2	4			X		X					
ENEE604016	Electronic Circuits Laboratory	1	4			X		X					
ENEE604017	Signal and Systems	3	4			X		X					
ENEE604018	Electric Power Engineering	3	4					X		X			
ENEE604019	Electric Power Engineering Laboratory	1	4			X		X					
ENEE604020	Numerical Computation	2	4			X		X					
ENEE604021	Electrical Materials	2	4					X					
ENEE604022	Embedded System 1	3	4					X		X			
ENEE604023	Algorithm and Programming	3	4					X		X			
ENEE605024	Introduction to Telecommunication System	3	5					X		X			
ENEE605025	Telecommunication System Laboratory	1	5					X		X			
ENEE605026	Electronic Circuits 2	2	5					X		X			
ENEE605027	Control Engineering	3	5					X		X			
ENEE605028	Control Engineering Laboratory	1	5					X		X			
ENEE605029	Embedded System 2	3	5							X			X
ENEE605030	Embedded System Laboratory	1	5					X		X			
ENEE605031	Modeling anda Machine Learning	3	5					X		X			
ENEE605032	Innovation and Entrepreneurship	2	5						X			X	
ENGE600012	Health, Safety & Environment	2	5	X									
ENEE606033	Electrical Engineering Project Design 1	2	6		X		X				X	X	
ENEE606034	Internship	2	6	X			X		X				
ENEE607035	Electrical Engineering Project Design 2	3	7	X	X		X				X		X
ENEE607036	Pra-Bachelor Theses	2	7				X		X			X	
ENEE608037	Bachelor Theses	4	8	X			X	X			X		X

Course Flow Diagram

Learning Outcome	Semester 1	Semester 2	Semester 3	Semester 4	Semester 5	Semester 6	Semester 7	Semester 8
Able to apply knowledge of mathematics, physics, information communication technology (ICT) and engineering to solve complex problems in the field of electrical engineering	Physics of Electricity, Magnetism, Optics, Waves, and Laboratory Linear Algebra Calculus	Physics of Mechanics and Heats, Laboratory Probability and Statistics Vector Analysis and Complex Variable	Physics of Semiconductor Advanced Linear Algebra Engineering Mathematics					
Able to identify the need for lifelong learning, including access to knowledge related to relevant current issues	Introduction to Electrical Engineering					Internship		
Able to solve complex problems in the field of electrical engineering by applying modern engineering methods, skills, and tools as well as information technology.		Electric Circuit 1 Fundamentals of Digital System and Laboratory	Electric Circuit 2 Electric Circuit Laboratory Electric Measurements Electric Measurements Lab. Basic Computer and Laboratory Electromagnetics	Signal and Systems Numerical Computation Electronic Circuits 1 Electrical Materiels				
Able to formulate complex engineering problems, and then apply effective methods and tools to solve them.				Electric Power Engineering Electric Power Engineering Lab. Algorithm and Programming Embedded System 1	Introduction to Telecom. System Telecommunication System Lab. Control Engineering Control Engineering Lab. Embedded System Lab. Modeling and Machine Learning Electronic Circuits 2			
Able to plan task units within existing limits as part of the process of completing engineering activities.					Innovation and Entrepreneurship	Electrical Engineering Project Design 1	Pra-Bachelor Theses	
Able to design components, systems, or processes to meet the need for solutions to technical problems within realistic limits, considering aspects, including legal, economic, environmental, social, political, health and safety, as well as their sustainability potential.					Embedded System 2		Electrical Engineering Project Design 2	Bachelor Theses

Course Structure Undergraduate Program (Regular/Parallel) in Electrical Engineering

Code	Course	SKS
	1st Semester	
UIGE600010-15	Religion	2
UIGE600003	English	2
ENGE600003	Calculus	4
ENGE600004	Linear Algebra	4
ENGE600007	Physics of Electricity, Magnetism, Optics, and Waves	3
ENGE600008	Physics of Electricity, Magnetism, Optics, and Waves Laboratory	1
ENEE601001	Introduction to Electrical Engineering	2
	Subtotal	**18**
	2nd Semester	
UIGE600001	Integrated Characteristic Building	5
ENGE600005	Physics of Mechanics and Heats	3
ENGE600006	Laboratory of Mechanics and Heats Physics	1
ENEE602002	Probability and Statistics	4
ENEE602003	Electric Circuit 1	3
ENEE602004	Vector Analysis and Complex Variable	2
ENEE602005-MB	Fundamentals of Digital System and Laboratory	3
	Subtotal	**21**
	3rd Semester	
ENEE603006	Electric Circuit 2	3
ENEE603007	Electric Circuit Laboratory	1
ENEE603008	Engineering Mathematics	4
ENEE603009	Physics of Semiconductor	2
ENEE603010	Advanced Linear Algebra	2
ENEE603011	Electromagnetics	4
ENEE603012	Electric Measurements	2
ENEE603013	Electric Measurement Laboratory	1
ENEE603014-MB	Basic Computer and Laboratory	3
	Subtotal	**22**
	4th Semester	
ENEE604015	Electronic Circuits 1	2
ENEE604016	Electronic Circuits Laboratory	1
ENEE604017	Signal and Systems	3
ENEE604018	Electric Power Engineering	3
ENEE604019	Electric Power Engineering Laboratory	1
ENEE604020	Numerical Computation	2
ENEE604021	Electrical Materials	2
ENEE604022	Embedded System	3
ENEE604023-MB	Algorithm and Programming	3
	Subtotal	**20**
	5th Semester	
ENEE605024	Introduction to Telecommunication System	3
ENEE605025	Telecommunication System Laboratory	1
ENEE605026	Electronic Circuits 2	2
ENEE605027	Control Engineering	3
ENEE605028	Control Engineering Laboratory	1
ENEE605029	Embedded System 2	3
ENEE605030	Embedded System Laboratory	1
ENEE605031	Modeling anda Machine Learning	3
ENEE605032-MB	Innovation and Entrepreneurship	2
ENGE600012-MB	Health, Safety & Environment	2
	Subtotal	**21**
	6th Semester	
ENEE606033	Electrical Engineering Project Design 1	2
ENEE606034-MB	Internship	2
MB	Major Elective Course	8
MB	Electives	4
	Subtotal	**16**
	7th Semester	
ENEE607035	Electrical Engineering Project Design 2	3
ENEE607036	Pra-Bachelor Thesis	2
MB	Major Elective Course	8
MB	Electives	2
	Subtotal	**15**
	8th Semester	
ENEE608037	Bachelor Theses	4
MB	Major Elective Course	5
MB	Electives	2
	Subtotal	**11**
	TOTAL	**144**

Elective Courses of Electric Power Engineering Field

Code	Course	SKS
	6th Semester	
ENEE606101	Energy Conversion and Renewable Energy	2
ENEE606102	Power Electronics and Laboratory	3
ENEE606103	Management and Engineering Economics	2
	Subtotal	**7**
	7th Semester	

ENEE607104	Electric Power System and Laboratory	3
ENEE607105	High Current & Voltage Engineering and Laboratory	3
ENEE607106	Building Electrical Installation	2
ENEE607107	Special Topics of Electric Power Engineering 1	2
	Subtotal	**10**
	8th Semester	
ENEE608108	Smart Grid	2
ENEE608109	Electric Power System Protection	2
ENEE608110	Special Topics of Electric Power Engineering	2
	Subtotal	**6**

Elective Courses of Electronic Engineering Field

Code	Course	SKS
	6th Semester	
ENEE606201	Design of Electronic Circuits	3
ENEE606202	Advanced Electronic Devices	3
ENEE606203	Design of Electronics Instrumentation	2
	Subtotal	**8**
	7th Semester	
ENEE607204	Optoelectronic Devices	3
ENEE607205	Design of VLSI Circuits	3
ENEE607206	Introduction to Nanoelectronics	2
ENEE607207	Special Topics of Electronics 1	2
	Subtotal	**10**
	8th Semester	
ENEE608208	Advanced Embedded System	3
ENEE608209	Special Topics of Electronics	2
	Subtotal	**5**

Elective Courses of Telecommunication Engineering Field

Code	Course	SKS
	6th Semester	
ENEE606301	Digital Communication	3
ENEE606302	Telecommunication System Devices	3
ENEE606303	Optical Communications	2
	Subtotal	**8**
	7th Semester	
ENEE607304	Antenna and Propagation	3
ENEE607305	Wireless Communication and Convergence Networks	3
ENEE607306	Capita Selecta of Telecommunication Ecosystems	2
ENEE607307	Special Topics of Telecommunication 1	2
	Subtotal	**10**
	8th Semester	
ENEE608308	Signal Processing and Multimedia Service	3
ENEE608309	Special Topics of Telecommunication	2
	Subtotal	**5**

Elective Courses of Control Engineering Field

Code	Course	SKS
	6th Semester	
ENEE606401	Electric Motor Control System	3
ENEE606402	Adaptive and Predictive Control System	3
ENEE606403	Industrial Automation System	2
	Subtotal	**8**
	7th Semester	
ENEE607404	Mechatronics	3
ENEE607405	Knowledge-based System	3
ENEE607406	Robotic System	2
ENEE607407	Special Topics of Control Engineering 1	2
	Subtotal	**10**
	8th Semester	
ENEE608408	Autonomous Vehicle System	3
ENEE608409	Special Topics of Control Engineering	2
	Subtotal	**5**

Course Structure of International Undergraduate Program

Code	Course	SKS
	1st Semester	
ENGE610003	Calculus	4
ENGE610007	Physics (Electric, Magnet, Optic, and Wave)	3
ENGE610008	Physics (Electric, Magnet, Optic, and Wave) Laboratory	1
ENGE610004	Linear Algebra	4
ENEE611001	Introduction to Electrical Engineering	2
ENEE611002	Fundamentals of Digital System and Laboratory	3
UIGE610002	Academic Writing	2
	Subtotal	**19**
	2nd Semester	
ENGE610005	Physics (Mechanics and Heat)	3
ENGE610006	Physics (Mechanics and Heat) Laboratory	1
ENEE612003	Basic Computer and Laboratory	3
ENEE612004	Probability and Statistics	4

ENEE612005	Vector and Complex Variable Analysis	2
ENEE612006	Electric Circuit 1	3
ENEE612007	Physics of Semiconductor	2
ENEE612008	Engineering Mathematics	4
	Subtotal	**22**
	3rd Semester	
ENEE613009	Electric Circuit 2	3
ENEE613010	Electric Circuit Laboratory	1
ENEE613011	Signal & Systems	3
ENEE613012	Electromagnetics	4
ENEE613013	Introduction to Telecommunication System	3
ENEE613014	Telecommunication system Laboratory	1
ENEE613015	Electronic Circuits 1	2
ENEE613016	Electronic Circuits Laboratory	1
ENEE613017	Electrical Measurements	2
ENEE613018	Advanced Linear Algebra	2
	Subtotal	**22**
	4th Semester	
ENEE614019	Control Engineering	3
ENEE614020	Control Engineering Laboratory	1
ENEE614021	Electronic Circuits 2	2
ENEE614022	Electrical Measurements Laboratory	1
ENEE614023	Numerical Computation	2
ENEE614024	Electrical Materials	2
ENEE614025	Embedded System 1	3
ENEE614026	Electrical Power Engineering	3
ENEE614027	Electrical Power Engineering Laboratory	1
ENEE614028	Algorithm and Programming	3
	Subtotal	**21**
	5th Semester	
UIGE610001	Integrated Characteristic Building	5
UIGE610005-9	Religion	2
ENEE615029	Embedded System 2	3
ENEE615030	Embedded System Laboratory	1
ENEE615031	Power Electronics and Laboratory	3
ENEE615032	Electric Motor Control System	3
ENEE615033	Wireless Communication and Convergence Networks	3
ENEE615034	Electronic Instrumentation Design	2
	Subtotal	**22**
	6th Semester	
ENEE616035	Autonomous Vehicle System	3
ENEE616036	Modeling and Machine Learning	3
ENEE616037	Electrical Engineering Project Design 1	2
ENEE616038	Introduction to Nanoelectronics	2
ENEE616039	Electric Power System and Laboratory	3
ENEE616040	Telecommunication System Devices	3
ENEE616041	Internship	2
ENEE616042	Innovation and Entrepreneurship	2
	Subtotal	**20**
	7th Semester	
ENGE610012	Health, Safety & Environment	2
ENEE617043	Electrical Engineering Project Design 2	3
ENEE617044	Optoelectronic Devices	2
ENEE617045	Pra-Bachelor Thesis	2
	Electives	3
	Subtotal	**12**
	8th Semester	
ENEE618047	Bachelor Thesis	4
	Electives	2
	Subtotal	**6**
	Total	**144**

Course Syllabus of University Subjects

INTEGRATED CHARACTER BUILDING
UIGE6000061/UIGE6100061
5 credits

Syllabus :

The Integrated Character Building is part of the Higher Education Personality Development Lecture which is held for students which contains elements of the internalization of basic life values, interaction/relationship skills, nationality and academic skills as the basis for student personality to carry out learning according to scientific disciplines.

MPKT is carried out in the form of a series of learning activities outside the formal class. activities carried out include participation in lectures/seminars, internships, field work practices, social work, sports and/or arts activities and other forms of activities that have the main goal of equipping students with soft skills and proven by portfolio documents. The form of this learning activity is different from the MPKT courses that have been carried out at the previous UI.

The material provided at MPKT aims to form a human thinking pattern with values and morals to create a human personality by having critical, logical, creative, innovative thinking, and having intellectual curiosity and an entrepreneurial spirit. The material provided includes 9 UI values, national, state and citizen values based on Pancasila. Solving problems in science, technology, health, and humans as natural managers by using reasoning and utilizing Information and Communication Technology (ICT) to achieve the final objectives of this module.

Lecture activities are carried out using an online student-centered learning (SCL) approach which can use the following methods: experiential learning (EL), collaborative learning (CL), problem-based learning (PBL), question-based learning, and project based learning. The use of these various methods is carried out through group discussion activities, independent assignment exercises, presentations, writing papers in Indonesian and interactive discussions in online discussion forums. The language of instruction in this lecture is Indonesian.

Graduate Learning Outcomes :

- CPL 1: Able to use spoken and written language in Indonesian and English both for academic and non-academic activities (C3, A5)
- CPL 2: Have integrity and are able to think critically, creatively, and innovatively and have intellectual curiosity to solve problems at the individual and group level (C4, A3)
- CPL 3: Able to provide alternative solutions to various problems that arise in the community, nation, and country (C4, A2)
- CPL 4: Able to take advantage of information communication technology (C3)
- CPL 5: Able to identify various entrepreneurial efforts characterized by innovation and independence based on ethics (C2, A5)

Course Learning Outcomes :

- CPMK 1: After completing this course, students are able to apply self-regulated learning characteristically in studying critically, logically, creatively, innovatively through analysis of societal problems, nation, state, and Pancasila ideology based on self-understanding as individuals and members. the community by using good and correct Indonesian and the latest information and communication technology (C4, A4)
- CPMK 2: Able to identify various entrepreneurial efforts characterized by innovation and independence based on ethics (C2, A5)
- CPMK 3: After completing this course, students are able to apply self-regulated learning characteristically in pursuing integrated and comprehensive knowledge through analysis of science problems, technology based on the role of nature manager by using good and correct Indonesian and information technology and current communications. (C4, A4)
- CPMK 4: After completing this course, students are able to plan creative activities to solve problems in society and the world of work/industry by showing creativity, critical thinking, collaborative self-discipline using good and correct Indonesian as well as the latest information and communication technology (C5, A5)

Prerequisite : -

ACADEMIC WRITING

UIGE610002
2 credits
The Objectives :

To activate students, English so that they will be able to communicate effectively in English;

To enable students to develop the learning strategies and study skills needed to finish their study successfully and o continue learning on their own after taking the MPK program (to develop independent learners)

Main Competencies :

- Listen to, understand and take notes of key information in academic lectures of between 5-10 minutes length;
- Improve their listening skills through various listening materials and procedures;
- Speak confidently, ask questions in and contribute to small group discussions;
- Use different reading strategies needed to the effective readers;
- Improve their reading skills through extensive reading material;
- Develop skills in connecting ideas using appropriate transitions and conjunctions;
- Work as part of a group to prepare and deliver a 25-minute presentation on an academic topic using appropriate organization, language and visual aids;
- Write a summary of a short academic article;
- Write an expository paragraph;
- Write a short essay.

Learning Method : Active learning, Contextual language learning, small group discussion.

Prerequisite :

1. Students Learning Orientation/Orientasi Belajar Mahasiswa (OBM)

ENGLISH

UIGE600003
2 credits
Learning Objectives :

After attending this subject, students are expected to capable of use English to support the study in university and improve language learning independently.

Syllabus :

Study Skills : (Becoming an active learner, Vocabulary Building: word formation and using the dictionary Listening strategies Extensive reading) Grammar: (Revision of Basic grammar Types of sentences Adjective clauses, Adverb clauses Noun clauses, Reduced clauses) Reading: (Reading skills: skimming, scanning, main idea, supporting ideas, Note-taking Reading popular science arti-cle, Reading an academic text) Listening: (Listening to short conversations, Listening to a lecture and notetaking, Listening to a news broadcast, Listening to a short story) Speaking: (Participating in discussions and meetings, Giving a presentation) Writing: (Writing a summary of a short article Describing graphs and tables, Writing an academic paragraph, Writing a basic academic essay (5 paragraphs).

ISLAMIC STUDIES

UIGE6000010/UIGE610005
2 credits
General Instructional Objectives :

The cultivation of students who have concern for social, na-tional and countrys issues based on Islamic values which is applied in the development of science through intellectual skills.

Learning Objectives :

Course participants are expected to do the following when faced with a problem or issue which they must solve :

1. Analyze the problem based on the Islamic values they adopted;
2. Analyze the problem by implementing active learning stages;

3. Discuss and express their thoughts and ideas by using proper and correct Indonesian language in discussion and academic writing.

Syllabus :

Islam history: the meaning of Islam, the characteristic of Islam, the sources of Islamic teachings, Muhammad SAW as prophet and history figure, introduction of Islam in Indonesia, the teaching essence of Islam: the basic principle of Islam teachings, the unity of Allah, worship prac-tice in live, eschatology and work ethics, human's basic rights and obligation, social structure in Islam: sakinah mawaddah and ramhah family, the social implication of family life, Mosque and the development of Islam, zakat and the economic empowerment of the people, Islam society, Science: reason and revelation in Islam, Islam's motivation in development of science, science characteristics, source of knowledge, IDI (each Faculty and Department/Study Program).

CATHOLIC STUDIES
UIGE6000011/UIGE610006
2 credits
General Instructional Objectives :

To help deliver students as intellectual capital in implementing lifelong learning process to become scientists with mature personality who uphold humanity and life.

Be scholars who believe in God according to the teachings of Jesus Christ by continuing to be responsible of his faith in life in church and society.

Syllabus :

Almighty God and the God teachings; Man, Morals, science technology and art; harmony between religions; Society, Culture, Politics, Law: the substance of theses studies will be addressed by integrating the four dimensions of the teachings of the Catholic faith: the personal dimension, the dimension of Jesus Christ, the dimension of the Church, and Community dimension. Dimensions are implemented in the following themes: People, Religion, Jesus Christ, the Church, and Faith in the society.

CHRISTIAN STUDIES
UIGE6000012/UIGE610007
2 credits
General Instructional Objectives :

Cultivating students with comprehensive Christian knowledge and teaching in the midst of the struggle and the fight of the nation while also discussing the student's participation in line with the study to help improve and build our country.

Learning Objectives :

Course participants are expected to do the following when faced with a problem or issue which they must solve:

1. Analyze the problem based on the Christian values
2. Analyze the problem by implementing active learning stages
3. Discuss the problem by using proper and correct Indonesian language

Syllabus :

History (Historical terms): Status of the Bible, the existence of God and Morality, Christ the Savior, the Holy Spirit as existence reformer and outlook on the world: Faith and Knowledge of Science, Church and service, Ecclesiology, Spiritual and enforcement of Christian Human Rights and the world of ethics: Christian Ethics, Christian and worship, Christianity and politics, Christian love and social reality: Christian Organizations, Students and Service, Christian and expectations.

HINDU STUDIES
UIGE6000013/UIGE610008
2 credits

Syllabus :

Hindu religion, Hindu history), Source and scope of Hinduism (the Veda as the source of Hindu religion teachings, the scope of the teachings in Hindu religion), The concept of the God (Brahman) according to the Veda, the Path to Brahman (Catur Marga Yoga, Mantra and Japa), Human Nature (The purpose of human life, Human's duties, obligations, and responsibilities both individually or collectively), Ethics and morality (Principles teaching, self-control), in-depth understanding of the scripture (deep understanding of the Bhagawadgita, deep understanding of the Sarasamuschaya), The Role of Hinduism in science, technology, and art (Hinduism benefits in science and technology in accordance with each department, benefit / the role of Hinduism in the arts), Cohesion and community's prosperity /independence (Benefits of unity in the religious plurality, independent community (kerthajagathita) as a common goal, Tri Pitakarana), Culture as an expression of Hindu religious practice, Contribution to the Hindu religion teachings in the political life of nation and country, laws and the enforcement of justice, Awareness of and obeying the Rita / Dharma.

BUDDHIST STUDIES
UIGE6000014/UIGE610009
2 credits

Syllabus :

Almighty God and the God Study (Faith and piety, Divine Philosophy/Theology), Human (Human Nature, Human Dignity, Human Responsibility), Moral (Implementation of Faith and Piety in everyday life), Science, Technology and Art (Faith, Science and Charity as a unity, the Obligation to study and practice what you are taught, Responsibility for nature and environment), harmony between religion (religion is a blessing for all mankind, the essence of the religious plurality and togetherness), community (the role of religious society in creating a prosperous independent society, the responsibility of religious society in the realization of human rights and democracy), Culture (the responsibility of religious society in the realization of critical thinking (academic), work hard and fair), Politics (Religion contribution in the political life of nation and country), Law (Raise awareness to obey and follow God's law, the role of religion in the formulation and enforcement of law, the function of religion in the legal profession).

KONG HU CU STUDY
UIGE6000015/UIGE610010
2 credits

Syllabus of Faculty Subjects

CALCULUS 1
ENGE600001/ENGE610001
3 credits
Course Learning Outcomes:

Able to use the basic concepts of calculus related to -a function of one variable, the derivative and integration of the function of one variable in order to solve its applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, basic engineering, and engineering specialization to be used in solving complex engineering problems.

Syllabus :
Introduction, Functions and Limits, The Derivative, Applications of the Derivative, The Definite Integral, Applications of The Definte Integral, Transcendental Functions, Techniques of Integration, Indeterminate Forms and Improper Integrals.

Prerequisite: None

Textbooks:

Main reference:
D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., Pearson, Prentice Hall, 2007.

Additional eferences:
1. George B. Thomas Jr., Thomas' Calculus Early Transcendental, 12th ed., Addison–Wesley Pearson, 2009.
2. Howard Anton, Calculus, 10th ed., John Wiley and Sons, 2012.

CALCULUS 2
ENGE600002/ENGE610002
3 SKS
Course Learning Outcomes:

Students are able to use the concepts of sequences, series, conic sections, and the basic concepts of calculus which involve the function of two or three variables to solve their applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus: :
Infinite sequences and infinite series, Test for convergence of positive series and alternating series, Power series and operation on operations, Taylor and MacLaurin series, Conic sections , Calculus in polar coordinates, Derivatives, limits, and continuity of multi-variables functions, Directional derivatives and gradients, Chain Rule, Tangent planes and Approximations, Lagrange multipliers. Double integrals in Cartesian coordinates and polar coordinates, triple integrals in Cartesian coordinates, cylindrical coordinates and spherical coordinates, Applications of double and triple Integral.

Prerequisite: Calculus 1

Textbooks:
1. D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., PEARSON, Prentice Hall, 2007.
2. Thomas, Calculus Thirteenth Edition Volume 2, Erlangga, 2019.

CALCULUS
ENGE600003/ENGE610003
4 SKS
Course Learning Outcomes:

Students are able to use the basic concepts of calculus involving functions of one to three variables to solve their applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :

Introduction, Functions and Limits, Derivatives, Derived Applications, Indeterminate Integral, Integral Applications, Infinite Row, and Series. Derivatives with many variables, Duplicate Integral (2 and 3), Duplicate Integral Application.

Prerequisite: None

Textbooks:

Main :
D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., Pearson, Prentice Hall, 2007.

George B. Thomas Jr., Thomas' Calculus Early Transcendental, 12th ed., Addison – Wesley Pearson, 2009.

LINEAR ALGEBRA
ENGE600004/ENGE610004
4 SKS
Learning Outcomes:
Able to explain the concepts of vectors and matrices and their applications; Able to apply vector and matrices operations in solving engineering problems; Able to apply the techniques of solving Linear Equation Systems, Determinants, Norm Vectors, Values and Eigenvectors, and Linear Transformations

Topics:

Matrics, Vector, Matrics and vector operation, linear system equation, determinant, vector space, vector norm, inner product, vector geometry, eigenvalue, eigenvector, linear transformation

Prerequisite: None

Textbooks:
1. S. Friedberg, A. Insel, L. Spence, "Linear Algebra, 4th edition", Pearson, 2014.
2. W. Keith Nicholson, "Linear Algebra with Applications, 7th edition", McGraw-Hill, 2013.

MECHANICAL AND HEAT PHYSICS
ENGE600005 / ENGE610005
3 credits
Course Learning Outcomes:

Able to explain the basic concepts of mechanics and thermodynamics, and be able to apply them to understand natural phenomena and human engineering, including their applications.

Graduate Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus:

Units, Magnitudes and Vectors, Motion Along Straight Lines, Motion in Two and Three Dimensions, Newton's Laws of Motion, Applications of Newton's Laws, Kinetic Energy, and Work, Potential Energy and Energy Conservation, Center of Mass, Linear Momentum, Rotation, Rolling Motion, Torque, Angular Momentum, Oscillation, Mechanical and Sound Waves, Gravity, Statics and Elasticity, Fluid Mechanics, Temperature, Heat, Law I Thermodynamics, Ideal Gas and Kinetic Theory of Gas, Heat Engine, Entropy, and Law II Thermodynamics.

Prerequisite: none

Textbooks:
1. Halliday, Resnick, and Walker, Principles of Physics 10th Edition, Wiley, 2014.

2. Serway Jewett, Physics for Scientists and Engineers 9th Edition, Thomson Brooks / Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008

ELECTRICAL MAGNETIC, OPTICAL AND WAVE PHYSICS

ENGE600007 / ENGE610007
3 credits
Course Learning Outcomes:

Students are able to apply the basic concepts of electrical physics, magnetism, waves, and optics to solve problems in the engineering field.

Graduate Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus:

Unit, Magnitude, Vector, Electric Charge, Electric Field, Gauss Law, Electric Potential, Capacitance, Electric Current, Resistance, Direct Current, Magnetic Field Due to Electric Current, Magnetic Field Source, Induced GGL, Inductance, Alternating Current, Electromagnetic Waves, Light Properties and Propagation, Optical Geometry.

Prerequisite: none

Textbooks :
1. Halliday, Resnick, and Walker, Principles of Physics 9th Edition, Wiley, 2011.
2. Serway Jewett, Physics for Scientists and Engineers 9th Edition, Thomson Brooks / Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008.

BASIC CHEMISTRY

ENGE600009 / ENGE610009
2 credits
Course Learning Outcomes:
Students are able to analyze the principe of basic chemistry for application in engineering.

Graduates' Learning Outcomes:
Able to apply mathematics, science, and basic engineering to be used in solving complex engineering problems.

Syllabus:

Material and measurements, atoms, molecules and ions, stochiometry, water phase reactions and solution stochiometry, thermochemistry, chemical equilibrium, acid and base equilibrium, electrochemistry, chemical kinetics, and chemical applications.

Prerequisite: none

Textbooks :
1. Ralph H. Petrucci, General Chemistry: Principles and Modern Applications, 8th Ed. Prentice Hall Inc., New York, 2001.
2. John McMurry, Robert C. Fay, Chemistry (3rd ed.), Prentice Hall, 2001.
3. Raymond Chang, Williams College, Chemistry (7th ed.), McGraw-Hill, 2003.

ENGINEERING ECONOMY

ENGE600011 / ENGE610011
3 credits
Course Learning Outcomes:

Students are able to analyze the economic and financial feasibility of making economic practice decisions.

Graduate Learning Outcomes:

Able to apply the principles of technical management and decision making based on economic considerations, in individual and group, as well as in project management.

Syllabus:

Introduction to Engineering Economics, Time Value of Money, Combining Factors, Interest Rates, Money Worth Analysis, Rate of Return Analysis, Effects of Inflation, Benefit Cost & Break-Even Point Analysis, Sensitivity Analysis, Depreciation, Tax Analysis, Cost Estimation & Allocation, Capital Budgeting & Replacement Analysis.

Prerequisite:
1. Civil Engineering : -
2. Environmental Engineering : -
3. Naval Engineering : -
4. Industrial Engineering : must pass the introductory Economic course and have completed 38 credits
5. Chemical Engineering : -
6. Bioprocess Engineering : -

Textbooks:
1. Blank, Leland and Tarquin, Anthony. 2018. Engineering Economy 8th Ed. McGraw Hill.
2. Park, Chan S. 2016. Contemporary Engineering Economics 6th Ed. Pearson. Upper Saddle River.
3. White, Case and Pratt. 2012. Principles of Engineering Economic Analysis 6th ed. John Wiley and Sons.

STATISTICS AND PROBABILISTICS

ENGE600010 / ENGE610010
2 credits
Course Learning Outcomes:

Students are able to handle quantitative data/information starting from the descriptive stage (collection, organization, and presentation) to the inductive stage, which includes forecasting and drawing conclusions based on the relationship between variables for decision making.

Graduate Learning Outcomes:
1. Apply descriptive statistics and probability theory to data processing and serving
2. Apply probability distribution to data processing and serving
3. Apply the principles of sampling and estimation for decision making
4. Apply hypothesis test samples for decision making

Syllabus:

Introduction to Statistics for Engineering Studies, Probability Theory, Dasar Basic concepts and definitions, Distribution Probability, Sampling, Estimation, Hypothesis testing, Hypothesis test 1 sample at an average value, Regression

Prerequisite: none

Textbooks :
1. Harinaldi, Basic Principles of Statistical Engineering and Science, Erlangga, 2004
2. Montgomery, DC., And Runger, GC., Applied Statistics and Probability for Engineers, John Wiley Sons, 2002

HSE PROTECTION

ENGE600012 / ENGE610012
2 credits
Course Learning Outcomes:

Upon completion of this subject students are expected to be able to carried out hazard identification, and characterization, to propose appropriate methods for risk reduction and mitigation, and to design safety management system. The student is also expected to improve their awareness on industrial safety and health, and understanding on safety regulation framework and standards as well as environmental program.

Graduate Learning Outcomes:
1. Students are expected to understand safety, health and environmental aspect as an integral part of fundamental principal in engineering code of ethics.
2. Students are expected to be able to carry out process of risk assessments by considering risk factors in the impact of hazards on people, facilities, and the surrounding community and environemt.
3. Students are expected to understand the regulatory framework and standard related to the stages of life cycle of machine, building structure, construction, and process.
4. Students are able to design and propose an effective hazard communication, management and engineering control, and risk mitigation through an engineering assignment project.
5. Students are able to identify the knowledge required to perform risk assesment, investigation and design improvement through a multidisiplinary case of incident and accident.

Syllabus:

Introduction to SHE Regulation and Standards, SHE Perception (Risk and Environment), Identification, Assessment and Management, Construction, machinery and Noise hazards, Process safety hazard and analysis technique, Fire and explosion hazard, Electrical hazard, Toxicology in the Workplace, Ergonomy Aspect, Hazard communication to employees, Environmental Protection, Case studies, Safety Health and Environment audits.

Prerequisite: none

Textbooks :
1. Charles A. Wentz, Safety, Health and Environmental Protection, McGraw Hill, 1998.
2. Asfahl, C.R., Rieske, D. W., Sixth Edition Industrial Safety and Health Management, Pearson Education, Inc., 2010.
3. United Kingdom - Health and Safety Executive, http://www.hse.gov.uk/
4. National laws and regulations related to the K3 Management System and the Environment.
5. Related Journal (http://www.journals.elsevier.com/safety-science/) etc, related standards and publications.

Electrical Engineering Course

INTRODUCTION TO ELECTRICAL ENGINEERING
ENEE601001/ENEE611001
2 CREDITS
Learning Outcomes:

Able to describe the profession and mindset of engineer, able to describe the scope of the field of electrical engineering, able to show a simple application in the field of electrical engineering

Topics:

The profession and role of the engineer in the field of electrical engineering, innovation, and entrepreneurship in the field of electrical engineering, mindset of the engineer, science and its application in the field of electrical engineering, exploration of electrical technologies.

Prerequisites: none

Textbook:
1. Diktat Pengantar Teknik Elektro UI
2. Dr. Raymond B. Landis, "Studying Engineering: A Road Map to a Rewarding Career, Chapter 2", 3rd edition, Discovery Press, 2019

PROBABILITY AND STATISTICS
ENEE602002/ENEE612004
4 CREDITS
Learning Outcomes:

Able to explain the stapes and methods in data processing and analysis as well as the principle of uncertainty in data; able to use data representation/modeling methods; able to apply data representation/modeling methods in engineering, especially electrical engineering

Topics:

General concepts of probability and statistics, population, sample, data preparation and explanation (frequency distribution, data presentation in tables/graphs, mean, standard deviations, variances, medians), random variables (discrete, continuous), types of probabilities, various types of probability distributions, sampling methods, sampling distributions, Bayes' Theorem, mean inference (point estimation, interval estimation, maximum likelihood estimation), variance inference (variance estimation, hypothesis), and proportion inference (proportion estimation, hypothesis, goodness of fit), Optimization, least squared method, linear regression (single, multiple), correlation

Prerequisites: none

Textbook:
1. R. Lyman, Michael Longnecker, "An Introduction to Statistical Methods & Data Analysis",7th Edition, Cengage Learning, 2016.
2. Irwin Miller, Marylees Miller, "Mathematical Statistics with Application", 8th Edition, Pearson Education, 2014.
3. Richard L. Scheaffer, Linda J. Young, "Introduction to Probability and Its Applications", Cengage Learning, 2010.

ELECTRIC CIRCUITS 1
ENEE602003/ENEE612006
3 CREDITS
Learning Outcomes:

Able to apply analysis techniques of complex electrical circuit; able to apply electrical circuit analysis methods; able to perform analysis of electrical circuit variables.

Topics:

Current, voltage, power and energy; voltage source, current source (free/ bound), resistor, and capacitor; series and parallel resistive circuits; RL, RC, RLC circuits; node analysis, supernode, mesh, supermesh; the superposition theorem, source transformation, and Thevenin-Norton; operational amplifier; time and frequency response of the RLC circuit

Prerequisite: Calculus, Physics (Electricity, MWO).

Textbook:
1. James W. Nilsson, Susan A. Riedel, "Electric Circuits, (Chapter 1-9)", 10th Edition, Pearson, 2015.
2. David E. Johnson, Johnny R. Johnson, John L. Hilburry, Peter D. Scott, "Electric Circuit Analysis, (Chapter 1-8)", 3rd Edition, Wiley, 1997.

VECTOR ANALYSIS COMPLEX VARIABLE
ENEE602004/ENEE612005
2 CREDITS
Learning Outcomes:

Able to explain the concepts of differential and integral vectors;

able to describe the application of differential and integral vectors in solving electrical engineering problems, able to apply appropriate mathematical operations on differential and integral vectors, able to apply mathematical operations methods in complex variables and functions.

Topics:

Differential vector, gradient, hessian, jacobian, divergence, curl, integral vector, line integral, Green theorem, surface integral, Gauss and Stokes divergence theorem, complex variabel and function, complex differential and integral.

Prerequisite: Calculus

Textbook:
1. Erwin Kreyszig, "Advanced Engineering Mathematics (chapter 9, 10, 13, 14, 15)", 10th Edition, Wiley Publisher 2010.
2. Glyn James, "Advanced Modern Engineering Mathematics (Chapter 3,)", 4th Edition, Pearson Education, 2011.

FUNDAMENTAL OF DIGITAL SYSTEM & LABORATORY
ENEE602005/ENEE611002
3 CREDITS
Learning Outcomes:

Able to explain the components of a digital system circuit, able to use simple digital circuit design methods, able to analyze a logic circuit

Topics:

Boolean Algebra Principles and applications; Interface Logic Families; Number System & Data Encoding; Basic Logic Circuits; Basic Modular Design of Combinational Circuits; Basic Modular Design of Sequential Circuits.

Practical work: Module 1-Introduction and introduction to Digital Circuit Basics, Module 2 - Boolean Algebra and Elementary logic gates, Module 3 – Karnaugh Map, Module 4 – complex logic gate, Module5 - Decoder and Encoder, Module 6 - Multiplexer and De-multiplexer, Module 7- Digital Arithmetic Circuit, Module 8 - Flip-Flop and Latch, Module 9-Registers and Counters, Module 10 – Group Project

Prerequisite: none

Textbook:
1. M. Morris R. Mano, Charles R. Kime, Tom Martin, Logic & Computer Design Fundamentals, 5th ed, Prentice Hall, 2015
2. Ronald J. Tocci, Neal S. Widmer, and Gregory L. Moss, Digital Systems: Principles and Applications, 11th Ed., Prentice Hall, 2010
3. Modul Praktikum Dasar Sistem Digital

ELECTRIC CIRCUITS 2
ENEE603006/ENEE613009
3 CREDITS
Learning Outcomes:

Able to apply laplace transform in electrical circuit analysis including deriving transfer function, able to apply filter design method and its analysis method using fourier transformation, able to analyze 3-phase electric circuit

Topics:

Electric power calculation; 3 phase ecircuits, laplace transformation; circuit analysis with laplace transforms; Fourier series and transformation; Fourier series analysis; active filter circuit; 4 poles circuits

Prerequisite: Electric Circuit 1

Textbook:
1. James W. Nilsson, Susan A. Riedel, "Electric Circuits, (Chapter 10-18)", 10th Edition, Pearson, 2015.
2. David E. Johnson, Johnny R. Johnson, John L. Hilburry, Peter D. Scott, "Electric Circuit Analysis, (Chapter 9-17)", 3rd Edition, Wiley, 1997.

ELECTRIC CIRCUIT LABORATORY
ENEE603007/ENEE613010
1 CREDITS
Learning Outcomes:

Able to explain the phenomenon of electric circuit variables, able to calculate electrical circuit variables using node, supernode, mesh, supermesh methods, able to analyze complex electrical circuit responses

Topics:

Analysis of nodes, supernode, mesh, supermesh; superposition theorem, source transformation, Thevenin-Norton, 3-phase circuit; inductance circuit; 4 poles circuit; active filter circuit

Prerequisite: Electric Circuits 1

Textbook: Modul Praktikum Rangkaian Listrik – Laboratorium Tegangan Tinggi dan Pengukuran Listrik.

ENGINEERING MATHEMATICS
ENEE603008/ENEE612008
4 CREDITS
Learning Outcomes:

Able to describe ordinary differential equations with constant/non-constant or linear/non-linear coefficients, partial differential equations, discrete differential equations, able to derive solutions of ordinary differential equations, able to apply the method of laplace/fourier/z transformation in solving differential equations

Topics:

Ordinary Differential Equations (Constant and Non-Constant Coefficient, linear, non-linear), Partial Differential Equations, Discrete Differential Equations, Laplace Transforms, Fourier Transforms, Z Transformations

Prerequisite: Vector Analysis and Complex Variables

Textbook:
1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley Publisher 2010.
2. Glyn James, "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education, 2011.

PHYSICS OF SEMICONDUCTOR
ENEE603009/ENEE612007
2 CREDITS
Learning Outcomes:

Able to explain the principles of semiconductor physics, able to apply the concepts of semiconductor physics in the analysis of semiconductor devices

Topics:

bond, Crystal, defect, band structures, mechanical properties, optical properties, heterostructures, nanostructure, polirized semiconductor, magnetic semiconductor

Prerequisite: Physics (Electricity, MWO).

Textbook:
1. Marius Grundmann, "The Physics of Semiconductors: An Introduction Including Devices and Nanophysics", Springer-Verlag, 2006.
2. Massimo Rudan," Physics of Semiconductor Devices, 2nd

edition", Springer-Verlag, 2018.

ADVANCED LINEAR ALGEBRA

ENEE603010/ENEE613018
2 CREDITS
Learning Outcomes:

Able to apply matrix decomposition and differentiation techniques, able to apply matrix operation techniques in data analysis, able to apply optimization methods.

Topics:

matrix geometry analysis (length, distance, angle, orthonormal, orthogonal), matrix decomposition (Cholesky decomposition, SVD, eigen decomposition), vector calculus (matrix gradient, computation), optimization (problem statements, computational optimization, gradient descent), applications Matrix Operations (PCA)

Prerequisite: Calculus, Linear Algebra

Textbook:
1. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, "Mathematics for Machine Learning", Cambridge University Press, 2019.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10^{th} Edition, Wiley Publisher 2010.

ELECTROMAGNETICS

ENEE603011/ENEE613013
4 CREDITS
Learning Outcomes:

Able to describe the concept of electromagnetic fields (electrostatic, magnetostatic, dynamic fields, plane waves), able to explain the application of electromagnetic concepts in the field of electrical engineering, able to anylze electromagnetic field in certain applications of electrical engineering

Topics:

Electrostatic, Magneto-static, Electromagnetic dynamic, Plane Waves, Maxwell's Laws, Electromagnetic Interference, transmission line

Prerequisite: Vector Analysis and Complex Variables

Textbook:
1. Fawwaz T Ulaby, Umberto Ravaioli, "Fundamental of Applied Electromagnetics, 7^{th} edition", Pearson, 2015.
2. William H. Hayt, Jr., John A. Buck, "Engineering Electromagnetics, 6^{th} edition", Mc Graw-Hill, 2001.

ELECTRIC MEASUREMENTS

ENEE603012/ENEE613017
2 CREDITS
Learning Outcomes:

Able to explain the basics of electrical measurement; Able to apply correct and safe measurement techniques; Able to evaluate measurement results

Topics:

Introduction of measuring instruments, the fault/error in measurement, the security and safety in Electrical Measurements, Measuring Electrical Quantities in General, measurement of Grounding Prisoners (Grounding Resistance), an Oscilloscope, Digital gauge

Prerequisite: Electric Circuit 1

Textbook:
1. Rudy Setiabudy, "Pengukuran Besaran Listrik," LP-FEUI, 2007.
2. Klaas B. Klaassen, "Electronic Measurement and Instrumentation," Cambridge University Press, 1996.

ELECTRIC MEASUREMENTS LABORATORY

ENEE603013/ENEE614022
1 CREDIT
Learning Outcomes:

Capable of measuring electrical quantities; Able to choose the measuring instrument to suit the needs of measurement topics:

Topics:

Gauge 1 phase, 3 phase measurement tool, the tool to measure the energy and power, grounding measuring instrument

Prerequisite: Electric Measurements

Textbook:

Modul Praktikum Pengukuran Besaran Listrik - Laboratorium Tegangan Tinggi dan Pengukuran Listrik.

BASIC COMPUTER AND LABORATORY

ENEE603014-MB/ENEE612003
3 CREDITS
Learning Outcomes:

Able to explain computer systems (hardware, software, networks), able to explain the principles of algorithm design, able to apply algorithm design methods: Pseudocode; Flow chart; Iteration; Selection/Branching; Able to analyze the results of the algorithm design

Topics:

The history of the computer, computer hardware Components, operating systems, computer networks; Pseudocode; Flowchart; Looping; Selection/Branching; Matlab Script; Structure and control in the C language

Prerequisite: Fundamentals of Digital System and Laboratory

Textbook:
1. Alan Evans, Kendall Martin, Mary Anne Poatsy, "Technology in Action (TiA)," 12th Edition, PrenticeHall, 2015.
2. Gary b. Shelly Misty e. Vermaat and, "Discovering Computers 2011: Living in a Digital World," Course Technology, Cengage Learning, 2011.
3. Deitel & Deitel, "C How to Program," 8th Edition, Pearson Education, 2015.

ELECTRONIC CIRCUIT 1

ENEE604015/ENEE613015
2 CREDITS
Learning Outcomes:

Able to apply analysis methods in the design of simple electronic circuits, able to analyze the response of simple electronic circuits

Topics:

Diode circuits, bipolar circuits of junction transistor, MOSFET circuits, transistor power supply circuit configurations, MOSFET power supply circuit configurations, transistor applications, and frequency responses

Prerequisite: Electric Circuit 1

Textbook:

Boylestad R, Nashhelsky L, "Electronic Devices and Circuit Theory 9th Edition", Prentice Hall, 2006.

ELECTRONIC CIRCUIT LABORATORY

ENEE604016/ENEE613016
1 CREDIT
Learning Outcomes:

Able to use experiment tools properly, able to practice the working principles of diodes, transistors, circuit configuration, frequency response, and amplifiers, able to analyze the dynamics of electronic circuit variables

Topics:

Diode circuits, transistor circuits, transistor power supply circuit configurations, transistor applications, frequency responses, and amplifier circuits.

Prerequisite: Electronic Circuit 1

Textbook:

Modul Praktikum Rangkaian Elektronika – Laboratorium Elektronika.

SIGNAL AND SYSTEM

ENEE604017/ENEE613011
3 CREDITS
Learning Outcomes:

Able to explain signals (discrete, continuous), systems and methods of transformation, able to apply methods of transformation and analysis of continuous and discrete systems, able to analyze the response of filter designed

Topics:

Signal and system definitions, Linear Time Invariant (LTI) Continuous and discrete systems, time domain representation and Fourier LTI systems, applications, Discrete Time Fourier Series (DTFS), Discrete Time Fourier Transform (DTFT), Laplace and z transformation applications, filter applications

Prerequisite: Engeneering Mathematics

Textbook:
1. Simon Haykin & Barry Van Veen, "Signals and System", 2nd Edition John Wiley & Sons Publisher, 2005.
2. Alan V. Oppenheim, Alan S. Willsky, S. Hamid Nawab, "Signals and Systems", Prentice Hall; 2nd Edition, 1996.

ELECTRIC POWER ENGINEERING

ENEE604018/ENEE614026
3 CREDITS
Learning Outcomes:

Able to identify problems of generation, transmission and distribution of electric power system, transformers, motors, generators; able to provide recommendations for components in an electric power system

Topics:

Electric power system, electric power generation, transmission and distribution, transformator, motor, generator

Prerequisite: Electric Circuit 2

Textbook:

S. J. Chapman, "Electric Machinery and Power System Fundamentals," McGraw-Hill Science/ Engineering/Math, 2001.

ELECTRIC POWER ENGINEERING LABORATORY

ENEE604019/ENEE614027
1 CREDIT
Learning Outcomes:

Able to practice the working of transformer, generator, motor; able to use measuring devices, able to analyze the performance of electric power system components

Topics: Transformator, generator, motor

Prerequisite: Electric Power Engineering

Textbook:

Modul Praktikum Teknik Tenaga Listrik- Laboratorium Konversi Energi Tenaga Listrik

NUMERICAL COMPUTATION

ENEE604020/ENEE614023
2 CREDITS
Learning Outcomes:

Able to make numerical computational algorithm, able to analyze the results of numerical computational.

Topics:

Designing numerical computation for root search, solving linear equation systems, curve fitting searches, integrals and differentials, ordinary differential equations, Interpolation, optimization

Prerequisite: Advanced Linear Algebra

Textbook:

Steven Chapra, Raymond Canale. "Numerical Methods for Engineer 7th Edition", McGraw Hill. 2014.

ELECTRICAL MATERIAL

ENEE604021/ENEE614025
2 CREDITS
Learning Outcomes:

Able to explain the general properties of electrical materials, able to classify types of electrical materials based on their properties and characteristics, able to examine the characteristics and specifications of various types of electrical materials in an application

Topics:

Atoms in solids; Dielectric Polarization; Dielectric losses; Classification of electrical materials: solids, ceramics, polymers; Insulation material: gas and liquid; material characteristics: conductivity, thermal, electrical, optical; Damage to insulation, optical material

Prerequisite: Physics of Semiconductor, Electric Circuit 1

Textbook:
1. Rudy Setiabudy, "Material Teknik Listrik", UI Press, 2007
2. R. E. Hummel, "Electronic Properties of Materials", Third Edition, Springer, 2000

EMBEDDED SYSTEM 1

ENEE604022/ENEE614025
3 CREDITS
Learning Outcomes:

Able to explain the components of embedded systems, microprocessors, microcontrollers; able to implement Asembly / C programming in embedded systems; able to choose the programming method that meet the need.

Topics:

Microprocessor Addressing Mode; Assembly/C Programming Language for microprocessors, microcontroller architecture, Input Output, serial communication, ADC, interruptions, microcontroller programming

Prerequisite: Basic Computer and Laboratory

Textbook:
1. Manuel Jimenez, Rogelio Palomera, Isidoro Couvertier, "Introduction to Embedded System Using Microcontroller and the MSP 430", Springer, 2014.
2. Perry Xiao,"Designing Embedded Systems and IOT with ARM MBED", Wiley, 2018.

3. Steven F. Barret, "Embedded System Design with Atmel AVR Microcontroller – Part I & II", Morgan & Claypol,2010.

ALGORITHM AND PROGRAMMING

ENEE604023/ENEE614028
3 CREDITS
Learning Outcomes:

Able to apply concepts: Modular; Iteration and Recursion; Sorting; Searching; Arrays; pointers; Linked List, able to analyze programming results in C language, able to recommend a programming design.

Topics:

Modular; Iteration and Recursion; Sorting; Searching; Array; Pointers; Linked List; Static and Dynamic Data Structure in C Language

Prerequisite: Basic Computer and Laboratory

Textbook:
1. Thomas H. Cormen, "Introduction to Algorithms", 3rd Edition, MIT Press, 2009
2. Robert Sedgewick & Kevin Wayne, "Algorithms", 4th Ed., Addison-Wesley Professional, 2011

INTRODUCTION TO TELECOMMUNICATION SYSTEM

ENEE605024/ENEE613013
3 CREDITS
Learning Outcomes:

Able to explain the parts in the telecommunications equipment system, able to identify concepts and technologies in the telecommunications system (modulation, transmission, numbering techniques)

Able to explain the parts of telecommunications system, able to identify concepts and technology in telecommunications systems (modulation, transmission, numbering techniques), able to choose a design of telecommunications system that suits the needs.

Topics:

Introduction to Telecommunications, Analog and Digital Communication Systems and Devices. Telecommunications Networks, Distortion, Decibel Principles (dB), Switching, Signaling, Queing and Routing Theory, Numbering Techniques, Transmission Lines: Wired and Wireless, Analog Modulation Principles: Amplitude and Frequency Modulation

Prerequisite: Signal and System, Electromagnetics

Textbook:
1. Simon Haykin, "Communication Systems", 5th Edition, John Wiley & Sons Inc., 2008.
2. Roger L. Freeman, "Telecommunication Systems Engineering", 4th Edition, John Wiley & Sons Inc., 2004.

TELECOMMUNICATION SYSTEM LABORATORY

ENEE605025/ENEE613014
1 CREDIT
Learning Outcomes:

Able to use telecommunication system measuring tools, able to practice basic concepts of telecommunication system, able to choose design of telecommunication system

Topics:

Multimedia information, Analog to Digital Conversion (ADC)-Digital to Analog Conversion (DAC), Information encodings, Digital Modulation-Demodulation, Analog Modulation-Modulation, Multiplexing (OFDM), Antenna Design, Transmission Channels.

Prerequisite: Introduction to Telecommunication System

Textbook:

Laboratory Workbook–Telecommunication Engineering Laboratory.

ELECTRONIC CIRCUITS 2

ENEE605026/ENEE614021
2 CREDITS
Learning Outcomes:

Able to apply methods of analysis and design of electronic circuits, able to analyze the performance of electronic circuit designs, able to provide recommendations for electronic circuit designs for certain purposes

Topics:

Power amplifier circuit, digital circuit with digital bipolar circuit, high-order active filter, oscillator circuit, Schmidt Trigger, and voltage regulators

Prerequisite: Electronic Circuits 1

Textbook:

Boylestad R, Nashhelsky L (2006), Electronic Devices and Circuit Theory 9th Edition, Prentice Hall, New Jersey, USA.

CONTROL ENGINEERING

ENEE605027/ENEE614019
4 CREDITS
Learning Outcomes:

Able to explain the concept of discrete & continuous control techniques and their methodology, able to apply discrete and continuous system analysis methods with block diagrams, Time Response, stability and steady-state errors, root locus, frequency response, able to choose control design methods (discrete and continuous) with according to the model and needs

Topics:

Continuous and discrete control system models, Block diagrams; response time; stability; steady-state error, root locus; frequency response, controller design with root locus; controller design with bode diagram, discrete / continuous state-space model, controller design in discrete / continuous state-space model

Prerequisite: Signal and System

Textbook:
1. N. Nise, "Control Systems Engineering", 9th Edition, Wiley, 2019.
2. Katsuhiko Ogata, "Modern Control Engineering" 5th Edition, Pearson, 2010.
3. Charles L. Phillips,H. Troy Nagle, Aranya Chakrabortty, "Digital Control System: analysis and design, 4th edition", Pearson, 2015.

CONTROL ENGINEERING LABORATORY

ENEE605028/ENEE614021
1 CREDIT
Learning Outcomes:

Able to apply time response analysis method, system stability and steady-state error, root locus, frequency response, controller design with root locus, controller design with Bode diagram, state-space, able to analyze control system design performance, able to provide alternative controller design methods

Topics:

Time response, system stability and steady error, root locus, frequency response, controller design with root locus, controller design with bode diagram, state-space

Prerequisite: Control Engineering

Textbook:

Laboratory Workbook–Control Systems Laboratory.

EMBEDDED SYSTEM 2

ENEE605029/ENEE615030
3 CREDITS
Learning Outcomes:

Being able to describe the components of the IoT system, being able to explain the application of a practical IoT system, being able to choose the right technology in the design of the IoT, able to design IoT system.

Topics:

Basics of Internet of Things, sensors, actuators, data communications, data communication protocols, radio layer, modem layer, MAC layer, cloud computing configuration for IoT networks (azzure and aws)

Prerequisite: Embedded System 1

Textbook:
1. Daniel Chew, "The Wireless Internet of Things", Wiley, 2019
2. Perry Xiao," Designing Embedded Systems and IOT with ARM MBED", Wiley, 2018.

EMBEDDED SYSTEM LABORATORY

ENEE605030/ENEE615031
1 CREDIT
Learning Outcome:

Able to implement programming methods in Assembly/C language in embedded systems for certain applications, able to analyze embedded system designs, able to investigate design performance

Topics: Microcontroller on Development Board, programming using assembly/C language

Prerequisite: Embedded System 1

Textbook:

Modul praktikum

MODELING AND MACHINE LEARNING

ENEE605031/ENEE616029
3 CREDITS
Learning Outcomes:

Able to explain the concept of data reduction, able to apply the PCA method in data reduction, able to use the matrix decomposition method, able to apply optimization methods in modeling, able to derive dynamic models from the data, able to choose a model evaluation method, able to choose a machine learning method according to the problem

Topics:

Data reduction, PCA, Optimization, dynamic and data modeling, dynamic model parameter estimation, supervised and unsupervised learning, clustering, classification, model evaluation, MSE, MAP, use of machine learning software

Prerequisite: Numerical Computation

Textbook:
1. Jeremy Watt, Reza Borhani, Anngelos K. Katsaggelos, "Machine Learning Refined: Foundations, Algoritms, and Applications", Cambridge University Press, 2016.
2. Ethem Alpaydin, "Introduction to Machine Learning", 2nd Edition, MIT Press, 2010
3. Harold Klee, Randal Allen," Simulation of Dynamic Systems with MATLAB and Simulink", CRC Press, 2011

INNOVATION AND ENTREPRENEURSHIP

ENEE605032/ENEE616042
2 CREDITS
Learning Outcomes:

Able to perform analysis and make business plans in expertise/product innovation in accordance with the development of information technology; Able to implement entrepreneurial concepts and skills in the field of electrical engineering

Topics:

Innovation, engineering business, Charging for Expertise, Think, Plan, Act Like Entrepreneur, Making a Business Successful, Taking the Initiative, Enabling an E-Business, Providing Outsourced Services & Building a Contracting Business, guest lecture

Prerequisite: none

Textbook:
1. New Venture Creation – Entrepreneurship for the 21st Century, 6th Edition, J.A. Timmons and S. Spinelli, McGraw-Hill Irvin, 2004.
2. Materi kuliah yang diberikan oleh praktisi wirausaha

ELECTRICAL ENGINEERING PROJECT DESIGN 1

ENEE606033/ENEE616037
2 CREDITS
Learning Outcomes:

Able to define product requirements and specifications, able to understand technical, financial and standard aspects in engineering products, able to understand aspects of market needs in planning, able to prepare electrical engineering project proposals

Topics:

Professional ethics, product engineering ideas, needs analysis, product specifications, technical feasibility, financial feasibility, engineering and product standards, business canvas, marketing, project proposal writing techniques

Prerequisite: Embedded System 1, Modeling and Machine Learning

Textbook:
1. Bruce R. Barringer, R. Duane Ireland, "Entrepreneurship: Successfully Launching New Ventures", 4th Edition, Pearson, 2012.
2. Bruce R. Barringer, R. Duane Ireland, "Entrepreneurship: Successfully Launching New Ventures", 4th Edition, Pearson, 2012.
3. Tim Clark, Alexander Osterwalder, Yves Pigneur, "Business Model: YOU", Wiley, 2012.
4. Paul Swamidass," Engineering Entrepreneurship from Idea to Business Plan", Cambridge University Press, 2016.
5. Pedoman Teknis Penulisan Tugas Akhir Mahasiswa Universitas Indonesia.

ELECTRICAL ENGINEERING PROJECT DESIGN 2

ENEE607035/ENEE617043
3 CREDITS

Learning Outcomes:

Able to work in a team, able to present the results of the design in oral and written, able to design technology in the field of electrical engineering

Topics: Project Implementation

Prerequisite: Electrical Engineering Project Design 1

Textbook:

Harvey F. Hoffman, "The Engineering Capstone Course: Fundamentals for Students and Instructors", Springer 2014.

Course of Electric Power Engineering Field

ENERGY CONVERSION AND RENEWABLE ENERGY
ENEE606101
2 CREDITS
Learning Outcomes:

Able to describe various types of energy resources for electric power generation, able to calculate various energy potential for electric power generation, able to analyze the process of electrical energy conversion, able to recommend the technology of electrical energy supply.

Topics:

Fundamental of Energy Conversion, Energy Resources, Renewable Energy, Electric Power Conversion Technologies, Thermal Power Plants, Non-Thermal Power Plants.

Textbook:
1. Djiteng Marsudi, "Pembangkitan Energi Listrik," Penerbit Erlangga, 2005.
2. Abdul Kadir, "Pembangkitan Tenaga Listrik," Penerbit UI, 1996.
3. D. Yogi Goswami, Frank Kreith, "Energy Conversion," Penerbit CRC Press, 2007.
4. Bent Sørensen, "Renewable Energy Conversion, Transmission and Storage," Elsevier, 2007.

POWER ELECTRONICS AND LABORATORY
ENEE606102/ENEE615032
3 CREDITS
Learning Outcomes:

Able to explain the philosophy of power electronics equipment, able to calculate parameters in the power electronics circuit, able to design power electronic system application

Topics:

Power electronics introduction, power electronics components, AC-AC conveters, AC-DC converters, DC-DC converters, DC-AC converters, power electronics applications

Prerequisite: Electric Power Engineering.

Textbook:
1. Muhammad H. Rashid, "Power Electronics Circuit, Devices and Applications," Prentice Hall Fourth Edition, 2013.
2. Modul Praktikum Elektronika Daya - Laboratorium Konversi Energi Listrik

MANAGEMENT AND ENGINEERING ECONOMY
ENEE606103
3 CREDITS
Learning Outcomes:

Able to classify energy fields, able to calculate the economics of electricity, able to analyze the comparison of alternative technologies, able to analyze the latest technology in the field of energy conversion, able to analyze the technical and economical aspects of energy project, able to provide technical and economic technology solutions in the energy and electricity sector

Topics:

Basic concepts of management, types of organization, organizational resources, economic concepts, correlation of money and time values, comparative studies, replacement analysis, basics of energy management, energy costs, calculation of energy potential

Prerequisite: Electric Power Engineering.

Textbook:
1. William G. Sullivan, Elin M. Wicks, James T. Luxhoj, "Engineering Economy," 13th Edition, Pearson Education International, 2006.
2. Andrew C. Paine, John V. Chelsom, Lawrence R.P. Reavill, "Management for Engineers," John Wiley and Sons, 1996.

ELECTRIC POWER SYSTEM AND LABORATORY
ENEE607104/ENEE616039
3 CREDITS
Learning Outcomes:

Able to calculate the parameters of the electric power network, able to model the components of the electric power system, able to analyze the flow of power in the electric power system, able to analyze short circuit disturbances in the electric power system, able to analyze the stability of the system, able to design an electric power system with an approach simulation

Topics:

Introduction of electric power systems, components of electric power systems, power flow analysis, short circuit analysis, system stability analysis, economic dispatch

Prerequisite: Electric Power Engineering

Textbook:

B.M. Weedy, B.J. Cory, "Electric Power Systems," 4th Edition, John Wiley and Sons, 2001.

HIGH CURRENT & VOLTAGE ENGINEERING AND LABORATORY
ENEE607105
3 CREDITS
Learning Outcomes:

Able to explain the phenomenon of high electric and magnetic fields, able to test electric power equipment, able to analyze the occurrence of interference due to high field phenomena, able to provide design solutions for high voltage technology

Topics:

The concept of high voltage, high voltage testing, high voltage generation, direct current and alternating current testing, electrical equipment testing

Prerequisite: Electric Power Engineering

Textbook:
1. Artono Arismunandar, "Teknik Tegangan Tinggi," Pradnya Paramita, Jakarta, Cetakan ke-7, 1994.
2. E. Kuffel, W.S. Zaengl, "High Voltage Engineering Fundamentals," Pergamon Press, 1984.
3. Modul Praktikum Teknik Arus dan Tegangan Tinggi - Laboratorium Tegangan Tinggi dan Pengukuran Listrik.

BUILDING ELECTRIC INSTALLATION
ENEE607106
2 CREDITS
Learning outcomes:

Able to make building electric installations plan; Able to calculate the parameters of electrical installations in buildings; Able to provide a building electrical installation design that suits the needs

Topics:

Basic of electrical installation, electrical installation components, electrical installation requirements, electrical installation security, lighting technology, security and safety technology, and electrical installation procedures for buildings

Prerequisite: Electric Power Engineering

Textbook:
1. William K Y Tao, Richard R Janis, "Mechanical and Electrical System in Building," Prentice Hall 1997.
2. Brian Scaddan, "Electrical Installation Work". Elsevier Publishing, 2005.

SPECIAL TOPICS OF ELECTRIC POWER ENGINEERING
ENEE607107
2 CREDITS
Learning Outcomes:

Able to identify problems, technology and current issues in the field of electric power engineering

Topics:

Presentation of material from practitioners and academics in the field of electric power engineering

Prerequisite: -

Textbook: -

SMART GRID
ENEE608108
2 CREDITS
Learning Outcomes:

Able to explain the concept of a smart grid and its difference with conventional systems, able to evaluate smart grid infrastructure, able to provide smart grid design solutions

Topics:

Definitions, characteristics, and advantages of smart grids, smart grid differences with conventional systems, data communication infrastructure, smartgrid standards, smart grid applications in distribution systems

Prerequisite: Electric Power Engineering

Textbook:

Salman K. Salman, "Introduction to the Smart Grid: Concepts, Technologies and Evolution", The Institution of Engineering and Technology, 2017.

ELECTRIC POWER SYSTEM PROTECTION
ENEE608109
2 CREDITS
Learning Outcomes:

Able to explain the philosophy of electric power system protection, able to calculate electrical protection systems, able to evaluate the electric power system protection, able to design electric power system protection

Topics:

Philosophy of electric power system protection, types of protection relays, the working principle of protection relays, the setting of protection relays, coordination principles of protection relays

Prerequisite: Electric Power Engineering

Textbook:

1. G.E.C. Alsthom, "Protective Relays Application Guide," U.K., 2015

SPECIAL TOPICS OF ELECTRIC POWER 2
ENEE608110
2 CREDITS
Learning Outcomes:

Able to explain current issues related to the electric power engineering field

Topics:

Presentation of practitioners and academics in electric power engineering fields

Prerequisite: -

Textbook: -

Course of Electronic Engineering Field

DESIGN OF ELECTRONIC CIRCUITS
ENEE606201
3 CREDITS
Learning Outcomes:

Able to design prototype of electronic circuit for several applications with the required specifications

Topics:

Review of Fundamentals of Devices and Circuits. Overall Design Process. The Design of the Power Supply and Overall Power Management. The Analogue World and Preprocessing of Signals. Essentials of the Data Conversion Process. Processing of the Digital Information. Role of Simulation as a Tool for Design Confirmation. Signal Integrity and Clock Distribution, PLL and Frequency Synthesisers, Signal Sources. System on a Chip (SoC) Concepts. Prototyping and Testing of the Product/ Release of a Design and Documentation.

Prerequisite: Electronic Circuits 2

Textbook:

Nihal Kularatna, "Electronic Circuit Design: From Concept to Implementation", CRC Press, 2019

ADVANCED ELECTRONIC DEVICES
ENEE606202
3 CREDITS
Learning Outcomes:

Able to explain semiconductor device fabrication processes; Able to use fabrication process design tools; Able to design semiconductor fabrication processes in microelectronic devices.

Topics:

History of the semiconductor industry, semiconductor materials, crystal growth and wafer preparation, contamination control, oxidation, lithography, diffusion, ion implantation, etching, deposition, use of Supreme ver.4

Prerequisite: Electronic Circuits 2

Textbook:
1. Peter Van Zant, "Microchip Fabrication," 8th Edition, International Edition, McGraw-Hill, 2004.
2. Modul Praktikum Fabrikasi divais semikonduktor - Laboratorium Elektronika

DESIGN OF ELECTRONICS INSTRUMENTATION
ENEE606203/ENEE615035
2 CREDITS

Learning Outcomes:
Able to design electronic instrumentation

Topics:

Industrial electronics instrumentation technology, medical electronic instrumentation, RF electronic instrumentation, IoT electronic instrumentation

Prerequisite: Electronic Circuits 2

Textbook:

Halit Eren, "Electronic Portable Instruments: Design and Applications", CRC Press, 2003

OPTOELECTRONIC DEVICES

ENEE607204
3 CREDITS
Learning Outcomes:

Able to explain the working principles of passive and active photonics, able to apply mathematical and physical principles to calculate photonic device variables, able to determine photonic device variables, able to formulate problems in optoelectronic device design

Topics:

Theory of light: Snellius's law, Fresnel's law, Maxwell's law, Fermat's equation, polarization, diffraction, NA, attenuation, mode understanding, dispersion, dispersive power, resolving power, free spectral range, coherence, vectors, matrix Jones, passive photonic devices: and optics, grating, polarisator; Active photonic devices: laser diode, LED and photodetector.

Prerequisite: Electronic Circuits 2

Textbook:
1. B.E.A. Saleh and M.C. Teich, "Fundamentals of Photonics," New York, NY: John Wiley and Sons, 1991. ISBN: 0471839655.
2. D. Griffiths, "Introduction to Quantum Mechanics," Second Edition, Upper Saddle River, NJ: Prentice Hall, 1995, ISBN: 0131118927.
3. Modul Praktikum Pilihan - Laboratorium Elektronika

OPTOELECTRONIC DEVICES

ENEE617044
2 CREDITS
Learning Outcomes:

Able to explain the working principles of passive and active photonics, able to apply mathematical and physical principles to calculate photonic device variables, able to determine photonic device variables, able to formulate problems in optoelectronic device design

Topics:

Theory of light: Snellius's law, Fresnel's law, Maxwell's law, Fermat's equation, polarization, diffraction, NA, attenuation, mode understanding, dispersion, dispersive power, resolving power, free spectral range, coherence, vectors, matrix Jones, passive photonic devices: and optics, grating, polarisator; Active photonic devices: laser diode, LED and photodetector

Prerequisite: Electronic Circuits 2

Textbook:
1. B.E.A. Saleh and M.C. Teich, "Fundamentals of Photonics," New York, NY: John Wiley and Sons, 1991. ISBN: 0471839655.
2. D. Griffiths, "Introduction to Quantum Mechanics," Second Edition, Upper Saddle River, NJ: Prentice Hall, 1995, ISBN: 0131118927.
3. Modul Praktikum Pilihan - Laboratorium Elektronika

DESIGN OF VLSI CIRCUITS

ENEE607205
3 CREDITS
Learning Outcomes:

Able to design VLSI circuits

Topics:

Review semiconductor device fabrication on CMOS, Design rules, Scale of Lambda, Asynchrony, Logic Gate Design, Inverter, NAND, NOR, Full custom design, Semi custom design, Validation, Packaging / IO, Design for fabrication, error modeling and test design, Coding for synthesis, Estimated characteristics and circuit performance, High level design optimization, Programmable logic array, CMOS subsystem Design, Properties of Logic: Area, Power, Delay, Time optimization, Sequential engine, and regular VLSI Structure.

Prerequisite: Electronic Circuits 2

Textbook:

N. Weiste & Kamran Eshraghian, "Principles of CMOS VLSI Design: A perspective," Second Edition, Addison Wesley 2002.

INTRODUCTION TO NANOELECTRONICS

ENEE607206/ENEE616038
2 CREDITS
Learning Outcomes:

Able to analyze the latest developments in the field of electronics and photonics; Able to analyze the workings of nanoelectronic and nanofotonic devices.

Topics:

Nano technology and its application in electronics, from micro to nano, miniaturization of electronic devices, transistor dimension scaling, the workings of single electron transistors, molecular electronics principles, fabrication and characterization of nano devices, nano technology and its applications in the field of photonics, the workings of single- photon detector, how the OLED works

Prerequisite: Electronic Circuits 2

Textbook:
1. Massimiliano Di Ventra, et al. Introduction to NST ch.11 Kluwer Acad. Publisher 2004.
2. Vladimir V. Mitin, Viatcheslav A. Kochelap, Michael A. Stroscio, "Introduction to Nanoelectronics", Cambridge University Press, 2008

SPECIAL TOPICS OF ELECTRONICS

ENEE6072017
2 CREDITS
Learning Outcomes:
Able to explain current issues related to the electronic field

Topics:

Presentation of practitioners and academics in electronic fields

Prerequisite: -

Textbook: -

ADVANCED EMBEDDED SYSTEM

ENEE608208
3 CREDITS
Learning Outcomes:
Able to design embedded systems with the latest methods

Topics:

Characteristics of embedded systems; minimum microcontroller system design; hardware and software data communication; sensor data acquisition and actuators.

Prerequisite: Electronic Circuits 2

Textbook:

Perry Xiao, "Designing Embedded Systems and the Internet of Things (IoT) with the ARM® Mbed™", Wiley, 2018

SPECIAL TOPICS OF ELECTRONICS 2
ENEE608209
2 CREDITS
Learning Outcomes:
Able to explain current issues related to the electronic field

Topics:

Presentation of practitioners and academics in electronic fields

Prerequisite: -

Textbook: -

Course of Telecommunication Engineering Field

DIGITAL COMMUNICATION
ENEE606301
3 CREDITS
Learning Outcomes:

Able to analyize telecommunication phenomenon using simulatuon devices, able to provide solutions for digital communication technology applications

Topics:

Mathematic for telecommunication, information theory, coding tehcniques, signal processing for telecommunication, Digital Modulation: ASK, FSK, and PSK, channel capacity analysis.

Prerequisite: Introduction to Telecommunication System

Textbook:
1. Martin Sibley, "Modern Telecommunications: Basic Principles and Practices", CRC Press, 2018.
2. V. K. Khanna, "Digital Communications", S. Chand & Company Ltd. 2009.

TELECOMMUNICATION SYSTEM DEVICES
ENEE606302/ENEE616040
3 CREDITS
Learning Outcomes:

Able to analyze the sub-system of communications devices, able to analyze transmission channel, equalizer, resonator, filter, amplifier, LNA, oscillator, mixer, able to analyze amplifier, LNA, ascillator, and mixer, able to design sub system of active communications devices

Topics: Pasif RF devices, Active RF devices

Prerequesite: Introduction to Telecommunication System

Textbook:
1. D. M. Pozar, "Microwave Engineering", Addison-Wesley, 1998.
2. Gonzalez, "Microwave Transistor Amplifiers: Analysis and Design", 2nd Edition, Prentice Hall, 1997.

OPTICAL COMMUNICATIONS
ENEE606303
2 CREDITS
Learning Outcomes:

Able to explain transmission channel using fiber and its principle; able to explain component of optical communication systems; able to analyze optical communication system, Able to provide application solutions for optical communication technology.

Topics:

Structure and optical fiber waveguide, signal degradation in on optical fiber, optical sources, optical components, optical coherent fiber communication; the techniques of modern systems; The techniques and coding theory; Performance analysis of optical communication systems

Prerequesite: Introduction to Telecommunication System.

Textbook:
1. Govind P. Agrawal, "Fiber-Optic Communication Systems", 3rd Edition, Wiley Interscience, 2002.
2. G. Keiser, "Optical Fiber Communications", 3rd Edition, McGraw Hill, 2000.

ANTENNA AND PROPAGATION
ENEE607304
3 CREDITS
Learning outcomes:

Able to describe wave propagation and transmission system and its implications on the performance of communication systems; Able to explain various mechanisms of propagation of electromagnetic waves; Able to explain the working principle of antenna and antenna performance parameters; Being able to describe the various types of antenna as a means for transmitting signals; Able to calculate the performance of the simple antenna systems which good in theory or application; Able to calculate the performance of a single element antenna such as a dipole, yagi, antenna loop, funnels, slot antenna and micro-strip antenna; Able to design a simple antenna and measure it; able to analyze the types of wave propagation and select the correct antenna for wireless communication system, bble to design simple antennas

Topics:

Working principles of the basic parameters of antenna, the antenna measurement techniques, several types of antennas: dipole antenna, monopole, antenna stacking, aperture antenna and antenna with reflector. Radio wave propagation (ground surface wave, wave, wave, space sky wave, and microwave and millimeter wave);

Prerequisite: Introduction to Telecommunication System.

Textbook :
1. Constantine A. Balanis, "Antenna Theory, Analysis and Design," Third Edition, John Willey and Son, Inc., 2005.
2. Saunders R. Simon, "Antennas and Propagation for Wireless Communication Systems," First Edition, John Wiley and Son, Inc., 1999.
3. Jurnal IEEE transaction Antenna and Propagation

WIRELESS COMMUNICATION AND CONVERGENCE NETWORKS
ENEE607305/ENEE615034
3 CREDITS
Learning Outcomes:

Able to explain concepts, techniques and components of wireless and mobile communication, able to apply wireless communication analysis methods, able to analyze the performance of various mobile wireless communication systems, able to provide alternative solutions for mobile wireless communication technology applications

Topics:

Overview of Wireless Communications, Cellular Concept/ Fundamentals, Large Scale Fading/Path Loss, Small Scale Fading, Modulation Techniques, Equalization, Diversity, Channel Coding / Error Control Coding Overview, Multiple Access, Emerging Wireless Technologies: WLAN, 3G and WCDMA, 4G and LTE, Mobile Adhoc Networks, Body Area Networks and Mobile Health, Future Wireless System.

Prerequisite: Introduction to Telecommunication System

Textbook:
1. Martin Sauter, "From GSM to LTE-Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband", John Wiley & Sons, 2017.
2. Savo G. Glisic, "Advanced Wireless Communications and Internet: Future Evolving Technologies, 3 edition", John Wiley & Sons, 2017.
3. T. S. Rappaport, "Wireless Communications: Principles and Practice", Upper Saddle River, New Jersey: Prentice Hall, 2nd Ed., 2002.

CAPITA SELECTA OF TELECOMMUNICATION ECOSYSTEMS
ENEE607306
2 CREDITS
Learning Outcomes:

Able to describe the latest issues related to telecommunications systems (technical, regulatory, industrial, business), able to provide evaluations of the latest technology of telecommunications systems, able to provide solutions for the latest technology application of telecommunications systems

Topics:

Lecturing from telecommunication engineer and expert.

Textbook: -

SPECIAL TOPICS OF TELECOMMUNICATION 1
ENEE607307
2 CREDITS
Learning Outcomes:
Able to explain current issues related to the telecommunication engineering field

Topics:
Presentation of practitioners and academics in telecommunication engineering fields

Prerequisite: -

Textbook: -

SIGNAL PROCESSING AND MULTIMEDIA SERVICES
ENEE608308
3 CREDITS
Learning Outcomes:

Able to explain concept of broadband multimedia services, able to apply analytical methods to a multimedia signal, able to evaluate the dynamics of multimedia signals, able to provide solutions for multimedia signal applications

Topics:

Multimedia concept, sinal processing based model: Probability, Bayes Inference, Least Square Error, Wiener-Kolmogorov Filters, Adaptive Filter: Kalman, RLS, LMS; Linear Prediction Models, Hidden Markov Models, Eigenvector Analysis, Principal Component Analysis and Independent Component Analysis, Machine Learning, Signal Processing for Multimedia application and telecommunication system.

Prerequesite: Introduction to Telecommunication System.

Textbook:
1. Guojun Lu, "Communication and Computing for Distributed Multimedia Systems," John Wiley and Sons
2. Luis Correia, "Mobile Broadband Multimedia Networks," Elsevier, UK, 2006
3. Multimedia Signals and Systems: Basic and Advanced Algorithms for Signal Processing, Second Edition

SPECIAL TOPICS OF TELECOMMUNICATION 2
ENEE608309
2 CREDITS
Learning Outcomes:

Able to explain current issues related to the telecommunication engineering field

Topics:

Presentation of practitioners and academics in telecommunication engineering fields

Prerequisite: -

Textbook: -

Course of Control Engineering Field

ELECTRIC MOTOR CONTROL SYSTEM
ENEE606401/ENEE615033
3 CREDITS
Learning Outcomes:

Able to analyze the components of the electric drive control system; able to evaluate the performance of the electric drive system by simulation; Able to design simple motor drive systems

Topics:

Electric drive systems, electric motor modeling (DC, PMSM, IM), power transfer circuits (3 phase inverter PWM), brushless DC servo motors, speed and position controllers, reference frame concepts, vector controllers, electric drive system simulations.

Prerequisite: Control Engineering

Textbook:
1. Peter Vas, "Electrical Machines and Drives: A Space-Vector Theory Approach", Oxford University Press UK, 1993.
2. Peter Vas, "Sensorless Vector and Direct Torque Control", Oxford University Press, 1998.

ADAPTIVE AND PREDICTIVE CONTROL SYSTEM
ENEE606402
3 CREDITS
Learning Outcomes:

Able to identify adaptive and predictive models and applications; able to analyze discrete control systems, the stability of non-linear systems using the Lyapunov method; able to evaluate the performance of adaptive and predictive control systems; able to design adaptive and predictive discrete controllers

Topics:

The basic concepts of adaptive and predictive control, recursive parameter estimation, pole placement method, minimum variance method, dynamic matrix control, algorithmic control model, generalized predictive control, predictive control of state space model

Prerequisite: Control Engineering

Textbook:
1. P.E. Wellstead and M.B. Zarrop, "Self-tuning Systems:

Control and Signal Processing", John Wiley and Sons, 1991.
2. J.M. Maciejowski, "Predictive control with constraints", Prentice Hall, 2000

INDUSTRIAL AUTOMATION SYSTEM

ENEE606403
2 CREDITS
Learning Outcomes:

Able to explain important components in industrial automation systems, able to describe technical specifications and performance of industrial automation systems, able to evaluate the performance of industrial automation systems, able to design simple industrial automation systems

Topics:

Important components of industrial automation systems, sensors, actuators, data communication systems, automation control methods, industrial control system modules (DCS, PLC), cyber security of industrial automation.

Prerequisite: Control Engineering

Textbook:
1. Shimon Y. Nof, "Handbook of Automation", Springer, 2009
2. Terry Bartelt, "Industrial Control Electronics: Devices, Systems, and Applications", Thomson Delmar Learning, 2006

MECHATRONICS

ENEE607404
3 CREDITS
Learning Outcomes:

Able to analyze the control components; able to analyze the limitations of mechatronic system components; able to design an integrated control system on a simple mechatronic system; able to design mechatronic systems for robotics applications by accommodating the limitations of components

Topics:

Introduction of mechatronic systems, characteristics and limitations of mechatronic systems Methods for increasing the reliability of mechatronic system components, mechatronic system design, electromechanical system modeling, design and development of application software, compliant control, telerobotics, bilateral control.

Prerequisite: Control Engineering

Textbook:

Robert Bishop, "Mechatronics and Introduction", 2006.

KNOWLEDGE-BASED SYSTEM

ENEE607405
3 CREDITS
Learning Outcomes:

Able to apply algorithms in programming languages for knowledge-based systems; Able to identify knowledge-based dynamic system models; Able to analyze the performance of artificial neural networks; Able to design algorithms in a knowledge-based system application

Topics:

The working system of neurons, cells, artifcial neural network architecture (JST); the learning method is JST; back propagation neural networks (BPNN); algorithms and analysis of programming error, function of BPNN in Matlab; optimization of parameters; application of BPNN program asthe system identifer of the pattern, the system control based neural network: an analysis of the use of methods of control, as a system of BPNN identifcation of neural network-based systems: representation of data and the use of BPNN as identifcation system, program development system identifcation using the BPNN full-based system, the development of BPNN and analysis theory and its application, program development system control using the BPNN full system integration based BPNN.

Prerequisite: Control Engineering

Textbook:
1. Lefteri H.,Tsoukalas and Robert E. Uhrig, "Fuzzy and Neural Approaches in Engineering", John Wiley & Sons, Inc., Singapore, 1997.
2. John Yen and Reza Langari, "Fuzzy Logic, Intelligence, Control and Information", Prentice Hall, Inc. New Jersey, 1999.

ROBOTIC SYSTEM

ENEE607406
2 CREDITS
Learning Outcomes:

Being able to identify the needs of robotics components; Able to analyze robot kinematics; Able to evaluate the robotics drive system; Able to design an integrated control system on a simple robotics system; Able to design robotics kinematics.

Topics:

Robotics automation system components (actuators, sensors, controllers), principle of robotics system working, robot kinematics, robotics control systems (position control) based on robot kinematics, interconnecting robotics system components, robot design techniques, robot programming, simulation using OpenGL, introduction to high level robot

Prerequisite: Control Engineering

Textbook:
1. Robotika: desain, kontrol, dan kecerdasan buatan, penerbit Andi, karangan Endra Pitowarno, 2006.
2. Introduction to Robotics: mechanics and control, 3rd Edition, John Craig, Pearson, 2009.

SPECIAL TOPICS OF CONTROL 1

ENEE607407
2 CREDITS
Learning Outcomes:
Able to explain current issues related to the control engineering

Topics:

Presentation of practitioners and academics in control engineering fields

Prerequisite: -

Textbook: -

AUTONOMUS VEHICLE SYSTEM

ENEE608408/ENEE616036
3 CREDITS
Learning Outcomes:

Able to explain the components of autonomous vehicle control systems, able to implement control system designs on autonomous vehicles, able to analyze the performance of autonomous vehicle control system components, able to provide simple application solutions for autonomous vehicle system technology

Topics:

Vehicle dynamic systems, vehicle navigation systems, vehicle wheel drive systems, autonomous vehicle simulation systems

Prerequisite: Control Engineering

Textbook:
1. Hong Cheng, "Autonomous Intelligent Vehicles: Theory, Algorithms, and Implementation", Springer-Verlag, 2011.
2. Jitendra R. Raol, Ajith K. Gopal, "Mobile Intelligent Autonomous System", CRC Press, 2013.

SPECIAL TOPICS OF CONTROL 2
ENEE608409
2 CREDITS
Learning Outcomes:

Able to explain current issues related to the control engineering field

Topics:

Presentation of practitioners and academics in control engineering fields

Prerequisite: -

Textbook: -

ACADEMIC WRITING
ENEE611003
2 CREDITS
Learning Outcomes:

Able to make proposals and scientifc papers for publication.

Topics:

Systematics of scientifc writing; experimental variables and sets up; statistical analysis tools; The use of the Bahasa Indonesia in scientifc works; The use of English languages in scientifc works; Word processing software; styling; referencing tools

Prerequisite: none

Textbook:

1. Ranjit Kumar, Research Methodology: A Step by Step Guide for Beginners, 3rd ed. Sage Publication, 2012
2. Robert a. Day and Barbara Gastel, How to Write and Publish a Scientifc Paper, 6th ed. Greenwood Press, London, 2006

Special Course

INTERNSHIP
ENEE616041
2 CREDITS
Learning Outcomes:

In this course students will undertake work internships in industries or laboratories related to the field of electrical engineering. In this course students are expected to be able to apply the technical knowledge they have gained during previous lectures and new material provided by practical work advisers. Students are also expected to be able to show professionalism in working, including the ability to work together in teams, disciplined behavior, responsibilities, initiatives & interests, leadership, able to participate in teams to complete work; able to presnt the results of internship

Topics: none

Prerequisite: Have passed the 90 credits

PRA-BACHELOR THESIS
ENEE607036/ENEE617045
2 CREDITS
Learning Outcomes:

Able to make proposal for designing a system, component, and process; able to write a research proposal; able to present research proposals.

Topics: none

Prerequisite: Have passed 120 credits

References:
1. Pedoman Teknis Penulisan Tugas Akhir Mahasiswa Universitas Indonesia.
2. IEEE Citation Reference.
3. Ivan Stojmenovic, "How To Write Research Articles in Computing and Engineering Disciplines," IEEE Transactions on Parallel And Distributed Systems, Vol. 21, No. 2, February 2010.

BACHELOR THESIS
ENEE618037/ENEE608037
4 CREDITS
Learning Outcomes:

Able to design systems, components and processes; able to carry out research plan; able to analyze the results of research; able to present research results in a bachelor thesis defense

Topics: none

Prerequisite: seminar

Referencees:
1. Pedoman Teknis Penulisan Tugas Akhir Mahasiswa Universitas Indonesia.
2. IEEE Citation Reference.
3. Ivan Stojmenovic, "How to Write Research Articles in Computing and Engineering Disciplines," IEEE Transactions on Parallel and Distributed Systems, Vol. 21, No. 2, February 2010.

Undergraduate Program in Computer Engineering

Program Specification

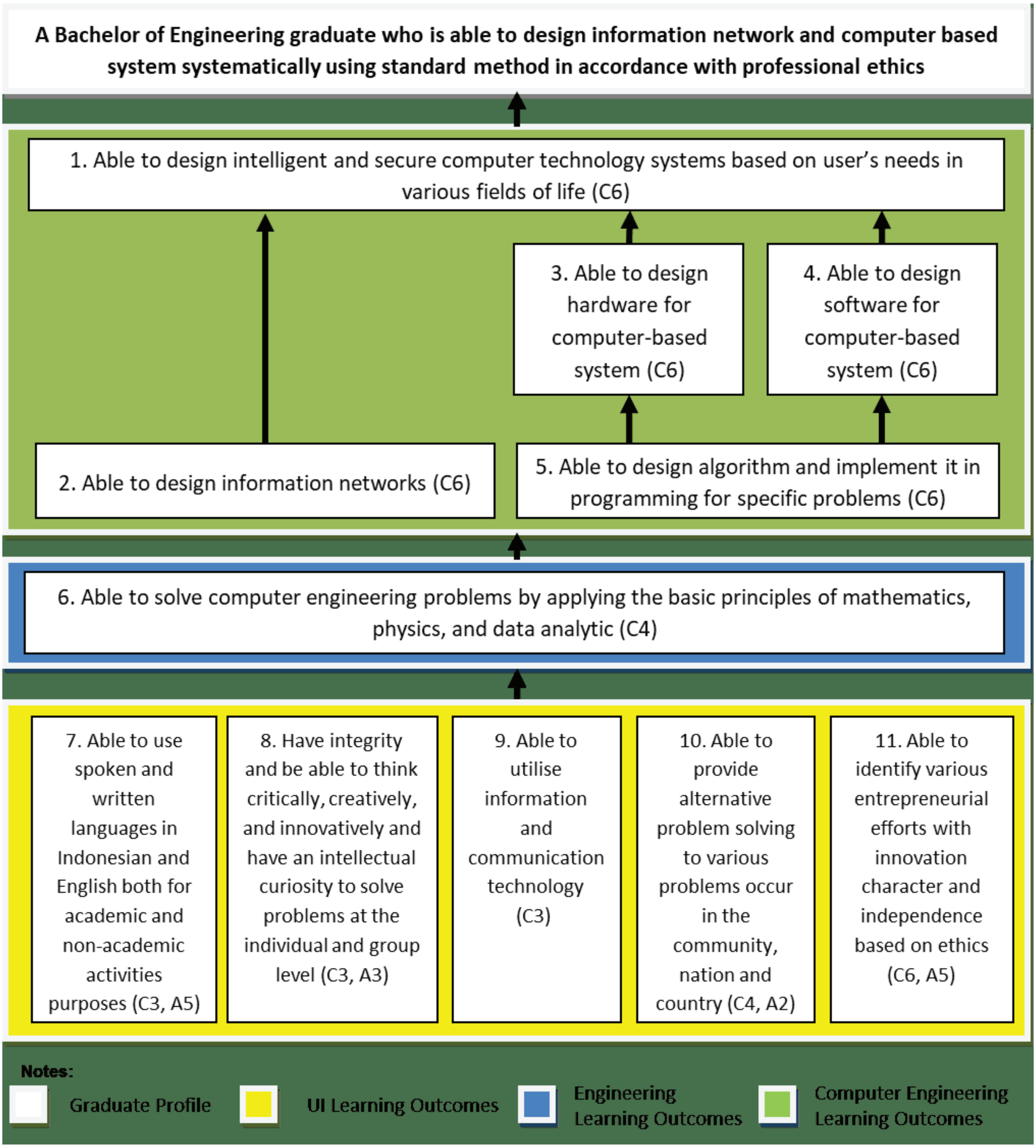
1.	**Awarding Institution**	Universitas Indonesia	
2.	**Teaching Institution**	Universitas Indonesia	
3.	**Faculty**	Engineering	
4.	**Program Title**	Undergraduate Program in Computer Engineering	
5.	**Vision and Mission**	**Vision** To be an excellent and competitive study program in education and research in the field of Computer Engineering to contribute to society nationally and globally. **Mission** The department has defined its mission to 1. Preparing graduates of computer engineering study program that is highly intellectual, innovative, adaptive to the needs of the society with ethics and integrity, has a spirit of nationality, and able to compete globally. 2. Conducting quality education and research, including improving community service, and being able to answer national and global challenges by responding, and providing solutions to problems in the community.	
6.	**Class**	Regular	
7.	**Final Award**	Sarjana Teknik (S.T)	
8.	**Accreditation Status**	BAN-PT: Accreditation-Excellent AUN: More than adequate (5) IABEE: General Accreditation	
9.	**Language(s) of Instruction**	Bahasa Indonesia	
10.	**Study Scheme (Full Time / Part Time)**	Full Time	
11,	**Entry Requirements**	High Shool /equivalent graduates and pass the entrance selection	
12.	**Duration for Study**	8 (eight) semesters or 4 (four) years	
	Type of Semester	Number of Semester	Number of weeks / semester
	Regular	8	16
	Short (optional)	3	8
13.	**Aims of the programme:** Produce graduates who have professional profiles as follows: 1. Become a professional who is capable of designing, analyzing and developing systems, processes and applications in the field of computer engineering to produce alternative solutions to the problem in their fields. 2. To be an inclusive computer engineer professional, including being part of stakeholders who have concern for the development of computer technology that has an impact on improving people's quality of life 3. Become an individual or professional who has innovation and entrepreneurial spirit with integrity and ethics.		
14.	**Graduate Profile:** Bachelor of Engineering who is able to design information networks and computer-based systems systematically using standard methods in accordance with professional ethics		

15.	**Expected Learning Outcomes:** 1. Able to design intelligent and secure computer technology systems based on user's needs in various fields of life (C6) 2. Able to design information network plan (C6) 3. Able to design hardware for computer based system (C6) 4. Able to design software for computer based system (C6) 5. Able to design algorithm and implement it in programming (C6) 6. Able to implement the basic principles of mathematics, physics, and statistic in solving computer-engineering problems (C4) 7. Able to use spoken and written language of Bahasa Indonesia and English in academic and nonacademic activities (C3, A5) 8. Have integrity and able to think critically, creatively, and innovatively and have the intellectual knowledge to solve problems in individual and group level (C4, A4) 9. Able to utilize communication information technology(C3) 10. Able to provide alternatives of solutions for various problems within the society, country, and nation (C4, A2) 11. Able to identify the various entrepreneurship efforts characterized with innovation and independence based on ethics (C4, A5)		
16.	**Composition of Subjects**		
No.	**Classification**	**Credit Hours (SKS)**	**Percentage**
i	**University General Subjects**	**9**	**6,25%**
ii	**Basic Engineering Subjects**	**16**	**11,11%**
iii	**Electrical Engineering Department Subjects**	**9**	**6,25%**
iv	**Computer Engineering Core Subjects**	**78**	**56,14%**
v	**Electives**	**24**	**13,89%**
vi	**Special Subjects (Practical Work, Seminars, Thesis)**	**8**	**5,56%**
	Total Credit Hours to Graduate	**144**	**100 %**

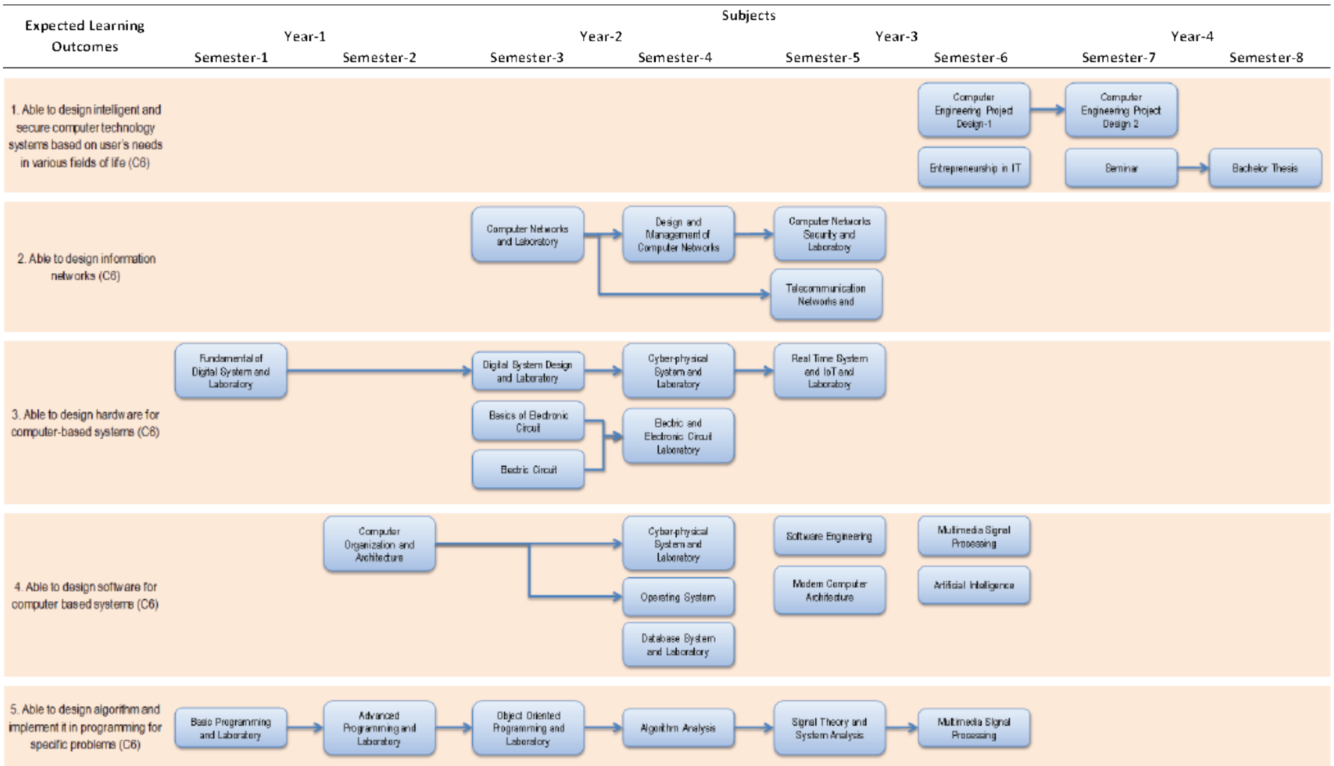
Employment Prospects

The program graduates are needed in almost all fields of work, e.g. industry, services, banking and all fields requiring the application IT (Information technology). Some professional profiles that are suited to this program's graduate are IT Manager, Project Manager, Program Manager, Programmer, System Analyst, Software Developer, Data Analyst, Product Specialist, Software Engineer, Computer Hardware Engineer, System Administrator, IT Support, etc.

Block Diagram of Expected Learning Outcomes (ELO)



Flow Diagram for Achieving ELO in Computer Engineering Undergraduate Program



Expected Learning Outcomes	Subjects							
	Year-1		Year-2		Year-3		Year-4	
	Semester-1	Semester-2	Semester-3	Semester-4	Semester-5	Semester-6	Semester-7	Semester-8
6. Able to solve computer engineering problems by applying the basic principles of mathematics, physics, and data analytic (C4)	Calculus Physics (Electricity, MWO) Physics (Electricity, MWO) Laboratory	Linear Algebra Physics (Mechanics and Thermal) Physics (Mechanics and Thermal) Laboratory	Discrete Structures Statistics	Advanced Linear Algebra Engineering Mathematics	Probability and Stochastic Process Signal Theory and System Analysis			
7. Able to use spoken and written languages in Indonesian and English both for academic and non-academic activities purposes (C3, A5)	English	Integrated Character Building Computer Organization and Architecture	Statistics	Algorithm Analysis	Software Engineering Modern Computer Architecture	Multimedia Signal Processing Internship Entrepreneurship in IT	Seminar	Bachelor Thesis
8. Have integrity and be able to think critically, creatively, and innovatively and have an intellectual curiosity to solve problems at the individual and group level (C3, A3)	Religion Fundamental of Digital System and Laboratory	Integrated Character Building Advanced Programming and Laboratory	Basics of Electronic Circuit	Advanced Linear Algebra Operating System	Computer Networks Security and Laboratory	Computer Engineering Project Design 1 Artificial Intelligence Internship Professionalism and Ethics in IT	Computer Engineering Project Design 2	
9. Able to utilise information and communication technology (C3)	Basic Programming and Laboratory	Advanced Programming and Laboratory	Digital System Design and Laboratory Discrete Structures Computer Networks and Laboratory Object Oriented Programming and Laboratory	Design and Management of Computer Networks Database System and Laboratory Electric and Electronic Circuit Laboratory	Real Time System and IoT and Laboratory Telecommunication Networks and Laboratory Signal Theory and System Analysis			

Expected Learning Outcomes	Subjects							
	Year-1		Year-2		Year-3		Year-4	
	Semester-1	Semester-2	Semester-3	Semester-4	Semester-5	Semester-6	Semester-7	Semester-8
10. Able to provide alternative problem solving to various problems occur in the community, nation and country (C4, A2)		Integrated Character Building		Algorithm Analysis		Computer Engineering Project Design 1	Computer Engineering Project Design 2 Seminar	Bachelor Thesis
11. Able to identify various entrepreneurial efforts with innovation character and independence based on ethics (C6, A5)							Internship	Entrepreneurship in Information Technology Professionalism and Ethics in IT

Course Structure Undergraduate Program in Computer Engineering

Code	Subject	SKS
	1st Semester	
UIGE600010-15	Religion	2
UIGE600003	English	2
ENGE600003	Calculus	4
ENGE600007	Physics (Electricity, MWO)	3
ENGE600008	Physics (Electricity, MWO) Laboratory	1
ENCE601001	Basic Programming and Laboratory	3
ENEE605033	Fundamental of Digital System and Laboratory	3
	Sub Total	**18**
	2nd Semester	
UIGE600001	Integrated Character Building	5
ENGE600004	Linear Algebra	4
ENGE600005	Physics (Mechanics and Thermal)	3
ENGE600006	Physics (Mechanics and Thermal) Laboratory	1
ENCE602002	Computer Organization and Architecture	3
ENCE602003	Advanced Programming and Laboratory	3
	Sub Total	**19**
	3rd Semester	
ENCE603004	Digital System Design and Laboratory	3
ENCE603005	Discrete Structures	3
ENCE603006	Computer Networks and Laboratory	4
ENCE603007	Object Oriented Programming and Laboratory	3
ENCE603008	Basics of Electronic Circuit	2
ENCE603009	Electric Circuit	2
ENCE603010	Statistics	3
	Sub Total	**20**
	4th Semester	
ENCE604011	Advanced Linear Algebra	2
ENCE604012	Cyber-physical System and Laboratory	3
ENCE604013	Algorithm Analysis	3
ENCE604014	Operating System	2
ENCE604015	Design and Management of Computer Networks and Laboratory	4
ENCE604016	Database System and Laboratory	3
ENEE603008	Engineering Mathematics	4
ENCE604017	Electric and Electronic Circuit Laboratory	1
	Sub Total	**22**
	5th Semester	
ENCE605018	Software Engineering	3
ENCE605019	Real Time System and IoT and Laboratory	3
ENCE605020	Computer Networks Security and Laboratory	3
ENCE605021	Telecommunication Networks and Laboratory	3
ENCE605022	Modern Computer Architecture	2
ENCE605023	Probability and Stochastic Process	2
ENCE605024	Signal Theory and System Analysis	2
	Electives	3
	Sub Total	**21**
	6th Semester	
ENCE606025	Computer Engineering Project Design 1	2
ENCE606026	Multimedia Signal Processing	3
ENCE606027	Artificial Intelligence	3
ENCE606028	Internship	2
ENCE606029	Entrepreneurship in Information Technology	2
ENCE606030	Professionalism and Ethics in Information Technology	2
	Electives	6
	Sub Total	**20**
	7th Semester	
ENCE607031	Computer Engineering Project Design 2	3
ENCE607032	Seminar	2
	Electives	9
	Sub Total	**14**
	8th Semester	
ENCE608033	Bachelor Thesis	4
	Electives	6
	Sub Total	**10**
	Total	**144**

Electives Computer Engineering Program

Code	Subject	SKS
	5th Semester	
ENCE605034	Big Data Technology	3
	Sub Total	3
	6th Semester	
ENCE600035	Cloud Computing	2
ENCE600036	Human Computer Interaction	**2**
ENCE600037	Wireless Technology	**2**
	Sub Total	6

	6th Semester	
ENCE607038	Geospatial Technology	2
ENCE607039	Capita Selecta in Computer Engineering	2
ENCE607040	Professional Engineer Development - 1	**2**
ENCE607041	Regulation & Public Policy on ICT Sector	**3**
	Sub Total	9
	6th Semester	
ENCE607042	Blockchain Technology	3
ENCE607043	Professional Engineer Development - 2	2
ENCE607044	Cryptography	2
ENCE607045	VLSI Design	2
	Sub Total	9

Transition Guidance

1. Curriculum 2020 is implemented starting from the Even Semester 2020/2021. In principle, after the 2020 Curriculum is implemented, only courses in the 2020 Curriculum will be opened.
2. The 2020 curriculum is effective from the class of 2020.
3. Class of 2019 and previous will participate in Curriculum 2020 with transition rules.
4. A transition period of 1 year is applied, namely from the Even Semester of the academic year 2020/2021 to the Odd Semester of the academic year 2021/2022.
5. For courses that change in the location of the semester in Curriculum 2020 (from Even to Odd, or vice versa), if necessary, will be opened in both semesters during the transition period.
6. For students who have not passed the compulsory courses in curriculum 2016, it is required to take the same or equivalent compulsory courses in curriculum 2020 (refer to Table of Equality Courses).
7. In the event of a change in the credit (SKS) of the course, then the number of SKS taken into account is the number of SKS at the time the course was taken last.

- For example, the same course or equivalent has a different SKS, if repeated will be listed with a new name and calculated with the weight of the new SKS.

8. New compulsory courses in Curriculum 2020 that do not have equality to the Curriculum 2016, are not required to be taken by students of the class of 2019 and earlier.
9. If the compulsory courses in Curriculum 2016 are removed and there is no equality in Curriculum 2020, for students who have passed the course, then it is still counted as a mandatory course in the calculation of SKS for graduation (144 SKS). For students who have not passed the course, he/she can take a new compulsory course or electives in Curriculum 2020 to complete 144 SKS.
10. Special rules for Integrated Character Building (MPKT A and B) courses: For the transition period, MPKT (5 credits) courses should only be taken by students of the Class of 2020. For students of class 2019 and previously who have passed one of the MPKT A or B courses, do not have to take both courses. For the transition period, students of Class 2019 and earlier can still repeat MPKT A and B courses.
11. Special rules for Class of 2017 (and before): IT Project Management course is open for the Class of 2017 (and before) during the transition period. If a student does not pass the course in the transition period, then it is mandatory to take Computer Engineering Project Design 1 (in even semester 2021/2022) and Computer Engineering Project Design 2 (in Odd Semester 2022/2023). Class of 2018 and 2019 remains obliged to take Computer Engineering Project Design 1 &2.

Table of Equality Courses in Undergraduate Chemical Engineering Study Program in Curriculum 2016 and Curriculum 2020

Name of Courses in Curriculum 2016	SKS 2016	Semester	Name of Courses in Curriculum 2020	SKS 2020	Semester
MPKT A MPKT B	6 6	2 1	Integrated Character Building	3	2
Introduction to Computer Engineering +Lab.	3	2	Basic Programming and Laboratory	3	1
Advanced Programming	3	3	Advanced Programming and Laboratory	3	2
Vector Analysis and Complex Variables	2	3	Advanced Linear Algebra	2	4
Embedded Systems 1	2	5	Cyber Pyhsical Systems and Laboratory	3	4
Algorithm	3	4	Algorithm Analysis	3	4
Operating Systems	3	5	Operating Systems	2	4
Embedded Systems 2 and Laboratory	3	6	Real Time Systems and IoT and Laboratory	3	5
Telecommunication Networks	3	6	Telecommunication Networks and Laboratory	3	5
Probability and Stochastic Process	3	5	Probability and Stochastic Process	2	5
Signal and Systems	3	4	Signal Theory and System Analysis	2	5
Project Management in IT	3	8	Computer Engineering Project Design 1	2	6
			Computer Engineering Project Design 2	2	7
Data Analysis Engineering	3	P-1	Artifial Intelligence	3	6
Wireless Technology	1	4	Wireless Technology	2	P-6
Human Computer Interaction	4	4	Human Computer Interaction	2	P-6
Capita Selecta in Computer Engineering	2	6	Capita Selecta in Computer Engineering	2	P-7

Fast-Track Curriculum (S1 and S2)

Students of Computer Engineering Undergraduate Program can join fast track program to master degree. The curriculum structure for the fast track program for Semester 1 up to Semester 6 is similar to the regular program, while for Semester 7 to Semester 10 is differentiated based on the major chosen for the Graduate Program

Course structure for Fast Track Program Bachelor of Computer Engineering and Master of Electrical Engineering Majoring in Cyber Security and Future Internet

	7th Semester	
ENCE607031	Design of Computer Engineering Project 2	3
ENCE607032	Seminar	2
ENEE801001	Data Processing and Analytic	4
ENEE801002	Research Methodology	4
ENEE801401	Network Security and Data Protection	2
ENEE801402	Advanced Network Computer Systems	
	Sub Total	**17**
	8th Semester	
ENCE607033	Bachelor Thesis	4
ENEE802405	Security Operation and Incident Handling	2
ENEE802406	Network & Digital Forensics	2
ENEE802407	Convergence Information Network NG	2
	Sub Total	**14**
	9th Semester	
ENEE801403	Network Security and Data Protection	2
ENEE803003	Technology Innovation and Entrepreneurship	3
ENEE803408	Cyber Threat Intelligence and Incident Analysis	2
ENEE803409	Security Risk Assessment and Analysis	2
	Elective Course	**2**
	Sub Total	**11**
	10th Semester	
ENEE802404	Applied Cryptography & Blockchain Technology	3
	Elective Course	2
ENEE804004	Thesis	4
ENEE804005	Publication	2
	Sub Total	**11**
TOTAL		**49**

Course structure Fast Track Program for Bachelor of Computer Engineering and Master of Electrical Engineering Majoring in Data Engineering and Business Intelligence

	7th Semester	
ENCE607031	Design of Computer Engineering Project 2	3
ENCE607032	Seminar	2
ENEE801001	Data Processing and Analytic	4
ENEE801002	Research Methodology	4
ENEE801601	Digital Enterprise Software Architecture	2
ENEE801603	Imaging Technology and Computer Vision	2
	Sub Total	**17**
	8th Semester	
ENCE607033	Bachelor Thesis	4
ENEE802604	Big Data Technology and Architecture	3
ENEE802605	Advanced Artificial Intelligence	2
ENEE802606	Advance Data Engineering	2
	Sub Total	**11**
	9th Semester	
ENEE801602	Business Analytics and Visualization	2
ENEE803003	Technology Innovation and Entrepreneurship	3
ENEE803608	Enterprise Cyber Threat Analysis	2
ENEE803609	Advanced IT Project Management	2
	Elective Course	2
	Sub Total	**11**
	10th Semester	
ENEE802607	Ethics and Professionalism	2
	Elective Course	2
ENEE804004	Thesis	4
ENEE804005	Publication	2
	Sub Total	**10**
TOTAL		**49**

Course Syllabus of University Subject

INTEGRATED CHARACTER BUILDING
UIGE6000061/UIGE6100061
5 credits

Syllabus :

The Integrated Character Building is part of the Higher Education Personality Development Lecture which is held for students which contains elements of the internalization of basic life values, interaction/relationship skills, nationality and academic skills as the basis for student personality to carry out learning according to scientific disciplines.

MPKT is carried out in the form of a series of learning activities outside the formal class. activities carried out include participation in lectures/seminars, internships, field work practices, social work, sports and/or arts activities and other forms of activities that have the main goal of equipping students with soft skills and proven by portfolio documents. The form of this learning activity is different from the MPKT courses that have been carried out at the previous UI.

The material provided at MPKT aims to form a human thinking pattern with values and morals to create a human personality by having critical, logical, creative, innovative thinking, and having intellectual curiosity and an entrepreneurial spirit. The material provided includes 9 UI values, national, state and citizen values based on Pancasila. Solving problems in science, technology, health, and humans as natural managers by using reasoning and utilizing Information and Communication Technology (ICT) to achieve the final objectives of this module.

Lecture activities are carried out using an online student-centered learning (SCL) approach which can use the following methods: experiential learning (EL), collaborative learning (CL), problem-based learning (PBL), question-based learning, and project based learning. The use of these various methods is carried out through group discussion activities, independent assignment exercises, presentations, writing papers in Indonesian and interactive discussions in online discussion forums. The language of instruction in this lecture is Indonesian.

Graduate Learning Outcomes :

- CPL 1: Able to use spoken and written language in Indonesian and English both for academic and non-academic activities (C3, A5)
- CPL 2: Have integrity and are able to think critically, creatively, and innovatively and have intellectual curiosity to solve problems at the individual and group level (C4, A3)
- CPL 3: Able to provide alternative solutions to various problems that arise in the community, nation, and country (C4, A2)
- CPL 4: Able to take advantage of information communication technology (C3)
- CPL 5: Able to identify various entrepreneurial efforts characterized by innovation and independence based on ethics (C2, A5)

Course Learning Outcomes :

- CPMK 1: After completing this course, students are able to apply self-regulated learning characteristically in studying critically, logically, creatively, innovatively through analysis of societal problems, nation, state, and Pancasila ideology based on self-understanding as individuals and members. the community by using good and correct Indonesian and the latest information and communication technology (C4, A4)
- CPMK 2: Able to identify various entrepreneurial efforts characterized by innovation and independence based on ethics (C2, A5)
- CPMK 3: After completing this course, students are able to apply self-regulated learning characteristically in pursuing integrated and comprehensive knowledge through analysis of science problems, technology based on the role of nature manager by using good and correct Indonesian and information technology and current communications. (C4, A4)
- CPMK 4: After completing this course, students are able to plan creative activities to solve problems in society and the world of work/industry by showing creativity, critical thinking, collaborative self-discipline using good and correct Indonesian as well as the latest information and communication technology (C5, A5)

Prerequisite : -

ACADEMIC WRITING
UIGE610002
2 credits
The Objectives :

To activate students, English so that they will be able to communicate effectively in English;

To enable students to develop the learning strategies and study skills needed to finish their study successfully and o continue learning on their own after taking the MPK program (to develop independent learners)

Main Competencies :

- Listen to, understand and take notes of key information in academic lectures of between 5-10 minutes length;
- Improve their listening skills through various listening materials and procedures;
- Speak confidently, ask questions in and contribute to small group discussions;
- Use different reading strategies needed to the effective readers;
- Improve their reading skills through extensive reading material;
- Develop skills in connecting ideas using appropriate transitions and conjunctions;
- Work as part of a group to prepare and deliver a 25-minute presentation on an academic topic using appropriate organization, language and visual aids;
- Write a summary of a short academic article;
- Write an expository paragraph;
- Write a short essay.

Learning Method : Active learning, Contextual language learning, small group discussion.

Prerequisite :

1. Students Learning Orientation/Orientasi Belajar Mahasiswa (OBM)

ENGLISH
UIGE600003
2 credits
Learning Objectives :

After attending this subject, students are expected to capable of use English to support the study in university and improve language learning independently.

Syllabus :

Study Skills : (Becoming an active learner, Vocabulary Building: word formation and using the dictionary Listening strategies Extensive reading) Grammar: (Revision of Basic grammar Types of sentences Adjective clauses, Adverb clauses Noun clauses, Reduced clauses) Reading: (Reading skills: skimming, scanning, main idea, supporting ideas, Note-taking Reading popular science arti-cle, Reading an academic text) Listening: (Listening to short conversations, Listening to a lecture and notetaking, Listening to a news broadcast, Listening to a short story) Speaking: (Participating in discussions and meetings, Giving a presentation) Writing: (Writing a summary of a short article Describing graphs and tables, Writing an academic paragraph, Writing a basic academic essay (5 paragraphs).

ISLAMIC STUDIES

UIGE6000010/UIGE610005
2 credits
General Instructional Objectives :

The cultivation of students who have concern for social, na-tional and countrys issues based on Islamic values which is applied in the development of science through intellectual skills.

Learning Objectives :

Course participants are expected to do the following when faced with a problem or issue which they must solve :

1. Analyze the problem based on the Islamic values they adopted;
2. Analyze the problem by implementing active learning stages;
3. Discuss and express their thoughts and ideas by using proper and correct Indonesian language in discussion and academic writing.

Syllabus :

Islam history: the meaning of Islam, the characteristic of Islam, the sources of Islamic teachings, Muhammad SAW as prophet and history figure, introduction of Islam in Indonesia, the teaching essence of Islam: the basic principle of Islam teachings, the unity of Allah, worship prac-tice in live, eschatology and work ethics, human's basic rights and obligation, social structure in Islam: sakinah mawaddah and ramhah family, the social implication of family life, Mosque and the development of Islam, zakat and the economic empowerment of the people, Islam society, Science: reason and revelation in Islam, Islam's motivation in development of science, science characteristics, source of knowledge, IDI (each Faculty and Department/Study Program).

CATHOLIC STUDIES

UIGE6000011/UIGE610006
2 credits
General Instructional Objectives :

To help deliver students as intellectual capital in implementing lifelong learning process to become scientists with mature personality who uphold humanity and life.

Be scholars who believe in God according to the teachings of Jesus Christ by continuing to be responsible of his faith in life in church and society.

Syllabus :

Almighty God and the God teachings; Man, Morals, science technology and art; harmony between religions; Society, Culture, Politics, Law: the substance of theses studies will be addressed by integrating the four dimensions of the teachings of the Catholic faith: the personal dimension, the dimension of Jesus Christ, the dimension of the Church, and Community dimension. Dimensions are implemented in the following themes: People, Religion, Jesus Christ, the Church, and Faith in the society.

CHRISTIAN STUDIES

UIGE6000012/UIGE610007
2 credits
General Instructional Objectives :

Cultivating students with comprehensive Christian knowledge and teaching in the midst of the struggle and the fight of the nation while also discussing the student's participation in line with the study to help improve and build our country.

Learning Objectives :

Course participants are expected to do the following when faced with a problem or issue which they must solve:

1. Analyze the problem based on the Christian values
2. Analyze the problem by implementing active learning stages
3. Discuss the problem by using proper and correct Indonesian language

Syllabus :

History (Historical terms): Status of the Bible, the existence of God and Morality, Christ the Savior, the Holy Spirit as existence reformer and outlook on the world: Faith and Knowledge of Science, Church and service, Ecclesiology, Spiritual and enforcement of Christian Human Rights and the world of ethics: Christian Ethics, Christian and worship, Christianity and politics, Christian love and social reality: Christian Organizations, Students and Service, Christian and expectations.

HINDU STUDIES

UIGE6000013/UIGE610008
2 credits

Syllabus :

Hindu religion, Hindu history), Source and scope of Hinduism (the Veda as the source of Hindu religion teachings, the scope of the teachings in Hindu religion), The concept of the God (Brahman) according to the Veda, the Path to Brahman (Catur Marga Yoga, Mantra and Japa), Human Nature (The purpose of human life, Human's duties, obligations, and responsibilities both individually or collectively), Ethics and morality (Principles teaching, self-control), in-depth understanding of the scripture (deep understanding of the Bhagawadgita, deep understanding of the Sarasamuschaya), The Role of Hinduism in science, technology, and art (Hinduism benefits in science and technology in accordance with each department, benefit / the role of Hinduism in the arts), Cohesion and community's prosperity /independence (Benefits of unity in the religious plurality, independent community (kerthajagathita) as a common goal, Tri Pitakarana), Culture as an expression of Hindu religious practice, Contribution to the Hindu religion teachings in the political life of nation and country, laws and the enforcement of justice, Awareness of and obeying the Rita / Dharma.

BUDDHIST STUDIES

UIGE6000014/UIGE610009
2 credits

Syllabus :

Almighty God and the God Study (Faith and piety, Divine Philosophy/Theology), Human (Human Nature, Human Dignity, Human Responsibility), Moral (Implementation of Faith and Piety in everyday life), Science, Technology and Art

(Faith, Science and Charity as a unity, the Obligation to study and practice what you are taught, Responsibility for nature and environment), harmony between religion (religion is a blessing for all mankind, the essence of the religious plurality and togetherness), community (the role of religious society in creating a prosperous independent society, the responsibility of religious society in the realization of human rights and democracy), Culture (the responsibility of religious society in the realization of critical thinking (academic), work hard and fair), Politics (Religion contribution in the political life of nation and country), Law (Raise awareness to obey and follow God's law, the role of religion in the formulation and enforcement of law, the function of religion in the legal profession).

KONG HU CU STUDY
UIGE6000015/UIGE610010
2 credits

Syllabus of Faculty Subjects

CALCULUS 1
ENGE600001/ENGE610001
3 credits
Course Learning Outcomes:

Able to use the basic concepts of calculus related to -a function of one variable, the derivative and integration of the function of one variable in order to solve its applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, basic engineering, and engineering specialization to be used in solving complex engineering problems.

Syllabus :
Introduction, Functions and Limits, The Derivative, Applications of the Derivative, The Definite Integral, Applications of The Definte Integral, Transcendental Functions, Techniques of Integration, Indeterminate Forms and Improper Integrals.

Prerequisite: None

Textbooks:

Main reference:
D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., Pearson, Prentice Hall, 2007.

Additional eferences:
1. George B. Thomas Jr., Thomas' Calculus Early Transcendental, 12th ed., Addison–Wesley Pearson, 2009.
2. Howard Anton, Calculus, 10th ed., John Wiley and Sons, 2012.

CALCULUS 2
ENGE600002/ENGE610002
3 SKS
Course Learning Outcomes:

Students are able to use the concepts of sequences, series, conic sections, and the basic concepts of calculus which involve the function of two or three variables to solve their applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus: :
Infinite sequences and infinite series, Test for convergence of positive series and alternating series, Power series and operation on operations, Taylor and MacLaurin series, Conic sections , Calculus in polar coordinates, Derivatives, limits, and continuity of multi-variables functions, Directional derivatives and gradients, Chain Rule, Tangent planes and Approximations, Lagrange multipliers. Double integrals in Cartesian coordinates and polar coordinates, triple integrals in Cartesian coordinates, cylindrical coordinates and spherical coordinates, Applications of double and triple Integral.

Prerequisite: Calculus 1

Textbooks:
1. D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., PEARSON, Prentice Hall, 2007.
2. Thomas, Calculus Thirteenth Edition Volume 2, Erlangga, 2019.

CALCULUS
ENGE600003/ENGE610003
4 SKS
Course Learning Outcomes:

Students are able to use the basic concepts of calculus involving functions of one to three variables to solve their applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :

Introduction, Functions and Limits, Derivatives, Derived Applications, Indeterminate Integral, Integral Applications, Infinite Row, and Series. Derivatives with many variables, Duplicate Integral (2 and 3), Duplicate Integral Application.

Prerequisite: None

Textbooks:

Main :
D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., Pearson, Prentice Hall, 2007.

George B. Thomas Jr., Thomas' Calculus Early Transcendental, 12th ed., Addison – Wesley Pearson, 2009.

LINEAR ALGEBRA
ENGE600004/ENGE610004
4 SKS
Course Learning Outcomes:
Students are able to calculate linear system problems to solve engineering problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :

Linear Systems and matrix equations, Determinants, Euclid vector spaces, Common vector spaces, eigenvalues and eigenvectors, inner product spaces, Diagonalization and General Linear Transformation.

Prerequisite: None

Textbooks:
1. Elementary Linear Algebra, Howard Anton & Chris Rorres, 11th edition, 2014
2. Gilbert Strang, Introduction to linear algebra 3rd edition Wellesley Cambridge Press, 2003

MECHANICAL AND HEAT PHYSICS

ENGE600005 / ENGE610005
3 credits
Course Learning Outcomes:

Able to explain the basic concepts of mechanics and thermodynamics, and be able to apply them to understand natural phenomena and human engineering, including their applications.

Graduate Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus:

Units, Magnitudes and Vectors, Motion Along Straight Lines, Motion in Two and Three Dimensions, Newton's Laws of Motion, Applications of Newton's Laws, Kinetic Energy, and Work, Potential Energy and Energy Conservation, Center of Mass, Linear Momentum, Rotation, Rolling Motion, Torque, Angular Momentum, Oscillation, Mechanical and Sound Waves, Gravity, Statics and Elasticity, Fluid Mechanics, Temperature, Heat, Law I Thermodynamics, Ideal Gas and Kinetic Theory of Gas, Heat Engine, Entropy, and Law II Thermodynamics.

Prerequisite: none

Textbooks:
1. Halliday, Resnick, and Walker, Principles of Physics 10th Edition, Wiley, 2014.
2. Serway Jewett, Physics for Scientists and Engineers 9th Edition, Thomson Brooks / Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008

ELECTRICAL MAGNETIC, OPTICAL AND WAVE PHYSICS

ENGE600007 / ENGE610007
3 credits
Course Learning Outcomes:

Students are able to apply the basic concepts of electrical physics, magnetism, waves, and optics to solve problems in the engineering field.

Graduate Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus:

Unit, Magnitude, Vector, Electric Charge, Electric Field, Gauss Law, Electric Potential, Capacitance, Electric Current, Resistance, Direct Current, Magnetic Field Due to Electric Current, Magnetic Field Source, Induced GGL, Inductance, Alternating Current, Electromagnetic Waves, Light Properties and Propagation, Optical Geometry.

Prerequisite: none

Textbooks :
1. Halliday, Resnick, and Walker, Principles of Physics 9th Edition, Wiley, 2011.
2. Serway Jewett, Physics for Scientists and Engineers 9th Edition, Thomson Brooks / Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008.

BASIC CHEMISTRY

ENGE600009 / ENGE610009
2 credits
Course Learning Outcomes:
Students are able to analyze the principe of basic chemistry for application in engineering.

Graduates' Learning Outcomes:
Able to apply mathematics, science, and basic engineering to be used in solving complex engineering problems.

Syllabus:

Material and measurements, atoms, molecules and ions, stochiometry, water phase reactions and solution stochiometry, thermochemistry, chemical equilibrium, acid and base equilibrium, electrochemistry, chemical kinetics, and chemical applications.

Prerequisite: none

Textbooks :
1. Ralph H. Petrucci, General Chemistry: Principles and Modern Applications, 8th Ed. Prentice Hall Inc., New York, 2001.
2. John McMurry, Robert C. Fay, Chemistry (3rd ed.), Prentice Hall, 2001.
3. Raymond Chang, Williams College, Chemistry (7th ed.), McGraw-Hill, 2003.

ENGINEERING ECONOMY

ENGE600011 / ENGE610011
3 credits
Course Learning Outcomes:

Students are able to analyze the economic and financial feasibility of making economic practice decisions.

Graduate Learning Outcomes:

Able to apply the principles of technical management and decision making based on economic considerations, in individual and group, as well as in project management.

Syllabus:

Introduction to Engineering Economics, Time Value of Money, Combining Factors, Interest Rates, Money Worth Analysis, Rate of Return Analysis, Effects of Inflation, Benefit Cost & Break-Even Point Analysis, Sensitivity Analysis, Depreciation, Tax Analysis, Cost Estimation & Allocation, Capital Budgeting & Replacement Analysis.

Prerequisite:
1. Civil Engineering : -
2. Environmental Engineering : -
3. Naval Engineering : -
4. Industrial Engineering : must pass the introductory Economic course and have completed 38 credits
5. Chemical Engineering : -
6. Bioprocess Engineering : -

Textbooks:
1. Blank, Leland and Tarquin, Anthony. 2018. Engineering Economy 8th Ed. McGraw Hill.
2. Park, Chan S. 2016. Contemporary Engineering Economics 6th Ed. Pearson. Upper Saddle River.
3. White, Case and Pratt. 2012. Principles of Engineering Economic Analysis 6th ed. John Wiley and Sons.

STATISTICS AND PROBABILISTICS

ENGE600010 / ENGE610010
2 credits
Course Learning Outcomes:

Students are able to handle quantitative data/information starting from the descriptive stage (collection, organization, and presentation) to the inductive stage, which includes forecasting and drawing conclusions based on the relationship between variables for decision making.

Graduate Learning Outcomes:
1. Apply descriptive statistics and probability theory to data processing and serving
2. Apply probability distribution to data processing and serving
3. Apply the principles of sampling and estimation for decision making
4. Apply hypothesis test samples for decision making

Syllabus:

Introduction to Statistics for Engineering Studies, Probability Theory, Dasar Basic concepts and definitions, Distribution Probability, Sampling, Estimation, Hypothesis testing, Hypothesis test 1 sample at an average value, Regression

Prerequisite: none

Textbooks :
1. Harinaldi, Basic Principles of Statistical Engineering and Science, Erlangga, 2004
2. Montgomery, DC., And Runger, GC., Applied Statistics and Probability for Engineers, John Wiley Sons, 2002

HSE PROTECTION
ENGE600012 / ENGE610012
2 credits
Course Learning Outcomes:

Upon completion of this subject students are expected to be able to carried out hazard identification, and characterization, to propose appropriate methods for risk reduction and mitigation, and to design safety management system. The student is also expected to improve their awareness on industrial safety and health, and understanding on safety regulation framework and standards as well as environmental program.

Graduate Learning Outcomes:
1. Students are expected to understand safety, health and environmental aspect as an integral part of fundamental principal in engineering code of ethics.
2. Students are expected to be able to carry out process of risk assessments by considering risk factors in the impact of hazards on people, facilities, and the surrounding community and environemt.
3. Students are expected to understand the regulatory framework and standard related to the stages of life cycle of machine, building structure, construction, and process.
4. Students are able to design and propose an effective hazard communication, management and engineering control, and risk mitigation through an engineering assignment project.
5. Students are able to identify the knowledge required to perform risk assesment, investigation and design improvement through a multidisiplinary case of incident and accident.

Syllabus:

Introduction to SHE Regulation and Standards, SHE Perception (Risk and Environment), Identification, Assessment and Management, Construction, machinery and Noise hazards, Process safety hazard and analysis technique, Fire and explosion hazard, Electrical hazard, Toxicology in the Workplace, Ergonomy Aspect, Hazard communication to employees, Environmental Protection, Case studies, Safety Health and Environment audits.

Prerequisite: none

Textbooks :

1. Charles A. Wentz, Safety, Health and Environmental Protection, McGraw Hill, 1998.
2. Asfahl, C.R., Rieske, D. W., Sixth Edition Industrial Safety and Health Management, Pearson Education, Inc., 2010.
3. United Kingdom - Health and Safety Executive, http://www.hse.gov.uk/
4. National laws and regulations related to the K3 Management System and the Environment.
5. Related Journal (http://www.journals.elsevier.com/safety-science/) etc, related standards and publications.

Electrical Engineering Department Subjects

FUNDAMENTAL OF DIGITAL SYSTEMS AND LABORATORY
ENEE602005
3 CREDITS
Learning Outcomes:

Able to explain the components of a digital system circuit, able to solve mathematical logic circuits, able to apply digital circuit concepts, able to use simple digital circuit design methods

Topics:

Boolean Algebra Principles and applications; Interface Logic Families; Number System & Data Encoding; Basic Logic Circuits; Basic Modular Design of Combinational Circuits; Basic Modular Design of Sequential Circuits.

Practical work: Module 1-Introduction and introduction to Digital Circuit Basics, Module 2 - Boolean

Algebra and Elementary logic gates, Module 3 – Karnaugh Map, Module 4 – complex logic gate, Module5 - Decoder and Encoder, Module 6 - Multiplexer and De-multiplexer, Module 7- Digital Arithmetic Circuit, Module 8 - Flip-Flop and Latch, Module 9-Registers and Counters, Module 10 – Group Project

Prerequisite: none

Textbook:
1. M. Morris R. Mano, Charles R. Kime, Tom Martin, Logic & Computer Design Fundamentals, 5th ed, Prentice Hall, 2015
2. Ronald J. Tocci, Neal S. Widmer, and Gregory L. Moss, Digital Systems: Principles and Applications, 11th Ed., Prentice Hall, 2010
3. Modul Praktikum Dasar Sistem Digital

ENGINEERING MATHEMATICS
ENEE603008
4 CREDITS
Learning Outcomes:

Upon completing this course, students are expected to be able to describe ordinary differential equations with constant/non-constant, linear/nonlinear coefficients, partial differential equations, discrete differential equations (C3); Able to derive solutions of ordinary differential equations and partial differential equations (C4); Able to apply the Laplace/Fourier/Z transformation method in the derivation of solutions to differential equations (C3); Able to explain the optimization concept of a mathematical problem (C2); And able to solve mathematical problems using the linear programming method/infinite optimization method (C4).

Topics:

Ordinary Differential Equations (Constant and Inconstant Coefficients, linear, non-linear), Partial Differential Equations, Discrete Differential Equations, Laplace Transform, Fourier

Transform, z Transformation, unconstrained optimization, linear programming

Textbook:
1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley Publisher 2010.
2. Glyn James, "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education, 2011.

Computer Engineering Subjects

BASIC PROGRAMMING AND LABORATORY
ENCE601001
3 CREDITS
Learning Outcomes:

This course is given for the first semester student of the Computer Engineering Study Program. In this course, students are introduced to ways of thinking and solving problems by creating algorithms, then translating those algorithms into programming languages that can be run by computers. After attending this course, students are expected to be able to make simple procedural computer programs (C3) and be able to use computer-programming software proficiently (C3).

Topics:
Introduction to Computers, Algorithms, Pseudocode, Introduction to C language, Controlling programs in C language, Structured programs in C language, Functions, Arrays, Pointers, Struct, Union, Enumeration Pointer

Prerequisite: -

Textbook:
1. Deitel & Deitel, "C How to Program", 8th Edition, Pearson International Edition, 2015.

COMPUTER ORGANIZATION & ARCHITECTURE
ENCE602002
3 CREDITS
Learning Outcomes:

This course discusses the architecture and organization of computer systems. Upon completing this course, students will be able to design software based on a particular microprocessor organization and architecture (C4) and be able to use spoken language well for presentations on problems in organization and computer architecture (C3).

Topics:

Introduction, History of Microprocessor, Designing for Performance, Top Level view of Computer System, Processor Organization; Memory; Peripheral subsystems; Fundamental of Assembly Programming; Addressing Modes; Data Transfer; Arithmetic and Logic Instruction, Program Control, Programming the Microprocessor

Prerequisite: Basic Programming and Laboratory

Textbook:
1. W. Stallings, "Computer Organization and Architecture", 10th Edition, Pearson International, 2015
2. Brey, Barry B, The Intel Microprocessors: 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium 4, and Core2 with 64-bit Extensions, 8th Ed., PHI Inc, USA, 2011.

ADVANCED PROGRAMMING AND LABORATORY
ENCE602003
3 CREDITS
Learning Outcomes :

This is an advanced course for learning how to program computers. In this course, you will learn about programming using high-level languages with procedural types. After attending this course, it is expected that students will be able to design complex procedural computer programs with dynamic data structures (C6), be able to demonstrate a critical, creative, and innovative attitude and respect other people in the group to solve common problems and group assignments. Advanced Programming (C3, A3) , and able to use computer programming software for complex programs proficiently (C3).

Topics:

Data structures: linked list, queue, stack, tree; Problem-solving strategies: searching, sorting; Recursion; Multi-threading, parallel programming

Prerequisite: Basic Programming and Laboratory

Textbook:

1. Deitel & Deitel, "C How to Program", 8th Edition, Pearson International Edition, 2015.

DIGITAL SYSTEM DESIGN AND LABORATORY
ENCE603004
3 CREDITS
Learning Outcomes:

In this course, it will discussed the principles in designing digital systems. After following this course, the student is expected to be able to design and analyze sequential and combinational circuit using a hardware modeling language definition language (HDL) and able to do synthesis into the PLD, CPLD and FPGA-like.

Topics:

Review of Sequential Circuit Design; VHDL; Control and datapath design; Design with programmable logic; System design constraints; Fault models, testing, and design for testability; Laboratory

Prerequisite: Basic Programming and Laboratory

Textbook:
1. Charles h. Roth, Jr., Lizy K John, Digital Systems Design Using VHDL, 2007
2. Bryan mealy, Fabrizio Tappero, Free Range VHDL, freerangefactory.org
3. Digital System Design Lab Modules

DISCRETE STRUCTURES
ENCE603005
3 CREDITS
Learning Outcomes:

In this course students will learn the basic principles of discrete mathematics and apply it to examine and study the modern computing techniques and build a foundation for analyzing problems in computer engineering and developing solutions. After following this course, the student will be able to create sets and functions, applying the techniques of proof, as well as being able to use the theory of graph, tree, iteration and recursion in various cases of problems in the field of computer engineering

Topics:

set; relation; function; Boolean algebra; proofing techniques; basic proof; graph; tree; iteration; recursion

Prerequisite: Basic Programming and Laboratory, Fundamental of Digital System and Laboratory

Textbook:
1. Kenneth h. Rosen, "Discrete Mathematics and Its Applications", 7th Edition , McGraw-Hill Science/Engineering/Math; 2011

2. Richard Johnsonbaugh, "Discrete Mathematics", 7th Edition, Pearson Intl. Edition, Prentice-Hall, NJ, 2009

COMPUTER NETWORKS AND LABORATORY

ENCE603006
4 CREDITS
Learning Outcomes:

In this course, students learn topics about computer networks that are discussed comprehensively from layer 1 to layer 7. After attending this course, students are able to configure and implement simple computer networks according to existing protocol standards, are able to apply the concept of VLAN, Inter VLAN Routing , LAN Redundancy, Dynamic Addressing, LAN Security, Wireless LAN and Static Protocol Routing in a simple network

Syllabus :

Network Architecture and Topology, Network Protocols and Communications; OSI and TCP/IP Layers; Physical Layer, Data Link Layer, Ethernet Switching; Transport Layer, Application Layer; IPv4 Addressing; IPv6 Addressing; Subnetting; VLANs and Inter-VLAN Routing; Ether Channel; FHRP; DHCPv4; DHCPv6; LAN Security; Wireless LANs; Static Protocol Routing

Prerequisites: Fundamental of Digital System and Laboratory

Textbooks:
1. A. Tanenbaum, "Computer Networks", Prentice Hall, 5th Eds, 2010
2. CISCO Networking Academy Program: Network Fundamentals, CCNA Exploration ver 4, http://cisco.netacad.net

OBJECT ORIENTED PROGRAMMING AND LABORATORY

ENCE603007
3 CREDITS
Learning Outcomes:

In this course, students will learn how to create programs with object -oriented concepts. After completing the course, students will be able to implement the design of software into the languages of oriented object programming; Being able to declare the concept of oriented object programming (class, constructor, scope of variables); Able to describe basic objects (arrays, array lists, object collections, iterators); able to describe the concept of class design (coupling, cohesion , refactoring, inheritance, polymorph, substitution); able to implement GUI-based programming , exception handling and multithreading.

Syllabus:

Java Language Elements; Java Language Operation; Defining and Using Class; System, Strings, String Buffer, Math & Wrapper Classes; Array; Class & Inheritance; Graphical User Interface & Event Driven Design; Exceptions; Collections; Threads and Javadoc

Prerequisites: Advanced Programming and Laboratory

Textbooks:
1. David J. Barnes, "Objects First with Java: A Practical Introduction to Using BlueJ ", 5th Ed., Pearson, 2011
2. Bart Baesens et.al., "Beginning Java Programming: The Object-Oriented Approach", Wrox , 2015

BASICS OF ELECTRONICS CIRCUITS

ENCE603008
2 CREDITS
Learning Outcomes:

In this course students will learn the basic electronics components as well as its circuitry. At the end of this course, students will be able to describe the properties of materials and the operation of a basic electronics component, such as a diode, transistors, op-amps, filters etc.

Topics:

Electronics Materials, diodes, bipolar transistors and; MOS transistor circuit, timing, and power; Storage cell Architecture; Operational Amplifiers

Prerequisite: Physics (Electricity, Magnetism, Waves and Optics)

Textbook:

1. Robert Boylestad Louis Nashelsky, & "Electronic Devices And Circuit Theory", Ninth Edition, Prentice Hall, Upper Saddle River, New Jersey, Columbus, Ohio, 2006.

ELECTRIC CIRCUIT

ENCE603009
2 CREDITS
Learning Outcomes :

In this course, students will learn the basic electrical circuits. At the end of this course, students will be able to analyze simple electronic and electrical circuits using appropriate techniques, analyze the resistive circuits, their AC and DC properties as the basics of electrical engineering.

Topics:

Introduction, resistive circuits, dependent sources and op. amps, analysis methods, energy–storage elements, first–order circuits, second–order circuits, sinusoidal sources and phasors, AC steady–state analysis, AC steady–state power.

Prerequisites : Physics (Electricity, Magnetism, Waves and Optics)

Textbook:
1. D . E. Johnson, J. R. Johnson, et.all. , "Electric Circuit Analysis", 3rd Edition, Prentice Hall International, Inc., 1997, (Chapters 1-9).
2. J. W. Nilsson, S.A. Riedel, "Electric Circuits", 10th Edition, Prentice Hall International Inc., 2014.

STATISTICS

ENCE603010
3 CREDITS
Learning Outcomes :

In this course, students will learn the basics of statistics and how to apply it in data processing. After attending this course, students will be able to analyze data based on statistical techniques (C4) and be able to use written language well to present data analysis problems using statistical methods (C3). Students will be able to analyze data descriptions quantitatively; Able to analyze curves and average values, median values, frequency distributions), able to explain the relationship between statistics and probability, probability distributions and their types, able to apply population parameter estimation methods and probability distributions, able to explain linear regression methods and their applications to data, able to apply linear regression method and correlation analysis.

Topics:

Descriptive Statistics: Tables & Graph, Averages, Variability, Normal Distribution, Correlation, Regression, Inferential Statistics: Populations, Samples, and Probability, Sampling Distribution of the Mean, Z-test, Estimation, T-test

Prerequisites : -

Textbook:
1. Robert S. Witte and John S. Witte, "Statistics", 11th ed., Wiley, 2017
2. Ronald E. Walpole, et.al, "Probability & Statistics for Engineers & Scientists", 9th ed., Prentice Hall, 2012

ADVANCED LINEAR ALGEBRA
ENCE604011
2 CREDITS
Learning Outcomes:

In this course, students will learn advanced linear algebra techniques for data processing. After attending this course, students will be able to apply advanced algebraic techniques to process complex data (C3) and be able to show a critical, creative, and innovative attitude and respect other people in the group to solve common problems and group assignments. Advanced Linear Algebra (C3, A3)

Topic:

Discrete probability for high-dimensional vector spaces; matrices and graphs to model the data; geometric approaches to eigen decompositions; least-squares; principal components analysis; data visualization

Prerequisites: Linear Algebra

Books Subjects:
1. Howard Anton, Chris Rorres, Anton Kaul, Elementary Linear Algebra, Applications Version, 12th Edition, Wiley, 2019
2. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Mathematics for Machine Learning, Cambridge University Press, 2020
3. Joel Grus, Data Science from Scratch, 2 nd ed., Oreilly , 2019

CYBER-PHYSICAL SYSTEM AND LABORATORY
ENCE604012
3 CREDITS
Learning Outcomes:

In this course, students learn to design embedded systems (hardware and software) using a microcontroller for special applications. After taking this course, students are able to design hardware for a cyber physical system (a system that is the interface between the physical world and the internet) (C6); able to design software for a cyber physical system (a system that becomes the interface between the physical world and the internet) (C6)

Topics:

Characteristics of embedded systems; Basic software techniques for embedded applications; Parallel input and output; Asynchronous and synchronous serial communication; Periodic interrupts, waveform generation, time measurement; Data acquisition, control, sensors, actuators; Laboratory

Prerequisite: Computer Organization & Architecture, Digital System Design and Laboratory

Textbook:
1. The 8051 Microcontroller and Embedded Systems, Second Edition, Muhammad Ali Mazidi, Prentice Hall, 2006
2. Lee & Seshia , " Introduction to Embedded Systems-A Cyber-Physical Systems Approach " , 2nd edition, UC-Berkeley , 2015

ALGORITHM ANALYSIS
ENCE604013
2 CREDITS
Learnig outcomes:
In this course, students learn how to evaluate algorithms and also some classical algorithms that can be applied to various problems in the field of computer engineering. After attending this course, students will be able to evaluate the application of classical algorithms for certain tasks (C5), be able to use spoken and written language well to present the results of research on the application of algorithms (C3) and be able to provide alternative solutions to problems from an algorithm point of view (C3, A2).

Topics:

Basic algorithm analysis; Algorithm Strategy; Classic algorithms for general tasks ; Analysis and design of algorithms for special applications ; Algorithm complexity.

Prerequisites: Advanced Programming and Laboratory, Discrete Structures

Textbooks:

1. Thomas H. Cormen , "Introduction to Algorithms", 3rd Edition, MIT Press, 2009

OPERATING SYSTEM
ENCE604014
2 CREDITS
Learning Outcomes:

This course discusses the basic principles of early and current generation operating systems. After attending this course, students will be able to evaluate a resource management algorithm for a computer system (C5), be able to analyse the advantages and disadvantages of various memory management techniques (C4), be able to conceptualize an efficient computer system resource management system (C3), and be able to describes the architecture of a distributed system (C2).

Topics:

Operating Systems Structures; Process; Thread; CPU Scheduling; Concurrency; Memory-system management, storage management; distributed system architectures

Prerequisite: Computer Organization and Architecture

Textbooks:
1. Abraham Silberschatz, "Operating System Concepts", 9th Ed., Dec. 17, 2012
2. Andrew S. Tanenbaum, "Modern Operating Systems", Pearson, Mar. 20, 2014

DESIGN AND MANAGEMENT COMPUTER NETWORK AND LABORATORY
ENCE604015
4 CREDITS
Learning Outcomes:

In this course, students will study how to design a network with the large scale by considering aspects of scalability and reliability. After completing this course, students will be able to implement the various techniques LAN redundancy and Link Aggregation to improve scalability and reliability of the network , capable of using OSPF and EIGRP routing protocol in scale of large network, and capable of designing network WAN and the Internet as well as applying the principles and procedures of management network.

Topic:

Network Scalability; LAN redundancy; Link Aggregation; Wireless LAN; OSPF Multiaccess and Multiarea; EIGRP. Hierarchical Network Design; WAN technologies; Point to Point and Frame Relay Connections; Broadband Solution; Internet VPN; Network Monitoring; Troubleshooting the networks; Network performance evaluation. Project: Designing computer networks in a corporate organization.

Prerequisites: Computer Networks and Laboratory

Books Subjects:
1. James D. McCabe, "Network Analysis, Architecture, and Design", 3nd Edition, Morgan Kaufmann, 2007
2. CISCO, CCNA Networking Academy, https://www.netacad.com
3. Huawei ICT Academy, HCIA Routing & Switching, https://e.huawei.com/en/talent/#/

DATABASE SYSTEM AND LABORATORY
ENCE604016
3 CREDITS
Learning Outcomes:

In this course, students will learn the concepts of database systems and their applications. After attending this course, students are able to design structured databases in software design and implement them into SQL database systems, able to optimize data processing in database systems using SQL and able to implement consistent data-based multi-user applications.

Topics: Database systems; Event-driven and concurrent programming; Using application programming interfaces

Prerequisites: Discrete Structures

Textbooks:
1. Ramez Elmasri, Shumatt B. Navathe, Fundamentals of Database Systems, 7th ed., Pearson, June 18, 2015
2. Avi Silberschatz et al., "Database System Concepts", 6th Edition, McGraw-Hill, 2011.

ELECTRIC AND ELECTRONIC CIRCUITS LAB
ENCE604017
1 CREDITS
Learning Outcomes:

In this course, students learn practically the components and basic circuits of electronics and electrical circuits. After following this practicum, students are able to analyze simple electrical and electronic circuits based on physical phenomena (C4), and are able to use hardware and software for electrical and electronic circuit analysis (C3).

Topics:

Module 1-Introduction; Module 2-Diode; Module 3-BJT Amplifiers; Module 4-FET Amplifier; Module 5-Op-Amp Amplifier; Module 6-Filter; Module 7-basic Electricity; Module 8-Mesh and Node analysis of Linearity; Module 9-Thevenin and Norton Superposition Analysis;

Prerequisites: Electrical Circuits, Basic of Electronics Circuits

Textbooks:
1. Robert Boylestad Louis Nashelsky, & "Electronic Devices And Circuit Theory", Ninth Edition, Prentice Hall, Upper Saddle River, New Jersey, Columbus, Ohio, 2006.
2. D . E. Johnson, J. R. Johnson, URet.all. , "Electric Circuit Analysis", 3rd Edition, Prentice Hall International, Inc., 1997, (Chapters 1-9).
3. J. W. Nilsson, S.A. Riedel, "Electric Circuits", 10th Edition, Prentice Hall International Inc., 2014.
4. Module electrical and electronic Circuit Teaching

SOFTWARE ENGINEERING
ENCE605018
3 CREDITS
Learning Outcomes:

In this course, students will learn how to design software with the right steps and be able to document it. After attending this course, students will be able to design software by implementing the software life cycle with the desired level of risk in implementing the system (C6) and be able to use written language well in software engineering project documentation, which consists of planning, design, testing, and software maintenance (C3)

Topics:

Definitions, processes and problems in software engineering; Artifacts and Roles in the Unified Software Development Process (USDP); Traditional Processes: Waterfall Model, Spiral Model, Incremental Model; Agile Processes: XP, TDD, Scrum; UML diagrams; Software Development Documentation: Software Validation & Verification Plan (SVVP), Software Quality Assurance Plan (SQAP), Software Configuration Management Plan (SCMP), Software Project Management Plan (SPMP), Software Design Document (SDD), software test documentation (STD)); Various implementation and collaboration procedures in software development; System Testing: Blackbox, Whitebox, Systematic Testing, and the risk of ignoring testing; Software maintenance: Type of maintenance, Standard Maintenance Procedure.

Prerequisites: Object Oriented Programming and Laboratory

Textbooks:
1. Ian Sommerville, Software Engineering, 10th Ed., Pearson, April 3, 2015
2. Robert C. Martin, Agile Software Development, Principles, Patterns, and Practices, Pearson 2013

REAL TIME SYSTEM AND IOT AND LABORATORY
ENCE605019
3 CREDITS
Learning Outcomes:

After attending this course, students will be able to design real-time embedded systems connected to the Internet (IoT) by paying attention to energy saving and mobile and networking (C6) needs; and able to use hardware and software for real time system (C3)

Topics:

Real-time operating system design; Operating systems for mobile devices; Support for concurrent processing; Implementation strategies for complex embedded systems; Techniques for low-power operation; Mobile and networked embedded systems; Advanced input / output issues; Computing platforms for embedded systems; Practice

Prerequisites: Operating System, Cyber-Physical System and Laboratory

Books Subjects:
1. Peter Marwedel , Embedded System Design: Embedded Systems, Foundations of Cyber-Physical Systems, and the Internet of Things, 3rd ed, Springer International Publishing, 2018
2. Xiaocong Fan, Real-Time Embedded Systems: Design Principles and Engineering Practices, Elsevier, 2015
3. Sam Siewert & John Pratt, Real-time embedded components and systems with Linux and RTOS, Mercury Learning and Information, 2016

COMPUTER NETWORKS SECURITY AND LABORATORY
ENCE605020
3 CREDITS
Learning Outcomes:

This course studies security techniques in computer networks. After attending this course, students are able to analyze and implement security aspects on computer networks, able to analyze data security and integrity and perform protection, able to apply authentication and cryptography techniques in network security; and perform troubleshooting related to network security cases

Topics:

ecurity and integrity of Data; Vulnerabilities; Resource Protection; Private & Public Key Cryptography; Authentication; Network and Web Security.

Prerequisites: Design and Management of Computer Networks and Laboratory

Textbooks:
1. W. Stallings, "Network Security Essentials: Application and Standards, 5/E, Prentice Hall, 2013.
2. R.R.Panko, Corporate Computer and Network Security, Prentice-Hall, 2004
3. M.E.Whitman and H.J.Mattord, Principles of Information Security, Thomson Course, 2003

TELECOMMUNICATION NETWORK AND LAB

ENCE605021
3 CREDITS
Learning Outcomes:

This course will discuss the telecommunication network system. After this course, students are able to describe principle and basic method of telecommunication engineering and the usage of the telecommunication devices in network system, able to describe modulation techniques and multiplexing; able to describe the usage of the telecommunication devices in network system.

Topics:

Introduction to Telecommunications Engineering, Modulation Techniques (Amplitude and frequency); Digital Modulation; Multiplexing Techniques; Coding; Telephony System; Telecommunication device technology

Prerequisites: Computer Network and Laboratory, Signal Theory and System Analysis

Textbooks:
1. S. Haykin, "Communication Systems", 5th Edition, John Wiley & Sons Inc., 2008.
2. R.L. Freeman, "Telecommunication Systems Engineering", 4th Edition, John Wiley & Sons Inc., 2004.

MODERN COMPUTER ARCHITECTURE

ENCE605022
2 CREDITS
Learning Outcomes:

In this course, students will study the architecture of modern computers, including learning the techniques applied to modern computers to speed up their performance. After attending this course, students will be able to design solutions to simple programming problems based on modern computer architecture (C4) and be able to use spoken language well to present problems in modern computer architecture (C3). Students will "be able to analyze processor design with pipelining (C4), be able to design program implementations on parallel processors and multicore processors (C4) and be able to describe the architecture of distributed systems and their level of parallelism (C2).

Topics:

Pipelining, Input / Output interfacing and communication, Peripheral subsystems, Multi / Many-core architectures, Distributed system architectures

Prerequisites: Computer Organization and Architecture

Books Subjects:

1. John L. Hennessy, David A. Patterson, Computer Architecture: A Quantitative Approach, 6 th ed., Morgan Kaufmann, 2017.

PROBABILITY AND STOCHASTIC PROCESS

ENCE605023
2 CREDITS
Learning Outcomes:
In this course, students will learn the basics of probability theory and stochastic processes (random processes). After attending this course, students will be able to analyze data by applying the concepts of probability and stochastic processes (C4). In this course, students will learn how to model, analyze, and simulate stochastic systems.

Topics:

Introduction to probability, discrete random variables, continuous random variables, cumulative distribution function, bivariate random variables, random vectors, Gaussian random vectors, random process, Markov Chains, Mean convergence.

Prerequisite: Calculus, Linear Algebra, Statistics

Textbooks:
1. John A. Gubner, "Probability and Random Processes for Electrical and Computer Engineers", Cambridge University Press, 2006
2. Steven Kay, "Intuitive Probability and Random Processes Using Matlab", Springer, 2006
3. Saeed Ghahramani, "Fundamentals of Probability with Stochastic Process", 4th ed., CRC Press, 2019

SIGNAL THEORY AND SYSTEM ANALYSIS

ENCE605024
2 CREDITS
Learning Outcomes:

In this course, students learn to analyze signals in a system and apply basic techniques (manipulation/filter, transformation) to a signal. After following this course, students will be able to make programs for signal processing systems (C6); able to apply signal processing techniques to analyze systems (C4); and able to use software to analyze signal (C3)

Topics:

Fundamental analysis of signals and systems, focusing on discrete-time and continuous-time representations (singular functions, complex exponentials and geometrics, Fourier representations, Laplace and Z transformations, sampling) and representations of linear, time-invariant systems (difference and differential equations) , block diagram, system function, pole and zero, convolution, impulse and step response, frequency response).

Prerequisites: Engineering Mathematics

Textbooks:
1. Simon Haykin and Barry Van Veen. 2002. Signals and Systems (2nd. ed.). John Wiley & Sons, Inc., USA.
2. Luis F. Chaparro, Aydin Akan, Signals and Systems Using MATLAB, Academic Press, 2019

COMPUTER ENGINEERING PROJECT DESIGN 1

ENCE606025
2 CREDITS
Learning Objectives:

Computer Engineering Project Design Courses 1 and Computer Engineering Project Design 2 are the main design courses (capstone design) in the Computer Engineering Undergraduate Study Program, where students will work in a team to create system designs that can solve complex engineering problems and must integrate the knowledge and skills that have been obtained in previous lectures. The design that is made also needs to take into account the impact on the environment, legal, social and economic community. In this Computer Engineering Project Design 1 course, we will discuss managerial principles in IT projects and how to make a design proposal for an engineering project. After attending this course, students are expected to be able to design a computer engineering project that is supported by theory and knowledge in the field of computer networks, software and hardware with social, economic and cost constraints, which are managed according to the correct managerial stages and processes (C6), able to demonstrate positive attitude critical, creative, and innovative and respects others in the Computer Engineering Design Project 1 (C3, A3) group and is able to provide alternative problem solving to various problems that arise in the community, nation, and state in the Computer Engineering Design Project 1 (C3) group , A2)

Topics:

Project management principles; Risk, dependability, safety and fault tolerance; IT Project Collaboration strategies; Relevant tools, standards and/or engineering constraints.

Prerequisites: Cyber-Physical System and Laboratory, Computer Network and Laboratory, Advanced Programming and Laboratory.

Textbooks:
1. K. Schwalbe, "Information Technology Project Management", 7th Edition, Course Technology, 2013.
2. W.S. Humphrey, "Introduction to the Team Software Process", Addison Wesley 2000.
3. Modul Desain Proyek Teknik Komputer

MULTIMEDIA SIGNAL PROCESSING

ENCE606026
3 CREDITS
Learning Outcomes:

In this course students will learn multimedia signal processing technology to support the delivery of multimedia information through the Internet. At the end of this course, the student will be able to perform analysis of multimedia signals in the network using appropriate techniques. Students will be able to describe components in multimedia files, multimedia compression techniques, are able to perform analysis and processing of multimedia data such as image, sound and video. Students will also be able to apply a digital image processing algorithm to analyze the information in it.

Topics:

Introduction to Multimedia network, Coding and compression of Multimedia Signals (im-ages, sounds, video), improvement the quality of an image, image processing, image Segmenta-tion, representation and description, object recognition.

Prerequisites: Advanced Programming, Signal Theory and System Analysis

Textbooks:
1. J.N. Hwang, "Multimedia Networking: From Theory to Practice," Cambridge University Press, 2009.
2. R.C. Gonzalez and R.E. Woods, Digital Image Processing, 3rd Edition, Prentice-Hall, 2007.

ARTIFICIAL INTELLIGENCE

ENCE606027
3 CREDITS

Learning Objectives:
IIn this course, students will learn basic machine learning techniques, such as regression, clustering and classification. At the end of this course, students are expected to be able to design solutions to data processing problems using a machine learning approach (C4) and be able to work together in teams to complete machine learning (A3) projects.

Topics:
Pattern Recognition and Artifical Neural Networks Introduction, Back-propagation Algorithm, Unsupervised Learning, Principal Component Analysis.

Prerequisites: Linier Algebra, Advanced Programming and Laboratory.

Textbooks:
1. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2011.
2. John D. Kelleher, Brian Mac Namee, and Aoife D'Arcy, Fundamentals of Machine Learning for Predictive Data

ENTREPRENEURSHIP IN INFORMATION TECHNOLOGY

ENCE606029
2 CREDITS
Learning Outcomes:
In this course students learn the basic concepts of project management and marketing that are specialized in the field of Information Technology. After completing this course, students are able to implement entrepreneurial skills and concepts in information technology innovation in the form of business plans in the form of product innovation and expertise in accordance with the development of information technology.
Topics:
Charging for Expertise, Think, Plan, Act Like Entrepreneur, Making a Successful Business, Taking the Initiative, Enabling an E-Business, Providing Outsourced Services & Building a Contracting Business, guest lecture
Prerequisite: none
Textbooks:
1. Bill Aulet, Disciplined Entrepreneurship: 24 Steps to a Successful Startup, Wiley, 2013

PROFESSIONALISM AND ETHICS IN INFORMATION TECHNOLOGY

ENCE606030
2 CREDITS
Learning Outcomes:

In this course, students will learn knowledge about professionalism and ethics in the field of information technology. After attending this course, students are able to analyze professional and ethical attitudes in accordance with the rules and laws in Information Technology (C3, A3) and are able to show a critical, creative, and respectful attitude towards others in the group to solve common problems in the task of Ethics Professionalism in Technology (C3, A3). Students will be able to analyze professional codes of ethics from several influential IT professional organizations in the world, able to elaborate on the relationship between professional ethics and applicable law, able to elaborate on the role and benefits of professional organizations for their members and the wider community; able to explain the current IT job classification, able to elaborate on the importance of professional certification in the IT field; able to identify and formulate solutions to problems related to professionalism and ethics within the scope of work in the IT field.

Topic: '

Ethics; Job,Professional and Professional; Profession in information technology; IT expert organization and code of conduct; cyber ethics; intellectual property rights; Internet crime

Prerequisite: -

1. ACM Code of Ethics and Porfessional Conduct, https://www.acm.org/about-acm/acm-code-of-ethics-and-professional-conduct;
2. IEEE Code of Ethics, https://www.ieee.org/about/corporate/governance/p7-8.html
3. British Computer Society Code of Conduct, https://www.bcs.org/media/2211/bcs-code-of-conduct.pdf.
4. George W. Reynolds, "Ethics in Information Technology" 5th Edition, Cengage Learning, 2015.
5. Frank Bott, "Professional Issues in Information Technology", British Computer Society, 2005.
6. Undang Undang Informasi dan Transaksi Elektronik (UU ITE) – diunduh di EMAS UI

COMPUTER ENGINEERING PROJECT DESIGN 2
ENCE607031
3 CREDITS
Learning Outcomes:

Computer Engineering Project Design Courses 1 and Computer Engineering Project Design 2 are the main design courses (capstone design) in the Computer Engineering Undergraduate Study Program, where students will work in a team to create system designs that can solve complex engineering problems and must integrate knowledge and skills acquired in previous lectures. The design that is made also needs to take into account the impact on the environment, legal, social and economic community. In this Computer Engineering Project Design 2 course, students will work in teams to realize design proposals into practical applications into a product/system. After taking this course, students are expected to be able to design a computer engineering project that is supported by theory and knowledge in the field of computer networks, software and hardware with social, economic and cost constraints, which is managed based on the project stages that have been made and based on ethics (C6) able to demonstrate a critical, creative, innovative attitude and respect for others in the group in the Computer Engineering Design Project 2 (C3, A3) and able to provide alternative problem solving to various problems that arise in the community, nation, and state in the design project group (C3, A2).

Topics:

Design revision, design execution, evaluation
Prerequisites: Computer Engineering Project Design 1
Textbooks: -

Special Subjects

INTERNSHIP
ENCE606028
2 CREDITS
Learning Outcomes:

In this course students undertake work internships in industries or labs related to computer engineering. Students are expected to be able to apply the technical knowledge they have gained from previous lectures and the new material of knowledge provided by their supervisor. Students are also expected to be able to demonstrate working professionalism, which includes the ability to work together in teams, disciplined behavior, responsibilities, initiatives & interests, leadership, commendable attitude / behavior, and the potential to develop. Able to participate in teams to complete the work. Students are expected to convey the internship results and present it in front of the examiner panels.

Topic:

In accordance with the topics agreed by the internship company, adjusted to the field of knowledge of Computer Engineering.

Prerequisite: Passed 85 credits.

Textbook: None.

SEMINAR
ENCE607032
2 CREDITS
Learning Outcomes:

Students are able to make system design proposals, components, and processes related to Computer Engineering; and able to write a research proposal; and able to present research proposals.

Topics:

Introduction, Background, Objectives, Research Limits, Literature Study, Design.

Prerequisite: Passed 114 credits.

Textbooks:

1. Rector Decree (Keputusan Rektor Universitas Indonesia) No. 2143/SK/R/UI/2017 about Technical Guidelines for Writing the Final Project of University of Indonesia Students (Pedoman Teknis Penulisan Tugas Akhir Mahasiswa Universitas Indonesia)
2. IEEE Citation Reference.
3. Ivan Stojmenovic, "How To Write Research Articles in Computing and Engineering Disciplines," IEEE Transactions on Parallel And Distributed Systems, Vol. 21, No. 2, February 2010.

BACHELOR THESIS
ENCE608033
4 CREDITS
Learning Outcomes:

After going through this course, students are expected to be able to create and present system designs, components, and processes in the field of embedded systems or computer networks within a research framework, implement them in the form of hardware and/or software and test and evaluate the results. Students are also expected to be able to use spoken and written language well in communicating and in thesis books, as well as being able to provide alternative solutions to various problems that arise in the community, nation, and state in the implementation of research designs

Topics:

Design Evaluation, Design Implementation, Analysis, Conclusions, Abstract

Prerequisite: Seminar

Textbooks:

1. Rector Decree (*Keputusan Rektor Universitas Indonesia*) No. 2143/SK/R/UI/2017 about Technical Guidelines for Writing the Final Project of University of Indonesia Students (*Pedoman Teknis Penulisan Tugas Akhir Mahasiswa Universitas Indonesia*)
2. IEEE Citation Reference.
3. Ivan Stojmenovic, "How To Write Research Articles in Computing and Engineering Disciplines," IEEE Transactions on Parallel And Distributed Systems, Vol. 21, No. 2, February 2010.

Computer Engineering Electives Subjects

BIG DATA TECHNOLOGY
ENCE605034
3 CREDITS
Learning Outcomes:

This course will discuss the technology used to solve the Big Data problems in various field (e.g. Internet, Telecommunication, Retail). Students will be able to manage (collection, preparation, processing, validation, interpretation) and analyze the data with amount size and has a random structure.

Topics:

Into to Data Engineering, Hadoop Architecture, The Hadoop Distributed Filesystem, Setting Up Hadoop Cluster, Administering Hadoop, MapReduce Framework, Developing a MapReduce Application, Hive Database, Spark Processing, Big Data Analytic Project

Prerequisites: Database System and Laboratory, Object Oriented Programming and Laboratory

Textbooks:
1. Jure Leskovec, Anand Rajaraman, Jeff Ullman, Mining of Massive Datasets, Cambridge University Press, 2014
2. Tom White,"Hadoop: The Definition Guide", Third Edition, O'Relly, 2012
3. Benjamin Bengfort, Jenny Kim, Data Analytics with Hadoop: An Introduction for Data Scientists, O'Reilly Media, 2016

CLOUD COMPUTING
ENCE606035
2 CREDITS
Learning Objectives:

At the end of the course, students will be able to explain models of cloud services and delivery (IaaS, PaaS, and SaaS), virtualization technology influence to cloud development, and related terminologies. Students also able to deploy cloud services model using public cloud providers such as AWS, Google Compute and Microsoft Azure.

Students will be able to design and deploy a typical data center by implementing cloud infrastructure components such as compute, storage, network, load balancer and DNS. Student will be able to deploy and manage software applications such as Java and Python as a platform, and able to deploy necessary security measures to the cloud system.

Topics:

Basics of cloud computing architecture, and its economic foundation including SLA, pricing scheme and mitigating single-point-of-failures. Basic concepts of the technology includes software defined architecture, virtualization and cloud service. Infrastructure as a Service (Iaas) as the lowest level infrastructure of cloud computing. Containers, Virtual Machine, JVM, Docker, Kubernetes. Public cloud infrastructures such as AWS, Google Computer, Microsoft Azure, etc. Service Models: Metal as a Service (MaaS), Platform as a Service (PaaS) and Web Service(Middleware) technology in cloud computing. Distributed storage such as Ceph, SWIFT, HDFS, NAS, SAN, Zookeeper.Also object-storage technology such as Amazon S3, virtualisasi block-storage and cloud API storage model, as well as integrating the cloud storage services into an application. The concept of security in cloud computing, including high availability, load balancing, data security, and network security. The concepts of cloud automation such as DevOps practice, continuous integration and deployment as well as its automation. Trends in cloud computing such as: Edge Computing. FOG Computing and microservices.

Prerequisite: Database System and Laboratory

Textbooks:
1. Cloud Computing Design Patterns, Thomas Erl, Robert Cope, Amin Naserpour, Prentice Hall, 2015, ISBN:978-0-13-385856-3

References:
1. Cloud service documentation from AWS, Google, Microsoft Azure
2. www.openstack.org, www.cncf.io

HUMAN COMPUTER INTERACTION
ENCE606036
2 CREDITS
Learning Outcomes:

In this course, students learn and apply HCI theory and analytical approach in producing a prototype of human and computer interaction that is high quality, effective, and efficient. After following this course, the student will be able to design and analyse an interface of computer-based systems.

Topics:

Factors in HCI; input and output devices; interaction; interaction design; HCI in software process; design rules; implementation support; evaluation techniques; universal design

Prerequisite: Software Engineering

Textbooks:
1. A.J. Dix, J.E. Finlay, G.D. Abowd and R. Beale, "Human-Computer Interaction", Third Edition, Prentice Hall, USA, 2003.
2. B. Shneiderman and C. Plaisant, "Designing The User Interface: Strategies for Effective Human Interaction", Fifth Edition, Pearson-Addison Weasley, 2010.

WIRELESS TECHNOLOGY
ENCE606037
2 CREDITS
Learning Outcomes:

In this course, students learn the basics of wireless technology including how it works, the techniques, and the standardization on wireless and mobile networks. After attending this course, students are able to explain the basics of wireless technology, techniques on wireless networks, IEEE 802.11, 802.15 technology standards and able to analyze the projections of future wireless technology.

Topics:

802.11 Technology (Wireless LAN); 802.15 Technology (Bluetooth, Zigbee, WPAN)

Prerequisites: Telecommunication Networks and Laboratory

Textbooks:
1. Eldad Perahia, "Next Generation Wireless LANs: 802.11n and 802.11ac," 2nd Edition, Cambridge University Press; 2 edition, June 24, 2013
2. Al Petrick, "IEEE 802.11 Handbook: A Designer's Companion," 2nd Edition, IEEE Standards Information Network, 2005

GEOSPATIAL TECHNOLOGY
ENCE607038
2 CREDITS
Learning Objectives:

Through this lecture students can explain and analyze information on the surface of the Earth from the image of geospatial satellites that utilize electromagnetic wave radiation either transmitted or reflected by its surface.

Topics:

History & Scope of Geospatial Technology, Source of Geospatial Data, Electromagnetic Radiation, Mapping Cameras, Digital Imagery, Image Interpretation, Geographic Information System (GIS), Geospatial Earth Observation Satellites, Active Microwave, Lidar, Thermal Imagery, Image Resolution, Hyperspectral data, Apps. in Geospatial Tech.: Change Detection, Plant Sciences, Land Use and Land Cover, City Planning, Disaster Assessment.

Prerequisite: Basic Programming and Laboratory

Textbooks:
1. J.D. Bossler, J.R. Jensen, R.B. McMaster, C. Rizos,"Manual of Geospatial Science and Technology," CRC Press, 2001.
2. J.B. Campbell and R.H. Wynne, "Introduction to Remote Sensing", 5th Edition, The Guildford Press, NY, 2011.
3. Canadian Centre for Remote Sensing, "Fundamental of Remote Sensing"

CAPITA SELECTA IN COMPUTER ENGINEERING

ENCE607039
2 CREDITS
Learning Objectives:

In this lecture, students will learn the latest topics in the industry in computer engineering. After attending this lecture, students are able to analyze industry developments in the field of computer engineering and problems faced in general.

Topics:

Latest computer technology concepts; Latest computer technology applications; Tradeoff on new technology in computer engineering; Recent problems in Computer Engineering
Prerequisites: none

Textbooks: none (to be given later)

PROFESSIONAL ENGINEER DEVELOPMENT 1

ENCE6007049
2 CREDITS
Learning Objectives:

Students can demonstrate the internalization of teamwork, project management, and ability to demonstrate technical skills.

Topics:

1. Integrated professional activities are carried out independently in an organization/industry oriented to engineering projects that apply accumulated skills during the learning process in the course.
2. This activity is a continuation of the work of practice and is carried out in part time between 10 -16 hours per week with long activities between 10-14 weeks (1 semester of lectures). Due to the nature of the part-time activities, students can manage their schedules flexibly along with their coursework activities.
3. Prior to doing an internship, students must make a Letter of Agreement between the three parties (organization/industry, university and student) which contains a work plan as well as the rights and obligations of students during the internship in the organization/industry.
4. Students must submit a portfolio of integrated Professional development activities in the form of:
   a. The weekly comprehensive log of activities signed by the industry Supervisor/team leader (LOG-book format as per the department specified). This Log should be reported per week to the lecturer as part of the monitoring process.
   b. Final report on results of activities and other achievements (certification/draft patent/design document/engineering)
   c. Self-evaluation and evaluation of the supervisor/team leader in the industry (defined department) at the end of the activity.
5. The portfolio at point 3 above is used in the assessment section of the achievement of this special course.

Prerequisite: already pass 85 credits

REGULATION & PUBLIC POLICY ON ICT SECTOR

ENCE607041
3 CREDITS
Learning Objectives:

In this course, will be discussed on the fundamentals of drafting and developing public policy and regulation, especially in the era of rapid information technology and communication (ICT) development. After attending this lecture, students will be able to explain the fundamentals of public policy, telecommunications laws and regulations, and the governance of the Internet. In this lecture will also be discussed examples of applicative regulations and policies in the field of telecommunications and the Internet, while anticipating the speed of change and the dynamics that occur in the community as an implication of ICT development.

Topics:

Public administration, significance of public policy, research and method of research policy, comparative study policy, introduction to telecommunications laws and regulations, economic Review of telecommunication regulations, key issues of telecommunication regulation, understanding Internet governance, stakeholders Internet governance, Internet governance process.

Prerequisites: -

Textbooks:
1. Ian Walden,"Telecommunications Law and Regulation", Oxford University Press, 2012
2. Jovan Kurbalija, "Tentang Tata Kelola Internet: Sebuah Pengantar", APJII, 2011
3. Riant Nugroho, "Public Policy: Dinamika Kebijakan, Analisis Kebijakan, Manajemen Kebijakan", Elex Media Komputindo, 2012

BLOCKCHAIN TECHNOLOGY

ENCE608042
3 CREDITS
Learning Objectives:

Able to implement a business process using blockchain technology. Able to evaluate various consensus algorithms. Able to implement smart contracts into the blockchain.

Topics:

History of Blockchain, Trust models, Cryptography and Hash functions, consensus mechanisms, Smart contracts, assets, blockchain regulation.

Prerequisite: Database System and Laboratory

Textbooks:
1. "Architecture for Blockchain Applications", Ingo Weber, Mark Staples, and Xiwei Xu, Springer, 2019
2. "Programming Bitcoin: Learn How to Program Bitcoin

from Scratch", Jimmy Song, Oreilly, 2019
3. "Blockchain: Blueprint for a New Economy", 1st Edition, Melanie Swan, Oreilly, 2015

PROFESSIONAL ENGINEER DEVELOPMENT 2
ENCE608043
2 CREDITS
Learning Objectives:

Students can demonstrate their ability to professional certification related to computer engineering.

Certification Acknowledgment

1. The certifications that are recognized:

a. Standard Competency of Indonesian National Work (Standard Kompetensi Kerja Nasional Indonesia, SKKNI) with KKNI level 6 for related field Prodi.

b. Special certification from international industry certification body with Associate level for related field.

3. The certification in question has a standardized reference document evaluated.

4. Students submit proof of certification following supporting documents (standard competency reference) to be evaluated by the assessment committee.

Competition Acknowledgment

1. Students submit proof of participation in the competition in the form of a certificate or statement from the organizer

2. Students show evidence that competition achievements are obtained during her/his academic status as a student.

3. Assessment is carried out based on a rubric that is adjusted to the type of competition being entered

CRYPTOGRAPHY
ENCE608044
2 CREDITS
Learning Objectives:

Students are able to import the concepts of classical cryptography, the basics of cryptanalysis, modern cryptography symmetric and asymmetric key, as well as its implementation for information system security.

Topics:

Fundamentals of Cryptographic mathematics, classical cryptographic algorithms, advanced classical cryptographic algorithms, Cryptoanalysis basics, mathematical cryptography structure algebra, Modern Block Chiper: Advanced Encryption Standard (AES), Symmetric cryptography application, modern RSA key asymmetric algorithm, asymmetric cryptographic application, Certificate Authority/Public Key Infrastructure

Prerequisite: Basic Programming and Laboratory

Textbooks:
1. Forouzan, Behrouz A., and Debdeep Mukhopadhyay. Cryptography and Network Security (Sie). McGraw-Hill Education, 2011.
2. Stallings, William. "Cryptography and Network Security. 2005." ISBN: 0-13-187316-4.
3. Attaway, Stormy. Matlab: a practical introduction to programming and problem solving. Butterworth-Heinemann, 2013.
4. Hoffstein, Jeffrey, et al. An introduction to mathematical cryptography. Vol. 1. New York: springer, 2008.
5. Menezes, Alfred J., Paul C. Van Oorschot, and Scott A. Vanstone. Handbook of applied cryptography. CRC press, 1996.
6. Stinson, Douglas R. Cryptography: theory and practice. CRC press, 2005.

VLSI DESIGN
ENCE608045
2 CREDITS
Learning Objectives:

Students are able to explain the process stages in CMOS design, implement Scale of Lambda design, evaluate the characteristics and performance of power transistor circuits and digital CMOS, and explain high-level design optimization techniques

Topics:

Mixed-signal circuits; Design parameters issues; Circuit modelling & Simulation methods

Prerequisite: Fundamental of Digital System and Laboratory

Textbooks:
1. N.E. Weste and K. Eslughian, "Principle of CMOS VLSI Design", Addison-Wesley, 1985.
2. F.M. Berti, "Analog Design For CMOS VLSI System", Kluwer Academic Publisher, 2006.

Undergraduate Program in Biomedical Engineering

Program Specification

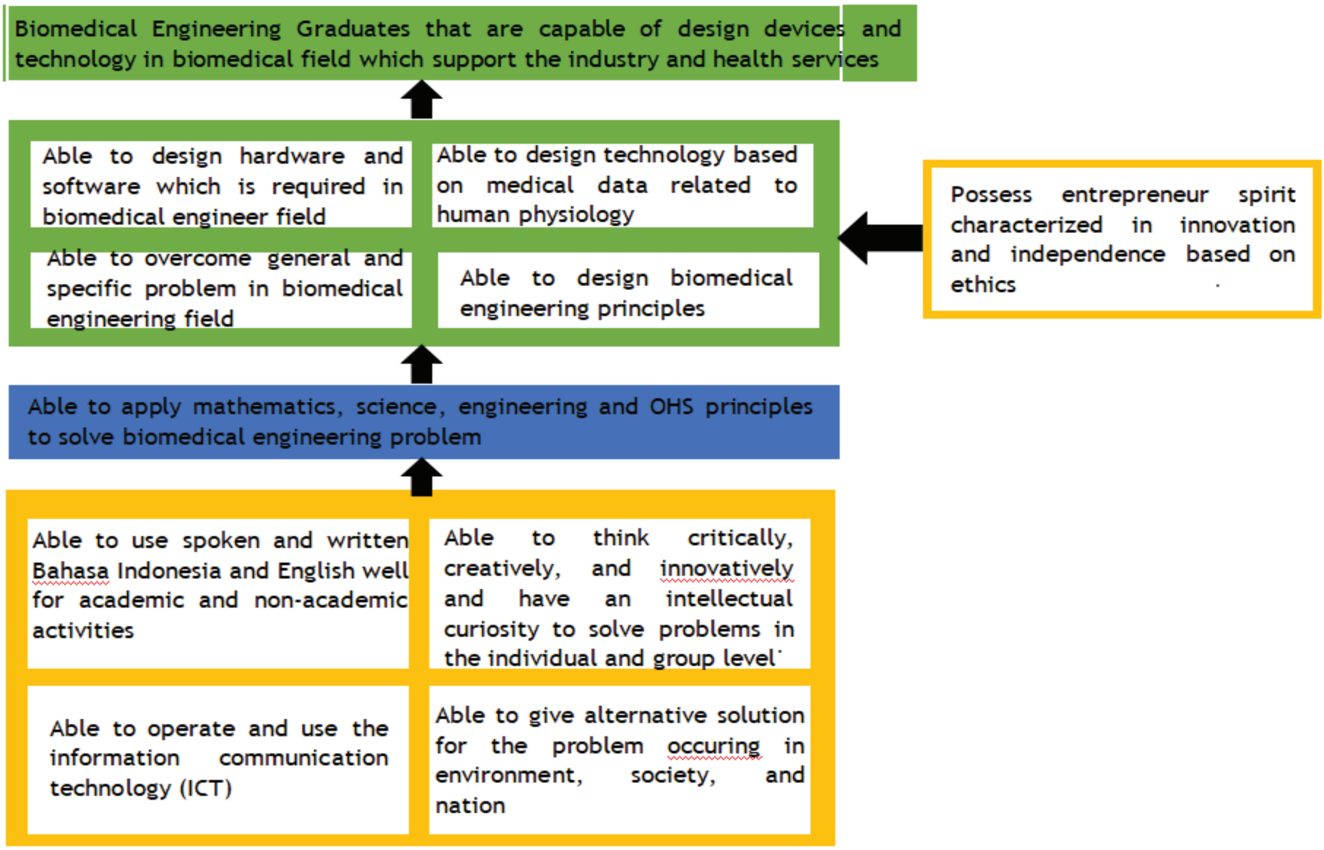
1.	**Awarding Institution**	Universitas Indonesia	
2.	**Teaching Institution**	Universitas Indonesia	
3.	**Programme Tittle**	Undergraduate Program in Biomedical Engineering	
4.	**Class**	Regular	
5.	**Final Award**	Sarjana Teknik (S.T)	
6 .	**Accreditation / Recognition**	Early accreditation by BAN PT for new study program	
7.	**Language(s) of Instruction**	Bahasa Indonesia	
8.	**Study Scheme (Full Time / Part Time)**	Full Time	
9.	**Entry Requirements**	High school / equivalent, AND pass the entrance exam.	
10.	**Study Duration**	Designed for 4 years	
	Type of Semester	Number of Semester	Number of weeks / semester
	Regular	8	16
	Short (optional)	3	8
11.	**Graduate Profiles:** Biomedical Engineering Graduates that are capable of design devices and technology in biomedical field which support the industry and health services.		
12.	**Expected Learning Outcomes:** Biomedical Engineering Graduates are expected to have the following competence: 1. Able to design hardware and software which is required in biomedical engineer field. 2. Able to overcome general and specific problem in biomedical engineering field. 3. Able to design technology based on medical data related to human physiology. 4. Able to design biomedical engineering principles. 5. Able to apply basic mathematics, chemistry, and physics to solve biomedical engineering problem. 6. Able to think critically, creatively, and innovatively and have an intellectual curiosity to solve problems in the individual and group level. 7. Possess entrepreneur spirit characterized in innovation and independence based on ethics. 8. Able to use spoken and written Bahasa Indonesia and English well for academic and non-academic activities. 9. Able to give alternative solution for the problem occurring in environment, society, and nation. 10. Able to operate and use the information communication technology (ICT).		
13.	**Classification of Subjects**		

No.	Classification	Credit Hours (SKS)	Percentage
i	**University General Subjects**	**9**	**6.25%**
ii	**Faculty Subjects**	**18**	**12.5%**
iii	**Expertise Subjects**	**84**	**58,3%**
iv	**Elective Subjects**	**25**	**17,36%**
v	**Special Subjects (Internship, Pre-Thesis, and Undergraduate Thesis)**	**8**	**5.56%**
	Total	**144**	**100 %**
	Total Credit Hours to Graduate		**144 SKS**

Career Prospects

Biomedical Engineering Study Program Graduate could work in various types of companies and health industries, information technology, education, government or regulator, and other industries related to health facilities, such as hospitals and health clinics.

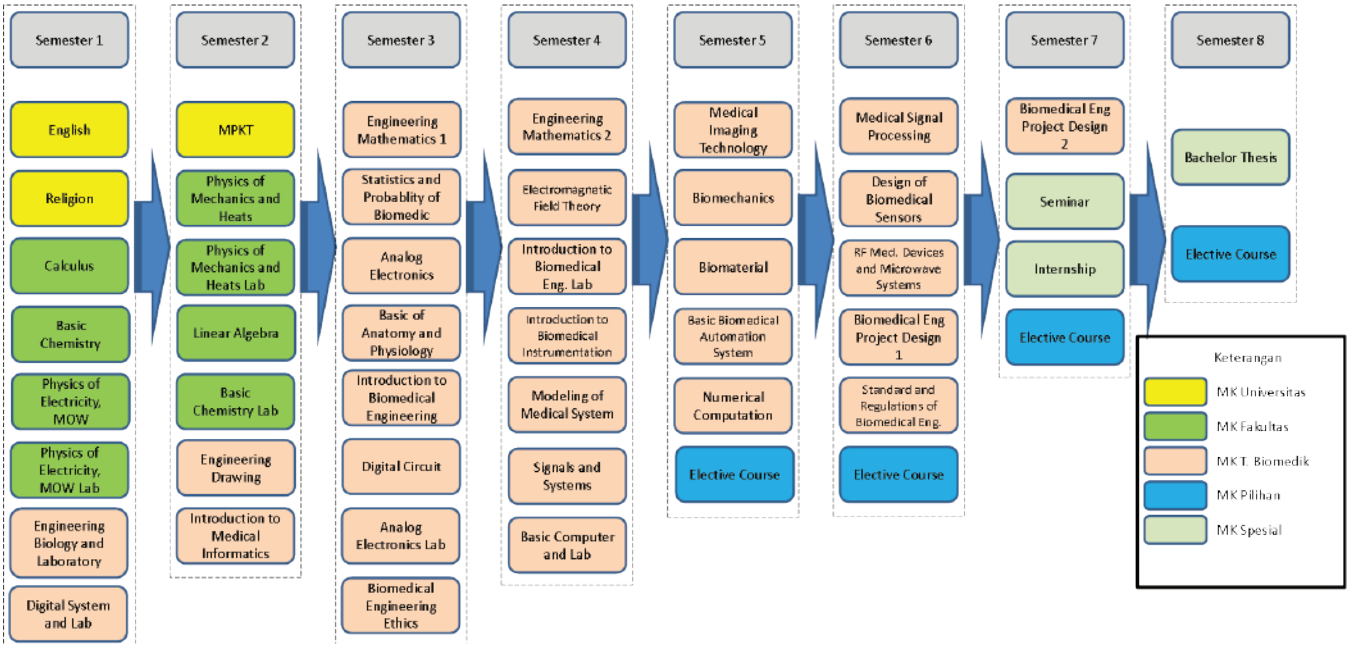
Learning Outcomes



Learning Output

No	KKNI Level 6	General Competency	Output
1	Able to apply their expertise and use science, technology, and/ or art in their respective fields in solving problems and able to adapt to any situation faced	Able to design system, component, or process n biomedical engineering field Able to apply tecnique, skill and modern assist tools such as hardware and software required in biomedical engineering Able to design imaging technique for biomedical engineering	• Undergraduate Thesis • Paper • Publication, including a summary article of undergraduate thesis with journal format on UI repository. • Internship training report.
2	Able to master theoretical concept in certain knowledge of a field in general and deep specialized theoretical concept in in said field and able to formulate problem-solving procedures	Able to design biomedical engineering principles Able to apply basic mathematics, chemistry, and physics to solve biomedical engineering problem	• Undergraduate Thesis • Paper • Publication, including a summary article of undergraduate thesis with journal format on UI repository. • Internship training report.
3	Able to make the correct decision based on information and data, and able to give instruction in choosing from a variety of solution alternatives both independently and in group.	Able to think critically, creatively, and innovatively and have an intellectual curiosity to solve problems in the individual and group level Able to give alternative solution for the problem occurring in environment, society, and nation	• Undergraduate Thesis • Paper • Publication, including a summary article of undergraduate thesis with journal format on UI repository. • Internship training report.
4	Be responsible for their own work and can be given responsibility in achieving organization's output	Able to give alternative solution for the problem occurring in environment, society, and nation Possess entrepreneur spirit characterized in innovation and independence based on ethics	• Undergraduate Thesis • Paper • Publication, including a summary article of undergraduate thesis with journal format on UI repository. • Internship training report.

Flow Diagram of Subjects



Course Structure Undergraduate Program in Biomedical Engineering

Code	Subject	SKS
	1st Semester	
UIGE600003	English	2
UIGE600010-15	Religion	2
ENGE600003	Calculus	4
ENGE600009	Basic Chemistry	2
ENGE600007	Physics of Electricity, Magnetism, Optics, and Waves	3
ENGE600008	Physics of Electricity, Magnetism, Optics, and Waves Laboratory	1
ENBE601001	Engineering Biology and Laboratory	3
ENEE602005	Digital System and Laboratory	3
	Sub Total	**20**
	2nd Semester	
UIGE600001	Integrated Characteristic Building Subject	5
ENGE600005	Physics of Mechanics and Heats	3
ENGE600006	Physics of Mechanics and Heats Laboratory	1
ENGE600004	Linear Algebra	4
ENBE602002	Basic Chemistry Laboratory	1
ENBE602003	Engineering Drawing	3
ENBE602004	Introduction to Medical Informatics	3
	Sub Total	**20**
	3rd Semester	
ENBE603005	Engineering Mathematics 1	3
ENBE603006	Statistics and Probablity of Biomedical Engineering	3
ENBE603007	Analog Electronics	3
ENBE603008	Basic of Anatomy and Physiology	3
ENBE603009	Introduction to Biomedical Engineering	3
ENBE603010	Electric Circuit	3
ENBE603011	Analog Electronics Laboratory	1
ENBE603012	Biomedical Engineering Ethics	2
	Sub Total	**21**
	4th Semester	
ENBE604013	Engineering Mathematics 2	4
ENBE604014	Electromagnetics	3
ENBE604015	Introduction to Biomedical Engineering Laboratory	1
ENBE604016	Introduction to Biomedical Instrumentation	3
ENBE604017	Modeling of Medical System	3
ENEE604017	Signals and Systems	3
ENEE603014	Basic Computer and Laboratory	3
	Sub Total	**20**
	5th Semester	
ENBE605018	Medical Imaging Technology	3
ENBE605019	Biomechanics	3
ENBE605020	Biomaterial	3
ENBE605021	Basic to Biomedical Automation System	3
ENEE604020	Numerical Computation	2
	Elective Course	5
	Sub Total	**19**
	6th Semester	
ENBE606022	Medical Signal Processing	3
ENBE606023	Biomedical Sensor Design	3
ENBE606024	RF Medical Devices and Microwave Systems	3
ENBE606025	Biomedical Engineering Project Design 1	2
ENBE606026	Standard and Regulations of Biomedical Engineering	2
	Elective Course	8
	Sub Total	**21**
	7th Semester	
ENBE607027	Biomedical Engineering Project Design 2	3
ENBE607028	Pre-Thesis	2
ENBE607029	Internship	2
	Elective Course	6
	Sub Total	**13**
	th Semester	
ENBE608030	Bachelor Thesis	4
	Elective Course	6
	Sub Total	**10**
	Total	**144**

Electives Subjects for Biomedical Study Program

Code	Subject	SKS
ENBE605031	Medical Communication System	3
ENBE605032	Health, Safety & Environment for Hospital	2
ENBE607033	Biomedical Special Topic 1	3
ENBE607034	Immune Engineering	3
ENBE607035	Basic Thermodynamics	3
ENBE607036	Artificial Intelligent	3
ENBE606037	Biomedical Embedded System	4
ENBE606038	Biomedical Embedded System Laboratory	1
ENBE608039	Biomedical Special Topic 2	3

ENBE608040	Bioinformatics and Genomics	3
ENBE608041	Medical Therapy Technology	3

Elective subjects can also be taken across study programs, departments, and faculties. For students to take subjects from other faculty, they must follow Universitas Indonesia regulation and procedure.

Course Sylabus of University Subjects

INTEGRATED CHARACTER BUILDING
UIGE6000061/UIGE6100061
5 credits

Syllabus :

The Integrated Character Building is part of the Higher Education Personality Development Lecture which is held for students which contains elements of the internalization of basic life values, interaction/relationship skills, nationality and academic skills as the basis for student personality to carry out learning according to scientific disciplines.

MPKT is carried out in the form of a series of learning activities outside the formal class. activities carried out include participation in lectures/seminars, internships, field work practices, social work, sports and/or arts activities and other forms of activities that have the main goal of equipping students with soft skills and proven by portfolio documents. The form of this learning activity is different from the MPKT courses that have been carried out at the previous UI.

The material provided at MPKT aims to form a human thinking pattern with values and morals to create a human personality by having critical, logical, creative, innovative thinking, and having intellectual curiosity and an entrepreneurial spirit. The material provided includes 9 UI values, national, state and citizen values based on Pancasila. Solving problems in science, technology, health, and humans as natural managers by using reasoning and utilizing Information and Communication Technology (ICT) to achieve the final objectives of this module.

Lecture activities are carried out using an online student-centered learning (SCL) approach which can use the following methods: experiential learning (EL), collaborative learning (CL), problem-based learning (PBL), question-based learning, and project based learning. The use of these various methods is carried out through group discussion activities, independent assignment exercises, presentations, writing papers in Indonesian and interactive discussions in online discussion forums. The language of instruction in this lecture is Indonesian.

Graduate Learning Outcomes :

- CPL 1: Able to use spoken and written language in Indonesian and English both for academic and non-academic activities (C3, A5)
- CPL 2: Have integrity and are able to think critically, creatively, and innovatively and have intellectual curiosity to solve problems at the individual and group level (C4, A3)
- CPL 3: Able to provide alternative solutions to various problems that arise in the community, nation, and country (C4, A2)
- CPL 4: Able to take advantage of information communication technology (C3)
- CPL 5: Able to identify various entrepreneurial efforts characterized by innovation and independence based on ethics (C2, A5)

Course Learning Outcomes :

- CPMK 1: After completing this course, students are able to apply self-regulated learning characteristically in studying critically, logically, creatively, innovatively through analysis of societal problems, nation, state, and Pancasila ideology based on self-understanding as individuals and members. the community by using good and correct Indonesian and the latest information and communication technology (C4, A4)
- CPMK 2: Able to identify various entrepreneurial efforts characterized by innovation and independence based on ethics (C2, A5)
- CPMK 3: After completing this course, students are able to apply self-regulated learning characteristically in pursuing integrated and comprehensive knowledge through analysis of science problems, technology based on the role of nature manager by using good and correct Indonesian and information technology and current communications. (C4, A4)
- CPMK 4: After completing this course, students are able to plan creative activities to solve problems in society and the world of work/industry by showing creativity, critical thinking, collaborative self-discipline using good and correct Indonesian as well as the latest information and communication technology (C5, A5)

Prerequisite : -

ACADEMIC WRITING
UIGE610002
2 credits
The Objectives :

To activate students, English so that they will be able to communicate effectively in English;

To enable students to develop the learning strategies and study skills needed to finish their study successfully and o continue learning on their own after taking the MPK program (to develop independent learners)

Main Competencies :

- Listen to, understand and take notes of key information in academic lectures of between 5-10 minutes length;
- Improve their listening skills through various listening materials and procedures;
- Speak confidently, ask questions in and contribute to small group discussions;
- Use different reading strategies needed to the effective readers;
- Improve their reading skills through extensive reading material;
- Develop skills in connecting ideas using appropriate transitions and conjunctions;
- Work as part of a group to prepare and deliver a 25-minute presentation on an academic topic using appropriate organization, language and visual aids;
- Write a summary of a short academic article;
- Write an expository paragraph;
- Write a short essay.

Learning Method : Active learning, Contextual language learning, small group discussion.

Prerequisite :

1. Students Learning Orientation/Orientasi Belajar Mahasiswa (OBM)

ENGLISH

UIGE600003
2 credits
Learning Objectives :

After attending this subject, students are expected to capable of use English to support the study in university and improve language learning independently.

Syllabus :

Study Skills : (Becoming an active learner, Vocabulary Building: word formation and using the dictionary Listening strategies Extensive reading) Grammar: (Revision of Basic grammar Types of sentences Adjective clauses, Adverb clauses Noun clauses, Reduced clauses) Reading: (Reading skills: skimming, scanning, main idea, supporting ideas, Note-taking Reading popular science arti-cle, Reading an academic text) Listening: (Listening to short conversations, Listening to a lecture and notetaking, Listening to a news broadcast, Listening to a short story) Speaking: (Participating in discussions and meetings, Giving a presentation) Writing: (Writing a summary of a short article Describing graphs and tables, Writing an academic paragraph, Writing a basic academic essay (5 paragraphs).

ISLAMIC STUDIES

UIGE6000010/UIGE610005
2 credits
General Instructional Objectives :

The cultivation of students who have concern for social, na-tional and countrys issues based on Islamic values which is applied in the development of science through intellectual skills.

Learning Objectives :

Course participants are expected to do the following when faced with a problem or issue which they must solve :

1. Analyze the problem based on the Islamic values they adopted;
2. Analyze the problem by implementing active learning stages;
3. Discuss and express their thoughts and ideas by using proper and correct Indonesian language in discussion and academic writing.

Syllabus :

Islam history: the meaning of Islam, the characteristic of Islam, the sources of Islamic teachings, Muhammad SAW as prophet and history figure, introduction of Islam in Indonesia, the teaching essence of Islam: the basic principle of Islam teachings, the unity of Allah, worship prac-tice in live, eschatology and work ethics, human's basic rights and obligation, social structure in Islam: sakinah mawaddah and ramhah family, the social implication of family life, Mosque and the development of Islam, zakat and the economic empowerment of the people, Islam society, Science: reason and revelation in Islam, Islam's motivation in development of science, science characteristics, source of knowledge, IDI (each Faculty and Department/Study Program).

CATHOLIC STUDIES

UIGE6000011/UIGE610006
2 credits
General Instructional Objectives :

To help deliver students as intellectual capital in implementing lifelong learning process to become scientists with mature personality who uphold humanity and life.

Be scholars who believe in God according to the teachings of Jesus Christ by continuing to be responsible of his faith in life in church and society.

Syllabus :

Almighty God and the God teachings; Man, Morals, science technology and art; harmony between religions; Society, Culture, Politics, Law: the substance of theses studies will be addressed by integrating the four dimensions of the teachings of the Catholic faith: the personal dimension, the dimension of Jesus Christ, the dimension of the Church, and Community dimension. Dimensions are implemented in the following themes: People, Religion, Jesus Christ, the Church, and Faith in the society.

CHRISTIAN STUDIES

UIGE6000012/UIGE610007
2 credits
General Instructional Objectives :

Cultivating students with comprehensive Christian knowledge and teaching in the midst of the struggle and the fight of the nation while also discussing the student's participation in line with the study to help improve and build our country.

Learning Objectives :

Course participants are expected to do the following when faced with a problem or issue which they must solve:

1. Analyze the problem based on the Christian values
2. Analyze the problem by implementing active learning stages
3. Discuss the problem by using proper and correct Indonesian language

Syllabus :

History (Historical terms): Status of the Bible, the existence of God and Morality, Christ the Savior, the Holy Spirit as existence reformer and outlook on the world: Faith and Knowledge of Science, Church and service, Ecclesiology, Spiritual and enforcement of Christian Human Rights and the world of ethics: Christian Ethics, Christian and worship, Christianity and politics, Christian love and social reality: Christian Organizations, Students and Service, Christian and expectations.

HINDU STUDIES

UIGE6000013/UIGE610008
2 credits

Syllabus :

Hindu religion, Hindu history), Source and scope of Hinduism (the Veda as the source of Hindu religion teachings, the scope of the teachings in Hindu religion), The concept of the God (Brahman) according to the Veda, the Path to Brahman (Catur Marga Yoga, Mantra and Japa), Human Nature (The purpose of human life, Human's duties, obligations, and responsibilities both individually or collectively), Ethics and morality (Principles teaching, self-control), in-depth understanding of the scripture (deep understanding of the Bhagawadgita, deep understanding of the Sarasamuschaya), The Role of Hinduism in science, technology, and art (Hinduism benefits in science and technology in accordance with each department, benefit / the role of Hinduism in the arts), Cohesion and community's prosperity /independence (Benefits of unity in the religious plurality, independent community (kerthajagathita) as a common goal, Tri Pitakarana), Culture as an expression of Hindu religious practice, Contribution to the Hindu religion teachings in the political life of nation and country, laws and the enforcement of justice, Awareness of and obeying the Rita / Dharma.

BUDDHIST STUDIES
UIGE6000014/UIGE610009
2 credits

Syllabus :

Almighty God and the God Study (Faith and piety, Divine Philosophy/Theology), Human (Human Nature, Human Dignity, Human Responsibility), Moral (Implementation of Faith and Piety in everyday life), Science, Technology and Art (Faith, Science and Charity as a unity, the Obligation to study and practice what you are taught, Responsibility for nature and environment), harmony between religion (religion is a blessing for all mankind, the essence of the religious plurality and togetherness), community (the role of religious society in creating a prosperous independent society, the responsibility of religious society in the realization of human rights and democracy), Culture (the responsibility of religious society in the realization of critical thinking (academic), work hard and fair), Politics (Religion contribution in the political life of nation and country), Law (Raise awareness to obey and follow God's law, the role of religion in the formulation and enforcement of law, the function of religion in the legal profession).

KONG HU CU STUDY
UIGE6000015/UIGE610010
2 credits

Syllabus of Faculty Subjects

CALCULUS 1
ENGE600001/ENGE610001
3 credits
Course Learning Outcomes:

Able to use the basic concepts of calculus related to -a function of one variable, the derivative and integration of the function of one variable in order to solve its applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, basic engineering, and engineering specialization to be used in solving complex engineering problems.

Syllabus :
Introduction, Functions and Limits, The Derivative, Applications of the Derivative, The Definite Integral, Applications of The Definte Integral, Transcendental Functions, Techniques of Integration, Indeterminate Forms and Improper Integrals.

Prerequisite: None

Textbooks:

Main reference:
D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., Pearson, Prentice Hall, 2007.

Additional eferences:
1. George B. Thomas Jr., Thomas' Calculus Early Transcendental, 12th ed., Addison–Wesley Pearson, 2009.
2. Howard Anton, Calculus, 10th ed., John Wiley and Sons, 2012.

CALCULUS 2
ENGE600002/ENGE610002
3 SKS
Course Learning Outcomes:

Students are able to use the concepts of sequences, series, conic sections, and the basic concepts of calculus which involve the function of two or three variables to solve their applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus: **:**
Infinite sequences and infinite series, Test for convergence of positive series and alternating series, Power series and operation on operations, Taylor and MacLaurin series, Conic sections , Calculus in polar coordinates, Derivatives, limits, and continuity of multi-variables functions, Directional derivatives and gradients, Chain Rule, Tangent planes and Approximations, Lagrange multipliers. Double integrals in Cartesian coordinates and polar coordinates, triple integrals in Cartesian coordinates, cylindrical coordinates and spherical coordinates, Applications of double and triple Integral.

Prerequisite: Calculus 1

Textbooks:
1. D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., PEARSON, Prentice Hall, 2007.
2. Thomas, Calculus Thirteenth Edition Volume 2, Erlangga, 2019.

CALCULUS
ENGE600003/ENGE610003
4 SKS
Course Learning Outcomes:

Students are able to use the basic concepts of calculus involving functions of one to three variables to solve their applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :

Introduction, Functions and Limits, Derivatives, Derived Applications, Indeterminate Integral, Integral Applications, Infinite Row, and Series. Derivatives with many variables, Duplicate Integral (2 and 3), Duplicate Integral Application.

Prerequisite: None

Textbooks:

Main :
D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., Pearson, Prentice Hall, 2007.

George B. Thomas Jr., Thomas' Calculus Early Transcendental, 12th ed., Addison – Wesley Pearson, 2009.

LINEAR ALGEBRA
ENGE600004/ENGE610004
4 SKS
Course Learning Outcomes:
Students are able to calculate linear system problems to solve engineering problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :

Linear Systems and matrix equations, Determinants, Euclid vector spaces, Common vector spaces, eigenvalues and eigenvectors, inner product spaces, Diagonalization and General Linear Transformation.

Prerequisite: None

Textbooks:
1. Elementary Linear Algebra, Howard Anton & Chris Rorres, 11th edition, 2014
2. Gilbert Strang, Introduction to linear algebra 3rd edition Wellesley Cambridge Press, 2003

MECHANICAL AND HEAT PHYSICS
ENGE600005 / ENGE610005
3 credits
Course Learning Outcomes:

Able to explain the basic concepts of mechanics and thermodynamics, and be able to apply them to understand natural phenomena and human engineering, including their applications.

Graduate Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus:

Units, Magnitudes and Vectors, Motion Along Straight Lines, Motion in Two and Three Dimensions, Newton's Laws of Motion, Applications of Newton's Laws, Kinetic Energy, and Work, Potential Energy and Energy Conservation, Center of Mass, Linear Momentum, Rotation, Rolling Motion, Torque, Angular Momentum, Oscillation, Mechanical and Sound Waves, Gravity, Statics and Elasticity, Fluid Mechanics, Temperature, Heat, Law I Thermodynamics, Ideal Gas and Kinetic Theory of Gas, Heat Engine, Entropy, and Law II Thermodynamics.

Prerequisite: none

Textbooks:
1. Halliday, Resnick, and Walker, Principles of Physics 10th Edition, Wiley, 2014.
2. Serway Jewett, Physics for Scientists and Engineers 9th Edition, Thomson Brooks / Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008

ELECTRICAL MAGNETIC, OPTICAL AND WAVE PHYSICS
ENGE600007 / ENGE610007
3 credits
Course Learning Outcomes:

Students are able to apply the basic concepts of electrical physics, magnetism, waves, and optics to solve problems in the engineering field.

Graduate Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus:

Unit, Magnitude, Vector, Electric Charge, Electric Field, Gauss Law, Electric Potential, Capacitance, Electric Current, Resistance, Direct Current, Magnetic Field Due to Electric Current, Magnetic Field Source, Induced GGL, Inductance, Alternating Current, Electromagnetic Waves, Light Properties and Propagation, Optical Geometry.

Prerequisite: none

Textbooks :
1. Halliday, Resnick, and Walker, Principles of Physics 9th Edition, Wiley, 2011.
2. Serway Jewett, Physics for Scientists and Engineers 9th Edition, Thomson Brooks / Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008.

BASIC CHEMISTRY
ENGE600009 / ENGE610009
2 credits
Course Learning Outcomes:
Students are able to analyze the principe of basic chemistry for application in engineering.

Graduates' Learning Outcomes:
Able to apply mathematics, science, and basic engineering to be used in solving complex engineering problems.

Syllabus:

Material and measurements, atoms, molecules and ions, stochiometry, water phase reactions and solution stochiometry, thermochemistry, chemical equilibrium, acid and base equilibrium, electrochemistry, chemical kinetics, and chemical applications.

Prerequisite: none

Textbooks :
1. Ralph H. Petrucci, General Chemistry: Principles and Modern Applications, 8th Ed. Prentice Hall Inc., New York, 2001.
2. John McMurry, Robert C. Fay, Chemistry (3rd ed.), Prentice Hall, 2001.
3. Raymond Chang, Williams College, Chemistry (7th ed.), McGraw-Hill, 2003.

ENGINEERING ECONOMY
ENGE600011 / ENGE610011
3 credits
Course Learning Outcomes:

Students are able to analyze the economic and financial feasibility of making economic practice decisions.

Graduate Learning Outcomes:

Able to apply the principles of technical management and decision making based on economic considerations, in individual and group, as well as in project management.

Syllabus:

Introduction to Engineering Economics, Time Value of Money, Combining Factors, Interest Rates, Money Worth Analysis, Rate of Return Analysis, Effects of Inflation, Benefit Cost & Break-Even Point Analysis, Sensitivity Analysis, Depreciation, Tax Analysis, Cost Estimation & Allocation, Capital Budgeting & Replacement Analysis.

Prerequisite:
1. Civil Engineering : -
2. Environmental Engineering : -
3. Naval Engineering : -
4. Industrial Engineering : must pass the introductory Economic course and have completed 38 credits

5. Chemical Engineering : -
6. Bioprocess Engineering : -

Textbooks:
1. Blank, Leland and Tarquin, Anthony. 2018. Engineering Economy 8th Ed. McGraw Hill.
2. Park, Chan S. 2016. Contemporary Engineering Economics 6th Ed. Pearson. Upper Saddle River.
3. White, Case and Pratt. 2012. Principles of Engineering Economic Analysis 6th ed. John Wiley and Sons.

STATISTICS AND PROBABILISTICS
ENGE600010 / ENGE610010
2 credits
Course Learning Outcomes:

Students are able to handle quantitative data/information starting from the descriptive stage (collection, organization, and presentation) to the inductive stage, which includes forecasting and drawing conclusions based on the relationship between variables for decision making.

Graduate Learning Outcomes:
1. Apply descriptive statistics and probability theory to data processing and serving
2. Apply probability distribution to data processing and serving
3. Apply the principles of sampling and estimation for decision making
4. Apply hypothesis test samples for decision making

Syllabus:

Introduction to Statistics for Engineering Studies, Probability Theory, Dasar Basic concepts and definitions, Distribution Probability, Sampling, Estimation, Hypothesis testing, Hypothesis test 1 sample at an average value, Regression

Prerequisite: none

Textbooks :
1. Harinaldi, Basic Principles of Statistical Engineering and Science, Erlangga, 2004
2. Montgomery, DC., And Runger, GC., Applied Statistics and Probability for Engineers, John Wiley Sons, 2002

HSE PROTECTION
ENGE600012 / ENGE610012
2 credits
Course Learning Outcomes:

Upon completion of this subject students are expected to be able to carried out hazard identification, and characterization, to propose appropriate methods for risk reduction and mitigation, and to design safety management system. The student is also expected to improve their awareness on industrial safety and health, and understanding on safety regulation framework and standards as well as environmental program.

Graduate Learning Outcomes:
1. Students are expected to understand safety, health and environmental aspect as an integral part of fundamental principal in engineering code of ethics.
2. Students are expected to be able to carry out process of risk assessments by considering risk factors in the impact of hazards on people, facilities, and the surrounding community and environemt.
3. Students are expected to understand the regulatory framework and standard related to the stages of life cycle of machine, building structure, construction, and process.
4. Students are able to design and propose an effective hazard communication, management and engineering control, and risk mitigation through an engineering assignment project.
5. Students are able to identify the knowledge required to perform risk assesment, investigation and design improvement through a multidisiplinary case of incident and accident.

Syllabus:

Introduction to SHE Regulation and Standards, SHE Perception (Risk and Environment), Identification, Assessment and Management, Construction, machinery and Noise hazards, Process safety hazard and analysis technique, Fire and explosion hazard, Electrical hazard, Toxicology in the Workplace, Ergonomy Aspect, Hazard communication to employees, Environmental Protection, Case studies, Safety Health and Environment audits.

Prerequisite: none

Textbooks :
1. Charles A. Wentz, Safety, Health and Environmental Protection, McGraw Hill, 1998.
2. Asfahl, C.R., Rieske, D. W., Sixth Edition Industrial Safety and Health Management, Pearson Education, Inc., 2010.
3. United Kingdom - Health and Safety Executive, http://www.hse.gov.uk/
4. National laws and regulations related to the K3 Management System and the Environment.
5. Related Journal (http://www.journals.elsevier.com/safety-science/) etc, related standards and publications.

Course Syllabus of Biomedical Engineering

ENGINEERING BIOLOGY AND LABORATORY
ENBE601001
3 CREDITS
Learning Outcomes:

After completing this course, students will be able to analyze comprehensive knowledge from engineering biology to biomedical engineering and health sciences.

Topics:

General structure of cells and their functions; the chemical components of cells and the shape and structure of proteins; DNA, chromosomes and genomes; the central dogma of molecular biology (replication, transcription and translation); metabolism (anabolism and catabolism), cell communication; cell division (mitosis and meiosis).

Prerequisites: None

Textbook:
1. Neil A. Campbell, Jane B. Reece, Lisa A. Urry, Michael L.Cain, Steven A. Wasserman, Peter V.Minrosky, Robert B. Jackson. Biology, Eight Edition, 2009.
2. Bruce Albert, Alexander Johnson, Julian Lewis, Martin Raff, Keith Robertsm Peter Walter. Molecular Biology of The Cell, Fifth Edition, 2008.

BASIC DIGITAL SYSTEM AND LABORATORY
ENEE602005
3 CREDITS
Learning Outcomes:

After completing this course, students are able to design combination circuits and sequential circuits by optimizing the function.

Topics:

Information Representation and Computer Structure, Number System, binary, octal and hexadecimal, Boolean

Algebra Formulas, Combinational Logic Circuit, Simplification of Functions, - Karnough map, - NAND-NOR Gate, - X-OR Gate, - Don't Care Condition, Combinational Logic Design, - Combination Circuit, Decoder and Encoder, - Multiplexer, Arithmatic Function and Circuit, - Adder, Half Adder, - Subtractor, Multiplication, - Binary Subtraction Complement, Sequential Circuit, - Analysis Procedure, - Design Procedure, - Seq Circuit Analysis , Sequential Circuit, - Analysis Procedure, - Design Procedure - Seq Circuit Analysis, Register and Counter.

Prerequisites: None

Textbook:
1. Morris R. Mano, Charles R. Kime, Tom Martin, Logic & Computer Design Fundamentals, 5th ed, Prentice Hall, 2015
2. Ronald J. Tocci, Neal S. Widmer, and Gregory L. Moss, Digital Systems: Principles and Applications, 11th Ed., Prentice Hall, 2010
3. Basic Digital Systems Laboratory Module

BASIC CHEMISTRY LABORATORY
ENBE602002
1 CREDIT
Learning Outcomes:

After completing this course, students are able to apply the basic principles of mathematics, chemistry, and physics in solving Biomedical Engineering problems

Topics:

Physical and chemical properties; Separation and purification of the substance; Identification of alkali metal ions, alkaline earth, ammonium, sulfate, iodid, bromide and nitrate; acid-base titration; metal and acid reaction; Water crystals.

Prerequisites: None

Textbook: Basic Chemistry Laboratory Module

ENGINEERING DRAWING
ENBE602003
3 CREDITS
Learning Outcomes:

Students are able to design the principles of biomedical engineering according to health standards and regulations.

Topics:

Illustrations, Basic understanding of geometry, Visualization of geometry (3D), Intersections and openings, Orthogonal projection (2D).

Prerequisites: None

Textbook:
1. ISO 1101, Technical Drawings, International Organization for Standardization.
2. A.W. Boundy, Engineering Drawing, McGraw-Hill Book Company.
3. Colin Simmons & Dennis Maguire, Manual of Engineering Drawing, Edward Arnold.
4. Warren J. Luzadder, Fundamentals of Engineering Drawing, Prentice- Hall, Inc.
5. Giesecke-Mithcell-Spencer-Hill-Dygdon-Novak, Technical Drawing, Prentice Hall Inc.

INTRODUCTION TO MEDICAL INFORMATICS
ENBE602004
3 CREDITS
Learning Outcomes:

After this course, students are expected to:

1. Able to understand the basic concept of information technology for application in the medical field.
2. Able to implement information basic method by combining basic knowledge of programming to acquire, organize, combine, and analyze health data sources.

Topics:

Introduction to Medical Informatics, Controlled Medical Terminology, The Electronic Health Record (EHR), Health Information Systems in Clinical Settings, Health Information Systems in Public Health, Informatics Issues in Virtual Healthcare, Telemedicine, and Expert Systems, Medical Informatics and Clinical Decision Making, Future Technologies, Fundamental Algorithms & Methods of Medical Informatics, Medical Data Resources: Acquisition, Processing, and Classification.

Prerequisites: None

Textbook:
1. Biomedical Informatics: Computer Applications in Health Care and Biomedicine (Health Informatics) 4th ed. 2014 Edition.
2. Method in Medical Informatics: Fundamentals of Healthcare Programming in Perl, Python, and Ruby, Jules Berman, CRC Press 2010.

ENGINEERING MATHEMATICS 1
ENEE603005
3 CREDITS
Learning Outcomes:

After completing this course, students are expected to:

1. Able to identify properties of vector properties and complex changers, as well as their relation to Maxwell's law in the phenomenon of electromagnetic waves.
2. Able to identify the properties of complex changer properties, to solve complex problems in the field of electrical engineering

Topics:

Basic vectors and scalars in the definition of algebra which includes multiplication and subtraction, Differential vectors and their various types such as: Gradient, Divergence and Curl, Vector integrals, which are followed by several Theorems that support Maxwell Equations, including: Divergence Theorem, Stoke's Theorem and Green Theorem, Understanding of complex numbers and their application in various functions, Complex integrations and differentiations, Power Series and Taylor Series in the context of numbers complex.

Prerequisites: Calculus.

Textbook:
1. Advanced Engineering Mathematics, by Edwin Kreyszig, Wiley International Edition, 9th Edition
2. Theory and Problems of Vector Analysis, by Murray R. Spiegel, Schaum's Outline Series, McGraw-Hill Book Company

BIOMEDICAL STATISTIC AND PROBABILITY
ENBE603006
3 CREDITS
Learning Outcomes:

After completing this course, students are able to analyze data and quantitative information, starting from the descriptive stage, which includes collecting, organizing, and presenting data by the scientific method, to the inductive or inferential stage, which includes the process of estimating and drawing conclusions based on available data and relationships between variables.

Topics:

Descriptive statistical methods, probability probability and distribution, discrete probability distribution, continuous probability distribution, estimation theory, hypothesis tests, regression and correlation methods, design and analysis of techniques for epidemiological studies, hypothesis tests: person-time data, Planning Experiments partitioning variation and construction a model, ANOVA, interpretation of analysis: from hypothesis tests to biology, category data, and nonparametric methods.

Prerequisites: None

Textbook:
1. Budiarto, Eko. 2001. Biostatistika Untuk Kedokteran dan Kesehatan Masyarakat. Jakarta: EGC
2. Forthofer R. N., Lee E. S., Hernandez, M. 2007. Biostatistics. A Guide to Design, Analysis, and Discovery 2nd Edition. Elsevier. Academic Press
3. McCleery, R.H., T.A. Watt, T. Hart. 2007. Introduction to Statistics for Biology 3rd Edition. CRC Press
4. Rosner, B. 2015. Fundamentals of Biostatistics 8th Edition. Cengage Learning
5. Walpole, R.E., R.H. Myers, S.L. Myers., K. Ye. 2016. Probability & Statistics for Engineers & Scientists 9th Edition. Pearson

ELECTRONIC ANALOG
ENBE603007
3 CREDITS
Learning Outcomes:

After completing this course, students are able to design a series of analog electronics in the field of biomedical engineering.

Topics:

The material presented in this course includes analog electronics components, such as diodes, bipolar junction transistors (BJT), field effect transistors (FETs), operational-amplifiers (Op-Amp), and filters.

Prerequisites: -

Text Books

1. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson Education, Inc., Uppersaddle River, New Jersey 07458, USA, 2006.
2. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, and Robert G. Meyer, Analysis and Design of Analog Integrated Circuits, John Wiley & Sons, Inc., Singapore, 2003.

BASIC ANATOMY AND PHYSIOLOGY
ENBE603008
3 CREDITS
Learning Outcomes:

After finishing this course, students are able to correlate various systems in the human body based on their anatomy and physiology.

Topics:

The concept of cells to organ systems, The concept of homeostasis, The concept of the integumentary system, the musculoskeletal system, the nervous system, the endocrine system, the sense system, the cardiovascular system, the immune system, the respiration system, the digestive system, the urinary system, and the reproductive system, Pathophysiological mechanisms of certain diseases.

Prerequisites: None

Textbook:
1. Martini FH, et al. 2014. Fundamentals of Anatomy and Physiology. Pearson Education.
2. Silverthorn, DU. 2016. Human Physiology: An Integrated Approach. Pearson Education.

INTRODUCTION TO BIOMEDICAL TECHNOLOGY
ENBE603009
3 CREDITS
Learning Outcomes:

After finishing this course, students are expected to have the following abilities:

1. Explain the concept of engineering system application to solve human biology problems.
2. Explain the concept of devices for monitoring human physiology signals.
3. Apply the basic principles of engineering to the biomedical field.

Topics:

Basics of biomedical engineering, biomaterials, biomechanics, Medical Instrumentation, Imaging, Biosensors, Bioinformatics, Bioelectric Phenomena.

Prerequisites: None

Textbook:
1. The Biomedical Engineering Handbook, J.D. Bronzino & D.R. Peterson, 4th Ed., CRC Press, 2006.
2. Standard Handbook of Biomedical Engineering and Design, M. Kutz, McGraw-Hill, 2003.
3. The biomedical Engineering Handbook, Biomedical Signals, Imaging and Informatics. J.D. Bronzino & D.R. Peterson,CRC Press, 2014
4. Wang, Biomedical Sensors and Measurements, 2011
5. Ibrahim, K. S., G. Gurusubramanian, Zothansanga, R. P. Yadav, N. S. Kumar, S. K. Pandian, P. Borah, S. Mohan, Bioinformatics – A Student's Companion, Springer 2017

ELECTRICAL CIRCUIT
ENBE603010
3 CREDITS
Learning Outcomes:

After finishing this course, students are expected to be able to design basic electrical circuits for applications in the field of biomedical engineering.

Topics:

Definition and definition of charge, current, voltage, energy and power of passive and active elements; The concept of Kirchoff's law, Ohm's law, Series and parallel circuits, Series of replacements for Thevenin and Norton; Application: Ammeter, Voltmeter and Ohmmeter; The principle of use of node, mesh, supernode, supermesh, and superposition analysis; A circuit with a non-free source; OpAmp basic suite: inverting, non – Inverting, summing, differentiator and integrator; Capacitor, Energy in capacitor, Circuit with capacitor; Inductor, Energy on inductor, Circuit with inductor; DC steady state response; Unsourced RC and RL circuits, Time constants, First-order circuits without sources; RC and RL circuits with DC source, Superposition on first-order circuits; Step unit function, Step input response and pulse; RLC circuit, Second-order equation; Natural response, Forced response, Total response, Step unit response; Properties of sinusoidal waves, Complex sources; Phasor, Law of voltage current for phasor, Impedance and

Admittance, Phasor circuit.

Prerequisites: Calculus, Electrical Physics

Textbook:
1. James W. Nilsson, Susan A. Riedel, "Electric Circuits, (Chapter 1-9)", 10th Edition, Pearson, 2015

ELECTRONIC ANALOG LABORATORY

ENBE603011-MB
1 CREDIT
Learning Outcomes:

After finishing this course, students are expected to able:

1. Analyzing simple electronic circuits based on physical phenomena
2. Using hardware and electronic analysis software.

Topics:

Electronic circuit components: diode, BJT, FET, OpAmp; Application of electronic circuits.

Prerequisites: Electrical Circuit

Textbook:

1. Electrical Circuit Laboratory Module
2. Robert Boylestad & Louis Nashelsky, "Electronic Devices And Circuit Theory", Ninth Edition, Prentice Hall, Upper Saddle River, New Jersey Columbus, Ohio, 2006

ETHICS OF BIOMEDICAL TECHNOLOGY

ENBE603012
2 CREDITS
Learning Outcomes:
Students are expected to be able to correlate various aspects with an ethical point of view in accordance with the conditions and regulations that apply when activities in the field of biomedical technology.

Topics:

Definition and ethical principles of biomedical technology (bioethics), Procedures and ethics that must be followed to test research subjects, Ethical dilemmas in biomedical engineering research and the importance of thinking about all sides of the problem, The impact of health technology on society, Some principles of justice related to gender, culture, and ethics in the development of biomedical technology.

Prerequisites: None

Textbook:
1. Ethics, Research Methods and Standards in Biomedical Engineering, Monique Frize, Publisher: Morgan & Claypool, 2011.
2. Biomedical Ethics for Engineers, Daniel A Vallero, Publisher: Elsevier, 2007.

ENGINEERING MATHEMATICS 2

ENBE604013
4 CREDITS
Learning Outcomes:

After finishing this course, students are expected to:

1. Analyzing engineering problems mathematically
2. Implementing mathematical equations in the field of engineering.

Topics:

First-order differential equations, Second-order differential equations, High-order differential equations, Partial differential equations, Fourier series, Laplace transformations.

Prerequisites: Calculus

Textbook:
1. Erwin Kreyszig, "Advanced Engineering Mathematics"9th Edition, Wiley Publisher 2006
2. Glyn James, "Advanced Modern Engineering Mathematics", 2nd Edition, Prentice Hall Publisher 1999

ELECTROMAGNETIC FIELD THEORY

ENBE604014
3 CREDITS
Learning Outcomes:

After finishing this course, students are expected to able to apply the basic principles of mathematics and physics through engineering in accordance with professional ethics.

Topics:

Electrostatics, Magnetostatics, Dynamic Fields, Maxwell Equations, Wave Equations and Plane Waves, Transmission Line, Waveguide, Antenna.

Prerequisites: Engineering Mathematics 1

Textbook:
1. Stuart M. Wentworth, "Fundamentals of Electromagnetics with Engineering Applications," John Wiley, 2005.
2. William H. Hayt and John A. Buck, "Engineering Electromagnetics," McGraw-Hill Companies: 6th Ed. 2001.

INTRODUCTION TO BIOMEDICAL TECHNOLOGY LABORATORY

ENBE604015
1 CREDIT
Learning Outcomes:

After completing this course, students are able to:

1. Conducting experiments on instrumentation related to biomedical engineering (C3)
2. Conducting experiments on software related to biomedical engineering (C3)
3. Conducting experiments related to biosensor (C3).

Topics:

Tensimeter for blood pressure, ECG, USG, Ventilator, Materials characterization, Bioinformatics database, Virtual lab of immunology, and Biosensor.

Prerequisites: Introduction to Biomedical Technology

Textbook:

Biomedical Engineering Laboratory Module

INTRODUCTION TO BIOMEDICAL INSTRUMENTATION

ENBE604016
3 CREDITS
Learning Outcomes:

After finishing this course, students are able to make a basic design of measurement systems in the field of biomedical technology.

Topics:

Understanding and role of biomedical engineering instrumentation in the medical field, Characteristics of measuring instruments, Errors in measuring physical quantities, Sensors and transducers, Signal condition (filtering and amplification), Signal Acquisition and

Processing Data, Biomedical Instrumentation (ECG, EEG, Mobile Health, Wearable Health Devices, Wireless Implanted Medical, Respiratory System Devices), Security systems in instrumentation systems and tools in the field of biomedical technology.

Prerequisites: Calculus, Electrical Physics – Magnetism – Waves and Optics, Electrical Circuits

Textbook:
1. Principle of Biomedical Instrumentation, Andrew G. Webb, Cambridge University Press, 2018
2. Biomedical Instrumentation and Measurement, Leslie Cromwell et al, Prentice Hall.

MODELING OF MEDICAL SYSTEM
ENBE604017
3 CREDITS
Learning Outcomes:

After completing this course, students are able to analyze a system model for certain physiological cases.

Topics:

Physiological complexity, physiological process modeling, systems modeling, data modeling, parametric modeling, parametric model estimation, bioelectric phenomena, introduction to MATLAB Simulink and SymBiology, and simulation case studies.

Prerequisites: Basic Anatomy and Physiology

Textbook:
1. Cobelli C and Carson ER, Introduction to Modeling in Physiology and Medicine. 1st ed. A volume in Biomedical Engineering. 2008
2. Enderle, J. D., Bioelectric Phenomena, Elsevier 2012
3. https://www.mathworks.com/support/learn-with-matlab-tutorials.html

SIGNAL AND SYSTEM
ENEE604017
3 CREDITS
Learning Outcomes:

After completing the lecture, students are expected to:

1. Demonstrates understanding of the concept of linear time invariant (LTI) system characteristics and signal manipulation
2. Analyzing continuous and discrete time LTI systems and their application in the field of Electrical Engineering through the application of transformation analysis and convolution engineering.

Topics:

Definition of signals and systems, Types of signals: continuous, discrete, basic signals, deterministic, and random signals, Types of systems and their characteristics, LTI systems in the time domain, LTI systems in the frequency domain, Signal transformation methods in the Laplace domain (s domain), Signal transformation methods in the Z domain, Methods of filtering digital signals using Matlab software-based FIR and IIR digital filters.

Prerequisites: None

Textbook:
1. Simon Haykin and Barry Van Veen, "Signals and System", 2nd Edition John Wiley & Sons Publisher, 2003

Additional:
2. Dennis Freeman, 2011, Lecture Notes, MIT. Dapat diakses di: https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-003-signals-and-systems-fall-2011/lecture-notes/
3. Dadang Gunawan, Filbert H Juwono, Pengolahan sinyal digital dengan pemrograman Matlab, 2012

BASIC COMPUTER AND LABORATORY
ENEE603014
3 CREDITS
Learning Outcomes:

After completing this course, students are expected to:

1. Able to design simple programming problem solving and implement them into programming languages.
2. Using computer programming software proficiently.

Topics:

Introduction: Computers and the Internet, Introduction: Programming basics and Algorithms, Structured programming, Program Control, Functions, Arrays, Pointers, Structures, Unions, Enumerations.

Prerequisites: None

Textbook:
1. Deitel & Deitel, "C How to Program," 8th Edition, Pearson Education, 2015.
2. Basic Programming Laboratory Module

MEDICAL IMAGING TECHNOLOGY
ENBE605018
3 CREDITS
Learning Outcomes:

After this course, students are expected to:
1. Able to design medical imaging techniques for applications in the health sector.
2. Able to recommend medical image processing techniques for applications in the health sector.

Topics:

Introduction to Medical Imaging Technologies (X-Ray and CT, MRI, Ultrasound, PET and SPECT, Electrical Impedance Tomography), Image formation and Reconstruction (Acquisition, Digitization, Image Reconstruction Methods), Image Enhancement (Fundamentals of enhancement techniques, Image enhancement with linear, nonlinear, fixed, adaptive, and pixel-based methods), Image Segmentation and Analysis (Fundamentals of Medical Image Segmentation, Image preprocessing and acquisition artifacts, Thresholding, Edge-based techniques, Region-based segmentation, Classification, Morphological Methods for Biomedical Image Analysis), Image Visualization (2-dimensional visualization, 3-dimensional visualization methods: surface rendering, volume rendering, Algorithm for 3-D visualization), Image Management (Fundamentals of Standards Compression Storage and Communication, Image archive and retrieval, three-dimensional compression).

Prerequisites: None

Textbook:
1. Joseph D. Bronzino, The Biomedical Engineering Handbook, Third Edition, "Medical Devices and Systems," CRC Press: 2006, Section II.
2. Avinash C. Kak and M. Slaney, "Principle of Computerized Tomographic Imaging," IEEE Press: 1999.
3. Isaac Bankman, "Handbook of Medical Imaging: Processing and Analysis Management," Academic Press: 2000, CA, USA.
4. E. S. Gopi, "Digital Signal Processing for Medical Imaging Using Matlab," Springer:2013, New York.

5. Medical Image Processing, Reconstruction and Restoration: Concepts and Methods, Jirí Jan, CRC Press: Taylor & Francis Group 2006, Boca Raton, FL, USA.

Additional:

6. Handbook of Medical Imaging, Vol. 2: Medical Image Processing and Analysis, M. Sonka & J.M. Fitzpatrick, SPIE Press, 2009, Washington, USA
7. Biomedical Image Processing, Thomas M. Deserno, Springer-Verlag Berlin Heidelberg, 2011
8. Biomedical Signal and Image Processing, Kayvan Najarian and Robert Splinter, CRC Press: Taylor & Francis Group 2012, Boca Raton, FL, USA.

BIOMECHANICS

ENBE605019
3 CREDITS
Learning Outcomes:

After completing this course, students are able to diversify the basic and applied sciences of biomechanics, as well as the application of biomechanics to various biomedical and clinical problems.

Topics:

Basics of mechanics: statics, kinematics, and dynamics. The cultivation of biomechanical technology design capabilities is fostered through biomechanical design materials. Furthermore, the material studied is the biomechanics of cells, tissues and musculoskeletal systems. Not only basic materials, materials discussing the application of biomechanics in the biomedical and clinical world were also studied, which included tissue engineering mechanics and the application of biomechanics to medical rehabilitation, orthopedics, sports, and gait analysis.

Prerequisites: None

Textbook:

1. N. Ozkaya, and M. Nordin, "Fundamental of Biomechanics: Equilibrium, Motion and Deformation", 2nd Ed., Springer, 1998.
2. E. Okuno, and L. Fratin, "Biomechanics of the Human Body", Springer, 2013.

BIOMATERIALS

ENBE605020
3 CREDITS
Learning Outcomes:

At the end of the course, students are expected to be able to:

1. Recommend the right biomaterial for a particular disease
2. Designing Finite Element Analysis (FEA) for Biomaterials.

Topics:

Introduction to biomaterials; physical, chemical, mechanical characterization of the biomaterial; the phenomenon of degradation, protein-adsorbed, and biocompatibility of the biomaterial; fabrication of biomaterials; application of biomaterials; finite element analysis.

Prerequisites: None

Textbook:

1. Introduction to Biomaterials: Basic Theory with Engineering Applications, C. Mauli Agrawal, Joo L. Ong, Mark R. Appleford, Gopinath Mani, Cambridge Texts in Biomedical Engineering, United Kingdom, 2014.
2. Tissue Engineering second edition, C. A. van Blitterswijk and J. de Boer. Elsevier 2015
3. Adsorbed Protein on Biomaterials, T. A. Horbert, R. A. Latour.

BASIC BIOMEDICAL AUTOMATION SYSTEM

ENBE605021
3 CREDITS
Learning outcomes:

After finishing this course, students are able to:

1. Analyze stability, transient response, and steady-state error in a control system
2. Choose a control system design method according to the control problem
3. Designing a controller on an example of a biomedical system

Topics:

Introduction, discusses the definition of control systems, configurations, main components of the system, theoretical history and examples of control applications; Mathematical models of systems in the biomedical field that can be designed automated control systems and the creation of simulations using MATLAB/Simulink or SCILAB/Xcos; The decline of mathematical models of continuous and discrete linear systems by using linearization methods, Laplace and z transformations; Decrease in the time domain model; Pole-zero, system block diagrams and their simplification; Transient response, stability and steady state error (error in the steady-state condition); Frequency response analysis; The technique of the seat of the roots; Design of PID controllers; Designing controllers and observers with a state space model; Design of controllers for biomedical field applications.

Prerequisites: None

Textbook:

1. Automatic Control Systems in Biomedical Engineering, Springer Verlag, 2018
2. Control Systems Engineering 6th ed, John Wiley & Sons, 2011
3. Feedback Control of Dynamic Systems 7th, Pearson, 2015
4. Control Engineering: MATLAB Exercises, Springer Verlag, 2019
5. Control Theory in Biomedical Engineering: Applications in Physiology and Medical Robotics, Academic Pres, 2020.

NUMERICAL COMPUTATION

ENEE604020
3 CREDITS
Learning Outcomes:

Students are able to complete it both individually and in groups by applying numerical methods with the help of computational tools in a critical, creative, and innovative way of thinking.

Topics:

Introduction to numerical and computational methods, Error analysis in numerical calculations, Excel-based programming, Closed methods for finding the roots of non-linear equations, Open methods for finding the roots of non-linear equations, Direct methods for solving systems of linear equations, Iterative methods for solving systems of linear equations, Methods of iteration of fixed points for solving systems of non-linear equations, Newton and Secant methods for solving systems of equations non-linear, Trapezoidal rule to perform numerical integration, Simpson rule to perform numerical integration, Installation of curves to perform data regression.

Prerequisites: None

Textbook:

1. Chapra, SC dan Canale, Metode Numerik RP untuk

Insinyur, Ed 6, McGraw-Hill Education, New York
2. Konstantinides, A. dan Mostoufi, N. Metode Numerik untuk Insinyur Kimia dengan Aplikasi MATLAB, Seri Internasional Prentice Hall, New Jersey
3. Joseph E. Billo, Unggul untuk Ilmuwan dan Insinyur: Metode Numerik, Wiley Interscience, 2007
4. Victor J. Law, Metode Numerik untuk Insinyur Kimia Menggunakan Excel, VBA, dan MATLAB, CRC Press, Taylor&Francis Group, Boca Raton

Additional:
1. Lecture notes (power point files)
2. Screencast of lectures (video files).

MEDICAL SIGNAL PROCESSING

ENBE606022
3 CREDITS
Learning Outcomes:

After completing this course, students are expected to:

1. Able to analyze medical signal processing methods
2. Able to analyze medical image processing methods
3. Able to apply medical signal and image processing methods using MATLAB software
4. Able to use correct Indonesian language in presenting ideas/opinions.

Topics:

Introduction to medical image and signal processing, Fourier transform application, Image Filtering, Enhancement, and Restoration, edge detection and image segmentation, Wavelet transform, artificial neural network recognition, deep learning recognition, basic signal processing EEG, ECG, PET, CT, X -Ray, MRI, Ultrasound and SEM.

Prerequisites: Signal and System

Textbook:
1. Kayvan Najarian and Robert Splinter, "Biomedical Signal and Image Processing, 2nd Ed", Taylor & Francis, 2012
2. E. S. Gopi "Digital Signal Processing for Medical Imaging Using Matlab", Springer, 2013.

DESIGN OF BIOMEDICAL SENSORS

ENBE606023
3 CREDITS
Learning Outcomes:

After completing this course, students will be able to design biosensors for medical applications.

Topics:

The basis of the sensor which includes sensor characteristics, sensor calculation technology, and biocompatibility of the sensor, Physical sensor which includes resistance sensor, inductive sensor, capacitive sensor, piezoelectric sensor, magnetoelectric sensor, photoelectric, and thermoelectric sensor, optical sensor, Chemical sensor includes ion sensor , gas sensors, humidity sensors, sensor arrays, and sensor networks, and biosensors including catalytic biosensors, affinity biosensors, cell and tissue biosensors, biochips, and nano-biosensors.

Prerequisites: None

Textbook:
1. Enderle J., Bronzino J. - Introduction to biomedical engineering-AP (2011).
2. Wang, P. Q. Liu. Biomedical Sensor and Measurement. Springer (2011).

RF MEDICAL SYSTEM DEVICE AND MICROWAVE

ENBE606024
3 CREDITS
Learning Outcomes:

After completing this course, students are expected to design the necessary hardware and software parts in the field of biomedical engineering.

Topics:

Maxwell equation review, review of electromagnetic wave equations in materials, Introduction to microwave engineering, Transmission lines, Waveguide, coaxial, microstrips, Microwave network and impedance matching techniques, Microwave resonators and antennas, Passive device coupler, hybrid and filter, Noise, active components and active device.

Prerequisites: Electromagnetic Field Theory

Textbook:
1. David M. Pozar, "Microwave Engineering," 4th Ed, John-Wiley & Sons, Inc.

Additional:
2. Advanced Design System 2011 Guide, Agilent Technologies, Santa Clara, CA 95052 USA
3. R.J. Weber: "Introduction to Microwave Circuits: Radio Frequency and Design Applications", IEEE Press: 2001

BIOMEDICAL ENGINEERING PROJECT DESIGN 1

ENBE606025
2 CREDITS
Learning outomes:

After completing this course, students are expected to be:

1. Able to formulate problems in the field of engineering that are relevant to real conditions
2. Able to understand and consider realistic boundaries and engineering standards in project planning
3. Able to understand and consider professional ethics in project planning
4. Able to convey project planning effectively in the form of writing (proposal)
5. Able to show the role of creative, innovative and mutual cooperation with each other in project planning.

Topics:

Engineering design concepts, engineering design processes, selection of required objects/devices, selection and decision making, Engineering standards, Realistic boundaries, Socioeconomic impacts, Research Methodology: Problem formulation, Objectives and problem limitations, methodology design and device selection. Project understanding and project management, organizational structure, function management, leadership in the project environment, cooperative management, investment analysis, control analysis for infrastructure development, cost and wealth allocation, risk management and quality management, work breakdown structure, scheduling, budgeting resources, controlling (S-curve), Engineering Economics (NPV, IRR, BEP), TOR technical proposals, and project proposals.

Prerequisites: None

Textbook:

1. Harvey F. Hoffman, The Engineering Capstone Course : Fundamental for Students and Instructors, Springer, 2014
2. David V. Thiel, Research Methods for Engineers,

Cambridge University Press, 2014

3. Code Etik PII – Persatuan Insinyur Indonesia

BIOMEDICAL ENGINEERING STANDARD AND REGULATION
ENBE606026
2 CREDITS
Learning Outcomes:

After completing this course, students are expected to correlate various aspects related to the standards and regulations that apply when activities in the field of biomedical engineering.

Topics:

Introduction to clinical engineering, Management and information systems of Health technology, Standards and regulations related to the clinical environment, Standards and regulations related to the development of medical devices.

Prerequisites: None

Textbook:
1. Dyro JF. 2004. Clinical Engineering Book. Elsevier Academic Press.
2. International Organization for Standardization (ISO). IEC 60601 Series.

BIOMEDICAL ENGINEERING PROJECT DESIGN 2
ENBE607027
3 CREDITS
Learning outcomes:

After completing this course, students are expected to be able to:

1. Formulate problems in the field of engineering that are relevant to real conditions
2. Able to design components, systems or processes to meet the needs of solutions to a problem Engineering within realistic limits, considering aspects, including, law, economy, environment, social, political, health and safety, as well as its sustainability potential
3. Able to deliver project planning effectively in the form of writing (proposals) and demonstrating the achievement of solutions in oral form (presentation)
4. Able to show the role of creative, innovative and mutual cooperation with each other in achieving common goals in project planning and implementation
5. Able to understand and consider professional ethics in project planning and implementation

Topics:

Review & discussion of proposals by ensuring the exact formulation of problems and their solutions, the content of realistic boundaries, engineering standards and socioeconomic impacts, the effectiveness and accuracy of the selection of concepts, components, devices, techniques, and systems used, well-planned project management content, professionalism of team members in carrying out planning, functional testing of supporting systems, implementation of solutions in solving problems, and testing problem solving.

Prerequisite: Biomedical Engineering Project Design 1

Textbook:
1. Harvey F. Hoffman, The Engineering Capstone Course: Fundamental for Students and Instructors, Springer, 2014
2. David V. Thiel, Research Methods for Engineers, Cambridge University Press, 2014
3. Code Etik PII – Persatuan Insinyur Indonesia

Special Subjects

PRE-THESIS
ENBE607028
2 CREDITS
Learning Outcomes:

After finishing this course, students are expected to be able to:

1. Students are able to recognize problems in the field of biomedical engineering and identify the feasibility of solving these problems
2. Students are able to present several possible solutions to the biomedical engineering problems they face supported by good arguments
3. Students are able to recognize the benefits of solving the biomedical engineering problems they face for society, either in the short or long term.

Topics:

Determination of research topics, literature studies, deepening of problem backgrounds, identification and formulation of problems, determination of research objectives, determination of research boundaries and assumptions, formulation of research methodology, formulation of research implementation schedules, writing thesis proposals, seminar.

Prerequisites: Earns more than 114 credits.

Textbook:
1. Day, R. A., & Gastel, B. (n.d.). How to write and publish a scientific paper. Cambridge University Press
2. Gustafsson, B., Hermerén, G., Petersson, B., & Vetenskapsrådet. (2006). Good Research Practice - what is It?: Views, Guidelines and Examples
3. References related to research topics

INTERNSHIP
ENBE607029
2 CREDITS
Learning Outcomes:

In this course, students are be expected to:

1. Able to use spoken and written language well in communication and in practical work reports
2. Able to show a critical, creative, and innovative attitude and respect others in Practical Work
3. Able to qualify good work ethics.

Topics: Adjusted to the assignments given and agreed upon during the implementation of the internship.

Prerequisites:

Earn 90 credits. Internship locations are industries, institutions, and laboratories connected to biomedical engineering with appointed supervisors and person in charge that can guide the students daily. The choice of companies or laboratories will start with an administrative process in the Biomedical Engineering Study Program.

Textbook: Adjusted to the assignments given and agreed upon during the implementation of the internship

UNDERGRADUATE THESIS
ENBE608030
4 CREDITS
Learning Outcomes:

After completing the study, students are expected to be able to:

1. Recommend alternative solutions to the latest biomedical engineering problems by referring to the right research methods.
2. Use spoken and written language well in communication and in thesis book..

Syllabus:

Introduction and research background, Literature study, Research Objectives, Research Design, Procedures for writing a thesis following a predetermined format or guidelines, Chaptering function, indexing images and tables, Styling IEEE references or others, Experimental variables and set up, Statistical analysis tools, Use of Indonesian and good English in thesis and scientific publications, Utilization of online references, Library utilization, Implementation of system design, Data analysis, Conclusion.

Prerequisites: Earns more than 120 credits

Textbook:
1. Keputusan Rektor Universitas Indonesia Nomor 2143/SK/R/UI/2017 tentang Pedoman Teknis Penulisan Tugas Akhir Mahasiswa Universitas Indonesia
2. IEEE Citation Reference.
3. Day, R.A., Gastel, B., (n.d). How to write and publish a scientific paper. Cambridge University Press
4. Gustafsso, B., Hermeren, G., Petersson., B., Vetenskapsardet. (2006). Good Research Practice.

Elective Courses for Biomedical Engineering

MEDICAL COMMUNICATION SYSTEM
ENBE605031
3 CREDITS
Learning Outcomes:
After completing this course, students are expected to be able to:
1. Designing communication systems for applications in the field of health
2. Analyze to solve critically and creatively at the individual and group level in the health sector.

Topics:

Communication system technology for health applications, analyzing the nature of electromagnetic waves and propagation in body-centric wireless communication (BWCS) technology and the effects of electromagnetic compatibility and interference (EMC / EMI), analyzing wearable devices and implant models for communication as well as the concept of body area network (BAN), telemedicine, e-health, hospital information system (HIS) and wireless power transfer (WPT); and in the end students can design a communication application for the health sector simply through the development of hardware and software.

Prerequisites: None

Textbook:
1. Joseph D. Bronzino, The Biomedical Engineering Handbook, Third Edition, "Medical Devices and Systems," CRC Press: 2006, Section II.
2. Mohamed K. Watfa, "E-Healthcare Systems and Wireless Communications: Current and Future Challenges," Publisher: IGI Global, 2012.
3. P.S. Hall, "Antennas and Propagation for Body Centric Wireless Communications," Publisher: Artech House, 2006.
4. H.W. Ott, "Electromagnetic Compatibility Engineering," John Wiley & Sons, New Jersey, 2009.
5. N. Shinohara, Wireless Power Transfer via Radiowaves, Publisher: John Wiley & Sons, New Jersey, 2014
6. Hebda T. & Czar P. (2013). Handbook of Informatics for Nurses & Healthcare Professionals (5th Edition). Pearson

Additional:

7. M. Kato, Electromagnetics in Biology, Publisher: Springer, Tokyo, 2006.
8. J. Y. Khan, and M. R. Yuce, "Wireless Body Area Network (WBAN) for Medical Applications", in New Developments in Biomedical Engineering. London, United Kingdom
9. Gartee R. (2016).Electronic Health Records (3rd Edition). Pearson.

HEALTH, SAFETY & ENVIRONMENT (HSE) FOR HOSPITAL
ENBE605032
2 CREDITS
Learning Outcomes:
After completing this course, students are expected to:
1. Apply the principles of occupational safety and health in the hospital environment.
2. Express the concept of the application of policies related to occupational safety and health in the health care facility environment.

Syllabus:

Patient safety and the biomedical engineer; Risk management; Patient safety best practices model; Hospital safety program; System approach to medical device safety; Electromagnetic interference in the hospital; Electrical safety in the hospital; Accident investigation; Medical devices Failure modes, accidents and liability

Prerequisites: None

Textbook:
1. Kemenkes RI, Pedoman manajemen Risiko di Fasilitas Pelayanan Kesehatan, 2013.
2. Joseph Dyro (ed.), Clinical Engineering Handbook, Elsevier Academic Press, 2004.
3. Keputusan Menteri Kesehatan Republik Indonesia Nomor: 1087/Menkes/Sk/Viii/2010 Tentang Standar Kesehatan Dan Keselamatan Kerja Di Rumah Sakit
4. Myer Kutz, Biomedical Engineering and Design Handbook (Volume 2: Applications), McGraw Hill, New York, 2nd edition, 2009.
5. Improving Patient safety: Insights from American, Australian and British Healthcare, ECRI Europe, 2012.
6. Elizabeth Mattox, Medical Devices and Patient Safety, AACN Journals Vol. 32, No.4 Agust 2014.

BIOMEDICAL SPECIAL TOPIC 1
ENBE607033
3 CREDITS
Learning Outcomes:

After completion this course, students are expected to be able:

1. To study the latest developments in biomedical engineering including technological, business and regulatory aspects.
2. To reference the latest biomedical engineering developments including technological, business and regulatory aspects.

Topics:

Current issues on aspects of technology, applications, business and regulation in the health sector.

Prerequisites: None

Textbook: None

IMMUNE ENGINEERING

ENBE607034
3 CREDITS
Learning outcomes:

After completing this course, students are able to make basic application concepts in the field of biomedical technology using the principles of immunology.

Topics:

The principles in immunity, includes innate and adaptive immunity; antibody and antigen interaction; hipersensitivity; autoimmune and host defense; vaccine; immune regulation; immune response against microbiological infection; diagnostic methods of infection; synthetic biology; biomimetic; personalized medicine; in vitro diagnostic.

Prerequisite: Engineering Biology and Laboratory

Textbook:
1. Abbas AK, et al, 2017, Cellular and Molecular Immunology, 9th ed., Elsevier
2. Delves PJ, et al, 2017, Roitt's Essential Immunology, Wiley Blackwell.
3. Silvestre R and Torrado e, 2018, Metabolic Interaction in Infection, Springer.

BASIC THERMODYNAMICS

ENBE607035
3 CREDITS
Learning outcomes:

After completing this course, students are expected to:

1. Apply the laws and basic concepts of thermodynamics, thermodynamic processes, and equations of state.
2. Design thermodynamic systems and information technology needed to achieve competence in the discipline of Biomedical Engineering.

Topics:

Scope and basic understanding of thermodynamics system, temperature concept, pressure, thermodynamics equilibrium, reversible/irreversible process, zero law of thermodynamics and absolute temperature, first law of thermodynamics, second law of thermodynamics, thermodynamics equation, gas power cycle, gas compressor, combustion engine cycle, internal combustion engine, simple gas turbine cycle, brayton's cycle, stirling's cycle, steam power cycle, refrigeration, carnot's cycle, simple rankine's cycle, rankine's cycle with modification, biner cycle, phsycometrich chart, cooling tower, real gas, real gas equation, enthalpy and entrophy.

Prerequisite: Basic Chemistry

Textbook:
1. Moran, Michael J. and Shapiro, Howard N. Fundamentals of Engineering Thermodynamics 5th edition. Danvers: John Wiley & Sons, 2006.
2. Cengel, Yunus A. and Boles, Michael A. Thermodynamic: an Engineering Approach 5th edition. Boston: McGraw-Hill, 2006g.

ARTIFICIAL INTELLIGENCE

ENBE607036
3 CREDITS
Learning outcomes:
At the end of the course, students are expected to:
1. Able to design machine learning-based medical decision support system software
2. Able to evaluate machine learning technology that processes medical information / data
3. Able to use Python programming language to implement machine learrning algorithms

Topics:

Introduction to machine learning and artificial intelligence, Data in machine learning, Regression, Clustering, Classification, Artificial neural networks, Deep Learning, Dimensional reduction with Principal Component Analysis, Designing recognition systems.

Prerequisite:

Engineering Mathematics 2, Biomedical Statistics and Probability, Numeric Computation, Basic Computer and Programming

Textbook:
1. Oliver Theobald, Machine Learning for Absolute Beginners: A Plain English Introduction, Independently published, 2018
2. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2011
3. Joel Gruss, Data Science from Scratch, O'Reilly, 2015
4. Other reading materials: Andrew Ng, Machine Learning, Online Course at Coursera.

BIOMEDICAL EMBEDDED SYSTEM

ENBE606037
4 CREDITS
Learning Outcomes:

After completing this course, students are able to design, program and create complex m-based embedded systems.

Topics:

The 8051 Microcontrollers; 8051 Assembly Language Programming; Jump, Loop, And Call Instructions; I/O Port Programming; 8051 Addressing Modes; Arithmetic, Logic Instructions, And Programs; 8051 Hardware Connection And Intel Hex File; 8051 Timer Programming In Assembly; 8051 Serial Port Programming In Assembly; Interrupts Programming In Assembly; LCD Programming in Assembly; Microcontroller project based on common microcontroller, like Arduino Uno etc.

Prerequisites: Analog Electronics

Textbook:

1. The 8051 Microcontroller and Embedded Systems Using Assembly and C, Second Edition, Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, USA, 2006.
2. Introduction to Embedded Systems Using ANSI C and the Arduino Development Environment, David J. Russell, Morgan & Claypool Publishers, 2010.

BIOMEDICAL EMBEDDED SYSTEM LABORATORY

ENBE606038
1 CREDITS
Learning Outcomes:

Students have capability to:

1. Design complex microcontroller-based embedded systems
2. Apply modern engineering devices to complex engineering practices.

Topics: Biomedical Embedded System Laboratory.

Prerequisites: Biomedical Embedded System Laboratory.

Textbook:

1. Biomedical Embedded System Laboratory Module

BIOMEDICAL SPECIAL TOPIC 2
ENBE600039
3 CREDITS
Learning Outcomes:

After completion this course, students are expected to be able:

1. To study the latest developments in biomedical engineering including technological, business and regulatory aspects.
2. To reference the latest biomedical engineering developments including technological, business and regulatory aspects.

Syllabus:

Current issues on aspects of technology, applications, business and regulation in the health sector.

Prerequisites: None

Textbook: None

BIOINFORMATICS AND GENOMICS
ENBE600040
3 CREDITS
Learning outcomes:

After completing this course, students are expected to be able to conclude the results of genomic data analysis through the bioinformatics approach (C4).

Topics: Fundamental information of genome along with its database and software; sequencing technology; nucleotide analysis; DNA marker analysis; RNA analysis; wet lab application related to bioinformatics; pathway and GO annotation system; molecular analysis of protein; biological system.

Prerequisite: Engineering Biology and Laboratory.

Textbook:
1. Ibrahim KS, et al, 2017, Bioinformatics-A Student's Companion. Springer. Singapore.
2. Keith JM. 2017. Bioinformatics Volume II: Structure, Function, and Application. Humana Press. New York.
3. Li X, et al. 2018. Non-Coding RNAs in complex diseases. Springer. Singapore.

MEDICAL THERAPY TECHNOLOGY
ENBE600041
3 CREDITS
Learning Outcomes:

After completing this course, students are expected to be able to:

1. Able to correlate various aspects related to problems in oncology cases related to human physiological conditions.
2. Able to connect oncology case studies with treatment methods that are in accordance with health standards and regulations.

Topics:

Introduction to the basic principles of oncology, Oncology case approach with precision medicine, Handling oncology cases with radiation therapy, Handling oncology cases with thermal therapy, Handling oncology cases with immunotherapy.

Prerequisites: None

Textbook:
1. Symonds P, Mills J, Duxbury A. Walter and Miller's Textbook of Radiotherapy: Radiation Physics, Therapy and Oncology. 8th ed: Elsevier; 2019.
2. Moros E. Physics of Thermal Therapy: Fundamentals and Clinical Applications. 1st ed: CRC/Taylor & Francis; 2013.
3. Cooper LJN, Mittendorf EA, Moyes J, Prabhakaran S. Immunotherapy in Translational Cancer Research. 1st ed: Wiley-Blackwell; 2018.

Transition Rules

1. The 2020 curriculum is implemented starting from the Odd Semester of 2020/2021. In principle, after the 2020 Curriculum is implemented, only the subjects in the 2020 Curriculum will be opened.
2. The class of 2019 and previously followed the 2020 curriculum with transition rules.
3. A transition period of 1 year is applied, namely in the 2020/2021 academic year for subjects that have changed the location of the organizing semester (from Even to Odd, or vice versa), if necessary, will be opened in both semesters during the transition period (Academic Year 2020/2021).
4. For students who have not passed the compulsory course in the 2018 Curriculum, they are required to take the same or equivalent course in the 2020 Curriculum. (The 2018 Curriculum subject, which is not listed in the Equality Table, means that it has not changed, both the name and the size of the credits.)
5. If there is a change in the credits of the subjects, then the number of credits that are taken into account in graduation is the number of credits at the time the course is taken. The same or equivalent subjects with different credit weights, if repeated or just taken, will be listed with a new name and calculated with the weight of the new credits.
6. If the compulsory subjects in the 2018 Curriculum are removed and there is no equality in the 2020 Curriculum, then for students who have passed the subject, it is still counted as compulsory course credits in the calculation of graduation of 144 credits. For students who have not passed the course, they can take a new compulsory course or elective course in the 2020 Curriculum to complete 144 credits.
7. Lack of credits due to differences in the weight of credits, can be obtained from elective courses.

Equality of S1 Biomedical Engineering Undergraduate Courses

No	Course in Curriculum 2018	SKS 2018	Course in Curriculum 2020	SKS 2020
1	Integrated Character Building A (sem 2)	6	Integrated Character Building (sem 2)	5
2	Integrated Character Building B (sem 1)	6		
3	Sports/Arts (sem 2)	1		
4	Engineering Biology (sem 2)	2	Engineering Biology and Laboratory (sem 2)	3
5			Basic Chemistry Laboratory (sem 2)	1
6			Linear Algebra (sem 2)	4
7	Digital Network and Laboratory (sem 2)	3	Basic Digital Systems and Laboratory (sem 1)	3
8	Vector Analysis (sem 3)	2	Engineering Mathematics 1 (sem 3)	2
9	Engineering Mathematics (sem 3)	4	Engineering Mathematics 2 (sem 4)	4
10	Basic Computers and Programming (sem 4)	3	Basic Computers and Laboratory (sem 4)	3
			Basic Biomedical Automation System (sem 5)	3
12	Health, Safety & Environment (HSE) for Hospital (sem 5)	2	Health, Safety & Environment (HSE) for Hospital (sem 5) Elective Course	2
13	**Scientific Writing (sem 6)**	2	-	
14	Knowledge-Based Intelligent Systems (sem 7)	3	Artificial Intelligence (sem 7) MK Pilihan	3
15	Engineering and Entrepreneurship (sem 7)	2		
16			Biomedical Engineering Project Design 1 (sem 6)	2
17			Biomedical Engineering Project Design 2 (sem 7)	3
18	Microprocessors and Microcontrollers (sem 6)	3	Biomedical Embedded Systems (sem 6)	3
19	Microprocessor and Microcontroller Laboratory (sem 6)	1	Biomedical Embedded Systems Laboratory (sem 6)	1
20	Seminar (sem 7)	2	**Pra-Skripsi (sem 7)**	2

Fast-Track Curriculum (Undergraduate and Master's Degree)

Subjects of Fast Track Program

Majoring in Biomedical Instrumentation and Medical Imaging

Code	Subject	SKS
	7th Semester	
ENBE607027	Biomedical Engineering Project Design 2	3
ENBE607028	Pre-Thesis	2
ENBE607029	Internship	2
ENBE801001	Anatomy and Modelling in Physiology	3
ENBE801002	Research Methodology 1	2
ENBE801003	Patient Safety Standards and Regulations	3
ENBE801005	Project Management for Biomedical Engineering	3
	Sub Total	**18**
	8th Semester	
ENBE608030	Bachelor Thesis	4
ENBE802006	Research Methodology 2	2
ENBE802101	Biomedical Instrumentation	3
ENBE802104	Medical Imaging and Image Processing	3
ENBE802103	Biomedical System Automation	3
	Sub Total	**15**
	9th Semester	
ENBE801004	Design and Prototyping Biomedical System	3
	Elective Course	6
	Sub Total	**9**
	10th Semester	
ENBE802102	Biomedical Sensors	3
ENBE804007	Scientific Publication	2
ENBE804008	Master Thesis	8
	Sub Total	**13**

Majoring in Medical Informatics

Code	Subject	SKS
	7th Semester	
ENBE607027	Biomedical Engineering Project Design 2	3
ENBE607028	Pre-Thesis	2
ENBE607029	Internship	2
ENBE801001	Anatomy and Modelling in Physiology	3
ENBE801002	Research Methodology 1	2
ENBE801003	Patient Safety Standards and Regulations	3
ENBE801005	Project Management for Biomedical Engineering	3
	Sub Total	**18**
	8th Semester	
ENBE608030	Bachelor Thesis	4
ENBE802006	Research Methodology 2	2
ENBE802201	Hospital Information System	3
ENBE802202	Decision Making System and Artificial Intelligent	3
ENBE802203	e-Health and Telemedicine	3
		15
	9th Semester	
ENBE801004	Design and Prototyping Biomedical System	3
	Elective Course	6
	Sub Total	**9**
	10th Semester	
ENBE802204	Computational Biology and Bioinformatics	3
ENBE804007	Scientific Publication	2
ENBE804008	Master Thesis	8
	Sub Total	**13**

Clinical and Hospital Engineering

Code	Subject	SKS
	7th Semester	
ENBE607027	Biomedical Engineering Project Design 2	3
ENBE607028	Pre-Thesis	2
ENBE607029	Internship	2
ENBE801001	Anatomy and Modelling in Physiology	3
ENBE801002	Research Methodology 1	2
ENBE801003	Patient Safety Standards and Regulations	3
ENBE801005	Project Management for Biomedical Engineering	3
	Sub Total	**18**
	8th Semester	
ENBE608030	Bachelor Thesis	4
ENBE802006	Research Methodology 2	2
ENBE802301	Hospital Medical Equipment	3
ENBE802302	Hospital Engineering	3
ENBE802304	Clinical Asset and Equipment Management System	3
		15
	9th Semester	
ENBE801004	Design and Prototyping Biomedical System	3
	Elective Course	6
	Sub Total	**9**
	10th Semester	
ENBE802303	Design of Hospital and Health-care Facilities	3
ENBE804007	Scientific Publication	2
ENBE804008	Master Thesis	8
	Sub Total	**13**

Undergraduate Program in Metallurgical & Materials Engineering

Program Specification

1.	**Awarding Institution**	Universitas Indonesia Double Degree: Universitas Indonesia & Partner Universities	
2.	**Teaching Institution**	Universitas Indonesia Double Degree: Universitas Indonesia & Partner Universities	
3.	**Faculty**	Engineering	
4.	**Name of Study Program**	Undergraduate Program in Metallurgy and Materials Engineering	
5.	**Vission and Mission**	**Vision:** To be a research-based center of excellence, as well as referral center and solution provider for problems in the field of metallurgical and materials engineering in national and global levels **Mission:** • To provide broad access to education and research for the public and industry • To produce high quality graduates with strong academic background and comprehensive skills in process technology, material engineering and design, who are capable of undertaking active and dynamic role in national, regional and international arenas • To perform quality Tridharma (three duties) relevant to the national and global challanges. • To create conducive academic environment to support the vision of the Department of Metallurgical and Materials Engineering	
6.	**Type of Class**	Reguler, Paralel, International	
7.	**Awarding Degree**	Sarjana Teknik (S.T.) Double Degree: Sarjana Teknik (S.T.) and Bachelor of Engineering (B.Eng.)	
9.	**Accreditation / Recognition**	BAN-PT: Excellent AUN-QA: Accredited IABEE: Accredited	
10.	**Language Course**	Bahasa (Indonesia) and English	
11.	**Learning Scheme (Full Time / Part Time)**	Full Time	
12.	**Entry Requirements**	High school graduate/equivalent, or Vocational/Polytechnique/ Community College	
11.	**Term of Study**	Programmed for 4 years	
	Type of Semester	Number of Semester	Number of weeks / semester
	Regular	8	16
	Short (optional)	3	8
13.	**Aims of the programme** 1. To produce high quality graduates with a strong academic foundation 2. To produce graduates who are comprehensively capable in process technology and material engineering 3. To produce graduates who are able to contribute an active and dynamic role in the national, regional and international community.		
14.	**Profile of Graduates** Bachelor of Engineering who is able to engineer materials that are environmentally friendly to improve the performance of manufactured products, material protection and development of advanced materials based on the utilization of material resources optimization; has strong adaptability, character and integrity; and able to contribute an active, dynamic and ethical role at the national and international level		

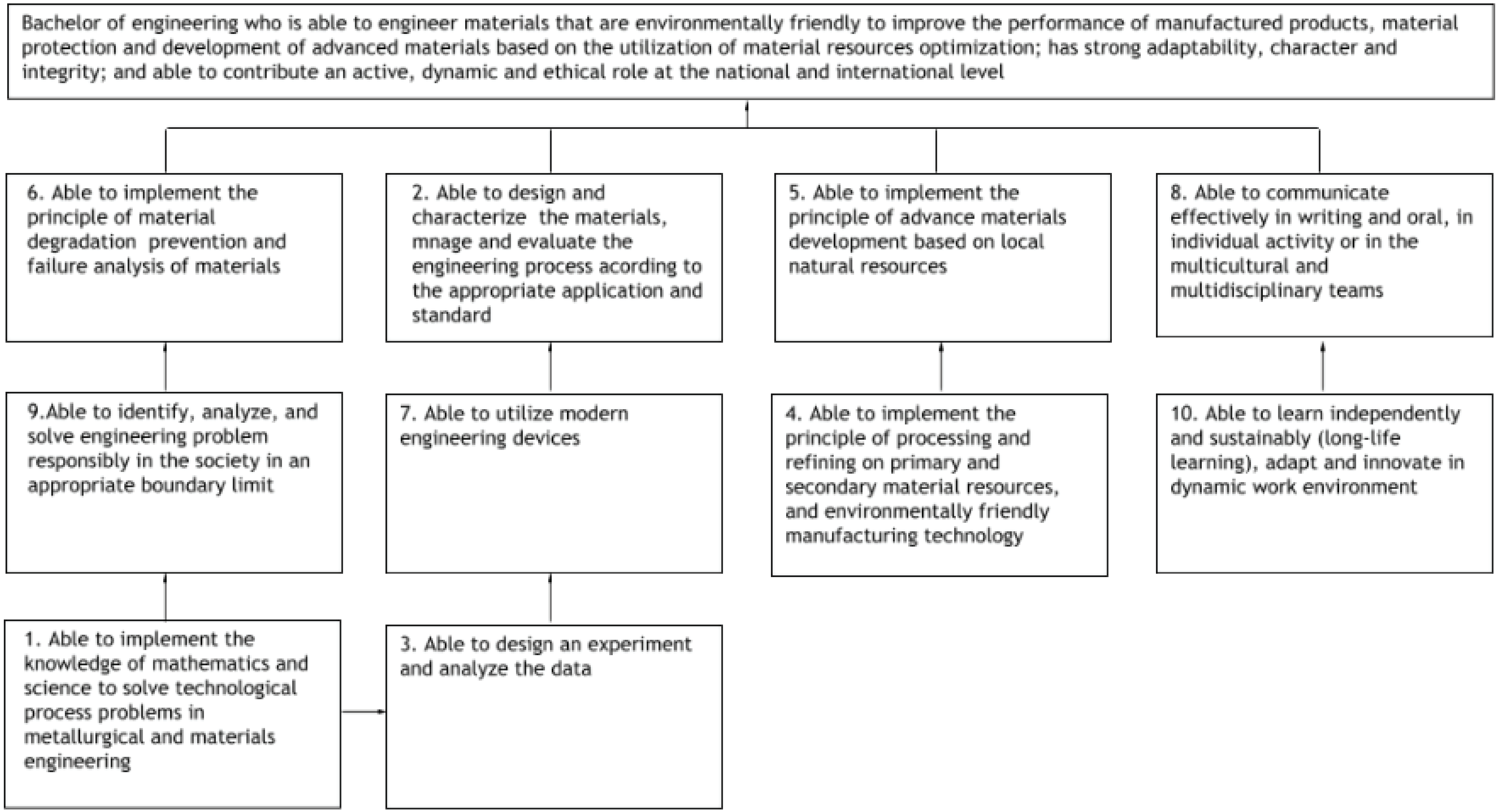
15.	**Expected Learning Outcomes:** The graduates of Metallurgical and Materials Engineering will have the following outcomes: 1. Able to implement the knowledge of mathematic and science in problems of metallurgy and materials technology process 2. Able to design and characterize the materials, manage and evaluate the engineering process according to the appropriate application and standard 3. Able to design an experiment and analyze the data 4. Able to implement the principle of processing and refining on primary and secondary material resources, and environmentally friendly manufacturing technology 5. Able to implement the principle of advance materials development based on local natural resources 6. Able to implement the principle of material degradation prevention and failure analysis of materials 7. Able to utilize modern engineering devices 8. Able to communicate effectively in writing and oral, in individual activity or in the multicultural and multidisciplinary teams 9. Able to identify, analyze, and solve engineering problem responsibly in the society in accordance with existing limits 10. Able to learn independently and sustainably (long-life learning), adapt and innovate in dynamic work environment
16.	**Course Composition**

No.	Type of Courses	Credits	Percentage
i	Basic University Courses	9	6,25 %
ii	Basic Engineering Courses	22	15,28 %
iii	Metallurgical and Materials Engineering Courses	77	53,47%
iv	Elective Courses	28	19,44%
v	Internship, Seminar, Final Year Projects	8	5,56 %
	Total	144	100 %
	Total Credit Hours to Graduate		144 credits

Job Prospects

Graduates of this study program can work in various sectors both private, state-owned and government such as in the automotive industry, manufacturing, heavy equipment, mining, oil and gas, research and development fields such as Pertamina, LIPI, BATAN, BPPT, LAPAN, Ministry of Industry, and Ministry of Energy and Mineral Resources.

Expected Learning Outcomes Matrix



Course Flowchart for Learning Outcome Achievement
Bachelor Program Metallurgical & Materials Engineering

Capaian Pembelajaran	Tahun 1		Tahun 2		Tahun 3		Tahun 4	
	Semester 1	Semester 2	Semester 3	Semester 4	Semester 5	Semester 6	Semester 7	Semester 8
1. Able to implement the knowledge of mathematic and science in problems of metallurgy and materials technology process	Calculus 1	Calculus 2	Numerical Computation					
	Basic Chemistry	Materials Physic 1	Materials Physic 2					
	Basic Chemistry Laboratory	Static and Mechanic of Materials	Electrochemistry					
	Introduction to Engineering Materials	Physics - Electricity, MWO	Linear Algebra					
	Physics - Mechanics and Heat	Physics - Electricity, MWO Laboratory	Introduction to Fluids Mechanics and Heat Transfer					
	Physics - Mechanics and Heat Laboratory	Thermodynamics of Materials						
2. Able to design and characterize the materials, manage and evaluate the engineering process according to the appropriate			Material Characterization		Materials Selection	Engineering Design of Products and Process		

application and standard								
3. Able to design an experiment and analyze the data				Data Analysis and Scientific Writing			Seminar	Final Project
4. Able to implement the principle of processing and refining on primary and secondary material resources, and environmentally friendly manufacturing technology				Mineral Processing	Extractive Metallurgy			
				Heat Treatment and Surface Engineering	Iron and Steel Making			
				Materials Joining	Materials Joining			
				Materials Characterization Laboratory	Metal Manufacturing Process			
5. Able to implement the principle of advance materials development based on local natural resources			Materials Physics 2	Materials Physics 3	Polymer Manufacturing Process	Ceramics Technology		
				Polymer Materials		Composite Technology		
6. Able to implement the principle of material degradation prevention and failure analysis of materials				Corrosion & Protection of Metals		Failure Analysis		
7. Able to utilize modern engineering devices	Basic Chemistry Laboratory	Physics - Electricity, MWO Laboratory		Materials Characterization Laboratory	Corrosion Laboratory	Extractive Metallurgy Laboratory		
	Engineering Drawing					Metals Manufacturing Laboratory		

	Physics - Mechanics and Heat Laboratory							
8. Able to communicate effectively in writing and oral, in individual activity or in the multicultural and multidisciplinary teams	English	Integrated Character-Buildi ng	Numerical Computation	HSE Protection	Extractive Metallurgy	Metals Manufacturing Laboratory	Technopreneurship	
	Engineering Drawing			Data Analysis and Scientific Writing	Iron and Steel Making	Extractive Metallurgy Laboratory	Internship	
				Materials Characterization Laboratory	Materials Selection		Seminar	
					Corrosion Laboratory			
9. Able to identify, analyze, and solve engineering problem responsibly in the society in accordance with existing limits			Materials Physics 2	Materials Physics 3		Failure Analysis	Internship	Final Project
			Material Characterization	Corrosion & Protection of Metals		Engineering Design of Products and Process		
				Polymer Materials				
				Mineral Processing				
10. Able to learn independently and sustainably (long-life learning), adapt and	Religious Study	Integrated Character-Buildi ng	Electrochemistry	Heat Treatment and Surface Engineering	Materials Joining	Ceramics Technology	Technopreneurship	
	Introduction to Engineering Materials	Materials Physic 1	Chemistry of Material		Metal Manufacturing Process	Composite Technology		
		Static and Mechanic of Materials	Introduction to Fluids Mechanics		Polymer Manufacturing Process			

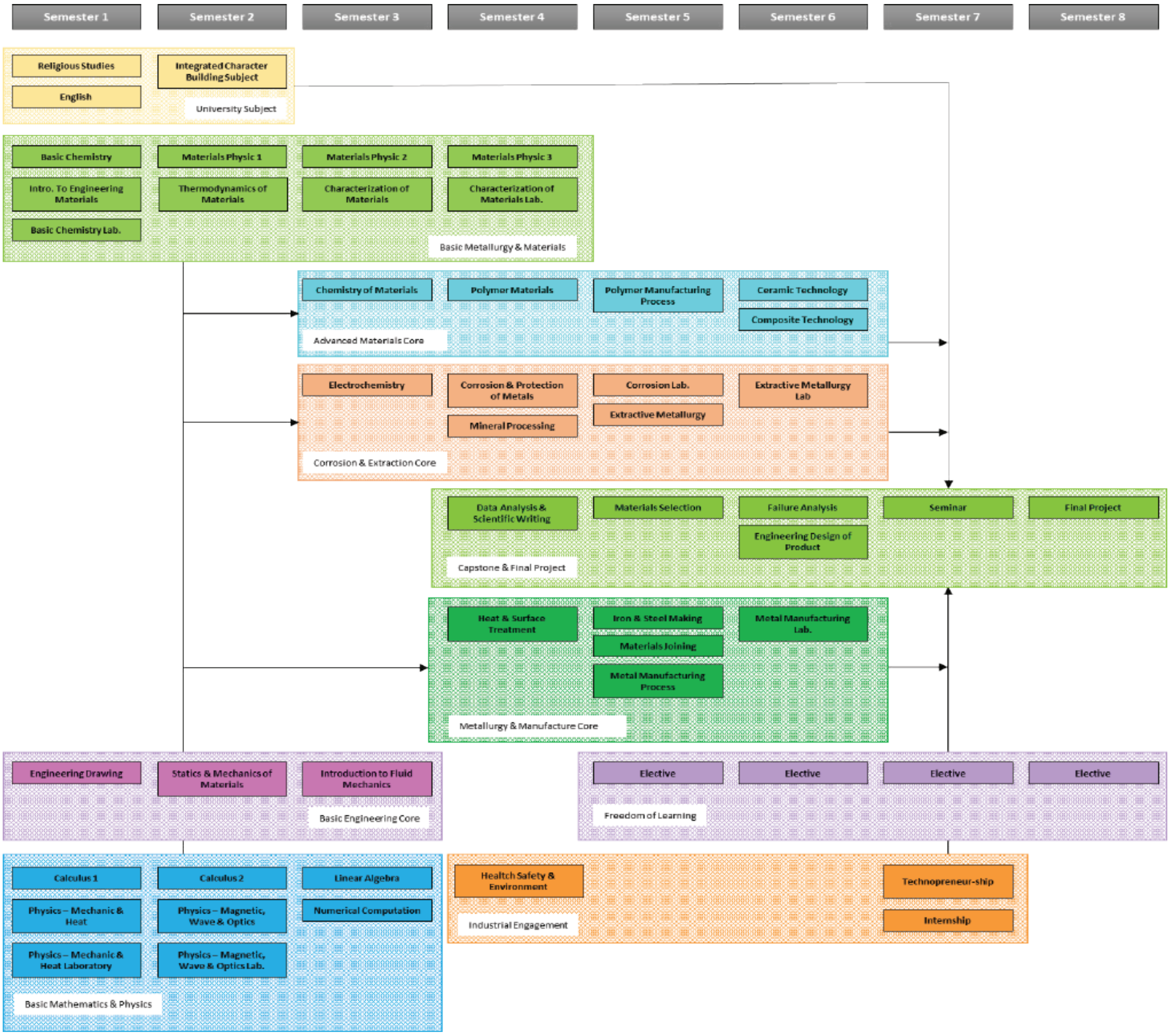
innovate in dynamic work environment			and Heat Transfer					
		Thermodynamics of Materials						

Course Type Distribution in Curriculum 2020

Semester 1	Semester 2	Semester 3	Semester 4	Semester 5	Semester 6	Semester 7	Semester 8
Religious Study	Inetgrated Character-Building	Linier Algebra	Health, Safety, and Environment	Materials Selection	Failure Analysis	Seminar	Final Project
English	Calculus 2	Numerical Computation	Data Analysis and Scientific Writing	Polymer Manufacturing Process	Engineering Design of Product and Process	Internship	Electives
Calculus 1	Physics: Electricity, Magnet, Wave and Optics	Chemistry of Materials	Polymer Materials	Extractive Metallurgy	Ceramics Technology	Techno-preneurship	
Physics: Mechanics and Heat	Physics: MWO Laboratory	Electro-chemistry	Corrosion and Protection of Metals	Corrosion Laboratory	Composite Technology	Electives	
Physics, Mechanics and Heat Laboratory	Statics and Mechanics of Materials	Introduction to Fluid Mechanics and Heat Transfer	Mineral Processing	Iron and Steel Making	Extractive Metallurgy Laboratory		
Enginenering Drawing	Thermodynamics of Materials	Materials Characterization	Materials Characterization Laboratory	Metals Manufacturing Process	Metals Manufacturing Process Laboratory		
Basic Chemistry	Materials Physics 1	Materials Physics 2	Materials Physics 3	Materials Joining	Electives		
Basic Chemistry Laboratory			Heat Treatment and Surface Engineering	Electives			
Introduction to Engineering Materials							

University Subject	Basics of Engineering	Metallurgy and Manufacture	Corrosion and Extraction	Capstone and Final Project
Basics of Metallurgy and Materials	Maths and Physics	Advanced Materials	Indsutrial Engagement	Freedom of Learning

Course Correlation in Curriculum 2020



Course Structure for Undergraduate Metallurgical & Materials Engineering Program (Regular & Parallel Class)

Code	Subject	SKS
	1st Semester	
UIGE600004	Religious Studies	2
UIGE600003	English for Academic Writing	2
ENGE600001	Calculus 1	3
ENGE600005	Physics - Mechanics and Heat	3
ENGE600006	Physics - Mechanics and Heat Laboratory	1
ENGE600009	Basic Chemistry	2
ENMT601001	Engineering Drawing	**2**
ENMT601002	Introduction to Engineering Materials	**2**
ENMT601003	Basic Chemistry Laboratory	1
	Sub Total	**18**
	2nd Semester	
UIGE600006	Integrated Character Building Subject	5
ENGE600002	Calculus 2	3
ENGE600007	Physics - Electricity, MWO	3
ENGE600008	Physics - Electricity, MWO Laboratory	1
ENMT602004	Materials Physic 1	2
ENMT602005	Static & Mechanic of Materials	3
ENMT602006	Thermodynamics of Materials	3
	Sub Total	**20**
	3rd Semester	
ENGE600004	Linear Algebra	4
ENMT603007	Electrochemistry	3
ENMT603008	Materials Physic 2	3
ENMT603009	Characterization of Materials	3
ENMT603010	Chemical Characterization of Materials	2
ENMT603011	Numerical Computation	2
ENMT603012	Introduction to Fluids Mechanics and Heat Transfer	2
	Sub Total	**19**
	4th Semester	
ENGE600012	HSE Protection	2
ENMT604013	Data Analysis and Scientific Writing	3
ENMT604014	Materials Physics 3	2
ENMT604015	Corrosion & Protection of Metals	3
ENMT604016	Polymer Materials	3
ENMT604017	Mineral Processing	3
ENMT604018	Heat Treatment and Surface Engineering	1
ENMT604019	Materials Characterization Laboratory	1
	Sub Total	**18**
	5th Semester	
ENMT605020	Extractive Metallurgy	3
ENMT605021	Iron & Steel Making	2
ENMT605022	Materials Selection	2
ENMT605023	Materials Joining	3
ENMT605024	Metal Manufacturing Process	4
ENMT605025	Polymer Manufacturing Process	3
ENMT606026	Corrosion Laboratory	**1**
ENMT607937-51	Elective	3
	Sub Total	**20**
	6th Semester	
ENMT606027	Failure Analysis	3
ENMT606028	Engineering Design of Products and Process	3
ENMT606029	Ceramics Technology	3
ENMT606030	Composite Technology	3
ENMT606031	Metal Manufacturing Laboratory	1
ENMT606032	Extractive Metallurgy Laboratory	1
ENMT608952-60	Elective	5
	Sub Total	**19**
	7th Semester	
ENMT607033	Technopreneurship	2
ENMT607034	Internship	2
ENMT607035	Seminar	2
ENMT607939-49	Elective	14
	Sub Total	**20**
	8th Semester	
ENMT600036	Final Project	4
ENMT608950-60	Elective	7
	Sub Total	**11**
	Total	**144**

Resume

Semester	Course	Prerequisite
4	HSE Protection	Minimum 50 credits
4	Materials Physic 3	Termodynamics of Materials, Introduction to Fluid Mechanics
4	Capita Selecta, Technology, and Society	Minimum 50 credits
4	Corrosion & Protection of Metals	Electrochemistry
4	Polymer Materials	

4	Mineral Processing	Materials Physics 1
4	Materials Characterization Laboratory	Characterization of Materials
4	Chemical Characterization of Materials Laboratory	Materials Characterization Laboratory
5	Extractive Metallurgy	Mineral Processing
5	Iron & Steel Making	Mineral Processing
5	Heat Treatment and Surface Engineering	Materials Physic 3
5	Metal Manufacturing Process	Materials Physic 3
5	Polymer Manufacturing Process	Polymer Materials
5	Corrosion Laboratory	Corrosion & Protection of Metals
6	Data Analysis and Scientific Writing	Minimum 90 credits
6	Materials Selection	Characterization of Materials, Materials Physics 2, Materials Physics 3
6	Materials Joining	Characterization of Materials, Materials Physics 3
6	Ceramics Technology	Materials Physics 3
6	Composite Technology	Polymer Materials
6	Metals Manufacturing Laboratory	Metal Manufacturing Process
6	Extractive Metallurgy Laboratory	Extractive Metallurgy
7	Failure Analysis	Materials Selection
7	Engineering Design of Products	Metal Manufacturing Process, Polymer Manufacturing Process, Ceramics Technology, Composite Technology, Materials Selection
7	Technopreneurship	Minimum 100 credits
7	Internship	Minimum 100 credits
7	Seminar	Minimum 105 credits
8	Final Project	Minimum 125 credits

Prerequisite List For Curriculum 2020 Courses

Code	Subject	SKS
	1st Semester	
ENMT607939	Special Alloyed Steels	2
ENMT607940	Biomaterial	2
ENMT607941	Engineering Ethics	2
ENMT607942	Computational Materials	2
ENMT607943	High Temperature Corrosion	2
ENMT607944	Electron Microscopy	2
ENMT607945	Polymer Compounding	2
ENMT607946	Quality Management Systems	2
ENMT607947	Advanced Solidification	2
ENMT607948	Special Processing and Assembly Technologies	2
ENMT607949	1st Term Advanced Internship	3
ENMT803918	Risk Based-Inspection and Integrity	3
ENMT803919	Advanced Polymer Manufacturing	3
ENMT803920	Electronic Materials	3
ENMT803921	Nanotechnology	3
	2nd Semester	
ENMT608950	Industrial Ecology	2
ENMT608951	Concrete Corrosion	2
ENMT608952	Energy Materials	2
ENMT608953	Refractory Materials	2
ENMT608954	Mechanics of Material Forming	2
ENMT608955	Industrial Mechanic Equipment	2
ENMT608956	Material Standardization	2
ENMT608957	Polymer Recycling Technology	2
ENMT608958	Rubber Technology	2
ENMT608959	Quenching Technology	2
ENMT608960	2nd Term Adv. Internship	3
ENMT804922	Advanced Manufacture	3
ENMT804923	Smart Materials	3
ENMT804924	Advanced Extractive Metallurgy	3
ENMT804925	Advanced Surface Engineering	3

Prerequisite for Elective Courses

Semester	Course	Prerequisite	Recommended Semester
1st Term	Special Alloyed Steels	Iron & Steel Making	7
1st Term	Biomaterial	Corrosion & Protection of Metals	5 or 7
1st Term	Engineering Ethics		5 or 7
1st Term	Computational Materials	Numerical Computation	5 or 7
1st Term	High Temperature Corrosion	Corrosion & Protection of Metals	5 or 7
1st Term	Electron Microscopy	Characterization of Materials	5 or 7
1st Term	Polymer Compounding	Polymer Materials	5 or 7
1st Term	Quality Management Systems	Data Analysis and Scientific Writing	7
1st Term	Advanced Solidification	Materials Physic 3	5 or 7
1st Term	Special Processing and Assembly Technologies	Materials Selection	7
1st Term	1st Term Advanced Internship	Minimum 125 credits	
1st Term	Risk Based-Inspection and Integrity	Characterization of Materials, Corrosion & Protection of Metals	(for fast-track / by department approval)
1st Term	Advanced Polymer Manufacturing	Polymer Manufacturing Process	(for fast-track / by department approval)
1st Term	Electronic Materials	Metal Manufacturing Process, Polymer Manufacturing Process, Ceramics Technology, Composite Technology	(for fast-track / by department approval)
1st Term	Nanotechnology	Metal Manufacturing Process, Polymer Manufacturing Process, Ceramics Technology, Composite Technology	(for fast-track / by department approval)
2nd Term	Industrial Ecology	Mineral Processing	6 or 8
2nd Term	Concrete Corrosion	Corrosion & Protection of Metals	8
2nd Term	Energy Materials		6 or 8
2nd Term	Refractory Materials	Ceramics Technology	8
2nd Term	Mechanics of Material Forming	Metal Manufacturing Process	6 or 8
2nd Term	Industrial Mechanic Equipment	Metal Manufacturing Process	6 or 8
2nd Term	Material Standardization	Characterization of Materials	6 or 8
2nd Term	Polymer Recycling Technology	Polymer Manufacturing Process	8
2nd Term	Rubber Technology	Polymer Manufacturing Process	8
2nd Term	Quenching Technology	Heat Treatment and Surface Engineering	6 or 8
2nd Term	2nd Term Advanced Internship	Minimum 125 credits	
2nd Term	Advanced Manufacture	Metal Manufacturing Process, Polymer Manufacturing Process, Ceramics Technology, Composite Technology	(for fast-track / by department approval)
2nd Term	Smart Materials	Metal Manufacturing Process, Polymer Manufacturing Process, Ceramics Technology, Composite Technology	(for fast-track / by department approval)

2nd Term	Advanced Extractive Metallurgy	Extractive Metallurgy	(for fast-track / by department approval)
2nd Term	Advanced Surface Engineering	Heat Treatment and Surface Engineering	(for fast-track / by department approval)

Transition Policy from Curriculum 2016 to Curriculum 2020

1. The Curriculum 2020 takes effect from the Second Term 2020/2021. After this curriculum is implemented, only the subjects in the Curriculum 2020 will be counted for the graduation: any subject in the Curriculum 2016 follows the transition rules.
2. Transition rules will be valid for 1 (one) year, starting from the Second Term of 2020/2021 until the First Term 2021/2022 for any subject changing in its place (from the first term to second term or vice versa). If it is necessary, the subject will be opened in both semesters.
3. Students who have not passed the compulsory subjects in the Curriculum 2016 are required to take the same or equivalent subjects in the Curriculum 2020.
4. If there is a change in the credit hours, the credits at the first time the subject taken will be considerred. The same or equivalent subjects with different credit hours, if repeated or newly taken, will be counted with the new name and credit hours.
5. The equivalence subjects for Curriculum 2016 and Curriculum 2020 can be seen in the Equivalency Table. Any unlisted subject in the Curriculum 2016 has been removed and is no longer offered.
6. If the compulsory subjects in the Curriculum 2016 are removed and there are no equivalencies in the Curriculum 2020:
   a. For students who have passed the subjects, the subjects will be counted as compulsory credits with the same name and credit hours.
   b. For students who have not passed the subjects, students can take new compulsory subjects or elective subjects with the new name and credit hours.
7. If a subject has a reduction in the credit hours while the student has already taken the subject required for the graduation, then the student is still allowed to graduate even though the total number of credits is less than the required one.

Equivalency of Curriculum 2016 and 2020

No	Course Name in Curriculum 2016	Credits	Course Name in Curriculum 2020	Credits
1	Academic Writing	3	Academic Writing	2
2	Integrated Character Building A	6	Integrated Character Building	5
3	Integrated Character Building B	6		
4	Statistics & Probability	2	Data Analysis and Scientific Writing	2
5	Physical Metallurgy 1	4	Materials Physics 1	2
6			Materials Physics 2	3
7	Testing of Materials	2	Characterization of Materials	3
8	Tech. of Microstructural Analysis	2		
9	Chemical Characterization	2	Characterization of Materials	2
10	Polymer Chemistry	4	Polymer Materials	3
11	Physical Metallurgy 2	3	Materials Physics 3	3
12	Mineral Processing	4	Mineral Processing	3
13	Transport Phenomenon	3	Introduction to Fluids Mechanics and Heat Transfer	2
14	Industrial Management	2	Technopreneurship	2
15	Polymer Technology	3	Polymer Manufacturing Process	3
16	Tech. of Microstructural Analysis Laboratory	1	Materials Characterization Laboratory	1
17	Testing of Materials Laboratory	1		
18	Chemical Characterization Laboratory	1		
19	Metal Manufacturing Process Laboratory	2	Metals Manufacturing Laboratory	1
20	Engineering Design of Products	3	Engineering Design of Products and Process	3
21	Capita Selecta	2	Technopreneurship	2
22	Fracture Mechanics & Failure Analysis	4	Failure Analysis	3

Other subjects that are not listed in this table do not change except for the subject code and curriculum code (full list is given in the SIAK-NG website)

Course Syllabus of University Subjects

INTEGRATED CHARACTER BUILDING

UIGE600001/UIGE610001
5 credits

Syllabus **:**
The **Integrated Character Building** is part of the Higher Education Personality Development Lecture which is held for students which contains elements of the internalization of basic life values, interaction/relationship skills, nationality and academic skills as the basis for student personality to carry out learning according to scientific disciplines.

MPKT is carried out in the form of a series of learning activities outside the formal class. activities carried out include participation in lectures/seminars, internships, field work practices, social work, sports and/or arts activities and other forms of activities that have the main goal of equipping students with soft skills and proven by portfolio documents. The form of this learning activity is different from the MPKT courses that have been carried out at the previous UI.

The material provided at MPKT aims to form a human thinking pattern with values and morals to create a human personality by having critical, logical, creative, innovative thinking, and having intellectual curiosity and an entrepreneurial spirit. The material provided includes 9 UI values, national, state and citizen values based on Pancasila. Solving problems in science, technology, health, and humans as natural managers by using reasoning and utilizing Information and Communication Technology (ICT) to achieve the final objectives of this module.

Lecture activities are carried out using an online student-centered learning (SCL) approach which can use the following methods: experiential learning (EL), collaborative learning (CL), problem-based learning (PBL), question-based learning, and project based learning. The use of these various methods is carried out through group discussion activities, independent assignment exercises, presentations, writing papers in Indonesian and interactive discussions in online discussion forums. The language of instruction in this lecture is Indonesian.

Graduates Learning Outcomes:
- **CPL 1: Able to use spoken and written language in Indonesian and English both for academic and non-academic activities (C3, A5)**
- **CPL 2: Have integrity and are able to think critically, creatively, and innovatively and have intellectual curiosity to solve problems at the individual and group level (C4, A3)**
- **CPL 3: Able to provide alternative solutions to various problems that arise in the community, nation, and country (C4, A2)**
- **CPL 4: Able to take advantage of information communication technology (C3)**
- **CPL 5: Able to identify various entrepreneurial efforts characterized by innovation and independence based on ethics (C2, A5)**

Course Learning Outcomes:
- **CPMK 1: After completing this course, students are able to apply self-regulated learning characteristically in studying critically, logically, creatively, innovatively through analysis of societal problems, nation, state, and Pancasila ideology based on self-understanding as individuals and members. the community by using good and correct Indonesian and the latest information and communication technology (C4, A4)**
- **CPMK 2: Able to identify various entrepreneurial efforts characterized by innovation and independence based on ethics (C2, A5)**
- **CPMK 3: After completing this course, students are able to apply self-regulated learning characteristically in pursuing integrated and comprehensive knowledge through analysis of science problems, technology based on the role of nature manager by using good and correct Indonesian and information technology and current communications. (C4, A4)**
- **CPMK 4: After completing this course, students are able to plan creative activities to solve problems in society and the world of work/industry by showing creativity, critical thinking, collaborative self-discipline using good and correct Indonesian as well as the latest information and communication technology (C5, A5)**

Prerequisite: None

CALCULUS 2

ENGE600002/ENGE610002
3 SKS
Course Learning Outcomes:

Students are able to use the concepts of sequences, series, conic sections, and the basic concepts of calculus which involve the function of two or three variables to solve their applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :

Infinite sequences and infinite series, Test for convergence of positive series and alternating series, Power series and operation on operations, Taylor and MacLaurin series, Conic sections , Calculus in polar coordinates, Derivatives, limits, and continuity of multi-variables functions, Directional derivatives and gradients, Chain Rule, Tangent planes and Approximations, Lagrange multipliers. Double integrals in Cartesian coordinates and polar coordinates, triple integrals in Cartesian coordinates, cylindrical coordinates and spherical coordinates, Applications of double and triple Integral.

Prerequisite: Calculus 1

Academic Writing

UIGE610002
3 SKS
The objectives of the English component of the MPK program are :
1. To activate students, English so that they will be able to communicate effectively in English;
2. To enable students to develop the learning strategies and study skills needed to finish their study successfully and o continue learning on their own after taking the MPK program (to develop independent learners)

Main Competencies :

By the end of the course, students should be able to:
- listen to, understand and take notes of key information in academic lectures of between 5-10 minutes length;
- improve their listening skills through various listening materials and procedures;
- speak confidently, ask questions in and contribute to small group discussions;
- use different reading strategies needed to the effective readers;
- improve their reading skills through extensive reading material;
- develop skills in connecting ideas using appropriate transitions and conjunctions;
- work as part of a group to prepare and deliver a 25-minute presentation on an academic topic using appropriate organization, language and visual aids;
- write a summary of a short academic article;
- write an expository paragraph;
- write a short essay.

Learning Method :

Active learning, Contextual language learning, small group discussion.

Prerequisite :
- Students Learning Orientation/Orientasi Belajar Mahasiswa (OBM)
- UI English Proficiency Test

English
UIGE600003
3 SKS
Learning Objectives :

After attending this subject, students are expected to capable of use English to support the study in university and improve language learning independently.

Syllabus : Study Skills : (Becoming an active learner, Vocabulary Building: word formation and using the dictionary Listening strategies Extensive reading) Grammar: (Revision of Basic grammar Types of sentences Adjective clauses, Adverb clauses Noun clauses, Reduced clauses) Reading: (Reading skills: skimming, scanning, main idea, supporting ideas, Note-taking Reading popular science article, Reading an academic text) Listening: (Listening to short conversations, Listening to a lecture and notetaking, Listening to a news broadcast, Listening to a short story) Speaking: (Participating in discussions and meetings, Giving a presentation) Writing: (Writing a summary of a short article Describing graphs and tables, Writing an academic paragraph, Writing a basic academic essay (5 paragraphs).

ISLAMIC STUDIES
UIGE600010/UIGE610005
2 SKS

General instructional objectives : The cultivation of students who have concern for social, na-tional and countrys issues based on Islamic values which is applied in the development of science through intellectual skills. **Learning Objectives :** Course participants are expected to do the following when faced with a problem or issue which they must solve :
1. Analyze the problem based on the Islamic values they adopted;
2. Analyze the problem by implementing active learning stages;
3. Discuss and express their thoughts and ideas by using proper and correct Indonesian language in discussion and academic writing.

Syllabus :

Islam history: the meaning of Islam, the characteristic of Islam, the sources of Islamic teachings, Muhammad SAW as prophet and history figure, introduction of Islam in Indonesia, the teaching essence of Islam: the basic principle of Islam teachings, the unity of Allah, worship prac-tice in live, eschatology and work ethics, human's basic rights and obligation, social structure in Islam: sakinah mawaddah and ramhah family, the social implication of family life, Mosque and the development of Islam, zakat and the economic empowerment of the people, Islam society, Science: reason and revelation in Islam, Islam's motivation in development of science, science characteristics, source of knowledge, IDI (each Faculty and Department/Study Program).

CATHOLIC STUDIES
UIGE600011/UIGE610006
2 SKS

General instructional objectives :
1. To help deliver students as intellectual capital in implementing a lifelong learning process to become scientists with mature personalities who uphold humanity and life.
2. Be scholars who believe in God according to the teachings of Jesus Christ by continuing to be responsible for his faith in life in church and society.

Syllabus :

Almighty God and the God teachings; Man, Morals, science technology and art; harmony between religions; Society, Culture, Politics, Law: the substance of theses studies will be addressed by integrating the four dimensions of the teachings of the Catholic faith: the personal dimension, the dimension of Jesus Christ, the dimension of the Church, and Community dimension. Dimensions are implemented in the following themes: People, Religion, Jesus Christ, the Church, and Faith in the society.

CHRISTIAN STUDIES
UIGE600012/UIGE610007
2 SKS

General instructional objectives :

Cultivating students with comprehensive Christian knowledge and teaching in the midst of the struggle and the fight of the nation while also discussing the student's participation in line with the study to help improve and build our country.

Learning Objectives:

Course participants are expected to do the following when faced with a problem or issue which they must solve:
1. Analyze the problem based on the Christian values
2. Analyze the problem by implementing active learning stages
3. Discuss the problem by using proper and correct Indonesian language

Syllabus :

History (Historical terms): Status of the Bible, the existence of God and Morality, Christ the Savior, the Holy Spirit as existence reformer and outlook on the world: Faith and Knowledge of Science, Church and service, Ecclesiology, Spiritual and enforcement of Christian Human Rights and the world of ethics: Christian Ethics, Christian and worship, Christianity and politics, Christian love and social reality: Christian Organizations, Students and Service, Christian and expectations.

HINDU STUDIES
UIGE600013/UIGE610008
2 SKS

Syllabus :

Hindu religion, Hindu history), Source and scope of Hinduism (the Veda as the source of Hindu religion teachings, the scope of the teachings in Hindu religion), The concept of the God (Brahman) according to the Veda, the Path to Brahman (Catur Marga Yoga, Mantra and Japa), Human Nature (The purpose of human life, Human's duties, obligations, and responsibilities both individually or collectively), Ethics and morality (Principles teaching, self-control), in-depth understanding of the scripture (deep understanding of the Bhagawadgita, deep understanding of the Sarasamuschaya), The Role of Hinduism in science, technology, and art (Hinduism benefits in science and technology in accordance with each department, benefit / the role of Hinduism in the arts), Cohesion and community's prosperity /independence (Benefits of unity in the religious plurality, independent community (kerthajagathita) as a common goal, Tri Pitakarana), Culture as an expression of Hindu religious practice, Contribution to the Hindu religion teachings in the political life of nation and country, laws and the enforcement of justice, Awareness of and obeying the Rita / Dharma.

BUDDHIST STUDIES
UIGE600014/UIGE610009
2 SKS

Syllabus :

Almighty God and the God Study (Faith and piety, Divine Philosophy/Theology), Human (Human Nature, Human Dignity, Human Responsibility), Moral (Implementation of Faith and Piety in everyday life), Science, Technology and Art (Faith, Science and Charity as a unity, the Obligation to study and practice what you are taught, Responsibility for nature and environment), harmony between religion (religion is a blessing for all mankind, the essence of the religious plurality and togetherness), community (the role of religious society in creating a prosperous independent society, the responsibility of religious society in the realization of human rights and democracy), Culture (the responsibility of religious society in the realization of critical thinking (academic), work hard and fair), Politics (Religion contribution in the political life of nation and country), Law (Raise awareness to obey and follow God's law, the role of religion in the formulation and enforcement of law, the function of religion in the legal profession).

KONG HU CU STUDIES
UIGE600015/UIGE610010
2 SKS

Syllabus :

Course Syllabus of Faculty Subjects

CALCULUS 1
ENGE600001/ENGE610001
3 credits
Course Learning Outcomes:

Able to use the basic concepts of calculus related to -a function of one variable, the derivative and integration of the function of one variable in order to solve its applied problems.

Graduates Learning Outcomes:

Introduction, Functions and Limits, The Derivative, Applications of the Derivative, The Definite Integral, Applications of The Definte Integral, Transcendental Functions, Techniques of Integration, Indeterminate Forms and Improper Integrals.

Syllabus :

Introduction, Functions and Limits, The Derivative, Applications of the Derivative, The Definite Integral, Applications of The Definte Integral, Transcendental Functions, Techniques of Integration, Indeterminate Forms and Improper Integrals.

Prerequisite: None

Textbooks:

Main reference:
D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., Pearson, Prentice Hall, 2007.

Additional eferences:
1. George B. Thomas Jr., Thomas' Calculus Early Transcendental, 12th ed., Addison–Wesley Pearson, 2009.
2. Howard Anton, Calculus, 10th ed., John Wiley and Sons, 2012.

CALCULUS 2
ENGE600002/ENGE610002
3 SKS
Course Learning Outcomes:

Students are able to use the concepts of sequences, series, conic sections, and the basic concepts of calculus which involve the function of two or three variables to solve their applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :
Infinite sequences and infinite series, Test for convergence of positive series and alternating series, Power series and operation on operations, Taylor and MacLaurin series, Conic sections , Calculus in polar coordinates, Derivatives, limits, and continuity of multi-variables functions, Directional derivatives and gradients, Chain Rule, Tangent planes and Approximations, Lagrange multipliers. Double integrals in Cartesian coordinates and polar coordinates, triple integrals in Cartesian coordinates, cylindrical coordinates and spherical coordinates, Applications of double and triple Integral.

Prerequisite: Calculus 1

Textbooks:
1. D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., PEARSON, Prentice Hall, 2007.
2. Thomas, Calculus Thirteenth Edition Volume 2, Erlangga, 2019.

CALCULUS
ENGE600003/ENGE610003
4 SKS
Course Learning Outcomes:

Students are able to use the basic concepts of calculus involving functions of one to three variables to solve their applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :

Introduction, Functions and Limits, Derivatives, Derived Applications, Indeterminate Integral, Integral Applications, Infinite Row, and Series. Derivatives with many variables, Duplicate Integral (2 and 3), Duplicate Integral Application.

Prerequisite: None

Textbooks:

Main reference:
D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., Pearson, Prentice Hall, 2007.

Additional:

George B. Thomas Jr., Thomas' Calculus Early Transcendental, 12th ed., Addison – Wesley Pearson, 2009.

LINEAR ALGEBRA
ENGE600004/ENGE610004
4 SKS
Course Learning Outcomes:

Students are able to calculate linear system problems to solve engineering problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :

Linear Systems and matrix equations, Determinants, Euclid vector spaces, Common vector spaces, eigenvalues and eigenvectors, inner product spaces, Diagonalization and General Linear Transformation.

Prerequisite: None

Textbooks:
1. Elementary Linear Algebra, Howard Anton & Chris Rorres, 11th edition, 2014
2. Gilbert Strang, Introduction to linear algebra 3rd edition Wellesley Cambridge Press, 2003

MECHANICAL AND HEAT PHYSICS
ENGE600005 / ENGE610005
3 credits
Course Learning Outcomes:

Able to explain the basic concepts of mechanics and thermodynamics, and be able to apply them to understand natural phenomena and human engineering, including their applications.

Graduate Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus:

Units, Magnitudes and Vectors, Motion Along Straight Lines, Motion in Two and Three Dimensions, Newton's Laws of Motion, Applications of Newton's Laws, Kinetic Energy, and Work, Potential Energy and Energy Conservation, Center of Mass, Linear Momentum, Rotation, Rolling Motion, Torque, Angular Momentum, Oscillation, Mechanical and Sound Waves, Gravity, Statics and Elasticity, Fluid Mechanics, Temperature, Heat, Law I Thermodynamics, Ideal Gas and Kinetic Theory of Gas, Heat Engine, Entropy, and Law II Thermodynamics.

Prerequisite: none

Textbooks:
1. Halliday, Resnick, and Walker, Principles of Physics 10th Edition, Wiley, 2014.
2. Serway Jewett, Physics for Scientists and Engineers 9th Edition, Thomson Brooks / Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008

ELECTRICAL MAGNETIC, OPTICAL AND WAVE PHYSICS
ENGE600007 / ENGE610007
3 credits
Course Learning Outcomes:

Students are able to apply the basic concepts of electrical physics, magnetism, waves, and optics to solve problems in the engineering field.

Graduate Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus:

Unit, Magnitude, Vector, Electric Charge, Electric Field, Gauss Law, Electric Potential, Capacitance, Electric Current, Resistance, Direct Current, Magnetic Field Due to Electric Current, Magnetic Field Source, Induced GGL, Inductance, Alternating Current, Electromagnetic Waves, Light Properties and Propagation, Optical Geometry.

Prerequisite: none

Textbooks :
1. Halliday, Resnick, and Walker, Principles of Physics 9th Edition, Wiley, 2011.
2. Serway Jewett, Physics for Scientists and Engineers 9th Edition, Thomson Brooks / Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008.

BASIC CHEMISTRY
ENGE600009 / ENGE610009
2 credits
Course Learning Outcomes:

Students are able to analyze the principe of basic chemistry for application in engineering.

Graduates' Learning Outcomes:

Able to apply mathematics, science, and basic engineering to be used in solving complex engineering problems.

Syllabus:

Material and measurements, atoms, molecules and ions, stochiometry, water phase reactions and solution stochiometry, thermochemistry, chemical equilibrium, acid and base equilibrium, electrochemistry, chemical kinetics, and chemical applications.

Prerequisite: none

Textbooks :
1. Ralph H. Petrucci, General Chemistry: Principles and Modern Applications, 8th Ed. Prentice Hall Inc., New York, 2001.
2. John McMurry, Robert C. Fay, Chemistry (3rd ed.), Prentice Hall, 2001.
3. Raymond Chang, Williams College, Chemistry (7th ed.), McGraw-Hill, 2003.

ENGINEERING ECONOMY

ENGE600011 / ENGE610011
3 credits
Course Learning Outcomes:

Students are able to analyze the economic and financial feasibility of making economic practice decisions.

Graduate Learning Outcomes:

Able to apply the principles of technical management and decision making based on economic considerations, in individual and group, as well as in project management.

Syllabus:

Introduction to Engineering Economics, Time Value of Money, Combining Factors, Interest Rates, Money Worth Analysis, Rate of Return Analysis, Effects of Inflation, Benefit Cost & Break-Even Point Analysis, Sensitivity Analysis, Depreciation, Tax Analysis, Cost Estimation & Allocation, Capital Budgeting & Replacement Analysis.

Prerequisite:
1. Civil Engineering : -
2. Environmental Engineering : -
3. Naval Engineering : -
4. Industrial Engineering : must pass the introductory Economic course and have completed 38 credits
5. Chemical Engineering : -
6. Bioprocess Engineering : -

Textbooks:
1. Blank, Leland and Tarquin, Anthony. 2018. Engineering Economy 8th Ed. McGraw Hill.
2. Park, Chan S. 2016. Contemporary Engineering Economics 6th Ed. Pearson. Upper Saddle River.
3. White, Case and Pratt. 2012. Principles of Engineering Economic Analysis 6th ed. John Wiley and Sons.

STATISTICS AND PROBABILISTICS

ENGE600010 / ENGE610010
2 credits
Course Learning Outcomes:

Students are able to handle quantitative data/information starting from the descriptive stage (collection, organization, and presentation) to the inductive stage, which includes forecasting and drawing conclusions based on the relationship between variables for decision making.

Graduate Learning Outcomes:
1. Apply descriptive statistics and probability theory to data processing and serving
2. Apply probability distribution to data processing and serving
3. Apply the principles of sampling and estimation for decision making
4. Apply hypothesis test samples for decision making

Syllabus:

Introduction to Statistics for Engineering Studies, Probability Theory, Dasar Basic concepts and definitions, Distribution Probability, Sampling, Estimation, Hypothesis testing, Hypothesis test 1 sample at an average value, Regression

Prerequisite: none

Textbooks :
1. Harinaldi, Basic Principles of Statistical Engineering and Science, Erlangga, 2004
2. Montgomery, DC., And Runger, GC., Applied Statistics and Probability for Engineers, John Wiley Sons, 2002

HSE PROTECTION

ENGE600012 / ENGE610012
2 credits
Course Learning Outcomes:

Upon completion of this subject students are expected to be able to carried out hazard identification, and characterization, to propose appropriate methods for risk reduction and mitigation, and to design safety management system. The student is also expected to improve their awareness on industrial safety and health, and understanding on safety regulation framework and standards as well as environmental program.

Graduate Learning Outcomes:
1. Students are expected to understand safety, health and environmental aspect as an integral part of fundamental principal in engineering code of ethics.
2. Students are expected to be able to carry out process of risk assessments by considering risk factors in the impact of hazards on people, facilities, and the surrounding community and environemt.
3. Students are expected to understand the regulatory framework and standard related to the stages of life cycle of machine, building structure, construction, and process.
4. Students are able to design and propose an effective hazard communication, management and engineering control, and risk mitigation through an engineering assignment project.
5. Students are able to identify the knowledge required to perform risk assesment, investigation and design improvement through a multidisiplinary case of incident and accident.

Syllabus:

Introduction to SHE Regulation and Standards, SHE Perception (Risk and Environment), Identification, Assessment and Management, Construction, machinery and Noise hazards, Process safety hazard and analysis technique, Fire and explosion hazard, Electrical hazard, Toxicology in the Workplace, Ergonomy Aspect, Hazard communication to employees, Environmental Protection, Case studies, Safety Health and Environment audits.

Prerequisite: none

Textbooks :
1. Charles A. Wentz, Safety, Health and Environmental Protection, McGraw Hill, 1998.
2. Asfahl, C.R., Rieske, D. W., Sixth Edition Industrial Safety and Health Management, Pearson Education, Inc., 2010.
3. United Kingdom - Health and Safety Executive, http://www.hse.gov.uk/
4. National laws and regulations related to the K3 Management System and the Environment.
5. Related Journal (http://www.journals.elsevier.com/safety-science/) etc, related standards and publications

Course Syllabus of Metallurgical and Material Engineering Subjects

Engineering Drawing
ENMT601001
2 credits
Syllabus:

Illustration: Function and beneft of Engineering Drawing; Measurement and Evaluation; Introduction to drawing equipment; Basic definition of geometric, paper format, draw regulation, line, feld, line confguration, basic geometric form; Visualization geometric: Skew projection and isometric, function and line types, confguration geometric form; Orthogonal Projection: Projection standard, viewing concept, width display principle; Advanced orthogonal projection: Circle region concept, special region concecpt, trimming concept, display width, refraction

Prerequisite: -

References:
1. ISO 1101, Technical Drawings, International Organization for Standardization.
2. A.W. Boundy, Engineering Drawing , McGrawHill Book Company
3. Colin Simmons & Dennis Maguire, Manual of Engineering Drawing, Edward Arnold
4. Warren J. Luzadder, Fundamentals of Engineering Drawing, Prentice-Hall, Inc.
5. Giesecke-Mitchell-Spencer-Hill-Dygdon-Novak, Technical Drawing, Prentice Hall Inc.

Introduction to Engineering Materials
ENMT601002
2 credits
Syllabus:

(1) Types of engineering materials and their applications; (2) Structures of engineering materials; (3) Properties of material; (4) Manufacturing and Processing of Metallic Materials; (5) Steel and iron: production and properties; (6) Aluminium: production and properties;(7) Other non-ferrous alloys: production and properties; (8) Polymer: processing and properties; (9) Ceramic: processing and properties; (10) Composite: processing and properties

Prerequisite: -

References:
1. Bondan T. Sofyan, Pengantar Material Teknik, Penerbit Salemba Teknika, 2010
2. W.D. Callister, Materials Science and Engineering: An Introduction, 6th ed., John Wiley & Sons, 2003
3. William F. Smith, Introduction to Materials Science and Engineering

Basic Chemistry Laboratory
ENMT601003
1 credits
Syllabus:

Physical and chemical properties; Separation and purification of substances; Identification of alkaline metal ions, alkaline earth, ammonium, sulfate, iodide, bromide and nitrate; Acid-base titration; Metal and acid reactions; Crystal water.

Prerequisite: Basic Chemistry

References:
Basic Chemistry Laboratory Module

Materials Physics
ENMT602004 1
2 credits
Syllabus:

Introduction to crystal, crystal lattice, Bravais lattice, Miller index, crystal projections / stereography, Wulff Net, crystal symmetry, crystal defects

Prerequisite: -

References:
1. Borchardt-Ott, W.; Crystallography; Springer; 1995
2. McKie, D. and McKie, C.; Essential of Crystallography; Blackwek Scientific; 1986
3. William D Callister; Materials Science and Engineering, an Introduction; john Wiley and Sons; 2004
4. Robert W Cahn and Peter Haasen; Physical Metallurgy; 1996

Statics and Mechanics of Materials
ENMT602005
3 credits
Syllabus:

Basic principle in statics and mechanis of materials, basic procedures, scalar and vectors, addition and operations, vector products, force vector, moment, cross product. Equivalent system, moment couple. Equilibrium mechanics, equilibrium conditions, free-body diagram. Simple trusses, joint method, zero-force member, section methods, frame and machine. Center of mass and gravitations, inertia moment, Parallel axis theorem, Center of mass and inertia moment of composite. Internal loading of a structure member, moment and shear diagram, relation of distributed loading, shear and moment. Stress concept, Normal stress, allowes stress, simple connection, deformation and strain. Stress and strain diagram, stress strain behvavior in ductile and brittle materials. Hooke law, strain energi and Poisson ratio. Saint Vernon principle, elastic deformation. Superposition principe. Thermal stress, crcluar shaft torsion deformation. Power transmission. Twist angle. Bending deformation in straight member, flexure formula, assymetrical bending, shear formula, stress shear for column, pressure in thin walled vessel. Stress plane transformation, Mohr cycle. Column and Buckling design. Critical loading. Inelastic Buckling.

Prerequisite: -

References:
1. Hibbeler, Russel C., Engineering mechanics,statics, 8th Ed., Macmillan Publishing Company,Inc.
2. Hibbeler, Russel C., Mechanical of Materials,Prentice Hall International Inc., 1997
3. Ferdinant L. Singer, Ilmu Kekuatan Bahan, Penerbit Erlangga, 1981
4. Beer, F.P. and Johston, E.R., Mechanics of Materials, McGraw-Hill, 1983

Thermodynamics of Materials
ENMT602006
3 credits

Syllabus:

Equilibrium of reaction in component systems .Basic principle in thermodynamics of materials, zeroth law of thermodynamics, first law of thermodynamics, second law of thermodynamics and third law of thermodynamics. Enthalpy, entropy and free energy concepts. Thermodynamics balance and materials balance. Heat balance. Thermodynamics phase equilibrium, phase equilibrium in one component system. Free energy as a function of temperature and pressure. Equilibrium of vapor phase and condensation phase. Gas behavior and gases reactions. Solvent phenomena, Raoul't law, Henry law, Gibb-Duhem equation, solvent free energy, regular solvent. Equilibrium of reaction in component systems, condensated solvent, equilibrium reaction in component system with condensated solvent. Phase diagrams.

Prerequisite: -

References:

1. David . R. Gaskell, Introduction to Metallurgcal Thermodynamics, 4td. ed., CRC. Taylor and Francis Groups , 2008.
2. D, V. Ragone , "Thermodynamics of Materials " Vol 1 and 2 , John Wiley &Sons New York, 1995.

Electro-Chemistry

ENMT603007
3 credits
Syllabus:

Basic concepts and applications of electrochemistry, and conductivity solution, Faraday's law, and their application. Elektrode electrochemical cell (definition, potential, equation Nerst, electrical double layer, the polarization, the measurement of potential, free energy and electrode potential, equilibrium potential), the reference electrode,Construction Pourbaix diagram and its application. Electrochemical kinetics, electrode reaction speed, mixed potential theory, Evans-diagram, the mixed-potential diagram

Prerequisite: -

References:

1. J.O.M. Bockris and A.K.N. Reddy; Modern Electrochemistry vol 1 & 2; Penum Rosetta Edition; 1997
2. Bard Faulkner and Larry R; Electrochemical Methods Fundamental and Application; Willey; 1980
3. Piron; The Electrochemistry of Corrosion; NACE; 1991

Materials Physics 2

ENMT603008
3 credits
Syllabus:

Dislocation theory: screw and edge, solid solution: substitution and interstition (impurities and alloys), plastic and elastic deformation theories, mechanical and physical properties of metals: strength, hardness, toughness, wear , fatigue, creep, basic of fracture mechanics. Case study.

Prerequisite: -

References:

1. Robert W Cahn and Peter Haasen; Physical Metallurgy; 1996
2. D. Hull and D.J. Bacon; Introduction to Disclocation 4th Ed.; Butterworth-Heinman; 2001
3. Smallman R.E. and Bishop R.J.; Metal and Materials; Butterworth-Heinmann; 1995

Characterization of Materials

ENMT603009
3 credits
Syllabus:

Introduction to material testing, Review of mechanical behavior of materials, Data analysis and presentation of test results, Testing procedures, Testing machine and instruments, Standardization of materials testing, Destructive testing (tensile, compression, shear, fatigue, stress relaxation, and wear), Non-destructive (visual, penetrant, ultrasonic, radiography, eddy current and magnetic particle). Techniques of microstructure analysis, Phase formation and general characteristic of material structures, Microstructure of steel; stable and metastable phases and the formation and mechanism, Microstructure of non-ferrous alloys; aluminum, copper, titanium, Macrostructure, Sampling techniques, Samples preparation, Observation techniques with optical and electron microscopes, Special measurements; micro-hardness, coating thickness, roughness, Quantitative metallography; grain size, volume fraction of phases and precipitates, electron interaction with samples, advanced microstructural analysis: SEM, TEM, FIB, EBSD, XRD, XRF, OES.

Prerequisite: -

References:

1. Davis H.E., G.E. Troxell, G.F.W. Hauck; The Testing of Engineering Materials; Mc Graw-Hill; 1982
2. ASM; Mechanical Testing of Metal; 1983
3. Lous Cartz, Non Destructive Testing; ASM International; 1995
4. Vernon john; Testing of Materials; 1992
5. Andreas Ohsner and Holm Altenbach; Properties and Characterization of Modern Materials; 2017
6. Callister, William D. 2007. Materials Science and Engineering, John Wiley & Sons.
7. Der Voort, Van. 1984. Metallography Principles and Practice, McGraw-Hill Book Company.
8. Goodnew, Peter J; Humphrey, John. 2000. Electron Microscopy and Analysis, CRC Press
9. Petzow, Gunter. 1991. Metallographic Etching, University Microfilms.
10. ASM Handbook Vol 9 – Metallography and Microstructures, ASM International
11. Zhang, Sam; Li, Lin; Kumar, Ashok. 2008. Materials Characterization Techniques, CRC Press.
12. Schwartz, A.J.; Kumar, M.; Adams, B.L.; Field, D.P. 2009. Electron Backscatter Diffraction in Materials Science, Springer US

Chemistry Materials

ENMT603010
2 credits
Syllabus:

Basic principles of atomic and molecular bonding, material classification, solid structure: crystalline, amorphous. Introduction to the chemistry of metals, polymers, ceramics, composites, semiconductors and advanced materials. Classification and nomenclature of organic compounds; type of organic reaction; polymer structure, polymerization, and molecular weight; polymer type. Overview of the structure and physiochemical properties of materials, concept of material analysis (qualitative and qualitative), principles of instrumentation analysis (theory, principles of tools and work, interpretation of outputs and their use); methods of separation using chromatography; spectroscopy (mass, UV / VIS, infrared-FTIR, emissions, XRF and spark emission, and some other sophisticated equipments; thermal (TGA, DTA / DSC, MFI and Vicat), and strategy in characterizing materials.

Prerequisite: -

References:

1. Ralph J. Fessenden and Joan S. Fessenden. Organic Chem-

istry, 5th edition, 1994, Brooks Cole: Pacific Grove. CA
2. G. Challa, Polymer Chemistry – An Introduction, 1993, Ellis Horwood Limited series in Polymer Science, UK

Numerical Computation
ENMT603011
3 credits
Syllabus:

Introduction to numerical methods, type of number, type of data, basic principles of computing, mathematical models. Type of errors, accuracy, propagation of errors, precision. Non linear equation problems, Bisection method, Regula-False method, Newton Raphson method and Secant method. Linear equation systems, Gauss method, Gauss-Jordan method and Gauss Seidel method. Ordinary differential equations, Euler Methods, Eigen systems, Runge Kutta method. Numerical integration methods, Trapezoid methods, Simpson 1/3, Simpson 3/8. Advanced computational methods, Stochastic methods, Dynamic Particle Methods. Nano Scale Computations. Application of numerical methods in metallurgical and materials engineering problems: Fluid motions, Heat Transfers, Grain Boundaries, Solidification, Band Gap Calculation, Strenght of materials, Partcile Dynamics.

Prerequisite: -

References:
1. Applied Numerical Methods with Matlab for Engineers and Scientists, Steven C. Chapra, Third Edition, McGraw-Hill, 2012.
2. Numerical and Analytical Methods with MATLAB® for Engineers and Scientists, William Bober, CRC Press, 2014.
3. Numerical Methods in Engineering with MATLAB, Jaan Kiusalaas, Cambrideg University Press, 2005.

Introduction to Fluid Mechanics and Heat Transfer
ENMT603012
2 credits
Syllabus:

Fluid flow concept, laminar flow, momentum conservation, turbulent flow, energy balance, fluid flow application, transient heat flow & heat transfer: conduction, convection, and radiation heat transfer.

Prerequisite: -

References:
1. Porer D.R. and Geiger G.H.; Transport Phenomena in Material Processing; Addison Wesley; 1998
2. Sindo Kou; transport Phenomena and Material Processing; John Wiley; 1996

Data Analysis and Scientific Writing
ENMT604013 /ENMT614013
2 credits
Syllabus:

Scientific understanding, research methodology, problem formulation, hypothesis, literature review, data collection and processing, preparation of research proposals and presentation of scientific papers. Descriptive statistics, probability, probability distribution, random variable, descrete probability distribution, continuous probability distribution, sampling distribution, estimation, one and two sample test of hypothesis, simple linear regression, applied statistics in engineering.

Prerequisite: -

References:
1. Devore, J.L., Probability and Statistics for Engineering and The Sciences (5th Ed.), Duxbury, 2000
2. Barnes J.W, Statistical Analysis for Engineers and Scientists, a Computer- Based Approach, McGraw-Hill, 1994
3. Donald H.S, Statistics, A First Course (6thEd), McGraw-Hill, 2001
4. Walpole, Ronald E, Probability & Statistics for Engineers & Scientist, 8th Ed, Pearson Prentice Hall, 2007.
5. Kothari, C.R., Research Methodology, Methods and Techniques, New Age International (P) Ltd., Publishers, New Delhi, 2004
6. Cargill, M. and O'Connor, P., Writing Scientific Research Articles, Strategy and Steps, Wiley-Blackwell, Hoboken, 2009

Materials Physics 3
ENMT604013
3 credits
Syllabus:

Phase rules, binary phase diagram, free energy diagram, introduction to ternary phase diagram, introduction to phase transformation and interface, solidification process, homogen and heterogen nucleation, nucleation rate, alloy solidification process, diffusional transformation, age hardening, eutectic transformation, non-diffusional transformation, martensitic transformation.

Prerequisite: Termodynamics of Materials, Introduction to Fluid Mechanics

References:
1. Porter, D. A and Easterling, K.E, Phase Transformation in Metals and Alloys, 3rd. ed., CRC Press, 2009.
2. ASM, ASM Handbook Vol. 3, Alloy Phase Diagram, Ohio, 2010
3. R.W. Cahn and P. Haasen (eds), Physical Metallurgy, North-Holland, 1996
4. M. Flemings, Solidification Processing, McGraw Hill, New York, 1974

Corrosion & Protection of Metals
ENMT604015
3 credits
Syllabus:
Principles of corrosion, kinetics of corrosion, polarization, passivation, measurement of corrosion rate, metallurgical aspects, corrosion tests, forms of corrosion, high temperature corrosion, cathodic protection, anodic protection, coating, inhibition, materials selection and design, monitoring and inspection, analysis of corrosion driven-damage, standards related to corrosion

Prerequisite: Electrochemistry

References:
1. Jones DA; Principles & Prevention of Corrosion; Mc Milan Pubs; 1992
2. Fontana; Corrosion Engineerng 3rd Ed; 1992
3. Roberge Pierre R; Handbook of Corrosion Engineerin; Mc Graw-Hill; 1999

Polymer Materials
ENMT604016
3 credits
Syllabus:

Chemical bonding, reactive species in organic chemistry. The classification of organic compounds. Organic compunds nomeclature. Isomer and assymmetric configuration in organic chemistry, conjugation in organic chemistry. Nucleophilic SN1 and SN2 substitution reaction. Electropile and Nucleophile addition reaction. Other reactions in organic chemistry. Introductory of polymer materials. Polymer chain configuration and type of polymers. Relation between polymer chain structure and its properties. Reactivity of polymer chains. Polymerization reaction of substitution and condensation.

Prerequisite: -

References:

1. G. Challa, Polymer Chemistry – An Introduction, 1993, Ellis Horwood Limited series in Polymer Science, UK
2. Young R.J. and Lovell P.A., Introduction to Polymers, 2nd edition, 1997, Chapman & Hall, Cambridge, UK
3. Cheremisinoff N.P., Polymer Characterization – Laboratory Techniques and Analysis, 1996, Noyes Publication, New Jersey, USA
4. Morton-Jones D.H., Polymer Processing, 1994, Chapman & Hall, UK

Mineral Processing
ENMT604017
3 credits
Syllabus:

Understanding mineralogy, classifcation of minerals, mineral properties, mineral that has economic value. Terminology and basic concepts of processing mineral / ore, potential sources of mineral / ore that can be processed in a technically and economically, the processes of size reduction (comminution): The process of crushing, screening, grinding, the classifcation process, process of separation / concentration: Gravity concentration: Concentration Heavy Jigging Flowing Film, Media Separation, Flotation process, Magnetic Separation, High Tension Separation, Dewatering and Thickening process

Prerequisite: Materials Physics 1

References:

1. Sorell. The Rocks and Minerals of the World, Collins, 1982
2. Hulburt, Jr. Manual of Mineralogy, John Willey and Sons, 1979
3. B.A. Wills, Mineral Processing Technology, 4th ed., Pergamon Press, 1988
4. Gilchrist J.D., Extraction Metallurgy, Pergamon Press, London, 1980
5. Gill C.B., Non Ferrous Extractive Metallurgy, John Wiley and Sons Inc., 1980

Heat Treatment & Surface Engineering

ENMT605022
3 credits
Syllabus:

Definition of heat treatment, phase transformation and microstructure, TTT and CCT diagram, the influence of heating and cooling rate, stable and metastable microstructure, hardenability, the influence of alloying element, hardening, softening, temper brittleness, distortion and its prevention, carburization, nitro-carburizing, nitriding, boronizing, non-ferrous heat treatment, surface hardening, surface deposition, various heat-treating furnace and its atmosphere, deviation in heat treatment process, special heat treatment, case study of heat treatment and surface engineering

Prerequisite: Materials Physic 3

References:

1. Bill Bryson; Heat Treatment Selection and Application of Tool Steel; Hanser Gardner Publication; 1997
2. ASM Practical Heat treatting; ASM International; 2006
3. ASM Handbook Vol. 4; ASM International; 1991

Materials Characterization Laboratory
ENMT604018
1 credits
Syllabus:

Tensile, hardness, wear and impact testing for some technical materials, non-destructive testing (penetrant and magnetic particles), metallographic sample preparation (cutting, sanding, polishing and etching techniques), microstructure analysis of metal structures (ferrous and non-ferrous) with optical microscope

Prerequisite: Characterization of Materials

References:

Materials Characterization Laboratory Module

Extractive Metallurgy
ENMT605020
4 credits
Syllabus:

Basic principles of extractive metallurgy (pyrometallurgy, hydrometallurgy and electrometallurgy). Process/treatment process of ore to be extracted. Leaching method of oxide and sulfide ores, Bayer process, Al, Au leaching by cyanidation (Leaching; precipitation techniques; ion exchange; solvent extraction; reverse osmosis). Electrometallurgy (Electro winning and electro refining). Molten salt electro winning. Hall process. Electro winning of Mg, Ti. Secondary metals. Obtaining metals from scrap and secondary sources by using pyro-, hydro-, and electrometallurgy. Pyrometallurgy, mineral separation, slag, blast furnace, raw materials, reactions, material balance, iron ore, roasting, smelting, refining of Sn, Ni, Cu, Zn, Pb.

Prerequisite: Mineral Processing

References:

1. Pehlke, Robert D., Unit Processes in Extractive Metallurgy, Elsevier Pub., New York, 1973
2. J. J. Moore., Chemical Metallurgy, Butterworth- Heinemann, London, 1981
3. J. D. Gilchrist., Extractive Metallurgy, Pergamon., 2nd ed., Oxford, Pergamon Press, 1980

Iron & Steel Making
ENMT605021
2 credits
Syllabus:

Kinetics and thermodynamics, blast furnace, direct reduction, desulphurization and dephosporization process, deoxidation, degassig, BOF steel making, EAF steel making, secondary metallurgy, continuous casting

Prerequisite: Mineral Processing

References:

1. John Peacey and Bill Davenport, The Iron Blast Furnace, Pergamon, 1979
2. Geerdes et al, Modern Blast furnace Ironmaking, an Introduction, 2009
3. A.Biswas, Principles of Blast Furnace Ironmaking, Theory and Practice, 1981
4. Babich et al, iron Making, RWTH Aachen, 2008
5. W.R. Irving: Continous Casting of Steels, Institute of Metals, 1993

Materials Selection
ENMT605022/ENMT605122
2 credits
Syllabus:

Classification of technical materials, factors and systematics of design and material selection, material selection criteria, material property chart and performance index, design for corrosion resistance, design for the use of high temperature materials and design for wear and fatigue resistant materials, design for plastics and composites as well as the selection of various types of carbon steel, cast iron and alloy steels (tool steels, stainless steels, heat resistant steels, wear-resistant steels, selection of super alloys (super alloys), and case studies on material selection.

Prerequisite: Materials Characterization, Materials Physic 2, Materials Physic 3

References:

1. Ashby, M. F, Materials Selection in Mechanical Design, 2nd ed., Cambridge Uni. Press., Oxford, 1999

Materials Joining

ENMT606028
3 credits
Syllabus:

Arc welding methods: SMAW, FCAW, SAW, ESW, GMAW, PAW. Electric resistance methods: spot welding, Seam welding, Projection welding, Flash welding. Pressure welding methods: Cold butt welding, Explosive welding, Diffusion welding, Forge welding, Ultrasonic welding, Friction welding. Other welding methods: Oxy-Acetylene welding, Thermite welding, Electron Beam welding, Laser Beam welding, Underwater welding, Soldering, Brazing. Welding design, standard and calculation (WPS) AWS, ASME, EN. Welding metallurgy for carbon steel, alloy steel, cast iron, non ferrous materials. Welding defects. Polymer joining: thermal bonding, cementing, adhesive bonding and mechanical fastening.

Prerequisite: Characterization of Materials, Materials Physics 3

References:

1. Larry F. Jeffus; Welding Principles and Applications
2. Kou; Welding Metallurgy 2nd Edition; John Wiley and Sons; 2005
3. Easterling; Introduction to Physical Metallurgy of Welding; Butterworth and Co; 1992
4. David A. Grewell; Plastics and Composites Welding Handbook
5. Alphonsus V.V. pocius; Adhesion and Adhesive Technology
6. Winarto & Anis; Lecture notes; 2007

Metal Manufacturing Process

ENMT605023
4 credits
Syllabus:

The forming of metals as a part of design process and manufacture; fundamentals of metal casting (mould, molten metal, solidification), mould (sand, ceramic, metal), pouring system (pattern, riser, pressure and unpressure, chill) and its simulation, solidification of cast iron and aluminum, liquid treatment for ferrous metals (inoculation, Mg treatment) and nonferrous (modifier, grain refiner), various methods of casting, casting defect; common principle of solid forming of a metal, techniques of metal forming through: pressing, forging, rolling, extrusion, wire drawing, sheet metal forming; thermo-mechanical processing (TMP). General principle of powder metallurgy, powder fabrication and mechanism of powder forming, powder characteristics and characterization, mechanical alloying, pre-compaction process, compaction, precursor characteristic, sintering and powder consolidation, full density processing, sintering equipment and related aspects, application of powder metallurgy products. Laboratory: (1) Sand particle size distribution, water content calculation, additive substance (bentonite) content in mould, sand flowablity, relation of water and additive content in sand with permeability, shear and compressive strength of sand, (2) utilization of simulation software in calculation and design of casting, (3) Design of inlet and riser, mould making from patterns, making of the core of the mould, melting and pouring of molten metal to the mould, analysis of casting defect, analysis of casting product related to the alloying element and casting process.

Prerequisite: Materials Physic 3

References:

1. Heine, R. W. et.al., Principles of Metal Casting, McGraw-Hill Pub., New Delhi, 1986
2. Surdia, T. Teknologi Pengecoran Logam, P. Paramita, 1985
3. John Campbell, Castings, Second Edition, Elsevier Butterworth-Heinemann, 2004

Polymer Manufacturing Process

ENMT605024
3 credits
Syllabus:

Basic principle and characteristics of polymer materials, as well as the fabrication methods of polymer raw materials into ready-to-use products, relationship between structure and behavior of polymer molecules; thermal, chemical, optical, and electrical properties of polymer materials; polymer rheology; fabrication process (formulation, continuous and discontinuous formation, and product finalization) of thermoplastic, thermoset, and rubber; and study case of polymer product technology on packaging (rigid and flexible), automotive, electronics, and construction applications.

Prerequisite: Polymer Materials

References:

1. G. Challa, Polymer Chemistry – An Introduction, 1993, Ellis Horwood Limited series in Polymer Science, UK
2. Young R.J. and Lovell P.A., Introduction to Polymers, 2nd edition, 1997, Chapman & Hall, Cambridge, UK
3. Cheremisinoff N.P., Polymer Characterization – Laboratory Techniques and Analysis, 1996, Noyes Publication, New Jersey, USA
4. Morton-Jones D.H., Polymer Processing, 1994, Chapman & Hall, UK

Corrosion Laboratory

ENMT605025
1 credits
Syllabus:

Corrosion cells, Measurement of the Corrosion Potential of Several Metals, Stainless steel Polarization, Cathodic Protection, Surface Engineering.

Prerequisite: Corrosion & Protection of Metals

References:

Corrosion Laboratory Module

Failure Analysis

ENMT606027 /ENMT616027
1 credits
Syllabus:

Aspects of failure engineering and its analysis, sources/factors contributing the material's failure, explanation of failure factors, types of fractures, stress system and residual stress, theories of fracture mechanics and introduction to the risk-based inspection, failure due to: fatigue, creep, wear, brittleness, heat treatment, residual stress, corrosion and environment, case study.

Prerequisite: Materials Selection

References:

1. Wulpi, D. J., Understanding How Components Fail, ASM, 1998

2. Charlie, R. B and Ashok, C., Metallurgical Failure Analysis, McGraw-Hill Inc., 1993
3. French, D. N., Metallurgical Failure in Fossil Fired Boilers, John Wiley & Sons, 1983

Engineering Design of Products

ENMT607034
4 credits
Syllabus:

Introduction to Engineering Design, total design activity, group dynamics and design management, problem identifcation and design specifcation, creativity and the conception of design, modeling, optimallisation, materials and process selection, design communication and presentation.

Prerequisite:

Metal Manufacturing Process, Polymer Manufacturing Process, Ceramics Technology, Composite Technology, Materials Selection

References:

1. Saptono, Rahmat. First Lecture on Engineering Design. Universitas Indonesia, 2006
2. Hurst, Kenneth S., Engineering Design Principles, 1st Ed., Arnold, New York, 1999
3. Pugh, Stuart, Total Design, Integrated Methods for Successful Product Engineering., Addison-Wesley Publisher Ltd., Edinburgh 1991
4. Dym, Clive L and Patrick Little, Engineering Design, A-Project-Based Introduction, John Wiley and Sons, Inc., 2000
5. Dieter, G. E., Engineering Design, A Material and Processing Approach, 2nd ed., McGraw Hill., 1991
6. Ashby, M. F, Materials Selection in Mechanical Design, 2nd ed., Cambridge Uni. Press., Oxford, 1999

Ceramics Technology

ENMT606029
3 credits
Syllabus:

Introduction to ceramics (general), crystal structure, glass structure, phase diagrams, phase transformations. Properties of ceramics: thermal, optical, mechanical, electrical and magnetic fields, as well as the dielectric nature. Manufacture of ceramic technology and applications: conventional ceramic (aluminum-silicate; clay, glaze); cement and concrete; glass and advanced ceramics (advanced ceramics). The processes for modern ceramics, ceramic thin film, ceramic for field application of mechanical, electronic, optical and magnetic. -Based ceramic matrix composites. Refractory ceramics. Refractory raw materials, types of refractories: refractory system Alumininum - silica, silica refractories, refractory magnesite, chromite refractories, refractory carbon, special refractories. Manufacture of refractories, the use of refractory metals in the industry and others, as well as the failure mechanism of refractory.

Prerequisite: Materials Physics 3

References:

1. Kingery et al, Introduction to Ceramics, 2nd ed., John Wiley & Sons., 1976
2. Hummel AF, Phase Equilibria in Ceramic Systems, Marcel Dekker Inc, 1984

Composite Technology

ENMT606030
3 credits
Syllabus:

The concept, definition and clarification of the composite, matrix and reinforcement type for composites, metal matrix composite, polymer matrix composite, ceramic matrix composite, fiber composite nature. Reinforced fibers and Whiskers, the rule of mixtures, the interface in composite materials, interfacial area, interfacial wettability, interfacial bonding.

Prerequisite: Polymer Materials

References:

1. Hull, D., An Introdution to composite Materials, Cambridge Uni. Press, 1981
2. Mattew, F.L. and R.D. Rawlings, Composite Materials: Engineering and Science, Chapman Hall, 1993
3. Bryan Harris, Engineering Composites Materials, 2nd Eddtion, Institute of Materials Communication Ltd, 1999

Metals Manufacturing Laboratory

ENMT606031
1 credits
Syllabus:

Sand size distribution, calculation of water content, content of additives (bentonite) in molds, sand flowability, relationship between water content and additives in sand with permaebility, shear strength and strength of sand pressure, use of simulation software for calculation and casting design, design making inlet systems and enhancers, making sand molds from patterns, making core molds, the process of melting and pouring molten metal into molds, analysis of casting defects, analysis of casting products related to alloying elements and casting processes. Metal Transformation Module: Solid cylindrical metal stressing, Sheet metal rolling, Sheet metal formation includes non-simulative sheet testing (tensile testing for n and r values) and sheet simulative testing (sheet stretching and pulling, dome height limit (LDH) and ratio limits withdrawal (LDR).

Prerequisite: Metal Manufacturing Process

References:
Metals Manufacturing Laboratory Module

Extractive Metallurgy Laboratory

ENMT606032
1 credits
Syllabus:

Metal extraction testing and electrometallurgical (e.g. Electroplating, froth flotation)

Prerequisite: Extractive Metallurgy

References:
Extractive Metallurgy Laboratory Module

Technopreneurship

ENMT607035
2 credits
Syllabus:

Introduction to technopreneurship and business, business idea and opportunity identification, business idea feasibility, development of effective business model, writing of business plan, management of marketing, operational, human resources and finance.

Prerequisite: Minimum of 100 credits obtained

References:

1. Simmons, J. & Spinelli, S. (2012). "New Venture Creation: Entrepreneurship for the 21st Century", (9th ed.). New York: McGraw-Hill Irwin
2. Barringer, B. R., & Ireland, R. D. (2010). Entrepreneurship: Successfully launching new ventures. Upper Saddle River, N.J: Prentice Hall.
3. Osterwalder, A., Pigneur, Y., & Clark, T. (2010). Business model generation: A handbook for visionaries, game

changers, and challengers. Hoboken, NJ: Wiley.
4. William, B. K., Sawyer, S. C., Berston, S., (2013). Business: A Practical Introduction. Upper Saddle River, N.J: Prentice Hall

Internship
ENMT607036
2 credits
Syllabus:

A minimum of one month of in the job training. The result of internship is submitted as written report and presented before the job training assembly

Prerequisite: Minimum of 100 credits obtained

References:

Seminar
ENMT607037
1 credits
Syllabus:

Final assignment writing guide including initial research, abstract writing guide, research methodology, type of references, discussion, also conclusion. To make scientifc paper from existing fnal report which then be presented according to certain journal term or final assignment proposal presentation.

Prerequisite: Minimum of 105 credits obtained

References: -

Final Project
ENMT607038
4 credits
Syllabus:

Implementation/application of various lectures taken by students on integration in a research to solve a problem in metallurgy and material engineering feld. The research result is presented in a form of scientifc report and presented in front of the judging lecturers.

Prerequisite: Minimum of 125 credits obtained

References: -

Elective Courses

Special Alloyed Steels
ENMT607939
2 credits
Syllabus:

Classifcation and utilisation of special steels and super alloys, alloying element and microstructure of alloy steels and super alloys, stainless steels (ferritic, austenitic, duplex, martensitic, precipitation-hardening stainelss steels), heat resistant steels, wear resistant steels, tool steels, other alloy steels, super alloys (Co- and Ni- based alloys)

Prerequisite: Iron & Steel Making

References:
1. J.R. Davis, Stainless Steel, ASM Specialty Hand Book, 1994
2. J.R. Davis, Heat Resistant Materials, ASM Specialty Hand-Book, 1997
3. Tool Steel Handbook, Fifth Edition, Geoge Roberts, ASM, 1998
4. E.F. Bradley, Super Alloy A Technical Guide, ASM International, 1998

Biomaterial
ENMT607940
2 credits
Syllabus:

Overview of Biomaterials and Their Use in Medical Devices, Physical and Mechanical Requirements for Medical Device Materials, Metallic Materials, Corrosion of Metallic Implants and Prosthetic Devices, Failure Analysis of Metallic Orthopedic Implants, Ceramic Materials, Polymeric Materials, Adhesives, Coatings, Biomaterials for Dental Applications, Tarnish and Corrosion of Dental Alloys, Friction and Wear of Dental Materials

Prerequisite: Corrosion & Protection of Metals

References:
1. J. Park R.S. Lakes, Biomaterials: An Introduction 3rd Edition, Springer, NY, 2007
2. J.R. Davis, Handbook of Materials for Medical Devices, ASM International , Metal Park OH, 2003
3. S. Shang, L. Woo, Selecting Materials for Medical Product in Handbook of Materials Selection Edited by Myer Kutz, John Wiley and Sons, NY, 2002.

Engineering Ethics
ENMT607941
2 credits
Syllabus:

Ethical theories and tools: basic ethical theories such as consequentialism, deontology, and virtue ethics, but also more modern theories such as discourse ethics, feminist ethics as well as theories about justice and equal opportunities. Decision-making models and frameworks within engineering ethics.

Case Study: Analysis of examples of situations which engineers may encounter in their professional life with the help of the studied ethical theory. Interview with professionally active engineers on ethical issues they have encountered during their career

Prerequisite: -

References:
1. Seebauer, E.G. and Barry, R.L. Fundamental of Ethics for Scientists and Engineers (New York: Oxford University Press, 2001).
2. Martin, M.W. and R. Schinzinger. Ethics in Engineering. 4 th Edition. (McGrawHill, Inc., 2005).
3. Harris Jr., C.E., Pritchard, M.S., Rabins, M.J., Engineering Ethics, Concepts, and Cases: 4th edition (California: Wadsworth Learning, 2009).
4. Whitbeck, Caroline. Ethics in Engineering – Practice and Research: 2nd edition (Cambridge: Cambridge University Press, 2011).

High Temperature Corrosion
ENMT607943
2 credits
Syllabus:

Thermodynamics of metal oxidation reactions, Ellingham Diagram, Structure oxide (corrosion products) and non-stoichiometri stoichiometri, oxide-type and n-type p, PillingBedworth ratio, oxide growth mechanisms: diffusion and migration, the kinetics of oxide growth rate: Wagner-parabolic, logarithmic, linear, aspects of the morphology of the oxide layer (corrosion products), high temperature corrosion in specifc environments: salt melt (hot corrosion), boiler, carburizing / metal dusting, sulfdisasi and thermal cycling, high temperature corrosion protection method: material selection, high temperature resistant alloys, coating / surface treatment

Prerequisite: Corrosion & Protection of Metals

References:
1. N. Birks and G.H. Meier, "Introduction to High Temperature Oxidation of Metals", Cambridge University Press, 2006
2. D.John Young, "High Temperature Oxidation and Corrosion of Metals", Publisher: Elsevier Science, 2008.
3. Per Kofstad, "High Temperature Corrosion", Elsevier Applied Science, 1988

Polimer Compounding
ENMT607945
2 credits
Syllabus:

Introduction to polymers and their products. Processing-related polymer properties. Polymer rheological theory. Stages and types of machine processes of polymer products. Injection molding. Extrusion (blown film, callendering, blow molding and thermoforming). Composite (Reinforcing process. Laminating process)

Prerequisite: Polymer Materials

References:
1. Edward.A.Muccio, Plastic Processing Technology, ASM International, ISBN:9780871704948

Quality Management System
ENMT607946
2 credits
Syllabus:

General, process approach, relation to ISO 9004, adaptation with other system such health safety and environment management. The terms on quality management system are including; scope of implementation, regulating model, term and defnition, terms of documentation, management responsibility, resources management, product realization, performance measurement, analysis and monitoring and also enhancement of sustainable system including internal audit, prevention and correction action.

Prerequisite: Data Analysis and Scientific Writing

References:
1. ISO Standard 9000:2000 series including ISO 9000, 9001 and ISO 9004, ISO 19011

Rubber Technology
ENMT608958
2 credits
Syllabus:

Introduction to rubber, type and characteristics on raw materials and rubber prodcut, additives in rubber product, equipment and manufacturing process for rubber product, testing method for raw materials and rubber product, application and development of rubber product

Prerequisite: Polymer Manufacturing Process

References:
M.Morton, Rubber Technology, Springer, 1999

Special Processing and Assembly Technologies
ENMT607948
2 credits
Syllabus: Materials Selection

The importance of economy and technology in assembly manufacturing. Production technology and economic prerequisites for automatic as wellas manualassembly. Design technical issues related to assembly. Equipment and techniques used for different part operations in assembly. Production philosophy and assembly systems. Industrial robot technology related to flexible automatic assembly. Dissassembly.**Prerequisite:**

References:

Fundamentals of Modern Manufacturing: Materials, Processes, and Systems By Mikell P. Groove

General Apprenticeship
ENMT607949
2 credits
Syllabus:

Apprenticeship at an institution for at least 3 months. The results of the internship are presented in the form of a report and presented before the internship examination

Prerequisite: Minimum of 110 credits hours during the break

References: -

Risk Based-Inspection and Integritiy
ENMT807946/ENMT817946
3 credits
Syllabus:

Definition & Definition: Asset Integrity & Risk Based Inspection. Policy: Production Level Policy and Health, Safety & Environment (HSE) Considerations. Strategy / Prioritization: Based on Priority Scale. Program Planning: Program Planning. Hazard / Threat Identification: Identification of Potential Threats. Damage Mechanism: Damage Mechanism. Probability of Failure: Failure Opportunity. Consequence of Failure: Consequences of Failure. Asset Register: Naming Facilities / Equipment. Risk Assessment: Risk Assessment. Program Implementation: Program Implementation. Data Compilation-Evaluation-Interpretation: Compilation, Evaluation & Interpretation of Data. Corrective Actions & Recommendations: Corrective actions & Recommendations. Inspection Interval: Inspection time period. Inspection Methods: Inspection Methods. Inspection Scope: Inspection Scope. Inspection Work package: Inspection Work Details.

Prerequisite: -

References:
1. Chapter 008, Risk-Based Inspection Technique by Mohamed El-Reedy (Author) Publisher: Gulf Professional Publishing (17 July 2012) ASIN: B00DGSWO4S

Computational Materials
ENMT607942
2 credits
Syllabus:

Basic computational techniques: methods of solving linear equations, methods of solving differential equations and other methods, Other advanced computational methods: Monte carlo method, stochastic, metropolis. Computational domains in material engineering: the macro domain (FEM), the meso domain (coarse graining), molecular dynamics, the nanoscale domain (quantum mechanics approximation), the macro domain, finite element computing (FEM). Weak formulation: finite element node, mesh element, procedure. Linear interpolation function: parameter function and interpolation function. One-dimensional analysis. FEM continued. Two-dimensional analysis Three-dimensional problem Isoparametric element Solution and finite element equation, Galerkin Method. FEM examples on ABAQUS. Meso computation (phase field method). Phase field method, spinodal decomposition using the Cahn Hillard method. Thermodynamics and Thermodynamics are irreversible processes. Meso computation uses molecular dynamics. Nano Computing (Density Functional Theory) I & II

Prerequisite: Numerical Computation

References:

1. Olukeke Oluwole, Finite Element Modelling for Materials Engineers Using MATLAB, Springer, London 2011 .
2. LAMMPS Tutorials, https://icme.hpc.msstate.edu
3. Toulouse, Julien, Introduction to density-functional theory. " (2015)

Electronic Materials

ENMT807948/ENMT817948
3 credits
Syllabus:

The basic principles of semiconductor devices such as thermoelectric, piezoelectric, LED, solar cells. Basic integrated circuit process.

Prerequisite: -

References:

1. Gordon McComb, Electronics for Dummies
2. C. Hamaguchi, Basic Semiconductor Physics
3. B.G. Yacobi, Semiconductor Materials – An Introduction to Basic Principles
4. Stephen W. Fardo & Dale R. Patrick, Electricity and Electronic Fundamentals
5. William J. Greig, Integrated Circuit Packaging, Assembly and Interconnections
6. Vasilis F. Pavlidis and Eby G. Friedman, Three-Dimensional integrated Circuit Design

Electron Microscopy

ENMT607944
2 credits
Syllabus:

Introduction to optics, principles of image formation, light microscopy techniques, principles of fluorescence, digital imaging, confocal microscopy, TIRF, STORM/PALM, STED, FRET-FLIM, and FRAP techniques, structured illumination, two-photon fluorescence, second harmonic generation, vibrational imaging, scanning probe microscopy (SPM) techniques, atomic force microscopy (AFM), electron microscopy (SEM, TEM and STEM), and X-ray microscopy/microCT.

Prerequisite: Characterization of Materials

References:

1. "Fundamentals of Light Microscopy and Electronic Imaging" by Douglas B. Murphy and Michael W. Davidson (ISBN: 047169214X)
2. "Transmission Electron Microscopy: A Textbook for Materials Science (4 Vol. set)" by David B. Williams and C. Barry Carter (ISBN: 0387765026)
3. "Atomic Force Microscopy" by Peter Eaton and Paul West (ISBN: 0199570450)
4. "Physical Principles of Electron Microscopy: An Introduction to TEM, SEM, and AEM" by Ray F. Egerton (ISBN: 1441938370)
5. "Low Voltage Electron Microscopy: Principles and Applications" by David C. Bell and Natasha Erdman (ISBN: 111997111X)
6. "MicroComputed Tomography: Methodology and Applications" by Stuart R. Stock (ISBN: 1420058762)

Advanced Solidification

ENMT607947
2 credits
Syllabus:

Solidification processes thermodynamics, kinetics and morphology of alloy solidification, Redistribution of the Solute and Scheil equation, solidification path, cooling curve analysis, competitive growth, columnar and equiaxed transition, eutectic growth, coupled zone and eutectic structure modification, Micro-macro segregation, Solidification simulation.

Prerequisite: Materials Physic 3

References:

1. M. Flemings, Solidification Processing, McGraw Hill, New York, 1974
2. Metals Handbook, 9th Edition, Vol. 15, Casting, ASM International, Materials Park, Ohio, 1988.
3. W. Kurz & D. J. Fisher, Fundamentals of Solidification, Trans Tech Publications, Aedermannsdorf, Switzerland, 1992.
4. J.A. Dantzig and M. Rappaz, Solidification, CRC Press, 2017
5. D.M. Stefanescu, Science and Engineering of Casting Solidification, Springer US, 2015

Nanotechnology

ENMT607947
3 credits
Syllabus:

Definition and scope, solid surface physical chemistry, nanostructures (zero, one and two-dimensional: 0D, 1D, 2D), special nano materials, fabrication processes (lithography, nanolithography, soft-lithography, assembly), characterization (structural, physical and chemical) and applications (chemical sensors, biosensors, MEMS / Microelectromechanical systems, DNA chips, photonic crystals).

Prerequisite: -

References:

1. Drexler, K. Eric (1986). Engines of Creation: The Coming Era of Nanotechnology. Doubleday. ISBN 978-0-385-19973-5.
2. Drexler, K. Eric (1992). Nanosystems: Molecular Machinery, Manufacturing, and Computation. New York: John Wiley & Sons. ISBN 978-0-471-57547-4.
3. Prasad, S. K. (2008). Modern Concepts in Nanotechnology. Discovery Publishing House. pp. 31–32. ISBN 978-81-8356-296-6.

Industrial Ecology

ENMT608950
2 credits
Syllabus:

Views on Industrial Ecology, Life-Cycle Assessment: Method Basics, Environmental Evaluation and Advanced Methods, Aggregate Materials Flows, Environmental Policy Strategies

Prerequisite: Mineral Processing

References:

1. T.E. Graedel and B.R. Allenby, "Industrial Ecology", AT&T, Prentice Hall, New Jersey 1995.
2. T.E. Graedel and B.R. Allenby, "Design for Environment", AT&T, Prentice Hall, New Jersey 1996.
3. UNEP, Life Cycle Assessment: What it is and how to do it, UN Publication, Paris 1996.
4. MIT Open course
5. Yale University https://environment.yale.edu/courses/2015-2016/detail/884/

Concrete Corrosion

ENMT608951
2 credits

Syllabus:

Cement characteristics: type of cement, water/cement ratio, porosity, permeability; transfer process on cement: porosity and water composition; transfer mechanism, water diffusion and migration; cement degradation: acid attack, sea water attack; corrosion mechanism inside cement: electrochemistry aspect, carbonate induced corrosion, chloride induced corrosion, stray-current induced corrosion, stress corrosion cracking, hydrogen induced cracking; corrosion prevention: inhibitor, surface engineering, material selection, cathodic protection, inspection and monitoring, repair.

Prerequisite: Corrosion & Protection of Metals

References:

1. Luca Bertolini, Bernhard Elsener Pietro Pedeferri, Rob Polder. Corrosion of Steel in Concrete, Prevention,Diagnosis, Repair, Willey-VCH, 2004
2. P.M. Chess, Cathodic Protection of teel in Concrete, E&FN spon, Great Britain, 1998

Refractory Materials

ENMT608953
2 credits
Syllabus:

Introduction, acid refractory, basic refractory, neutral refractory, bricks refractory, monolithic refractories, fused cast refractories, insulating refractories, refractory application in ferrous, non-ferrous, heat treatment, ceramics, glass, and other industries

Prerequisite: Ceramics Technology

References:

1. Kingery et al, Introduction to Ceramics, 2nd ed., John Wiley & Sons., 1976
2. Hummel AF, Phase Equilibria in Ceramic Systems, Marcel Dekker Inc, 1984

Mechanics of Material Forming

ENMT608954
Syllabus:

Review of Stress and Strain, Energy-Balance Analysis, Force-Balance Analysis, Upper Bound Analysis, Slip Line Field Analysis, Finite Element Analysis, Circle Grid Analysis, Distortion and Deformations Analysis.

Prerequisite: Metal Manufacturing Process

References:

1. W. Hosford and R.M. Caddel, Metal Forming: Mechanics and Metallurgy 4th Edition, Cambridge University Press, Cambridge, 2011.
2. Z. Marciniak, J.L. Duncan, S.J. Hu, Mechanics of Sheet Metal Forming 2nd Edition, Butterworth-Heinemann, Oxford, 2002.
3. S. Kobayashi, S. Oh, T. Altan, Metal Forming and the Finite Element Method, Oxford University Press, Oxford, 1989.
4. R.J. Shipley and D.A. Moore, “Analysis of Distortion and Deformation” in ASM Metals Handbook Volume 11: Failure Analysis and Prevention, ASM Internationals, Metal Parks OH, 2002.

Industrial Mechanic Equipment

ENMT608955
2 credits
Syllabus:

Code and Standard, Pipes and Pipe Fittings, Special Items, Valves, Pipe Connection to Process Equipments (Tanks, Pressure Vessels, Heat Exchangers, Columns, Pumps, Compressors), Piping System for Oil, Gas, LNG, Geothermal, Water, Chemical, Piping System for Instrumentation, Piping and Instrument Diagram (P & ID), Plot Plan, Isometric, Cross Section, Pipe Fabrication Drawings, Process Pipes, Utility Pipes, Onshore and Offshore

Prerequisite: Metal Manufacturing Process

References:

1. Peter Smith, Piping Materials Selection & Applications, Gulf Professional Publishing, Elsevier, 2005
2. Mohinder Nayyar, “Piping Handbook”, 7th Ed., McGraw-Hill Professional; 1999, ISBN: 0070471061
3. Tyler G. Hicks, Power Plant Evaluation & Design Reference Guide, McGraw Hill, 1986
4. Saranavamutto et. al., Gas Turbine Theory, 5th Ed., Prentice Hall, 2001
5. Smith Eric, Thermal Design of Heat Exchanger, Jon Willey & Son, 1996, New York.

Materials Standardization

ENMT608956
2 credits
Syllabus:

Introduction, characteristics of standards, organization for standards, ISO structure and development, metal classification, ASTM, JIS, BS, DIN, NACE, AWS, and API standards

Prerequisite: Characterization of Materials

References:

1. Peter Smith, Piping Materials Selection & Applications, Gulf Professional Publishing, Elsevier, 2005
2. Mohinder Nayyar, “Piping Handbook”, 7th Ed., McGraw-Hill Professional; 1999, ISBN: 0070471061

Polymer Recycling Technology

ENMT608957
2 credits
Syllabus:

National and international regulations on polymer recycling. Polymer material cycle. The polymer industry classification in Indonesia. Polymeric and ecological products. The basic principle of recycling. Stages and types of processes / machinery for recycling polymer products. The choice of the method for recycling the polymer product. Chemical and physical engineering of polymer recycled products. Case study of recycling of polymer products (polyethylentereptate-PET, PE & PP, polystyrene-styrofoam, PVC, polyacrylate, thermoplastic enjineering-ABS, rubber and thermoset)

Prerequisite: Polymer Manufacturing Process

References:

Edward.A.Muccio, Plastic Processing Technology, ASM International, ISBN:9780871704948

Polymer Recycling Technology

ENMT608958/ENMT618958
2 credits
Syllabus:

National and international regulations on polymer recycling. Polymer material cycle. The polymer industry classification in Indonesia. Polymeric and ecological products. The basic principle of recycling. Stages and types of processes / machinery for recycling polymer products. The choice of the method for recycling the polymer product. Chemical and physical engineering of polymer recycled products. Case study of recycling of polymer products (polyethylentereptate-PET, PE & PP, polystyrene-styrofoam, PVC, polyacrylate, thermoplastic enjineering-ABS, rubber and thermoset)

Prerequisite: -

References:

1. Edward.A.Muccio, Plastic Processing Technology, ASM International, ISBN:9780871704948

Quenching Technology

ENMT608959
2 credits
Syllabus:

Introduction, comparison of conventional and advanced cooling processes, types of advanced cooling media

Prerequisite: Heat Treatment and Surface Engineering

References:

1. Handbook of Quenchatnts and Quenching Technology
2. Quenching technology: a selected overview of the current state-of-the-art. Mat. Res. vol.8 no.4 São Carlos Oct./Dec. 2005

Industrial Apprenticeship

ENMT608060
6 credits
Syllabus:

Apprenticeship in an industry for at least 3 months. The results of the apprenticeship are submitted in the form of a report and presented before the apprenticeship examination committee

Prerequisite: Minimum of 110 credit hours during the break

References: -

Advanced Manufacturer

ENMT808061/ENMT818061
3 credits

Syllabus:

Metal forming as part of the design and manufacturing process; general principles, phenomena and mechanisms related to metal casting; molds (sand, ceramics, metals), gating systems and simulations, freezing of cast iron and aluminum processes, liquid treatment for ferrous metals (inoculation, Mg treatment) and non-ferrous (modifiers, grain refiner), various casting methods cast defects (casting defects); general principles, phenomena and mechanisms for the formation of solid phase metals, through the processes of forging, rolling, extrusion, withdrawal, sheet metal forming, and thermo-mechanical treatment. Phenomenon and mechanism in powder metallurgy, metal powder fabrication and powder forming mechanism, powder characteristics and characterization, mechanical alloying, pre-compacting process, compacting, feed characteristics, sintering process and powder consolidation, full density processing, sintered equipment type and related aspects, application and use of powder metallurgical products. Case study of process selection and evaluation of manufacturing processes.

Prerequisite: -

References:

1. Heine, R. W. et.al., Principles of Metal Casting, McGraw-Hill Pub., New Delhi, 1986
2. Surdia, T. Teknologi Pengecoran Logam, P. Paramita, 1985
3. John Campbell, Castings, Second Edition, Elsevier Butterworth-Heinemann, 2004

Advanced Polymer Manufacturing

ENMT808062/ENMT808z062
2 credits

Syllabus:

Polymer production fabrication process (formulation, shaping and finalization). Purpose and finalization process for polymer product types (deflashing, smoothing and polishing, sawing and cutting, drilling, grinding and sanding, routing, milling & turning, tapping & threading, cleaning, annealing, assembling, and decoration). Types of assembly processes (mechanical joining, welding and adhesive bonding). Type of decoration process (painting, plating, thermal spray coating, vacuum metalizing, hotstamping, coloring). Machinery and process construction mechanisms. The process of finalizing the manufacture of polymer products. Case studies on the fabrication process for product packaging (rigid and flexible), automotive, electronics and construction equipment.

Prerequisite: -

References:

1. G. Challa, Polymer Chemistry – An Introduction, 1993, Ellis Horwood Limited series in Polymer Science, UK
2. Young R.J. and Lovell P.A., Introduction to Polymers, 2nd edition, 1997, Chapman & Hall, Cambridge, UK
3. Cheremisinoff N.P., Polymer Characterization – Laboratory Techniques and Analysis, 1996, Noyes Publication, New Jersey, USA
4. Morton-Jones D.H., Polymer Processing, 1994, Chapman & Hall, UK

Advanced Polymer Manufacturing

ENMT808062 /ENMT808062
2 credits
Syllabus:

Polymer production fabrication process (formulation, shaping and finalization). Purpose and finalization process for polymer product types (deflashing, smoothing and polishing, sawing and cutting, drilling, grinding and sanding, routing, milling & turning, tapping & threading, cleaning, annealing, assembling, and decoration). Types of assembly processes (mechanical joining, welding and adhesive bonding). Type of decoration process (painting, plating, thermal spray coating, vacuum metalizing, hotstamping, coloring). Machinery and process construction mechanisms. The process of finalizing the manufacture of polymer products. Case studies on the fabrication process for product packaging (rigid and flexible), automotive, electronics and construction equipment.

Prerequisite: -

References:

1. G. Challa, Polymer Chemistry – An Introduction, 1993, Ellis Horwood Limited series in Polymer Science, UK
2. Young R.J. and Lovell P.A., Introduction to Polymers, 2nd edition, 1997, Chapman & Hall, Cambridge, UK
3. Cheremisinoff N.P., Polymer Characterization – Laboratory Techniques and Analysis, 1996, Noyes Publication, New Jersey, USA
4. Morton-Jones D.H., Polymer Processing, 1994, Chapman & Hall, UK

ENMT808963/ENMT818963

Syllabus:

Introduction and definition of smart materials, properties of materials, current developments in materials and technology, applications in various fields and functionalities: multiferoic and magnetoelectric materials for spintronics, concept of smart materials for photovoltaic, piezo and electro-active materials, shape-remember materials (shape memory alloys and polymers), and smart coatings.

Prerequisite: -

References:

Igor A. Luk'yanchuk and Daoud Mezzane, Smart Materials for Energy, Communications and Security, Springer Science + Business Media B.V. Dordrecht, 2007.

Energy Materials

ENMT808964/ENMT818964
2 credits

Syllabus:

Overview of materials and materials related energy: society's present needs and future energy demands on conventional energy sources and systems, including fossil fuels and then focus on alternate renewable energy. Synthesis of materials: Solid state, sol-gel, gas phase (CVD/ALD). Synthesis of bulk and nanomaterials, chemical properties of energy-relevant materials at the nanoscale. Crystal field theory for solid-state materials. Semiconductors and their use in energy relevant applications. Materials related energy with applications in energy storage, batteries and related areas. Advanced concept in fuel cells, supercapacitors, thermoelectrics, solar cells, solar heat, batteries and other renewable energy sources and possible future hydrogen storage and nanotechnology in energy.

Prerequisite: -

References:

1. Bent Sørensen: Renewable Energy, Physics, Engineering, Environmental Impacts, Economics & Planning, 4th Ed., Elsevier, Burlington, MA (2011).
2. Radu D. Rugescu: Solar Energy, Intech, Vukovar, Croatia (2010)
3. Zekai Şen: Solar Energy Fundamentals and Modeling Techniques, Springer-Verlag London Limited (2008)
4. Aldo Vieira da Rosa: Fundamentals of Renewable Energy Processes, ElsevierAcademic Press, Burlington, MA (2005)

Advanced Extractive Metallurgy

ENMT808965/ENMT818965
3 credits

Syllabus:

Waste characterization for process raw materials. Innovation of wet metallurgical processes (hydrometallurgy) and hot metallurgy (pyrometallurgy) for low-grade raw materials and energy efficiency: reaction mechanisms and applications, such as metal extraction with plasma, microwaves. Metal recycling process. Processing slag, dust and metallurgical ash particles. Processing and utilization of by-products (by product): slag utilization, cross processing, fly ash processing. Acquisition of metals from process wastes (such as tailings, residues, sludges): mineral processing from tailings, recovery of metals from red mud, recovery of metals from waste sludges. New technology for metal recycling.

Prerequisite: -

References:

S. Ramachandra Rao, Resources Recovery and Recycling from Metallurgical Waste, waste Management Series vol. 7, Oxford, 2006.

Related publications in journals e.g. Metallurgical and Materials Transaction, B; Journal of Metals, Hydrometallurgy, etc.

Advanced Surface Engineering

ENMT808966/ENMT818966

3 credits

Syllabus:

Basic surface engineering, conventional surface engineering, advanced surface engineering, surface coating, surface modification, thin film characterization.

Prerequisite: -

References:

1. Chattopadhyay et al, Green Tribology, ASM Intenational, 2014.
2. H.O. Pierson, Handbook of Chemical Vapor Deposition, Noyes Publication, 2000
3. D.M. Mattox, Handbook of Physical Vapor Deposition, Elsevier, 2010
4. J.P. Davim, Materials and Surface Engineering, Woodhead Publishing, 2012
5. A.S. Hamdy, Handbook of Smart Coating for Materials Protection, Woodhead Publ, 2014

Curriculum of International Program Metallurgical and Materials Engineering

Code	Subject	SKS
	1st Semester	
UIGE600004	Religion	2
UIGE600003	English	2
ENGE600001	Calculus 1	3
ENGE600005	Physics - Mechanics and Heat	3
ENGE600006	Physics - Mechanics and Heat Laboratory	1
ENGE600009	Basic Chemistry	2
ENMT601001	**Engineering Drawing**	**2**
ENMT601002	**Introduction to Engineering Materials**	**2**
ENMT601003	Basic Chemistry Laboratory	1
	Sub Total	**18**
	2nd Semester	
UIGE600006	Integrated Character Building Subject	5
ENGE600002	Calculus 2	3
ENGE600007	Physics - Electricity, MWO	3
ENGE600008	Physics - Electricity, MWO Laboratory	1
ENMT602004	Materials Physic 1	2
ENMT602005	Static & Mechanic of Materials	3
ENMT602006	Thermodynamics of Materials	3
	Sub Total	**20**
	3rd Semester	
ENGE610004	Linear Algebra	4
ENMT613007	Characterization of Materials	3
ENMT613008	Chemical Characterization of Materials	2
ENMT613009	Electrochemistry	3
ENMT613010	Introduction to Fluids Mechanics	2
ENMT613011	Materials Physic 2	3
ENMT613012	Numerical Computation	3
ENGE610004	Linear Algebra	4
	Sub Total	**20**
	4th Semester	
ENGE610012	HSE Protection	2
ENMT614013	Capita Selecta, Technology, and Society	2
ENMT614014	Corrosion & Protection of Metals	3
ENMT614015	Materials Physic 3	3
ENMT614016	Mineral Processing	3
ENMT614017	Polymer Materials	3
ENMT614018	Characterization Laboratory	1
ENMT614019	Chemical Characterization of Materials Laboratory	1
	Sub Total	**18**
	5nd Semester	
ENMT615020	Extractive Metallurgy	4
ENMT615021	Heat Treatment and Surface Engineering	3
ENMT615022	Iron & Steel Making	2
ENMT615023	Metal Manufacturing Process	4
ENMT615024	Polymer Manufacturing Process	3
ENMT615025	Corrosion Laboratory	1
ENMT607939-53	Elective 1	3
	Sub Total	**20**
	6rd Semester	
ENMT616026	Ceramics Technology	3
ENMT616027	Composite Technology	3
ENMT616028	Data Analysis and Scientific Writing	2
ENMT616029	Materials Joining	3
ENMT616030	Materials Selection	3
ENMT616031	Extractive Metallurgy Laboratory	1
ENMT616032	Metals Manufacturing Labora-tory	1
ENMT608954-68	Elective 2	2
ENMT608954-68	Elective 3	2
	Sub Total	**20**
	7rd Semester	
ENMT617033	Engineering Design of Products	4
ENMT617034	Failure Analysis	3
ENMT617035	Technopreneurship	2
ENMT610036	Internship	2
ENMT610037	Seminar	1
ENMT607939-53	Elective 4	2
ENMT607939-53	Elective 5	2
ENMT607939-53	Elective 6	2
	Sub Total	**20**
	8rd Semester	
ENMT610036	Final Project	4
ENMT608954-68	Elective 7	2
ENMT608954-68	Elective 8	2
ENMT608954-68	Elective 9	2
	Sub Total	**10**
	Total	**144**

Elective Courses

Code	Subject	SKS
	1st Semester	
ENMT607939	Special Alloyed Steels	2
ENMT607940	Biomaterial	2
ENMT607941	Engineering Ethics	2
ENMT607942	Computational Materials	2
ENMT607943	High Temperature Corrosion	2
ENMT607944	Electron Microscopy	2
ENMT607945	Polymer Compounding	2
ENMT607946	Quality Management Systems	2
ENMT607947	Advanced Solidification	2
ENMT607948	Special Processing and Assembly Technologies	2
ENMT607949	1st Term Advanced Internship	3
ENMT803918	Risk Based-Inspection and Integrity	3
ENMT803919	Advanced Polymer Manufacturing	3
ENMT803920	Electronic Materials	3
ENMT803921	Nanotechnology	3
	2st Semester	
ENMT608950	Industrial Ecology	2
ENMT608951	Concrete Corrosion	2
ENMT608952	Energy Materials	2
ENMT608953	Refractory Materials	2
ENMT608954	Mechanics of Material Forming	2
ENMT608955	Industrial Mechanic Equipment	2
ENMT608956	Material Standardization	2
ENMT608957	Polymer Recycling Technology	2
ENMT608958	Rubber Technology	2
ENMT608959	Quenching Technology	2
ENMT608960	2nd Term Adv. Internship	3
ENMT804922	Advanced Manufacture	3
ENMT804923	Smart Materials	3
ENMT804924	Advanced Extractive Metallurgy	3
ENMT804925	Advanced Surface Engineering	3

Transition Policy from Curriculum 2016 to Curriculum 2020

1. The Curriculum 2020 takes effect from the Second Term 2020/2021. After this curriculum is implemented, only the subjects in the Curriculum 2020 will be counted for the graduation: any subject in the Curriculum 2016 follows the transition rules.
2. Transition rules will be valid for 1 (one) year, starting from the Second Term of 2020/2021 until the First Term 2021/2022 for any subject changing in its place (from the first term to second term or vice versa). If it is necessary, the subject will be opened in both semesters.
3. Students who have not passed the compulsory subjects in the Curriculum 2016 are required to take the same or equivalent subjects in the Curriculum 2020.
4. If there is a change in the credit hours, the credits at the first time the subject taken will be considered. The same or equivalent subjects with different credit hours, if repeated or newly taken, will be counted with the new name and credit hours.
5. The equivalence subjects for Curriculum 2016 and Curriculum 2020 can be seen in the Equivalency Table. Any unlisted subject in the Curriculum 2016 has been removed and is no longer offered.
6. If the compulsory subjects in the Curriculum 2016 are removed and there are no equivalencies in the Curriculum 2020:
   a. For students who have passed the subjects, the subjects will be counted as compulsory credits with the same name and credit hours.
   b. For students who have not passed the subjects, students can take new compulsory subjects or elective subjects with the new name and credit hours.
7. If the credit hour of a subject has been reduced while the student has already taken the subject required for the graduation, then the student is still allowed to graduate even though the total number of credits is less than the required one.

Equivalency of Curriculum 2016 and 2020

No	Course Name in Curriculum 2016	Credits	Course Name in Curriculum 2020	Credits
1	Academic Writing	3	Academic Writing	2
2	Integrated Character Building A	6	Integrated Character Building	5
3	Integrated Character Building B	6		
4	Statistics & Probability	2	Data Analysis and Scientific Writing	2
5	Physical Metallurgy 1	4	Materials Physics 1	2
6			Materials Physics 2	3
7	Testing of Materials	2	Characterization of Materials	3
8	Tech. of Microstructural Analysis	2		
9	Chemical Characterization	2	Characterization of Materials	2
10	Polymer Chemistry	4	Polymer Materials	3
11	Physical Metallurgy 2	3	Materials Physics 3	3
12	Mineral Processing	4	Mineral Processing	3
13	Transport Phenomenon	3	Introduction to Fluids Mechanics and Heat Transfer	2
14	Industrial Management	2	Technopreneurship	2
15	Polymer Technology	3	Polymer Manufacturing Process	3
16	Tech. of Microstructural Analysis Laboratory	1	Materials Characterization Laboratory	1
17	Testing of Materials Laboratory	1		
18	Chemical Characterization Laboratory	1		
19	Metal Manufacturing Process Laboratory	2	Metals Manufacturing Laboratory	1
20	Engineering Design of Products	3	Engineering Design of Products and Process	3
21	Capita Selecta	2	Technopreneurship	2
22	Fracture Mechanics & Failure Analysis	4	Failure Analysis	3

Other subjects that are not listed in this table do not change except for the subject code and curriculum code (full list is given in the SIAK-NG website)

Undergraduate Program in Architecture

Program Specification

1.	**Awarding Institution**	Universitas Indonesia For Double Degree Program: Universitas Indonesia & Partner Universities	
2.	**Teaching Institution**	Universitas Indonesia For Double Degree Program : Universitas Indonesia & Partner Universities	
3.	**Faculty**	Engineering	
4.	**Program**	Undergraduate Program in Architecture	
5.	**Vision and Mission of Study Program**	Vision: "Establishing a high-quality Architecture Education Institution that receives national and international recognition, to foster future leaders who are critical, knowledgeable, and creative thinkers, with sensibility to local wisdom and environment sustainability." Mission: "Establishing the Architecture Education institutional system with excellent productivity towards the implementation of Tridarma in higher education."	
6 .	**Class**	Reguler, Parallel, International	
7.	**Degree Offered**	Sarjana Arsitektur (S.Ars.), for Double Degree: Sarjana Arsitektur (S.Ars) and Bachelor of Architecture (B.Arch)	
8.	**Accreditation / Recognition**	Accredited A by BAN-PT dan internationally assessed by AUN-QA	
9.	**Language of Instruction**	Bahasa Indonesia and English	
10.	**Study Scheme (Full time/Part time)**	Full Time	
11.	**Entry Requirement**	SMA Graduate/equal or D3/Polytechnique graduate	
12.	**Period of Study**	4 years	
	Semester	Total Semester	Weeks / semester
	Regular	8	17
	Short (optional)	3	8
13.	**Aims of the programme:** 1. **Education**: creating architecture graduates who master certain competencies in accordance with the level of education in a superior and quality manner. 2. **Research**: encouraging excellent research works that are able to compete at the regional and international levels. 3. **Community Service**: encouraging the application of architectural knowledge in the form of the empowerment of the community		
14.	**Graduate Profiles:** Sarjana Arsitektur is a graduate who has the ability to design architecture with respect to context and local needs and is based on the application of basic knowledge of architecture. Graduate of this program are expected to have the ability as: • **The Initiator** – Able to provide solutions to spatial problems critically and creatively with respect to local context and needs • **The Designer** – have the skill in assembling architectural elements and materials, have an understanding of built aspects, and have a sensibility in creating meaningful architectural design • **The Communicator** – able to communicate ideas through words, writings, drawings, modeling and other media. • **The Collaborator** – able to work together with various stakehoders to propose creative solutions for real problems.		

15.	**Graduates Competencies:** A bachelor Architect will have graduate competencies as follow: 1. Able to create architectural design by integrating basic architectural knowledge, applying design and communication skill, applying ability for imagination, creative thinking, innovation and three-dimensional thinking. 2. Able to synthesize the knowledge of architectural history and theories, including knowledge on art, culture and humanities that could influences the quality of architectural design. 3. Able to integrate analysis of the context into architectural design. 4. Able to analyse the needs and characterictis of the users and integrate them as the basis to define contextual and functional requirement on different types of space. 5. Able to construct the basic knowledge of architectural design methods. 6. Able to integrate the basic knowledge of structure, material, construction and building technology into architectural design. 7. Able to integrate the basic knowledge of natural and environmental system into a sustainale architecture design. 8. Aware of various roles of architects in the society. 9. Able to gather information, formulate, analyse and synthesize problems that are related to architecture. 10. Able to apply mathematics, science, and basic engineering into the solution of comples technical problems. 11. Have integrity, able to demonstrate critical, creative, and innovative thinking, and have intellectual curiosity in solving the problems both at individual and group levels. 12. Able to offer alternative solutions towards various problems in the society, the community, and the nation. 13. Able to utilize information and communication technology. 14. Able to use verbal and written language in Bahasa Indonesia and English fluently in academic and non-academic activities. 15. Able to identify various innovative and independent entrepreneurial endeavours with respect to ethics.

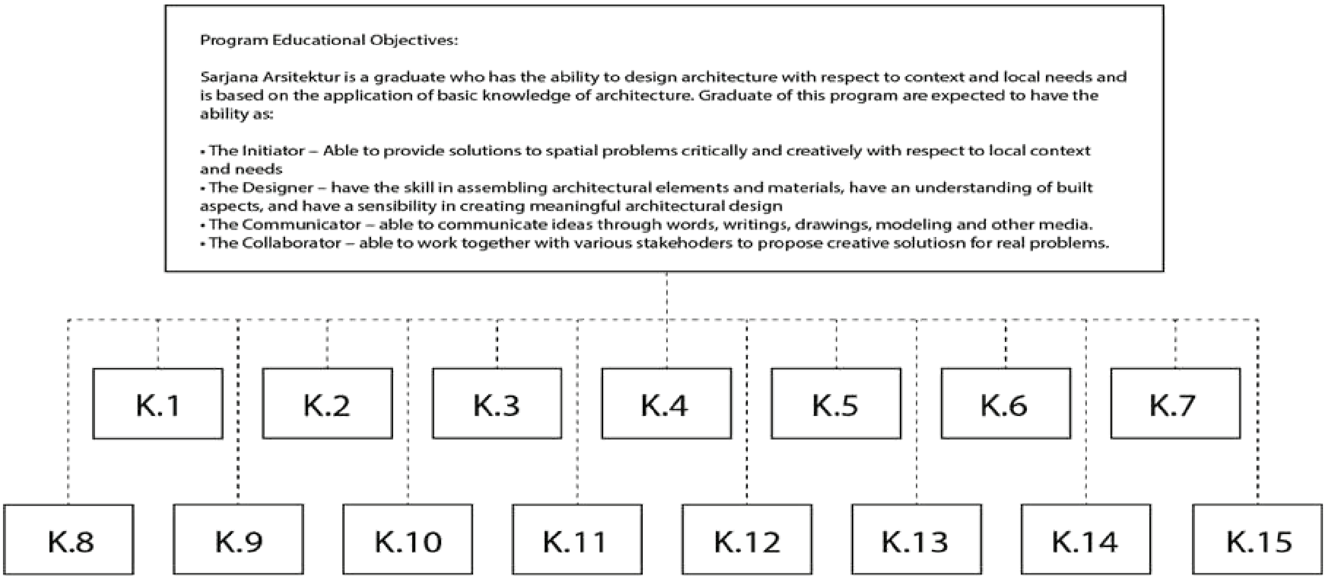
16.	**Course Composition**		
No.	**Type of Courses**	**Credits**	**Percentage**
I	University General Subjects	9	6.25 %
II	Basic Engineering Subjects	10	6.94 %
III	Architecture Core Course	81	56.25 %
IV	Specialization Course	-	-
V	Electives	38	26.39 %
VI	Undergraduate Thesis or Final Project	6	4.17 %
	Total	144	100 %
	Total Credits for Graduation		**144 sks**

Job Opprtunity

Graduates of Strata-1 Architecture Program UI hold a Sarjana Arsitektur with pre-professional qualifications. The graduate can or will be able to work as an intern in a professional practice or to continue on to a Professional Architectural Education Program (PPARS) (Architect). To obtain professional certification, a graduate has to perform an internship and pass the qualification as- sessment by the professional association (IAI/Indonesian Institute of Architects).

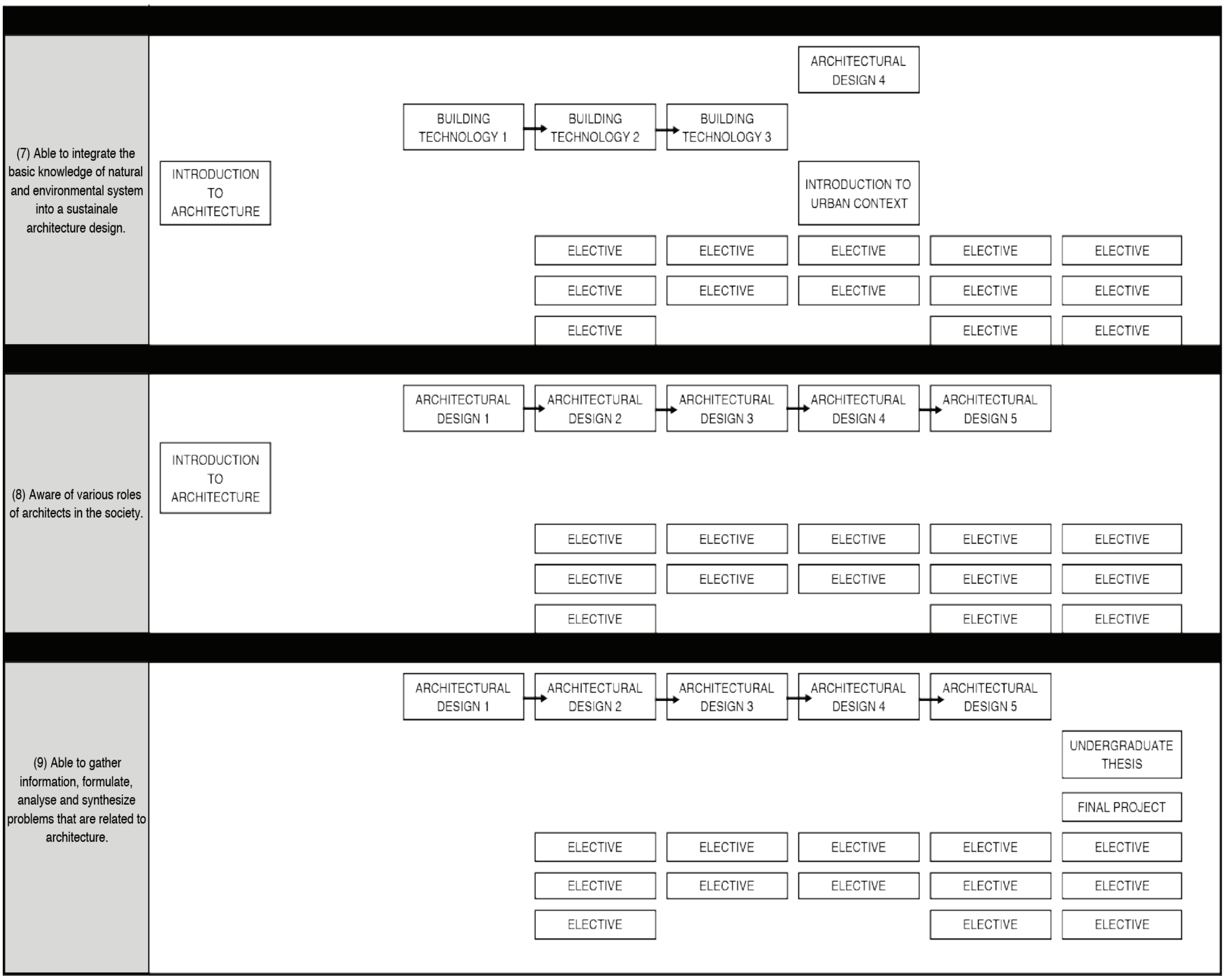
A graduate holding a Sarjana Arsitektur UI can work in various fields of the construction industry such as architecture, interior design or construction supervision. In addition to pursuing a career in the architectural field, graduates are able to develop a career as an assessor for project feasibility studies, building and environmental management, to work in the building materials industries as well as working in the public sector related to government buildings, construction and the built environment. In addition to these areas, graduates can also work in various fields of work that employ creative abilities and critical thinking skills.

Diagram of Graduate Compentencies



Course Diagram in Achieving Compentencies
Undergraduate Program in Architecture

	SEMESTER 1	SEMESTER 2	SEMESTER 3	SEMESTER 4	SEMESTER 5	SEMESTER 6	SEMESTER 7	SEMESTER 8
(1) Able to create architectural design by integrating basic architectural knowledge, applying design and communication skill, applying ability for imagination, creative thinking, innovation and three-dimensional thinking.	BASIC DESIGN 1 DIGITAL DESIGN MEDIA	BASIC DESIGN 2	ARCHITECTURAL DESIGN 1	ARCHITECTURAL DESIGN 2 ELECTIVE ELECTIVE ELECTIVE	ARCHITECTURAL DESIGN 3 ELECTIVE ELECTIVE	ARCHITECTURAL DESIGN 4 ELECTIVE ELECTIVE	ARCHITECTURAL DESIGN 5 ELECTIVE ELECTIVE ELECTIVE	ELECTIVE ELECTIVE ELECTIVE
(2) Able to synthesize the knowledge of architectural history and theories, including knowledge on art, culture and humanities that could influences the quality of architectural design.	BASIC DESIGN 1	BASIC DESIGN 2 HISTORY AND THEORY OF ARCHITECTURE 1	ARCHITECTURAL DESIGN 1 HISTORY AND THEORY OF ARCHITECTURE 2	ARCHITECTURAL DESIGN 2 ELECTIVE ELECTIVE ELECTIVE	ELECTIVE ELECTIVE	ELECTIVE ELECTIVE	ELECTIVE ELECTIVE ELECTIVE	ELECTIVE ELECTIVE ELECTIVE
(3) Able to integrate analysis of the context into architectural design.				ELECTIVE ELECTIVE ELECTIVE	ARCHITECTURAL DESIGN 3 ELECTIVE ELECTIVE	ARCHITECTURAL DESIGN 4 INTRODUCTION TO URBAN CONTEXT ELECTIVE ELECTIVE	ARCHITECTURAL DESIGN 5 ELECTIVE ELECTIVE ELECTIVE	ELECTIVE ELECTIVE ELECTIVE
(4) Able to analyse the needs and characterictis of the users and integrate them as the basis to define contextual and functional requirement on different types of space.	INTRODUCTION TO ARCHITECTURE		ARCHITECTURAL DESIGN 1 DESIGN METHODS	ARCHITECTURAL DESIGN 2 ELECTIVE ELECTIVE ELECTIVE	ARCHITECTURAL DESIGN 3 ELECTIVE ELECTIVE	ARCHITECTURAL DESIGN 4 ELECTIVE ELECTIVE	ARCHITECTURAL DESIGN 5 ELECTIVE ELECTIVE ELECTIVE	ELECTIVE ELECTIVE ELECTIVE
(5) Able to construct the basic knowledge of architectural design methods.	INTRODUCTION TO ARCHITECTURE	HISTORY AND THEORY OF ARCHITECTURE 1	ARCHITECTURAL DESIGN 1 DESIGN METHODS HISTORY AND THEORY OF ARCHITECTURE 2	ARCHITECTURAL DESIGN 2 ELECTIVE ELECTIVE ELECTIVE	ARCHITECTURAL DESIGN 3 ELECTIVE ELECTIVE	ARCHITECTURAL DESIGN 4 ELECTIVE ELECTIVE	ARCHITECTURAL DESIGN 5 ELECTIVE ELECTIVE ELECTIVE	ELECTIVE ELECTIVE ELECTIVE
(6) Able to integrate the basic knowledge of structure, material, construction and building technology into architectural design.			BUILDING TECHNOLOGY 1	BUILDING TECHNOLOGY 2 ELECTIVE ELECTIVE ELECTIVE	ARCHITECTURAL DESIGN 3 BUILDING TECHNOLOGY 3 ELECTIVE ELECTIVE	ELECTIVE ELECTIVE	ARCHITECTURAL DESIGN 5 ELECTIVE ELECTIVE ELECTIVE	ELECTIVE ELECTIVE ELECTIVE


(7) Able to integrate the basic knowledge of natural and environmental system into a sustainale architecture design.
INTRODUCTION TO ARCHITECTURE
BUILDING TECHNOLOGY 1
BUILDING TECHNOLOGY 2
BUILDING TECHNOLOGY 3
ARCHITECTURAL DESIGN 4
INTRODUCTION TO URBAN CONTEXT
ELECTIVE
(8) Aware of various roles of architects in the society.
INTRODUCTION TO ARCHITECTURE
ARCHITECTURAL DESIGN 1
ARCHITECTURAL DESIGN 2
ARCHITECTURAL DESIGN 3
ARCHITECTURAL DESIGN 4
ARCHITECTURAL DESIGN 5
ELECTIVE
(9) Able to gather information, formulate, analyse and synthesize problems that are related to architecture.
ARCHITECTURAL DESIGN 1
ARCHITECTURAL DESIGN 2
ARCHITECTURAL DESIGN 3
ARCHITECTURAL DESIGN 4
ARCHITECTURAL DESIGN 5
UNDERGRADUATE THESIS
FINAL PROJECT
ELECTIVE

S1 Arsitektur

Semester	GENERAL AND BASIC ENGINEERING	BASIC	SKILL	ENRICHMENT	
8			Undergraduate Thesis/Final Project [6]	Elective [3] Elective [3] Elective [3]	15 SKS
7			Arch. Design 5 [9]	Elective [3] Elective [3] Elective [2]	17 SKS
6		Introduction to Urban Context [3]	Arch. Design 4 [9]	Elective [3] Elective [3]	18 SKS
5		Building Technology 3 [3]	Arch. Design 3 [9]	Elective [3] Elective [3]	18 SKS
4		Building Technology 2 [3]	Arch. Design 2 [8]	Elective [3] Elective [3] Elective [3]	20 SKS
3	Mechanics and Thermal Physics [3]	Design Methods [3] Building Technology 1 [3] History and Theory of Architecture 2 [3]	Arch. Design 1 [7]		19 SKS
2	Integrated Character Building [5] Linear Algebra [4]	History and Theory of Architecture 1 [3]	Basic Design 2 [7]		19 SKS
1	English [2] Religion [2] Calculus 1 [3]	Introduction to Architecture [3] Digital Design Media [3]	Basic Design 1 [5]		18 SKS

Curriculum Structure Undergraduate Program in Architecture

Code	Subject	SKS
	1st Semester	
UIGE600003	MPK English	2
UIGE600004	MPK Religion	2
ENGE600001	Calculus 1	3
ENAR600001	Basic Design 1	5
ENAR600009	Introduction to Architecture	3
ENAR600015	Digital Design Media	3
	Sub Total	**18**
	2nd Semester	
UIGE600006	Integrated Character Building	5
ENGE600004	Linear Algebra	4
ENAR600002	Basic Design 2	7
ENAR600010	History and Theory of Architecture 1	3
	Sub Total	**19**
	3rd Semester	
ENGE600005	Mechanics and Thermal Physics	3
ENAR600003	Architectural Design 1	7
ENAR600011	Design Methods	3
ENAR600012	Building Technology 1	3
ENAR600013	History and Theory of Architecture 2	3
	Sub Total	**19**
	4th Semester	
ENAR600004	Architectural Design 2	8
ENAR600014	Building Technology 2	3
	Elective *	3
	Elective *	3
	Elective *	3
	Sub Total	**20**
	5th Semester	
ENAR600005	Architectural Design 3	9
ENAR600016	Building Technology 3	3
	Elective *	3
	Elective *	3
	Sub Total	**18**
	6th Semester	
ENAR600006	Architectural Design 4	9
ENAR600017	Introduction to Urban Context	3
	Elective *	3
	Elective *	3
	Sub Total	**18**
	7th Semester	
ENAR600007	Architectural Design 5	9
	Elective *	3
	Elective *	3
	Elective *	**2**
	Sub Total	**17**
	8th Semester	
ENAR600008	Undergraduate Thesis/Final Project	6
	Elective *	3
	Elective *	3
	Elective *	3
	Sub Total	**15**
	Total	**144**

*) Students are required to take 2 courses outside of the Undergraduate Architecture Program with the approval of the Academic Supervisor and Credit Transfer Team. Students can take Minor packages outside the Undergraduate Architecture Program with the approval of the Academic Supervisor and Credit Transfer Team.

**) Students can take an exchange program with a partner university with the approval of the Academic Advisor and the Credit Transfer Team

As the application of Merdeka Belajar, students can take electives in the form of internship, excursion/research project, community engagement, community development, etc.

Students who want to pursue double degree with partner university should learn two years at the Department of Architecture Universitas Indonesia and two years in partner university.

Elective Introduction to Sustainability is mandatory for those planning to take double degree in Curtin University or QUT

***Design Studies is mandatory for students taking Final Project

Electives Course

Code	Elective Course	SKS
ENAR600018	Acoustics	3
ENAR600019	Architecture and Spatial Ethnography	3
ENAR600020	Architecture and Text	3
ENAR600021	Coastal Architecture	3
ENAR600022	Ethnic Architecture	3
ENAR600023	Architecture, City, and Power	3
ENAR600024	Architecture, Media and Context	3
ENAR600025	BIM: Project Documentation - Basic	3
ENAR600026	Diagram and Architecture	3
ENAR600027	Urban Ecology	3
ENAR600028	Digital Fabrication	3
ENAR600029	High Rise Building Facades	3
ENAR600030	Photography	3
ENAR600031	Geometry Architecture	3
ENAR600032	Field Study	3
ENAR600033	Independent Study	3
ENAR600034	Design Study***	3
ENAR600035	Capita Selecta	3
ENAR600036	Internship/Community Outreach	3
ENAR600037	Everyday and Architecture	3
ENAR600038	2D Digital Design Communication	3
ENAR600039	3D Digital Design Communication	3
ENAR600040	Lifecycle Environment	3
ENAR600041	Introduction to Spatial Analysis	3
ENAR600042	Interior Design	3
ENAR600043	City Planning	3
ENAR600044	Urban Design Principles	3
ENAR600045	Architectural Psychology	3
ENAR600046	Real Estate	3
ENAR600047	Project Feasibility Study	3
ENAR600048	Lighting Design	3
ENAR600049	Site Planning and Design	3
ENAR600050	Urban Housing Theory	3
ENAR600051	Special Topic of Collaboration	3
ENAR600052	Special Topic on Architectural Design	3
ENAR600053	Special Topic on Urban Design	3
ENAR600054	Special Topic on Urban Housing and Settlement	3
ENAR600055	Special Topic on Architectural History, Theory and Criticism	3
ENAR600056	Special Topic on Building Technology	3
ENAR600057	Building Utility	3
ENAR600058	Tectonic Workshop	3

***) Design Study are mandatory for students taking Final Project

Elective courses open to study programs outside architecture/ interior architecture:

Code	Elective Course	SKS
ENAR600021	Coastal Architecture	3
ENAR600023	Architecture, City, and Power	3
ENAR600027	Urban Ecology	3
ENAR600047	Project Feasibility Study	3

S1 Architecture KKI (single degree)

	GENERAL AND BASIC ENGINEERING	BASIC	SKILL	ENRICHMENT	
8			Undergraduate Thesis/Final Project [6]	Elective [2] Elective [3] Elective [3]	14 SKS
7			Arch. Design 5 [9]	Elective [3] Elective [3]	15 SKS
6	Integrated Character Building [5]	Introduction to Urban Context [3]	Arch. Design 4 [9]	Elective [3]	20 SKS
5	Religion [2]	Building Technology 3 [3]	Arch. Design 3 [9]	Elective [2] Elective [3]	19 SKS
4		Building Technology 2 [3]	Arch. Design 2 [8]	Elective [3] Elective [3] Elective [3]	20 SKS
3		Design Methods [3] Building Technology 1 [3] History and Theory of Architecture 2 [3]	Arch. Design 1 [7]	Elective [3]	19 SKS
2	Linear Algebra [4]	History and Theory of Architecture 1 [3]	Basic Design 2 [7]	Elective [3]	17 SKS
1	Academic Writing [3] Calculus 1 [3] Mechanics and Thermal Physics [3]	Introduction to Architecture [3] Digital Design Media [3]	Basic Design 1 [5]		20 SKS

Curriculum Structure Undergraduate Architecture International Program

Code	Subject	SKS
	1st Semester	
UIGE610002	Academic Writing	3
ENGE610001	Calculus 1	3
ENGE610005	Physics (Mechanics and Thermal)	3
ENAR611001	Basic Design 1	5
ENAR610009	Introduction to Architecture	3
ENAR610015	Digital Design Media	3
		20
	2nd Semester	
ENGE610004	Linear Algebra	4
ENAR610002	Basic Design 2	7
ENAR610010	History & Theory of Architecture 1	3
	Elective	3
	Sub Total	**17**
	3rd Semester	
ENAR610003	Architectural Design 1	7
ENAR610011	Design Methods	3
ENAR613012	Building Technology 1	3
ENAR610013	History & Theory of Architecture 2	3
	Elective	3
	Sub Total	**19**
	4th Semester	
ENAR610004	Architectural Design 2	8
ENAR610014	Building Technology 2	3
	Elective	3
	Elective	3
	Elective	3
	Sub Total	**20**
	5th Semester	
UIGE610004	MPK Religion	2
ENAR610005	Architectural Design 3	9
ENAR610016	Building Technology 3	3
	Elective	3
	Elective	2
	Sub Total	**19**
	6th Semester	
UIGE610006	Integrated Character Building	5
ENGE610006	Architectural Design 4	9
ENAR610017	Introduction to Urban Context	3
	Elective	3
	Sub Total	**20**
	7th Semester	
ENAR610007	Architectural Design 5	9
	Elective	3
	Elective	3
	Sub Total	**15**
	8th Semester	
ENAR610008	Undergraduate Thesis	6
	Elective	3
	Elective	3
	Elective	2
	Sub Total	**14**
	Total	**144**

*) Students are required to take 2 courses outside of the Undergraduate Architecture Program with the approval of the Academic Supervisor and Credit Transfer Team. Students can take Minor packages outside the Undergraduate Architecture Program with the approval of the Academic Supervisor and Credit Transfer Team.

**) Students can take an exchange program with a partner university with the approval of the Academic Advisor and the Credit Transfer Team

***) Elective Introduction to Sustainability is mandatory for those planning to take double degree in Curtin University or QUT

As the application of Merdeka Belajar, students can take electives in the form of internship, excursion/research project, community engagement, community development, etc.

For students taking single degree, all 144 credits will be taken in Universitas Indonesia. Students who want to pursue double degree with partner university should learn two years at the Department of Architecture Universitas Indonesia and two years in partner university.

Electives Courses

Code	Elective Course	SKS
ENAR610018	2D-Digital Design Communication	3
ENAR610019	3D-Digital Design Communication	3
ENAR610020	Acoustics	3
ENAR610021	Architecture, City and Power	3
ENAR610022	Capita Selecta	3
ENAR610023	Design Studies**	3
ENAR610024	Ethnic Architecture	3
ENAR610025	Field Study	3
ENAR610026	Heritage Architecture	3
ENAR610027	Independent Study	3
ENAR610028	Internship	3
ENAR610029	Introduction to Sustainability***	3
ENAR610030	Life Cycle Environment	3
ENAR610031	Lighting Design	3
ENAR610032	Photography	3
ENAR610033	Site Planning and Design	3
ENAR610034	Special Topic on Architectural Design	3
ENAR610035	Special Topic on Architectural History, Theory, and Criticism	3
ENAR610036	Special Topic on Building Technology	3

ENAR610037	Special Topic on Urban Design	3
ENAR610038	Special Topic on Urban Housing and Settlement	3

***) Design Study are mandatory for students taking Final Project

Course Structure at Curtin University

Code	Course Title	Credits
	Year 3-Semester 5 (July)	
COMS1010	Academic and Professional Communications	25
ARCH2022	Architectural Contexts Studio	25
ARCH2023	Architectural Contexts Methods	25
ARCH2004	Architecture and Identity	25
	Sub Total	100
	Year 3-Semester 6 (February)	
ARCH3026	Architectural Discourse and Spatial Intelligence Studio	25
ARCH3027	Architectural Discourse and Spatial Intelligence Methods	25
ARCH3009	Urban Contexts	25
ARCH3006	Environmental and Technological Systems in Architecture 1	25
	Sub Total	100
	Year 4-Semester 7 (July)	
ARCH3024	Architectural Discourse and Spatial Intelligence Studio	25
ARCH3025	Architectural Discourse and Spatial Intelligence Methods	25
ARCH3007	Environmental and Technological Systems in Architecture 2	25
ARCH3009	Architecture, Theory and Critique	25
	Sub Total	**100**
	Total Credits taken at Curtin University	**300**

Course Structure at Queensland University of Technology (QUT)

QUT Study Plan – February Entry

Code	Subject
	Year 1 - February (First Semester at QUT)
DYB102	Impact Lab 2: People
DAB311	Systems and Structures
DAB301	Architectural Design : Commercial
	One Elective Unit
	Year 1 - July (Second Semester at QUT)
DAB212	Small Scale Building Construction
DAB302	Architectural Design 6: Communities
DAB303	Integrated Architectural Technology
DAB312	Building Services
	Year 2 - February (Third Semester at QUT)
DYB201	Impact Lab 3: Planet
DYB112	Spatial Materiality
DAB200	Modern Architecture
DAB312	Select one unit from the Impact Lab Unit Options List: • DYB301 Impact Lab 4: Purpose OR • KKB341 Work Integrated Learning 1 OR • KKB350 Creative Industries Study Tour

QUT Study Plan – July ntry

Code	Subject
	Year 1 - July semester (First Semester at QUT)
DYB102	Impact Lab 2: People
DAB303	Integrated Architectural Technology
DAB212	Small Scale Building Construction
	One Elective Unit
	Year 2 - Feb semester (Second Semester at QUT)
DYB112	Spatial Materiality
DAB200	Modern Architecture
DAB311	Systems and Structures
DAB301	Architectural Design 5: Commercial
	Year 2 - July semester (Third Semester at QUT)
DAB302	Architectural Design 6: Communities
DYB201	Impact Lab 3: Planet
DAB312	Building Services
	Select one unit from the Impact Lab Unit Options List: • DYB301 Impact Lab 4: Purpose OR • KKB341 Work Integrated Learning 1 OR • KKB350 Creative Industries Study Tour

Course Syllabus of University Subjects

INTEGRATED CHARACTER BUILDING

UIGE600001/UIGE610001
5 credits

Syllabus:

The Integrated Character Building is part of the Higher Education Personality Development Lecture which is held for students which contains elements of the internalization of basic life values, interaction/relationship skills, nationality and academic skills as the basis for student personality to carry out learning according to scientific disciplines.

MPKT is carried out in the form of a series of learning activities outside the formal class. activities carried out include participation in lectures/seminars, internships, field work practices, social work, sports and/or arts activities and other forms of activities that have the main goal of equipping students with soft skills and proven by portfolio documents. The form of this learning activity is different from the MPKT courses that have been carried out at the previous UI.

The material provided at MPKT aims to form a human thinking pattern with values and morals to create a human personality by having critical, logical, creative, innovative thinking, and having intellectual curiosity and an entrepreneurial spirit. The material provided includes 9 UI values, national, state and citizen values based on Pancasila. Solving problems in science, technology, health, and humans as natural managers by using reasoning and utilizing Information and Communication Technology (ICT) to achieve the final objectives of this module.

Lecture activities are carried out using an online student-centered learning (SCL) approach which can use the following methods: experiential learning (EL), collaborative learning (CL), problem-based learning (PBL), question-based learning, and project based learning. The use of these various methods is carried out through group discussion activities, independent assignment exercises, presentations, writing papers in Indonesian and interactive discussions in online discussion forums. The language of instruction in this lecture is Indonesian.

Graduate Learning Outcomes:
- CPL 1: Able to use spoken and written language in Indonesian and English both for academic and non-academic activities (C3, A5)
- CPL 2: Have integrity and are able to think critically, creatively, and innovatively and have intellectual curiosity to solve problems at the individual and group level (C4, A3)
- CPL 3: Able to provide alternative solutions to various problems that arise in the community, nation, and country (C4, A2)
- CPL 4: Able to take advantage of information communication technology (C3)
- CPL 5: Able to identify various entrepreneurial efforts characterized by innovation and independence based on ethics (C2, A5)

Course Learning Outcomes:
- CPMK 1: After completing this course, students are able to apply self-regulated learning characteristically in studying critically, logically, creatively, innovatively through analysis of societal problems, nation, state, and Pancasila ideology based on self-understanding as individuals and members. the community by using good and correct Indonesian and the latest information and communication technology (C4, A4)
- CPMK 2: Able to identify various entrepreneurial efforts characterized by innovation and independence based on ethics (C2, A5)
- CPMK 3: After completing this course, students are able to apply self-regulated learning characteristically in pursuing integrated and comprehensive knowledge through analysis of science problems, technology based on the role of nature manager by using good and correct Indonesian and information technology and current communications. (C4, A4)
- CPMK 4: After completing this course, students are able to plan creative activities to solve problems in society and the world of work/industry by showing creativity, critical thinking, collaborative self-discipline using good and correct Indonesian as well as the latest information and communication technology (C5, A5)

Prerequisites :

None

ACADEMIC WRITING

UIGE610002
2 credits

The objectives of the English component of the MPK program are :

6. To activate students, English so that they will be able to communicate effectively in English;
7. To enable students to develop the learning strategies and study skills needed to finish their study successfully and o continue learning on their own after taking the MPK program (to develop independent learners)

Main Competencies :

By the end of the course, students should be able to :
- Listen to, understand and take notes of key information in academic lectures of between 5-10 minutes length;
- Improve their listening skills through various listening materials and procedures;
- Speak confidently, ask questions in and contribute to small group discussions;
- Use different reading strategies needed to the effective readers;
- Improve their reading skills through extensive reading material;
- Develop skills in connecting ideas using appropriate transitions and conjunctions;
- Work as part of a group to prepare and deliver a 25-minute presentation on an academic topic using appropriate organization, language and visual aids;
- Write a summary of a short academic article;
- Write an expository paragraph;
- Write a short essay.

Learning Method : Active learning, Contextual language learning, small group discussion.

Prerequisite :
1. Students Learning Orientation/Orientasi Belajar Mahasiswa (OBM)

ENGLISH

UIGE600003
2 credits

The objectives :

After attending this subject, students are expected to be capable of using English to support the study in university and improve language learning independently.

Syllabus :

Study Skills : (Becoming an active learner, Vocabulary Building: word formation and using the dictionary Listening strategies Extensive reading) Grammar: (Revision of Basic grammar Types of sentences Adjective clauses, Adverb clauses Noun clauses, Reduced clauses) Reading: (Reading skills: skimming, scanning, main idea, supporting ideas, Note-taking Reading popular science arti-cle, Reading an academic text) Listening: (Listening to short conversations, Listening to a lecture and notetaking, Listening to a news broadcast, Listening to a short story) Speaking: (Participating in discussions and meetings, Giving a presentation) Writing: (Writing a summary of a short article Describing graphs and tables, Writing an academic paragraph, Writing a basic academic essay (5 paragraphs).

ISLAMIC STUDIES
UIGE600010/UIGE610005
2 credits

General instructional objectives :

The cultivation of students who have concern for social, na-tional and countrys issues based on Islamic values which is applied in the development of science through intellectual skills.

Learning Objectives :

Course participants are expected to do the following when faced with a problem or issue which they must solve :
1. Analyze the problem based on the Islamic values they adopted;
2. Analyze the problem by implementing active learning stages;
3. Discuss and express their thoughts and ideas by using proper and correct Indonesian language in discussion and academic writing.

Syllabus :

Islam history: the meaning of Islam, the characteristic of Islam, the sources of Islamic teachings, Muhammad SAW as prophet and history figure, introduction of Islam in Indonesia, the teaching essence of Islam: the basic principle of Islam teachings, the unity of Allah, worship prac-tice in live, eschatology and work ethics, human's basic rights and obligation, social structure in Islam: sakinah mawaddah and ramhah family, the social implication of family life, Mosque and the development of Islam, zakat and the economic empowerment of the people, Islam society, Science: reason and revelation in Islam, Islam's motivation in development of science, science characteristics, source of knowledge, IDI (each Faculty and Department/Study Program).

CATHOLIC STUDIES
UIGE600011/UIGE610006
2 credits

General instructional objectives :
1. To help deliver students as intellectual capital in implementing lifelong learning process to become scientists with mature personality who uphold humanity and life.
2. Be scholars who believe in God according to the teachings of Jesus Christ by continuing to be responsible for his faith in life in church and society.

Syllabus :

Almighty God and the God teachings; Man, Morals, science technology and art; harmony between religions; Society, Culture, Politics, Law: the substance of theses studies will be addressed by integrating the four dimensions of the teachings of the Catholic faith: the personal dimension, the dimension of Jesus Christ, the dimension of the Church, and Community dimension. Dimensions are implemented in the following themes: People, Religion, Jesus Christ, the Church, and Faith in the society.

CHRISTIAN STUDIES
UIGE600012/UIGE610007
2 credits

General instructional objectives :

Cultivating students with comprehensive Christian knowledge and teaching in the midst of the struggle and the fight of the nation while also discussing the student's participation in line with the study to help improve and build our country.

Learning Objectives :

Course participants are expected to do the following when faced with a problem or issue which they must solve:
1. Analyze the problem based on the Christian values
2. Analyze the problem by implementing active learning stages
3. Discuss the problem by using proper and correct Indonesian language

Syllabus :

History (Historical terms): Status of the Bible, the existence of God and Morality, Christ the Savior, the Holy Spirit as existence reformer and outlook on the world: Faith and Knowledge of Science, Church and service, Ecclesiology, Spiritual and enforcement of Christian Human Rights and the world of ethics: Christian Ethics, Christian and worship, Christianity and politics, Christian love and social reality: Christian Organizations, Students and Service, Christian and expectations.

HINDU STUDIES
UIGE600013/UIGE610008
2 credits

Syllabus :

Hindu religion, Hindu history), Source and scope of Hinduism (the Veda as the source of Hindu religion teachings, the scope of the teachings in Hindu religion), The concept of the God (Brahman) according to the Veda, the Path to Brahman (Catur Marga Yoga, Mantra and Japa), Human Nature (The purpose of human life, Human's duties, obligations, and responsibilities both individually or collectively), Ethics and morality (Principles teaching, self-control), in-depth understanding of the scripture (deep understanding of the Bhagawadgita, deep understanding of the Sarasamuschaya), The Role of Hinduism in science, technology, and art (Hinduism benefits in science and technology in accordance with each department, benefit / the role of Hinduism in the arts), Cohesion and community's prosperity /independence (Benefits of unity in the religious plurality, independent community (kerthajagathita) as a common goal, Tri Pitakarana), Culture as an expression of Hindu religious practice, Contribution to the Hindu religion teachings in the political life of nation and country, laws and the enforcement of justice, Awareness of and obeying the Rita / Dharma.

BUDDHIST STUDIES
UIGE600014/UIGE610009
2 credits

Syllabus :

Almighty God and the God Study (Faith and piety, Divine Philosophy/Theology), Human (Human Nature, Human Dignity, Human Responsibility), Moral (Implementation of Faith and Piety in everyday life), Science, Technology and Art (Faith, Science and Charity as a unity, the Obligation to study and practice what you are taught, Responsibility for nature and environment), harmony between religion (religion is a blessing for all mankind, the essence of the religious plurality and togetherness), community (the role of religious society in creating a prosperous independent society, the responsibility of religious society in the realization of human rights and democracy), Culture (the responsibility of religious society in the realization of critical thinking (academic), work hard and fair), Politics (Religion contribution in the political life of nation and country), Law (Raise awareness to obey and follow God's law, the role of religion in the formulation and enforcement of law, the function of religion in the legal profession).

KONG HU CU STUDY

UIGE600015/UIGE610010
2 credits

Course Syllabus of Faculty Subjects

CALCULUS 1

ENGE600001/ENGE610001
3 Credits

Course Learning Outcomes:

Able to use the basic concepts of calculus related to -a function of one variable, the derivative and integration of the function of one variable in order to solve its applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, basic engineering, and engineering specialization to be used in solving complex engineering problems.

Syllabus :

Introduction, Functions and Limits, The Derivative, Applications of the Derivative, The Definite Integral, Applications of The Definte Integral, Transcendental Functions, Techniques of Integration, Indeterminate Forms and Improper Integrals.

Prerequisite: None

Textbooks:

Main reference:
D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., Pearson, Prentice Hall, 2007.

Additional eferences:
1. George B. Thomas Jr., Thomas' Calculus Early Transcendental, 12th ed., Addison–Wesley Pearson, 2009.
2. Howard Anton, Calculus, 10th ed., John Wiley and Sons, 2012.

CALCULUS 2

ENGE600002/ENGE610002
3 Credits
Course Learning Outcomes:

Students are able to use the concepts of sequences, series, conic sections, and the basic concepts of calculus which involve the function of two or three variables to solve their applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :

Infinite sequences and infinite series, Test for convergence of positive series and alternating series, Power series and operation on operations, Taylor and MacLaurin series, Conic sections , Calculus in polar coordinates, Derivatives, limits, and continuity of multi-variables functions, Directional derivatives and gradients, Chain Rule, Tangent planes and Approximations, Lagrange multipliers. Double integrals in Cartesian coordinates and polar coordinates, triple integrals in Cartesian coordinates, cylindrical coordinates and spherical coordinates, Applications of double and triple Integral.

Prerequisite: Calculus 1

Textbooks:
1. D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., PEARSON, Prentice Hall, 2007.
2. Thomas, Calculus Thirteenth Edition Volume 2, Erlangga, 2019.

CALCULUS

ENGE600003/ENGE610003
4 Credits
Course Learning Outcomes:

Students are able to use the basic concepts of calculus involving functions of one to three variables to solve their applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :

Introduction, Functions and Limits, Derivatives, Derived Applications, Indeterminate Integral, Integral Applications, Infinite Row, and Series. Derivatives with many variables, Duplicate Integral (2 and 3), Duplicate Integral Application.

Prerequisite: None

Textbooks:

Main reference:

D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., Pearson, Prentice Hall, 2007.

Additional:

George B. Thomas Jr., Thomas' Calculus Early Transcendental, 12th ed., Addison – Wesley Pearson, 2009 .

LINEAR ALGEBRA

ENGE600004/ENGE610004
4 Credits
Course Learning Outcomes:

Students are able to calculate linear system problems to solve engineering problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :

Linear Systems and matrix equations, Determinants, Euclid vector spaces, Common vector spaces, eigenvalues and eigenvectors, inner product spaces, Diagonalization and General Linear Transformation.

Prerequisite: None

Textbooks:
1. Elementary Linear Algebra, Howard Anton & Chris Rorres, 11th edition, 2014
2. Gilbert Strang, Introduction to linear algebra 3rd edition Wellesley Cambridge Press, 2003

MECHANICAL AND HEAT PHYSICS
ENGE600005 / ENGE610005
3 Credits
Course Learning Outcomes:

Able to explain the basic concepts of mechanics and thermodynamics, and be able to apply them to understand natural phenomena and human engineering, including their applications.

Graduate Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus:

Units, Magnitudes and Vectors, Motion Along Straight Lines, Motion in Two and Three Dimensions, Newton's Laws of Motion, Applications of Newton's Laws, Kinetic Energy, and Work, Potential Energy and Energy Conservation, Center of Mass, Linear Momentum, Rotation, Rolling Motion, Torque, Angular Momentum, Oscillation, Mechanical and Sound Waves, Gravity, Statics and Elasticity, Fluid Mechanics, Temperature, Heat, Law I Thermodynamics, Ideal Gas and Kinetic Theory of Gas, Heat Engine, Entropy, and Law II Thermodynamics.

Prerequisite: none

Textbooks:
1. Halliday, Resnick, and Walker, Principles of Physics 10th Edition, Wiley, 2014.
2. Serway Jewett, Physics for Scientists and Engineers 9th Edition, Thomson Brooks / Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008

ELECTRICAL MAGNETIC, OPTICAL AND WAVE PHYSICS
ENGE600007 / ENGE610007
3 Credits
Course Learning Outcomes:

Students are able to apply the basic concepts of electrical physics, magnetism, waves, and optics to solve problems in the engineering field.

Graduate Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus:

Unit, Magnitude, Vector, Electric Charge, Electric Field, Gauss Law, Electric Potential, Capacitance, Electric Current, Resistance, Direct Current, Magnetic Field Due to Electric Current, Magnetic Field Source, Induced GGL, Inductance, Alternating Current, Electromagnetic Waves, Light Properties and Propagation, Optical Geometry.

Prerequisite: none

Textbooks :
1. Halliday, Resnick, and Walker, Principles of Physics 9th Edition, Wiley, 2011.
2. Serway Jewett, Physics for Scientists and Engineers 9th Edition, Thomson Brooks / Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008.

BASIC CHEMISTRY
ENGE600009 / ENGE610009
2 Credits
Course Learning Outcomes:

Students are able to analyze the principe of basic chemistry for application in engineering.

Graduates' Learning Outcomes:

Able to apply mathematics, science, and basic engineering to be used in solving complex engineering problems.

Syllabus:

Material and measurements, atoms, molecules and ions, stochiometry, water phase reactions and solution stochiometry, thermochemistry, chemical equilibrium, acid and base equilibrium, electrochemistry, chemical kinetics, and chemical applications.

Prerequisite: none

Textbooks :
1. Ralph H. Petrucci, General Chemistry: Principles and Modern Applications, 8th Ed. Prentice Hall Inc., New York, 2001.
2. John McMurry, Robert C. Fay, Chemistry (3rd ed.), Prentice Hall, 2001.
3. Raymond Chang, Williams College, Chemistry (7th ed.), McGraw-Hill, 2003.

ENGINEERING ECONOMY
ENGE600011 / ENGE610011
3 Credits
Course Learning Outcomes:

Students are able to analyze the economic and financial feasibility of making economic practice decisions.

Graduate Learning Outcomes:

Able to apply the principles of technical management and decision making based on economic considerations, in individual and group, as well as in project management.

Syllabus:

Introduction to Engineering Economics, Time Value of Money, Combining Factors, Interest Rates, Money Worth Analysis, Rate of Return Analysis, Effects of Inflation, Benefit Cost & Break-Even Point Analysis, Sensitivity Analysis, Depreciation, Tax Analysis, Cost Estimation & Allocation, Capital Budgeting & Replacement Analysis.

Prerequisite:
1. Civil Engineering : -
2. Environmental Engineering : -
3. Naval Engineering : -
4. Industrial Engineering : must pass the introductory Economic course and have completed 38 credits
5. Chemical Engineering : -
6. Bioprocess Engineering : -

Textbooks:
1. Blank, Leland and Tarquin, Anthony. 2018. Engineering Economy 8th Ed. McGraw Hill.
2. Park, Chan S. 2016. Contemporary Engineering Economics 6th Ed. Pearson. Upper Saddle River.

3. White, Case and Pratt. 2012. Principles of Engineering Economic Analysis 6th ed. John Wiley and Sons.

STATISTICS AND PROBABILISTICS
ENGE600010 / ENGE610010
2 Credits
Course Learning Outcomes:

Students are able to handle quantitative data/information starting from the descriptive stage (collection, organization, and presentation) to the inductive stage, which includes forecasting and drawing conclusions based on the relationship between variables for decision making.

Graduate Learning Outcomes:
1. Apply descriptive statistics and probability theory to data processing and serving
2. Apply probability distribution to data processing and serving
3. Apply the principles of sampling and estimation for decision making
4. Apply hypothesis test samples for decision making

Syllabus:

Introduction to Statistics for Engineering Studies, Probability Theory, Dasar Basic concepts and definitions, Distribution Probability, Sampling, Estimation, Hypothesis testing, Hypothesis test 1 sample at an average value, Regression

Prerequisite: none

Textbooks :
1. Harinaldi, Basic Principles of Statistical Engineering and Science, Erlangga, 2004
2. Montgomery, DC., And Runger, GC., Applied Statistics and Probability for Engineers, John Wiley Sons, 2002

HSE PROTECTION
ENGE600012 / ENGE610012
2 Credits
Course Learning Outcomes:

Upon completion of this subject students are expected to be able to carried out hazard identification, and characterization, to propose appropriate methods for risk reduction and mitigation, and to design safety management system. The student is also expected to improve their awareness on industrial safety and health, and understanding on safety regulation framework and standards as well as environmental program.

Graduate Learning Outcomes:
1. Students are expected to understand safety, health and environmental aspect as an integral part of fundamental principal in engineering code of ethics.
2. Students are expected to be able to carry out process of risk assessments by considering risk factors in the impact of hazards on people, facilities, and the surrounding community and environemt.
3. Students are expected to understand the regulatory framework and standard related to the stages of life cycle of machine, building structure, construction, and process.
4. Students are able to design and propose an effective hazard communication, management and engineering control, and risk mitigation through an engineering assignment project.
5. Students are able to identify the knowledge required to perform risk assesment, investigation and design improvement through a multidisiplinary case of incident and accident.

Syllabus:

Introduction to SHE Regulation and Standards, SHE Perception (Risk and Environment), Identification, Assessment and Management, Construction, machinery and Noise hazards, Process safety hazard and analysis technique, Fire and explosion hazard, Electrical hazard, Toxicology in the Workplace, Ergonomy Aspect, Hazard communication to employees, Environmental Protection, Case studies, Safety Health and Environment audits.

Prerequisite: none

Textbooks :
1. Charles A. Wentz, Safety, Health and Environmental Protection, McGraw Hill, 1998.
2. Asfahl, C.R., Rieske, D. W., Sixth Edition Industrial Safety and Health Management, Pearson Education, Inc., 2010.
3. United Kingdom - Health and Safety Executive, http://www.hse.gov.uk/
4. National laws and regulations related to the K3 Management System and the Environment.
5. Related Journal (http://www.journals.elsevier.com/safety-science/) etc, related standards and publications

Course Description: Required Courses

INTRODUCTION TO ARCHITECTURE
ENAR600009/ENAR610009
3 CREDITS
Learning Objective:

Student should be able to understand basic principles in architecture, including basic theories, the relationship between architecture and human, architecture and nature, architecture and aesthetic, and architecture and technology; able to understand the position of architecture position among other disciplines.

Syllabus:

What is architecture? (Introduction: Architecture as discourse, career in architecture, arkhe + tekton; tekhne; Laugier primitive hut and the idea of shelter) Aesthetic (proportion; rhythm; scale; golden rules; aesthetic trinity of classic Greek; Mandala and Maya; Taoism and nature, mathematical pattern in geometry)

Form and Space (Plato and form; type and how Quatrèmere de Quincy mimic nature; form and function; various views on space and the different meaning of raum and spatium) Materiality and Materialization (re-investigating tekhne; the importance of understanding the characteristic and potential of material, tectonic which does not limit to construction)

Context (understanding of natural environment, artificial environment, and built environment; our existence and place according to Heidegger; material and context) Human and relationship with others I (the importance of understanding human for designer; under- standing of human being; body, senses and space; personal space according to Hall)

Human and relationship with others II (space, the presence and the remoteness of people, the meaning of place for human) Architects as profession

Prerequisites: -

References:
1. James O'Gorman, *ABC of Architecture*, University of Pennsylvania Press, 1998
2. Marcus Vitruvius Pollio, *Decem Libri de Architectura*, BiblioBazaar, 2008
3. Adrian Forty, *Words and Buildings: a Vocabulary of Modern*

Architecture, Thames and Hudson, 2004
4. Yusuf B. Mangunwijaya, *Wastu Citra*, Gramedia Pustaka Utama, 1988
5. Martin Heidegger, *Building Dwelling Thinking, in Poetry, Language, Thought*, HarperPerennial, 1975
6. M. Merleau-Ponty, *Phenomenologie de la Perception Chapter II*, Routledge & Kegan Paul Ltd, 1962
7. Edward T. Hall, *The Hidden Dimension*, Doubleday, 1966

HISTORY AND THEORY OF ARCHITECTURE 1

ENAR600010/ENAR610010

3 CREDITS

Learning Objective:

Student should be able to understand the history of modern architecture up to the contemporary era.

Syllabus:

This course is a survey of modern architecture history from 1750s to present, with main focus on the development of modern architecture. This course also discusses the relationship between the development of architecture and its socio-cultural, political, and technological contexts. This course also investigates principles in architecture and design. It emphasizes on several important moments in the development of modern architecture, and provide knowledge on the theories that are relevant to modern architecture.

Prerequisites: -

References:

1. Kenneth Frampton, *Modern Architecture: A Critical History 3rd Ed,* Thames & Hudson, 1997
2. Leonardo Benevolo, *History of Modern Architecture, Volume I & II*, MIT Press, 1979
3. Iain Borden, *Architecture and the Sites of History, Interpretations of Buildings and Cities*, Butterworth Architecture, 1995
4. William J.R. Curtis, *Modern Architecture since 1900, Third Edition*, Phaidon Press, 2002
5. Diane Ghirardo, *Architecture After Modernism,* Thames & Hudson, 1996
6. Spiro Kostof, *A History of Architecture, Settings & Rituals, 2nd Edition*, Oxford University Press, 1994
7. Bernd Evers & Christof Thoenes (eds.), *Architectural Theory: from the Renaissance to the Present,* Taschen, 2003

DESIGN METHODS

ENAR600011/ENAR610011

3 CREDITS

Learning Objective:

Student should be able to understand the basic thinking and methods of designing built environment; student should be able to explain the basic thinking and apply one of the design methods through writings and drawings.

Syllabus:

Theory and method of thinking; phenomenology, semiotic; theory and method of identifying problems; architectural observation, design knowledge, factual, deontic, instrumental, black box, clear box; theory and method of understanding problems, analysis and synthesis; Theory and methods of problem solving.

Prerequisites:
Student has taken Introduction to Architecture

References:

1. Christoper Alexander, *Notes on The Synthesis of Form*, Harvard University Press,1994
2. Don Koberg & Tim Bagnall, *The Universal Traveller: a Soft System Guide to Creativity, Problem Solving, & the Process of Reaching Goals*, Crisp Learning, 1991.
3. Gunawan Tjahjono, *Metode Perancangan: Suatu Pengantar untuk Arsitek dan Perancang*, 1998
4. Jean-Pierre Protzen & David J. Harris, *The Universe of Design: Horst Rittel's Theories of Design and Planning*, Routledge, 2010

HISTORY AND THEORY OF ARCHITECTURE 2

ENAR600013/ENAR610013

3 CREDITS

Learning Objective:

Student should be able to demonstrate knowledge of history of architecture in Indonesia from the end of 19th century to 20th century

Syllabus:

This course is a survey of history of architecture in Indonesia from the end of 19th century to 20th century. Various influences from overseas–India, China, Middle East and Western –take part in the development of architecture in Indonesia. Therefore it is important to understand Indonesian architecture and its relation with Non-Western and Western architecture, and architecture of vari- ous ethnic groups in Indonesia. Through discussion and analysis of buildings, drawings, photos and written materials, this course emphasizes on the interdependence among architecture, human, tropical climate, socio-culture background, politics and the development of technology in Indonesia.

Prerequisites: -

References:

1. Adolf Heuken SJ, *Tempat-Tempat Bersejarah di Jakarta*, Yayasan Cipta Loka Caraka, 1997
2. Helen Jessup, *Dutch Architectural Visions of the Indonesian Tradition*, Muqarnas v. 3, 1985, pp: 138-61.
3. Kemas Ridwan Kurniawan, *Postcolonial History of Architecture and Urbanism of Indonesian Tin Mining in Muntok Bangka*, VDM, 2011
4. Abidin Kusno, *Behind the Postcolonial: Architecture, Urban Space and Political Cultures in Indonesia,* Routledge, 2000
5. Scott Mirelles, *Historical Photographs of Batavia*
6. Rudolph Mrazek, *Engineers of Happy Land: Technology and Nationalism in a Colony*, Princeton University Press, 2002
7. Peter J.M Nas (ed.), *The past in the Present: Architecture in Indonesia*, NAi Publishers, 2006
8. Pauline Rosmaline, *Designing Colonial Cities: the Making of Modern Town Planning in the Dutch East Indies and Indonesia 1905-1950,* International Institute for Asian Studies the Newsletter 57, 2011
9. Iwan Sudradjat, *A Study of Indonesian Architectural History*, Ph.D Thesis at the Department of Architecture, University of Sydney, 1991
10. Yulianto Sumalyo, *Arsitek Kolonial Belanda dan Karya-karyanya*, Gama Press, 1992
11. Gunawan Tjahjono (ed), *The Indonesian Heritage Series*, Archipelago Press, 1998.
12. M. Nanda Widyarta, *Mencari Arsitektur Sebuah Bangsa; Sebuah Kisah Indonesia*, Wastu Laras Grafika, 2007
13. Yulia Nurliani Lukito, *Exhibiting Modernity and Indonesian Vernacular Architecture*, Springer VS, 2016

DIGITAL DESIGN MEDIA

ENAR600015/ENAR610015

3 CREDITS

Learning Objective:

Student should be able to express, explore, investigate and communicate architectural ideas by using digital media.

Syllabus:

Introduction to techniques and variety of digital media which can be applied to represent architectural ideas, investigate the basic abilities of various digital tools, choosing the appropriate digital tools and techniques to express, explore or investigate certain architectural ideas, studying the workflow of digital and analog media as a part of the architectural design process.

Prerequisites: -

References:

1. L Farrelly, *Basic Architecture: Representation Techniques.* London, Thames&Hudson, 2008
2. B Kolarevic, (Ed), *Architecture in the Digital Age: Design and Manufacturing*, Spon Press, 2003
3. P Laseau, *Architectural Representation Handbook: Traditional and Digital Techniques for Graphic Communication*, McGraw-Hill Companies, 2000

BASIC DESIGN 1

ENAR600001/ENAR610001
5 CREDITS
Learning Objective:

Student should be able to produce 2D and 3D works as creative responses towards contexts by appplying basic knowledge of visual art and design; Student should be able to acquire and apply basic 2D and 3D representational techniques.

Syllabus:

Basic knowledge of visual art and design, basic knowledge of aesthetic; basic knowledge of space; visual elements: shape, color, texture, etc; basic principles of composition; introduction to art history and its role in the making of art; basic drawing techniques: expression drawing; shape drawing (natural and manmade objects); basic modeling and assembling techniques; understanding characteristics of media and materials; perceiving visually and communicating what is perceived; display and layout techniques.

Prerequisites: -

References:

1. Louis Fisher Rathus, *Understanding Art*, Prentice Hall, 1994
2. Claire Holt, *Art in Indonesia, Continuity and Changes*, Cornel University,Ithaca and London, 1967
3. Johannes Itten, *The Elements of Color*, John Wiley & Sons, 1970
4. Harvard Anarson, *History of Modern Art: Painting, Sculpture, Architecture & Photography*, Prentice Hall, 1998
5. Kimberly Elam, *Geometry of Design: Studies in Proportion and Composition*, Princeton, 1998
6. Gyorgy Kepes, *Structure in Art and in Science,* George Braziller, 1965
7. Frank D. K. Ching, *Architecture: Form, Space & Order*, John Wiley & Son, 1997
8. John Heskett. *Design: A Very Short Introduction*. Oxford: Oxford University Press, 2002.

BASIC DESIGN 2

ENAR600002/ENAR610002
7 CREDITS
Learning Objective:

Student should be able to produce spatial works as creative responses towards contexts by applying knowledge of visual art and design and employed various 2D and 3D representation techniques; Student should be able to communicate architectural ideas by using appropriate techniques and media.

Syllabus:

Basic knowledge of relationship among space, human and time; Exploration of visual elements, non-visual elements (audio, kinesthetic) and moving elements (kinetics); creating spatial ideas as response to contexts; principles of architectural communication, basic architectural communication techniques: projection drawing, orthographic drawing, perspective drawing; modeling and assembling techniques; model making; understanding characteristics of media and materials; com- municating object and space for various purpose and audiences; communicate human activity space.

Prerequisites:
Student has taken Basic Design 1

References:

1. Francis D.K. Ching, *Drawing & Perceiving: A Visual Dictionary of Architecture*, John Wiley & Sons, 1996
2. Francis D.K. Ching, *Architectural Graphics, 2nd Ed*, John Wiley & Sons, 2002
3. Francis DK Ching, *Drawing: A Creative Process*, Wiley, 1989
4. Paul Laseau and Norman Crewe, *Visual Notes for Architects and Designers*, Wiley, 1986
5. Jeffrey Balmer, Michael T. Swisher, *Diagramming the Big Idea: Methods for Architectural Composition*, Routledge, 2012
6. Mark Basinger, *Drawing Ideas*, Random House, 2013
7. Don Norman, *The Design of Everyday Things*, Basic Books, 2013
8. Atelier Bow Wow, *Graphic Anatomy,* Toto, 2007
9. Joy Monice Malnar, *Sensory Design,* University of Minnesota Press, 2004
10. Peter Zumthor, *Atmospheres: Architectural Elements, Surrounding Objects,* Birkhauser, 2006

ARCHITECTURAL DESIGN

Architectural design courses are the studio courses at the Department of Architecture. The studios denote learning locations as well as learning methods. At the end of studio-based learning process, students should be able to demonstrate their ability to think critically and creatively, which can be assessed from their ability to explain and present his/her design ideas. Architectural Design learning process is implemented through Design Projects, which are direct manifestations of integration of knowledge, consisting of:

- Factual knowledge: understanding and formulating design problems which are abstract, qualitative, and related to socio-cultural aspects of human/space activities.
- The context and the environment of living space, ranging from micro/local/personal space, family, community, to urban/rural environment.
- Technical aspects such as structure (statics), tectonics (including building materials), building physics, and building systems.
- Design Methods
- Communication Techniques

In practice, Design Projects accommodate learning materials from several courses: Architectural Design, Building Technology, and Introduction to Urban Context, within the following order:

- Design Project 1 integrates Architectural Design 1 and Building Technology 1
- Design Project 2 integrates Architectural Design 2 and Building Technology 2

- Design Project 3 integrates Architectural Design 3 and Building Technology 3
- Design Project 4 integrates Architectural Design 4 and Introduction to Urban Context

Gradual acquitison of knowledge and ability is structured within each stage of learning in Architectural Design in each semester.

DESIGN PROJECT 1

Design Project 1 focuses on the design of space for human self. Design Project 1 is an integration of knowledge on spatial design, based on the understanding of the relationship between human and space, basic structural logic, and basic principles of environmental comfort within spatial design. Design Project 1 consist of learning activities performed in two courses which complement each other, Architectural Design 1 and Building Technology 1.

ARCHITECTURAL DESIGN 1
ENAR600003/ENAR610003
7 CREDITS
Learning Objective:

Student should be able to design a space for a single person, through understanding the relationship between human and space.

Syllabus:

Architectural Design 1 is an early and critical stage to introduce students to architecture through imaginative, creative, and innovative spatial design. Architectural knowledge encompasses basic comprehension about the personal spatial meaning and experience, interaction between human body and spatial quality, understanding of site and surrounding context as experienced by human body. Design activities consists of information gathering, formulation of design problem, analysis, and making critical decisions to formulate an active strategy toward human space, ability to think three-dimensionally through spatial design exploration, and communicating design ideas.

Design exercises consist of: Designing a simple space for a single person that is materialized through 1:1 scaled model; Designing a space for an episode of human life.

Prerequisites:
Students have taken Basic Design 2
Students have taken or are taking Building Technology 1

References:

1. Bruno Zevi, *Architecture as Space: How to Look at Architecture,* 1993.
2. Donlyn Lyndon and Charles W. Moore, *Chambers For A Memory Palace,* MIT Press, 1994
3. Edward T. Hall, *The Hidden Dimension*, Peter Smith Publications, 1992
4. Francis DK Ching, *Architecture: Form, Space and Order*, Wiley, 1996.
5. Karen Franck & Bianca Lepori, *Architecture Inside Out*, Academy Press, 2000.
6. Michael Pollan, *A Place of My Own*. Penguin Press, 2008.
7. Steen Eiler Rasmussen, *Experiencing Architecture*, MIT Press, 1959.
8. Yi-Fu Tuan, *Space and Place: The Perspective of Experience*, University of Minnesota Press, 1981

BUILDING TECHNOLOGY 1
ENAR600012/ENAR610012
3 CREDITS
Learning Objective:

Students should be able to understand basic technical aspects of structure, material, construction, and building comfort; should be able to formulate technical design process and integration of structure and construction technologies into a functionally effective whole; should be able to produce a report of analysis and synthesis of all aspects of building technology.

Syllabus:

Structure in nature; Basic principle sof structure and construction (logic of structure, basic mechanics); Site context (natural elements that influence building); Building material (material use and position in building, material property values that influence comfort); Basic building physics (building orientation, environmental influence to comfort); Introduction to basic structure and construction principles of simple building; Introduction to working drawing.

Prerequisites: -

References:

1. Mario Salvadori, *Why Building Stands Up*, W.W. Norton & Company, 2002
2. W. O. Kilmer, *Construction Drawings and Details for Interiors: Basic Skills*, John Wiley and Sons, 2003
3. Bjorn N Sandaker, Arne P Eggen, and Mark R Cruvellier, *The Structural Basis of Architecture: Second Edition*, Routledge, 2011
4. Forest Wilson, *Structure: The Essence of Architecture*, Van Nostrand Reinhold Company, 1971
5. Mark Dekay and G. Z. Sun Brown, *Wind & Light: Architectural Design Strategies: 3rd Edition,* John Wiley & Sons, 2014
6. Francis DK Ching, *Building Construction Illustrated,* Wiley, 2014
7. Edward Allen and Joseph Iano, *The Architect Studio Companion: Rules of Thumb for Preliminary Design,* Wiley and Sons, 2002
8. Ken Parsons, *Humn Thermal Environments: The effects of Hot, Moderate, and Cold Environments on Human Health, Comfort, and Performance*, CRC, 2014
9. Pete Silver and Will McLean, *Introduction to Architectural Technology.* Laurence King, 2013

DESIGN PROJECT 2

Design Project 2 is about designing space for core social unit (family, a couple, etc). Design Project 2 integrates knowledge on spatial design based on the idea dwelling, the analysis of family life cycle and daily activities, application of basic structural principles and constructions of low rise building, building systems, and principle of building physics. Design Project 2 integrates the learning activities performed in two courses that complement each other, Architectural Design 2 and Building Technology 2.

ARCHITECTURAL DESIGN 2
ENAR600004/ENAR610004
8 CREDITS
Learning Objective:

Students should be able to design a dwelling as a living space for core social unit through tectonic approach and by thorough consideration of the life cycle and daily activities of the core social unit.

Syllabus:

Architectural Design 2 proposes critical issues of human living space in urban community context, through the design of a dwelling. Design knowledge herewith includes the understanding concept of dwelling, observation and analysis of core social unit, formulating spatial program based on understanding of the needs of core social unit, development of spatial idea through tectonic explo- ration as *the art of joining* and exploration of spatial composition as an integration of *part-whole* that appropriately accommodate the programs, which are implemented into an integrated spatial design and communicated by complying with standard principles of architectural communication.

Design exercises consist of: Comprehensive precedent analysis of good dwelling; designing dwelling space for core social unit.

Prerequisites:

Students have taken Architectural Design 1
Students have taken or are taking Building Technology 2

References:

1. Martin Heidegger, *Building Dwelling Thinking, in Poetry, Language, Thought*, HarperPerennial, 1975
2. Adam Sharr with Simon Unwin, *Heidegger's Hut, in ARQ (Architectural Research Quarterly) Vol.5 No.1*, 2001
3. J Macgregor Wise, *Home: Territory and Identity pp. 391-396, in INTIMUS Interior Design Theory Reader,* 2006
4. Norberg Schulz, *The Concept of Dwelling – Introduction*, Rizzoli International Publications,1985
5. Hannah Arendt, *The Human Condition - Chapter I & II*, University of Chicago Press, 1958
6. A. Rapoport, *House Form and Culture - Chapter II Alternative Theories of House Form & Chapter III Socio-cultural Factors and House Form, pp. 18-82*, Prentice Hall Inc, 1969
7. Kenneth Frampton, *Studies in Tectonic Culture: The Poetics of Construction – Chapter I Introduction: Reflections on the Scope of the Tectonic*, MIT Press, 2001
8. Charles Moore, Gerrad Allen, Donlyn Lyndon, *Assembling A Room, in The Place of Houses*, University of California Press, 2000
9. Francis D. K. Ching, *Architecture: Form, Space and Order*, Wiley, 2014
10. Erik H. Erikson, *Life Cycle Completed – Chapter 3 Major Stages in Psychosocial Development*, W. W. Norton & Company, 1998
11. Jonathan Hill, *Immaterial Architecture – House and Home,* Routledge, 2006
12. Peter Zumthor, *Atmospheres: Architectural Environments, Surrounding Objects*, Birkhäuser Architecture, 2006

BUILDING TECHNOLOGY 2

ENAR600014/ENAR610014
3 CREDITS
Learning Objective:

Students should be able to understand technical aspects of structure, material, construction, and building comfort for low rise building; should be able to formulate technical design process and integration of structure, construction technologies and building systems into a functionally effective whole; should be able to produce a report of analysis and synthesis of all aspects of building technology.

Syllabus:

Identification of all aspects of building technology in a simple low rise building that include: structural logic, buildability, and comfort; Introduction to in-depth knowledge on the materiality of material, construction techniques and details; Dimension and configuration of materials and their relation to structure and construction of simple building; Elements of air conditioning and lighting in a building; Introduction to basic knowledge of building utility; Creating technical documentations (working drawing).

Prerequisites:

Students have taken Building Technology 1
Students have taken or are taking Architectural Design 2

References:

1. Francis DK Ching, *Building Construction Illustrated,* Wiley, 2014
2. Arthurs Lyons, *Materials for Architect & Builders*, Butterworth-Heinemann, 2008
3. Graham Bizley, *Architecture in Details*, Architectural Press, 2008
4. Andrea Deplazes, *Constructing Architecture: Materials Processes Structures, A Handbook*, Birkhauser, 2008
5. Gail Peter Borden, *Material The Typology of Modern Tectonics*, Wiley, 2010
6. Thomas Schropfer, *Material Design*, Birkhauser Architecture, 2010
7. Norbert Lechner, *Heating, Cooling, Lighting: The Sustainable Design Methods for Architect*, Wiley, 2013
8. Charlie Wing, *How Your House Works: a Visual Guide to Understanding and Maintaining Your Home, Updated and Expanded,* RSMeans, 2012
9. Corky Binggeli, *CorkyBuilding Systems for Interior Designers*, John Wiley & Sons, 2003

DESIGN PROJECT 3

Design Project 3 is studio that focuses on aspects of buildability and building performances. Design Project 3 is an integration of design knowledge through technological approach, implementation of structural principles, construction and material, building supporting system and the use of tech- nology in the design process. Design Project 3 integrates the learning activities performed in two courses that support each other, Architectural Design 3 and Building Technology 3.

ARCHITECTURAL DESIGN 3

ENAR600005/ENAR610005
9 CREDITS
Learning Objective:

Students should be able to design a building based on the development of technological ideas.

Syllabus:

Architectural Design 3 proposes the critical issues on the aspects of buildability and building performance. Design knowledge includes the development of advanced tectonic ideas, encompassing exploration of material, detail and construction, and the development of architectural ideas based on building performance and system. Knowledge of site and environment includes the contextual explanation of design through the understanding of the site physical condition and consideration of sustainability. Knowledge on the role of technology in architectural design process in terms of representation, modeling and simulation.

Prerequisites:

Students have taken Architectural Design 2
Students have taken or are taking Building Technology 3

References:

1. Chris Abel, *Architecture, Technology and Process*, Architec- tural Press, 2004.
2. Ed van Hinte et al, *Smart Architecture,* 101 Publishers, 2003.
3. Robert Kronenburg & Filiz Klassen, *Theory, Context, Design and Technology – Trasnportable Environments 3,* Taylor & Francis, 2006.
4. Pete Silver and Will McLean, *Introduction to Architectural Technology*, Laurence King Publishing, 2013.
5. Bjorn Sandaker, *On Span and Space: Exploring Structures in*

Architecture, Routledge, 2008
6. Branko Kolarevic and Ali Malkawi, *Performative Architecture : Beyond Instrumentality*, Spon Press, 2005

BUILDING TECHNOLOGY 3

ENAR600016/ENAR610016
3 CREDITS
Learning Objective:

Students should be able to understand technical aspect of structure, material, construction, and building comfort for advanced building (high rise/wide span building); should be able to formulate technical design process and integration of structure, construction technology and utility system as a functionally effective whole; should be able to formulate utility system, transportation and communication system, building maintenance and safety; should be able to perform technical documentation and to create analysis/synthesis report from all aspect of building technology; should be able to understand energy conservation issues and ecological sustainability.

Syllabus:

Advanced building structure (wide span and/or high rise); Building system, advanced utility system (comfort, transportation, communication, maintenance, and building safety); Sustainable building energy conservation; Basic knowledge of ecological sustainability issues.

Prerequisites:
Students have taken Building Technology 2
Students have taken or are taking Architectural Design 3

References:
1. Yonca Hurol, *The Tectonic sof Structural Systems: An Architectural Approach*, Routledge, 2015
2. D Schodek, *Structures, 7th Edition*, Prentice Hall, 2013
3. Chris Lefteri, *Materials for Design*, Laurance King Publishing, 2014
4. Bjarke Ingels, *Big, Hot To Cold: an Oddsey of Architectural Adaptation,* Taschen, 2015
5. Farshid Moussavi, *The Function of Form*, Harvard Graduate School of Design, 2009
6. William McDonough and Michael Braungart, *The Upcycle: Beyond Sustainability: Design for Abundance*, North Point Press, 2013
7. Rob Thompson, *Sustainable Materials, Processes and Production*, Thames and Hudson, 2013
8. Wolfgang Schueller, *Highrise Building Structures*, John Wiley and Sons, 1977
9. Thomas Hootman, *Net Zero Energy Design: A Guide for Commercial Architecture*, Wiley, 2012
10. Pete Silver and Will McLean, *Structural Engineering for Architect: A Handbook*, Laurence King, 2014
11. Esther Rivas Adrover, *Deployable Structures*, Laurance King, 2015
12. Dwi Tangoro, *Utilitas Bangunan*, UI Press, 2004

DESIGN PROJECT 4

Design Project 4 focuses on the design of public space. It integrates architectural typology-based design method, issue-based design and basic knowledge of urban context. Design Project 4 integrates the learning activities performed in two courses that support each other, Architectural Design 4 and Introduction to Urban Context.

ARCHITECTURAL DESIGN 4

ENAR600006/ENGE600006
9 CREDITS
Learning Objective:

Students should be able to design public space through architectural typology-based design approach, issue-based design approach and creative exploration of architectural form and spatial quality.

Syllabus:

Architectural Design 4 proposes the critical issues of human living space with socio-cultural complexities as found in urban/suburban context, through two approaches: a) top-down approach through the exploration of design ideas based on typology, and b) bottom-up approach through exploration of issue-based design ideas. Design knowledge herewith consist of the understanding of the concept of *public*, analysis of functional types, spatial programming, the concept of institution and how it is elaborated into spatial design, the formulation of initial statement based on issues, development of architectural programs and how they are elaborated into spatial design. Knowledge of site and environment includes the contextual explanation of the design through the understanding toward site physical condition, urban socio-cultural context, and consideration of sustainability.

Design assignments consist of: Designing space within social environment context with a close kinship; Designing space in more complex urban environmental context.

Prerequisites:
Students have taken Architectural Design 3
Students have taken or are taking Introduction to Urban Context

References:
1. Adrian Forty, *Words and Buildings: A Vocabulary of Modern Architecture, Chapter 'Space', hal. 256-275*, Thames & Hudson, 2000
2. Yi-Fu Tuan, *Space and Place: The Perspective of Experience*, University of Minnesota Press, 1981
3. Henri Lefebvre, *The Production of Space*, Blackwell, 1991
4. Jeremy Till, *Architecture Depends*, MIT Press, 2009
5. Karen Franck & Bianca Lepori, *Architecture Inside Out*, Academy Press, 2000
6. Giulio Carlo Argan, *On the Typology of Architecture, in Nesbitt, Theorizing a New Agenda for Architecture hal. 240-246*, Princeton Architectural Press, 1996
7. Jonathan D. Sime, *Creating Places or Designing Spaces*, Journal of Environmental Psychology, Vol 6, hal. 49-63, 1986
8. Andrew Ballantyne, *What is Architecture?,* Routledge, 2002
9. Aaron Betsky & Erik Adigard, *Architecture Must Burn: Manifestos for the Future of Architecture*, Gingko Press, 2001
10. Robert Venturi & Denise Brown, *Learning from Las Vegas*, MIT Press, 1977
11. Jane Jacobs, *The Death and Life of Great American Cities*, Random House, 1961
12. Bernard Tschumi, *Architecture and Limits I-III, in Nesbitt, Theorizing a New Agenda for Architecture hal. 150-167*, Princeton Architectural Press, 1996
13. Bauman Lyons Architects, *How to be a Happy Architect*, Black Dog Publishing, 2008

INTRODUCTION TO URBAN CONTEXT

ENAR600017/ENAR610017
3 CREDITS
Learning Objective:

Student should be able to know and understand basic knowledge about physical urban forms, and able to implement and apply building rules and codes in design building in urban context.

Syllabus:

Basic principles and issues on urban physical forms: Cities, growth and development, urban physical form and urban physical development, planned and unplanned urban development, site planning and design.

Prerequisites: Students have taken or are taking Architectural Design 4

References:
1. *Journal of the American Planning Association* (sesuai topik bahasan)
2. Jane Jacobs, *The Death and Life of Great American Cities*, Random House, 1961
3. Spiro Kostof, *The City Assembled: The Elements of Urban Form Through History*, Thames and Hudson, 1992
4. Richard T LeGates and Frederic Stout (eds.), *The City Reader*, Routledge, 2003
5. Lewis Mumford, *The Urban Prospect*, Harvest Book, 1968

ARCHITECTURAL DESIGN 5
ENAR600007/ENAR610007
9 CREDITS
Learning Objective:

Students should be able to create architectural design based on particular design method; should be able to produce design ideas that demonstrate buildability and compliance to general building codes; should be able to demonstrate the application of advanced knowledge of structural principles, tectonic principles of construction detail and building utility system.

Syllabus:

Designing with particular approach or method within design units. Design units offered may include but not limited to: typology-based design; evidence-based design; architectural design as part of urban context; architectural design with technology, computation, or parametric approach. Knowledge and implementation of building codes that include safety, security, health, comfort, and accessibility. Design communication that comply with standard drawing convention. Awareness and understanding of role of various disciplines of design, construction, mechanical and electrical in architectural design process.

Prerequisites:
Students have taken Architectural Design 4

References:
1. Bryan Lawson, *How Designers Think*, Architectural Press, 2005.
2. Michael Hensel, *Performance-Oriented Architecture: Rethinking Architectural Design and the Built Environment*, Wiley, 2013.
3. Bernard Leupen, *Time-Based Architecture*, 101 Publishers, 2005.
4. Herman Hertzberger, *Space and the Architects*, 101 Publishers, 2000
5. Referensi lain yang relevan dengan masing-masing unit perancangan.

UNDERGRADUATE THESIS
ENAR600008/ENAR610008
6 CREDITS
Learning Objective:

Student should be able to identify, study and communicate issues within specific area of study related to architecture; able to develop basic skills in scientific reading, researching and writing; able to develop understanding of research as an activity that requires systematic and logical thinking; able to develop critical understanding of various architectural issues.

Syllabus:

The thesis begins with an inquiry into what the student wishes to study in depth. It involves the understanding of issues and explanation of the understanding with limited depth level. At this level, the student is neither required to solve a problem nor create or invent something new that would contribute to the discipline architecture. Simple investigation is performed through literature search and/or case studies. Originality. Modes of writing: descriptive, narrative, explanatory

Prerequisites:
Students have earned 114 credits and have taken Architectural Design 4

References:
1. John Zeisel, *Inquiry by Design*, W. W. Norton & Company, 2006
2. David Evans & Paul Gruba, *How To Write A Better Thesis Dissertation*, Springer, 2014
3. F. Crews. *The Random House Handbook, ed, pgs 10-114*, McGraw-Hill Higher Education,1992
4. I. Border and K. Ruedi, *The Dissertation: an Architecture Student's Handbook*, Oxford University Press, 2000.
5. T. Y. Hardjoko, *Panduan Meneliti dan Menulis Ilmiah*, Departemen Arsitektur Universitas Indonesia, 2005

FINAL PROJECT
ENAR600008/ENAR610008
6 CREDITS
Learning Objective:

Student should be able to identify, study and communicate issues within specific area of study related to architecture; able to develop basic skill in analyzing and synthetizing theory and demonstrate it through design; able to develop understanding of research as an activity that requires systematic and logical thinking; able to develop critical understanding of various architectural issues.

Syllabus:

The thesis begins with an inquiry into what the student wishes to study in depth. It involves the understanding of issues and explanation of the understanding with limited depth level, which is demonstrated through architectural design.

Prerequisites: Students have earned 114 credits and have taken Architectural Design 5

References:
1. John Zeisel, *Inquiry by Design*, W. W. Norton & Company, 2006
2. I. Border and K. Ruedi, *The Dissertation: an Architecture Student's Handbook*, Oxford University Press, 2000.
3. John Zeisel, *Inquiry by Design*, W. W. Norton & Company, 2006
4. Iain Border and Katarina Ruedi, *The Dissertation: an Architecture Student's Handbook*, Oxford University Press, 2000.
5. Murray Fraser, *Design Research in Architecture*, Ashgate Publishing, 2013

Course Description: Elective Courses

ACOUSTICS
ENAR600018/ENAR610020
3 CREDITS
Learning Objective:

Student should be able to understand basic principles of acoustic in space and environment; able to conduct analysis in order to create good acoustic design.

Syllabus:

Basic acoustics, characteristics of sounds, acoustic criteria in space, sound intensification and sound isolation, environmental noise.

Prerequisites: -

References:

1. Leslie L. Doelle & Lea Prasetio, *Akustik Lingkungan*, Erlangga,1993
2. PH Parkin & HR Humpreys, *Acoustics Noise and Buildings*, Faber and Faber Ltd, 1984
3. Finarya Legoh & Siti Hajarinto, *References AKUSTIK*, 2002

ARCHITECTURE AND SPATIAL ETHNOGRAPHY

ENAR600019
3 CREDITS
Learning Objective:

This course will equip students with ethnographic theories and methods to understand 'space', 'place', 'spatial practices' and 'production of space' in architectural and urban contexts. Ethnographic approaches to 'space' and 'place' are very important for understanding the practice and production of the space in which people live, work, create and socially live.

Syllabus:

The syllabus of this course follows a 4-part chronology: (1) what is ethnography; (2) space and spatial practice; (3) production space; (4) conducting spatial ethnography.

Alternatively, the syllabus chronological order can also be interrupted and arranged like a survey class which arranges the material into key themes related to the latest spatial ethnographic theory, methods and practice, keeping up with the latest developments in related fields and methods.

Prerequisites:

Enjoys reading and experiencing urban space by participating in the spatial practice of its citizens. Studenthave taken the compulsory courses in Architectural Design Theory and Methods.

References:

1. Duneier, M, The Urban Ethnography Reader, Oxford University Press, 2014
2. Dovey, Kim, Mapping Urbanities, Morphologies, Flows, Possibilities, Routledge, 2017
3. Dovey, Kim, "Mapping Urban Assemblages: The Production of Spatial Knowledge," Journal of Urbanism, Vol 10(1) Routledge, 2017
4. Krase, Jerome, "The Multitude Approach to Urban Ethnography: Blessing or Curse?" In Prado & Palto (eds) The Palgrave Handbook of Urban Ethnography, Palgrave Macmillan, 2018
5. Nabeel Hamdi, The Spacemaker's Guide to Big Change: Design and Improvisation in Development Practices, Routledge, 2014
6. O'Reilly, Karen. Key Concepts in Ethnography. SAGE, 2008
7. Setha Low, Spatializing Culture: The Ethnography of Space and Place, Taylor Franchise, 2017

ARCHITECTURE AND TEXTS

ENAR600020
3 CREDITS
Learning Objective:

Introducing architecture as text that can be read and interpreted based on the relationship between the text and its context, as well as providing tools (methods) for reading architecture as text.

Syllabus:

"Il n'y a pas de hors-texte" (nothing outside the text). This is a sentence stated by the philosopher Jacques Derrida. Text is often unserstood as a written communication. However, in the context of this course, the text is not limited to written words. For example, facial expressions, advertisements, traffic signs, painting are also texts. The word "text", the word which has connection with the word "texture" and "context", comes from the Latin word texere, which means knit. This course is an introduction to architecture as a text. This course give us knowledge, how to read architecture as text, How do we read architecture as a knitting between architectural works and architects, including society condition and so on.

Prerequisites: -

References:

1. Roland Barthes, Mythologies, Vintage Classics, 2000
2. John D Caputo (ed.), Deconstruction in a Nutshell: a Conversation with Jacques Derrida, Fordham University Press, 1997
3. Umberto Eco, A Theory of Semiotics, Indiana University Press, 1976
4. Joel Gilberthorpe, What is a Text?: on the Limits of a Text as an Object of Knowledge (http://www.arts.mq.edu.au/documents/NEO_Article_5_2009_Joel_Gilberthorpe.pdf)

COASTAL ARCHITECTURE

ENAR600021
3 CREDITS
Learning Objective:

Student should be able to understand the relationship between spatial temporal, cultural, and eco-athropomorphic systems changes in coastal areas. Such understanding would contribute to awareness to integrate eco-anthroposystem ideas into architectural design in coastal areas; Student should be able to systematically express their own understanding and awarenees of design issues in coastal context.

Syllabus:

Water and architecture, basic understanding and knowledge of coastal area, continental area, sea, archipelago, spatial-temporal-cultural aspects, coastal eco-anthroposystem, the effect of island- sea interactions to coastal living-livelihood, spatial planning, facilities and architecture of coastal areas, the dynamics of dwelling and dwelling form in Indonesian coastal areas, climate change and disaster risk in Indonesian coastal area, spatial-temporal-cultural changes and eco-anthroposystem in certain Indonesian coastal area, the role of architects in coastal spatial planning and the future of coastal architecture.

Prerequisites:
Student have taken Design Methods.

References:

1. Abimanyu Takdir Alamsyah, *Regionisme dalam Penataan Permukiman di Gugus Pulau Mikro*, unpublished doctoral dissertation, PSIL Universitas Indonesia, 2006
2. Abimanyu Takdir Alamsyah, *Menata Permukiman Pulau-Laut, Mempertahankan Keberlanjutan Bertanahair Kepulauan*, Pidato pengukuhan Guru Besar Universitas Indonesia. Depok, 2009
3. Michael R. Bloomberg and Amanda M. Burden, *Urban Waterfront Adaptive Strategies in Waterfront Vision & Enhancement Strategy,* NYC Planning, 2013
4. Subandono Diposaptono and Budiman, *Tsunami*, Penerbit Buku Ilmiah Populer, 2006
5. Charles Moore and Jane Lidz, *Water + Architecture*, Thames and Hudson Ltd, 1994

6. Malcolm Newson, *Land, Water and Development: River Basin Systems and their Sustainable Development*, Routledge,1992
7. Koen Olthuis and David Keuning, *Float!. Building on Water to Combat Urban Congestion and Climate Change*, Frame Publishers, 2010
8. Djoko Pramono, *Budaya Bahari*, Gramedia Pustaka Utama, 2005
9. Alan P. Trujillo and Harold V. Thurman, *Essentials of Oceanography, Ninth Edition*, Pearson Education *Ltd, 2008*
10. Heather Vies and Tom Spencer, *Coastal Problems: Geomorphology, Ecology and Society at the Coast*, Edward Arnold, 1995
11. Ary Wahyono, AR Patji, SS Laksono, R. Indrawasih, Sudiyono dan Surmiati Ali, *Hak Ulayat Laut di Kawasan Indonesia Timur*, Media Presindo Yogjakarta, 2000

ETHNIC ARCHITECTURE

ENAR600022/ENAR610024

3 CREDITS

Learning Objective:

Student should be able to understand various aspects of architecture which arise from ethnic groups' traditions in order to explain and analyse elements and principles of architecture from particular ethnic group; able to comprehend the phenomena of ethnic architecture in general and to analyze architecture tradition of particular ethnic group.

Syllabus:

Understanding of principles and elements of ethnic architecture, forming factors, symbolic classification, cosmological view and worldview, space, place, time, meaning, anthropomorphic.

Prerequisites: -

References:

1. Amos Rapoport, *House Form and Culture*, Englewood Cliffs, 1960
2. N. Egenter, *Architectural Anthropology*, Structura Mundi, 1996
3. John Hutchinson (ed.), Anthony D. Smith (ed.), *Ethnicity*, Oxford University Press, 1996
4. Roxanna Waterson, *The Living House: An Anthropology of Architecture in Southeast Asia*, Oxford University Press, 1990
5. Rodney Needham , *Symbolic Classification*, Scott Foresman Trade, 1979
6. J. Fox (ed.), *Inside Austronesian House*, The Australian National Uni- versity, 1993
7. Bourdier & N.AlSayyad (eds), *Tradition, Dwellings and Settlements: Cross-cultural Perspectives*. University Press of America, 1989

ARCHITECTURE, CITY AND POWER

ENAR600023/ENAR610021

3 CREDITS

Learning Objective:

Student should be able to understand the role of architecture, planning and design within and between urban contexts; should be able to improve their understanding on the relationship between built environmental design and power; should be able to increase awareness of the intertwining relationship between architecture, social aspects, political aspects, economy, and culture; should be able to understand that built environment is conceived out of, and would yield particular power relation amongst the users in a specific context.

Syllabus:

The role of architecture and planning in the broader context. The relationship between design and power. Syllabus is prepared according to the themes related to the aforementioned relationship, which includes the following themes: Architecture and consumption, poverty and inequality; informality, disasters, theme parks/leisure, space of colonial/post-colonial/nation/globalization/ neoliberalism; spatial enclaves/zone/segregation based on gender, race and ethnicity, social class, religion, spatial justice; housing and infrastructure.

Prerequisites: -

References:

1. Benedict Anderson, *Language and Power: Exploring Political Culture in Indonesia*, Ithaca: Cornell University Press, 1990 (esp. chapter "The Idea of Power in Javanese Culture")
2. James D Faubion, *Michel Foucoult: Power, Essential Works of Foucault 1954-1984, New York: The New Press, 1997*
3. Kim Dovey, *Framing Spaces: Mediating Power in Built Form*, New York: Routledge, 1999
4. Lawrence Vale, *Architecture, Power and National Identity*, Routledge, 2002 (2nd ed)
5. Abidin Kusno, *Behind the Postcolonial: Architecture, Urban Space and Political Culture in Indonesia,* Routledge, 2000
6. *Abidin Kusno, After the New Order: Space, Politics and Jakarta,* University of Hawaii Press, 2013
7. Brenda S.A Yeoh, *Contesting Space in Colonial Singapore: Power Relations and the Urban Built Environment*, Singapore University Press, 2003
8. Nezar AlSayyad (ed), *Forms of Dominance: On the Architecture and Urbanism of Colonial Enterprise*, Avebury, 1992
9. Gwendolyn Wright, *The Politics of Design in French Colonial Urbanism*, Chicago: The University of Chicago Press, 1991
10. David Harvey, *Spaces of Hope*, University of California Press, 2000
11. James C. Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed*, Yale University Press, 1998
12. James Holston, *The Modernist City: an Anthropological Critique of Brasilia*, The University of Chicago Press, 1989
13. Janice E. Perlman, *Favela: Four Decades of Living on the Edge in Rio de Janeiro,* Oxford University Press, 2010
14. Mike Davis, *Evil Paradise: Dreamworlds of Neoliberalism*, The New Press, New York, 2007
15. Nezar AlSayyad & Ananya Roy, *Urban Informality: Transnational Perspectives from the Middle East, Latin America and South Asia*, New York: Lexington Book, 2004
16. Rafi Segal and Eval Weizman, *Civilian Occupation: the Politics of Israeli Architecture*, Babel and Verso, 2003
17. Teresa Caldeira, *City of Wall*, University of California Press, 2000
18. Don Mitchell, *The Right to the City: Social Justice and the Fight for Public Space*, The Guildford Press, 2003
19. Edward S. Popko, *Transition: A Photographic Documentation of a Squatter Settlement*, McGraw-Hill, 1978
20. Justin Mc Guirk, *Radical Cities: Across Latin America in Search of New Architecture,* London: Verso, 2014
21. David Harvey, *Rebel Cities: From The Right to The City to The Urban Revolution,* London: Verso, 2012
22. Marshall Berman, *All That is Solid Melt into Air: The Experience of Modernity*, New York: Penguin Books, 1982
23. Leopold Lambert, *Weaponized Architecture: The Impossibility of Innocence,* DPR-Barcelona, 2013
24. Andy Merrifield, *Metromarxism: A Marxist Tale of the City*, New York: Routledge, 2001
25. Nezar AlSayyad & Mejgan Massoumi (eds), *Fundamentalist*

City? Religiousity and the Remaking of Urban Space, London: Routledge, 2011
26. Edward W. Soja, *Seeking Spatial Justice,* University of Minnesota Press, 2010
27. Faranak Mirahtab & Neema Kudva (eds), *Cities of the Global South Reader,* Routledge, 2015
28. Etienne Turpin, et.al, *Jakarta: Architecture & Adaptation*, Jakarta: Universitas Indonesia Press, 2013 (esp. chapters Introduction and sections on interviews)
29. AbdouMaliq Simone, *Jakarta Drawing the City Near,* University of Minnesota Press, 2014
30. and various movies related to themes and learning objectives

ARCHITECTURE, MEDIA AND CONTEXT

ENAR600024
3 CREDITS
Learning Objective:

The course is concerned with how media operates in architecture and bring forward various scales and contexts of architectural projects. We consider scale as both a physical attribute of objects and spaces and as ideology – as an operative idea – about relationships, which are both internal and external to the architectural object and/or field. Scale in architecture always implies context, whether the context is implied in objects, landscapes or urban fabrics. Therefore, this course also examines the dynamic and complex relationship between media, scale and architecture. We will look at architecture as media and embodiments of particular ideas and values—and at the impact that communication media have had on the practice of architecture and the way we experience our built environments.

Understanding architecture as an embodiment of ideas and there is a deep connection between the communication media used such as pictures, photos and films of architectural practices and the way we understand space. Students explore how understanding media in architecture and related contexts helps us to understand architecture and is able to transfer theoretical knowledge into architectural applications and criticism.

Syllabus:

This lecture deals with how media operate in architecture and is used in various contexts and scales. There is an introduction to history and theory about media and architecture and traces the use of media in architecture as well as understanding the relationship between architectural theory and practice and the meaning of space. In general, the discussion includes the use of media in architecture and art, media in the Renaissance & Classicism era, several observational techniques and new views on space, Collage & Montage in architecture, photography and representation in Architecture, film and architecture, reading media contexts and scales such as miniature and Megastructure, signs and semiotics in architecture, and society of spectacle.

Prerequisites: -

References:

1. Moore, Charles and Allen, Gerald. *Dimensions. Space, shape & scale in architecture*, (McGraw-Hill, 1977)
2. Colomina, Beatriz. “The Media House.” *Assemblage*, no. 27 (1995)
3. Jonathan Crary, Techniques of the observer: on vision and modernity in the nineteenth century, the MIT Press, 1992
4. Sergei M. Eisenstein, Yve-Alain Bois, and Michael Glenny. “Montage and Architecture.” *Assemblage*, no. 10 (1989).
5. Colin Rowe and Fred Koetter, “Collage city and the reconquest of time,” in *Collage City* (MIT Press, 1978), 118-149; “Excursis” (images): 151-177.
6. James Ackerman, “On the Origins of Architectural Photography” In Kester Rattenbury, Ed., *This is Not Architecture: Media Constructions* (New York: Routledge, 2002): 26-35.
7. Giuliana Bruno, “Site-seeing: Architecture and the Moving Image” Wide Angle 19:4 (1997): 8-24.
8. Benjamin, Walter. 1969. ‘The Work of Art in the Age of Mechanical Reproduction,’ *Illuminations.* Ed. H. Arendt. (New York: Schocken) pp. 217–251.
9. Susan Steward, “ Miniature,” in On Longing: Narratives of the Miniature, the Gigantic, the Souvenir, the Collection (John Hopkins U.P., 1984).
10. Rem Koolhaas, *Delirious New York* (New York: Monaceli Press, 1978).
11. Debord, Guy. 1994. *The society of the spectacle*. New York: Zone Books.
12. Baudrillard, Jean. 1994. *Simulacra and Simulation*, Ed. Sheila Faria Glaser, Michigan: University of Michigan Press.
13. Venturi, Denise Scott Brown, Steven Izenour, *Learning From Las Vegas*
14. Roland Barthes, “Semiology and Urbanism,” in Joan Ockman (ed), *Architecture Culture 1943-1968* (New York: Rizzoli, 1993), pp. 412-418.
15. Henri Lefebvre, *The Production of Space*, Blackwell, 1991.

BIM: BASIC PROJECT DOCUMENTATION

ENAR600025
3 CREDITS
Learning Objective::

Student should be able to use *Building Information Modeling* software in designing, developing and documenting basic architectural design.

Syllabus:

Introduction to BIM in architecture; model development, information and database handlinge, basic analysis and documentation.

Prerequisites: -
References:

1. Eastman, C., Eastman, C.M., Teicholz, P. and Sacks, R., *BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors.* John Wiley & Sons, 2011
2. Kensek, K, and Noble, D., *Building Information Modeling: BIM in Current and Future Practice*, John Wiley & Sons, 2014
3. Holzer, D, *The BIM Manager’s Handbook: Guidance for Professionals in Architecture, Engineering and Construction*, John Wiley & Sons

DIAGRAM AND ARCHITECTURE

ENAR600026
3 CREDITS
Learning Objective:

Students are introduced with the advanced theory of diagram in architecture, providing the understanding on the role of diagram as part of design process, both as representation or as part of design thinking. Students were given insights on the different phases and complexity in constructing a diagram based on relevant information within a design process. Students are introduced to various forms of diagram, depending on the different aims and contexts of design.

Syllabus:

Diagrams as design thinking, diagramming as observational or active responses, organising informations for diagram-making, diagramming practices, diagramming systems, diagram as performative, diagram as design proposition and/or design activism.

Prerequisites:
Student has taken Architectural Design 2.

References:

1. Alison and Peter Smithson, *The Charged Void: Architecture*, New York: The Monacelli Press, 2001
2. Bernard Tschumi, *Notations: Diagrams and Sequences*. London: Artifice Press, 2014
3. Denis Wood, *Everything Sings: Maps for a Narrative Atlas,* Los Angeles: Siglio, 2011
4. Doina Petrescu, 'The Indeterminate Mapping of the Common', *Field Journal* 1 (1), 2007
5. Edward R Tufte, *Envisioning Information*, Cheshire, Connecticut: Graphics Pr, 1990
6. Judith Wasserman, 'A World in Motion: The Creative Synergy of Lawrence and Anna Halprin', *Landscape Journal* 31 (1/2): 33–52, 2012
7. Julienne Hanson, *Decoding Homes and Houses,* Cambridge: Cambridge University Press, 2003
8. Katie Lloyd Thomas, 'Building While Being in It: Notes on Drawing "Otherhow"'. In *Altering Practices: Feminist Politics and Poetics of Space*, edited by Doina Petrescu, London ; New York: Routledge, 2007
9. Mark Garcia, *The Diagrams of Architecture: AD Reader,* Chichester: Wiley, 2010
10. Michael T Swisher, *Diagramming the Big Idea: Methods for Architectural Composition*, New York: Routledge, 2012
11. Peter Eisenman, *Diagram Diaries,* London: Thames & Hudson, 1999
12. Petra Kempf, *You Are the City: Observation, Organization and Transformation of Urban Settings,* Baden: Lars Muller Publishers, 2009
13. Roger H Clark and Michael Pause, *Precedents in Architecture: Analytic Diagrams, Formative Ideas, and Partis,* Hoboken, N.J: Wiley, 2004
14. Sadler, Simon. 1999. *The Situationist City*. New Ed edition. Cambridge, Mass.: MIT Press.
15. Stan Allen, *Points+lines: Diagrams and Projects for the City*, New York: Princeton Architectural Press, 1999

HERITAGE ARCHITECTURE

ENAR610026
3 CREDITS
Learning Objective:

Student should be able to understand the definition and issues in heritage and conservation of architecture from the past, in particular heritage building and heritage site.

Syllabus:

Introduction to heritage architecture, including tangible and intangible aspects, Outstanding Universal Value from heritage building and heritage site. Discussion on critical issues related to heritage in architecture and city. Introduction to conservation strategies including data collection, documentation, planning, protection, development and reuse of heritage building and heritage site. Discussion on precedents of conservation in Indonesia.

Prerequisites: -

References:

1. Bernard M Feilden, *Conservation of Historic Building*, Butterworth-Heinemann Ltd, 1994
2. *Pengantar Panduan Konservasi Bangunan Bersejarah Masa Kolonial*, Pusat Dokumentasi Arsitektur dan Badan Pelestarian Pusaka Indonesia, 2011
3. Undang-undang Republik Indonesia Nomor 11 Tahun 2010 tentang Cagar Budaya
4. Peraturan Daerah Daerah Khusus Ibukota Jakarta Nomor 9 Tahun 1999 Tentang Pelestarian dan Pemanfaatan Lingkungan dan Bangunan Cagar Budaya
5. Amorim, Luiz et. Al. 'Preserving Space'. *Proceedings 6th International Space Syntax Symposium, Istanbul*, 2007 pp. 032-01 – 032-14.
6. Jean-Paul Corten et.al, *Heritage As An Asset for Inner-City Development: An Urban Manager's Guide Book*, Ammersfoort: Cultural Heritage Agency, nai010 Publishers, 2015
7. Fernando Diez, 'Heritage', dalam Cairns, Stephen, Crysler, Greig C., Heyne, Hilde. *The SAGE Handbook of Architectural Theory*. SAGE Publications, 2012, pp 274 – 86.
8. Peter J. Larkham, 'Conflict and Conservation' in *Conservation and the City*, Routledge, 1996, pp 3 – 30.
9. Adolf SJ Heuken, *Tempat-tempat Bersejarah di Jakarta*, Cipta Loka Caraka, 1997

URBAN ECOLOGY

ENAR600027
3 CREDITS
Learning Objective:

Student should be able to understand principles of ecological architecture, architectural works which consider socio-cultural values, environmental sustainability, and holistic mode of thought in designing a building or an area.

Syllabus:

Ecological functions that are able to 'provides' for the primary needs of city inhabitants, including clean water, waste disposal management, air pollution, transportation, and green spaces.

Prerequisites: -
References:

1. Amos Rapoport, *Human Aspects of Urban Form: Towards a Man Environment Approach to Urban Form and Design*, Pergamon Press, 1997
2. Amos Rapoport, *The Meaning of The Built Environment: A Non Verbal Communication Approach*, Sage Publication, 1982
3. Graham Haughton et al, *Sustainable Cities*, Cromwell Press, 1994
4. Iftikar Ahmed, ed, *Beyond Rio: The Environmental Crisis and Sustainable Livelihoods in the third world*, MacMilan Press, 1995.
5. Moh. Soeryani, ed, *Lingkungan: Sumberdaya Alam dan Kependudukan dalam Pembangunan*, UI Press, 1987

DIGITAL FABRICATION

ENAR600028
3 CREDITS
Learning Objective:

Student should be able to use digital fabrication equipment as a part of design process using various modeling approaches and tools.

Syllabus:

Introduction to fabrication process in architectural design, modeling technique, parametric approach.

Prerequisites:

Student have taken Design and Digital Media; Have basic skill in using architectural modeling software (Rhinoceros, CAD, SketchUp)

References:

1. L. Iwamoto, *Digital Fabrication: Architectural and Material Techniques*, Princenton Architectural Press, 2009
2. B. Kolarevic ed, *Architecture in The Digital Age: Design and Manufacturing*. Spon Press, 2003
3. Mode Lab, n.d. *Foundations: Grasshopper Primer* Third

Edition.
4. B. Peters and P. Terri, *Inside Smart Geometry: Expanding the Architectural Possibilities of Computational Design*, Wiley & Sons Ltd, 2013

HIGH RISE BUILDING FAÇADE

ENAR600029
3 CREDITS
Learning Objective:

Student should be able to master the principles of high rise building façade including aesthetics, technical, and environmental aspects.

Syllabus:

The essence of building façade of high rise building (resistance to earth quakes, lateral force/wind and water resistance); Façade design; Material and technology for façade detailing; Green façade.

Prerequisites: -

References:

1. Wolfgang Schueller, *Struktur Bangunan Bertingkat Tinggi*, PT Eresco, 1989
2. Mario Camp, *Skycrapers: An Architectural Type of Modern Urbanism*, Birkhauser, 2000
3. Hart, Henn, and Sontag, Multi-*Storey Buildings in Steel*, Granada Publishing, 1978
4. *Details in Architecture*
5. The Images Publishing Group, *Creative Detailing by Some of The World's Leading Architects*, The Images Publishing Group Pty Ltd, 2004

INTRODUCTION TO SUSTAINABILITY (Required for International Program)

ENAR610029
3 CREDITS
Learning Objective:

To introduce students to sustainable development related to architecture: an awareness and understanding of the ecology of our globe that consists of human survival as social beings and their intervention over nature (equity & economy) and nature's laws; students are to understand inconsiderate massive human activities exploiting nature that causes both man-made as well as natural disasters.

Syllabus:

Global warming, green architecture, conflicting and competing ideas on sustainability, sustainable environments (living creatures, place & stuff), human life cycle space, social aspects of the built environment, cradle-to-cradle and upcycle.

Prerequisites: -

References:

1. Abraham, John, (2017). "An Inconvenient Sequel" – The Science, History, and Politics of Climate Change" *In* the Guardian 15 November 2017 uploaded 27 January 2018.
2. Meyer, Robinson, (2017). An Inconvenient Time for *An Inconvenient Sequel*. *In: The Atlantic Monthly, July 26, 2017*
3. Nijhius, Michelle, (2017) "What's Missing from an Inconvenient Sequel," Al Gore's New Climate Change Documentary?" in The New Yorker, July 29, 2017, uploaded 27 January 2018.
4. Al Gore on Inconvenient Truth, Ten Years Later. Climate State Oct 28, 2017, *27 minutes* https://www.youtube.com/watch?v=tr1vp23guOE
5. Al Gore on "An Inconvenient Sequel" Climate change "ends with a victory for humanity". Jul 24, 2017, 14:13 minutes https://www.youtube.com/watch?v=tx2l2du7Tdg
6. Al Gore: The innovation community's role in solving the Climate Crisis July 25, 2018, 34:56 minutes https://www.youtube.com/watch?v=Vcjk_X8S5WY
7. McDonough, William, and Michael Braungart, *Cradle to Cradle: 'Remaking the Way We Make Things*. (New York: North Point Press, 2002).
8. William McDonough: "Design as Optimism" Talks at Google. May 8, 2017, 56:39 minutes https://www.youtube.com/watch?v=6pg6OxQ7vOg
9. Global Shared Prosperity | William McDonough at the CGI 2016 Annual Meeting. September 21, 2016 8:50 minutes https://www.youtube.com/watch?v=Qloqi_N36LY
10. Resource Abundance by Design, Wiliam McDonough at WEF, October 17, 2014, 21.44 minutes https://www.youtube.com/watch?v=OcO1O99UoUs
11. William McDonough explains steel's place in his 'Cradle to Cradle' concept June 26, 2018, 30:54 min https://www.youtube.com/watch?v=OLPyADxFudM
12. Schumacher, E.F. (1973). Small is Beautiful: Economics as if People Mattered." Chapter 5, "A Question of Size." London: Blond and Briggs, Ltd. http://sciencepolicy.colorado.edu/students/envs_5110/small_is_beautiful.pdf

PHOTOGRAPHY

ENAR600030/ENAR610032
3 CREDITS
Learning Objective:

Students are able to produce photography works with artistic elements and architectural photography communication through photographic process and photo-essays.

Syllabus:

Understanding visual communication principles throughtwo-dimensional medium, lighting, principles of zone system, principles of visual graphics, exposure management, and photo image perfection.

Prerequisites: -

References:

1. Michael Freeman, *The Photographer's Eyes*, Focal Press, 2007
2. Michael Freeman, Perfect Exposure, Focal Press, 2009
3. Michael Freeman, *The Photographer's Story*, Focal Press, 2012
4. Graham Clarke, *The Photograph*, Oxford University Press, 1997
5. Marita Sturken & Lisa Carthwright, Practice of Looking". Oxford University Press, 2nd edition, 2009
6. Soeprapto Soedjono, *Pot-Poutrri Fotografi*, Universitas Trisakti, 2007

GEOMETRY AND ARCHITECTURE

ENAR600031
3 CREDITS
Learning Objective:

Student should be able to understand the role of geometry as a basis of architectural form; should be able to explore various possible uses of geometry as the critical tools of analysis of existing architectural works and in the process of generating architectural design works.

Syllabus:

Development of knowledge on geometry and its implication for the development of architectural ideas and creativity; geometry and classical aesthetics of architecture; Euclidean and non-Euclidean geometry in architecture; geometry and the concept of ideal city; geometry, music, and architecture; geometry and perception; topology in architecture; geometry in nature; exploration of the mechanism of geometry in shaping a design work and its potential for further development.

Prerequisites: -

References:

1. Vitruvius, *Ten Books on Architecture*, Dover Publications, 1960
2. Colin Rowe, *Mathematics of an Ideal Villa*, MIT Press, 1976
3. Peter Davidson & Donald L. Bates, *Architecture after Geometry,* Architectural Design, 1999
4. Irenee Scalbert, Archis, *Towards a Formless Architecture: The House of the Future by A+P Smithson*, Archis, 1999
5. D'Arcy Thompson, *On Growth and Form*, Dover Publications, 1992
6. Jane Jacobs, *The Death and Life of Great American Cities*, RandomHouse, 1961
7. Elizabeth Martin, *Architecture as a Translation of Music in Pamphlet Architecture 16*, Princeton Architectural Press, 1994

FIELD STUDY

ENAR600032/ENAR610025
3 CREDITS
Learning Outcomes:

Students are able to analyze architectural phenomena and / or practices in a context of both natural and socio-cultural environments that are obtained through experience or field observations. Students are able to demonstrate this knowledge in the form of reports and documentation.

Syllabus:

Introduction to the field context, both the natural environment and the socio-cultural system; architectural observation approaches and their context; measurement, documentation and representation methods; planning activities and compiling the results of field observations.

Precondition: -
Textbooks: Relevant references to the topic offered.

INDEPENDENT STUDY

ENAR600033/ENAR610027
3 CREDITS
Learning Objective:

Students should be able to demonstrate advanced architectural knowledge on particular topic and to implement the knowledge into the development of ideas of architectural intervention.

Syllabus:

Advanced studies on architectural knowledge in particular context; development of architectural intervention ideas based on thorough inquiry of contexts and theoretical inquiry on related topic.

Prerequisites: -
References: Relevant references to the topic offered.

DESIGN STUDY

ENAR600034/ENAR610023
3 CREDITS
Learning Objective:

Students should able to develop basic skills on reading, inquiry and writing a scientific writing related to design activities.

Syllabus:

Communicating design process through a writing that complies with scientific writing requirements; Communicating systematically literature review, development of design methods and design process through in writing.

Prerequisites: Student has passed Architectural Design 4 and is taking Final Project.

References:

1. John Zeisel, *Inquiry by Design*, W. W. Norton & Company, 2006
2. David Evans & Paul Gruba, *How To Write A Better Thesis Dissertation*, Springer, 2014
3. F. Crews. *The Random House Handbook, ed, pgs 10-114*, McGraw-Hill Higher Education,1992
4. Borden and K. Ruedi, *The Dissertation: an Architecture Student's Handbook*, Oxford University Press, 2000.
5. T. Y. Hardjoko, *Panduan Meneliti dan Menulis Ilmiah*, Departemen Arsitektur Universitas Indonesia, 2005

CAPITA SELECTA

ENAR600035/ENAR610022
3 CREDITS
Learning Objective:

Students should be able to expand their knowledge on various topics that support acquisition of architectural knowledge and design skills.

Syllabus:

Selected topics that are relevant to architectural knowledge, design skills and their recent development.

Prerequisites: -
References: Relevant references to the topic offered.

INTERNSHIP

ENAR600048/ENAR610048
3 CREDITS
Learning Objective:

Students should be able to understand the processes of planning, implementation and evaluation of engineering activities; to demonstrate knowledge on teamwork of relevant disciplines in professional practice; to demonstrate knowledge on the processes of planning, design and implementation of a built environment; to get involved as assistant designer/ planner, assistant field project officer, assistant field supervisor, or community architect.

Syllabus:

Real project management process in a company, architecture consultant or organization. Techniques of writing simple proposal and reporting field work. Techniques of presentation, Method of managing material, data, equipment, human resources and coordination among stakeholders in engineering planning and implementation activities.

Prerequisites: -

References: -

EVERYDAY AND ARCHITECTURE

ENAR600037
3 CREDITS
Learning Objective:

Student should be able to understnd the existence of everyday phenomena as an approach to architecture; should be able to define the position of architecture discipline in responsing to various phenomena of everyday living space.

Syllabus:

Understanding and historical background of the concept of the 'everyday' in architecture; domestic space; aesthetic in architecture and the 'everyday', the concept of an ideal city and its relation to the 'everyday'; cyber space and virtual space; the phenomenon of the 'everyday' in urban space: a participatory approach in architecture.

Prerequisites: -

References:
1. Steven Harris & Deborah Berke (eds.), *Architecture of the Everyday*, Princeton Architectural Press, 1997
2. Sarah Wigglesworth & Jeremy Till (eds.), *The Everyday and Architecture*, Architectural Design, 1998
3. Michel de Certeau, *The Practice of Everyday Life*, University of California Press, 1998
4. Malcolm Miles, *The Uses of Decoration: Essays in the Architectural Everyday*, Wiley, 2000
5. Arnstein, *Ladder of Citizen Participation*, 1969

2D DIGITAL DESIGN COMMUNICATION

ENAR600038/ENAR610018
3 CREDITS
Learning Objective:

Student should be able to use 2D digital drawing media in architectural design process; should be able to choose and use various way and technique in drawing for particular purpose.

Syllabus:

Drawings in CAD and NURBS, pixel base drawing, vector base drawing, architectural representation and diagram.

Prerequisites: Student have taken Basic Design 2

References:
1. Hamad M.M, *Autocad 2010 Essentials,* Jones and Bartlett, 2010
2. Robert McNeel & Associates, *Rhinoceros: NURBS Modelling for Windows*, USA, 1998
3. H Sondermann, *Photoshop in Architectural Graphics*, SpringerWienNewYork, 2009

3D DIGITAL DESIGN COMMUNICATION

ENAR600039/ENAR610019
3 CREDITS
Learning Objective:

Student should be able to understand the concept of rendering/visualization in architecture and interior, including framing, lighting and material. Student should be able to use 3D Digital Environment to produce drawing in developing and communicating design idea.

Syllabus:

Introduction to framing, using vRay for exterior and interior framing, using naturang light, artificial light, material and texture, post-production

Prerequisites: -

References:
1. ChaosGroup Youtube Channel: https://www.youtube.com/user/ChaosGroupTV/playlists
2. Alex Hogrefe's Architectural Graphic Tutorials: https://visualizingarchitecture.com

LIFE CYCLE ENVIRONMENT

ENAR600040/ENAR610030
3 CREDITS
Learning Objective:

Student should be able to evaluate environmental feasibility for the users, based on their life cycles: birth, infancy, early childhood, childhood, adolescence, adulthood, old age, death, in terms of places and rites.

Syllabus:

Introduction, overview and definition to life-cycle environment in urban and rural/traditional environment; psychology of pregnant mother, birth environment, house, hospital, and maternity hospital, rites of birth, infant and his/her parent environment; sensory development of infant, psychological development of a child; playing environment and unwritten rules of playing, home environment, vicinity, and pre-school; parent and childecare; adolescence and rites, adolescence space; adult production space and marital rites; working environment; elderly; death space and rites.

Prerequisites: -

References:
1. Koentjaraningrat, *Ritus-Ritus Peralihan di Indonesia*, Balai Pustaka, 1979
2. A.Van Gennep, *The Rites of Passage*, (Terjemahan M. Viadon dan G), University of Chicago Press, 1960
3. Erik H Erickson, *Life Cycle Completed*, WW Norton & Company, 1997
4. Howard E. Gruber and J Jacques Voneche, *The Essential Piaget*, Gruber, NY: Basic Book, 1977
5. Saya S Shiraishi, *Young Heroes*, Cornell University Press, 1997.
6. Film: *Not One Less*, 1999; *Freedom Writers*, 2007;*The Human Body: The Incredible Journey from Birth to Death* (BBC, The Original BBC TV Series Plus: The Making of The Human Body), *Human Instinct* (BBC, The Complete Series)

INTRODUCTION TO SPATIAL ANALISIS

ENAR600041
3 CREDITS
Learning Objective:

This course trains students with spatial and quantitative data analysis to answer simple and basic urban planning problems. This course uses active, case-based learning with a focus on spatial data analysis using geographic information systems (GIS). Students will be required to attend classes, complete exercises and independent assignments in the first half of the semester. On the second half, students will have to propose a planning issue to be solved using GIS.

Syllabus:

Students will be taught to use of GIS to obtain, store, manage, present and analyse spatial and quantitative data to help urban architects and planners. This course uses computer aids with ESRI ArcGIS software and internet networks to connect students with the UI distance learning system, namely EMAS. This course will use Indonesian for regular classes and English for International Special Classes (KKI).

References:
1. Allen, D. W. (2013). GIS Tutorial 2: Spatial Analysis Workbook. Third Edition. Redlands, CA: ESRI Press.
2. Banai-Kashani, R. (1989). A New Method for Site Suitability Analysis: The Analytic Hierarchy Process. Environmental Management, 13(6), 685-693.
3. Gorr, W. L., & Kurland, K. S. (2013). GIS Tutorial 1: Basic Workbook, 10.1 Edition. Fifth Edition. Redlands, CA: ESRI Press.
4. Lu, D., Mausel, P., Brondízio, E., & Moran, E. (2004). Change Detection Techniques. International Journal of Remote Sensing, 25(12), 2365-2401.
5. Malczewski, J. (2004). GIS-based Land-Use Suitability Analysis: A Critical Overview. Progress in Planning, 62(1), 3-65.
6. McLafferty, S. L. (2003). GIS and Health Care. Annual Review of Public Health, 24(1), 25-42. Mitchell, A. (1999). The ESRI Guide to GIS Analysis: Geographic Patterns & Relationships
7. (Vol. 1). Redlands, CA: ESRI.

8. Mitchell, A. (2005). The ESRI Guide to GIS Analysis: Spatial Measurements & Statistics (Vol. 2). Redlands, CA: ESRI.
9. Setha Low, Spatializing Culture: The Ethnography of Space and Place, Taylor Franchise, 2017

INTERIOR DESIGN

ENAR600042
3 CREDITS
Learning Objective:

Student should be able to have knowledge about concept, principles, elements, and systems in interior space that support human comfort, safety, and well-being, with consideration of human factors in the design process.

Syllabus:

Principles and issues in interior design, elements of interior space, atmosphere and spatial perception, material and interior construction, spatial comfort factors, human factors and universal design, interior space typology.

Prerequisites: -

References:

1. Binggeli,Corky, *Building Systems for Interior Designer,* Wiley, 3rd edition, 2016
2. Caan, Sashi. *Rethinking Design and Interiors: Human Beings in the Built Environment.* Laurence King Publishing, 2011.
3. Dodsworth, Simon. *Fundamental of Interior Design*, Ava Publishing, 2009
4. Farrelly, Lorraine. *Construction+Materiality.* Ava Publishing, 2009
5. Leydecker, Sylvia. *Designing Interior Architecture: Concept, Typology, Material, Construction*. Basel. Birkhauser, 2013
6. Mesher, Lynne. *Basic Interior Design: Retail Design*. Ava Publishing, 2009

CITY PLANNING

ENAR600043
3 CREDITS
Learning Objective:

Student should be able to understand history and theory of urban planning though historical survey and/or through key themes; should be able to understand (1) how urban space works (based on historical context) based on spatial planning research; (2) key paradigms in urban planning think- ing. This subject is arranged around principle that history of urban planning is a theory of urban planning that is bounded by planning ethics.

Syllabus:

Syllabus is arranged following a chronological order that is divided by 5 sections: (1) reflection towards design ideas, origin and design practice; industrial city and housing question; spatial or- der exploration; (2) Modernist City; Colonial and Post-Colonial experiments; (3) Sub-urban dream (legacy of American city planning); from ghetto to city role model (racial and ethnic control); (4) City and citizenship in different historical moments; spatial rules and arrangements (basic rules of design); urban crisis, urban management, and business city; building a world class city in global south; (5) compatible theories in design and justice; see design over neo-liberalism: paradigm occurs in planning.

As an alternative, syllabus could also interrupt this chronological order and arrange as a survey class that arrange these materials in key themes, such as: Empire; Colonial/Post-colonial; Modernity and Alternatives; Pacific Rim Capitalism Transnational Urbanism; Race/Ethnic, Planning and Real Estate; City and Village; Marginality; Re-building A City; Entrepreneur City; Dystopia Planning and Post-city.

Prerequisites: -

References:

1. Selected articles from *Journal of Planning Theory & Practices; Cities, Space & Polity, International Journal on Urban Regional Research; Journal of Planning Education and Research; Journal of Urban Studies; Journal of Urban Forum; Journal of Urban History, Environment and Urbanization; Antipode; Journal of Planning Literature*
2. Paul H. Gleye, "City Planning versus Urban Planning: Resolving Profession's Bifurcated Heritage," in *Journal of Planning Literature*, 2015, Vol 30(1), 3-17.
3. John Friedmann. *Planning in the Public Domain: From Knowledge to Action*, 1987
4. Peter Hall, *Cities of Tomorrow: An Intellectual History of Urban Planning and Design in the Twentieth Century*, Blackwell Publishing, 2002 (3rd ed)
5. Friedrich Engels, *The Housing Question,* Lawrence and Wishart, Ltd, 1942
6. Mike Davis, *Planet of Slum,* Verso, *2007*
7. Dolores Hayden, *Redesigning the American Dream: The Future of Housing, Work, and Family Life,* W.W Norton & Company, 2007 (2nd ed)
8. Christine Boyer, *Dreaming the Rational City: The Myth of American City Planning,* MIT Press, 1986
9. Kermit C Parsons & David Schuyler (eds), *From Garden City to Green City: The Legacy of Ebenezer Howard,* Baltimore: The John Hopkins University Press, 2002
10. The Congress for the New Urbanism. 2001. Charter.
11. Robert Caro, *The Power Broker: Robert Moses and the Fall of New York*, Vintage, 1975
12. Marshall Berman, *All That is Solid Melts into Air,* Penguin Book, 1988
13. James Scott, *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed*, Yale University Press, 1999
14. Nezar AlSayyad (ed), *Forms of Dominance: On the Architecture and Urbanism of the Colonial Enterprise,* Avebury, 1992
15. Lisa Peattie, *Planning: Rethinking Ciudad Guayana,* University of Michigan Press, 1987
16. James Holston, *The Modernist City: An Anthropological Critique of Brasilia,* University of Chicago Press, 1989
17. June Manning Thomas and Marsha Ritzdorf (eds), *Urban Planning and the African American Community: In the Shadows,* SAGE Publication, Inc, 1996
18. Kenneth T. Jackson, *Crabgrass Frontier: The Suburbanization of the United States*, Oxford University Press, 1987
19. St Clare Drake & Horace R. Cayton, *Black Metropolis: A Study of Negro Life in a Northern City,* University of Chicago Press, 1993.
20. Edward Banfield, *Unheavenly City Revisited*, Waveland Press, 1990
21. Susan S Fainstein & Scott Campbell, *Reading in Planning Theory,* Wiley-Blackwell, 2011
22. Lewis Mumford, *The City in History: Its Origin, Its Transformation and Its Prospects*, A Harvest/HBJ Books, 1961
23. Stephen Graham & Simon Marvin, *Splintering Urbanism: Networked Infrastructures, Technological Mobilities, and the Urban Condition*, 2001
24. Aihwa Ong & Ananya Roy (eds), *Worlding Cities and the Art of Being Global*, Wiley-Blackwell, 2011
25. Patsy Haley, E.A Silva, et.al, "*Routledge Handbook on Planning Research Methods*" Routledge, 2015.
26. Faranak Mirahtab, *Cities in the Global South Reader,* Routledge, 2014.

URBAN DESIGN PRINCIPLES

ENAR600044
3 CREDITS
Learning Objective:

Student should be able to understand urban spatial design theory and its application into urban physical design; able to understand urban design method, inquiry, and design research, know various perspectives and approaches in urban design; able to understand basic principles of urban spatial design and able to interpret it into certain case of urban area.

Syllabus:

Principles of ordering system in two and three-dimension (vista, type, scale, precedent). Urban spatial condition and spaces between buildings, theory of urban spatial and urban typology, elements of urban design, conceptual exploration and basic research method through urban design enquiry and design research, environmental and spatial planning study. Component of urban design as control of process in forming the physical environment of urban space (land use, building intensity, setbacks, building coverage, building coefficient, building envelope, open green spaces, circulation, parking, infrastructure, conservation and visual/townscape corridor).

Prerequisites: -

References:

1. Hamid Shirvani, *Urban Design Process*, Van Nostrand Reinhold Co, 1987
2. Ali Madanipour, *Design of Urban Space: an Inquiry into a Socio-Spatial Process*, John Wiley and Sons, 1996
3. Gideon S. Golany, *Ethics and Urban Design: Culture, Form and Environment*, Wiley, 1995
4. Matthew Carmona, et al, *Public Places - Urban Spaces*, Architectural Press, 2003
5. Ray Gindroz, *The Urban Design Handbook: Techniques and Working Methods*, W.W. Norton and Company, 2003
6. Geoffrey Broadbent, *Emerging Concepts in Urban Space Design*, Taylor and Francis, 1995
7. Congress for the New Urbanism, *Charter of the New Urbanism*, McGraw-Hill Professional, 1999
8. Allan B. Jacobs, *The Great Streets*, The MIT Press, 1995
9. Roger Trancik, *Finding Lost Space Theories of Urban Design*, Van Nostrand Reinhold Company, New York, 1986
10. Christopher Alexander, *The Oregon Experiment*, Oxford University Press, 1975
11. Yoshinobu Ashinara, *The Aesthetics Townscape*, MIT Press, 1984
12. Edmund Bacon, *Design of Cities*, Thames and Hudson, 1967.
13. Kevin Lynch, *The Image of The City*, MIT Press 1960
14. Kevin Lynch, *What is Time and Place,* MIT Press 1972

ARCHITECTURAL PSYCHOLOGY

ENAR600045
3 CREDITS
Learning Objective:

Student should be able to use basic conceptual knowledge of psychological process to identify and analysis human need in using built environment and outdoor space.

Syllabus:

Relationship between architecture and human behavior, motivation, needs, and value as basis of human actions, Gestalt perception, Ecological perception (Gibson), Affordances and its implementation in architecture, definition of cognition and its implementation in architecture, personal space, privacy, territoriality, crowding, post occupancy evaluation (POE).

Prerequisites: -

References:

1. Bell, Fischer and Greene, *Environmental Psychology*, Harcourt Publisher, 1996
2. Bryan Lawson, *The Language of Space*, Architectural Press, 2001
3. Byron Mikellides, *Architecture for People: Exploration in a New Humane Environment*, 1980
4. Wolfgang F.E. Preisser, Harvey Z. Rabinowitz, Edward T. White, *Post-Occupany Evaluation*, Van Nostrad Reinhold, 1988
5. Dak Kopec, *Environmental Psychology for Design* , Fairchild Books, 2012

REAL ESTATE

ENAR600046
3 CREDITS
Learning Objective:

Student should be able to demonstrate knowledge on real estate, and its relation to architecture and built environment.

Syllabus:

Definition of real estate, planning and development process of real estate (the eight phases of Real Estate Development Process), basic knowledge on property rental and sales project's cash-flow (short and long term project) and simple feasibility study.

Prerequisites: -

References:

1. Mike A. Miles, et.al, *Real Estate Development: Principles and Process*, Urban Land Institute, 2000
2. Carl Gunther, *Real Estate Fundamentals (Study Guide)*, 1995
3. Hartono Poerbo, *Tekno Ekonomi Bangunan Bertingkat Banyak*, Djambatan, 1993
4. Ralph Basile, et.al, *Downtown Development Handbook*, Urban Land Institute, 2000
5. Adrienne Schmitz, *Residential Development Handbook*, 3rd ed, Urban Land Institute, 2004
6. Dean Schwanke, *Mixed Used Development Handbook*, 2nd ed, Urban Land Institute, 2003

PROJECT FEASIBILITY

ENAR600047
3 CREDITS
Learning Objective:

Student should be able to propose a project plan and explain the feasibility of a project, or program development in a clear, comprehensive and systematic manner.

Syllabus:

Basic knowledge which covers the requirement analysis, technical and environmental feasibility, time feasibility, socio-cultural aspects, legal feasibility, market and economic feasibility, exercise on issue formulation, SWOT analysis, scope, activities types and products, strategy, operational standard procedure, analyzing organizational plans, human resources and management, calculating market and economic possibility, as well as legal feasibility in relation to institutional consequences.

Prerequisites: -

References:

1. Novom, Martin L. *The Fundraising Feasibility Study: It's Not About the Money.* Hoboken, New Jersey: John Wiley & Sons Inc, 2007.
2. Suad Husnan, *Studi Kelayakan Proyek Bisnis*, Yogyakarta:

UPP STIM YKP, 2014.

3. Kasmir, Jakfar, *Studi Kelayakan Bisnis*, Jakarta: Kencana Prenada Media Group, 2013.

LIGHTING DESIGN

ENAR600048/ENAR610031
3 CREDITS
Learning Objective:

Student should be able to design lighting fixtures and ambience for interior and exterior uses, using artificial as well as natural lights through a critical, active collaborative learning process based on functional and aesthetical problems.

Syllabus:

Basic lighting, color, natural light, artificial light, light distribution, interior lighting, exterior lighting (façade of a house and high rise), urban lighting.

Prerequisites: -

References:

1. William M.C. Lam, *Perception and Lighting as Formgivers for Architecture*, McGraw-Hill, 1977
2. Norbert Lechner, *Heating Lighting Cooling*, 2nd edition, translated by PT RajaGrafindo Persada, 2007
3. John E Flyinn, *Architectural Interior System, Van Nostrand Reinhold Environmental Engineering Series*, Van Nostrand Reinhold Company, 1971

SITE PLANNING AND DESIGN

ENAR600049/ENAR610033
3 CREDITS
Learning Objective:

Student should be able to implement basic principles of site and environmental planning in an integrated way.

Syllabus:

Principles and issues in site planning, mass orientation, natural site condition, role of outdoor elements, topographical study of site and environment, trees and vegetation, typology and analysis of site planning, site and environmental design method.

Prerequisites: -
References:

1. Joseph DeChiara & Lee L. Koppelman, *Standard Perancangan Tapak*, Penerbit Erlangga, 1994
2. Albert J. Rutledge, *Anatomy of a Park: The Essentials of Recreation Area Planning and Design*, ASLA, 1971
3. William A. Mann, *Landscape Architecture, An Illustrated History in Timeless, Site Plans and Biography*, 1993
4. Geoffrey & Susan Jellicoe, *The Landscape of Man, Shaping the Environment From Prehistory to the Present Day*, Thames and Hudson Ltd,1995
5. Charles W. Moore et al, *The Poetics of Gardens*, MIT Press, 1993
6. Francis DK Ching, *Architecture: Form, Space and Order*, Erlangga, 1996

URBAN HOUSING THEORY

ENAR600050
3 CREDITS
Learning Objective:

Student should be able to analyze the impact of housing, planning, and development in urban setting.

Syllabus:

Housing problems in an urban setting, studies on typology and housing area, methods and building typology, studies on economics and management of housing, studies on planning and design of urban housing.

Prerequisites: -

References:

1. Norma L. Newmark & Patricia J. Thompson, *Self, Space & Shelter: An Introduction to Housing.* New York: Harper and Row, Publisher, Inc., 1977
2. John F. C. Turner, *Housing By People: Towards Autonomy in Building Environtments*, Marion Boyars Publishers Ltd, 1976
3. Graham Towers, *At Home in The City: An Introduction to Urban Housing Design*, 2005
4. Paul Balchin & Maureen Rhoden. *Housing: The Essential Foundations,* Routledge, New York 2003
5. Abidin Kusno, *Politik Ekonomi Perumahan Rakyat dan Utopia Jakarta*, 2012

SPECIAL TOPIC OF COLLABORATION

ENAR600051
3 CREDITS
Learning Outcomes:

Having the ability to solve design problems by collaborating with students from several fields of study. Having insights about engineering in the future.

Syllabus:

Study the development of design and engineering; the application of contemporary engineering; developments in some other disciplines that affect architectural design.

Precondition: -

Textbooks: Relevant references to the topic offered.

SPECIAL TOPIC ON ARCHITECTURAL DESIGN

ENAR600052/ENAR610034
3 CREDITS
Learning Objective:

Students should be able to demonstrate knowledge on current architectural discourse and its implementation in architectural design.

Syllabus:

Studies on the development of contemporary architectural theories; the development of architectural design methods; the development of architectural representation techniques; the development in other relevant disciplines that have impacts of the development of architectural design theories and methods.

Prerequisites: -

References: Relevant references to the topic offered.

SPECIAL TOPIC IN URBAN DESIGN

ENAR600053/ENAR610037
3 CREDITS
Learning Objective:

Students should be able to demonstrate knowledge on current urban design discourse and its implementation in urban design.

Syllabus:

Studies on the development of urban design theories; the development of urban design methods; studies on current issues that are relevant to urban design; the development in other relevant disciplines that have impacts on the development of urban design theories and methods.

Prerequisites: -

References: Relevant references to the topic offered.

SPECIAL TOPIC ON URBAN HOUSING AND SETTLEMENT

ENAR600054/ENAR610038
3 CREDITS
Learning Objective:

Students should be able to demonstrate knowledge on current development of urban housing and settlement.

Syllabus:

Studies on the development of urban housing and settlement theories; studies on current issues that are relevant to urban housing and settlement.

Prerequisites: -
References: Relevant references to the topic offered.

SPECIAL TOPIC ON ARCHITECTURAL HISTORY, THEORY AND CRITICISM

ENAR600055/ENAR610055
3 CREDITS
Learning Objective:

Students should be able to demonstrate historical and theoretical knowledge on the development of architecture.

Syllabus:

Studies of architectural history throughout various periods of time; the development of discourse on architectural history and theory.

Prerequisites: -

References: Relevant references to the topic offered.

SPECIAL TOPIC ON BUILDING TECHNOLOGY

ENAR600056/ENAR610036
3 CREDITS
Learning Objective:

Students should be able to demonstrate knowledge on current discourse on sustainability and its implementation on architectural design.

Syllabus:

Studies on the development of theories on bulding technology and sustainable environment; studies on relevant issues of sustainability; architectural design innovative practice related to sustainability; innovation on building structure, construction, material and systems.

Prerequisites: -
References: Relevant references to the topic offered.

BUILDING UTILITY

ENAR600057
3 CREDITS
Learning Objective:

Student should be able to explain utility system in high-rise and wide span building that support the building to function well from the perspective of user safety and comfort.

Syllabus:

Clean, grey, and black water system, artificial ventilation system, artificial lighting system, audio system, CCTV, telephone, lightning rod, vertical transportation system, building cleaning system.

Prerequisites: -

References:

1. John S Reynolds and Benjamin Stein, Mechanical and Electrical Equipement for Buildings, John Willey and Sons, 1999
2. Ken Yeang, The Skyscraper Bioclimatically Considered, Academy Press, 1998
3. Esmond Reid, Understanding Building, MIT Press, 1984
4. Hartono Poerbo, Utilitas Bangunan: Buku Pintar untuk Mahasiswa Arsitektur-Sipil, Djambatan, 1992

TECTONIC WORKSHOP

ENAR600058
3 CREDITS
Learning Objective:

Students should be able to produce construction design based on tectonic knowledge and to realize the design by applying making skills.

Syllabus:

Design through material exploration approach; materiality of materials; construction, construction skills and techniques; detail and finishing.

Prerequisites: -
References:

1. Kenneth Frampton, *Studies in Tectonic Culture: The Poetics of Construction in Nineteenth and Twentieth Century Architecture*, MIT Press, 2001
2. Richard Weston, *Material, Form and Architecture*, Yale University Press, 2003
3. Markus Heinsdorff, *Die Bambusbauten, The Bamboo Architecture, Design with Nature*, Design Media Publishing, 2013
4. Francis DK Ching, *Building Construction Illustrated,* Wiley, 2014

Transition Rules

1. The implementation of 2020 curriculum will start at the Odd Semester 2020/2021. In principle, after the 2020 Curriculum is implemented, only the subjects listed in the 2020 curriculum will be offered.
2. Class of 2019 and earlier should follow the 2020 curriculum by referring to the transition rules.
3. The transition period takes place for one year in the academic year of 2020/2021. When necessary, courses with changes on its semester's placement (from Even to Odd, or vice versa) will be opened in both semesters of the transition period (Academic Year 2020 / 2021).
4. If there is a change in a subject's credit, the number of credits that will be calculated for graduation are the number of credits applied when the students took the course. Students who need to retake such subjects after the 2020 Curriculum is implemented will acquire the subjects with its new credit numbers.
5. If a compulsory subject in the 2016 Curriculum is removed without any equivalence in the 2020 Curriculum, then credits obtained from such subject will still be included in the calculation of total 144 credits required for graduation. Students who have not passed such course can take either newly required subjects or other elective courses in the 2020 Curriculum to complete their 144 credits.
6. Students who have not passed the compulsory subjects in the 2016 Curriculum will need to take the similar or equivalent subjects in the 2020 Curriculum. The 2016 Curriculum courses that are not listed in the transition table below will have a similar name and credit numbers in the 2020 Curriculum.
7. Students from the 2018 class or earlier who have not passed the Physics (Mechanical and Thermal) Laboratory in Curriculum 2016 should take any Elective subject in the 2020 Curriculum.
8. The Digital Design Media and History and Theory of Architecture 2 subjects are now offered in the odd semester. In the transition period, Digital Design Media and History and Theory of Architecture 2 subjects will be open in the even semester for students of 2019 and above who need to take/retake the subjects.

Table 8. Subject Equivalence of 2016 Curriculum and 2020 Curriculum for Undergraduate Architecture Program

No.	Subject name in Curriculum 2016	Credit 2016	Subject name in Curriculum 2020	Credit 2020
1.	Integrated Character Building A	6	Integrated Character Building (MPKT)	5
	Integrated Character Building B	6		
2.	English	3	English	2
3.	Sports/Arts	1	Can be changed into Electives	1-3
4.	Physics (Mechanical and Thermal) Laboratory	1	Can be changed into Electives	1-3

Undergraduate Program in Interior Architecture

Program Specification

1.	**Awarding Institution**	Universitas Indonesia	
2.	**Teaching Institution**	Universitas Indonesia	
3.	**Faculty**	Engineering	
4.	**Program**	Undergraduate Program in Interior Architecture	
5.	**Vision and Mission of Study Program**	Vision: "To establish an excellence in Higher Education Institutions in Interior Architecture with national and international recognition, in order to nurture future leaders who think critically, act prudently and creatively with global insights and respect to the local wisdom and environmental sustainability." Mission: "To develop the system for Higher Education Institutions in Interior Architecture and to maintain its excellence in productivity in order to conduct Higher Education Tridarma."	
6 .	**Class**	Reguler, Parallel	
7.	**Degree Offered**	Sarjana Arsitektur (S.Ars.)	
8.	**Accreditation / Recognition**	Accredited A by BAN-PT dan internationally assessed by AUN-QA	
9.	**Language of Instruction**	Bahasa Indonesia and English	
10.	**Study Scheme (Full time/Part time)**	Full Time	
11.	**Entry Requirement**	SMA Graduate/ equal or D3/ Politeknik	
12.	**Period of Study**	4-year Program	
	Semester	Total Semester	Weeks / semester
	Regular	8	17
	Short (optional)	3	8
13.	**Aims of the Program** 1. **Education**: promoting graduates of interior architecture who master certain competencies in accordance with the level of education in a superior and quality manner. 2. **Research**: encouraging superior scientific research works that are able to compete at the international level. 3. **Community Service**: encouraging the implementation of practical/applied knowledge to the community in the form of empowerment.		
14.	**Profile of Graduates** Sarjana Arsitektur Interior is a graduate who has the ability to design interior architectural works with respect to context and local needs and based on the application of basic knowledge of interior architecture. Graduates are expected to demonstrate the ability as: 1. **An Initiator** – able to provide solutions to spatial problems critically and creatively with respect to local contexts and needs. 2. **A Designer** – have the skill in assembling interior architectural elements and materials, have an understanding of buildability aspects, and have sensitivity in creating meaningful interior architectural design. 3. **A Communicator** – able to communicate ideas verbally and through writings, drawings, models and other media. 4. **A Collaborator** – able to work together with various stakeholders in the society to propose creative solutions for real problems.		

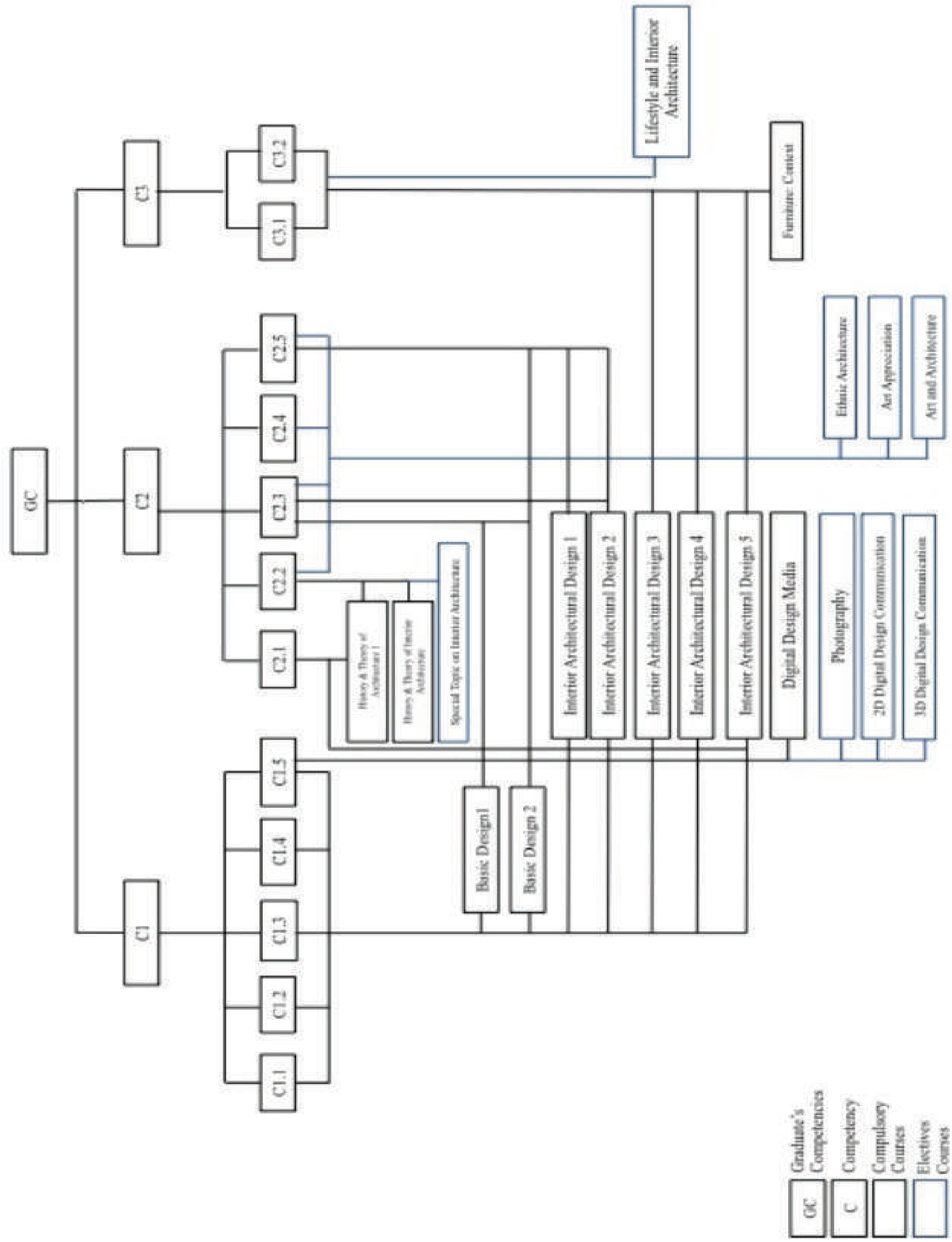
15.	**Graduate's Competencies:** An Arsitektur Interior graduate has the expected learning outcomes as follow: 1. Able to create interior architectural design based on interiority by integrating basic interior architectural knowledge, applying design and communication skill, applying ability for imagination, creative thinking, innovation and three-dimensional thinking. 2. Able to synthesize the knowledge of interior architectural history and theories, including knowledge on art, culture and humanities that could influence the quality of interior architectural design. 3. Able to analyze context in which interior architecture is designed and integrate it through design that responds appropriately to the context. 4. Able to analyze the needs and characteristics of the users, knowledge of ergonomics and anthropometric and integrate them as the basis to define contextual and functional requirement on different types of interior space. 5. Able to construct the basic knowledge of interior architectural design methods. 6. Able to construct the basic knowledge of structural systems, construction, and building technology aspects that are relevant to interior architectural design. 7. Able to construct the basic knowledge of materials both technically and in relation to tactility and human experience in interior space. 8. Able to integrate the basic knowledge of natural and environmental systems into a sustainable interior architectural design. 9. Aware of various roles of interior architects in the society and professional aspects of interior architecture. 10. Able to gather information, formulate, analyze and synthesize problems that are related to interior architecture. 11. Able to apply mathematics, science, and basic engineering into the solution of complex technical problems. 12. Have integrity, able to demonstrate critical, creative, and innovative thinking, and have intellectual curiosity in solving the problems both at individual and group levels. 13. Able to offer alternative solutions towards various problems in the society, the community, and the nation. 14. Able to utilize information and communication technology. 15. Able to use verbal and written language in Bahasa Indonesia and English fluently in academic and non-academic activities. 16. Able to identify various innovative and independent entrepreneurial endeavors with respect to ethics.

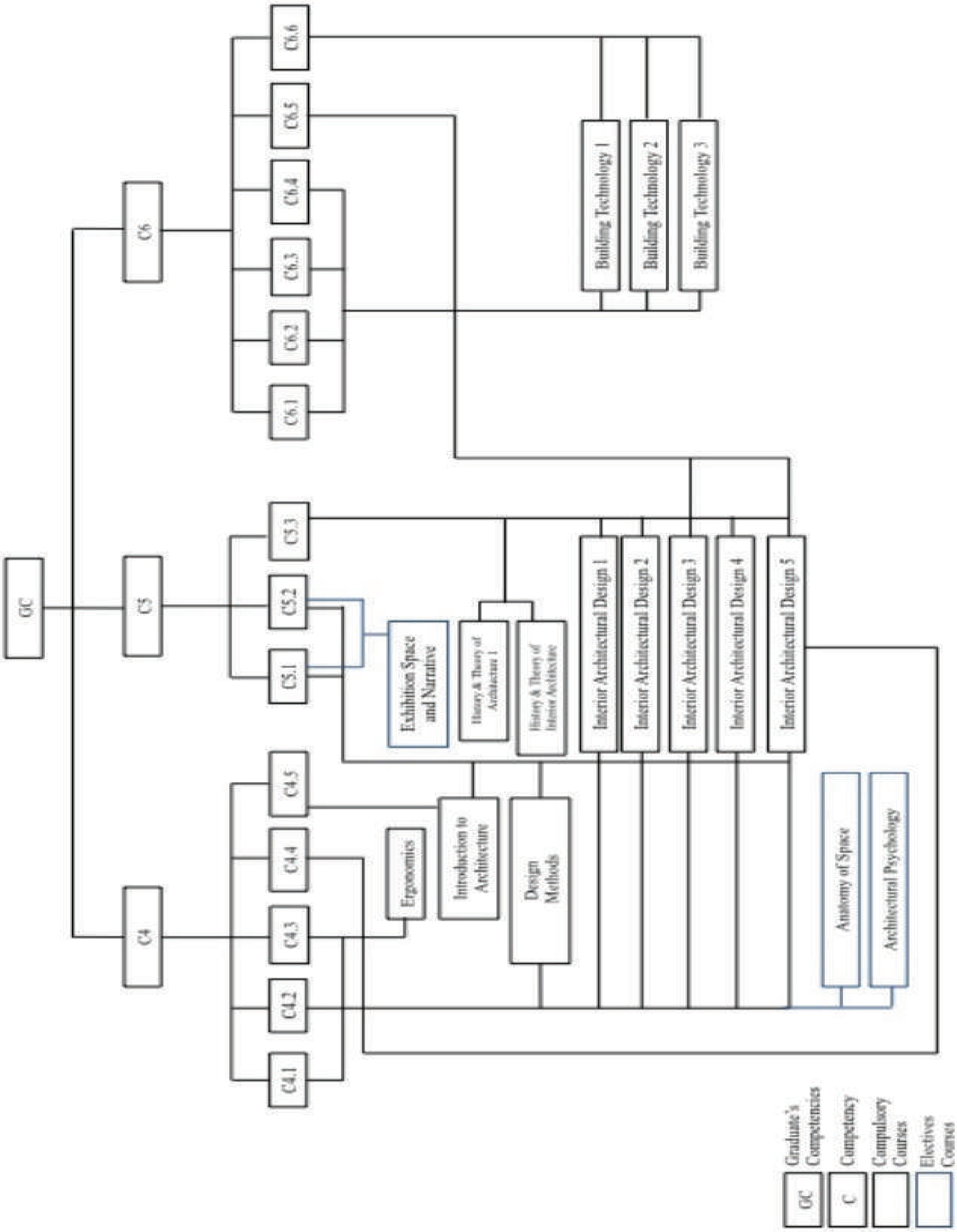
16.	**Course Composition**		
No.	**Type of Courses**	**Credits**	**Percentage**
I	University General Subjects	9	6.25 %
II	Basic Engineering Subjects	10	6.94 %
III	Architecture Core Course	84	58.33%
IV	Specialization Course	-	-
V	Electives	35	24.31%
VI	Undergraduate Thesis or Final Project	6	4.17 %
	Total	144	100 %
	Total Credits for Graduation		**144 sks**

Job Opportunity

A graduate is able to work as an interior architect in the design of interior spaces of residential buildings; commercial buildings; hospitals and other public buildings. S/he can also work as a design principal in an interior design consultancy, act as a corporate designer or a designer of movie, TV, theater sets as well as working as an academic and as a critic.

Graduate's Competencies/ Learning Outcomes Network




GC
C4
C5
C6
C4.1
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C4.5
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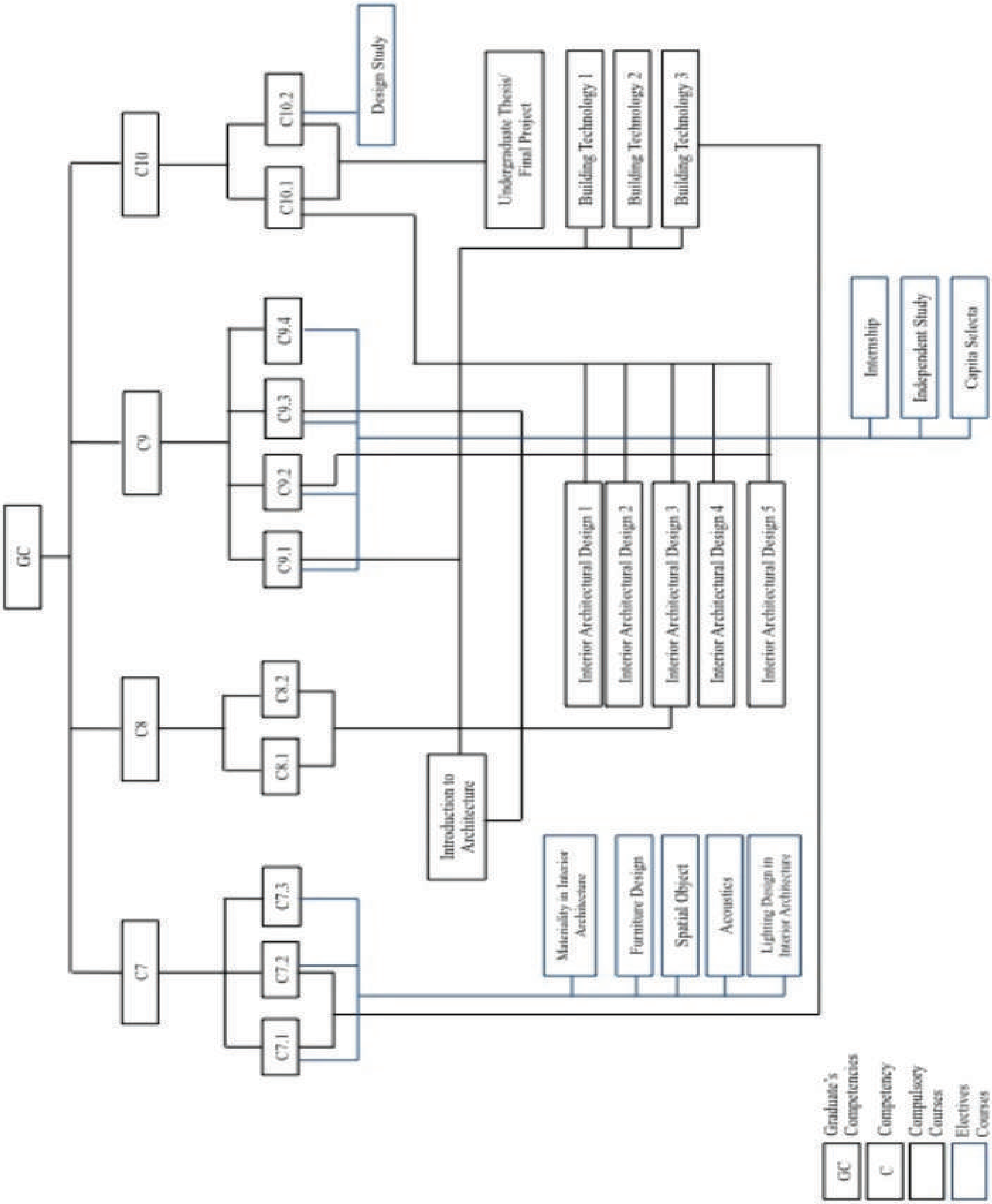
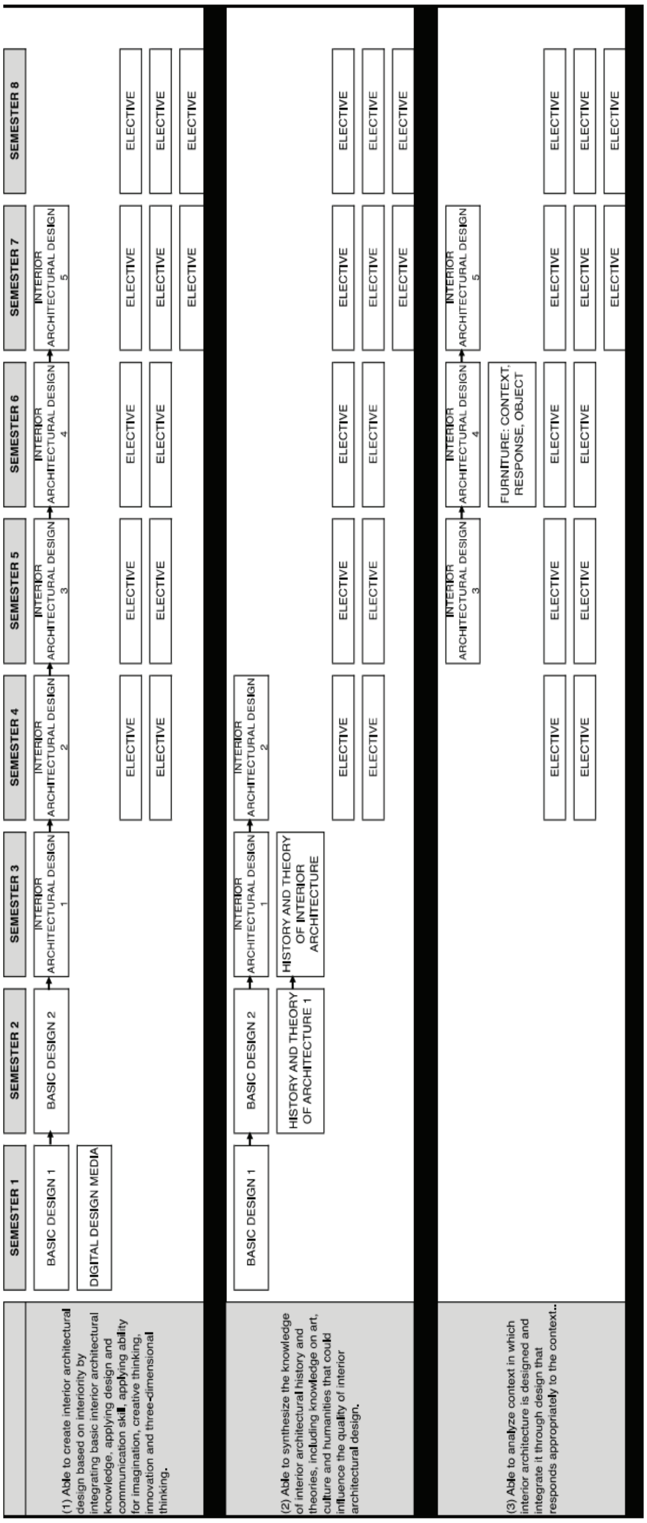
C5.2
C5.3
C6.1
C6.2
C6.3
C6.4
C6.5
C6.6
Ergonomics
Introduction to Architecture
Design Methods
Exhibition Space and Narrative
History & Theory of Architecture 1
History & Theory of Interior Architecture
Interior Architectural Design 1
Interior Architectural Design 2
Interior Architectural Design 3
Interior Architectural Design 4
Interior Architectural Design 5
Building Technology 1
Building Technology 2
Building Technology 3
Anatomy of Space
Architectural Psychology
GC Graduate's Competencies
C Competency
Compulsory Courses
Electives Courses


GC
C7
C8
C9
C10
C7.1
C7.2
C7.3
C8.1
C8.2
C9.1
C9.2
C9.3
C9.4
C10.1
C10.2
Design Study
Undergraduate Thesis/ Final Project
Building Technology 1
Building Technology 2
Building Technology 3
Internship
Independent Study
Capita Selecta
Interior Architectural Design 1
Interior Architectural Design 2
Interior Architectural Design 3
Interior Architectural Design 4
Interior Architectural Design 5
Introduction to Architecture
Materiality in Interior Architecture
Furniture Design
Spatial Object
Acoustics
Lighting Design in Interior Architecture
Graduate's Competencies
Competency
Compulsory Courses
Electives Courses

Course Diagram in Achieving Compentencies
Undergraduate Program in Interior Architecture



(4) Able to analyze the needs and characteristics of the users, knowledge of ergonomics and anthropometric and integrate them as the basis to define contextual and functional requirement on different types of interior space.	INTRODUCTION TO ARCHITECTURE		INTERIOR ARCHITECTURAL DESIGN 1 → DESIGN METHODS	INTERIOR ARCHITECTURAL DESIGN 2 → ERGONOMICS ELECTIVES	INTERIOR ARCHITECTURAL DESIGN 3 → ELECTIVE ELECTIVE	INTERIOR ARCHITECTURAL DESIGN 4 → ELECTIVE ELECTIVE	INTERIOR ARCHITECTURAL DESIGN 5 ELECTIVE ELECTIVE	ELECTIVE ELECTIVE ELECTIVE
(5)Able to construct the basic knowledge of interior architectural design methods.	INTRODUCTION TO ARCHITECTURE	HISTORY AND THEORY OF ARCHITECTURE 1 →	INTERIOR ARCHITECTURAL DESIGN 1 → DESIGN METHODS HISTORY AND THEORY OF INTERIOR ARCHITECTURE	INTERIOR ARCHITECTURAL DESIGN 2 → ELECTIVE	INTERIOR ARCHITECTURAL DESIGN 3 → ELECTIVE ELECTIVE	INTERIOR ARCHITECTURAL DESIGN 4 → ELECTIVE ELECTIVE	INTERIOR ARCHITECTURAL DESIGN 5 ELECTIVE ELECTIVE	ELECTIVE ELECTIVE ELECTIVE
(6) Able to construct the basic knowledge of structural systems, construction, and building technologyaspects that are relevant to interior architectural design.			BUILDING TECHNOLOGY 1 →	BUILDING TECHNOLOGY 2 → ELECTIVE	INTERIOR ARCHITECTURAL DESIGN 3 → BUILDING TECHNOLOGY 3 ELECTIVE ELECTIVE	ELECTIVE ELECTIVE	INTERIOR ARCHITECTURAL DESIGN 5 ELECTIVE ELECTIVE	ELECTIVE ELECTIVE ELECTIVE
(7)Able to construct the basic knowledge of materials both technically and in relation to tactility and human experience in interior space.			BUILDING TECHNOLOGY 1 →	BUILDING TECHNOLOGY 2 → ELECTIVE	BUILDING TECHNOLOGY 3 ELECTIVE ELECTIVE	ELECTIVE ELECTIVE	ELECTIVE ELECTIVE	ELECTIVE ELECTIVE ELECTIVE

(8)Able to integrate the basic knowledge of natural and environmental systems into a sustainable interior architectural design.	INTRODUCTION TO ARCHITECTURE		BUILDING TECHNOLOGY 1	BUILDING TECHNOLOGY 2 ELECTIVE	INTERIOR ARCHITECTURAL DESIGN 3 BUILDING TECHNOLOGY 3 ELECTIVE ELECTIVE	ELECTIVE ELECTIVE	ELECTIVE ELECTIVE	ELECTIVE ELECTIVE ELECTIVE
(9 Aware of various roles of interior architects in the society and professional aspects of interior architecture.	INTRODUCTION TO ARCHITECTURE		INTERIOR ARCHITECTURAL DESIGN 1	INTERIOR ARCHITECTURAL DESIGN 2 ELECTIVE	INTERIOR ARCHITECTURAL DESIGN 3 ELECTIVE ELECTIVE	INTERIOR ARCHITECTURAL DESIGN 4 ELECTIVE ELECTIVE	INTERIOR ARCHITECTURAL DESIGN 5 ELECTIVE ELECTIVE	ELECTIVE ELECTIVE ELECTIVE
(10) Able to gather information, formulate, analyze and synthesize problems that are related to interior architecture.			INTERIOR ARCHITECTURAL DESIGN 1	INTERIOR ARCHITECTURAL DESIGN 2 ELECTIVE	INTERIOR ARCHITECTURAL DESIGN 3 ELECTIVE ELECTIVE	INTERIOR ARCHITECTURAL DESIGN 4 ELECTIVE ELECTIVE	INTERIOR ARCHITECTURAL DESIGN 5 ELECTIVE ELECTIVE	UNDERGRADUATE THESIS FINAL PROJECT ELECTIVE ELECTIVE ELECTIVE

S1 Arsitektur Interior

Semester	GENERAL AND BASIC ENGINEERING	BASIC	SKILL	ENRICHMENT	
8			Undergraduate Thesis/Final Project [6]	Elective [3] Elective [3] Elective [3]	15 SKS
7			Interior Arch. Design 5 [9]	Elective [3] Elective [3] Elective [2]	17 SKS
6		Furniture: Context, Response, Object [3]	Interior Arch. Design 4 [9]	Elective [3] Elective [3]	18 SKS
5		Building Technology 3 [3]	Interior Arch. Design 3 [9]	Elective [3] Elective [3]	18 SKS
4		Building Technology 2 [3] Ergonomi [3]	Interior Arch. Design 2 [8]	Elective [3] Elective [3]	20 SKS
3	Mechanics and Thermal Physics [3]	Design Methods [3] Building Technology 1 [3] History and Theory of Interior Architecture 2 [3]	Interior Arch. Design 1 [7]		19 SKS
2	Integrated Character Building [5] Linear Algebra [4]	History and Theory of Architecture 1 [3]	Basic Design 2 [7]		19 SKS
1	English [2] Religion [2] Calculus 1 [3]	Introduction to Architecture [3] Digital Design Media [3]	Basic Design 1 [5]		18 SKS

Curriculum Structure Undergraduate Interior Architecture Program

Code	Subject	SKS
	1st Semester	
UIGE600003	English	2
UIGE600004	Religion	2
ENGE600001	Calculus 1	3
ENAI600001	Basic Design 1	5
ENAR600009	Introduction to Architecture	3
ENAI600015	Digital Design Media	3
	Sub Total	**18**
	2nd Semester	
UIGE600006	Integrated Character Building	5
ENGE600004	Linear Algebra	4
ENAI600002	Basic Design 2	7
ENAI600010	History and Theory of Architecture 1	3
	Sub Total	**19**
	3rd Semester	
ENGE600005	Mechanics and Thermal Physics	3
ENAI600003	Interior Architectural Design 1	7
ENAR600011	Design Methods	3
ENAI600012	History and Theory of Interior Architecture	3
ENAI600013	Building Technology 1	3
	Sub Total	**19**
	4th Semester	
ENAI600004	Interior Architectural Design 2	8
ENAI600014	Building Technology 2	3
ENAI600018	Ergonomics	3
	Elective *	3
	Elective *	3
	Sub Total	**20**
	5th Semester	
ENAI600005	Interior Architectural Design 3	9
ENAI600016	Building Technology 3	3
	Elective *	3
	Elective *	3
	Sub Total	**18**
	6th Semester	
ENAI600006	Interior Architectural Design 4	9
ENAI600017	Furniture: Context, Response, Object	3
	Elective *	3
	Elective *	3
	Sub Total	**18**
	7th Semester	
ENAI600007	Interior Architectural Design 5	9
	Elective *	3
	Elective *	3
	Elective *	2
	Sub Total	**17**
	8th Semester	
ENAI600008	Undergraduate Thesis/Final Project	6
	Elective *	3
	Elective *	3
	Elective *	2
	Sub Total	**15**
	Total	**144**

*) Students are required to take 2 courses outside of the Undergraduate Architecture Program with the approval of the Academic Supervisor and Credit Transfer Team. Students can take Minor packages outside the Undergraduate Architecture Program.

Students can take an exchange program/ credit earning with a partner university with the approval of the Academic Advisor and the Credit Transfer Team.

As the application of Merdeka Belajar, students can take electives in the form of internship, excursion/research project, community engagement, community development, etc.

***) Design Study is required as elective for students who choose to take Final Project

Electives

Code	Elective Course	SKS
ENAI600019	Acoustics	3
ENAI600020	Anatomy of Space	3
ENAI600021	Art Appreciation	3
ENAI600022	Furniture Design	3
ENAI600023	Lifestyle and Interior Architecture	3
ENAI600024	Field Study	3
ENAI600025	**Independent Study**	**3**
ENAI600026	**Design Study****	**3**
ENAI600027	Internship/ Community Outreach	3
ENAI600028	2D Digital Design Communication	3
ENAI600029	3D Digital Design Communication	3
ENAI600030	Materiality in Interior Architecture	3
ENAI600031	Spatial Object	3
ENAI600032	Architectural Psychology	3
ENAI600033	Exhibition Space and Narrative	3
ENAI600034	Art and Architecture	3
ENAI600035	Lighting Design in Interior Architecture	3
ENAI600036	Special Topic on Interior Architecture	3
ENAI600037	Special Topic of Collaboration	3

Course Syllabus of University Subjects

INTEGRATED CHARACTER BUILDING

UIGE6000061/UIGE6100061
5 credits

Syllabus :

The Integrated Character Building is part of the Higher Education Personality Development Lecture which is held for students which contains elements of the internalization of basic life values, interaction/relationship skills, nationality and academic skills as the basis for student personality to carry out learning according to scientific disciplines.

MPKT is carried out in the form of a series of learning activities outside the formal class. activities carried out include participation in lectures/seminars, internships, field work practices, social work, sports and/or arts activities and other forms of activities that have the main goal of equipping students with soft skills and proven by portfolio documents. The form of this learning activity is different from the MPKT courses that have been carried out at the previous UI.

The material provided at MPKT aims to form a human thinking pattern with values and morals to create a human personality by having critical, logical, creative, innovative thinking, and having intellectual curiosity and an entrepreneurial spirit. The material provided includes 9 UI values, national, state and citizen values based on Pancasila. Solving problems in science, technology, health, and humans as natural managers by using reasoning and utilizing Information and Communication Technology (ICT) to achieve the final objectives of this module.

Lecture activities are carried out using an online student-centered learning (SCL) approach which can use the following methods: experiential learning (EL), collaborative learning (CL), problem-based learning (PBL), question-based learning, and project based learning. The use of these various methods is carried out through group discussion activities, independent assignment exercises, presentations, writing papers in Indonesian and interactive discussions in online discussion forums. The language of instruction in this lecture is Indonesian.

Graduate Learning Outcomes :

- CPL 1: Able to use spoken and written language in Indonesian and English both for academic and non-academic activities (C3, A5)
- CPL 2: Have integrity and are able to think critically, creatively, and innovatively and have intellectual curiosity to solve problems at the individual and group level (C4, A3)
- CPL 3: Able to provide alternative solutions to various problems that arise in the community, nation, and country (C4, A2)
- CPL 4: Able to take advantage of information communication technology (C3)
- CPL 5: Able to identify various entrepreneurial efforts characterized by innovation and independence based on ethics (C2, A5)

Course Learning Outcomes :

- CPMK 1: After completing this course, students are able to apply self-regulated learning characteristically in studying critically, logically, creatively, innovatively through analysis of societal problems, nation, state, and Pancasila ideology based on self-understanding as individuals and members. the community by using good and correct Indonesian and the latest information and communication technology (C4, A4)
- CPMK 2: Able to identify various entrepreneurial efforts characterized by innovation and independence based on ethics (C2, A5)
- CPMK 3: After completing this course, students are able to apply self-regulated learning characteristically in pursuing integrated and comprehensive knowledge through analysis of science problems, technology based on the role of nature manager by using good and correct Indonesian and information technology and current communications. (C4, A4)
- CPMK 4: After completing this course, students are able to plan creative activities to solve problems in society and the world of work/industry by showing creativity, critical thinking, collaborative self-discipline using good and correct Indonesian as well as the latest information and communication technology (C5, A5)

Prerequisite : -

ACADEMIC WRITING

UIGE610002
2 credits
The Objectives :

To activate students, English so that they will be able to communicate effectively in English;

To enable students to develop the learning strategies and study skills needed to finish their study successfully and o continue learning on their own after taking the MPK program (to develop independent learners)

Main Competencies :

- Listen to, understand and take notes of key information in academic lectures of between 5-10 minutes length;
- Improve their listening skills through various listening materials and procedures;
- Speak confidently, ask questions in and contribute to small group discussions;
- Use different reading strategies needed to the effective readers;
- Improve their reading skills through extensive reading material;
- Develop skills in connecting ideas using appropriate transitions and conjunctions;
- Work as part of a group to prepare and deliver a 25-minute presentation on an academic topic using appropriate organization, language and visual aids;
- Write a summary of a short academic article;
- Write an expository paragraph;
- Write a short essay.

Learning Method : Active learning, Contextual language learning, small group discussion.

Prerequisite :

1. Students Learning Orientation/Orientasi Belajar Mahasiswa (OBM)

ENGLISH

UIGE600003
2 credits

Learning Objectives :

After attending this subject, students are expected to capable of use English to support the study in university and improve language learning independently.

Syllabus :

Study Skills : (Becoming an active learner, Vocabulary Building: word formation and using the dictionary Listening strategies Extensive reading) Grammar: (Revision of Basic grammar Types of sentences Adjective clauses, Adverb clauses Noun clauses, Reduced clauses) Reading: (Reading skills: skimming, scanning, main idea, supporting ideas, Note-taking Reading popular science arti-cle, Reading an academic text) Listening: (Listening to short conversations, Listening to a lecture and notetaking, Listening to a news broadcast, Listening to a short story) Speaking: (Participating in discussions and meetings, Giving a presentation) Writing: (Writing a summary of a short article Describing graphs and tables, Writing an academic paragraph, Writing a basic academic essay (5 paragraphs).

ISLAMIC STUDIES

UIGE6000010/UIGE610005
2 credits
General Instructional Objectives :

The cultivation of students who have concern for social, na-tional and countrys issues based on Islamic values which is applied in the development of science through intellectual skills.

Learning Objectives :

Course participants are expected to do the following when faced with a problem or issue which they must solve :

1. Analyze the problem based on the Islamic values they adopted;
2. Analyze the problem by implementing active learning stages;
3. Discuss and express their thoughts and ideas by using proper and correct Indonesian language in discussion and academic writing.

Syllabus :

Islam history: the meaning of Islam, the characteristic of Islam, the sources of Islamic teachings, Muhammad SAW as prophet and history figure, introduction of Islam in Indonesia, the teaching essence of Islam: the basic principle of Islam teachings, the unity of Allah, worship prac-tice in live, eschatology and work ethics, human's basic rights and obligation, social structure in Islam: sakinah mawaddah and ramhah family, the social implication of family life, Mosque and the development of Islam, zakat and the economic empowerment of the people, Islam society, Science: reason and revelation in Islam, Islam's motivation in development of science, science characteristics, source of knowledge, IDI (each Faculty and Department/Study Program).

CATHOLIC STUDIES

UIGE6000011/UIGE610006
2 credits
General Instructional Objectives :

To help deliver students as intellectual capital in implementing lifelong learning process to become scientists with mature personality who uphold humanity and life.

Be scholars who believe in God according to the teachings of Jesus Christ by continuing to be responsible of his faith in life in church and society.

Syllabus :

Almighty God and the God teachings; Man, Morals, science technology and art; harmony between religions; Society, Culture, Politics, Law: the substance of theses studies will be addressed by integrating the four dimensions of the teachings of the Catholic faith: the personal dimension, the dimension of Jesus Christ, the dimension of the Church, and Community dimension. Dimensions are implemented in the following themes: People, Religion, Jesus Christ, the Church, and Faith in the society.

CHRISTIAN STUDIES

UIGE6000012/UIGE610007
2 credits
General Instructional Objectives :

Cultivating students with comprehensive Christian knowledge and teaching in the midst of the struggle and the fight of the nation while also discussing the student's participation in line with the study to help improve and build our country.

Learning Objectives :

Course participants are expected to do the following when faced with a problem or issue which they must solve:

1. Analyze the problem based on the Christian values
2. Analyze the problem by implementing active learning stages
3. Discuss the problem by using proper and correct Indonesian language

Syllabus :

History (Historical terms): Status of the Bible, the existence of God and Morality, Christ the Savior, the Holy Spirit as existence reformer and outlook on the world: Faith and Knowledge of Science, Church and service, Ecclesiology, Spiritual and enforcement of Christian Human Rights and the world of ethics: Christian Ethics, Christian and worship, Christianity and politics, Christian love and social reality: Christian Organizations, Students and Service, Christian and expectations.

HINDU STUDIES

UIGE6000013/UIGE610008
2 credits

Syllabus :

Hindu religion, Hindu history), Source and scope of Hinduism (the Veda as the source of Hindu religion teachings, the scope of the teachings in Hindu religion), The concept of the God (Brahman) according to the Veda, the Path to Brahman (Catur Marga Yoga, Mantra and Japa), Human Nature (The purpose of human life, Human's duties, obligations, and responsibilities both individually or collectively), Ethics and morality (Principles teaching, self-control), in-depth understanding of the scripture (deep understanding of the Bhagawadgita, deep understanding of the Sarasamuschaya), The Role of Hinduism in science, technology, and art (Hinduism benefits in science and technology in accordance with each department, benefit / the role of Hinduism in the arts), Cohesion and community's prosperity /independence (Benefits of unity in the religious plurality, independent community (kerthajagathita) as a common goal, Tri Pitakarana), Culture as an expression of Hindu religious practice, Contribution to the Hindu religion teachings in the political life of nation and country, laws and

the enforcement of justice, Awareness of and obeying the Rita / Dharma.

BUDDHIST STUDIES
UIGE6000014/UIGE610009
2 credits

Syllabus :

Almighty God and the God Study (Faith and piety, Divine Philosophy/Theology), Human (Human Nature, Human Dignity, Human Responsibility), Moral (Implementation of Faith and Piety in everyday life), Science, Technology and Art (Faith, Science and Charity as a unity, the Obligation to study and practice what you are taught, Responsibility for nature and environment), harmony between religion (religion is a blessing for all mankind, the essence of the religious plurality and togetherness), community (the role of religious society in creating a prosperous independent society, the responsibility of religious society in the realization of human rights and democracy), Culture (the responsibility of religious society in the realization of critical thinking (academic), work hard and fair), Politics (Religion contribution in the political life of nation and country), Law (Raise awareness to obey and follow God's law, the role of religion in the formulation and enforcement of law, the function of religion in the legal profession).

KONG HU CU STUDY
UIGE6000015/UIGE610010
2 credits

Course Syllabus of Faculty Subjects

CALCULUS 1
ENGE600001/ENGE610001
3 credits
Course Learning Outcomes:

Able to use the basic concepts of calculus related to -a function of one variable, the derivative and integration of the function of one variable in order to solve its applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, basic engineering, and engineering specialization to be used in solving complex engineering problems.

Syllabus :
Introduction, Functions and Limits, The Derivative, Applications of the Derivative, The Definite Integral, Applications of The Definte Integral, Transcendental Functions, Techniques of Integration, Indeterminate Forms and Improper Integrals.

Prerequisite: None

Textbooks:

Main reference:
D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., Pearson, Prentice Hall, 2007.

Additional eferences:
1. George B. Thomas Jr., Thomas' Calculus Early Transcendental, 12th ed., Addison–Wesley Pearson, 2009.
2. Howard Anton, Calculus, 10th ed., John Wiley and Sons, 2012.

CALCULUS 2
ENGE600002/ENGE610002
3 SKS
Course Learning Outcomes:

Students are able to use the concepts of sequences, series, conic sections, and the basic concepts of calculus which involve the function of two or three variables to solve their applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus: :
Infinite sequences and infinite series, Test for convergence of positive series and alternating series, Power series and operation on operations, Taylor and MacLaurin series, Conic sections , Calculus in polar coordinates, Derivatives, limits, and continuity of multi-variables functions, Directional derivatives and gradients, Chain Rule, Tangent planes and Approximations, Lagrange multipliers. Double integrals in Cartesian coordinates and polar coordinates, triple integrals in Cartesian coordinates, cylindrical coordinates and spherical coordinates, Applications of double and triple Integral.

Prerequisite: Calculus 1

Textbooks:
1. D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., PEARSON, Prentice Hall, 2007.
2. Thomas, Calculus Thirteenth Edition Volume 2, Erlangga, 2019.

CALCULUS
ENGE600003/ENGE610003
4 SKS
Course Learning Outcomes:

Students are able to use the basic concepts of calculus involving functions of one to three variables to solve their applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :

Introduction, Functions and Limits, Derivatives, Derived Applications, Indeterminate Integral, Integral Applications, Infinite Row, and Series. Derivatives with many variables, Duplicate Integral (2 and 3), Duplicate Integral Application.

Prerequisite: None

Textbooks:

Main :
D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., Pearson, Prentice Hall, 2007.

George B. Thomas Jr., Thomas' Calculus Early Transcendental, 12th ed., Addison – Wesley Pearson, 2009.

LINEAR ALGEBRA
ENGE600004/ENGE610004
4 SKS
Course Learning Outcomes:
Students are able to calculate linear system problems to solve engineering problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :

Linear Systems and matrix equations, Determinants, Euclid

vector spaces, Common vector spaces, eigenvalues and eigenvectors, inner product spaces, Diagonalization and General Linear Transformation.

Prerequisite: None

Textbooks:
1. Elementary Linear Algebra, Howard Anton & Chris Rorres, 11th edition, 2014
2. Gilbert Strang, Introduction to linear algebra 3rd edition Wellesley Cambridge Press, 2003

MECHANICAL AND HEAT PHYSICS
ENGE600005 / ENGE610005
3 credits
Course Learning Outcomes:

Able to explain the basic concepts of mechanics and thermodynamics, and be able to apply them to understand natural phenomena and human engineering, including their applications.

Graduate Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus:

Units, Magnitudes and Vectors, Motion Along Straight Lines, Motion in Two and Three Dimensions, Newton's Laws of Motion, Applications of Newton's Laws, Kinetic Energy, and Work, Potential Energy and Energy Conservation, Center of Mass, Linear Momentum, Rotation, Rolling Motion, Torque, Angular Momentum, Oscillation, Mechanical and Sound Waves, Gravity, Statics and Elasticity, Fluid Mechanics, Temperature, Heat, Law I Thermodynamics, Ideal Gas and Kinetic Theory of Gas, Heat Engine, Entropy, and Law II Thermodynamics.

Prerequisite: none

Textbooks:
1. Halliday, Resnick, and Walker, Principles of Physics 10th Edition, Wiley, 2014.
2. Serway Jewett, Physics for Scientists and Engineers 9th Edition, Thomson Brooks / Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008

ELECTRICAL MAGNETIC, OPTICAL AND WAVE PHYSICS
ENGE600007 / ENGE610007
3 credits
Course Learning Outcomes:

Students are able to apply the basic concepts of electrical physics, magnetism, waves, and optics to solve problems in the engineering field.

Graduate Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus:

Unit, Magnitude, Vector, Electric Charge, Electric Field, Gauss Law, Electric Potential, Capacitance, Electric Current, Resistance, Direct Current, Magnetic Field Due to Electric Current, Magnetic Field Source, Induced GGL, Inductance, Alternating Current, Electromagnetic Waves, Light Properties and Propagation, Optical Geometry.

Prerequisite: none

Textbooks :
1. Halliday, Resnick, and Walker, Principles of Physics 9th Edition, Wiley, 2011.
2. Serway Jewett, Physics for Scientists and Engineers 9th Edition, Thomson Brooks / Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008.

BASIC CHEMISTRY
ENGE600009 / ENGE610009
2 credits
Course Learning Outcomes:
Students are able to analyze the principe of basic chemistry for application in engineering.

Graduates' Learning Outcomes:
Able to apply mathematics, science, and basic engineering to be used in solving complex engineering problems.

Syllabus:

Material and measurements, atoms, molecules and ions, stochiometry, water phase reactions and solution stochiometry, thermochemistry, chemical equilibrium, acid and base equilibrium, electrochemistry, chemical kinetics, and chemical applications.

Prerequisite: none

Textbooks :
1. Ralph H. Petrucci, General Chemistry: Principles and Modern Applications, 8th Ed. Prentice Hall Inc., New York, 2001.
2. John McMurry, Robert C. Fay, Chemistry (3rd ed.), Prentice Hall, 2001.
3. Raymond Chang, Williams College, Chemistry (7th ed.), McGraw-Hill, 2003.

ENGINEERING ECONOMY
ENGE600011 / ENGE610011
3 credits
Course Learning Outcomes:

Students are able to analyze the economic and financial feasibility of making economic practice decisions.

Graduate Learning Outcomes:

Able to apply the principles of technical management and decision making based on economic considerations, in individual and group, as well as in project management.

Syllabus:

Introduction to Engineering Economics, Time Value of Money, Combining Factors, Interest Rates, Money Worth Analysis, Rate of Return Analysis, Effects of Inflation, Benefit Cost & Break-Even Point Analysis, Sensitivity Analysis, Depreciation, Tax Analysis, Cost Estimation & Allocation, Capital Budgeting & Replacement Analysis.

Prerequisite:
1. Civil Engineering : -
2. Environmental Engineering : -
3. Naval Engineering : -
4. Industrial Engineering : must pass the introductory Economic course and have completed 38 credits
5. Chemical Engineering : -
6. Bioprocess Engineering : -

Textbooks:
1. Blank, Leland and Tarquin, Anthony. 2018. Engineering Economy 8th Ed. McGraw Hill.

2. Park, Chan S. 2016. Contemporary Engineering Economics 6th Ed. Pearson. Upper Saddle River.
3. White, Case and Pratt. 2012. Principles of Engineering Economic Analysis 6th ed. John Wiley and Sons.

STATISTICS AND PROBABILISTICS
ENGE600010 / ENGE610010
2 credits
Course Learning Outcomes:

Students are able to handle quantitative data/information starting from the descriptive stage (collection, organization, and presentation) to the inductive stage, which includes forecasting and drawing conclusions based on the relationship between variables for decision making.

Graduate Learning Outcomes:
1. Apply descriptive statistics and probability theory to data processing and serving
2. Apply probability distribution to data processing and serving
3. Apply the principles of sampling and estimation for decision making
4. Apply hypothesis test samples for decision making

Syllabus:

Introduction to Statistics for Engineering Studies, Probability Theory, Dasar Basic concepts and definitions, Distribution Probability, Sampling, Estimation, Hypothesis testing, Hypothesis test 1 sample at an average value, Regression

Prerequisite: none

Textbooks :
1. Harinaldi, Basic Principles of Statistical Engineering and Science, Erlangga, 2004
2. Montgomery, DC., And Runger, GC., Applied Statistics and Probability for Engineers, John Wiley Sons, 2002

HSE PROTECTION
ENGE600012 / ENGE610012
2 credits
Course Learning Outcomes:

Upon completion of this subject students are expected to be able to carried out hazard identification, and characterization, to propose appropriate methods for risk reduction and mitigation, and to design safety management system. The student is also expected to improve their awareness on industrial safety and health, and understanding on safety regulation framework and standards as well as environmental program.

Graduate Learning Outcomes:
1. Students are expected to understand safety, health and environmental aspect as an integral part of fundamental principal in engineering code of ethics.
2. Students are expected to be able to carry out process of risk assessments by considering risk factors in the impact of hazards on people, facilities, and the surrounding community and environemt.
3. Students are expected to understand the regulatory framework and standard related to the stages of life cycle of machine, building structure, construction, and process.
4. Students are able to design and propose an effective hazard communication, management and engineering control, and risk mitigation through an engineering assignment project.
5. Students are able to identify the knowledge required to perform risk assesment, investigation and design improvement through a multidisiplinary case of incident and accident.

Syllabus:

Introduction to SHE Regulation and Standards, SHE Perception (Risk and Environment), Identification, Assessment and Management, Construction, machinery and Noise hazards, Process safety hazard and analysis technique, Fire and explosion hazard, Electrical hazard, Toxicology in the Workplace, Ergonomy Aspect, Hazard communication to employees, Environmental Protection, Case studies, Safety Health and Environment audits.

Prerequisite: none

Textbooks :
1. Charles A. Wentz, Safety, Health and Environmental Protection, McGraw Hill, 1998.
2. Asfahl, C.R., Rieske, D. W., Sixth Edition Industrial Safety and Health Management, Pearson Education, Inc., 2010.
3. United Kingdom - Health and Safety Executive, http://www.hse.gov.uk/
4. National laws and regulations related to the K3 Management System and the Environment.
5. Related Journal (http://www.journals.elsevier.com/safety-science/) etc, related standards and publications.

Interior Architecuture Required Courses

INTRODUCTION TO ARCHITECTURE
ENAR600009
3 CREDITS
Learning Objective:

Student should be able to understand basic principles in architecture, including basic theories, the relationship between architecture and human, architecture and nature, architecture and aesthetic, and architecture and technology; able to understand the position of architecture position among other disciplines.

Syllabus:

What is architecture? (Introduction: Architecture as discourse, career in architecture, arkhe + tekton; tekhne; Laugier primitive hut and the idea of shelter)

Aesthetic (proportion; rhythm; scale; golden rules; aesthetic trinity of classic Greek; Mandala and Maya; Taoism and nature, mathematical pattern in geometry)

Form and Space (Plato and form; type and how Quatrèmere de Quincy mimic nature; form and function; various views on space and the different meaning of raum and spatium)

Materiality and Materialization (re-investigating tekhne; the importance of understanding the characteristic and potential of material, tectonic which does not limit to construction)

Context (understanding of natural environment, artificial environment, and built environment; our existence and place according to Heidegger; material and context)

Human and relationship with others I (the importance of understanding human for designer; under- standing of human being; body, senses and space; personal space according to Hall)

Human and relationship with others II (space, the presence and the remoteness of people, the meaning of place for human)

Architects as profession

Prerequisitest: -

References:
1. James O'Gorman, *ABC of Architecture*, University of Pennsylvania Press, 1998
2. Marcus Vitruvius Pollio, *Decem Libri de Architectura*, Biblio

Bazaar, 2008
3. Adrian Forty, *Words and Buildings: a Vocabulary of Modern Architecture*, Thames and Hudson, 2004
4. Yusuf B. Mangunwijaya, *Wastu Citra*, Gramedia Pustaka Utama, 1988
5. Martin Heidegger, *Building Dwelling Thinking, in Poetry, Language, Thought*, HarperPerennial, 1975
6. M. Merleau-Ponty, *Phenomenologie de la Perception Chapter II*, Routledge & Kegan Paul Ltd, 1962
7. Edward T. Hall, *The Hidden Dimension*, Doubleday, 1966

HISTORY AND THEORY OF ARCHITECTURE 1

ENAR600010
3 CREDITS
Learning Objective:

Student should be able to understand the history of modern architecture from 1750s to present.

Syllabus:

This course is a survey of modern architecture history from 1750s to present, with main focus on the development of modern architecture. This course also discusses the relationship between the development of architecture and its socio-cultural, political, and technological contexts. This course also investigates principles in architecture and design. It emphasizes on several important moments in the development of modern architecture, and provide knowledge on the theories that are relevant to modern architecture.

Prerequisites: -

References:

1. Kenneth Frampton, *Modern Architecture: A Critical History 3rd Ed,* Thames & Hudson, 1997
2. Leonardo Benevolo, *History of Modern Architecture, Volume I & II*, MIT Press, 1979
3. Iain Borden, *Architecture and the Sites of History, Interpretations of Buildings and Cities*, Butterworth Architecture, 1995
4. William J.R. Curtis, *Modern Architecture since 1900, Third Edition*, Phaidon Press, 2002
5. Diane Ghirardo, *Architecture After Modernism,* Thames & Hudson, 1996
6. Spiro Kostof, *A History of Architecture, Settings & Rituals, 2nd Edition*, Oxford University Press, 1994
7. Bernd Evers & Christof Thoenes (eds.), *Architectural Theory: from the Renaissance to the Present,* Taschen, 2003

DESIGN METHODS

ENAR600011
3 CREDITS
Learning Objective:

Student should be able to understand the basic thinking and methods of designing built environment; student should be able to explain the basic thinking and apply one of the design methods through writings and drawings.

Syllabus:

Theory and method of thinking; phenomenology, semiotic; theory and method of identifying problems; architectural observation, design knowledge, factual, deontic, instrumental, black box, clear box; theory and method of understanding problems, analysis and synthesis; Theory and methods of problem solving.

Prerequisites:

Student has taken Introduction to Architecture

References:

1. Christoper Alexander, *Notes on The Synthesis of Form*, Harvard University Press,1994
2. Don Koberg & Tim Bagnall, *The Universal Traveller: a Soft System Guide to Creativity, Problem Solving, & the Process of Reaching Goals*, Crisp Learning, 1991.
3. Gunawan Tjahjono, *Metode Perancangan: Suatu Pengantar untuk Arsitek dan Perancang*, 1998
4. Jean-Pierre Protzen & David J. Harris, *The Universe of Design: Horst Rittel's Theories of Design and Planning*, Routledge, 2010

HISTORY AND THEORY OF INTERIOR ARCHITECTURE

ENAI600013
3 CREDITS
Learning Objectives:

Students should be able to have an understanding architecture history and its relation to interior design history and art history, and also theories that are evolved in the development of interior architecture.

Syllabus:

Interior and interiority; relationship between body and space; types in interior architecture; sign and society; design in society; semiotics in design; critical regionalism; locality issue in design, development of interior representation.

Prerequisites:

Student has taken History and Theory of Architecture 1

References:

1. Shashi Caan Being, *Rethinking Design and Interiors: Human Beings in the Built Environment*, Laurence King Publishing, 2011.
2. Christine McCarthy, *Toward a Definition of Interiority*, in *Space and Culture,* Vol. 8, 2005, pp. 112-125
3. Mark Kingwell, Mark Taylor and Julieanna Preston, *Tables, Chairs, and Other Machines for Thinking,* in *Intimus,* by Mark Taylor and Julieanna Preston (eds.), Wiley-Academy, 2006, pp. 173-179
4. Gaston Bachelard, *The Dialectics of Outside and Inside,* in *Intimus,* by Mark Taylor and Julieanna Preston (eds.), Wiley-Academy, 2006, pp. 22-25
5. Ed Hollis, *The Secret Lives of Buildings: From the Ruins of the Parthenon to the Vegas Strip in Thirteen Stories*, Picador, 2010.
6. Michel Foucault, *Discipline and Punish: The Birth of The Prison (Chapter on Disciplining the Docile Bodies) 2nd ed,* Vintage Books, 1995
7. Neil Leach (ed), *Rethinking Architecture: A Reader in Cultural Thepry (Articles by Umberto Eco and Roland Barthes),* Routledge, 1997
8. Jean Baudrillaed, *System of Objects*, Verso Books, 2006
9. Evans, Robin "The Developed Surface: An Enquiry into the Brief Life of an Eighteenth Century Drawing Technique", in *Translations from Drawing to Building and Other Essays*, London: Architectural Association, 1997): 195-231.

DIGITAL DESIGN MEDIA

ENAR600015
3 CREDITS
Learning Objective:

Student should be able to express, explore, investigate and communicate architectural ideas by using digital media.

Syllabus:

Introduction to techniques and variety of digital media which can be applied to represent architectural ideas, investigate the basic abilities of various digital tools, choosing the appropriate digital tools and techniques to express, explore or investigate certain architectural ideas, studying the workflow of digital and analog media as a part of the architectural design process.

Prerequisites:

Student has taken Basic Design 2

References:
1. L Farrelly, *Basic Architecture: Representation Techniques*. London, Thames & Hudson, 2008
2. B Kolarevic, (Ed), *Architecture in the Digital Age: Design and Manufacturing*, Spon Press, 2003
3. P Laseau, *Architectural Representation Handbook: Traditional and Digital Techniques for Graphic Communication*, McGraw-Hill Companies, 2000

BASIC DESIGN 1

ENAI600001
5 CREDITS
Learning Objective:

Student should be able to produce 2D and 3D works as creative responses towards contexts by applying basic knowledge of visual art and design; Student should be able to acquire and apply basic 2D and 3D representational techniques.

Syllabus:

Basic knowledge of visual art and design, basic knowledge of aesthetic; basic knowledge of space; visual elements: shape, color, texture, etc; basic principles of composition; introduction to art history and its role in the making of art; basic drawing techniques: expression drawing; shape drawing (natural and manmade objects); basic modeling and assembling techniques; understanding characteristics of media and materials; perceiving visually and communicating what is perceived; display and layout techniques.

Prerequisites: -

References:
1. Louis Fisher Rathus, *Understanding Art*, Prentice Hall, 1994
2. Claire Holt, *Art in Indonesia, Continuity and Changes*, Cornel University,Ithaca and London, 1967
3. Johannes Itten, *The Elements of Color*, John Wiley & Sons, 1970
4. Harvard Anarson, *History of Modern Art: Painting, Sculpture, Architecture & Photography*, Prentice Hall, 1998
5. Kimberly Elam, *Geometry of Design: Studies in Proportion and Composition*, Princeton, 1998
6. Gyorgy Kepes, *Structure in Art and in Science,* George Braziller, 1965
7. Frank D. K. Ching, *Architecture: Form, Space & Order*, John Wiley & Son, 1997
8. John Heskett. *Design: A Very Short Introduction*. Oxford: Oxford University Press, 2002.

BASIC DESIGN 2

ENAI600002
7 CREDITS
Learning Objective:

Student should be able to produce spatial works as creative responses towards contexts by applying knowledge of visual art and design and employed various 2D and 3D representation techniques; Stu- dent should be able to communicate architectural ideas by using appropriate techniques and media.

Syllabus:

Basic knowledge of relationship among space, human and time; Exploration of visual elements, non-visual elements (audio, kinesthetic) and moving elements (kinetics); creating spatial ideas as response to contexts; principles of architectural communication, basic architectural communication techniques: projection drawing, orthographic drawing, perspective drawing; modeling and assembling techniques; model making; understanding characteristics of media and materials; communicating object and space for various purpose and audiences; communicate human activity space.

Prerequisites:

Student has taken Basic Design 1

References:
1. Francis D.K. Ching, *Drawing & Perceiving: A Visual Dictionary of Architecture*, John Wiley & Sons, 1996
2. Francis D.K. Ching, *Architectural Graphics, 2nd Ed*, John Wiley & Sons, 2002
3. Francis DK Ching, *Drawing: A Creative Process*, Wiley, 1989
4. Paul Laseau and Norman Crewe, *Visual Notes for Architects and Designers*, Wiley, 1986
5. Jeffrey Balmer, Michael T. Swisher, *Diagramming the Big Idea: Methods for Architectural Composition*, Routledge, 2012
6. Mark Basinger, *Drawing Ideas*, Random House, 2013
7. Don Norman, *The Design of Everyday Things*, Basic Books, 2013
8. Atelier Bow Wow, *Graphic Anatomy,* Toto, 2007
9. Joy Monice Malnar, *Sensory Design,* University of Minnesota Press, 2004
10. Peter Zumthor, *Atmospheres: Architectural Elements, Surrounding Objects,* Birkhauser, 2006

INTERIOR ARCHITECTURAL DESIGN

Interior architectural design courses are the studio courses at the Department of Architecture. The studios denote learning locations as well as learning methods. At the end of studio-based learning process, students should be able to demonstrate their ability to think critically and creatively, which can be assessed from their ability to explain and present his/her design ideas. Interior Architectural Design learning process is implemented through Design Projects, which are direct manifestations of integration of knowledge, consisting of:
- Factual knowledge: understanding and formulating design problems which are abstract, qualitative, and related to socio-cultural aspects of human/space activities
- The context and the environment of interior living space, ranging from micro/local/personal space, family, community, to urban/rural environment
- Technical aspects such as structure, tectonics (including building materials), building physics, building systems, and building utilities that are relevant to the interior design.
- Design methods
- Communication techniques

In practice, Design Projects accommodate learning materials from several courses: Interior Architectural Design, Building Technology, and Furniture: Context, Response and Object, within the following order:
- Design Project 1 integrates Interior Architectural Design 1 and Building Technology 1
- Design Project 2 integrates Interior Architectural Design 2 and Building Technology 2
- Design Project 3 integrates Interior Architectural Design 3 and Building Technology 3
- Design Project 4 integrates Interior Architectural Design 4 and Furniture: Context, Response, Object

Gradual acquisition of knowledge and ability is structured within each stage of learning in Architectural Design in each semester.

DESIGN PROJECT 1

Design Project 1 focuses on the design of space for human self. Design Project 1 is an integration of knowledge on spatial design, based on the understanding of the relationship between human and space, basic structural logic, and basic principles of environmental comfort within spatial design. Design Project 1 consist of learning activities performed in two courses which complement each other, Interior Architectural Design 1 and Building Technology 1.

INTERIOR ARCHITECTURAL DESIGN 1

ENAI600003
7 CREDITS
Learning Objectives:

Student should be able to design a space for a single person, through understanding the relation- ship between human and space.

Syllabus:

Interior Architectural Design 1 is an early and critical stage to introduce students to architecture through imaginative, creative, and innovative spatial design. Architectural knowledge encompasses basic comprehension about the personal spatial meaning and experience, interaction between human body and spatial quality, understanding of site and surrounding context as experienced by human body. Design activities consists of information gathering, formulation of design problem, analysis, and making critical decisions to formulate an active strategy toward human space, ability to think three-dimensionally through spatial design exploration, and communicating design ideas.

Design exercises consist of: Designing a simple space for a single person that is materialized through 1:1 scaled model; Designing a space for an episode of human life.

Prerequisites:

Students have taken Basic Design 2

Students have taken or are taking Building Technology 1

References:

1. Bruno Zevi, *Architecture as Space: How to Look at Architecture,* 1993.
2. Donlyn Lyndon and Charles W. Moore, *Chambers For A Memory Palace,* MIT Press, 1994
3. Edward T. Hall, *The Hidden Dimension*, Peter Smith Publications, 1992
4. Francis DK Ching, *Architecture: Form, Space and Order,* Wiley, 1996.
5. Karen Franck & Bianca Lepori, *Architecture Inside Out*, Academy Press, 2000.
6. Michael Pollan, *A Place of My Own*. Penguin Press, 2008.
7. Steen Eiler Rasmussen, *Experiencing Architecture*, MIT Press, 1959.
8. Yi-Fu Tuan, *Space and Place: The Perspective of Experience*, University of Minnesota Press, 1981

BUILDING TECHNOLOGY 1

ENAI600012
3 CREDITS
Learning Objectives:

Students should be able to understand basic technical aspects of structure, material, construction, and building comfort; should be able to formulate technical design process and integration of structure and construction technologies into a functionally effective whole; should be able to produce a report of analysis and synthesis of all aspects of building technology.

Syllabus:

Structure in nature; Basic principle of structure and construction (logic of structure, basic mechanics); Site context (natural elements that influence building); Building material (material use and position in building, material property values that influence comfort); Basic building physics (building orientation, environmental influence to comfort); Introduction to basic structure and construction principles of simple building; Introduction to working drawing.

Prerequisites: -

References:

1. Mario Salvadori, *Why Building Stands Up*, W.W. Norton & Company, 2002
2. W. O. Kilmer, *Construction Drawings and Details for Interiors: Basic Skills*, John Wiley and Sons, 2003
3. Bjorn N Sandaker, Arne P Eggen, and Mark R Cruvellier, *The Structural Basis of Architecture: Second Edition*, Routledge, 2011
4. Forest Wilson, *Structure: The Essence of Architecture*, Van Nostrand Reinhold Company, 1971
5. Mark Dekay and G. Z. Sun Brown, *Wind & Light: Architectural Design Strategies: 3rd Edition,* John Wiley & Sons, 2014
6. Francis DK Ching, *Building Construction Illustrated,* Wiley, 2014
7. Edward Allen and Joseph Iano, *The Architect Studio Companion: Rules of Thumb for Preliminary Design,* Wiley and Sons, 2002
8. Ken Parsons, *Humn Thermal Environments: The effects of Hot, Moderate, and Cold Environments on Human Health, Comfort, and Performance*, CRC, 2014
9. Pete Silver and Will McLean, *Introduction to Architectural Technology*. Laurence King, 2013

DESIGN PROJECT 2

Design Project 2 is about designing space for core social unit (family, a couple, etc). Design Project 2 integrates knowledge on spatial design based on the idea dwelling, the analysis of family life cycle and daily activities, application of basic structural principles and constructions of low rise building, building systems, and principle of building physics. Design Project 2 integrates the learning activities performed in two courses that complement each other, Interior Architectural Design 2 and Building Technology 2.

INTERIOR ARCHITECTURAL DESIGN 2

ENAI600004
8 CREDITS
Learning Objectives:

Students should be able to design a dwelling as a living space for core social unit through tectonic approach and by thorough consideration of the life cycle and daily activities of the core social unit.

Syllabus:

Interior Architectural Design 2 proposes critical issues of human living space in urban community context, through the design of a dwelling. Design knowledge herewith includes the understanding concept of dwelling, observation and analysis of core social unit, formulating spatial program based on understanding of the needs of core social unit, development of spatial idea through tectonic exploration as *the art of joining* and exploration of spatial composition as an integration of *part-whole* that appropriately accommodate the programs, which are implemented into an integrated spatial design and communicated by complying with standard principles of architectural communication.

Prerequisites:

Students have taken Interior Architectural Design 1

Students have taken or are taking Building Technology 2

References:

1. Martin Heidegger, *Building Dwelling Thinking, in Poetry, Language, Thought*, HarperPerennial, 1975
2. Adam Sharr with Simon Unwin, *Heidegger's Hut, in ARQ (Architectural Research Quarterly) Vol.5 No.1*, 2001
3. J Macgregor Wise, *Home: Territory and Identity pp. 391-396, in INTIMUS Interior Design Theory Reader,* 2006
4. Norberg Schulz, *The Concept of Dwelling – Introduction*, Rizzoli International Publications,1985
5. Hannah Arendt, *The Human Condition - Chapter I & II*, University of Chicago Press, 1958
6. Rapoport, *House Form and Culture - Chapter II Alternative Theories of House Form & Chapter III Socio-cultural Factors and House Form, pp. 18-82*, Prentice Hall Inc, 1969
7. Kenneth Frampton, *Studies in Tectonic Culture: The Poetics of Construction – Chapter I Introduction: Reflections on the Scope of the Tectonic*, MIT Press, 2001
8. Charles Moore, Gerrad Allen, Donlyn Lyndon, *Assembling A Room, in The Place of Houses*, University of California Press, 2000
9. Francis D. K. Ching, *Architecture: Form, Space and Order*, Wiley, 2014
10. Erik H. Erikson, *Life Cycle Completed – Chapter 3 Major Stages in Psychosocial Development*, W. W. Norton & Company, 1998
11. Jonathan Hill, *Immaterial Architecture – House and Home*, Routledge, 2006
12. Peter Zumthor, *Atmospheres: Architectural Environments, Surrounding Objects*, Birkhäuser Architecture, 2006

BUILDING TECHNOLOGY 2

ENAI600014
3 CREDITS
Learning Objectives:

Students should be able to understand technical aspects of structure, material, construction, and building comfort for low rise building; should be able to formulate technical design process and integration of structure, construction technologies and building systems into a functionally effective whole; should be able to produce a report of analysis and synthesis of all aspects of building technology.

Syllabus:

Identification of all aspects of building technology in a simple low rise building that include: structural logic, buildability, and comfort; Introduction to in-depth knowledge on the materiality of material, construction techniques and details; Dimension and configuration of materials and their relation to structure and construction of simple building; Elements of air conditioning and lighting in a building; Introduction to basic knowledge of building utility; Creating technical documentations (working drawing).

Prerequisites:

Students have taken Building Technology 1

Students have taken or are taking Interior Architectural Design 2

References:

1. Francis DK Ching, *Building Construction Illustrated,* Wiley, 2014
2. Arthurs Lyons, *Materials for Architect & Builders*, Butterworth-Heinemann, 2008
3. Graham Bizley, *Architecture in Details*, Architectural Press, 2008
4. Andrea Deplazes, *Constructing Architecture: Materials Processes Structures, A Handbook*, Birkhauser, 2008
5. Gail Peter Borden, *Material The Typology of Modern Tectonics*, Wiley, 2010
6. Thomas Schropfer, *Material Design*, Birkhauser Architecture, 2010
7. Norbert Lechner, *Heating, Cooling, Lighting: The Sustainable Design Methods for Architect*, Wiley, 2013
8. Charlie Wing, *How Your House Works: a Visual Guide to Understanding and Maintaining Your Home, Updated and Expanded,* RSMeans, 2012
9. Corky Binggeli, *Corky Building Systems for Interior Designers*, John Wiley & Sons, 2003

DESIGN PROJECT 3

Design Project 3 focuses on buildability and performances of interior space. Design Project 3 is an integration of design knowledge through the understanding of existing technological context, exploration of technological aspects, application of structural principles, construction and materials and building support system into interior design process. Design Project 3 integrates the learning activities in two courses that support one another, Interior Architectural Design 3 and Building Technology 3.

INTERIOR ARCHITECTURAL DESIGN 3

ENAI600005
9 CREDITS
Learning Objectives:

Students should be able to design public interior space through exploration on development of technology ideas in interior architecture.

Syllabus:

Interior Architecture Design 3 proposes critical issues on the aspect of buildability and interior space performance. Design knowledge consists of design as a response to technological aspects of existing interior space condition; program development based on analysis of existing technological context; development of advanced tectonic ideas, including material development, detail, and construction; development of interior architecture ideas based on its performance and building system. Design assignment consists of: interior space design based on exploration of technological aspects, such as materials, assembly techniques, portable/ flexible furniture, etc.; Interior space design as a response to the existing building context in medium to large scale.

Prerequisite:

Students have taken Interior Architectural Design 2

Students is taking Building Technology 3

References:

1. Mark Taylor, Julieanna Preston (eds), *Intimus: Interior Design Theory Reader,* Academy Press, 2006
2. Mark Kingwell. "Tables, Chairs and Other Machines for Thinking," *in Intimus,* Queen's Quarterly, 2005
3. Peter Opsvik, *Rethinking Sitting*, W. W. Norton & Company, 2009
4. Eva Maria Herrmann, Marcus Kaiser, Tobias Katz, *Furnishing, Zoning: Spaces, Materials, Fit Out*, Birkhauser, 2014
5. Sylvia Leydecker, *Designing Interior Architecture: Concept, Typology, Material, Construction*,
6. Corky Binggeli, *Building Systems for Interior Designers*, Wiley, 2009
7. Lisa Godsey, *Interior Design Materials and Specification*, Fairchild Books, 2012

8. Sally Augustin, *Place Advantage: Applied Psychology for Interior Architecture, John Wiley & Sons, 2009*

BUILDING TECHNOLOGY 3

ENAI600016
3 CREDITS
Learning Objectives:

Students should be able to understand advanced technical aspects of structure, material, construction, and building comfort that are relevant to interior architecture design approach in order to respond the architectural existing condition; should be able to formulate technical design process and integration of technological aspects of interior space that consist of structural system, construction technology, materials and utility system into a functionally effective whole; should be able to create technical documentation and create analysis/ synthesis report from all aspects of building technology; should be able to understand energy conservation issues and ecological sustainability in interior context.

Syllabus:

Building technology aspects that are relevant to the design approach through fitting out, remodeling, renovating, retrofitting, extension. Understanding and responding to existing structure condition. Understanding the utility of existing condition and modifying it on basis of design necessities. Knowledge of materials in terms of detail and construction, relationship between material and acoustics, lighting and maintenance, as well material innovation and development of advance material. Communication of technological aspects, such as, furniture, fixture and other interior entirety.

Prerequisites:

Students have taken Building Technology 2

Students have taken or are taking Interior Architectural Design 3

References:

1. Gary Gordon, *Interior Lighting*, Wiley, 2003
2. Corky Binggeli, *Building Systems for Interior Designers*, Wiley, 2009
3. Lisa Godsey, *Interior Design Materials and Specification*, Fairchild Books, 2012
4. John E. Flynn, Arthur W. Segil, *Architectural Interior System: Lighting, Accoustics, Air Conditioning*, Van Nostrand Reinhold, 1992
5. Deplazes, *Constructing Architecture: Materials, Process, Structures*, A. Basel: Birkhauser, 2005
6. Atelier Bow Wow, *Graphic Anatomy Atelier Bow-Wow*, Toto, 2007
7. Christian Schittich, *In Detail: Interior Spaces: Space, Light, Material*, Birkhauser, 2002
8. Blaine Brownell, *Transmaterial: A Catalog of Materials That Redefine our Physical Environment (1, 2, & 3)*, Princeton Architectural Press, 2005, 2008, & 2010

ERGONOMICS

ENAI600018
3 CREDITS
Learning Objectives:

Students should be able to understand and apply the basic concept of ergonomics and human factors and anthropometry in interior design as well universal design.

Syllabus:

Basic principles of ergonomics and human factors; basic principles of anthropometry; application of ergonomics and human factors in the design of built environment; basic principles of universal design.

Prerequisites: -

References:

1. Mark S Sanders and Ernest J. McCormick. *Human Factors in Engineering and Design*, McGraw Hill, Singapore, 1992
2. Galen Cranz, *The Chair: Rethinking Culture, Body and Design*, W & W Norton Company, 2000
3. R. S. Bridger, *Introduction to Ergonomics*, Routledge-Taylor & Francis, London, 2003
4. Pheasant, Stephan. *Bodyspace: Anthropometry, Ergonomics and the Design of Work*. Taylor & Francis, London, 2003
5. H. E. Kroemer, Ann D. Kroemer, *Office Ergonomics*, Taylor & Francis, London, 2001
6. Edward Steinfeld, Jordana L. Maisel, *Universal Design*, Wiley, New Jersey, 2012

DESIGN PROJECT 4

Design Project 4 focuses on the design of public space. It integrates architectural typology-based design method, issue-based design and basic knowledge of urban interior. Design Project 4 integrates the learning activities performed in two courses that support each other, Interior Architectural Design 4 and Furniture: Context, Response, Object.

INTERIOR ARCHITECTURAL DESIGN 4

ENAI600006
9 CREDITS
Learning objectives:

Students develop their ability in designing interiors of public space through architectural typology- based design approach and issue-based design approach, by considering urban interior knowledge as well creatively exploring ideas on form and space quality.

Syllabus:

Interior Architectural Design 4 proposes the critical issues of human interior living space with socio-cultural complexities as found in urban/suburban interior context, through two approaches: a) top-down approach through the exploration of design ideas based on typology, and b) bottom- up approach through exploration of issue-based design ideas. Urban interior knowledge consists of comprehension on interior concepts of urban scale. Design knowledge includes the understanding of the concept of *public*, analysis of functional interior types, spatial programming, the concept of institution and how it is elaborated into interior spatial design, the formulation of initial statement based on issues, development of architectural programs and how they are elaborated into interior spatial design. Knowledge of site and environment includes the contextual explanation of the design through the understanding toward site physical condition, socio-cultural context or urban-scaled interior space, and consideration of sustainability.

Design assignments consist of: Designing interior space within social environment context with a close kinship; Designing interior space in more complex urban environmental context.

Prerequisite:

Students have taken Interior Architectural Design 3
Students have taken or are taking Building Technology 3

References:

1. Adrian Forty, *Words and Buildings: A Vocabulary of Modern Architecture, Chapter 'Space', hal. 256-275*, Thames & Hudson, 2000
2. Yi-Fu Tuan, *Space and Place: The Perspective of Experience*, University of Minnesota Press, 1981

3. Henri Lefebvre, *The Production of Space*, Blackwell, 1991
4. Jeremy Till, *Architecture Depends*, MIT Press, 2009
5. Karen Franck & Bianca Lepori, *Architecture Inside Out*, Academy Press, 2000
6. Giulio Carlo Argan, *On the Typology of Architecture, in Nesbitt, Theorizing a New Agenda for Architecture hal. 240-246*, Princeton Architectural Press, 1996
7. Jonathan D. Sime, *Creating Places or Designing Spaces*, Journal of Environmental Psychology, Vol 6, hal. 49-63, 1986
8. Andrew Ballantyne, *What is Architecture?*, Routledge, 2002
9. Aaron Betsky & Erik Adigard, *Architecture Must Burn: Manifestos for the Future of Architecture*, Gingko Press, 2001
10. Robert Venturi & Denise Brown, *Learning from Las Vegas*, MIT Press, 1977
11. Bernard Tschumi, *Architecture and Limits I-III, in Nesbitt, Theorizing a New Agenda for Architecture hal. 150-167*, Princeton Architectural Press, 1996
12. Suzie Attiwill & Rochus Urban Hinkel, *Urban Interior: Informal Explorations, Interventions and Occupations*, Spurbuchverlag, 2011
13. Christine McCarthy, "Before the Rain: Humid Architecture," *Space and Culture*, 6, 337, 2003
14. Graeme Brooker, *Key Interiors since 1900*, Laurence King, 2013

FURNITURE: CONTEXT, RESPONSE, OBJECT

ENAI606017
3 CREDITS
Learning Objectives:

Students should be able to understand the concepts, functions, and construction of furniture; able to understand theories and methods to develop furniture concept and design.

Syllabus:

This course encourages student to learn about furniture and its existence in a space. Furniture is observed as a tool to connect space that is located between human bodies, as in a building or on a broader scope. Furniture is observed as functional objects that occupy the space. Students are expected to learn and criticize a priori knowledge on furniture, so that they can consider a new perspective in designing furniture.

Prerequisites:

Students have taken or are taking Interior Architecture Design 4

References:

1. Galen Cranz, *The Chair, Rethinking Culture, Body and Design*, W. W. Norton & Company, 2000
2. Christopher Natale, *Furniture Design and Construction for the Interior Designer*, Fairchild Pub, 2009
3. Jim Postell, *Furniture Design*, Wiley, 2007.
4. M. F. Ashby, Kara Johnson, *Materials and Design: The Art and Science of Material Selection in Product Design*, Elsevier, 2002

INTERIOR ARCHITECTURAL DESIGN 5

ENAI600007
9 CREDITS
Learning Objective:

Students should be able to design interior architecture based on particular design method; should be able to produce design ideas that demonstrate buildability and compliance to general building and interior codes; should be able to demonstrate the application of knowledge on the principles of building technology that are relevant to interior architectural design.

Syllabus:

Designing with *fitting out, remodelling, renovating, retrofitting, or extension* approach within design units. Design units offered may include but not limited to: typology-based design (commercial, educational, hospitality); designing based on adaptive reuse; evidence-based design; designing with technological, computational, or parametric approach. Knowledge and implementation of building and interior codes that include safety, security, health, comfort, and accessibility. Design communication that comply with standard drawing convention. Awareness and understanding of role of various disciplines of design, construction, mechanical and electrical in interior architectural design process.

Prerequisites:

Students have taken Interior Architectural Design 4

References:

1. Stewart Brand, *How Buildings Learn: What Happens After They're Built*, Penguin Books, 1995
2. Sally Stone and Graeme Brooker, *Re-Readings: Interior Architecture and the Design Principles of Remodelling Existing Buildings*, RIBA Publishing, 2014
3. Adrian Forty, *Words and Buildings: a Vocabulary of Modern Architecture*, Thames and Hudson, 2004
4. Fred Scott, *On Altering Architecture*, Routledge, 2008
5. Charles Bloszies, *Old Buildings New Designs: Architectural Transformations*, Princeton Architectural Press, 2011
6. Julianna Preston, *Interior Atmosphere*, Architectural Design series, May/June 2008
7. Peter Zumthor, *Atmospheres: Architectural Environments, Surrounding Objects*, Birkhäuser Architecture, 2006
8. Edward Dimendberg, *Diller Scofidio + Renfro: Architecture After Images*, University Of Chicago Press, 2013
9. Atelier Bow Wow, *Graphic Anatomy Atelier Bow-Wow*, Toto, 2007
10. Christopher Gorse and David Highfield, *Refurbishment and Upgrading of Buildings*, Spon Press, 2009
11. Corky Binggeli, *Building Systems for Interior Designers*, John Wiley & Sons, 2009

UNDERGRADUATE THESIS

ENAI600008
6 CREDITS
Learning Objectives:

Student should be able to identify, study and communicate issues within specific area of study related to architecture; able to develop basic skills in scientific reading, researching and writing; able to develop understanding of research as an activity that requires systematic and logical thinking; able to develop critical understanding of various architectural issues.

Syllabus:

The thesis begins with an inquiry into what the student wishes to study in depth. It involves the understanding of issues and explanation of the understanding with limited depth level. At this level, the student is neither required to solve a problem nor create or invent something new that would contribute to the discipline architecture. Simple investigation is performed through literature search and/or case studies. Originality. Modes of writing: descriptive, narrative, explanatory or argumentative.

Prerequisites:

Students have earned 114 CREDITS and have taken Interior Architectural Design 4

References:

1. John Zeisel, *Inquiry by Design*, W. W. Norton & Company, 2006

2. David Evans & Paul Gruba, *How To Write A Better Thesis Dissertation*, Springer, 2014
3. F. Crews. *The Random House Handbook, ed, pgs 10-114*, McGraw-Hill Higher Education,1992
4. Border and K. Ruedi, *The Dissertation: an Architecture Student's Handbook*, Oxford University Press, 2000.
5. T. Y. Hardjoko, *Panduan Meneliti dan Menulis Ilmiah*, Departemen Arsitektur Universitas Indonesia, 2005

FINAL PROJECT
ENAI600008
6 CREDITS
Learning objectives:

Student should be able to identify, study and communicate issues within specific area of study related to architecture; able to develop basic skill in analyzing and synthetizing theory and demonstrate it through design; able to develop understanding of research as an activity that requires systematic and logical thinking; able to develop critical understanding of various architectural issues.

Syllabus:

The thesis begins with an inquiry into what the student wishes to study in depth. It involves the understanding of issues and explanation of the understanding with limited depth level, which is demonstrated through architectural design.

Prerequisites:

Students have earned 114 CREDITS and have taken Interior Architectural Design 5

References:
1. John Zeisel, *Inquiry by Design*, W. W. Norton & Company, 2006
2. Border and K. Ruedi, *The Dissertation: an Architecture Student's Handbook*, Oxford University Press, 2000.
3. John Zeisel, *Inquiry by Design*, W. W. Norton & Company, 2006
4. Iain Border and Katarina Ruedi, *The Dissertation: an Architecture Student's Handbook*, Oxford University Press, 2000.
5. Murray Fraser, *Design Research in Architecture*, Ashgate Publishing, 2013

Course Description: Elective Courses

ACOUSTICS
ENAI600019
3 CREDITS
Learning Objectives:

Student should be able to understand basic principles of acoustic in space and environment; able to conduct analysis in order to create good acoustic design.

Syllabus:

Basic acoustics, characteristics of sounds, acoustic criteria in space, sound intensification and sound isolation, environmental noise.

Prerequisites: -

References:
1. Leslie L. Doelle & Lea Prasetio, *Akustik Lingkungan*, Erlangga,1993
2. PH Parkin & HR Humpreys, *Acoustics Noise and Buildings*, Faber and Faber Ltd, 1984
3. Finarya Legoh & Siti Hajarinto, *Buku Ajar Akustik*, 2002

ANATOMY OF SPACE
ENAI600020
3 CREDITS
Learning Objectives:

Students should be able to master the principles in disassembling the elements and system of a space in terms of user's needs.

Syllabus:

Dissection method in anatomy as an approach to analyze space, understanding the parts, the characteristics, the relationship among one another and how together they create a working system of space; Anatomy of domestic space: domestic service space, space saving strategy, flow, and flexibility; Anatomy of public space: hierarchy and public space organization, back and front separation, grid; Anatomy of space for special needs: the concept of enabling environment, architecture for users with limited vision, hearing difficulty, limited mobility, architecture for children with special needs (such as ADHD, autism, mental retardation).

Prerequisites: -

References:
1. Jean Baudrillard, *Structures of Interior Design in The Domestic Space Reader,* University of Toronto Press, 2012
2. Karel Teige, *The Minimum Dwelling*, MIT Press, 2002
3. Jeremy Till & Tatjana Schneider, *Flexible Housing*, Routledge, 2007
4. Erving Goffman, *Front and Back Region in Everyday Life in Everyday Life Reader* by Ben Highmore, Routledge, 2001
5. Jos Boys, *Doing Disability Differently: An alternative handbook on architecture, dis/ability and designing for everyday life,* Routledge, 2014

ART APPRECIATION
ENAI600021
3 CREDITS
Learning Objectives:

Students should be able to understand art and art appreciation and to apply this practice through delivering experience (sense and aesthetic) and understanding (concept and theory) of art works; on basis of formal-technic criteria; should be able to demonstrate a comprehension on theories through interpretive view of visual and spatial art works that are relevant to interior architecture; understand context of art gallery and curatorial process.

Syllabus:

Art and art appreciation. Critic and art appreciation. Aesthetic principles. Art history timeline. Visual elements in visual artwork. Spatial art, multisensory art, public art. Introduction to art and national gallery. The role in art. Curating.

Prerequisites: -

References:
1. E H Gombrich, *The Story Of Art*, Paidon Press, 1995
2. Immanuek Kant, *The Critique Of Judgement*, Oxford University Press, 2009
3. Maurice Merleau-Ponty, *Phenomenology Of Perception*, Routledge, 2002
4. Thierry de Duve, *Kant After Duchamp*, MIT Press, 1996
5. L H Hanks, J Hale & S Macleod, *Making: Narratives, Architectures, Exhibitions, (Museum Meaning),* Routledge, 2012
6. Joshua C Taylor, *Learning To Look*, University of Chicago Press, 1957

FURNITURE DESIGN
ENAI600022
3 CREDITS
Learning Objectives:

Students should be able to understand the basic principles of designing furniture as disposable items that serve as forming element of spatial quality, in relation to architectural design, space and interiority.

Syllabus:

Furniture as disposable objects with certain prerequisites based on the intention behind the design. Interiority and spatial quality as inseparable aspects of furniture design. After such comprehension is established, the learning process will include: basic furniture construction and furniture construction that shapes the space quality.

Prerequisites: -

References:
1. Joyce Ernest, *The Technique of Furniture Making*, B.T. Batsford Liminted, 1970
2. *Sunset Series for Furniture Making, Cabinet and Book Shelves Making, Bedroom Storage; Kitchen Storage.*
3. Ernest Scott, *The Mitchell Beazley Illustrated Encyclopaedia of Working in Wood: Tools - Methods - Materials – Classic*, Mitchell Beazley, 1992

LIFESTYLE AND INTERIOR ARCHITECTURE
ENAI600023
3 CREDITS
Learning Objectives:

Students should be able to understand the role of lifestyle in interior and its application.

Syllabus:

Lifestyle principles in society and in interior design. The development of style from the beginning of modern period until now and its role in interior design. Appropriate style in society and its effect in interior design.

Prerequisites: -

References:
1. Idi Subandy Ibrahim, *Lifestyle Ecstasy: Kebudayaan Pop dalam Masyarakat Komoditas Indonesia*, Jalasutra, 2004
2. Jean Baudrillard, *The Consumer Society: Myths and Structures 1st Ed*, Sage Publications Ltd, 1998
3. Dominic Strinati, *An Introduction to Theories of Popular Culture 2nd Ed*, Routledge, 2004
4. Agus Sachari & Yan Yan Sunarya, *Modernisme: Sebuah Tinjauan Historis Desain Modern*, Balai Pustaka, 1999
5. David Chaney, *Life Style: Key Ideas*, Routledge, 1996.
6. Francois Baudot, *Styles: Compendium of Interiors*, Assouline, 2005

FIELD STUDY
ENAI600024
3 CREDITS
Learning Outcomes:

Students are able to analyze architectural phenomena and / or practices in a context of both natural and socio-cultural environments that are obtained through experience or field observations. Students are able to demonstrate this knowledge in the form of reports and documentation.

Syllabus:

Introduction to the field context, both the natural environment and the socio-cultural system; architectural observation approaches and their context; measurement, documentation and representation methods; planning activities and compiling the results of field observations.

Prerequisite: -

Textbooks:

Relevant references to the topic offered.

INDEPENDENT STUDY
ENAI600025
3 CREDITS
Learning Objectives:

Students should be able to demonstrate advanced architectural knowledge on particular topic and to implement the knowledge into the development of ideas of architectural intervention.

Syllabus:

Advanced studies on architectural knowledge in particular context; development of architectural intervention ideas based on thorough inquiry of contexts and theoretical inquiry on related topic.

Prerequisite:

References: Relevant references to the topic offered.

DESIGN STUDY
ENAI6000236
3 CREDITS
Learning Objectives:

Students should able to develop basic skills on reading, inquiry and writing a scientific writing related to design activities.

Syllabus:

Communicating design process through a writing that complies with scientific writing requirements; Communicating systematically literature review, development of design methods and design process through in writing.

Prerequisite:

Student has passed Interior Architectural Design 4 and is taking Final Project.

References:
1. John Zeisel, *Inquiry by Design*, W. W. Norton & Company, 2006
2. David Evans & Paul Gruba, *How To Write A Better Thesis Dissertation*, Springer, 2014
3. F. Crews. *The Random House Handbook, ed, pgs 10-114*, McGraw-Hill Higher Education,1992
4. I. Borden and K. Ruedi, *The Dissertation: an Architecture Student's Handbook*, Oxford University Press, 2000.
5. T. Y. Hardjoko, *Panduan Meneliti dan Menulis Ilmiah*, Departemen Arsitektur Universitas Indonesia, 2005

INTERNSHIP
ENAI600027
3 CREDITS
Learning Objectives:

Students should be able to understand the processes of planning, implementation and evaluation of engineering activities; to demonstrate knowledge on teamwork of relevant disciplines in professional practice; to demonstrate knowledge on the processes of planning, design and implementation of a built environment; to get involved as assistant interior designer, assistant field project officer, assistant field supervisor, or community interior architect.

Syllabus:

Real project management process in a company, architecture consultant or organization. Techniques of writing simple proposal and reporting field work. Techniques of presentation, Method of managing material, data, equipment, human resources and coordination among stakeholders in engineering planning and implementation activities.

Prerequisite: -

References: -

2D DIGITAL DESIGN COMMUNICATION

ENAI600028
3 CREDITS
Learning Objectives:

Student should be able to use 2D digital drawing media in architectural design process; should be able to choose and use various way and technique in drawing for particular purpose.

Syllabus:

Drawings in CAD and NURBS, pixel base drawing, vector base drawing, architectural representation and diagram.

Prerequisites:

Student have taken Basic Design 2

References:

1. Hamad M.M, *Autocad 2010 Essentials,* Jones and Bartlett, 2010
2. Robert McNeel & Associates, *Rhinoceros: NURBS Modelling for Windows*, USA, 1998
3. H Sondermann, *Photoshop in Architectural Graphics*, SpringerWienNewYork, 2009

3D DIGITAL DESIGN COMMUNICATION

ENAI600029
3 CREDITS
Learning Objectives:

Student should be able to use 2D digital modelling tool in architectural design process; should be able to choose and use various way and technique in digital modelling; should be able to create appropriate graphical representation for the model.

Syllabus:

Polygon and NURBS-based digital model, inter-platform exchange, from 2D representation to 3D model, rendering techniques.

Prerequisites:

Student have taken Basic Design 2

References:

1. Chaos Group Youtube Channel: https://www.youtube.com/user/ChaosGroupTV/playlists
2. Alex Hogrefe's Architectural Graphic Tutorials: https://visualizingarchitecture.com

MATERIALITY IN INTERIOR ARCHITECTURE

ENAI600030
3 CREDITS
Learning Objectives:

Students should be able to understand material as an essential part of thinking and design process.

Syllabus:

Conceptual understanding of material through the idea of materiality; Relationship between material and human body, space and senses; Tectonic and detail of material; Material innovation in interior architecture.

Prerequisites: -

References:

1. Kenneth Frampton, *Studies in Tectonic Culture: The Poetics of Construction in Nineteenth and Twentieth Century Architecture*, The MIT press, 1995
2. K Lloyd Thomas (ed), *Material Matters: Architecture and Material Practice*, Routledge, 2007
3. Martin Bechtold, *Innovative Surface Structures: Technologies and Applications*, Taylor & Francis, 2008
4. Blaine Brownell, *Transmaterial: A Catalog of Materials That Redefine our Physical Environment (1, 2, & 3),* Princeton Architectural Press, 2005, 2008, & 2010
5. Blaine Brownell, *Material Strategies: Innovative Applications in Architecture*, Princeton Architectural Press, 2012
6. Michael Bell and Jeannie Kim, ed, *Engineered transparency: the technical, visual, and spatial effects of glass*, Princeton Architectural Press, 2009
7. Andrea Bruno, et al, *Featuring Steel: Resources Architecture Reflections*, Arcelor Mittal, 2009
8. Sigfried Giedion, *Mechanization Takes Command: A Contribution to Anonymous History*, W.W. Norton, 1948
9. *Innovation in Glass*, Corning: Corning Glass Museum, 1999
10. Sheila Kennedy, *KVA: Material Misuse*, Architectural Association, 2001
11. Klaus-Michael Koch with Karl J. Habermann, *Membrane Structures: Innovative Building with Film and Fabric*, Prestel, 2004
12. Christian Schittich, et al, *Glass Construction Manual*, Birkhauser, 2007
13. Thomas Schropfer, *Material Design: Informing Architecture by Materiality*, Birkhauser, 2011
14. Toshiko Mori, *Immaterial Ultramaterial*, George Brazillier, 2002

SPATIAL OBJECTS

ENAI600031
3 CREDITS
Learning Objectives:

Students should be able to understand and identify spatial objects with potential in creating the quality of interior space; develop spatial object design ideas within interior architecture context and realize it into prototype.

Syllabus:

Understanding of spatial object and its role in producing spatial quality; creative methods to develop spatial object design; materials, tools, techniques and technology in the making of spatial objects; developing the design of spatial objects; realization of design into prototype.

Prerequisites: -

References:

1. Michalko, Michael. *Thinkertoys*. Berkeley, Calif.: Ten Speed Press, 2006
2. Moore, Rowan. *Why We Build*.
3. Gorman, Carma. *The Industrial Design Reader*. New York: Allworth Press, 2003
4. Meikle, Jeffrey L. *Design In The USA*. Oxford: Oxford University Press, 2005
5. Yelavich, Susan, and Elio Caccavale. *Design As Future-Making.*
6. Rodgers, Paul, and Alex Milton. *Product Design*. London: Laurence King, 2011
7. Aspelund, Karl. *The Design Process.* Fairchild Books.
8. Norman, Donald A. *The Psychology of Everyday Things*. New York: Basic Books, 1988
9. Karl. T. Ulrich & Steven D. Epingger. *Product Design Development.* 3rd Edition. Mc Graw-Hill. 2004

10. Dieter. *Design Engineering,* 3rd edition, Mc.Graw Hill, 2000
11. James G. Bralla. *Design For Excellence*. McGrawHill, 1996
12. Milton D. Rosenav, Jr. et. al. *The PDMA Handbook of New Product Development*, John Willey & Sons, 1996
13. Hamid Noor & Russel Radford. *Production & Operation Management*, McGrawHill, 1995

ARCHITECTURAL PSYCHOLOGY
ENAI600032
3 CREDITS

Learning Objectives:

Student should be able to use basic conceptual knowledge of psychological process to identify and analysis human need in using built environment and outdoor space.

Syllabus:

Relationship between architecture and human behavior, motivation, needs, and value as basis of human actions, Gestalt perception, Ecological perception (Gibson), Affordances and its implementation in architecture, definition of cognition and its implementation in architecture, personal space, privacy, territoriality, crowding, post occupancy evaluation (POE).

Prerequisites: -

References:

1. Bell, Fischer, Greene, *Environmental Psychology*, Harcourt Publisher, 1996
2. Bryan Lawson, *The Language of Space*, Architectural Press, 2001
3. Byron Mikellides, *Architecture for People: Exploration in a New Humane Environment*, 1980
4. Wolfgang F.E. Preisser, Harvey Z. Rabinowitz, Edward T. White, *Post-Occupany Evaluation*, Van Nostrad Reinhold, 1988
5. Dak Kopec, *Environmental Psychology for Design*, Fairchild Books, 2012

EXHIBITION SPACE AND NARRATIVE
ENAI600033
3 CREDITS
Learning Objectives:

Students should be able to understand the basic principles of exhibition space design through narrative approach and critical thinking towards the interpretive experiences of objects.

Syllabus:

Various types of exhibition space, the process of designing exhibition space to create meaningful experiences of objects, ideas, and information in physical spaces and virtual spaces. Exhibition space types, exhibition, museum, pop-up event. Narrative approach in spatial design. Development of curatorial concept, designing display strategies, graphic and materials.

Prerequisites: -

References:

1. Martin M Pegler, *Visual Merchandising and Dislplay*, Blomsbury Academic, 2011
2. David Dernie, *Exhibition Design*, Laurence King Publisher, 2006
3. Pam Locker, *Basic Interior Design : Exhibition Design*, Ava Publishing, 2011
4. Reesa Greenberg, Bruce W.Ferguson and Sandy Nairne, *Thinking About Exhibitions,* Routledge, 1996
5. Kossman De Jong, *Engaging Space: Exhibition Design Explored*, Frame Publisher, 2012
6. Bryan Lawson, *Language of Space*, Routledge, 2001
7. L H Hanks, J Hale & S Macleod, *Making: Narratives, Architectures, Exhibitions, (Museum Meaning),* Routledge, 2012
8. David Dean, *Museum Exhibition*, Routledge, 1996
9. Kathleen McLean, *Planning for People in Museum Exhibitions*, Association of Science-Technology Centers, 1993
10. Nigel Holmes, *The Best in Diagrammatic Graphics*, Rotovision, 1996
11. Giles Velarde, *Designing Exhibitions 2nd ed*, Gower Pub, 2001
12. Stephanie Weaver, *Creating Great Visitor Experiences: A Guide for Museums, Parks, Zoos, Gardens & Libraries*, Routledge, 2008
13. John H Falk, *Identity and the Visitor Experience*, Routledge, 2009
14. Nina Simon, *The Participatory Museum*, Museum 2.0, 2010
15. Porter Abbott, H, *The Cambridge Introduction to Narrative*, Cambridge University Press, 2002
16. Potteiger, M and Purington, J, *Landscape Narratives: Design Practices for Telling Stories*, John Wiley and Sons, 1998

ART AND ARCHITECTURE
ENAI600034
3 CREDITS
Learning Objectives:

Students should be able to understand the potential of art in architectural space; create art in architectural setting.

Syllabus:

Art and architecture, Art Nouveau and Art Deco, Bauhaus, International style, Cubism, Surealism, etc, Art and Architecture installation, installation in the setting: Happy Art; detail in architectural element.

Prerequisites: -

References:

1. Cinthya Maris Dantzic, Design Dimensions, An Introduction to the Visual Surface, Prentice Hall College Div, 1990
2. Maly and Dietfried Gerhardus, Cubism and Futurism: The evolution of the self-sufficient Picture, Phaidon Oxford
3. Arsen Pohribny, Abstract Painting, Phaidon Oxford
4. “The Ideal Place” in Art and Design Magazine No.42
5. Chris Drury, Silent Spaces, Thames and Hudson Ltd, 1989
6. Fiedler Jeannine and Peter Feierabend, Bauhaus, Konemann, 1999
7. Booqs,1000 Details in Architecture, Belgium, 2010
8. William Hardy, A Guide to Art Nouveau Style, World Pubns, 1996
9. Patrick Lowry, The Essential Guide to Art and Design, Hodder & Stoughton, 1997

LIGHTING DESIGN IN INTERIOR ARCHITECTURE
ENAI600035
3 CREDITS
Learning Objectives:

Student should be able to design lighting fixtures and ambience for interior uses, using artificial as well as natural lights through a critical, active collaborative learning process based on functional and aesthetical problems.

Syllabus:

Basic lighting, color, natural light, artificial light, light distribution, interior lighting, exterior lighting (façade of a house and high rise), urban lighting.

Prerequisite: -

References:

1. William M.C. Lam, Perception and Lighting as Formgivers for Architecture, McGraw-Hill, 1977
2. Norbert Lechner, Heating Lighting Cooling, 2nd edition, translated by PT RajaGrafindo Persada, 2007
3. John E Flyinn, Architectural Interior System, Van Nostrand Reinhold Environmental Engineering Series, Van Nostrand Reinhold Company, 1971

SPECIAL TOPIC ON INTERIOR ARCHITECTURE
ENAI600036
3 CREDITS
Learning Objectives:

Students should be able to demonstrate knowledge on current discourse on interiority and interior architecture.

Syllabus:

Studies on the development of theories on interiority; current issues on interior architecture and interiority; the development in other relevant disciplines that have impacts of the development of interior architectural design theories and methods.

Prerequisite: -

References:

Relevant references to the topic offered.

SPECIAL TOPIC OF COLLABORATION
ENAI600037
3 CREDITS
Learning Outcomes:

Having the ability to solve design problems by collaborating with students from several fields of study. Having insights about engineering in the future.

Syllabus:

Study the development of design and engineering; the application of contemporary engineering; developments in some other disciplines that affect architectural design.

Prerequisite: -

Textbooks:

Relevant references to the topic offered.

Transition Rules

1. The implementation of 2020 curriculum will start at the Odd Semester 2020/2021. In principle, after the 2020 Curriculum is implemented, only the subjects listed in the 2020 curriculum will be offered.
2. Class of 2019 and earlier should follow the 2020 curriculum by referring to the transition rules.
3. The transition period takes place for one year in the academic year of 2020/2021. When necessary, courses with changes on its semester's placement (from Even to Odd, or vice versa) will be opened in both semesters of the transition period (Academic Year 2020 / 2021).
4. If there is a change in a subject's credit, the number of credits that will be calculated for graduation are the number of credits applied when the students took the course. Students who need to retake such subjects after the 2020 Curriculum is implemented will acquire the subjects with its new credit numbers.
5. If a compulsory subject in the 2016 Curriculum is removed without any equivalence in the 2020 Curriculum, then credits obtained from such subject will still be included in the calculation of total 144 credits required for graduation. Students who have not passed such course can take either newly required subjects or other elective courses in the 2020 Curriculum to complete their 144 credits.
6. Students who have not passed the compulsory subjects in the 2016 Curriculum will need to take the similar or equivalent subjects in the 2020 Curriculum. The 2016 Curriculum courses that are not listed in the transition table below will have a similar name and credit numbers in the 2020 Curriculum.
7. Students from the 2018 class or earlier who have not passed the Physics (Mechanical and Thermal) Laboratory in Curriculum 2016 should take any Elective subject in the 2020 Curriculum.
8. The Digital Design Media and History and Theory of Architecture 2 subjects are now offered in the odd semester, while History and Theory of Architecture 1 is now available in the even semester. Students from the 2018 class and before who have not passed any of these subjects should retake them in its new semester placement.

Table 8. Subject Equivalence of 2016 Curriculum and 2020 Curriculum for Undergraduate Interior Architecture Program

No.	Subject name in Curriculum 2016	Credit 2016	Subject name in Curriculum 2020	Credit 2020
1.	Integrated Character Building A	6	Integrated Character Building (MPKT)	5
	Integrated Character Building B	6		
2.	English	3	English	2
3.	Sports/Arts	1	Can be changed into Electives	1-3
4.	Physics (Mechanical and Thermal) Laboratory	1	Can be changed into Electives	1-3

Undergraduate Program in Chemical Engineering

Program Specification

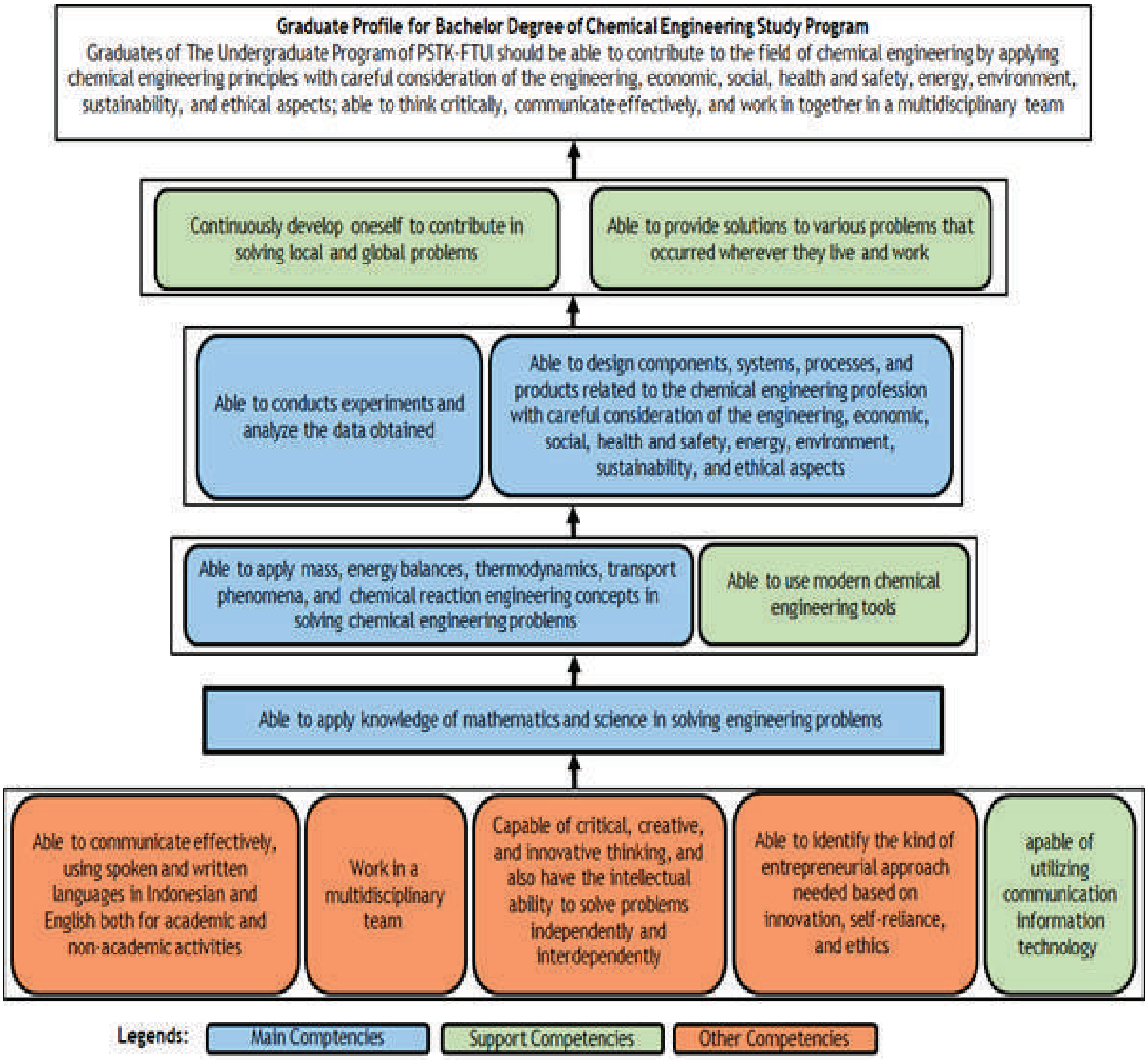
1.	**Awarding Institution**	a. Regular and Parallel: Universitas Indonesia b. International Program: - Double Degree: Universitas Indonesia and Partner University - Single Degree: Universitas Indonesia	
2.	**Host Institution**	a. Regular and Parallel: Universitas Indonesia b. International Program: - Double Degree: Universitas Indonesia and Partner University - Single Degree: Universitas Indonesia	
3.	**Faculty**	Engineering	
4.	**Program Tittle**	Undergraduate Program in Chemical Engineering	
5.	**Vision and Mission**	**Vision** Becoming a superior and competitive Chemical Engineering Study Program, through efforts to educate the nation's life to improve people's welfare, thus contributing to the development of Indonesian and world society **Missions** • Providing broad and fair access, as well as quality education and teaching in Chemical Engineering; • Organizing quality Tridharma activities that are relevant to national and global challenges; • Creating graduates of Chemical Engineering who are of high quality, noble character, and able to compete globally; • Creating an academic climate that can support the realization of the vision of the Department	
6.	**Class**	Regular, Parale, International Program	
7.	**Final Award**	a. Regular and Parallel: Sarjana Teknik (ST) b. International Program: - Double Degree: Sarjana Teknik (S.T) And Bachelor of Engineering (B.ENG) - Single Degree: Sarjana Teknik (ST)	
8.	**Accreditation / Recognition**	Accredited: BAN-PT (Excellent), JABEE and IABEE Assessment: AUN QA	
9.	**Language(s) of Instruction**	• Regular and Parallel: Bahasa Indonesia • International Program: English	
10.	**Study Scheme (Full Time / Part Time)**	Full Time	
11.	**Entry Requirements**	• Regular and International Program: High Shool / equivalent • Parallel: High School /Equivalent, or D3 / Polytechnique / Equivalent, and Pass The Entrance Exam.	
12.	**Study Duration**	8 (eight) Semesters or 4 (Four) years	
	Type of Semester	Number of Semester	Number of weeks / semester
	Regular	8	16
	Short (optional)	3	8
13.	**Aims of the program is to provide the highest quality education so that graduates have:** 1. Able to apply their knowledge in working in the field of chemical process technology 2. Able to develop themselves as industrial planners and managers 3. Able to contribute to science and technology		
14.	**Graduate Profile:** Graduates of The Undergraduate Program of PSTK-FTUI should be able to contribute to the field of chemical engineering by applying chemical engineering principles with careful consideration of the engineering, economic, social, health and safety, energy, environment, sustainability, and ethical aspects; able to think critically, communicate effectively, and work in together in a multidisciplinary team.		

15.	**Expected Learning Outcomes:** 1. Able to communicate effectively, using spoken and written languages in Indonesian and English both for academic and non-academic activities 2. Able to work in a multidisciplinary team. 3. Capable of critical, creative, and innovative thinking, and also have the intellectual ability to solve problems independently and interdependently. 4. Capable of utilizing communication information technology 5. Able to apply knowledge of mathematics and science in solving engineering problems. 6. Able to apply mass and energy balances, thermodynamics, transport phenomena, and chemical reaction engineering concepts in solving chemical engineering problems. 7. Able to use modern chemical engineering tools. 8. Able to conducts experiments and analyze the data obtained. 9. Able to design components, systems, processes, and products related to the chemical engineering profession with careful consideration of the engineering, economic, social, health and safety, energy, environment, sustainability, and ethical aspects. 10. Able to provide solutions to various problems that occurred wherever they live and work. 11. Able to identify the kind of entrepreneurial approach needed based on innovation, self-reliance, and ethics. 12. Continuously develop oneself to contribute in solving local and global problems.		
16.	**Classification of Courses**		
No.	**Classification**	**Credit Hours (SKS)**	**Percentage**
i	**University General Subjects**	**9**	**6,25%**
ii	**Basic Engineering Subjects**	**25**	**17,36%**
iii	**Core Subjects**	**75**	**52,08%**
iv	**Elective Subjects**	**26**	**18,06%**
v	**Special Subject (Internship, Seminar, Undergraduate Thesis or Skripsi)**	**9**	**6,25%**
	Total	**144**	**100 %**
	Total Credit Hours to Graduate		**144 SKS**

Employment Prospects

A graduate of the Chemical Engineering Study Program at UI can be described as a “Universal Engineer” as they learn the basics of engineering such as thermodynamics, reaction kinetics, reactor design, separation processes, as well as transport phenomena (momentum, energy, and mass). Graduates of the Chemical Engineering Department at UI have contributed in the following areas: energy (oil and gas industry), engineering contractor companies (engineering, procurement, construction, and trial operation), chemical industry (petrochemicals, bulk, and specialty chemicals), research and development of process and/or chemical products, and processing and synthesis of food products and pharmaceuticals.

The Network of Expected Learning Outcome (ELO)



Expected Learning Outcome (ELO)	Name of Course							
	1st Semester	2nd Semester	3rd Semester	4th Semester	5th Semester	6th Semester	7th Semester	8th Semester
Able to communicate effectively, using spoken and written languages in Indonesian and English both for academic and non-academic activities	Communication Skills	Integrated Character Building	Instrumental Analytical Chemistry	Heat Transfer		Chemical Product Design	Plant Design	
	English		Physical Chemistry	Chemical Engineering Thermodynamics				
Able to work in a multidisciplinary team	Communication Skill	Integrated Character Building				Chemical Product Design	Plant Design	
	Religion							
Capable of critical, creative, and innovative thinking, and also have the intellectual ability to solve problems independently and interdependently			Instrumental Analytical Chemistry	Heat Transfer				
			Physical Chemistry	Chemical Engineering Thermodynamics				
Capable of utilizing communication information technology			Numerical Computation	Chemical Engineering Modelling	Chemical Process Simulation			
Able to apply knowledge of mathematics and science in solving engineering problems	Basic Chemistry	Linear Algebra	Biochemistry	Material Science & Corrosion	Engineering Economics			
	Calculus	Physics (Mechanics and Thermal)	Numerical Computation					
		Statistic and Probability						
		Organic Chemistry	Instrumental Analytical Chemistry	Chemical Engineering Modelling				
	Physics (Electricity, MWO)	Organic and Basic Chemistry Lab	Physical Chemistry					
			Phys. & Anal. Chem. Lab					
Able to apply mass, energy balances, thermodynamics, transport phenomena, and chemical reaction engineering concepts in solving chemical engineering problems	Introduction to chemical engineering		Transport Phenomena	Fluid and Particle Mechanics	Chemical Reaction Engineering 1	Chemical Reaction Engineering 2		
			Mass and Energy Balance	Heat Transfer	Mass Transfer	Process Control		

Expected Learning Outcome (ELO)	Name of Course							
	1st Semester	2nd Semester	3rd Semester	4th Semester	5th Semester	6th Semester	7th Semester	8th Semester
				Chemical Engineering Thermodynamics				
Able to use modern chemical engineering tools			Numerical Computation	Process Engineering Drawing Chemical Engineering Modelling	Chemical Process Simulation	Process Equipment Design Chemical Product Design Process Control	Plant Design	
Able to conduct experiments and analyze the data obtained	Physics (Electricity, MWO) Lab	Organic and Basic Chemistry Lab Physics (Mechanics and Thermal) Lab	Phys. & Anal. Chem. Lab		Unit Operation Process Lab I	Unit Operation Process Lab II	Research Methodology & Seminar	Undergraduat Thesis
Able to design components, systems, processes, and products related to the chemical engineering profession with careful consideration of the engineering, economic, social, health and safety, energy, environment, sustainability, and ethical aspects					HSE Protection Engineering Economics	Process Equipment Design Chemical Product Design Process Control	Industrial Project Management Plant Design Research Methodology & Seminar	Undergraduat Thesis
Able to provide solutions to various problems that occurred wherever they live and work					HSE Protection	Chemical Product Design	Plant Design	Undergraduat Thesis
Able to identify the kind of entrepreneurial approach needed based on innovation, self-reliance, and ethics.						Chemical Product Design	Plant Design	Undergraduat Thesis Capita Select
Continuously develop oneself to contribute to solving local and global problems						Chemical Product Design	Plant Design	Undergraduat Thesis

List of Course

Code	Name of Course	Credit
	University Courses (9 Credits)	
UIGE600006	MPK Terintegrasi / Integrated Character Building	5
UIGE600003	MPK Bahasa Inggris / English	2
UIGE600004	MPK Agama / Religion	2
	Faculty Courses (25 Credits)	
ENGE600003	Kalkulus / Calculus	4
ENGE600004	Aljabar Linear / Linear Algebra	4
ENGE600005	Fisika Mekanik dan Panas / Physics (Mechanics and Thermal)	3
ENGE600006	Praktikum Fisika Mekanik dan Panas / Physics (Mechanics and Thermal) Lab	1
ENGE600007	Fisika Listrik, Magnet, Gelombang dan Optik / Physics [Electricity, Magnetic, Wave, Ophtics (MWO)]	3
ENGE600008	Praktikum Fisika Listrik, Magnet, Gelombang dan Optik / Physics (Electricity, MWO) Lab	1
ENGE600009	Kimia Dasar / Basic Chemistry	2
ENGE600010	Statistik dan Probablitas / Statistic and Probability	2
ENGE600011	Ekonomi Teknik / Engineering Economics	3
ENGE600012	Kesehatan, Keselamatan Kerja & Lindung Lingkungan / HSE Protection	2
	Special Courses (9 Credits)	
ENCH600028/ENCH610031	Kerja Praktek / On The job Training (Internship)	2
ENCH600029/ENCH610032	Metodologi Penelitian dan Seminar / Research Methodology & Seminar	2
ENCH600033/ENCH610033	Skripsi / Undergraduate Thesis	5
	Chemical Engineering Courses (75 Credits)	
ENCH600001/ENCH610001	Pengantar Teknik Kimia / Introduction to chemical engineering	3
ENCH600002/ENCH610002	Kecakapan Komunikasi / Communication Skills	2
ENCH600003/ENCH610003	Kimia Organik / Organic Chemistry	3
ENCH600004/ENCH610004	Praktikum Kimia Dasar dan Kimia Organik / Basic and Organic Chemistry Lab	1
ENCH600005/ENCH610007	Komputasi Numerik / Numerical Computation	3
ENCH600006/ENCH610008	Kimia Nalaitik Intrumental / Instrumental Analytical Chemistry	3
ENCH600007/ENCH610005	Kimia Fisika / Physical Chemistry	3
ENCH600008/ENCH610009	Praktikum Kimia Fisika dan Kimia Analitik / Phys. & Anal. Chem. Lab	1
ENCH600009/ENCH610006	Neraca Massa dan Energi / Mass and Energy Balance	3
ENCH600010/ENCH610010	Peristiwa Perpindahan / Transport Phenomena	3
ENCH600011/ENCH610014	Pemodelan Teknik Kimia / Chemical Engineering Modelling	3
ENCH600012/ENCH610011	Mekanika Fluida dan Partikel / Fluid and Particle Mechanics	3
ENCH600013/ENCH610012	Termodinamika Teknik Kimia / Chemical Engineering Thermodynamics	4
ENCH600014/ENCH610015	Perpindahan Kalor / Heat Transfer	3
ENCH600015/ENCH610017	Menggambar Teknik Proses / Process Engineering Drawing	3
ENCH600016/ENCH610013	lmu Bahan dan Korosi / Material Science & Corrosion	2
ENCH600017/ENCH610016	Perpindahan Massa / Mass Transfer	3
ENCH600018/ENCH610020	Praktikum UOP 1 / Unit Operation Process Lab I	1
ENCH600019/ENCH610021	Chemical Reaction Engineering 1	3
ENCH600020/ENCH610018	Chemical Process Simulation	3
ENCH600021/ENCH610023	Process Control	3
ENCH600022/ENCH610024	Unit Operation Process Lab II	1
ENCH600023/ENCH610025	Chemical Reaction Engineering 2	3
ENCH600024/ENCH610026	Process Equipment Design	3
ENCH600025/ENCH610027	Chemical Product Design	4
ENCH600026/ENCH610028	Industrial Project Management	2

ENCH600027/ENCH610029	Plant Design	4
ENCH600030/ENCH610030	Capita Selecta	2
Elective Courses (26 Credits)		
	Mata Kuliah Pilihan 1 / Elective 1	3
	Mata Kuliah Pilihan 2 / Elective 2	3
	Mata Kuliah Pilihan 3 / Elective 3	3
	Mata Kuliah Pilihan 4 / Elective 4	3
	Mata Kuliah Pilihan 5 / Elective 5	3
	Mata Kuliah Pilihan 6 / Elective 6	3
	Mata Kuliah Pilihan 7 / Elective 7	3
	Mata Kuliah Pilihan 8 / Elective 8	3
	Mata Kuliah Pilihan 9 / Elective 9	2

Courses Structure of Undergraduate Program in Chemical Engineering for Regular and Parallel Class Program

Code	Subject	SKS
	1st Semester	
UIGE600004	Religion	2
UIGE600003	English	2
ENGE600003	Calculus	4
ENGE600007	Physics (Electricity, MWO)	3
ENGE600008	Physics (Electricity, MWO) Lab	1
ENGE600009	Basic Chemistry	2
ENCH600001	Introduction to chemical engineering	2
ENCH600002	Communication Skills	2
	Sub Total	**18**
	2nd Semester	
UIGE600006	Integrated Character Building	5
ENGE600004	Linear Algebra	4
ENGE600005	Physics (Mechanics and Thermal)	3
ENGE600006	Physics (Mechanics and Thermal) Lab	1
ENGE600010	Statistic and Probability	2
ENCH600003	Organic Chemistry	3
ENCH600004	Organic and Basic Chemistry Lab	1
	Sub Total	**19**
	3rd Semester	
ENCH600005	Numerical Computation	3
ENCH600006	Instrumental Analytical Chemistry	3
ENCH600007	Physical Chemistry	3
ENCH600008	Phys. & Anal. Chem. Lab	1
ENCH600009	Mass and Energy Balance	3
ENCH600010	Transport Phenomena	3
	Elective 1	3
	Sub Total	**19**
	4th Semester	
ENCH600011	Chemical Engineering Modelling	3
ENCH600012	Fluid and Particle Mechanics	3
ENCH600013	Chemical Engineering Thermodynamics	4
ENCH600014	Heat Transfer	3
ENCH600015	Process Engineering Drawing	2
ENCH605016	Material Science & Corrosion	3
	Elective 2	3
	Sub Total	**21**
	5th Semester	
ENGE600011	Engineering Economics	3
ENGE600012	HSE Protection	2
ENCH600017	Mass Transfer	4
ENCH600018	Unit Operation Process Lab I	1
ENCH600019	Chemical Reaction Engineering 1	3
ENCH600020	Chemical Process Simulation	3
	Elective 3	3
	Sub Total	**19**
	6th Semester	
ENCH600021	Process Control	3
ENCH600022	Unit Operation Process Lab II	1
ENCH600023	Chemical Reaction Engineering 2	3
ENCH600024	Process Equipment Design	3
ENCH600025	Chemical Product Design	4
	Elective 4	3
	Elective 5	3
	Sub Total	**20**
	7th Semester	
ENCH600026	Industrial Project Management	2
ENCH600027	Plant Design	4
ENCH600028	On The Job Training (Internship)	2
ENCH600029	Research Methodology & Seminar	2
	Elective 6	3
	Elective 7	3
	Elective 8	3
	Elective 9	2
	Sub Total	**21**
	8th Semester	
ENCH600030	Capita Selecta	2
ENCH600031	Undergraduate Thesis	5
	Sub Total	**7**
	Total	144

List of Elective Courses in Odd Semester

Code	Subject	SKS
	Odd Semester	
ENCH800014	Oleochemical Industry	3
ENCH800015	Food Technology	3
ENCH800016	Protein Engineering	3
ENCH800017	Herbal Technology	3
ENCH800018	Composite Material	3
ENCH800019	Applied Thermodynamics	3
ENCH800020	Dynamic System	3
ENCH800021	Thermodynamic Properties of Hydrocarbon	3
ENCH800022	Lubricant Technology	3
ENCH800023	Cryogenic Technology	3
ENCH800024	Combustion Technology	3
ENCH800025	Plasma and Ozone Technology	3
ENCH800026	Heterogeneous Catalytic	3
ENCH800027	Sustainable Energy	3
ENCH800028	Risk Management	3
ENCH800029	Electrochemical Technology	3

ENCH800030	Extraction Technology & Isolation for Natural Products	3
ENCH800031	Special Topic 1	3
ENCH800032	Biochemistry	3
ENCH800033	Natural Gas Processing	3

List of Elective Courses in Even Semester

Code	Subject	SKS
	Even Semester	
ENCH800034	Storage and Packing Technology	3
ENCH800035	Bioinformatics	3
ENCH800036	Drugs and Cosmetics Technology	3
ENCH800037	Petroleum Processing	3
ENCH800038	Petrochemical Processing	3
ENCH800039	Photocatalytic Technology	3
ENCH800040	Hydrocarbon Exploration and Production	3
ENCH800041	Waste Management and Prevention	3
ENCH800042	Microalgae Cultivation and Development Technology	3
ENCH800043	Plant Utility and Maintenance	3
ENCH800044	Transportation and Utilization of Natural Gas	3
ENCH800045	Mixing Technology	3
ENCH800046	Problem Solving Skills	3
ENCH800047	Polymer Technology	3
ENCH800048	Genetically Modified Organism	3
ENCH800049	Controlled Drug Release Technology	3
ENCH800050	Special Topic 2	3
ENCH800051	Biomass Thermochemical Conversion	3
ENCH800052	Basic Computer Programming	3

Curriculum 2020 for Fast-Track Undergraduate to Master in Chemical Engineering Study Program

Courses Placement of Fast Track Undergraduate to Master Courses in Chemical Engineering Study Program from Chemical Engineering Undergraduate Program

Code	Subject	SKS
	7th Semester	
ENCH800033	Natural Gas Processing	3
ENCH600028	Industrial Project Management	2
ENCH600027	Plant Design	4
ENCH600028	Internship	2
ENCH600029	Research Methodology & Seminar	2
ENCH800001	Advanced Chemical Engineering Termodynamics	3
ENCH800027	Sustainable Energy	3
	Elective 6	3
	Total	**22**
	8th Semester	
ENCH600033	Undergraduate Thesis	5
ENCH600030	Capita Selecta	2
ENCH800003	Advanced Transport Phenomenon	3
ENCH800004	Advanced Chemical Reaction Engineering	3
ENCH800005	Advanced Chemical Engineering Modelling	3
	Elective 7	3
	Elective 8	3
	Total	**22**
	9th Semester	
ENCH800006	Research Methodology	3
ENCH800007	Pre-Thesis	2
	Elective 9	3
	Elective 10	3
	Elective 11	3
	Elective 12	2
	Total	**16**
	10th Semester	
ENCH800008	Thesis	6
ENCH800055	Research Publication	2
	Total	**8**

Curriculum 2020 for Fast-Track Undergraduate to Doctor in Chemical Engineering Study Program

Courses Placement of Fast Track Undergraduate to Doctor Courses in Chemical Engineering Study Program from Chemical Engineering Undergraduate Program

Code	Subject	SKS
	7th Semester	
ENCH600027	Natural Gas Processing	3
ENCH600028	Industrial Project Management	2
ENCH600027	Plant Design	4
ENCH600028	Internship	2
ENCH600029	Research Methodology & Seminar	2
ENCH800001	Advanced Chemical Engineering Termodynamics	3
ENCH800027	Sustainable Energy	3
	Elective 6	3
	Total	**22**
	8th Semester	
ENCH600033	Undergraduate Thesis	5
ENCH600030	Capita Selecta	2
ENCH800003	Advanced Transport Phenomenon	3
ENCH800004	Advanced Chemical Reaction Engineering	3

ENCH800006	Advanced Chemical Engineering Modelling	3
	Elective 7	3
	Elective 8	3
	Total	**22**
	9th Semester	
ENCH800006	Research Methodology	3
ENCH800007	Pre-Thesis	2
	Elective 9	3
	Elective 10	3
	Elective 11	3
ENCH900003	Research Group Periodic Seminar	8
	Total	**22**
	10th Semester	
ENCH800008	Thesis	4
ENCH800055	Research Publication	2
	Elective 12	2
ENCH900005	Research Proposal	6
	Total	**14**
	11th Semester	
ENCH900007	Publication 1 – International Conference	6
	Total	**6**
	12th Semester	
ENCH900008	Research Defense	10
	Total	**10**
	13th Semester	
ENCH900010	Publication 2 – International Journal	8
	Total	**8**
	14th Semester	
ENCH900011	Publication 3 – International Journal	8
ENCH900012	Doctoral Promotion	6
	Total	**14**

Transition Guidance from Curriculum 2016 to 2020 for Regular and Parallel Undergraduate Class

1. New curriculum 2020 will be applied effectively from Odd Semester 2020/2021. In principle, after curriculum 2020 is implemented, then only courses from this new curriculum will be opened.
2. For class 2019 and above will follow these transition rules.
3. The enforcement of the transitional period is one year. During this transition period, if a course in curriculum 2020 is in odd Semester while in the previous curriculum in even Semester (vice versa), then this course can be held (if necessary) in both semesters.
4. For students who have not passed the compulsory courses in curriculum 2016, are required to take the same course or equivalent in curriculum 2020. Equivalence courses can be seen in the table below. All courses in the curriculum 2016 that are not listed in the equivalence table have not changed, both in names and credits.

Table of Equality Courses in Undergraduate Chemical Engineering Study Program in Curriculum 2016 and Curriculum 2020

No	Name of Courses in Curriculum 2016	Semester	Credits 2016	Name of Courses in Curriculum 2020	Semester	Credits 2020
1	MPKT A (Integrated Character Building A)	2	6	MPKT Terintegrasi (Integrated Character Building)	2	5
2	MPKT B (Integrated Character Building B)	1	6			
3	MPK Bahasa Inggris (English)	3	3	MPK Bahasa Inggris (English)	1	2
4	Pengantar Teknik Kimia (Introduction to Chemical Engineering	2	3	Pengantar Teknik Kimia (Introduction to Chemical Engineering)	1	2
5	Biologi Molekular (Molecular Biology)	4	3	Biokimia (Biochemistry)	Elective (Odd)	3
6	Pengolahan Gas Bumi (Natural Gas Processing)	7	3	Pengolahan Gas Bumi (Natural Gas Processing)	Elective (Odd)	3
7	MPK Olah raga/seni (Sport/Art)	1	1	MPK Olah raga/seni (Sport/Art)	-	-
8	Skripsi (Undergraduate Thesis)	8	4	Skripsi (Undergraduate Thesis)	8	5
9	Statistik & Probabilistik (Statistic and Probability)	4	2	Statistik & Probabilistik (Statistic and Probability)	2	2

5. When there is a change in the course credits, then the number of graduation credits counted in is the number of credits when it was taken. The same or equivalent courses, when are equated with different credits, if retaken, or just taken, will be acknowledged under a new name and credits.
6. When a compulsory subject in the curriculum 2016 is deleted, and there is no equivalence in the curriculum 2020 then:
   a. For students who have passed these subjects, the credits that are achieved will be counted in the calculation of graduation 144 credits.
   b. For students who did not pass these courses, they can take new compulsory courses or choose elective subjects in the curriculum 2020 to complete 144 credits.
7. In addition to changes in curriculum structure from 2016 to 2020, there are also the addition of several elective courses: Teknologi Elektrokimia), Teknologi Pencampuran (Mixing Technology), Teknologi Pengembangan dan Pemanfaatan Mikroalga (Microalgae Cultivation and Development Technology), Teknologi Ekstraksi dan Isolasi Bahan Alam (Extraction & Isolation Technology for Natural Products), Konversi Termokimia Biomassa (Biomass Termochemical Conversion Technology), Modifikasi Genetik Makhluk Hidup (Genetically Modified Organism), and Dasar Pemrograman Computer (Basic Computer Programming)

Course Structure of Undergraduate Program in Chemical Engineering for International Class

Code	Subject	SKS
	1st Semester	
UIGE600004	Religion Studies	2
ENGE610003	Calculus	4
ENGE610007	Physics (Electric, Magnet, Wave & Optic)	3
ENGE610008	Physics (Electric, Magnet, Wave & Optic) Laboratory	1
ENGE610009	Basic Chemistry	2
ENCH610001	Introduction to Chemical Engineering	2
ENCH610002	Communication Skills	2
ENGE610010	Statistics and Probabilistic	2
	Total	18
	2nd Semester	
UIGE600002	Academic Writing	2
ENGE610004	Linear Algebra	4
ENGE610005	Physics (Mechanics and Thermal)	3
ENGE610006	Physics(Mechanics and Thermal) Laboratory	1
ENCH610003	Organic Chemistry	3
ENCH610004	Basic Chem. and Org. Chem. Lab.	1
ENCH610005	Physical Chemistry	3
ENCH610006	Mass and Energy Balances	3
	Sub Total	20
	3rd Semester	
ENCH610007	Numerical Computation	3
ENCH610008	Instrumental Analytical Chem-istry	3
ENCH610009	Phys. Chem. and Anal. Chem. Lab.	1
ENCH610010	Transport Phenomena	3
ENCH610011	Fluid and Particle Mechanics	3
ENCH610012	Chemical Engineering Thermo-dynamics	4
ENCH610013	Material Science and Corrosion	3
	Sub Total	20
	4th Semester	
ENGE610012	Health, Safety and Environmental Protection	2
ENCH610014	Chemical Engineering Modeling	3
ENCH610015	Heat Transfer	3
ENCH610016	Mass Transfer	4
ENCH610017	Process Engineering Drawing	2
ENCH610018	Chemical Process Simulation	3
	Elective 1	3
	Sub Total	20
	5th Semester	
ENGE610011	Engineering Economics	3
ENCH610020	Unit Operation Laboratory 1	1
ENCH610021	Chemical Reaction Engineering 1	3
	Elective 2	3
	Elective 3	3
	Elective 4	3
	Elective 5	3
	Sub Total	19
	6th Semester	
UIGE610006	Integrated Character Building	5
ENCH610023	Process Control	3
ENCH610024	Unit Operation Laboratory 2	1
ENCH610025	Chemical Reaction Engineering 2	3
ENCH610026	Process Equipment Design	3
ENCH610027	Chemical Product Design	4
	Sub Total	19
	7th Semester	
ENCH610028	Industrial Project Management	2
ENCH610029	Plant Design	4
ENCH610030	Capita Selecta	2
ENCH610031	On the Job Training (Internship)	2
ENCH610032	Research Methodology and Seminar	2
	Elective 6	3
	Elective 7	3
	Sub Total	18
	8th Semester	
ENCH610033	Undergraduate Thesis	5
	Elective 8	3
	Elective 9	2
	Sub Total	10
	Total	144

List of Elective Courses in Odd Semester

Code	Subject	SKS
	Odd Semester	
ENCH800014	Oleochemical Industry	3
ENCH800015	Food Technology	3
ENCH800016	Protein Engineering	3
ENCH800017	Herbal Technology	3
ENCH800018	Composite Material	3
ENCH800019	Applied Thermodynamics	3
ENCH800020	Dynamic System	3
ENCH800021	Thermodynamic Properties of Hydrocarbon	3
ENCH800022	Lubricant Technology	3
ENCH800023	Cryogenic Technology	3
ENCH800024	Combustion Technology	3
ENCH800025	Plasmaand Ozone Technology	3
ENCH800026	Heterogeneous Catalytic	3
ENCH800027	Sustainable Energy	3
ENCH800028	Risk Management	3
ENCH800029	Electrochemical Technology	3

ENCH800030	Extraction Technology & Isolation for Natural Products	3
ENCH800031	Special Topic 1	3
ENCH800032	Biochemistry	3
ENCH800033	Natural Gas Processing	3

List of Elective Courses in Even Semester

Code	Subject	SKS
	Even Semester	
ENCH800034	Storage and Packing Technology	3
ENCH800035	Bioinformatics	3
ENCH800036	Drugs and Cosmetics Technology	3
ENCH800037	Petroleum Processing	3
ENCH800038	Petrochemical Processing	3
ENCH800039	Photocatalytic Technology	3
ENCH800040	Hydrocarbon Exploration and Production	3
ENCH800041	Waste Management and Prevention	3
ENCH800042	Microalgae Cultivation and Development Technology	3
ENCH800043	Plant Utility and Maintenance	3
ENCH800044	Transportation and Utilization of Natural Gas	3
ENCH800045	Mixing Technology	3
ENCH800046	Problem Solving Skills	3
ENCH800047	Polymer Technology	3
ENCH800048	Genetically Modified Organism	3
ENCH800049	Controlled Drug Release Technology	3
ENCH800050	Special Topic 2	3
ENCH800051	Biomass Thermochemical Conversion	3
ENCH800052	Basic Computer Programming	3

Courses Structure of Undergraduate Program in Chemical Engineering at Partner Universities

Couse Structure in Chemical Engineering at Monash University

3rd Year	Courses	
Code	Semester 5 (in July)	Credits
CHE3162	Process control	6
CHE3164	Reaction engineering	6
CHE3166	Process design	6
	Choose one stream	6
	Subtotal	24
Code	Semester 6 (in February)	Credits
CHE3162	Chemistry and chemical thermodynamics	6
CHE3164	Sustainable processing I	6
CHE3166	Separation processes	6
	Transport phenomena and numerical methods	6
	Subtotal	24
4th Year	Courses	
Code	Semester 7 (in July)	Credits
CHE4162	Particle technology	6
CHE4170	Design project	12
	Choose one stream	6
	Subtotal	24
Code	Semester 8 (in February)	Credits
CHE4161	Engineers in society	6
CHE4180	Chemical engineering project	12
	Choose one stream	6
	Subtotal	24

Elective Courses

3rd Year		
Code	Courses	Credits
Biotechnology Stream		
CHE3171	Bioprocess technology	6
Nanotechnology and Materials Stream		
CHE3172	Nanotechnology and materials I	6
Sustainable Processing Stream		
CHE3175	Process engineering	6
4th Year		
Code	Courses	Credits
Biotechnology Stream		
BCH2011	Structure and function of cellular biomolecules	6
CHE4171	Biochemical engineering	6
Nanotechnology and Materials Stream		
CHE4172	Nanotechnology and materials II	6
MTE2541	Nanostructure of materials	6
Sustainable Processing Stream		
CHE4173	Sustainable processing II	6
ENE3608	Environmental impact and management systems	6

Couse Structure in Chemical Engineering at Curtin University

3rd Year	Courses	
Code	Semester 5 (in July)	Credits
CHE 223	Thermodynamics	25
CHE 324	Fluid & Particle Processes	25
CHE 325	Reaction Engineering	25
CHE 328	Process Instrumentation & Control	25
	Subtotal	100
Code	Semester 6 (in February)	Credits
ChE 322	Process Plant Engineering	25
ChE 312	Proc Syn & Design 1	12.5
ChE 479	Advanced Special Topics	12.5
CHE	Mass Transfer Operations	25

ChE 421	Risk Management	25
	Subtotal	100
4th Year	**Courses**	
Code	**Semester 7 (in July)**	**Credits**
ChE 423	Process Economics & Management	25
ChE 422	Advanced Separation Processes	25
ChE 499	Design Project (Lectures/ Feasibility Studies)	50
	Subtotal	100
Code	**Semester 8 (in February)**	**Credits**
ChE 481	Process Laboratory Projects	25
ChE 414	Proc Syn & Design II	12.5
ChE 411	Advanced Process Control	12.5
CHE 491	Research Project	12.5
CHE 493	Research Project	12.5
	Optional Unit	12.5
	Optional Unit	12.5
	Subtotal	100

Elective Courses

Code	Courses	Credits
CHE374	Mineral processing	12.5
CHE475	Petroleum processing	12.5
CHE39	Special topics (biochemical engineering	12.5
CHE493	Research project	12.5
CHE477	Computational fluid dynamics	12.5
CHE313	Fundamentals of air pollution control	12.5

Couse Structure in Chemical Engineering at University of Queensland

3rd Year	Courses	
Code	**Semester 5 (in July)**	Credits
CHEE3004	Unit operations	2
CHEE3005	Reaction engineering	2
CHEE3006	Process and control system synthesis	2
CHEE3007	Process modeling and dynamics	2
	Subtotal	8
Code	**Semester 6 (in February)**	**Credits**
CHEE4002	Environmental risk assessment	2
CHEE4009	Transport phenomena	2
CHEE1001	Principles of biological engineering	2
	Part B2 Advanced Elective	2
	Subtotal	8
4th Year	**Courses**	
Code	**Semester 7 (in July)**	**Credits**
CHEE4001	Process engineering design project	4
	Part B2 Advanced Elective	2
	Part B2 Advanced Elective	2
	Subtotal	8
Code	**Semester 8 (in February)**	**Credits**
	Part B2 Advanced Elective	2
	Part B2 Advanced Elective	2
	Part B2 Advanced Elective	2
	Subtotal	6

Elective Courses

Code	Courses	Credits
Part B2 Advanced Electives		
CHEE4003	Special Topics A	2
CHEE4005	Polymer rheology & processing	2
CHEE4006	Individual inquiry A	2
CHEE4007	Individual inquiry B	2
CHEE4012	Industrial wastewater & solid waste management	2
CHEE4015	Special Topics VII	2
CHEE4020	Biomolecular engineering	2
CHEE4021	Particle design & processing	2
CHEE4022	Principles of adsorption	2
CHEE4024	Energy systems in sustainable development	2
CHEE4028	Metabolic engineering	2
CHEE4301	Cell & tissue engineering	2
CHEE4302	Nanomaterials and their characterization	2
CHEE4101	Electrochemistry and corrosion	2
CHEE4102	Systems engineering & design management	2
CHEE4103	Advanced product design method	2
Part B3 Process Engineering Electives		
CHEE2005	Chemical product design	2
CHEE3008	Special Topics C	12.5
CHEE3301	Polymer engineering	12.5
CHEE3305	Biomaterials: Materials in Medicine	12.5
CHEM2002	Biophysical chemistry	
CIVL3150	Modeling of environmental systems	
MINE2201	Physical & chemical processing of minerals	

Transition Guidance from Curriculum 2016 to 2020 for International Undergraduate Class

1. New curriculum 2020 will be applied effectively from Odd Semester 2020/2021. In principle, after curriculum 2020 is implemented, then only courses from this new curriculum will be opened.
2. For class 2019 and above will follow these transition rules.
3. The enforcement of the transitional period is one year. During this transition period, if a course in curriculum 2020 is in odd Semester while in the previous curriculum in even Semester (vice versa), then this course can be held (if necessary) in both semesters.
4. For students who have not passed the compulsory courses in curriculum 2016, are required to take the same course or equivalent in curriculum 2020. Equivalence courses can be seen in the table below. All courses in the curriculum 2016 that are not listed in the equivalence table have not changed, both in names and credits.

Table of Equality Courses in Undergraduate Chemical Engineering Study Program in Curriculum 2016 and Curriculum 2020

No	Name of Courses in Curriculum 2016	Semester	Credits 2016	Name of Courses in Curriculum 2020	Semester	Credits 2020
1	MPKT A (Integrated Character Building A)	2	6	MPKT Terintegrasi (Integrated Character Building)	2	5
2	MPKT B (Integrated Character Building B)	1	6			
3	Academic Writing	3	3	MPK Bahasa Inggris (English)	1	2
4	Introduction to Chemical Engineering	2	3	Introduction to Chemical Engineering	1	2
5	Biologi Molekular (Molecular Biology)	4	3	Biokimia (Biochemistry)	Elective (Odd)	3
6	Pengolahan Gas Bumi (Natural Gas Processing)	7	3	Pengolahan Gas Bumi (Natural Gas Processing)	Elective (Odd)	3
7	Sport/Art	1	1	Sport/Art	-	-
8	Undergraduate Thesis	8	4	Undergraduate Thesis	8	5

5. When there is a change in the course credits, then the number of graduation credits counted in is the number of credits when it was taken. The same or equivalent courses, when are equated with different credits, if retaken, or just taken will be acknowledged under a new name and credits.
6. When a compulsory subject in the curriculum 2016 is deleted, and there is no equivalence in the curriculum 2020 then:
   a. For students who have passed these subjects, the credits that are achieved will be counted in the calculation of graduation 144 credits.
   b. For students who did not pass these courses, they can take new compulsory courses or choose elective subjects in the curriculum 2020 to complete 144 credits.
7. In addition to changes in curriculum structure from 2016 to 2020, there are also the addition of several elective courses: Teknologi Elektrokimia), Teknologi Pencampuran (Mixing Technology), Teknologi Pengembangan dan Pemanfaatan Mikroalga (Microalgae Cultivation and Development Technology), Teknologi Ekstraksi dan Isolasi Bahan Alam (Extraction & Isolation Technology for Natural Products), Konversi Termokimia Biomassa (Biomass Termochemical Conversion Technology), Modifikasi Genetik Makhluk Hidup (Genetically Modified Organism), dan Dasar Pemrograman Computer (Basic Computer Programming)

SYLLABUS OF UNDERGRADUATE PROGRAM IN CHEMICAL ENGINEERING FOR REGULER, PARALEL AND INTERNATIONAL CLASSES

Course Sylabus of University Subjects

INTEGRATED CHARACTER BUILDING

UIGE600001/UIGE610001
5 credits

Syllabus :

The **Integrated Character Building** is part of the Higher Education Personality Development Lecture which is held for students which contains elements of the internalization of basic life values, interaction/relationship skills, nationality and academic skills as the basis for student personality to carry out learning according to scientific disciplines.

MPKT is carried out in the form of a series of learning activities outside the formal class. activities carried out include participation in lectures/seminars, internships, field work practices, social work, sports and/or arts activities and other forms of activities that have the main goal of equipping students with soft skills and proven by portfolio documents. The form of this learning activity is different from the MPKT courses that have been carried out at the previous UI.

The material provided at MPKT aims to form a human thinking pattern with values and morals to create a human personality by having critical, logical, creative, innovative thinking, and having intellectual curiosity and an entrepreneurial spirit. The material provided includes 9 UI values, national, state and citizen values based on Pancasila. Solving problems in science, technology, health, and humans as natural managers by using reasoning and utilizing Information and Communication Technology (ICT) to achieve the final objectives of this module.

Lecture activities are carried out using an online student-centered learning (SCL) approach which can use the following methods: experiential learning (EL), collaborative learning (CL), problem-based learning (PBL), question-based learning, and project based learning. The use of these various methods is carried out through group discussion activities, independent assignment exercises, presentations, writing papers in Indonesian and interactive discussions in online discussion forums. The language of instruction in this lecture is Indonesian.

Graduate Learning Outcomes :
- CPL 1: Able to use spoken and written language in Indonesian and English both for academic and non-academic activities (C3, A5)
- CPL 2: Have integrity and are able to think critically, creatively, and innovatively and have intellectual curiosity to solve problems at the individual and group level (C4, A3)
- CPL 3: Able to provide alternative solutions to various problems that arise in the community, nation, and country (C4, A2)
- CPL 4: Able to take advantage of information communication technology (C3)
- CPL 5: Able to identify various entrepreneurial efforts characterized by innovation and independence based on ethics (C2, A5)

Course Learning Outcomes :
- CPMK 1: After completing this course, students are able to apply self-regulated learning characteristically in studying critically, logically, creatively, innovatively through analysis of societal problems, nation, state, and Pancasila ideology based on self-understanding as individuals and members. the community by using good and correct Indonesian and the latest information and communication technology (C4, A4)
- CPMK 2: Able to identify various entrepreneurial efforts characterized by innovation and independence based on ethics (C2, A5)
- CPMK 3: After completing this course, students are able to apply self-regulated learning characteristically in pursuing integrated and comprehensive knowledge through analysis of science problems, technology based on the role of nature manager by using good and correct Indonesian and information technology and current communications. (C4, A4)
- CPMK 4: After completing this course, students are able to plan creative activities to solve problems in society and the world of work/industry by showing creativity, critical thinking, collaborative self-discipline using good and correct Indonesian as well as the latest information and communication technology (C5, A5)

Prerequisite : -

ACADEMIC WRITING

UIGE610002
2 credits

The objectives of the English component of the MPK program are :
1. To activate students, English so that they will be able to communicate effectively in English;
2. To enable students to develop the learning strategies and study skills needed to finish their study successfully and o continue learning on their own after taking the MPK program (to develop independent learners)

Main Competencies :

By the end of the course, students should be able to:
- Listen to, understand and take notes of key information in academic lectures of between 5-10 minutes length;
- Improve their listening skills through various listening materials and procedures;
- Speak confidently, ask questions in and contribute to small group discussions;
- Use different reading strategies needed to the effective readers;
- Improve their reading skills through extensive reading material;
- Develop skills in connecting ideas using appropriate transitions and conjunctions;
- Work as part of a group to prepare and deliver a 25-minute presentation on an academic topic using appropriate organization, language and visual aids;
- Write a summary of a short academic article;
- Write an expository paragraph;
- Write a short essay.

Learning Method :

Active learning, Contextual language learning, small group discussion.

Prerequisite : Students Learning Orientation/Orientasi Belajar Mahasiswa (OBM)

ENGLISH

UIGE610003
2 credits
Learning Objectives :

After attending this subject, students are expected to capable of use English to support the study in university and improve language learning independently.

Syllabus :

Study Skills : (Becoming an active learner, Vocabulary Building: word formation and using the dictionary Listening strategies Extensive reading) Grammar: (Revision of Basic grammar Types of sentences Adjective clauses, Adverb clauses Noun clauses, Reduced clauses) Reading: (Reading skills: skimming, scanning, main idea, supporting ideas, Note-taking Reading popular science arti-cle, Reading an academic text) Listening: (Listening to short conversations, Listening to a lecture and notetaking, Listening to a news broadcast, Listening to a short story) Speaking: (Participating in discussions and meetings, Giving a presentation) Writing: (Writing a summary of a short article Describing graphs and tables, Writing an academic paragraph, Writing a basic academic essay (5 paragraphs).

ISLAMIC STUDIES

UIGE600010/UIGE610005
2 credits
General instructional objectives :

The cultivation of students who have concern for social, na-tional and countrys issues based on Islamic values which is applied in the development of science through intellectual skills.

Learning Objectives :

Course participants are expected to do the following when faced with a problem or issue which they must solve :
1. Analyze the problem based on the Islamic values they adopted;
2. Analyze the problem by implementing active learning stages;
3. Discuss and express their thoughts and ideas by using proper and correct Indonesian language in discussion and academic writing.

Syllabus :

Islam history: the meaning of Islam, the characteristic of Islam, the sources of Islamic teachings, Muhammad SAW as prophet and history figure, introduction of Islam in Indonesia, the teaching essence of Islam: the basic principle of Islam teachings, the unity of Allah, worship prac-tice in live, eschatology and work ethics, human's basic rights and obligation, social structure in Islam: sakinah mawaddah and ramhah family, the social implication of family life, Mosque and the development of Islam, zakat and the economic empowerment of the people, Islam society, Science: reason and revelation in Islam, Islam's motivation in development of science, science characteristics, source of knowledge, IDI (each Faculty and Department/Study Program).

CATHOLIC STUDIES

UIGE600011/UIGE610006
2 credits
General instructional objectives :
1. To help deliver students as intellectual capital in implementing lifelong learning process to become scientists with mature personality who uphold humanity and life.
2. Be scholars who believe in God according to the teachings of Jesus Christ by continuing to be responsible of his faith in life in church and society.

Syllabus :

Almighty God and the God teachings; Man, Morals, science technology and art; harmony between religions; Society, Culture, Politics, Law: the substance of theses studies will be addressed by integrating the four dimensions of the teachings of the Catholic faith: the personal dimension, the dimension of Jesus Christ, the dimension of the Church, and Community dimension. Dimensions are implemented in the following themes: People, Religion, Jesus Christ, the Church, and Faith in the society.

CHRISTIAN STUDIES

UIGE600012/UIGE610007
2 credits
General instructional objectives :

Cultivating students with comprehensive Christian knowledge and teaching in the midst of the struggle and the fight of the nation while also discussing the student's participation in line with the study to help improve and build our country.

Learning Objectives :

Course participants are expected to do the following when faced with a problem or issue which they must solve:
1. **Analyze the problem based on the Christian values**
2. **Analyze the problem by implementing active learning stages**
3. **Discuss the problem by using proper and correct Indonesian language**

Syllabus :

History (Historical terms): Status of the Bible, the existence of God and Morality, Christ the Savior, the Holy Spirit as existence reformer and outlook on the world: Faith and Knowledge of Science, Church and service, Ecclesiology, Spiritual and enforcement of Christian Human Rights and the world of ethics: Christian Ethics, Christian and worship, Christianity and politics, Christian love and social reality: Christian Organizations, Students and Service, Christian and expectations.

HINDU STUDIES

UIGE600013/UIGE610008
2 credits

Syllabus :

Hindu religion, Hindu history), Source and scope of Hinduism (the Veda as the source of Hindu religion teachings, the scope of the teachings in Hindu religion), The concept of the God (Brahman) according to the Veda, the Path to Brahman (Catur Marga Yoga, Mantra and Japa), Human Nature (The purpose of human life, Human's duties, obligations, and responsibilities both individually or collectively), Ethics and morality (Principles teaching, self-control), in-depth understanding of the scripture (deep understanding of the Bhagawadgita, deep understanding of the Sarasamuschaya), The Role of Hinduism in science, technology, and art (Hinduism benefits in science and technology in accordance with each department, benefit / the role of Hinduism in the arts), Cohesion and community's prosperity /independence (Benefits of unity in the religious plurality, independent community (kerthajagathita) as a common goal, Tri Pitakarana), Culture as an expression of Hindu religious practice, Contribution to the Hindu religion teachings in the political life of nation and country, laws and the enforcement of justice, Awareness of and obeying the Rita / Dharma.

BUDDHIST STUDIES
UIGE600014/UIGE610009
2 credits
Syllabus :

Almighty God and the God Study (Faith and piety, Divine Philosophy/Theology), Human (Human Nature, Human Dignity, Human Responsibility), Moral (Implementation of Faith and Piety in everyday life), Science, Technology and Art (Faith, Science and Charity as a unity, the Obligation to study and practice what you are taught, Responsibility for nature and environment), harmony between religion (religion is a blessing for all mankind, the essence of the religious plurality and togetherness), community (the role of religious society in creating a prosperous independent society, the responsibility of religious society in the realization of human rights and democracy), Culture (the responsibility of religious society in the realization of critical thinking (academic), work hard and fair), Politics (Religion contribution in the political life of nation and country), Law (Raise awareness to obey and follow God's law, the role of religion in the formulation and enforcement of law, the function of religion in the legal profession).

KONG HU CU STUDY
UIGE600015/UIGE610010
2 credits

Syllabus Of Basic Engineering Subjects

CALCULUS 1
ENGE600001/ENGE610001
3 credits
Course Learning Outcomes:

Able to use the basic concepts of calculus related to -a function of one variable, the derivative and integration of the function of one variable in order to solve its applied problems.

Graduates Learning Outcomes:

Introduction, Functions and Limits, The Derivative, Applications of the Derivative, The Definite Integral, Applications of The Definte Integral, Transcendental Functions, Techniques of Integration, Indeterminate Forms and Improper Integrals.

Syllabus :

Introduction, Functions and Limits, The Derivative, Applications of the Derivative, The Definite Integral, Applications of The Definte Integral, Transcendental Functions, Techniques of Integration, Indeterminate Forms and Improper Integrals.

Prerequisite: None

Textbooks:

Main reference:

D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., Pearson, Prentice Hall, 2007.

Additional eferences:
1. George B. Thomas Jr., Thomas' Calculus Early Transcendental, 12th ed., Addison–Wesley Pearson, 2009.
2. Howard Anton, Calculus, 10th ed., John Wiley and Sons, 2012.

CALCULUS 2
ENGE600002/ENGE610002
3 SKS
Course Learning Outcomes:

Students are able to use the concepts of sequences, series, conic sections, and the basic concepts of calculus which involve the function of two or three variables to solve their applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :

Infinite sequences and infinite series, Test for convergence of positive series and alternating series, Power series and operation on operations, Taylor and MacLaurin series, Conic sections , Calculus in polar coordinates, Derivatives, limits, and continuity of multi-variables functions, Directional derivatives and gradients, Chain Rule, Tangent planes and Approximations, Lagrange multipliers. Double integrals in Cartesian coordinates and polar coordinates, triple integrals in Cartesian coordinates, cylindrical coordinates and spherical coordinates, Applications of double and triple Integral.

Prerequisite: Calculus 1

Textbooks:
1. D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., PEARSON, Prentice Hall, 2007.
2. Thomas, Calculus Thirteenth Edition Volume 2, Erlangga, 2019.

CALCULUS
ENGE600003/ENGE610003
4 SKS
Course Learning Outcomes:

Students are able to use the basic concepts of calculus involving functions of one to three variables to solve their applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :

Introduction, Functions and Limits, Derivatives, Derived Applications, Indeterminate Integral, Integral Applications, Infinite Row, and Series. Derivatives with many variables, Duplicate Integral (2 and 3), Duplicate Integral Application.

Prerequisite: None

Textbooks:

Main reference:

D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., Pearson, Prentice Hall, 2007.

Additional:

George B. Thomas Jr., Thomas' Calculus Early Transcendental, 12th ed., Addison – Wesley Pearson, 2009.

LINEAR ALGEBRA
ENGE600004/ENGE610004
4 SKS
Course Learning Outcomes:

Students are able to calculate linear system problems to solve engineering problems.

Graduates Learning Outcomes:
Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :

Linear Systems and matrix equations, Determinants, Euclid vector spaces, Common vector spaces, eigenvalues and eigenvectors, inner product spaces, Diagonalization and General Linear Transformation.

Prerequisite: None

Textbooks:
1. Elementary Linear Algebra, Howard Anton & Chris Rorres, 11th edition, 2014
2. Gilbert Strang, Introduction to linear algebra 3rd edition Wellesley Cambridge Press, 2003

MECHANICAL AND HEAT PHYSICS

ENGE600005 / ENGE610005
3 credits
Course Learning Outcomes:

Able to explain the basic concepts of mechanics and thermodynamics, and be able to apply them to understand natural phenomena and human engineering, including their applications.

Graduate Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus:

Units, Magnitudes and Vectors, Motion Along Straight Lines, Motion in Two and Three Dimensions, Newton's Laws of Motion, Applications of Newton's Laws, Kinetic Energy, and Work, Potential Energy and Energy Conservation, Center of Mass, Linear Momentum, Rotation, Rolling Motion, Torque, Angular Momentum, Oscillation, Mechanical and Sound Waves, Gravity, Statics and Elasticity, Fluid Mechanics, Temperature, Heat, Law I Thermodynamics, Ideal Gas and Kinetic Theory of Gas, Heat Engine, Entropy, and Law II Thermodynamics.

Prerequisite: none

Textbooks:
1. Halliday, Resnick, and Walker, Principles of Physics 10th Edition, Wiley, 2014.
2. Serway Jewett, Physics for Scientists and Engineers 9th Edition, Thomson Brooks / Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008

ELECTRICAL MAGNETIC, OPTICAL AND WAVE PHYSICS

ENGE600007 / ENGE610007
3 credits
Course Learning Outcomes:

Students are able to apply the basic concepts of electrical physics, magnetism, waves, and optics to solve problems in the engineering field.

Graduate Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus:

Unit, Magnitude, Vector, Electric Charge, Electric Field, Gauss Law, Electric Potential, Capacitance, Electric Current, Resistance, Direct Current, Magnetic Field Due to Electric Current, Magnetic Field Source, Induced GGL, Inductance, Alternating Current, Electromagnetic Waves, Light Properties and Propagation, Optical Geometry.

Prerequisite: none

Textbooks :
1. Halliday, Resnick, and Walker, Principles of Physics 9th Edition, Wiley, 2011.
2. Serway Jewett, Physics for Scientists and Engineers 9th Edition, Thomson Brooks / Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008.

BASIC CHEMISTRY

ENGE600009 / ENGE610009
2 credits
Course Learning Outcomes:

Students are able to analyze the principe of basic chemistry for application in engineering.

Graduates' Learning Outcomes:

Able to apply mathematics, science, and basic engineering to be used in solving complex engineering problems.

Syllabus:

Material and measurements, atoms, molecules and ions, stochiometry, water phase reactions and solution stochiometry, thermochemistry, chemical equilibrium, acid and base equilibrium, electrochemistry, chemical kinetics, and chemical applications.

Prerequisite: none

Textbooks :
1. Ralph H. Petrucci, General Chemistry: Principles and Modern Applications, 8th Ed. Prentice Hall Inc., New York, 2001.
2. John McMurry, Robert C. Fay, Chemistry (3rd ed.), Prentice Hall, 2001.
3. Raymond Chang, Williams College, Chemistry (7th ed.), McGraw-Hill, 2003.

ENGINEERING ECONOMY

ENGE600011 / ENGE610011
3 credits
Course Learning Outcomes:

Students are able to analyze the economic and financial feasibility of making economic practice decisions.

Graduate Learning Outcomes:

Able to apply the principles of technical management and decision making based on economic considerations, in individual and group, as well as in project management.

Syllabus:

Introduction to Engineering Economics, Time Value of Money, Combining Factors, Interest Rates, Money Worth Analysis, Rate of Return Analysis, Effects of Inflation, Benefit Cost & Break-Even Point Analysis, Sensitivity Analysis, Depreciation, Tax Analysis, Cost Estimation & Allocation, Capital Budgeting & Replacement Analysis.

Prerequisite:
1. Civil Engineering : -
2. Environmental Engineering : -
3. Naval Engineering : -
4. Industrial Engineering : must pass the introductory Economic course and have completed 38 credits
5. Chemical Engineering : -
6. Bioprocess Engineering : -

Textbooks:
1. Blank, Leland and Tarquin, Anthony. 2018. Engineering Economy 8th Ed. McGraw Hill.
2. Park, Chan S. 2016. Contemporary Engineering Economics 6th Ed. Pearson. Upper Saddle River.
3. White, Case and Pratt. 2012. Principles of Engineering Economic Analysis 6th ed. John Wiley and Sons.

STATISTICS AND PROBABILISTICS
ENGE600010 / ENGE610010
2 credits
Course Learning Outcomes:

Students are able to handle quantitative data/information starting from the descriptive stage (collection, organization, and presentation) to the inductive stage, which includes forecasting and drawing conclusions based on the relationship between variables for decision making.

Graduate Learning Outcomes:
1. Apply descriptive statistics and probability theory to data processing and serving
2. Apply probability distribution to data processing and serving
3. Apply the principles of sampling and estimation for decision making
4. Apply hypothesis test samples for decision making

Syllabus:

Introduction to Statistics for Engineering Studies, Probability Theory, Dasar Basic concepts and definitions, Distribution Probability, Sampling, Estimation, Hypothesis testing, Hypothesis test 1 sample at an average value, Regression

Prerequisite: none

Textbooks :
1. Harinaldi, Basic Principles of Statistical Engineering and Science, Erlangga, 2004
2. Montgomery, DC., And Runger, GC., Applied Statistics and Probability for Engineers, John Wiley Sons, 2002

HSE PROTECTION
ENGE600012 / ENGE610012
2 credits
Course Learning Outcomes:

Upon completion of this subject students are expected to be able to carried out hazard identification, and characterization, to propose appropriate methods for risk reduction and mitigation, and to design safety management system. The student is also expected to improve their awareness on industrial safety and health, and understanding on safety regulation framework and standards as well as environmental program.

Graduate Learning Outcomes:
1. Students are expected to understand safety, health and environmental aspect as an integral part of fundamental principal in engineering code of ethics.
2. Students are expected to be able to carry out process of risk assessments by considering risk factors in the impact of hazards on people, facilities, and the surrounding community and environemt.
3. Students are expected to understand the regulatory framework and standard related to the stages of life cycle of machine, building structure, construction, and process.
4. Students are able to design and propose an effective hazard communication, management and engineering control, and risk mitigation through an engineering assignment project.
5. Students are able to identify the knowledge required to perform risk assesment, investigation and design improvement through a multidisiplinary case of incident and accident.

Syllabus:

Introduction to SHE Regulation and Standards, SHE Perception (Risk and Environment), Identification, Assessment and Management, Construction, machinery and Noise hazards, Process safety hazard and analysis technique, Fire and explosion hazard, Electrical hazard, Toxicology in the Workplace, Ergonomy Aspect, Hazard communication to employees, Environmental Protection, Case studies, Safety Health and Environment audits.

Prerequisite: none

Textbooks :
1. Charles A. Wentz, Safety, Health and Environmental Protection, McGraw Hill, 1998.
2. Asfahl, C.R., Rieske, D. W., Sixth Edition Industrial Safety and Health Management, Pearson Education, Inc., 2010.
3. United Kingdom - Health and Safety Executive, http://www.hse.gov.uk/
4. National laws and regulations related to the K3 Management System and the Environment.
5. Related Journal (http://www.journals.elsevier.com/safety-science/) etc, related standards and publications.

Chemical Engineering Courses

INTRODUCTION TO CHEMICAL ENGINEERING
ENCH600001 / ENCH610001
3 CREDITS
Learning Objectives:

Able to distinguish chemical engineering from other techniques, able to explain the development of chemical engineering, understand the basics of chemical engineering and existing process systems, and able to do simple mass and energy balance calculations and know the criteria of process equipment.

Syllabus:

Introduction to Chemical Engineering (understanding and history); Profile, employment, and contribution of Chemical Engineering; Code of Ethics of the Chemical Engineering profession; Chemical engineering processes (units and dimensions and basic process systems); Chemical engineering equipment; The flow of chemical engineering processes in certain industries

Prerequisites: -

Textbooks:
1. Chemical Process Industries, McGraw Hill, 1984.
2. R.M., Felder and R.W. Rosseau, Elementary Principles of Chemical Processes, 3rd Edition, Wiley, 2005.
3. R. Schizininger and M.W. Martin, Introduction to Engineering Ethics, Mc. Graw-Hill, 2000.

COMMUNICATION SKILLS
ENCH600002 / ENCH610002
2 CREDITS
Learning Objectives:

Able to plan communication products through audience analysis, then compile them into a coherent and logical sequence of messages, and can present them effectively using appropriate technology media.

Syllabus:

Effective communication, audience analysis, writing process, making memos, making summaries / abstracts, structure of technical papers, oral presentation.

Prerequisites: -

Textbooks:

Donald R. Woods, Communicating effectively, McMaster University Bookstore, 1996

ORGANIC CHEMISTRY

ENCH600003 / ENCH610003
3 CREDITS
Learning Objectives:

Able to apply the concepts and laws of analytical, organic, and physical chemistry and apply them in solving everyday problems.

Syllabus:

Naming of organic compounds; The role of structure and stereochemistry in the physical/chemical properties of an organic compound; Cracking reactions or alkane free radicals; Alkene polymerization; Aromatic electrophilic substitution in benzene; Ubtstitution reaction and elimination; Acylation and esterification reaction; Dehydration-polymerization reaction

Prerequisites: -

Textbooks:
1. Fessenden, alih bahasa: A. Hadiyana Pujatmaka, Kimia Organik, edisi Kedua Erlangga 1986
2. Morrison, RT and Boyd, RN, Organic Chemistry, 6th ed., Prentice Hall 1998
3. Organic Chemistry Lecture Note.

BASIC AND ORGANIC CHEMISTRY LAB

ENCH600004 / ENCH610004
1 CREDITS
Learning Objectives:

Able to make a preliminary report, conduct experiments in the laboratory, analyze data from the results of practicum and explain the phenomena that occur from the results of practicum done, which are outlined in the form of a final report.

Syllabus:

Physical and Chemical Properties; Separation and Refining of Compounds; Metal Reaction with Acid; Crystal Water; Suspension Formation Reaction; Identification of Hydrocarbon Compounds; Alcohol and phenol identification; Identification of Carbonyl Compounds; Carbohydrate; Lipid Analysis; Extraction and Identification of Fatty Acids from Corn Oil

Prerequisites: -

Textbooks:
1. Brown, T.L., et al., Chemistry The Central Science, 8th ed., Prentice Hall, 2000.
2. Morrison, R.T., R. N. Boyd, Organic Chemistry, 6th ed., Prentice Hall, 2002.
3. Vogel's Qualitative Inorganic Analysis, 7th ed., 1996.
4. Penuntun Praktikum Kimia Dasar dan Kimia Organik, Teknik Kimia FTUI.

NUMERICAL COMPUTATION

ENCH600005 / ENCH610007
3 CREDITS
Learning Objectives:

Able to solve chemical process problems with computational methods.

Syllabus:

Programming with Pascal and Fortran; Regression; Systems of linear algebraic equations; Numerical integration; Finding the roots of non-linear algebraic equations' The system of non-linear algebraic equations; An explicit method for solving first-order differential equations;

Prerequisites: -

Textbooks:
1. Handouts dari dosen
2. Constantinides, Alkis. 2008. "Numerical Methods for Chemical Engineers with Mathlab Applications". Pearson Education, United States.
3. Bismo, S. & Muharam, Y. 2015. "Metode Numerik dengan Pemrograman Fortran dan Pascal".

INSTRUMENTAL ANALYTICAL CHEMISTRY

ENCH600006 / ENCH610008
3 CREDITS
Learning Objectives:

Able to apply the concepts and laws of analytical, organic, and physical chemistry and apply them in solving everyday problems.

Syllabus:

Process skills workshop; Electrochemistry; Potentiometry; Atomic absorption spectroscopy; Infrared molecular spectroscopy; Gas chromatography;

Prerequisites: -

Textbooks:
1. D. A. Skoog, et.al., Fundamentals of Analytical Chemistry 9th., Cengage Learning, Inc., 2013.
2. G. D. Christian and J. E. O' Reilly, Instrumental Analysis, 7th. Ed., Allyn Bacon Inc., 2003.
3. D.A. Skoog, et al. Principles of Instrumental Analysis 7th Ed. Cengage Learning, Inc. 2016.
4. D.L. Pavia, et al. Introduction to Spectroscopy 5th Ed. Cengage Learning, Inc. 2014

PHYSICAL CHEMISTRY

ENCH600007 / ENCH610005
3 CREDITS
Learning Objectives:

Able to apply basic principles, laws, and theories related to gases, liquids, equilibrium, and solutions in solving problems in the field of physical chemistry; Able to solve problems in the form of working groups by applying stages of problem-solving.

Syllabus:

The nature of gases and liquids: Definition, laws of ideal gases and real gases, use of gas laws, gas kinetics theory (velocity, collisions, average free way), phase diagrams, critical conditions, viscosity; Chemical reaction equilibrium: Definition, homogeneous equilibrium constant, factors affecting equilibrium constant, heterogeneous equilibrium, Le Chatelier's principle, effect of P on K, effect of T on K; Ideal solution: Definition, type of solution, solution concentration, Raoult's law, Henry's law, case examples, partial molar volume, vapor pressure, boiling point, freezing point, and solution osmosis pressure; Electrolyte solutions: Definition, colligative properties, electrolytic conductance, factors affecting conductance, case examples, ion migration, Hittorf's law and transport numbers; Chemical Reaction Kinetics: Basic understanding, first, second, third order reactions, reversible, parallel, consecutive reactions, chain reactions, Arrhenius equations and activation energies, collision theory of bimolecular reactions, transition form theory; Surface phenomena: Basic understanding, surface tension, monolayer and multilayer adsorption, catalytic reaction kinetics, heterogeneous reaction order, catalytic reaction inhibitors, temperature effects on heterogeneous reactions.

Prerequisites: -

Textbooks:
1. Levine, I.N., Physical Chemistry, 6th ed., McGraw-Hill, 2008.
2. Atkins & de Paula, Atkin's Physical Chemistry, 9th ed., Oxford University Press, 2009

PHYSICAL & ANALYTICAL CHEMISTRY LAB

ENCH600008 / ENCH610009
1 CREDITS
Learning Objectives:

Able to compile a preliminary report which is a theory that supports the practicum module; carry out experiments in the laboratory; and compile the final report that contains the results of processing and analysis of experimental data and an explanation of the phenomena that occur

Syllabus:

Isothermic adsorption; Effect of concentration and temperature on the reaction rate; Colligative nature of the solution; Determination of chemical equilibrium constants; Determination of gas molecular weight; Volumetric analysis; Potentiometric methods; Visible light spectrophotometry; The conductometry method; Gas chromatography

Prerequisites:

Basic Chemistry, Physical Chemistry and Instrumental Analytical Chemistry

Textbooks:
1. Petunjuk Praktikum Kimia Fisika TGP-FTUI 1989.
2. Penuntun Praktikum Kimia Fisika dan Kimia Analitik, Departemen Teknik Kimia FTUI
3. D. A. Skoog, et al., Fundamentals of Analytical Chemistry 5th., Saunders College Publishing, 1998 atau edisi terbaru
4. Shoemaker, D.P., C.W. Garland, J.W. Nibler, Experiments in Physical Chemistry, ed. 6, Mc-Graw Hill, 1996.
5. Atkins & de Paula, Atkin's Physical Chemistry, 9th ed., Oxford University Press, 2009

MASS AND ENERGY BALANCE

ENCH600009 / ENCH610006
3 CREDITS
Learning Objectives:

Able to use basic principles in chemical engineering for mass and energy calculations, which will form the basis of calculations for many operating units and processes in the chemical/bioprocess industry; Formulate and solve problems in the form of mass and energy balance sheets related to chemical processes.

Syllabus:

The scope of the mass and energy balance sheet; Mass balance without chemical reactions and multi-unit systems; Mass balance of chemical reactions; Biological reaction mass balance; Chemical / biological reaction mass based on the component mass balance and element mass balance; General chemical energy balance; Energy balance of chemical reactions

Prerequisites: -

Textbooks:
1. Himmelblau D.M. Basic Principles and Calculation in Chemical Engineering, 7th ed, Prentice Hall 2004.
2. Pauline Doran, Basic Principles of Bioprocess Engineering, Wiley VCH, 2006.
3. Sumber data: Perry's Chemical Handbook dan lainnya yang terkait data *physical and chemical properties*

TRANSPORT PHENOMENA

ENCH600010 / ENCH610010
3 CREDITS
Learning Objectives:

Able to identify and explain and analyze the phenomena of momentum, mass, and heat transfer through the application of microscopic and macroscopic balances.

Syllabus:

Preliminary; Viscosity; Thermal Conductivity and Diffusivity; Shell's momentum balance and Shell's energy balance; Shell mass balance; The equation of change; Mass transfer, momentum, and energy with two independent variables; The transfer of momentum, energy, and mass in a turbulent flow; Movement between two phases; Macroscopic balance of an isothermal system; Macroscopic balance of non-isothermal systems; Macroscopic balance sheet of multi-component systems

Prerequisites:
Introduction to Chemical Engineering; Calculus

Textbooks:
1. Referensi wajib: R.B. Bird, W.E. Stewart, and E.N. Lightfoot, Transport Phenomena, John Wiley and Sons, New York, 2nd edition, 2002.
2. Referensi pilihan: Harry C. Hershey, Robert S. Brodkey, Transport Phenomena: A Unified Approach, Vol. 1, McGraw-Hill, New York, 1987, pp. 847.

CHEMICAL ENGINEERING MODELLING

ENCH600011 / ENCH610014
3 CREDITS
Learning Objectives:

Able to develop mathematical equations from chemical process systems; able to solve mathematical equations that describe chemical process systems.

Syllabus:

An explicit method for solving ordinary differential equations; Finite difference method for solving ordinary & partial differential equations; Empirical Model; Phenomenological model for multi-component separation systems; Phenomenological model for chemical reaction systems; Phenomenological model for reactor systems;

Prerequisites:
Komputasi Numerik/Numerical Computation

Textbooks:
1. Constantinides, A. dan Mostouvi, N., Numerical Methods for Chemical Engineers with MATLAB Applications, Prentice Hall, 1999.
2. Davis, M.E., Numerical Methods and Modeling for Chemical Engineer, John Willey & Sons, New York, 1984.
3. Rice, G.R. dan Duong D.D., Applied Mathematics and Modeling for Chemical Engineers, John Willey & Sons, New York, 1995.
4. Tosun, I., Modeling in Transport Phenomena: A Conceptual Approach, Elsevier, 2002.

FLUID AND PARTICLE MECHANICS

ENCH600012 / ENCH610011
3 CREDITS
Learning Objectives:

Able to apply the basic concepts of fluid mechanics and apply them in solving real problems. In addition, students are able to apply the principles of fluid mechanics (press. Continuity, Bernoulli, etc.), to solve problems in the unit process through energy and force calculations, etc., especially in fluid flow systems in piping, rate measuring devices and transportation tools fluid, as well as in fluid-solid flow systems (fluidization, filtration, sedimentation, movement of particles in the gas.

Syllabus:

Fluid property; Static fluid and its application; The basic equation of fluid flow (mass & press balance. Continuity, energy balance and press. Bernoulli); Press application. Bernoulli for flow rate measurement; Friction Loss of fluid flow through pipes, porous media, fluid transport devices: pumps, compressors, turbines; High-speed gas flow; Movement of particles through fixed and fluidized beds and Filtration; Sedimentation of particles in a liquid

Prerequisites:

Transport Phenomena

Textbooks:
1. Noel de Nevers, Fluid Mechanics for Chemical Engineers, 2nd Ed., McGraw-Hill, 1991.
2. Bruce R. Munson, Donald F. Young, Theodore H. Okiishi, Fundamentals of Fluid Mechanics, John Wiley & Sons, 2006.

CHEMICAL ENGINEERING THERMODYNAMICS
ENCH600013 / ENCH610012
4 **CREDITS**
Learning Objectives:

Able to apply heuristics of problem solving skills and basic concepts of thermodynamics to solve various thermodynamic triggers in the Problem-Based Learning (PBL) learning format; able to increase the ability to direct learning independently (self-directed learning) at the individual or group level

Syllabus:

PVP properties of pure compounds, process trajectories, steamed tables (Trigger 1); Steady and non-steady system energy balance (Trigger 2); Cyclic processes: Rankine cycle for energy generation and refrigeration cycle (Trigger 3); Ideal system phase equilibrium and the activity coefficient approach (Trigger 4); Phase equilibrium at high pressure: a coefficient of fugacity approach through the cubic state equation (Trigger 5); Reaction balance (Trigger 6)

Prerequisites:
Mass and Energy Balance

Textbooks:
1. M.J. Moran and H.N. Saphiro, Fundamentals of Engineering Thermodynamics, 2nd/3rd ed., Wiley.
2. J.M. Smith, H.C. Van Ness, and M.M. Abbott, Introduction to Chemical Engineering Thermodynamics, 6th/7th ed., McGraw Hill.
3. Kamarza Mulia dan Praswasti PDK Wulan, Diktat Termodinamika Teknik Kimia.
4. Donald R. Woods, Problem-Based Learning: How to gain the most from PBL, McMaster Bookstore, Hamilton, Ontario, Canada, 1994.
5. Internet sites, books, manuals, software instructions, and other reliable sources of information.

HEAT TRANSFER
ENCH600014 / ENCH610015
3 CREDITS
Learning Objectives:

Able to analyze the phenomenon of heat transfer and apply it to solve problems in the heat transfer process unit.

Syllabus:

Skills Workshop Review which includes: The importance of self-assessment, awareness of the thought process, problem-solving strategies and work skills in groups; Steady conduction; Induction Conduction; Natural Convection; Forced Convection; Radiation; Heat Exchanger

Prerequisites:
Transport Phenomena

Textbooks:
1. Holman, J.P., "Perpindahan Kalor (alih bahasa: E. Jasjfi), Edisi ke-6, Penerbit Erlangga, Jakarta 1993.
2. Mc. Adam, W. H., "Heat Transmission", 3rd Ed., Mc.Graw-Hill International Book Company, 1981.
3. Kern, D. Q., "Process Heat Transfer", Mc.Graw-Hill International Book Company, 1984.
4. Treybal, R.E., "Mass Transfer Operation", McGraw-Hill International Book Company, 1984.
5. Coulson, J.M. dan Richardson, J.R., "Chemical Engineering", Vol.2, Pergamon Press, 1989.
6. Donald R. Woods, Problem based learning: How to gain the most from PBL, McMaster University, Hamilton, 1994.

PROCESS ENGINEERING DRAWING
ENCH600015 / ENCH610017
3 CREDITS
Learning Objectives:

Able to manually draw process flow diagrams, P&ID and plant layouts, recognize the use of software for drawing, understand, and be able to read the meaning of images.

Syllabus:

Introduction to drawing techniques; Basics of drawing technique; Block Process Flow Diagram; Symbols basic symbols of equipment Chemical industry and process flow; Process Flow Diagram (PFD); Equipment symbols, pipes, instrumentation; Piping and Instrumentation Diagram (P&ID); Software for drawing; Plant Plots & Plant Layouts; Piping Route and Isometric Drawing; Spool Drawing and Bill of Materials (BOM). Bill of Quantity (BOQ)

Prerequisites: -

Textbooks:
1. W. Boundy, Engineering Drawing, McGraw-Hill Book Company
2. Colin Simmons & Dennis Maguire, Manual of Engineering Drawing, Edward Arnold
3. ISO 1101, Mechanical Engineering Drawings, International Organization for Standardization
4. Japanese Industrial Standard, Technical Drawing for Mechanical Engineering, Japanese Standard Association.
5. Warren J. Luzadder, Fundamentals of Engineering Drawing, Prentice-Hall, Inc.

MATERIAL SCIENCE & CORROSION
ENCH600016 / ENCH610013
3 CREDITS
Learning Objectives:

Able to understand the role of material selection in designing equipment; able to understand the properties of materials; able to understand corrosion: the process, prevention, testing and protection; Calculate and design simple corrosion protection

Syllabus:

History of Material Science in human civilization; Application of Material Science in Chemical Engineering; Atoms, Molecules, Chemical Bonds and their correlation with material properties;

Crystal Structure; Phase Diagrams and their relationship to metal making; Material Mechanical Properties and Test Equipment; Metals and alloys; Corrosion and Chemical Industry; Basic concepts of corrosion, electrochemistry, polarization, passivity; Types of corrosion-mechanisms and their prevention; Cathodic Protection and Corrosion Inhibitors & Monitoring

Prerequisites: -

Textbooks:

Ilmu Bahan dan Teknologi Bahan (Lawrence H.Van Vlack diterjemahkan oleh Ir. Sriati Djaprie, M.E.,M.Met), Bagian Pendahuluan.

MASS TRANSPORT

ENCH600017 / ENCH610016
3 CREDITS
Learning Objectives:

Able to use basic technical principles for the calculation of major mass transfer operations: Distillation, Absorption, Extraction, Humidification and Drying.

Syllabus:

Introduction; Distillation; Drying / Humidification; Absorption; Extraction; Leaching

Prerequisites:

Termodinamika Teknik Kimia; Peristiwa Perpindahan (Thermodynamics of Chemical Engineering; Trasport Phenomena)

Textbooks:
1. Treyball, "Mass Transfer Operation", MGH, 1984.
2. McCabe and Smith, "Unit Operation for CE", JWS, 1989.
3. Coulson and Richardson, "Chemical Engineering", Pergamon, 1991.
4. Geankoplis, "Transport Processes and Unit Operation", Prentice Hall, 1993.

UNIT OPERATION PROCESS LAB I

ENCH600018 / ENCH610020
1 CREDITS
Learning Objectives:

Students practice operating the equipment of fluid mechanics and heat transfer units and able to analyze experimental data obtained through written reports.

Syllabus:

Introduction of miniature forms of tools and Laboratory-scale Chemical Engineering Process Operation Units; Application of various principles of displacement events, fluid mechanics, heat transfer given in lectures on the Process equipment and Chemical Engineering Operations Unit

Prerequisites:
Fluid and Particle Mechanics, Heat Transfer

Textbooks:

Buku Petunjuk Praktikum Proses dan Operasi Teknik Kimia 1, DTK FTUI.

CHEMICAL REACTION ENGINEERING 1

ENCH600019 / ENCH610021
3 CREDITS
Learning Objectives:

Able to understand the basic concepts of chemical reaction kinetics (reaction rates, reaction mechanisms), both for homogeneous and heterogeneous reactions, and are able to determine the equation of reaction rates and understand surface phenomena and catalysis.

Syllabus:

Basic Concepts of Chemical Kinetics and Thermodynamics of Chemical Reactions; Molecular Reaction; Homogeneous Elementary Reactions: Data Modeling and Analysis; Homogeneous Non-Elementary Reactions; Kinetics of Heterogeneous Reactions; Heterogeneous Catalytic Reaction Data Analysis; Effects of External Diffusion on Heterogeneous Catalytic Reactions; Diffusion and Reaction; Case Study in the Methanol & Sulfuric Acid Industry; Case Study in the Fertilizer Industry

Prerequisites:
Physical Chemistry

Textbooks:
1. H. Scott Fogler, Elements of Chemical Reaction Engineering, Prentice-Hall, 4th Edition, 2006.
2. O. Levenspiel, Chemical Reaction Engineering, 3rd Edition, John Wiley & Sons, New York, 1999.
3. S.H., Fogler, and LeBlanc, Strategies for Creative Problem Solving, Prentice-Hall, 1995.
4. K. J. Leidler, Chemical Kinetics, 3rd ed., Harper Publish, 1987.
5. Widodo, W. P., Slamet, Diktat Kuliah Kinetika dan Perancangan Reaktor Kimia, TGP-FTUI, 2002.
6. CRE course onlines:
7. http://www.engin.umich.edu/~cre/344/
8. http://ocw.mit.edu/OcwWeb/Chemical-Engineering/10-37Spring-2007/CourseHome/

CHEMICAL PROCESS SIMULATION

ENCH600020 / ENCH610018
3 CREDITS
Learning Objectives:

Able to use the latest chemical engineering software to create steady-state and dynamic simulations and able to manipulate variable processes and unit topology processes in the chemical industry.

Syllabus:

Steady-state and dynamic models; Stream; Heat exchangers equipment; Piping equipment and rotating equipment; Separation Equipment; Columns and Towers; Reactor; Refrigeration system; PID Controller Selection for Temperature, Pressure, Level and Flow; Cascade Controller; Model Testing and Adjustment of PID Controllers.

Prerequisites: Chemical Engineering Thermodynamics, Mass and Energy Balances

Textbooks:
1. Fogler, H.S., Elements of Chemical Reaction Engineering, Prentice-Hall.
2. Douglas, J. M., Conceptual Design of Chemical Processes, McGraw-Hill, 1998.
3. Peter, M.S, and K.D. Timmerhaus, Plant Design and Economic for Chemical Engineering 4th Edition, McGraw-Hill, 1991.
4. HYSYS Steady State Model and Tutorial.
5. SuperPro Designer User Guide and Tutorial, Inteligent, Inc.

PROCESS CONTROL

ENCH600021 / ENCH610023
3 CREDITS
Learning Objectives:

Able to design a single loop control system and connect the dynamics of the process with performance.

Syllabus:

Introduction to Process Control; Objectives and Benefits of Control; Principles of Mathematical Modeling; Process Control Modeling and Analysis; Dynamic Behavior of a Typical Process System; Empirical Model Identification; Feedback loop; PID controller; PID Control Settings; Stability Analysis;

Prerequisites:
Mass and Energy Balance, Numerical Computation

Textbooks:
1. T. Marlin, Process Control: Designing Processes and Control Systems for Dynamic Performance, 2nd Edition, McGraw-Hill, New York, 2000.
2. Carlos A. Smith, Armando B. Corripio, Principles and Practice of Automatic Process Control, John Wiley & Sons, 1985, ISBN 0-471-88346-8 2.
3. D. E Seborg, T. F. Edgar, D. A. Mellichamp, Process Dynamics and Control, John Wiley & Sons, 1989, ISBN 0-471-86389-0 3.
4. Ogata, Katsuhiko, Teknik Kontrol Automatik (Sistem Pengaturan), Jilid 1, Penerbit Erlangga, 1985, Bandung.
5. Bequette, R. W., Process Dynamics: Modeling, Analysis, and Simulation, Prentice Hall, 1998.
6. Luyben, William L., Process Modeling, Simulation and Control for Chemical Engineers, Second Edition, McGraw-Hill International Edition, 1990.
7. Kuo, Benjamin C., Automatic Control Systems, Sixth Edition, Prentice-Hall International Editions, 1991.
8. Stephanopoulos, George, Chemical Process Control: An Introduction to Theory and Practice, Prentice-Hall International, 1984.

UNIT OPERATION PROCESS LAB 2
ENCH600022 / ENCH610024
1 CREDITS
Learning Objectives:

Students practice operating the equipment of fluid mechanics and heat transfer units and able to analyze experimental data obtained through written reports.

Syllabus:

Introduction of miniature forms of tools and Laboratory-scale Chemical Engineering Process Operation Units; Application of various principles of mass transfer and process control events to the Process Equipment and Chemical Engineering Operations Unit.

Prerequisites:

Mass Transfer, Heat Transfer, Fluid & Particle Mechanics, Process Control

Textbooks:

Buku Petunjuk Praktikum Proses dan Operasi Teknik 2, Departemen Teknik Kimia UI.

CHEMICAL REACTION ENGINEERING 2
ENCH600023 / ENCH610025
3 CREDITS
Learning Objectives:

Able to understand the basic concepts of chemical reactor design, do the basic design of chemical reactors, and conduct analysis to determine the types and operating conditions of chemical reactors.

Syllabus:

The basic concept of chemical reactor design; Ideal-Isothermal Reactor Design; Non-Isothermal Reactor Design; Visitation to industry or guest lectures; RTD concept to analyze flow patterns in ideal and non-ideal reactors; Concentration is based on various models of non-ideal reactors and analyzing the profile of real (non-ideal) reactor paths.

Prerequisites:
Chemical Reaction Engineering 1

Textbooks:
1. H. Scott Fogler, Elements of Chemical Reaction Engineering, Prentice-Hall, 4th Edition, 2006.
2. O. Levenspiel, Chemical Reaction Engineering, 3rd Edition, John Wiley & Sons, New York, 1999.
3. S.H., Fogler, and LeBlanc, Strategies for Creative Problem Solving, Prentice-Hall, 1995.
4. E. B. Nauman, Chemical Reactor Design, Optimization, and Scale up, McGraw-Hill, 2002.
5. Widodo, W. P., Slamet, Diktat Kuliah Kinetika dan Perancangan Reaktor Kimia, TGP-FTUI, 2002.
6. CRE course onlines
7. http://www.engin.umich.edu/~cre/344/
8. http://ocw.mit.edu/OcwWeb/Chemical-Engineering/10-37Spring-2007/CourseHome/
9. O. Levenspiel, Tracer Technology Modeling the Flow of Fluids in Fluid Mechanics and its Applications Vol. 96.
10. Series Editor: R. Moreau Madylam, Springer, 2012.

PROCESS EQUIPMENT DESIGN
ENCH600024 / ENCH610026
3 CREDITS
Learning Objectives:

Able to design chemical process equipment in accordance with applicable standards. Syllabus: Pumps, compressors, piping, pressure vessels and tanks, distillation columns, heat exchangers.

Syllabus: Pumps, compressors, piping, pressure vessels and tanks, distillation columns, heat exchangers.

Syllabus:

Introduction to process design; Fluid Transportation: Piping systems, pump designs, compressors; Distillation Column Design; Heat Exchanger Design: Double pipe HE, Shell and Tube, SHTE; Vessel Design

Prerequisites:

Fluid Mechanics and Particles; Heat Transfer; Mass Transfer; Material Science & Corrosion

Textbooks:
1. Kern, D. Q., "Process Heat Transfer", Mc.Graw-Hill International Book Company, 1984.
2. Ludwid, Applied Process Design for Chemical and Petrochemical Plant, Vol. 2, Gulf Publishing Co.
3. Towler, G. and Sinnott, R., Chemical Engineering Design: Principles, Practice and Economics of Plant and Process Design, Elsevier, 2008.

CHEMICAL PRODUCT DESIGN
ENCH600025 / ENCH610027
4 CREDITS
Learning Objectives:

Able to use the knowledge gained from several previous subjects to be applied to the design of a complete chemical product which includes: Needs, Ideas, Selection and Manufacture, Supply Chain, Intellectual Property Rights, HSE, and Economics; Students have problem-solving skills and work in teams; Students are capable of entrepreneurship.

Syllabus:

Understanding of consumer needs, product specifications, creating and selecting product concepts, product formulations, product manufacturing, supply chains, economics.

Prerequisites:

Mass and Energy Balance; Fluid Mechanics and Particles; Heat Transfer; Mass Transfer; Chemical Reaction Engineering; Engineering Economics.

Textbooks:

1. Cussler, L., G.D. Moggridge, Chemical Product Design, Cambridge University Press, 2011.
2. Seider W.D., Seader J.D., Lewin D.R., Product and Process Design Principles, Synthesis, Analysis and Evaluation, Wiley and Sons Inc., 2009.
3. Wesselingh J.A., Kiil, S. and Vigild M.E., Design and Development of Biological, Chemical, Food and Pharmaceutical Products, John Wiley & Sons, Ltd., 2007.
4. Ulrich K.T., Eppinger S.D., Product Design and Development, 5th edition, McGraw Hill.
5. Birgit Kamm, Patrick R. Grubber, Michael Kamm, Biorefineries – Industrial Processes and Products, Wiley-VCH, Swiss, 2005.
6. Peter, M.S. and K.D. Timmerhaus, Plant Design and Economic for Chemical Engineering 4th edition, McGraw Hill, 1991.
7. Dolgui A., Soldek J. and Zaikin O., Supply Chain Optimization: Product/Process Design, Facility Location and Flow Control, Springer, 2005.
8. Douglas, J.M., Conceptual Design of Chemical Processes, McGraw Hill, 1998.
9. Kirk-Othmer, Enyclopedia of Chemical Technology, 3rd edition, McGraw Hill, 1991.
10. Perry's Chemical Handbook

INDUSTRIAL PROJECT MANAGEMENT
ENCH600026 / ENCH610028
2 CREDITS
Learning Objectives:

Able to apply project management concepts in their field of work well.

Syllabus:

Concept of Project-Production; Project Life Cycle; Project Selection; Project Planning; Project Implementation; Project Completion & Evaluation.

Prerequisites:
Engineering Economics

Textbooks:
Suharto, Imam, Manajemen Proyek, 1990

PLANT DESIGN
ENCH600027 / ENCH610029
4 CREDITS
Learning Objectives:

Able to theoretically design a factory/industry by explore information from books, journals and the internet to find the latest solutions in product and factory design with due regard to standards and regulations.

Syllabus:

Conceptual design of processes/plants, process development flow diagrams, heuristic synthesis and analysis of processes, process simulations, rule of thumb design of process tools and construction meters, heat/process integration, plant layouts, and economic analysis.

Prerequisites:

Process Control, Process Equipment Design, Chemical Process Simulation, Engineering Economics

Textbooks:

1. Douglas, J. M., 1998, Conceptual Design of Chemical Processes, McGraw-Hill.
2. Seider W. D., Seader J. D., Lewin D. R., Sumatri Widagdo, 2008, Product and Product Design Principles. Synthesis, Analysis and Evaluation, Wiley and Sons Inc, 3 edition.
3. Turton, R., R. C. Bailie, W. B. Ehiting and J. A. Shaeiwitz, 1998, Analysis, Synthesis, and Design of Chemical Process, Prentice-Hall
4. Gavin Towler, R K Sinnott, 2012, Chemical Engineering Design: Principles, Practice and Economics of Plant and Process Design, Butterworth-Heinemann, Second Edition.
5. Peter, M. S, and K. D. Timmerhaus, Ronald West, and Max Peters, 2002, Plant Design and Economic for Chemical Engineering, 5 Edition, McGraw-Hill.
6. Biegler L. T, I. E, Grossmann and A. W. Westerberg, 1997, Systematic Methods for Chemical Process Design, Prentice-Hall.
7. Branan, C., 1998, Rule of Thumb for Chemical Engineers : A manual of quick, accurate solutions to everyday process engineering problems, 2nd edition, Gulf Publishing, Co.
8. Wallas, Stanley M. 1990, Chemical Process Equipment : Selection and Design, Buther Worths.
9. Ed Bausbacher, Roger Hunt, 1993, Process Plant Layout and Piping Design, Prentice Hall; 1 edition
10. CHEMCAD Manual, HEATEXET Manual, HYSYS/ UNISIM ManualBerk, Z, Food Process Engineering and Technology, Academic Press, 2009
11. Lydersen BK, Bioprocess Engineering: System, Equipment and Facilities, John & Wiley & Sons, Inc., New York, 1993.
12. Peter, M. S. dan K. D. Timmerhaus, Plant design and Economic for Chemical Engineering, 4th Ed., McGraw Hill.
13. SuperPro Designer Manual. Intelligen, Inc

CAPITA SELECTA
ENCH600030 / ENCH610030
2 CREDITS
Learning Objectives:

Able to make a summary of the material presented by guest lecturers

Syllabus:

Held by inviting competent guest lecturers in the fields according to the needs in each study program (may vary in each semester)

Prerequisites:
passed 90 credits

Textbooks: -

Special Courses

ON THE JOB TRAINING (INTERNSHIP)
ENCH600028 / ENCH610031
2 CREDITS
Learning Objectives:

At the end of the lecture, students have real knowledge and experience in the field of oil and gas, petrochemical, pharmacy, oleochemical, and other chemical industries that involve aspects of technology, processes, operations, and management.

Syllabus: -

Prerequisites:

Already taken at least 110 credits (minimum D) with GPA 2,5

Textbooks: -

RESEARCH METHODOLOGY & SEMINAR
ENCH600029 / ENCH610032
2 CREDITS
Learning Objectives:

Able to determine the right method for research activities as well as express ideas, processes, and results of scientific research verbally and in writing

Syllabus:

Introduction, techniques to identify problems and form hypotheses, logical and critical thinking, scientific writing techniques, research proposal writing techniques, research design techniques, presentation techniques, data collection techniques, analyze and present the results.

Prerequisites:
Already taken at least 90 credits (minimum D) with IPK 2,5

Textbooks:
1. Handout
2. Research proposal format from various institutions

UNDERGRADUATE THESIS
ENCH600033 / ENCH600033
5 CREDITS
Learning Objectives:

Able to analyze and solve chemical technology problems and present them in oral and written forms in the form of scientific papers.

Syllabus:

Following topics taken

Prerequisites:
Research methodology & Seminar

Textbooks:
1. Pedoman Teknis Penulisan Tugas Akhir Mahasiswa Universitas Indonesia.
2. IEEE Citation Reference.
3. Ivan Stojmenovic, "How To Write Research Articles in Computing and Engineering Disciplines," IEEE Transactions on Parallel And Distributed Systems, Vol. 21, No. 2, February 2010.
4. Buku petunjuk praktis pelaksanaan MK. Skripsi, Depok, 1999.

Elective Courses

ELECTIVE COURSES IN ODD SEMESTER

OLEOCHEMICAL INDUSTRY
ENCH800014
3 CREDITS
Learning Objectives:

Able to know the various processes that commonly used in the oleochemical industry, and able to make a plan to develop the produce of oleochemicals from vegetable oils.

Syllabus:

Fatty acids, biodiesel, paints and polymers, detergents, soaps, fatty alcohol, glycerin, oils and fats, oil and greese, the development of oleochemicals, vegetable oil processing, vegetable oil technology in the process.

Prerequisites:

Organic Chemistry

Textbook:

Oleochemical Manufacture and Applications by Frank D. Gunstone, Richard J. Hamilton. Blackwell

FOOD TECHNOLOGY
ENCH800015
3 CREDITS
Learning Objectives:

Able to understand the processes of making food in the food industry, which includes the selection, handling, and processing of raw materials, the operating unit of food production, packaging, storage, and control of the process from the beginning stage to the end.

Syllabus:

Introduction, physical properties of raw materials, the basic concepts of energy and mass transfer, reaction kinetics, process control. Mixing, filtration, centrifugation, extraction and membrane processes, adsorption and ion exchange column, with the temperature settings, drying, preservation, packaging, food storage, and hygiene.

Prerequisites: -

Textbook:
1. Zeki Berk, Food Process Engineering and Technology, Academic Press, Elsevier 2009
2. Food Technology: an introduction by Anita Tull. Oxford University Press, 2002
3. Introduction to Food Engineering by R. Paul Singh, R. Paul Singh, and Dennis R. Heldman.
4. Academic Press
5. Introduction to Food Process Engineering by P. G. Smith. Springer
6. Fundamentals of Food Process Engineering by Romeo T. Toledo. Springer

PROTEIN ENGINEERING
ENCH800016
3 CREDITS
Learning Objectives:

Abble to determine protein engineering strategies for the benefit of separation, biocatalysts and medic.

Syllabus:

Introduction, Protein docking methods, Protein tagging strategies, Gen synthesis design, Enzyme stabilization, Molecular exploration, Protein engineering, Case study.

Prerequisite:
Organic Chemistry

Textbook:
1. Protein Engineering in Industrial Biotechnology, Lilia Alberghina, Harwood academic publishers, 2005
2. Proteins: Biotechnology and Biochemistry by Dr. Gary Walsh. Wiley
3. Protein engineering and design by Sheldon J. Park, Jennifer R. Cochran. CRC Press
4. Protein Engineering and Design by Paul R. Carey. Academic Press
5. Protein Engineering: Principles and Practice. Wiley-Liss

HERBAL TECHNOLOGY
ENCH800017
3 CREDITS
Learning Objectives:

Able to explain the development of herbal technology, herbal separation technology, herbal formulation basis, herbal regulation, and distinguish with other pharmaceutical products

Syllabus:

Definition and basic concepts of herbs, herbal materials, herbal separation technology, herbal formulations, herbal regulation.

Prerequisites:
Organic Chemistry

Textbook:

The Complete Technology Book on Herbal Perfumes & Cosmetics by H. Panda. National Institute of Industrial Research 2003

COMPOSITE MATERIAL

ENCH800018
3 CREDITS
Learning Objectives:

Able to: Explain the characteristics of composite materials and compare it with conventional materials; Explain the manufacturing process, and research development of composite materials.

Syllabus:

The position of composite materials in materials science in general, common characteristics of composite materials, the type of composite based on the composition, the types of polymer matrix and reinforcement, the role of surface treatment in the strength of composite materials, manufacturing processes, durability, the process of splicing and repair of composite materials, code and standards for application of composite materials, the development of composite materials research.

Prerequisites:
Organic Chemistry

Textbook:
1. Fiber-reinforced Composites (Materials Engineering, Manufacturing and Design), P. K. Mallick, Marcel Dekker, Inc., 1993.
2. Handbook of Plastics, Elastomers, and Composites, 3rd ed., Charles A. Harper, McGraw-Hill, 1996.
3. Reinforced Plastics - Theory and Practice, 2nd ed., M. W. Gaylord, Chaners Books, 1974.

APPLIED THERMODYNAMICS

ENCH800019
3 CREDITS
Learning Objectives:

Students are able to analyze problems of thermodynamics based on a thorough review including fundamental aspects of thermodynamics, experimental, and green chemistry, based on current information from scientific journals

Syllabus:

The case study of industrial thermodynamic, example cycle processes, phase equilibrium, and chemical reaction equilibrium to process and product engineer; friendly solvents such as supercritical CO2 and ionic liquid

Prerequisites:
Chemical Engineering Thermodynamics

Textbook:
1. References relevant to a given problem
2. Mulia, K dan Wulan, PPDK, Buku Teks Termodinamika Kimia

DYNAMIC SYSTEM

ENCH800020
3 CREDITS
Learning Objectives:

Able to build dynamic models of process systems, biological, industrial, social and economic.

Syllabus:

Introduction to dynamical systems, causal loops, model and validation, analysis, case study.

Prerequisites:
Numerical Computation

Textbook:
1. Forrester, J. W., 2002, Principles of Systems, Productivity Press
2. Goodman, Michael R., 1998, Study Notes in System Dynamics, Productivity Press
3. Richardson, George P. and Pugh III, Alexander L., 1999, Introduction to System Dynamics Modeling, Pegasus Communications
4. Andersen, David, etc., Introduction to Computer Simulation - A System Dynamics: Systems Thinking and Modeling for a Complex World, McGraw-Hill

THERMODYNAMICS PROPERTIES OF HYDROCARBON

ENCH800021
3 CREDITS
Learning Objectives:

Able to predict the magnitude of thermodynamic properties of hydrocarbons and the phase condition, either manually or using software calculations.

Syllabus:

Introduction to hydrocarbon thermodynamics properties, basic thermodynamic concepts, P-V-T data correlations, physical properties of hydrocarbon fluids, computing aided thermodynamics properties, the vapor-liquid behavior of two-phase systems, water-hydrocarbon system behavior, product specifications in the disposal lease of hydrocarbon

Prerequisites:
Chemical Engineering Thermodynamics

Textbook:
1. Wayne C. Edmister, Byung Ik Lee, Applied hydrocarbon thermodynamics, Volume 1, Gulf Publishing Company (1988), Houston, Texas.
2. John M. Campbell, Gas Conditioning and Processing, Vol. 1, 8th Edition Campbell Petroleum Series 2001.

LUBRICANT TECHNOLOGY

ENCH800022
3 CREDITS
Learning Objectives:

Able to explain the working principles of lubrication, lubricant function, and several parameters of the quality and lubricant classification, lubricant chemical, and its production technology, either mineral lubricant, synthesis and vegetal.

Syllabus:

Principles of lubrication on friction and wear phenomena on the two surfaces of solid objects are moving together; mode lubrication: hydrodynamic and elastohydrodynamic; lubricants: mineral, synthetic, and vegetable; additives, formulations, degradation, contamination, and maintenance of lubricants; latest development of lubricant technology.

Prerequisites:
Organic Chemistry

Textbook:
1. E. Richard Booster, Handbook of Lubricant: Theory and Practice of Tribology, Vol. I, Vol. II, Vol. III, CRC Press (1984), Inc., Boca Raton, Florida
2. Mervin H. Jones, Industrial Tribology: The Practical Aspect of Friction, Lubricant, and Wear, Elsevier Scientific Publishing Co., New York, 1983.
3. J. Halling, Principle of Tribology, Macmillan Press Ltd., London, 1978
4. Handout

CRYOGENIC TECHNOLOGY
ENCH800023
3 CREDITS
Learning Objectives:

Able to explain the various processes to liquefy gas in cryogenic technology

Syllabus:

History and development of cryogenic, cryogenic scope of work. Refrigeration and liquefaction of natural gas, air, oxygen, nitrogen, helium, neon, and argon.

Prerequisites:
Chemical engineering thermodynamics

Textbook:
1. Timmerhaus, K.D., Cryogenic Process Engineering, Plenum Press 1989, New York.
2. Barron, Randall. Cryogenic Systems, McGraw Hill, 1985, New York.

COMBUSTION TECHNOLOGY
ENCH800024
3 CREDITS
Learning Objectives:

Able to explain the phenomenon of combustion and resolve the problems that rendered correctly.

Syllabus:

Chemical kinetics and combustion, the flame, premix flame, diffusion flame, the combustion process applications.

Prerequisite:

Transport Phenomena, Chemical Reaction Engineering 1, Chemical Engineering Thermodynamics

Textbook:
1. Warnatz, J., Maas, U. dan Dibble, R.W., Combustion: Physical and Chemical Fundamentals, Modeling and Simulation, Experiments, Pollutant Formation, 2nd ed., Springer, Heidelberg, 1999.
2. Turns, S.R., An Introduction to Combustion: Concepts and Applications, 2nd ed, McGraw-Hill, 2000.
3. Glassman, I., Combustion, Academic Press, 1997.
4. El-Mahallawy dan el-Din Habik, S., Fundamental and Technology of Combustion, Elsevier, 2002.
5. Combustion, T. J. Poinsot and D. P. Veynante, in Encyclopedia of Computational Mechanicsedited by Erwin Stein, Ren´e de Borst and Thomas J.R. Hughes, 2004 John Wiley & Sons, Ltd.
6. Introduction to Combustion, Concepts and Applications, Stephen R. Turns, 2nd edition, McGraw Hill, 2000
7. Introduction to Combustion Phenomena, A. Murty Kanury, Gordon and Breach Science Publishers, 1975
8. Heat Transfer from Burners, Charles E. Baukal, in Industrial Burners Handbook, edited by Charles E. Baukal, CRC Press, 2004.

PLASMA AND OZONE TECHNOLOGY
ENCH800025
3 CREDITS
Learning Objectives:

Able to explain the physics and chemistry phenomena of plasma formation and release of electromagnetic energy and the use of plasma and ozone technology.

Syllabus:

Basic phenomena and physical-chemical processes of gases that are given an electrical charge (corona discharge), the generation process or formation of ozone, role and use of plasma technology and ozone in chemical engineering processes, the potential of ozone technology in control technology environmental pollution, the ozone generator module manufacturing equipment.

Prerequisite:
Physics Electricity Magnetism

Textbook:
1. E. T. Protasevich: “Cold Non-Equilibrium Plasma”, Cambridge International science Publishing, Cambridge, 1999.
2. Rice, R. G., and M. E. Browning: “Ozone Treatment of Industrial Water water”, Notes Data Corporation, Park Ridyl, 1981.
3. Metcalf & Eddy, Inc. (Tchobano-glous, G., and FL Burton): “Wastewater Engineering: Treatment, Disposal, and Reuse”, McGraw-Hill Book. Co., Singapore, 1991.

HETEROGENEOUS CATALYST
ENCH800026
3 CREDITS
Learning Objectives:

Able to explain the phenomenon of basic concepts heterogeneous catalysts and its application

Syllabus:

The general property of catalyst, thermodynamic of the reaction with catalyst, the distribution of the catalyst based on the type of reaction, the core function is active, the method of selecting catalysts for certain reactions, characterization of the corresponding want to know the nature of the target, the catalyst test methods, methods of development of the catalyst, and reaction products.

Prerequisites:
Chemical Reaction Engineering 1

Textbook:
1. Nasikin M, Susanto BH, “Katlaisis Heterogen”, UI Press, 2010
2. Satterfield, C. N., heterogeneous Catalysis in Industrial Practice, McGraw-Hill Inc., New York, 1991.
3. Rase, F. R., Commercial Catalyst, CRC Press, New York, 1991
4. Richardson, T, J., Principles of Catalyst Development, Plenum Press, New York, 1989
5. Thomas J.M. And WJ Thomas, Principles and Practice of Heterogeneous Catalysis, VCH, Weinhem, Germany, 1997
6. Emmet, R. H., Catalysis, Reinhold Publishing Corpora-tion, New York, 1961

SUSTAINABLE ENERGY
ENCH800027
3 CREDITS
Learning Objectives:

Able to explain the relationship of energy with a social aspect, economic and environmental and sustainability concepts, and able to analyze the performance of techno-economy and the continuity, especially fossil energy system, new, and renewable.

Syllabus:

Concept of sustainability and sustainable energy, energy hierarchy, energy linkages with economic, environmental and social, fossil energy/fuels and Impacts, global climate change and its mitigation, conversion, transportation/distribution and storage, the analysis method of energy sustainability: LCA, sustainability index, hydrogen and fuel cells and nuclear energy, solar energy (PV and thermal), wind and ocean, hydropower, bioenergy, geothermal energy, energy efficiency and conservation, carbon capture, and storage.

Prerequisites:

Chemical Engineering Thermodynamics or Biochemical Engineering

Textbook:
1. Jefferson W. Tester, et al., Sustainable Energy: Choosing Among Options, MIT Press, 2005.
2. Godfrey Boyle, et al., Energy Systems and Sustainability: Power for a Sustainable Future,
3. Oxford University Press, 2003.
4. E. Cassedy S, Prospects for Sustainable Energy: A critical assessment, Cambridge University Press, 2000.
5. DeSimone et al., Eco-Efficiency. The Business Link to Sustainable Development, MIT Press, 1997.
6. D. Elliot, Energy, Society, and Environment, Technology for a sustainable future, Rouledge, 1997
7. Miller, G. T., Environment Science. Sustaining Earth, Wardworld Publish Co. 1993

RISK MANAGEMENT
ENCH800028
3 CREDITS
Learning Objectives:

Able to explain and apply risk management in a risk assessment.

Syllabus:

Introduction to the risk, the basic principles and guidelines concerning risk, risk management standards, risk assessment, risk analysis, risk analysis and simulation, simulation of the risk with Montecarlo method, the risk of using software simulation crystal ball.

Prerequisites: -

Textbook:
J. F. A. Stoner, Management, 1986

ELECTROCHEMICAL TECHNOLOGY
ENCH800029
3 CREDITS
Learning Objectives:

Able to understand the basic principles of electrochemical technology and apply them in the design of electrochemical systems for various applications.

Syllabus:

Basic electrochemical principles and electrochemical cell concepts; electrochemical cell thermodynamics (Nernst equation, Pourbaix diagram, etc.); electrochemical cell kinetics (the mechanism of electrochemical redox reactions, Marcus theory, Butler-Volmer model, etc.); polarization/ overpotential on electrochemical cells (ohm polarization, activation polarization, concentration polarization, etc.); the phenomenon of mass transfer in electrochemical cells (migration, diffusion, convection, etc.); electrochemical analysis (voltammetry, chronoamperometry, AC impedance, etc.); electrode-electrolyte interface phenomena (double layer theory, surface capacitance, ion adsorption, etc.); semiconductor electrodes (photoelectrochemical); and various electrochemical applications (fuel cells, solar cells, batteries, etc.)

Prerequisite:

Physical Chemistry, Thermodynamics of Chemical Engineering, Chemical Reaction Engineering 1

Textbook:
1. Keith B. Oldham dan Jan C. Myland. Fundamentals of Electrochemical Science, Academic Press, Inc., 1st Edition, London, 1994.
2. Richard G. Comption dan Craig E. Banks. Understanding Voltammetry, 3rd Edition, World Scientific, London, 2018
3. Norio Sato. Electrochemistry at Metal and Semiconductor Electrodes, 1st Edition, Elsevier Science & Technology, Oxford, 1998.
4. Marcel Pourbaix. Atlas of Electrochemical Equilibria in Aqueous Solutions, 2nd Edition, NACE International, Brussels, 1974
5. Allen J. Bard, Martin Stratmann, and all authors. Encyclopedia of Electrochemistry, 1st Edition, *John Wiley & Sons*, New York 2007

EXTRACTION & ISOLATION FOR NATURAL PRODUCTS TECHNOLOGY
ENCH800030
3 CREDITS
Learning Objectives:

Able to compare various principles that relate to extraction technology and isolation of natural materials; Determine extraction and / or isolation techniques appropriate for certain natural materials; Developing process skills to solve problems related to the field of extraction technology and natural material isolation

Syllabus:

Natural substances and secondary metabolites, Variety of natural material products, Selection and preparation of materials for extraction, Selection and preparation of materials for isolation, Natural material extraction techniques, Fractionation techniques and isolation of natural materials

Prerequisite: -

Textbook:
1. Rydberg, Cox, & Musikas. Solvent Extraction Principles and Practice 2nd Edition. Marcel Dekker, Inc. 2004.
2. Meireles, M. Angela A. Extracting Bioactive Compounds for Food Products: Theory and Applications. CRC Press – Taylor & Francis Group, LLC. 2009.
3. Rostagno, Mauricio A. & Prado, Juliana M. Natural Product Extraction: Principles and Applications. RSC Publishing. 2013.

SPECIAL TOPIC 1
ENCH800031
3 **CREDITS**

BIOCHEMISTRY
3 **CREDITS**

Learning Objectives:

Able to describe the relationship of structure and chemical compounds in living things, including the functions, synthesis processes and metabolism of these chemical compounds that occur in living things.

Syllabus:

Introduction to cells and tissues; Membranes and organelles; The role of DNA and protein; Energy in cells; Nucleic acid; Structure and replication of DNA and RNA; Transcription and translation; Amino acid; Synthesis and structure of proteins; Enzyme; Metabolism

Prerequisites: -

Textbooks:
1. Lehninger Principles of Biochemistry & eBook by Albert Lehninger, David L. Nelson and Michael M. Cox (Jun 15, 2008)
2. Biochemistry (3rd Edition) by Christopher K. Mathews, Kensal E. van Holde and Kevin G. Ahern (Dec 10, 1999)
3. Bruckner, Monica Z. Basic Cellular Staining.Serc.carleton.edu.
4. Aryulina, D., Manaf, S., Muslim, C., & Winarni, E.W. 2007. BIOLOGI 3. Jakarta : Esis. Binur
5. Robi. 2011. Teknologi RNA Interference. Retrieved from Campbell, Reece. 2009. Biology. Sansome Street, San Francisco: Pearson Benjamin Cummings.

NATURAL GAS PROCESSING
ENCH800033
3 **CREDITS**

Learning Objectives:

Able to design natural gas refineries for piped gas, pressurized natural gas, or LNG if given a fluid composition that reaches the surface of the reservoir.

Syllabus:

Introduction and terms in Natural Gas Processing; Physical Properties of Hydrocarbon Fluid; Hydrocarbon Water System; Hydrate; Dew Point Control Unit; AGRU; Absorption Dehydration Unit; Adsorption Dehydration Regeneration Unit; Heavy Hydrocarbon Recovery Unit; LNG Processing

Prerequisites: Chemical Process Simulation

Textbooks:
1. Gas Conditioning and Processing Vol. 1
2. Gas Conditioning and Processing Vol. 2

ELECTIVE COURSES IN EVEN SEMESTER

PACKAGING AND STORAGE TECHNOLOGY
ENCH800034
3 CREDITS
Learning Objective :

Students are able to describe characteristics, packaging and storage food technology, the relation between storage and packaging with quality of food, describe factors affecting deviation of food qualities as well as able to choose storage methods and packaging types which is appropriate to food materials.

Syllabus:

hydratase, material storage technology and food products, deviation of food material qualities, microbial contaminant, purpose and function of food packaging, interaction between food packaging and packaging material types

Prerequisite : -

Textbook :
1. Examining Food Technology by Anne Barnett. Heinemann Secondary,1996
2. Julianti, Sri. The Art of Packaging. Gramedia Pustaka Utama. 2014.
3. Han, Jung H., et al. Innovations in Food Packaging. Elsevier. 2005.

BIOINFORMATICS
ENCH800035
3 CREDITS
Learning Objective :

Are able to explore database and programs to be applied in genetic engineering sectors, proteomic etc

Syllabus :

Database, genomics, genetic molecular, phylogeny, protein structure, metabolism and tissues

Textbook:
1. Bioinformatics by Shalini Suri. APH Publishing, 2006
2. Bioinformatics: A Primer by Charles Staben and Staben. Jones & Bartlett Publishers, 2005

DRUGS AND COSMETICS TECHNOLOGY
ENCH800036
3 CREDITS
Syllabus:

Definition of drugs and cosmetics, types of skins and characteristics, cosmetic types, ethics and regulation of drugs and cosmetics, new drug development technology, process technology in drug and cosmetics industries, packaging technology of drugs and cosmetics technology.

Prerequisite:
Organic Chemistry

Textbook:
1. Handbook of Cosmetic Science and Technology by Andre O. Barel, Marc Paye, Howard I. Maibach. INFRMA-HC 2009
2. Biodesign: The Process of Innovating Medical Technologies by Stefanos Zenios, Josh Makower , Paul Yock , Todd J. Brinton, Uday N. Kumar, Lyn Denend, Thomas M. Krummel.

PETROLEUM PROCESSING
ENCH800037
3 CREDITS
Learning Objectives:

Able to explain petroleum characteristics and its refined product and the stages of the process from various petroleum processing technologies.

Syllabus:

Introduction terminology, oil composition, thermal properties of petroleum, chemical processing of petroleum processing, distillation, hydrogenation and dehydrogenation, cracking processes, the processes of reforming, gas processing and petroleum light products, product improvement.

Prerequisites:

Fluid and Particle Mechanics, Thermodynamics, Mass Transfer.

Textbook:
1. James G. Speight, The Chemistry and Technology of Petroleum, 5th Edition. CRC Press, 2014.
2. Mark J. Kaiser, Arno de Klerk, James H. Gary and Glenn E. Handwerk, Petroleum Refining: Technology, Economics, and Markets, 6th Edition. CRC Press, 2019.
3. D. S. J. Jones, Elements of Petroleum Processing, John & Sons Wiley

PETROCHEMICAL PROCESSING
ENCH800038
3 CREDITS
Learning Objectives:

Able to explain the development of petrochemical products and raw material potential, upstream / downstream petrochemical production lines (olefin center, aromatic center, and the pathways of methane) and the major production processes of several petrochemical industries through methane, olefins and aromatics; able to analyze the impact of industrial processes and petrochemical products to the environment.

Syllabus:

History of the general petrochemical products development and raw material potential, the scope of the petrochemical industry, petrochemical classification process, the type and processing raw materials into petrochemical products, the details of various petrochemical industry: olefins center, aromatics and the center line of methane, industrial and environmental impact of products petrochemicals.

Prerequisites:
Organic Chemistry

Textbook:
1. Martyn V. Twigg, "Catalyst Handbook", 2nd Ed., Wolfe Pub. Ltd.
2. Lewis T. Hatch, Sami Matar, "From Hydrocarbon to Petrochemical".
3. Wells, Margaret G., "Handbook of Petrochemicals and Processes", Gower Publishing Company Ltd., 1991.
4. Pandjaitan Maraudin, Industri Petrokimia dan Pengaruh Lingkungan, Gadjah Mada University Press, 2002.

PHOTOCATALYSIS TECHNOLOGY
ENCH800039
3 CREDITS
Learning Objectives:

Able to understand the basic concepts and photocatalysis and apply them in the various simple daily problem, especially related to environment, health, and energy.

Syllabus:

The basic concept photocatalysis processes, thermodynamics and kinetics of photocatlytic process, semiconductor photocatalyst materials, the basic parameters of photocatlytic process, Photocatalyst Nanomaterial Engineering, photocatlytic applications for degradation of organic pollutants and heavy metals, photocatalysis applications for self-cleaning and anti fogging, photocatalysis applications for anti-bacterial and cancer therapy, photocatalysis applications for engineering 'daily life tools', photocatalysis applications in renewable energy sector, solar detoxification engineering with photocatalysis, intensification of photocatalysis process.

Prerequisites:
Chemical Reaction Engineering 1

Textbook:
1. M. Schiavello, Heterogeneous Photocatalysis, John Wiley & Sons, 1997.
2. A. Fujishima, K. Hashimoto, and T. Watanabe, TiO2 Photocatalysis: Fundamentals and Applications, BKC Inc. Japan, 1999.
3. J.B. Galvez, et.al., Solar Detoxification, Natural Sciences, Basic and Engineering Sciences, UNESCO.
4. M. Kaneko, I. Okura, Photacatalysis Science and Technology, Springer USA, 2002.
5. C.A. Grimes, G.K. Mor, TiO2 Nanotube Arrays: Synthesis, Properties, and Applications, Springer, New York, 2009.
6. Paper-paper dan bahan lain dari berbagai Jurnal Ilmiah dan website.

EXPLORATION AND PRODUCTION OF HYDROCARBON
ENCH800040
3 CREDITS
Learning Objectives:

Students are able to explain the economic concept of natural gas and analyze the 4e economy.

Syllabus:

Introduction of hydrocarbon, life cycle of field development, hydrocarbon form and hydrocarbon property and reservoir, hydrocarbon exploration: geology, geophysics, and drilling, field appraisal, reservoir development, drilling development, hydrocarbon production, HSE, hydrocarbon economy and lease, coal and hydrocarbon unconventional (CBM, Shale gas, and Hydrate Gas)

Prerequisites:-

Textbook:
1. Frank Jahn et all, 2008, Hydrocarbon Exploration and Production, Developments in Petroleum Science, second edition
2. Babusiauz et al., 2004, Oil and Gas Exploration and Production. Reserves, Cost and Contracts, IFP-Technip,
3. M. Kelkar, 2008, Natural Gas Production Engineering, PennWell Publications
4. Norman J. Hyne, 2001, Nontechnical Guide to Petroleum Geology, Exploration, Drilling and Production, Pennwell Books, 2 edition.

WASTE MANAGEMENT AND PREVENTION
ENCH800041
3 CREDITS
Learning Objectives:

Able to explain the concepts of pollution prevention and able to design the waste treatment system.

Syllabus:

Introduction to the concept of pollution prevention, wastewater treatment outline and preparation, wastewater treatment in physical, biological, and chemical as well as the operating unit, bioremediation, bioseparation and biodegradation, advanced oxidation processes, the handling of waste gas, waste handling B3, solid waste handling, effluent treatment, gas, is unconventional.

Prerequisites: Chemical Reaction Engineering 1.

Textbook:
1. Freeman, H. M., Industrial Pollution Prevention Handbook, McGraw-Hill, New York, 1995.
2. Eckenfelder, W. W., Jr.., Industrial Water Pollution Control. 3rd ed. McGraw-Hill International Editions, New York, 2000.
3. Metcalf & Eddy. (Revised by Tchobanoglous, G. & F. L. Burton). Waste Water Engineering: Treatment, Disposal, Reuse, 3rd ed., McGraw-Hill, Singapore, 1991.
4. Heinson R. J. & R. L. Cable. Source and Control of Air Pollution. Prentice Hall. New Jersey. Of 1999.
5. Legislation on the prevention of pollution and waste management.
6. Journals, the Internet.

MICROALGAE CULTIVATION AND DEVELOPMENT TECHNOLOGY

ENCH800042
3 CREDITS
Learning Objectives:

Able to have insight into the use of microalgae from the cultivation process to its conversion into products of high economic value; able to develop the utilization of microalgae by using a variety of technologies that are currently developing.

Syllabus:

Introduction to microalgae, microalgae cultivation process, microalgae harvesting techniques, the process of extracting microalgae into algal oil and its residues, economic analysis of the development and utilization of microalgae.

Prerequisites:

Textbook:
1. Richmond, Amos, et al. 2013. Handbook of Microalgal Culture: Applied Phycology and Biotechnology, 2nd Ed. John Wiley and Sons
2. E.W. Becker. 1994. Microalgae: Biotechnology and Microbiology. London, Cambridge University Press.

UTILITIES AND PLANT MAINTENANCE

ENCH800043
3 CREDITS
Learning Objectives:

Able to explain the strategy of plant and utility maintenance.

Syllabus:

Plant maintenance strategy: maintenance program, maintainability, reliability, planning and scheduling

Prerequisite:
Chemical Engineering Thermodynamics

Textbook:
1. Dhillon, B.S., Engineering Maintenance: A Modern Approach, CRC Press, 2002.
2. Higgins, L.R., Mobley, R.K. dan Smith, R., Maintenance Engineering Handbook, McGraw-Hill, 2002.
3. Sanders, R.E., Chemical Process Safety, Elsevier, 2005.
4. Palmer, D., Maintenance Planning and Scheduling Handbook, McGraw-Hill, 1999.

TRANSPORTATION AND UTILIZATION OF NATURAL GAS

ENCH800042
3 CREDITS
Learning Objectives:

Able to analyze several options for the use of natural gas for both energy and feedstocks

Syllabus:

Overview of natural gas: nature and quality, historical milestones, environmental aspects, international issues, and structure of the natural gas industry; transportation and storage of natural gas in the gas phase and liquid phase; natural gas utilization: gas as fuels, gas to synfuels and chemicals, gas to wires/power

Prerequisite: -

Textbook: -

MIXING TECHNOLOGY

ENCH800045
3 CREDITS
Learning Objectives:

Able to understand the basic principles of mixing technology and apply them in the design of mixing systems for various applications in industry.

Syllabus:

Definition of mixing, basic principles and basic concepts of mixing; mixing and mixing mechanism, mixing thermodynamics, mixing fluid flow, friction in mixing, etc.), types of mixing (gas-liquid, liquid-liquid, liquid-solid, suspension, emulsification), mixing techniques (agitation, blending, mixing, particle size reduction, sear etc.), mixing equipment both batch and continuous (mixer type, drainage type, etc.), mixing monitoring and control. Examples of the application of blending in the chemical, pharmaceutical, cosmetic and food industries.

Prerequisites:
Physical Chemistry, Fluid Mechanics and Materials Science

Textbooks:
1. Handbook of Industrial Mixing: Science and Practice edited by Edward L. Paul, Victor A. Atiemo-Obeng, Suzanne M. Kresta, John Wiley and Sons Inc. Publication (2003).
2. Food Mixing: Principles and Applications, edited by P. J. Cullen, Ireland, John Wiley and Sons Inc. Publication (2007).
3. Pharmaceutical Blending and Mixing 1st Edition by P. J. Cullen (Editor), Rodolfo J. Romañach (Editor), Nicolas Abatzoglou (Editor), Chris D. Rielly, John Wiley and Sons Inc. Publication (2015)..

PROBLEM SOLVING SKILLS

ENCH800046
3 CREDITS
Learning Objectives:

Able to develop an understanding of the Problem Based Learning (PBL) learning method in order to be able to direct their own learning (independent learning), communicate effectively and work in groups; able to develop the ability to think critically, creatively, innovatively and have the intellectual ability to solve problems effectively both individually and in groups

Syllabus:

Introduction to PBL, individual problem-solving concepts, problem-solving concepts in groups

Precondition: -

Textbooks:
1. Woods, D. R., 1994, Problem based learning: How to gain the most from PBL, McMaster University, Hamilton, ON L8S 4L8.
2. Journal or articles related to each PBL problem.

POLYMER TECHNOLOGY

ENCH800047
3 CREDITS
Learning Objectives:

Able to develop an understanding of the basic principles of polymer synthesis and characterization, so that they can understand, solve polymer problems found in daily life and in industry, and can keep abreast of developments in the latest polymer technology.

Syllabus:

The concept of polymers, Synthesis and kinetics of polymerization, Polymer solutions, Characterization, Plastic manufacturing processes.

Prerequisite:
Organic Chemistry

Textbooks:
1. Billmeyer, F.W, 2011, Textbook of Polymer Science,3rd edition, John Wiley & Sons Inc.
2. Young, R.J. and Lovell, P.A, 2011, Introduction to Polymers, R.J.Lovell, 3rd edition, CRC Press. Taylor & Francis Group, Boca Raton, FL 33487-2742.
3. Seymour, R.B, 1989, Polymers for Engineering Applications, ASM International.
4. Crawford, R.J, 1998, Plastic Engineering, 3rd edition, Butterworth-Heinemann, Woburn, MA 01901-2041.
5. Woods, D. R., 1994, Problem based learning: How to gain the most from PBL, McMaster University, Hamilton, ON L8S 4L8.
6. Journal or articles related to each PBL problem.

GENETICALLY MODIFIED ORGANISM
ENCH800048
3 CREDITS
Learning Objectives:

Students are able to plan the design of transgenic organisms for purposes in the fields of food, pharmacy and health, energy, or the environment as one of the supporting knowledge in Bioprocess Technology courses

Syllabus:

Gene expression and function, genome, introduction and development of GMO organisms, genome modification techniques, methods of analyzing GMO organisms, GMO organisms in food, GMO organisms in pharmacy and health, GMO organisms in energy, GMO organisms in the field the environment, and the latest research and applications related to GMO organisms.

Prerequisite:
Genetic Engineering

Textbooks:
1. Harvey Lodish, Arnold Berk, Chris A. Kaiser and Monty Krieger. W. H. Molecular Cell Biology. 6th edition. FreemanS
2. T. A. Brown. 2010. Gene Cloning and DNA Analysis. 6th edition. Willey Blackwell: Hongkong.
3. Jurnal ilmiah terbaru terindeks scopus

DRUG CONTROLLED RELEASED TECHNOLOGY
ENCH800049
3 CREDITS
Learning Objective:

Able to describe the principle of control drug release or bioactive compound for medical purposes and utilize the principle to apply control drug released technology

Syllabus:

Polymeric biomaterial that is easily degradable, various methods to drug encapsulation and bioactive compounds in nano/microsphere, diffusion and permeation, the strategy of control released, case study

Prerequisite:
Organic Chemistry

Textbook:
1. Juergen Siepmann et al. (ed.) Fundamentals and Applications of Controlled Release Drug Delivery, Springer
2. Clive Wilson and Patrick Crowley (ed.) Controlled Release in Oral Drug Delivery, Springer
3. Hong Wen and kinam Park (ed.) Oral Controlled Release Formulation Design and Drug Delivery, Wiley, 2010.
4. WM Saltzman, Drug Delivery: Engineering Principles for Drug Therapy, Oxford University Press, 2001.
5. Nissim Garti, Delivery and *controlled release of bioactives in foods and nutraceuticals*, CRC Press, 2008.

SPECIAL TOPIC 2
ENCH800050
3 CREDITS

BIOMASS TERMOCHEMICAL CONVERSION TECHNOLOGY
ENCH800051
3 CREDITS
Learning Objectives:

Able to understand the chemical characteristics of biomass and the basic principles of thermo-chemical biomass conversion technology and its application in the design of biomass thermochemical conversion systems to produce fuels and chemicals.

Syllabus:

Chemical characteristics of biomass, biomass classification, thermo-chemical conversion through pyrolysis (fast pyrolysis, slow pyrolysis, co-pyrolysis, hydrodeoxygenation, catalytic pyrolysis, catalytic co-pyrolysis, pyrolysis reactor), thermo-chemical conversion through biomass gasification, thermo-chemical conversion through biomass ligation , physical and chemical analysis of biomass feed and biomass thermo-chemical conversion products, pyrolysis for the manufacture of biofuels and chemicals, biomass gasification for the manufacture of synthetic gases, liquefaction of biomass for the manufacture of biofuels.

Prerequisites:

Organic Chemistry, Heat Transfer, Chemical Reaction Techniques 1

Textbooks:
1. Robert C. Brown, Thermochemical processing of biomass: conversion into fuels, chemicals and power, 2nd edition, Wiley Series in Renewable Resources, 2019
2. Mark Crocker, Laurie Peter, Ferdi Schuth, Tim Z. Zhao, Heinz Frei, Thermochemical conversion of biomass to liquid fuels and chemicals, RSC Publishing, 1st edition, 2010
3. James Clark and Fabien Deswarte, Introduction to chemicals from biomass, 2nd edition, John Wiley and Sons, 2015
4. Piet Schenkelaars, Value-added chemicals from biomass, Pira International Ltd, 2012

BASIC COMPUTER PROGRAMMING
ENCH800052
3 CREDITS

Learning Objectives:

Able to formulate and solve cases using logical concepts and programming algorithms and able to construct simple programs consisting of consecutive instructions in Python and MATLAB.

Syllabus:

Introduction: Why should one learn to write programs; Variables, expressions, and statements; Conditional executions; Functions; Iteration; Strings; Files; Lists; Dictionaries; Tuples; Using Python for numerical integration with the Simpson's rule, to solve root finding problem employing the secant method, to solve ordinary differential equation; Introduction to MATLAB/GNU Octave; Numerical methods with MATLAB/GNU Octave; Application of MATLAB/GNU Octave in transport phenomena and chemical reaction engineering.

Prerequisite:

Textbooks:
1. Charles R. Severance: Python for Everybody, accessible via https://www.py4e.com
2. John. M. Zelle: Python Programming: An Introduction to Computer Science, 3rd edition, 2016.
3. Yeong Koo Yeo: Chemical Engineering Computation with MATLAB, CRC Press, 2017.

Undergraduate Program in Bioprocess Engineering

Program Specification

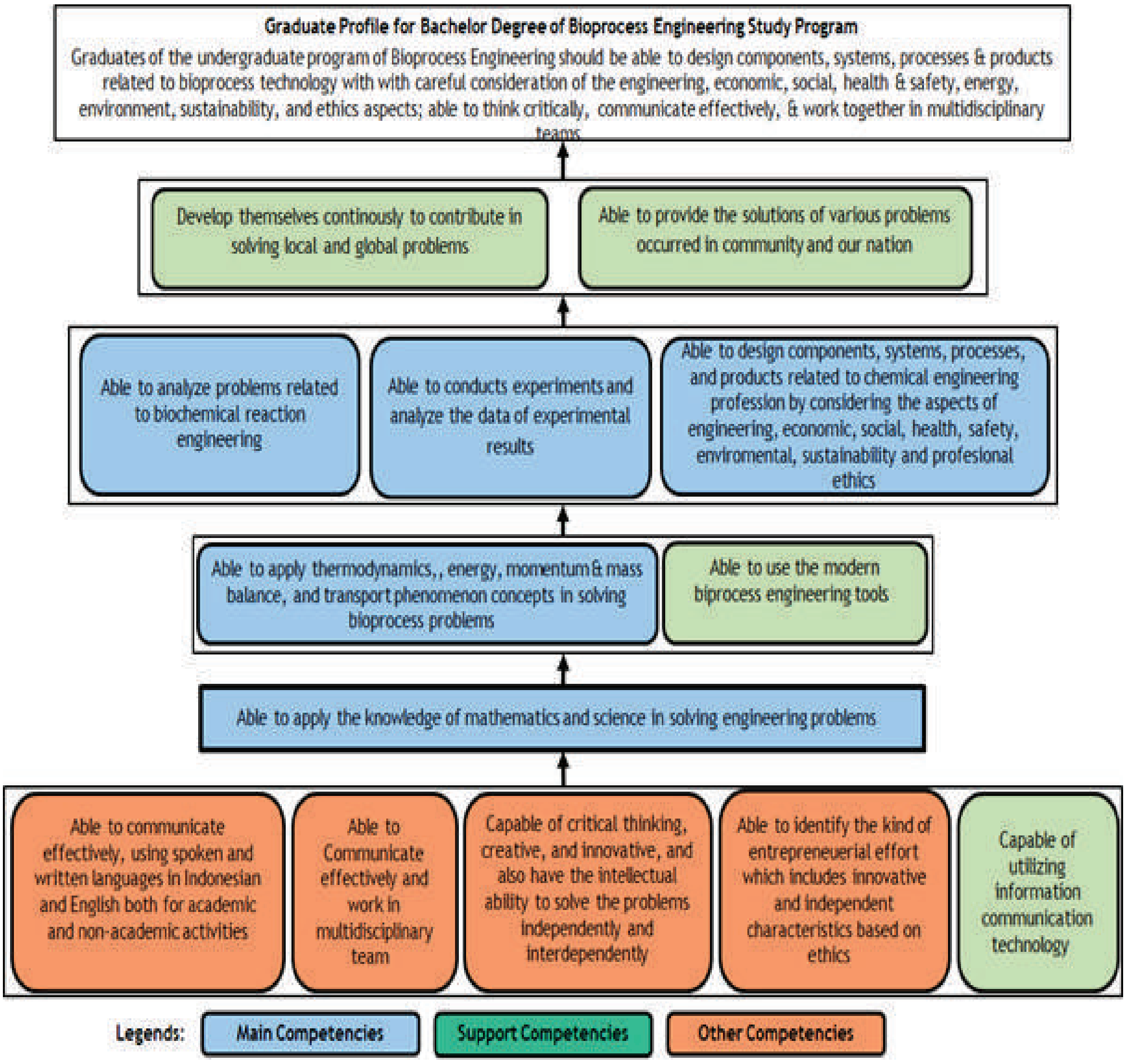
1.	**Awarding Institution**	Universitas Indonesia	
2.	**Host Institution**	Universitas Indonesia	
3.	**Faculty**	Engineering	
4.	**Program Tittle**	Undergraduate Program in Bioprocess Engineering	
5.	**Vision and Mission**	**Vision** Becoming a superior and competitive Bioprocess Engineering Study Program, through efforts to educate the nation's life to improve people's welfare, thus contributing to the development of Indonesian and world society **Missions** • Providing broad and fair access, as well as quality education and teaching in Bioprocess Engineering; • Organizing quality Tridharma activities that are relevant to national and global challenges; • Creating graduates of Bioprocess Engineering who are of high quality, noble character, and able to compete globally; • Creating an academic climate that can support the realization of the vision of the Department	
6.	**Class**	Regular	
7.	**Final Award**	Sarjana Teknik (S.T.)	
8.	**Accreditation / Recognition**	Accredited: BAN-PT (Excellent) and IABEE Assessment: AUN QA	
9.	**Language(s) of Instruction**	Bahasa Indonesia	
10.	**Study Scheme (Full Time / Part Time)**	Full Time	
11.	**Entry Requirements**	High Shool / Equivalent	
12.	**Study Duration**	8 (eight) Semesters or 4 (Four) years	
	Type of Semester	Number of Semester	Number of weeks / semester
	Regular	8	16
	Short (optional)	3	8
13.	**Aims of the program is to provide the highest quality education so that graduates have:** 1. Able to apply their knowledge in working in the field of bioprocess technology 2. Able to develop themselves as industrial planners and managers 3. Able to contribute to science and technology		
14.	**Graduate Profile:** Graduates of The Undergraduate Program of PSTB-FTUI should be able to contribute to the field of bioprocess engineering by applying bioprocess engineering principles with careful consideration of the engineering, economic, social, health and safety, energy, environment, sustainability, and ethical aspects; able to think critically, communicate effectively, and work in together in a multidisciplinary team.		

15.	**Expected Learning Outcomes:** 1. Able to communicate effectively, using spoken and written languages in Indonesian and English both for academic and non-academic activities 2. Able to work in a multidisciplinary team. 3. Capable of critical, creative, and innovative thinking, and also have the intellectual ability to solve problems independently and interdependently. 4. Capable of utilizing communication information technology 5. Able to apply knowledge of mathematics and science in solving engineering problems. 6. Able to apply mass and energy balances, thermodynamics, transport phenomena, and chemical reaction engineering concepts in solving chemical engineering problems. 7. Able to analyze problems related to biochemical reaction engineering 8. Able to use modern bioprocess engineering tools. 9. Able to conducts experiments and analyze the data obtained. 10. Able to design components, systems, processes, and products related to the bioprocess engineering profession with careful consideration of the engineering, economic, social, health and safety, energy, environment, sustainability, and ethical aspects. 11. Able to provide solutions to various problems that occurred wherever they live and work. 12. Able to identify the kind of entrepreneurial approach needed based on innovation, self-reliance, and ethics. 13. Continuously develop oneself to contribute in solving local and global problems.		
16.	**Course Composition**		
No.	**Type of Courses**	**Credits**	**Percentage**
I	University General Subjects	9	6,25%
II	Basic Engineering Subjects	25	17,36%
III	Core Subjects	75	52,08%
IV	Elective Subjects	26	18,06%
V	Special Subject (Internship, Seminar, Undergraduate Thesis or Skripsi)	9	6,25%
	Total	144	100 %
	Total Credits for Graduation		**144**

Employment Prospects

A graduate of Bioprocess Engineering Study Program at UI can be contributed in the following areas: food, pharmaceuticals, cosmetics and biotechnology industries, engineering contractor companies (engineering, procurement, construction, and trial operation), renewable energy, and environmental treatment industry, government officer, researcher, education, etc.

The Network of Expected Learning Outcome (ELO)



Mapping Table for Achieving ELO in the Bioprocess Engineering Undergraduate Program

Expected Learning Outcome (ELO)	Name of Courses							
	1st Semester	2nd Semester	3rd Semester	4th Semester	5th Semester	6th Semester	7th Semester	8th Semester
Able to communicate effectively, using spoken and written languages in Indonesian and English both for academic and non-academic activities	Communication Skills	Integrated Character Building	Instrumental Analytic Chemistry	Heat Transfer		Bio Product Design	Plant Design	
	English		Physical Chemistry	Thermodynamic in Biological System				
	Religion							
Able to work in a multidisciplinary team	Communication Skills	Integrated Character Building				Bio Product Design	Plant Design	
	Religion							
Capable of critical, creative, and innovative thinking, and also have the intellectual ability to solve problems independently and interdependently			Instrumental Analytic Chemistry	Heat Transfer				
			Physical Chemistry	Thermodynamic in Biological System				
Capable of utilizing communication information technology			Numerical Computation	Bioprocess Engineering Modelling	Bioprocess System Simulation			
				Genetic Engineering				
Able to apply knowledge of mathematics and science in solving engineering problems	Basic Chemistry	Linear Algebra	Biochemistry	Cell Culture	Engineering Economics			
	Physics (Electricity, MWO)	Statistics & Probability		Genetic Engineering				
	Calculus	Physics (Mechanics and Thermal)	Numerical Computation	Bioprocess Engineering Modelling				

Expected Learning Outcome (ELO)	Name of Courses							
	1st Semester	2nd Semester	3rd Semester	4th Semester	5th Semester	6th Semester	7th Semester	8th Semester
		Organic Chemistry Basic & Organic Chemistry Lab	Instrumental Analytical Chemistry Physical Chemistry Physic Chemistry & Analytics Lab					
Able to apply mass, energy balances, thermodynamics, transport phenomena, and chemical reaction engineering concepts in solving bioprocess engineering problems	Introduction to bioprocess engineering		Transport Phenomena in Biological Systems Mass and Energy Balance	Fluid and Particle Mechanics Heat Transfer Thermodynamic in Biological System	Biochemical Reaction Engineering Separation	Bioreactor Engineering Process Control		
Able to analyze problems related to biochemical reaction engineering				Cell Culture Genetic Engineering	Biochemical Reaction Engineering	Bioreactor Engineering		
Able to use modern bioprocess engineering tools			Numerical Computation	Genetic Engineering	Bioprocess System Simulation	Bioprocess Equipment Design Bio Product Design	Plant Design	
Able to conducts experiments and analyze the data obtained	Physics (Electricity, MWO) Lab	Basic & Organic Chemistry Lab Physics (Mechanics and Thermal) Lab	Physic Chemistry & Analytics Lab	Biochemistry Laboratory	Bioprocess Unit Operation Lab I	Bioprocess Unit Operation Lab II	Research Methodology & Seminar	Undergraduate Thesis
Able to design components, systems, processes, and products related to the bioprocess engineering profession					Bioprocess System Simulation	Bioprocess Equipment Design	Industrial Project Management	Undergraduate Thesis

Expected Learning Outcome (ELO)	Name of Courses							
	1st Semester	2nd Semester	3rd Semester	4th Semester	5th Semester	6th Semester	7th Semester	8th Semester
with careful consideration of the engineering, economic, social, health and safety, energy, environment, sustainability, and ethical aspects					HSE Protection	Bio Product Design	Plant Design	
					Engineering Economics	Process Control	Research Methodology & Seminar	
Able to provide solutions to various problems that occurred wherever they live and work					HSE Protection	Bio Product Design	Plant Design	Undergraduate Thesis
Able to identify the kind of entrepreneurial approach needed based on innovation, self-reliance, and ethics.						Bio Product Design	Plant Design	Undergraduate Thesis
								Capita Selecta
Continuously develop oneself to								Undergraduate

List of Course

Code	Name of Course	Credit
	University Courses (9 Credits)	
UIGE600006	MPK Terintegrasi / Integrated Character Building	5
UIGE600003	MPK Bahasa Inggris / English	2
UIGE600004	MPK Agama / Religion	2
	Faculty Courses (25 Credits)	
ENGE600003	Kalkulus / Calculus	4
ENGE600004	Aljabar Linear / Linear Algebra	4
ENGE600005	Fisika Mekanik dan Panas / Physics (Mechanics and Thermal)	3
ENGE600006	Praktikum Fisika Mekanik dan Panas / Physics (Mechanics and Thermal) Lab	1
ENGE600007	Fisika Listrik, Magnet, Gelombang dan Optik / Physics [Electricity, Magnetic, Wave, Ophtics (MWO)]	3
ENGE600008	Praktikum Fisika Listrik, Magnet, Gelombang dan Optik / Physics (Electricity, MWO) Lab	1
ENGE600009	Kimia Dasar / Basic Chemistry	2
ENGE600010	Statistik dan Probablitas / Statistic and Probability	2
ENGE600011	Ekonomi Teknik / Engineering Economics	3
ENGE600012	Kesehatan, Keselamatan Kerja & Lindung Lingkungan / HSE Protection	2
	Special Courses (9 Credits)	
ENBE600029	Kerja Praktek / On The job Training (Internship)	2
ENBE600030	Metodologi Penelitian dan Seminar / Research Methodology & Seminar	2
ENBE600032	Skripsi / Undergraduate Thesis	5
	Biprocess Engineering Courses (75 Credits)	
ENBE600001	Pengantar Teknik bioproses / Introduction to bioprocess engineering	2
ENBE600002	Kecakapan Komunikasi / Communication Skills	3
ENBE600003	Praktikum Kimia Dasar dan Kimia Organik / Basic & Organic Chemistry Lab	1
ENBE600004	Kimia Organik / Organic Chemistry	2
ENBE600005	Komputasi Numerik / Numerical Computation	3
ENBE600006	Kimia Nalaitik Intrumental / Instrumental Analytical Chemistry	3
ENBE600007	Kimia Fisika / Physical Chemistry	3
ENBE600008	Praktikum Kimia Fisika dan Kimia Analitik / Physic Chemistry & Analytics Lab	1
ENBE600009	Neraca Massa dan Energi / Mass and Energy Balance	3
ENBE600010	Biokimia / Biochemistry	3
ENBE600011	Peristiwa Perpindahan dalam Sistem Hayati / Transport Phenomena in Biologycal System	3
ENBE600012	Mekanika Fluida dan Partikel / Fluid and Particle Mechanics	3
ENBE600013	Kultur Sel / Cell Culture	3
ENBE600014	Perpindahan Kalor / Heat Transfer	3
ENBE600015	Praktikum Biokimia / Biochemistry Laboratory	2
ENBE600016	Rekayasa Genetik / Genetic Engineering	3
ENBE600017	Termodinamik Sistem Hayati / Thermodynamic in Biologycal System	3
ENBE600018	Teknik Reaksi Biokimia / Biochemical Reaction Engineering	3
ENBE600019	Separasi / Separation	3
ENBE600020	Praktikum Unit Operasi Bioproses I / Bioprocess Unit Operation Lab I	1
ENBE600021	Simulasi Sistem Bioproses / Bioprocess System Simulation	3
ENBE600022	Praktikum Unit Operasi Bioproses I / Bioprocess Unit Operation Lab II	1
ENBE600023	Rekayasa Bioreaktor / Bioreactor Engineering	3
ENBE600024	Perancangan Alat Bioproses / Bioprocess Equipment Design	3

ENBE600025	Perancangan Produk Hayati / Bio Product Design	4
ENBE600026	Pengendalian Bioproses / Bioprocess Control	3
ENBE600027	manajemen Proyek industry / Industrial Project Management	2
ENBE600028	perancangan Pabrik / Plant Design	4
ENBE600031	kapita Selekta / Capita Selecta	2
Elective Courses (26 Credits)		
	Mata Kuliah Pilihan 1 / Elective 1	3
	Mata Kuliah Pilihan 2 / Elective 2	3
	Mata Kuliah Pilihan 3 / Elective 3	3
	Mata Kuliah Pilihan 4 / Elective 4	3
	Mata Kuliah Pilihan 5 / Elective 5	3
	Mata Kuliah Pilihan 6 / Elective 6	3
	Mata Kuliah Pilihan 7 / Elective 7	3
	Mata Kuliah Pilihan 8 / Elective 8	3
	Mata Kuliah Pilihan 9 / Elective 9	2

Curriculum Structure Undergraduate Bioprocess Engineering

Code	Subject	SKS
	1st Semester	
UIGE600003	English	2
UIGE600004	Religion	2
ENGE600003	Calculus	4
ENGE600007	Physics (Electricity, MWO)	3
ENGE600008	Physics (Electricity, MWO) Lab	1
ENGE600009	Basic Chemistry	2
ENBE600001	Introduction to bioprocess engineering	2
ENBE600002	Communication Skills	2
	Sub Total	**18**
Calculus	2nd Semester	
UIGE600006	Integrated Character Building	5
ENGE600004	Linear Algebra	4
ENGE600005	Physics (Mechanics and Thermal)	3
ENGE600006	Physics (Mechanics and Thermal) Lab	1
ENGE600010	Statistic and Probability	2
ENBE600003	Basic & Organic Chemistry Lab	1
ENBE600004	Organic Chemistry	3
	Sub Total	**19**
	3rd Semester	
ENBE600005	Numerical Computation	3
ENBE600006	Instrumental Analytical Chemistry	3
ENBE600007	Physical Chemistry	3
ENBE600008	Physic Chemistry & Analytics Lab	1
ENBE600009	Mass and Energy Balance	3
ENBE600010	Biochemistry	3
ENBE600011	Transport Phenomena in Biologycal System	3
	Sub Total	**19**
	4th Semester	
ENBE600012	Fluid and Particle Mechanics	3
ENBE600013	Cell Culture	3
ENBE600014	Heat Transfer	3
ENBE600015	Biochemistry Laboratory	1
ENBE600016	Genetic Engineering	3
ENBE600017	Thermodynamic in Biologycal System	3
	Elective 1	3
	Elective 2	2
	Sub Total	**21**
	5th Semester	
ENGE600011	Engineering Economics	3
ENGE600012	HSE Protection	2
ENBE600018	Biochemical Reaction Engineering	3
ENBE600019	Separation	3
ENBE600020	Bioprocess Unit Operation Lab I	1
ENBE600021	Bioprocess System Simulation	3
	Elective 3	3
	Elective 4	3
	Sub Total	**21**
	6th Semester	
ENBE600022	Bioprocess Unit Operation Lab II	1
ENBE600023	Bioreactor Engineering	3
ENBE600024	Bioprocess Equipment Design	3
ENBE600025	Bio Product Design	4
ENBE600026	Process Control	3
	Elective 5	3
	Elective 6	3
	Sub Total	**20**
	7th Semester	
ENBE600027	Industrial Project Management	2
ENBE600028	Plant Design	4
ENBE600029	On The job Training (Internship)	2
ENBE600030	Research Methodology & Seminar	2
	Elective 7	3
	Elective 8	3
	Elective 9	3
	Sub Total	**19**
	8th Semester	
ENBE600031	Capita Selecta	2
ENBE600032	Undergraduate Thesis	5
	Sub Total	**7**
	Total	**144**

Elective Courses

Code	Odd Semester	SKS
ENCH800014	Oleochemical Industry	3
ENCH800015	Food Technology	3
ENCH800016	Protein Engineering	3
ENCH800017	Herbal Technology	3
ENCH800018	Composite Material	3
ENCH800019	Applied Thermodynamics	3
ENCH800020	Dynamic System	3
ENCH800021	Thermodynamic Properties of Hydrocarbon	3
ENCH800022	Lubricant Technology	3
ENCH800023	Cryogenic Technology	3
ENCH800024	Combustion Technology	3
ENCH800025	Plasma and Ozone Technology	3
ENCH800026	Heterogeneous Catalytic	3
ENCH800027	Sustainable Energy	3
ENCH800028	Risk Management	3
ENCH800029	Electrochemical Technology	3
ENCH800030	Extraction Technology & Isolation for Natural Products	3
ENCH800031	Special Topic 1	3

ENCH800033	Natural Gas Processing	3
	Even Semester	
ENCH800034	Storage and Packing Technology	3
ENCH800035	Bioinformatics	3
ENCH800036	Drugs and Cosmetics Technology	3
ENCH800037	Petroleum Processing	3
ENCH800038	Petrochemical Processing	3
ENCH800039	Photocatalytic Technology	3
ENCH800040	Hydrocarbon Exploration and Production	3
ENCH800041	Waste Management and Prevention	3
ENCH800042	Microalgae Cultivation and Development Tech.	3
ENCH800043	Plant Utility and Maintenance	3
ENCH800044	Transportation and Utilization of Natural Gas	3
ENCH800045	Mixing Technology	3
ENCH800046	Problem Solving Skills	3
ENCH800047	Polymer Technology	3
ENCH800048	Genetically Modified Organism	3
ENCH800049	Controlled Drug Release Technology	3
ENCH800050	Special Topic 2	3
ENCH800051	Biomass Thermochemical Conversion Tech.	3
ENCH800052	Basic Computer Programming	3
ENCH800053	Bioprocess Engineering Model	3
ENCH800054	Bioprocess Engineering Drawing	2

Courses Placement of Fast Track Undergraduate to Master Courses in Chemical Engineering Study Program from Bioprocess Engineering Undergraduate Program

Code	Subject	SKS
	7th Semester	
ENBE600027	Industrial Project Management	2
ENBE600028	Plant Design	4
ENBE600029	On The job Training (Internship)	2
ENBE600030	Research Methodology & Seminar	2
ENCH800001	Advanced Chemical Engineering	3
ENCH800027	Sustainable Energy	3
ENCH800033	Natural Gas Processing	3
	Elective 7	3
	Subtotal	**22**
	8th Semester	
ENBE600031	Capita Selecta	2
ENBE600032	Undergraduate Thesis	5
ENCH800003	Advanced Transport Phenomenon	3
ENCH800004	Advanced Chemical Reaction Engineering	3
ENCH800005	Advanced Chemical Engineering Modelling	3
	Elective 8	3
	Elective 9	3
	Subtotal	**22**
	9th Semester	
ENCH800006	Research Methodology	3
ENCH800007	Pre-Thesis	2
	Elective 10	3
	Elective 11	3
	Elective 12	3
	Subtotal	**14**
	10th Semester	
ENCH800008	Thesis	6
ENCH800055	Research Publication	2
	Subtotal	**8**

Courses Placement of Fast Track Undergraduate to Doctor Courses in Chemical Engineering Study Program from Bioprocess Engineering Undergraduate Program

Code	Subject	SKS
	7th Semester	
ENBE600027	Industrial Project Management	2
ENBE600028	Plant Design	4
ENBE600029	On The job Training (Internship)	2
ENBE600030	Research Methodology & Seminar	2
ENCH800001	Advanced Chemical Engineering	3
ENCH800027	Sustainable Energy	3
ENCH800033	Natural Gas Processing	3
	Elective 7	3
	Subtotal	**22**
	8th Semester	
ENBE600031	Capita Selecta	2
ENBE600032	Undergraduate Thesis	5
ENCH800003	Advanced Transport Phenomenon	3
ENCH800004	Advanced Chemical Reaction Engineering	3
ENCH800005	Advanced Chemical Engineering Modelling	3
	Elective 8	3
	Elective 9	3
	Subtotal	**22**
	9th Semester	
ENCH800006	Research Methodology	3
ENCH800007	Pre-Thesis	4
	Elective 10	3
	Elective 11	3
ENCH900003	Research Group Periodic Seminar	8
	Subtotal	**21**
	10th Semester	
ENCH800008	Thesis	**4**
ENCH800055	Research Publication	**2**
ENCH900005	Research Proposal	**6**

	Elective 12	**3**
	Subtotal	**15**
	11th Semester	
ENCH900007	Publication 1 – International Conference	**6**
	Subtotal	**6**
	12th Semester	
ENCH900008	Research Defense	**10**
	Subtotal	**10**
	13th Semester	
ENCH900010	Publication 2 – International Journal	**8**
	Subtotal	**8**
	14th Semester	
ENCH900011	Publication 3 – International Journal	**8**
ENCH900012	Doctoral Promotion	**6**
	Subtotal	**14**

Transition Guidance from Curriculum 2016 to 2020 for Regular Undergraduate Class

1. New curriculum 2020 will be applied effectively from Odd Semester 2020/2021. In principle, after curriculum 2020 is implemented, then only courses from this new curriculum will be opened.
2. For class 2019 and above will follow these transition rules.
3. The enforcement of the transitional period is one year. During this transition period, if a course in curriculum 2020 is in odd Semester while in the previous curriculum in even Semester (vice versa), then this course can be held (if necessary) in both semesters.
4. For students who have not passed the compulsory courses in curriculum 2016, are required to take the same course or equivalent in curriculum 2020. Equivalence courses can be seen in the table below. All courses in the curriculum 2016 that are not listed in the equivalence table have not changed, both in names and credits.

Table of Equality Courses in Undergraduate Bioprocess Engineering Study Program in Curriculum 2016 and Curriculum 2020

No	Name of Courses in Curriculum 2016	Semester	Credits 2016	Name of Courses in Curriculum 2020	Semester	Credits 2020
1	MPKT A (Integrated Character Building A)	2	6	MPKT Terintegrasi (Integrated Character Building)	2	5
2	MPKT B (Integrated Character Building B)	1	6			
3	MPK Bahasa Inggris (English)	3	3	MPK Bahasa Inggris (English)	1	2
4	-	-	-	Praktikum Kimia Dasar dan Kimia Organik (Basic and Organic Chemistry Lab)	2	1
5	Pengantar Teknik Bioproses (Introduction to Bioprocess Engineering)	1	3	Pengantar Teknik Bioproses (Introduction to Bioprocess Engineering)	1	2
6	Biologi Molekular (Molecular Biology)	3	3	Biokimia (Biochemistry)	3	3
7	Biologi sel (Cel Biology)	2	3	Teknik Reaksi Biokimia (Biochemistry Reaction Engneering)	5 -	3 -
8	Biokatalisis	5	3			
9	Rekayasa Biokimia	5	3			
10	Bioenergetika (Bioenergetica)	5	2	Termodinamika Sistem Hayati (Thermodynamic in Biological System)	4	3
11	MPK Olah raga/seni (Sport/Art)	1	1	MPK Olah raga/seni (Sport/Art)	-	-
12	Skripsi (Undergraduate Thesis)	8	4	Skripsi (Undergraduate Thesis)	8	5
13	Statistik & Probabilistik (Statistic and Probability)	4	2	Statistik & Probabilistik (Statistic and Probability)	2	2

5. When there is a change in the course credits, then the number of graduation credits counted in is the number of credits when it was taken. The same or equivalent courses, when are equated with different credits, if retaken, or just taken, will be acknowledged under a new name and credits.
6. When a compulsory subject in the curriculum 2016 is deleted, and there is no equivalence in the curriculum 2020 then:

a. For students who have passed these subjects, the credits that are achieved will be counted in the calculation of graduation 144 credits.
b. For students who did not pass these courses, they can take new compulsory courses or choose elective subjects in the curriculum 2020 to complete 144 credits.

7. In addition to changes in curriculum structure from 2016 to 2020, there are also the addition of several elective courses: Teknologi Elektrokimia), Teknologi Pencampuran (Mixing Technology), Teknologi Pengembangan dan Pemanfaatan Mikroalga (Microalgae Cultivation and Development Technology), Teknologi Ekstraksi dan Isolasi Bahan Alam (Extraction & Isolation Technology for Natural Products), Konversi Termokimia Biomassa (Biomass Termochemical Conversion Technology), Modifikasi Genetik Makhluk Hidup (Genetically Modified Organism), dan Dasar Pemrograman Computer (Basic Computer Programming)

Course Sylabus of University Subjects

INTEGRATED CHARACTER BUILDING

UIGE6000061/UIGE6100061
5 credits

Syllabus :

The Integrated Character Building is part of the Higher Education Personality Development Lecture which is held for students which contains elements of the internalization of basic life values, interaction/relationship skills, nationality and academic skills as the basis for student personality to carry out learning according to scientific disciplines.

MPKT is carried out in the form of a series of learning activities outside the formal class. activities carried out include participation in lectures/seminars, internships, field work practices, social work, sports and/or arts activities and other forms of activities that have the main goal of equipping students with soft skills and proven by portfolio documents. The form of this learning activity is different from the MPKT courses that have been carried out at the previous UI.

The material provided at MPKT aims to form a human thinking pattern with values and morals to create a human personality by having critical, logical, creative, innovative thinking, and having intellectual curiosity and an entrepreneurial spirit. The material provided includes 9 UI values, national, state and citizen values based on Pancasila. Solving problems in science, technology, health, and humans as natural managers by using reasoning and utilizing Information and Communication Technology (ICT) to achieve the final objectives of this module.

Lecture activities are carried out using an online student-centered learning (SCL) approach which can use the following methods: experiential learning (EL), collaborative learning (CL), problem-based learning (PBL), question-based learning, and project based learning. The use of these various methods is carried out through group discussion activities, independent assignment exercises, presentations, writing papers in Indonesian and interactive discussions in online discussion forums. The language of instruction in this lecture is Indonesian.

Graduate Learning Outcomes :

- CPL 1: Able to use spoken and written language in Indonesian and English both for academic and non-academic activities (C3, A5)
- CPL 2: Have integrity and are able to think critically, creatively, and innovatively and have intellectual curiosity to solve problems at the individual and group level (C4, A3)
- CPL 3: Able to provide alternative solutions to various problems that arise in the community, nation, and country (C4, A2)
- CPL 4: Able to take advantage of information communication technology (C3)
- CPL 5: Able to identify various entrepreneurial efforts characterized by innovation and independence based on ethics (C2, A5)

Course Learning Outcomes :

- CPMK 1: After completing this course, students are able to apply self-regulated learning characteristically in studying critically, logically, creatively, innovatively through analysis of societal problems, nation, state, and Pancasila ideology based on self-understanding as individuals and members. the community by using good and correct Indonesian and the latest information and communication technology (C4, A4)
- CPMK 2: Able to identify various entrepreneurial efforts characterized by innovation and independence based on ethics (C2, A5)
- CPMK 3: After completing this course, students are able to apply self-regulated learning characteristically in pursuing integrated and comprehensive knowledge through analysis of science problems, technology based on the role of nature manager by using good and correct Indonesian and information technology and current communications. (C4, A4)
- CPMK 4: After completing this course, students are able to plan creative activities to solve problems in society and the world of work/industry by showing creativity, critical thinking, collaborative self-discipline using good and correct Indonesian as well as the latest information and communication technology (C5, A5)

Prerequisite : -

ACADEMIC WRITING

UIGE610002
2 credits
The Objectives :

To activate students, English so that they will be able to communicate effectively in English;

To enable students to develop the learning strategies and study skills needed to finish their study successfully and o continue learning on their own after taking the MPK program (to develop independent learners)

Main Competencies :

- Listen to, understand and take notes of key information in academic lectures of between 5-10 minutes length;
- Improve their listening skills through various listening materials and procedures;
- Speak confidently, ask questions in and contribute to small group discussions;
- Use different reading strategies needed to the effective readers;
- Improve their reading skills through extensive reading material;
- Develop skills in connecting ideas using appropriate transitions and conjunctions;
- Work as part of a group to prepare and deliver a 25-minute presentation on an academic topic using appropriate organization, language and visual aids;
- Write a summary of a short academic article;
- Write an expository paragraph;
- Write a short essay.

Learning Method : Active learning, Contextual language learning, small group discussion.

Prerequisite :

1. Students Learning Orientation/Orientasi Belajar Mahasiswa (OBM)

ENGLISH

UIGE600003
2 credits

Learning Objectives :

After attending this subject, students are expected to capable of use English to support the study in university and improve language learning independently.

Syllabus :

Study Skills : (Becoming an active learner, Vocabulary Building: word formation and using the dictionary Listening strategies Extensive reading) Grammar: (Revision of Basic grammar Types of sentences Adjective clauses, Adverb clauses Noun clauses, Reduced clauses) Reading: (Reading skills: skimming, scanning, main idea, supporting ideas, Note-taking Reading popular science arti-cle, Reading an academic text) Listening: (Listening to short conversations, Listening to a lecture and notetaking, Listening to a news broadcast, Listening to a short story) Speaking: (Participating in discussions and meetings, Giving a presentation) Writing: (Writing a summary of a short article Describing graphs and tables, Writing an academic paragraph, Writing a basic academic essay (5 paragraphs).

ISLAMIC STUDIES

UIGE6000010/UIGE610005
2 credits
General Instructional Objectives :

The cultivation of students who have concern for social, na-tional and countrys issues based on Islamic values which is applied in the development of science through intellectual skills.

Learning Objectives :

Course participants are expected to do the following when faced with a problem or issue which they must solve :

1. Analyze the problem based on the Islamic values they adopted;
2. Analyze the problem by implementing active learning stages;
3. Discuss and express their thoughts and ideas by using proper and correct Indonesian language in discussion and academic writing.

Syllabus :

Islam history: the meaning of Islam, the characteristic of Islam, the sources of Islamic teachings, Muhammad SAW as prophet and history figure, introduction of Islam in Indonesia, the teaching essence of Islam: the basic principle of Islam teachings, the unity of Allah, worship prac-tice in live, eschatology and work ethics, human's basic rights and obligation, social structure in Islam: sakinah mawaddah and ramhah family, the social implication of family life, Mosque and the development of Islam, zakat and the economic empowerment of the people, Islam society, Science: reason and revelation in Islam, Islam's motivation in development of science, science characteristics, source of knowledge, IDI (each Faculty and Department/Study Program).

CATHOLIC STUDIES

UIGE6000011/UIGE610006
2 credits
General Instructional Objectives :

To help deliver students as intellectual capital in implementing lifelong learning process to become scientists with mature personality who uphold humanity and life.

Be scholars who believe in God according to the teachings of Jesus Christ by continuing to be responsible of his faith in life in church and society.

Syllabus :

Almighty God and the God teachings; Man, Morals, science technology and art; harmony between religions; Society, Culture, Politics, Law: the substance of theses studies will be addressed by integrating the four dimensions of the teachings of the Catholic faith: the personal dimension, the dimension of Jesus Christ, the dimension of the Church, and Community dimension. Dimensions are implemented in the following themes: People, Religion, Jesus Christ, the Church, and Faith in the society.

CHRISTIAN STUDIES

UIGE6000012/UIGE610007
2 credits
General Instructional Objectives :

Cultivating students with comprehensive Christian knowledge and teaching in the midst of the struggle and the fight of the nation while also discussing the student's participation in line with the study to help improve and build our country.

Learning Objectives :

Course participants are expected to do the following when faced with a problem or issue which they must solve:

1. Analyze the problem based on the Christian values
2. Analyze the problem by implementing active learning stages
3. Discuss the problem by using proper and correct Indonesian language

Syllabus :

History (Historical terms): Status of the Bible, the existence of God and Morality, Christ the Savior, the Holy Spirit as existence reformer and outlook on the world: Faith and Knowledge of Science, Church and service, Ecclesiology, Spiritual and enforcement of Christian Human Rights and the world of ethics: Christian Ethics, Christian and worship, Christianity and politics, Christian love and social reality: Christian Organizations, Students and Service, Christian and expectations.

HINDU STUDIES

UIGE6000013/UIGE610008
2 credits

Syllabus :

Hindu religion, Hindu history), Source and scope of Hinduism (the Veda as the source of Hindu religion teachings, the scope of the teachings in Hindu religion), The concept of the God (Brahman) according to the Veda, the Path to Brahman (Catur Marga Yoga, Mantra and Japa), Human Nature (The purpose of human life, Human's duties, obligations, and responsibilities both individually or collectively), Ethics and morality (Principles teaching, self-control), in-depth understanding of the scripture (deep understanding of the Bhagawadgita, deep understanding of the Sarasamuschaya), The Role of Hinduism in science, technology, and art (Hinduism benefits in science and technology in accordance with each department, benefit / the role of Hinduism in the arts), Cohesion and community's prosperity /independence (Benefits of unity in the religious plurality, independent community (kerthajagathita) as a common goal, Tri Pitakarana), Culture as an expression of Hindu religious practice, Contribution to the Hindu religion teachings in the political life of nation and country, laws and

the enforcement of justice, Awareness of and obeying the Rita / Dharma.

BUDDHIST STUDIES
UIGE6000014/UIGE610009
2 credits

Syllabus :

Almighty God and the God Study (Faith and piety, Divine Philosophy/Theology), Human (Human Nature, Human Dignity, Human Responsibility), Moral (Implementation of Faith and Piety in everyday life), Science, Technology and Art (Faith, Science and Charity as a unity, the Obligation to study and practice what you are taught, Responsibility for nature and environment), harmony between religion (religion is a blessing for all mankind, the essence of the religious plurality and togetherness), community (the role of religious society in creating a prosperous independent society, the responsibility of religious society in the realization of human rights and democracy), Culture (the responsibility of religious society in the realization of critical thinking (academic), work hard and fair), Politics (Religion contribution in the political life of nation and country), Law (Raise awareness to obey and follow God's law, the role of religion in the formulation and enforcement of law, the function of religion in the legal profession).

KONG HU CU STUDY
UIGE6000015/UIGE610010
2 credits

Course Syllabus of Faculty Subjects

CALCULUS 1
ENGE600001/ENGE610001
3 credits
Course Learning Outcomes:

Able to use the basic concepts of calculus related to -a function of one variable, the derivative and integration of the function of one variable in order to solve its applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, basic engineering, and engineering specialization to be used in solving complex engineering problems.

Syllabus :
Introduction, Functions and Limits, The Derivative, Applications of the Derivative, The Definite Integral, Applications of The Definte Integral, Transcendental Functions, Techniques of Integration, Indeterminate Forms and Improper Integrals.

Prerequisite: None

Textbooks:

Main reference:
D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., Pearson, Prentice Hall, 2007.

Additional eferences:
1. George B. Thomas Jr., Thomas' Calculus Early Transcendental, 12th ed., Addison–Wesley Pearson, 2009.
2. Howard Anton, Calculus, 10th ed., John Wiley and Sons, 2012.

CALCULUS 2
ENGE600002/ENGE610002
3 SKS
Course Learning Outcomes:

Students are able to use the concepts of sequences, series, conic sections, and the basic concepts of calculus which involve the function of two or three variables to solve their applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus: :
Infinite sequences and infinite series, Test for convergence of positive series and alternating series, Power series and operation on operations, Taylor and MacLaurin series, Conic sections , Calculus in polar coordinates, Derivatives, limits, and continuity of multi-variables functions, Directional derivatives and gradients, Chain Rule, Tangent planes and Approximations, Lagrange multipliers. Double integrals in Cartesian coordinates and polar coordinates, triple integrals in Cartesian coordinates, cylindrical coordinates and spherical coordinates, Applications of double and triple Integral.

Prerequisite: Calculus 1

Textbooks:
1. D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., PEARSON, Prentice Hall, 2007.
2. Thomas, Calculus Thirteenth Edition Volume 2, Erlangga, 2019.

CALCULUS
ENGE600003/ENGE610003
4 SKS
Course Learning Outcomes:

Students are able to use the basic concepts of calculus involving functions of one to three variables to solve their applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :

Introduction, Functions and Limits, Derivatives, Derived Applications, Indeterminate Integral, Integral Applications, Infinite Row, and Series. Derivatives with many variables, Duplicate Integral (2 and 3), Duplicate Integral Application.

Prerequisite: None

Textbooks:

Main :
D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., Pearson, Prentice Hall, 2007.

George B. Thomas Jr., Thomas' Calculus Early Transcendental, 12th ed., Addison – Wesley Pearson, 2009.

LINEAR ALGEBRA
ENGE600004/ENGE610004
4 SKS
Course Learning Outcomes:
Students are able to calculate linear system problems to solve engineering problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :

Linear Systems and matrix equations, Determinants, Euclid

vector spaces, Common vector spaces, eigenvalues and eigenvectors, inner product spaces, Diagonalization and General Linear Transformation.

Prerequisite: None

Textbooks:
1. Elementary Linear Algebra, Howard Anton & Chris Rorres, 11th edition, 2014
2. Gilbert Strang, Introduction to linear algebra 3rd edition Wellesley Cambridge Press, 2003

MECHANICAL AND HEAT PHYSICS

ENGE600005 / ENGE610005
3 credits
Course Learning Outcomes:

Able to explain the basic concepts of mechanics and thermodynamics, and be able to apply them to understand natural phenomena and human engineering, including their applications.

Graduate Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus:

Units, Magnitudes and Vectors, Motion Along Straight Lines, Motion in Two and Three Dimensions, Newton's Laws of Motion, Applications of Newton's Laws, Kinetic Energy, and Work, Potential Energy and Energy Conservation, Center of Mass, Linear Momentum, Rotation, Rolling Motion, Torque, Angular Momentum, Oscillation, Mechanical and Sound Waves, Gravity, Statics and Elasticity, Fluid Mechanics, Temperature, Heat, Law I Thermodynamics, Ideal Gas and Kinetic Theory of Gas, Heat Engine, Entropy, and Law II Thermodynamics.

Prerequisite: none

Textbooks:
1. Halliday, Resnick, and Walker, Principles of Physics 10th Edition, Wiley, 2014.
2. Serway Jewett, Physics for Scientists and Engineers 9th Edition, Thomson Brooks / Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008

ELECTRICAL MAGNETIC, OPTICAL AND WAVE PHYSICS

ENGE600007 / ENGE610007
3 credits
Course Learning Outcomes:

Students are able to apply the basic concepts of electrical physics, magnetism, waves, and optics to solve problems in the engineering field.

Graduate Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus:

Unit, Magnitude, Vector, Electric Charge, Electric Field, Gauss Law, Electric Potential, Capacitance, Electric Current, Resistance, Direct Current, Magnetic Field Due to Electric Current, Magnetic Field Source, Induced GGL, Inductance, Alternating Current, Electromagnetic Waves, Light Properties and Propagation, Optical Geometry.

Prerequisite: none

Textbooks :
1. Halliday, Resnick, and Walker, Principles of Physics 9th Edition, Wiley, 2011.
2. Serway Jewett, Physics for Scientists and Engineers 9th Edition, Thomson Brooks / Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008.

BASIC CHEMISTRY

ENGE600009 / ENGE610009
2 credits
Course Learning Outcomes:
Students are able to analyze the principe of basic chemistry for application in engineering.

Graduates' Learning Outcomes:
Able to apply mathematics, science, and basic engineering to be used in solving complex engineering problems.

Syllabus:

Material and measurements, atoms, molecules and ions, stochiometry, water phase reactions and solution stochiometry, thermochemistry, chemical equilibrium, acid and base equilibrium, electrochemistry, chemical kinetics, and chemical applications.

Prerequisite: none

Textbooks :
1. Ralph H. Petrucci, General Chemistry: Principles and Modern Applications, 8th Ed. Prentice Hall Inc., New York, 2001.
2. John McMurry, Robert C. Fay, Chemistry (3rd ed.), Prentice Hall, 2001.
3. Raymond Chang, Williams College, Chemistry (7th ed.), McGraw-Hill, 2003.

ENGINEERING ECONOMY

ENGE600011 / ENGE610011
3 credits
Course Learning Outcomes:

Students are able to analyze the economic and financial feasibility of making economic practice decisions.

Graduate Learning Outcomes:

Able to apply the principles of technical management and decision making based on economic considerations, in individual and group, as well as in project management.

Syllabus:

Introduction to Engineering Economics, Time Value of Money, Combining Factors, Interest Rates, Money Worth Analysis, Rate of Return Analysis, Effects of Inflation, Benefit Cost & Break-Even Point Analysis, Sensitivity Analysis, Depreciation, Tax Analysis, Cost Estimation & Allocation, Capital Budgeting & Replacement Analysis.

Prerequisite:
1. Civil Engineering : -
2. Environmental Engineering : -
3. Naval Engineering : -
4. Industrial Engineering : must pass the introductory Economic course and have completed 38 credits
5. Chemical Engineering : -
6. Bioprocess Engineering : -

Textbooks:
1. Blank, Leland and Tarquin, Anthony. 2018. Engineering Economy 8th Ed. McGraw Hill.

2. Park, Chan S. 2016. Contemporary Engineering Economics 6th Ed. Pearson. Upper Saddle River.
3. White, Case and Pratt. 2012. Principles of Engineering Economic Analysis 6th ed. John Wiley and Sons.

STATISTICS AND PROBABILISTICS
ENGE600010 / ENGE610010
2 credits
Course Learning Outcomes:

Students are able to handle quantitative data/information starting from the descriptive stage (collection, organization, and presentation) to the inductive stage, which includes forecasting and drawing conclusions based on the relationship between variables for decision making.

Graduate Learning Outcomes:
1. Apply descriptive statistics and probability theory to data processing and serving
2. Apply probability distribution to data processing and serving
3. Apply the principles of sampling and estimation for decision making
4. Apply hypothesis test samples for decision making

Syllabus:

Introduction to Statistics for Engineering Studies, Probability Theory, Dasar Basic concepts and definitions, Distribution Probability, Sampling, Estimation, Hypothesis testing, Hypothesis test 1 sample at an average value, Regression

Prerequisite: none

Textbooks :
1. Harinaldi, Basic Principles of Statistical Engineering and Science, Erlangga, 2004
2. Montgomery, DC., And Runger, GC., Applied Statistics and Probability for Engineers, John Wiley Sons, 2002

HSE PROTECTION
ENGE600012 / ENGE610012
2 credits
Course Learning Outcomes:

Upon completion of this subject students are expected to be able to carried out hazard identification, and characterization, to propose appropriate methods for risk reduction and mitigation, and to design safety management system. The student is also expected to improve their awareness on industrial safety and health, and understanding on safety regulation framework and standards as well as environmental program.

Graduate Learning Outcomes:
1. Students are expected to understand safety, health and environmental aspect as an integral part of fundamental principal in engineering code of ethics.
2. Students are expected to be able to carry out process of risk assessments by considering risk factors in the impact of hazards on people, facilities, and the surrounding community and environemt.
3. Students are expected to understand the regulatory framework and standard related to the stages of life cycle of machine, building structure, construction, and process.
4. Students are able to design and propose an effective hazard communication, management and engineering control, and risk mitigation through an engineering assignment project.
5. Students are able to identify the knowledge required to perform risk assesment, investigation and design improvement through a multidisiplinary case of incident and accident.

Syllabus:

Introduction to SHE Regulation and Standards, SHE Perception (Risk and Environment), Identification, Assessment and Management, Construction, machinery and Noise hazards, Process safety hazard and analysis technique, Fire and explosion hazard, Electrical hazard, Toxicology in the Workplace, Ergonomy Aspect, Hazard communication to employees, Environmental Protection, Case studies, Safety Health and Environment audits.

Prerequisite: none

Textbooks :
1. Charles A. Wentz, Safety, Health and Environmental Protection, McGraw Hill, 1998.
2. Asfahl, C.R., Rieske, D. W., Sixth Edition Industrial Safety and Health Management, Pearson Education, Inc., 2010.
3. United Kingdom - Health and Safety Executive, http://www.hse.gov.uk/
4. National laws and regulations related to the K3 Management System and the Environment.
5. Related Journal (http://www.journals.elsevier.com/safety-science/) etc, related standards and publications.

Bioprocess Engineering Courses

INTRODUCTION TO BIOPROCESS ENGINEERING
ENBE600001
2 CREDITS
Learning Objectives:

Able to explain the scope of bioprocess technology and industries related to.

Syllabus:

Microbial Structure, Microbial Growth, Nutrition & Culture Media, Control. ; Biochemistry, physiology, stoichiometry and growth kinetics and metabolism. ; Basic genetic engineering of prokryot and mushrooms. ; Food Industry, Health Industry; Energy industry.

Prerequisites: -

Textbooks:
1. Hand Out/diktat perkuliahan dari dosen
2. Mosler, N. S, Modern Biotechnology, John Wiley & Sons, 2009
3. Bioprocess Engineering: Basic Concepts by Michael Shuler. Pearson

COMMUNICATION SKILLS
ENBE600002
2 CREDITS
Learning Objectives:

Able to plan communication products through audience analysis, then compile them into a coherent and logical sequence of messages, and can present them effectively using appropriate technology media.

Syllabus:

Effective communication, audience analysis, writing process, making memos, making summaries / abstracts, structure of technical papers, oral presentation.

Prerequisites: -

Textbooks:

Donald R. Woods, Communicating effectively, McMaster University Bookstore, 1996.

BASIC AND ORGANIC CHEMISTRY LAB

ENBE600003
1 CREDITS
Learning Objectives:

Able to make a preliminary report, conduct experiments in the laboratory, analyze data from the results of practicum and explain the phenomena that occur from the results of practicum done, which are outlined in the form of a final report.

Syllabus:

Physical and Chemical Properties; Separation and Refining of Compounds; Metal Reaction with Acid; Crystal Water; Suspension Formation Reaction; Identification of Hydrocarbon Compounds; Alcohol and phenol identification; Identification of Carbonyl Compounds; Carbohydrate; Lipid Analysis; Extraction and Identification of Fatty Acids from Corn Oil

Prerequisites: -

Textbooks:

1. Brown, T.L., et al., Chemistry The Central Science, 8th ed., Prentice Hall, 2000.
2. Morrison, R.T., R. N. Boyd, Organic Chemistry, 6th ed., Prentice Hall, 2002.
3. Vogel's Qualitative Inorganic Analysis, 7th ed., 1996.
4. Penuntun Praktikum Kimia Dasar dan Kimia Organik, Teknik Kimia FTUI

ORGANIC CHEMISTRY

ENBE600004
3 CREDITS
Learning Objectives:

Able to apply the concepts and laws of analytical, organic, and physical chemistry and apply them in solving everyday problems.

Syllabus:

Naming of organic compounds; The role of structure and stereochemistry in the physical/chemical properties of an organic compound; Cracking reactions or alkane free radicals; Alkene polymerization; Aromatic electrophilic substitution in benzene; Ubtstitution reaction and elimination; Acylation and esterification reaction; Dehydration-polymerization reaction

Prerequisites: -

Textbooks:

1. Fessenden, alih bahasa: A. Hadiyana Pujatmaka, Kimia Organik, edisi Kedua Erlangga 1986
2. Morrison, RT and Boyd, RN, Organic Chemistry, 6th ed., Prentice Hall 1998
3. Organic Chemistry Lecture Note.

NUMERICAL COMPUTATION

ENBE600005
3 CREDITS

Learning Objectives:

Able to solve chemical process problems with computational methods.

Syllabus:

Programming with Pascal and Fortran; Regression; Systems of linear algebraic equations; Numerical integration; Finding the roots of non-linear algebraic equations' The system of non-linear algebraic equations; An explicit method for solving first-order differential equations;

Prerequisites: -

Textbooks:

1. Handouts dari dosen
2. Constantinides, Alkis. 2008. "Numerical Methods for Chemical Engineers with Mathlab Applications". Pearson Education, United States.
3. Bismo, S. & Muharam, Y. 2015. "Metode Numerik dengan Pemrograman Fortran dan Pascal".

INSTRUMENTAL ANALYTICAL CHEMISTRY

ENBE600006
3 CREDITS
Learning Objectives:

Able to apply the concepts and laws of analytical, organic, and physical chemistry and apply them in solving everyday problems.

Syllabus:

Process skills workshop; Electrochemistry; Potentiometry; Atomic absorption spectroscopy; Infrared molecular spectroscopy; Gas chromatography;

Prerequisites: -

Textbooks:

1. D. A. Skoog, et.al., Fundamentals of Analytical Chemistry 9th., Cengage Learning, Inc., 2013.
2. G. D. Christian and J. E. O' Reilly, Instrumental Analysis, 7th. Ed., Allyn Bacon Inc., 2003.
3. D.A. Skoog, et al. Principles of Instrumental Analysis 7th Ed. Cengage Learning, Inc. 2016.
4. D.L. Pavia, et al. Introduction to Spectroscopy 5th Ed. Cengage Learning, Inc. 2014.

PHYSICAL CHEMISTRY

ENBE600007
3 CREDITS
Learning Objectives:

Able to apply basic principles, laws, and theories related to gases, liquids, equilibrium, and solutions in solving problems in the field of physical chemistry; Able to solve problems in the form of working groups by applying stages of problem-solving.

Syllabus:

The nature of gases and liquids: Definition, laws of ideal gases and real gases, use of gas laws, gas kinetics theory (velocity, collisions, average free way), phase diagrams, critical conditions, viscosity; Chemical reaction equilibrium: Definition, homogeneous equilibrium constant, factors affecting equilibrium constant, heterogeneous equilibrium, Le Chatelier's principle, effect of P on K, effect of T on K; Ideal solution: Definition, type of solution, solution concentration, Raoult's law, Henry's law, case examples, partial molar volume, vapor pressure, boiling point, freezing point, and solution osmosis pressure; Electrolyte solutions: Definition, colligative properties, electrolytic conductance, factors affecting conductance, case examples, ion migration, Hittorf's law and transport numbers; Chemical Reaction Kinetics: Basic understanding, first, second, third order reactions, reversible, parallel, consecutive reactions, chain reactions, Arrhenius equations and activation energies, collision theory of bimolecular reactions, transition form theory; Surface phenomena: Basic understanding, surface tension, monolayer and multilayer adsorption, catalytic reaction kinetics, heterogeneous reaction order, catalytic reaction inhibitors, temperature effects on heterogeneous reactions.

Prerequisites: -

Textbooks:

1. Levine, I.N., Physical Chemistry, 6th ed., McGraw-Hill, 2008.

2. Atkins & de Paula, Atkin's Physical Chemistry, 9th ed., Oxford University Press, 2009

PHYS. & ANAL. CHEM. LAB

ENBE600008
1 CREDITS
Learning Objectives:

Able to compile a preliminary report which is a theory that supports the practicum module; carry out experiments in the laboratory; and compile the final report that contains the results of processing and analysis of experimental data and an explanation of the phenomena that occur

Syllabus:

Isothermic adsorption; Effect of concentration and temperature on the reaction rate; Colligative nature of the solution; Determination of chemical equilibrium constants; Determination of gas molecular weight; Volumetric analysis; Potentiometric methods; Visible light spectrophotometry; The conductometry method; Gas chromatography

Prerequisites:

Kimia Dasar, Kimia Fisika dan Kimia Analitik Instrumental/ Basic Chemistry, Physical Chemistry and Instrumental Analytical Chemistry

Textbooks:
1. Petunjuk Praktikum Kimia Fisika TGP-FTUI 1989.
2. Penuntun Praktikum Kimia Fisika dan Kimia Analitik, Departemen Teknik Kimia FTUI
3. D. A. Skoog, et al., Fundamentals of Analytical Chemistry 5th., Saunders College Publishing, 1998 atau edisi terbaru
4. Shoemaker, D.P., C.W. Garland, J.W. Nibler, Experiments in Physical Chemistry, ed. 6, Mc-Graw Hill, 1996.
5. Atkins & de Paula, Atkin's Physical Chemistry, 9th ed., Oxford University Press, 2009

MASS AND ENERGY BALANCE

ENBE600009
3 CREDITS
Learning Objectives:

Able to use basic principles in chemical engineering for mass and energy calculations, which will form the basis of calculations for many operating units and processes in the chemical/bioprocess industry; Formulate and solve problems in the form of mass and energy balance sheets related to chemical processes.

Syllabus:

The scope of the mass and energy balance sheet; Mass balance without chemical reactions and multi-unit systems; Mass balance of chemical reactions; Biological reaction mass balance; Chemical / biological reaction mass based on the component mass balance and element mass balance; General chemical energy balance; Energy balance of chemical reactions

Prerequisites: -

Textbooks:
1. Himmelblau D.M. Basic Principles and Calculation in Chemical Engineering, 7th ed, Prentice Hall 2004.
2. Pauline Doran, Basic Principles of Bioprocess Engineering, Wiley VCH, 2006.
3. Sumber data: Perry's Chemical Handbook dan lainnya yang terkait data *physical and chemical properties*

BIOCHEMISTRY

ENBE600010
3 CREDITS
Learning Objectives:

Able to describe the relationship of structure and chemical compounds in living things, including the functions, synthesis processes and metabolism of these chemical compounds that occur in living things.

Syllabus:

Introduction to cells and tissues; Membranes and organelles; The role of DNA and protein; Energy in cells; Nucleic acid; Structure and replication of DNA and RNA; Transcription and translation; Amino acid; Synthesis and structure of proteins; Enzyme; Metabolism

Prerequisites: -

Textbooks:
1. Lehninger Principles of Biochemistry & eBook by Albert Lehninger, David L. Nelson and Michael M. Cox (Jun 15, 2008)
2. Biochemistry (3rd Edition) by Christopher K. Mathews, Kensal E. van Holde and Kevin G. Ahern (Dec 10, 1999)
3. Bruckner, Monica Z. Basic Cellular Staining.Serc.carleton.edu.
4. Aryulina, D., Manaf, S., Muslim, C., & Winarni, E.W. 2007. BIOLOGI 3. Jakarta : Esis. Binur
5. Robi. 2011. Teknologi RNA Interference. Retrieved from Campbell, Reece. 2009. Biology. Sansome Street, San Francisco: Pearson Benjamin Cummings

TRANSPORT PHENOMENA IN BIOLOGYCAL SYSTEM

ENBE600011
3 CREDITS
Learning Objectives:

Able to identify and explain and analyze the phenomena of momentum, mass, and heat transfer through the application of microscopic and macroscopic balances.

Syllabus:

Preliminary; Viscosity; Thermal Conductivity and Diffusivity; Shell's momentum balance and Shell's energy balance; Shell mass balance; The equation of change; Mass transfer, momentum, and energy with two independent variables; The transfer of momentum, energy, and mass in turbulent flow; Movement between two phases; Macroscopic balance of an isothermal system; Macroscopic balance of non-isothermal systems; Macroscopic balance sheet of multi-component systems

Prerequisites:

Pengantar Teknik Kimia; Kalkulus (Introduction to Chemical Engineering; Calculus)

Textbooks:
1. Rubenssien, D, Bioflued Mechanics, Elsevier Academic Press, 2012
2. Konsool, Signal and System for Bioengineer,Academic Press, 2nd Ed, 2012
3. Sekar V, Transport Phenomena of Food and Biological Material, CRC,2000
4. R. B. Bird, W. E. Stewart dan E. N. Lightfoot, Transport Phenomena, John Wiley, 1965.
5. J.R. Welty et al., Fundamentals of Momentum, Heat and Mass Transfer, 3rd ed., Wiley, 2984.
6. Brodkey, R. S dan RC Herskey, Transport Phenomena, McGraw-Hill, 1998

FLUID AND PARTICLE MECHANICS

ENBE600012
3 CREDITS
Learning Objectives:

Able to apply the basic concepts of fluid mechanics and apply them in solving real problems. In addition, students are able to apply the principles of fluid mechanics (press. Continuity, Bernoulli, etc.), to solve problems in the unit process through energy and force calculations, etc., especially in fluid flow systems in piping, rate measuring devices and transportation tools fluid, as well as in fluid-solid flow systems (fluidization, filtration, sedimentation, movement of particles in the gas.

Syllabus:

Fluid property; Static fluid and its application; The basic equation of fluid flow (mass & press balance. Continuity, energy balance and press. Bernoulli); Press application. Bernoulli for flow rate measurement; Friction Loss of fluid flow through pipes, porous media, fluid transport devices: pumps, compressors, turbines; High-speed gas flow; Movement of particles through fixed and fluidized beds and Filtration; Sedimentation of particles in a liquid

Prerequisites:

Peristiwa Perpindahan (Transport Phenomena)

Textbooks:
1. A. W. Nienow, Bioreactor and Bioprocess Fluid Dynamics - Wiley, 1 edition (April 15, 1993)
2. Noel de Nevers, Fluid Mechanics for Chemical Engineers, 2nd Ed., McGraw-Hill, 1991.
3. Bruce R. Munson, Donald F. Young, Theodore H. Okiishi, Fundamentals of Fluid Mechanics, John Wiley & Sons, 2006.

CELL CULTURE
ENBE600013
3 CREDITS
Learning Objectives:

Able to apply the basic principles of cell culture at an industrial level

Syllabus:

Cell types (prokaryotes and eukaryotes); Cell structure; Introduction to cell culture; Cell culture procedures; Media Development grows; Bioprocess cell line development

Prerequisites:

Biokimia (Biochemistry)

Textbooks:
1. Cell Culture Engineering (Advances in Biochemical Engineering Biotechnology) by Wei Shu Hu (Editor). Springer
2. Cell Culture Engineering VI by Michael J. Betenbaugh. Springer

HEAT TRANSFER
ENBE600014
3 CREDITS
Learning Objectives:

Able to analyze the phenomenon of heat transfer and apply it to solve problems in the heat transfer process unit.

Syllabus:

Skills Workshop Review which includes: The importance of self-assessment, awareness of the thought process, problem-solving strategies and work skills in groups; Steady conduction; Induction Conduction; Natural Convection; Forced Convection; Radiation; Heat Exchanger

Prerequisites:

Peristiwa Perpindahan/ Transport Phenomena

Textbooks:
1. Holman, J.P., "Perpindahan Kalor (alih bahasa: E. Jasjfi)", Edisi ke-10, Penerbit Erlangga, Jakarta 2010.
2. Bergman, T.L. et al. "Fundamentals of Heat & Mass Transfer", Edisi ke-8, John Wiley & Sons, New York 2017.
3. Cengel, Yunus A. "Heat and Mass Transfer: Fundamentals & Applications", Edisi ke-5, McGraw Hill, Singapore 2014.
4. Cengel, Yunus A. "Introduction to Thermodynamics & Heat Transfer", Edisi ke-2, McGraw Hill, United States 2009.

BIOCHEMISTRY LAB
ENBE600015
2 CREDITS
Learning Objectives:

Able to compile a preliminary report on the theory that supports the practicum module, carry out experiments in the laboratory, process and analyze experimental results data, explain phenomena that occur, and, compile the final report

Syllabus:

Physical and chemical properties; Separation and purification of substances; Reaction of metals with acids; Crystal Water; Identification of hydrocarbon compounds; Identification of alcohols and phenols; Identification of protein compounds; Nucleic acid; Carbonyl; Carbohydrate; Lipid analysis; Extraction and identification of fatty acids from corn oil; Bacterial culture

Prerequisites:

Kimia organik, Biokimia, dan Kultur sel (Organic Chemistry, Biochemistry, and Cell Culture)

Textbooks:
1. Fessenden, alih bahasa: A. Hadiyana Pujatmaka, Kimia Organik, Erlangga 1986
2. Morrison, RT and Boyd, RN, Organic Chemistry, 6th ed., Prentice Hall 1998.
3. Vogel, Practical Organic Chemistry
4. Penuntun Praktikum Kimia Dasar dan Kimia Organik, Departemen Teknik Kimia, FTUI
5. Moran, L. dan Masciangioli, T. Keselamatan dan Keamanan Laboratorium Kimia, the National Academies Press, 2010
6. Brown, T.L., H. E. LeMay and B.E. Bursten, Chemistry, ed. 8, Prentice Hall, 2000.
7. Vogel, Analisis Anorganik Kualitatif, PT. Kalman Media Pustaka, 1985.
8. Lehninger Principles of Biochemistry & eBook by Albert Lehninger, David L. Nelson and Michael M. Cox (Jun 15, 2008)
9. Biochemistry (3rd Edition) by Christopher K. Mathews, Kensal E. van Holde and Kevin G. Ahern (Dec 10, 1999)

GENETIC ENGINEERING
ENBE600016
3 CREDITS
Learning Objectives:

Able to apply the concepts and techniques of genetic and protein engineering to apply them for cloning and protein production

Syllabus:

Introduction; Basic techniques for genetic engineering, DNA cutting and unification; Simple genetic engineering in bacteria; Mutagenesis; Application of genetic engineering technology

Prerequisites:

Biokimia (Biochemistry)

Textbooks:
1. Primrose SB, Twyman RM, and Old RW. "Principles of Gene Manipulation" sixth edition, Blackwell science Ltd. 2001
2. An Introduction to Genetic Engineering by Desmond S. T. Nicholl (Jun 23, 2008). Cambridge University Press
3. Genetic Engineering: Manipulating the Mechanisms of Life (Genetics & Evolution) by Russ Hodge and Nadia Rosenthal (May 2009). Facts on File
4. Principles of Gene Manipulation and Genomics by Sandy B. Primrose and Richard Twyman. Wiley-Blackwell
5. Introduction to Biotechnology and Genetic Engineering by A. J. Nair. Jones & Bartlett Publishers
6. Gene Cloning & DNA Analysis, T.A. Brown. 2016. Wiley – Black Will.

THERMODYNAMIC IN BIOLOGICAL SYSTEM

ENBE600017
3 CREDITS
Learning Objectives:

Able to apply the basic concepts of thermodynamics and principles of energy transformation involving living organisms; able to apply heuristics of problem solving skills and basic concepts of thermodynamics to solve various thermodynamic problems; able to increase the ability to direct learning independently (self - directed learning) at the individual or group level

Syllabus:

Energy Transformation (Energy, System and Environment Distribution, Energy Consumption, carbon, energy and life); 1st Law of Thermodynamics (Energy in, work, application of law 1, enthalpy, standard state, heat capacity and energy conversion in living things); 2nd Law of Thermodynamics (Entropy, Entropy of the universe, isothermal system, 3rd law and biology, Irreversibility and life); Gibbs Energy Theory and its application to biological systems; Equilibrium ties in the biological system; Border Biodynamic system thermodynamics

Prerequisites:

Neraca Massa dan Energi (Mass and Energy Balance)

Textbooks:
1. Haynie, D.T., Biological Thermodynamics, Cambridge University Press, 2008.
2. Hammes, G.G., Thermodynamics and Kinetics for The biological sciences, Wiley-Interscience, 2000.
3. Stockar U.V., Biothermodynamics: The Role of Thermodynamics in Biochemical Engineering, EFPL Press, 2013.
4. J.M. Smith, H.C. van Ness, and M.M. Abbott, Introduction to Chemical Engineering Thermodynamics, 6th/7th ed., McGraw Hill.
5. Donald R. Woods, Problem-Based Learning: How to gain the most from PBL, McMaster Bookstore, Hamilton, Ontario, Canada, 1994
6. Situs internet, buku, manual, petunjuk piranti lunak, dan sumber-sumber informasi lainnya yang dapat dipercaya.

BIOCHEMICAL REACTION ENGINEERING

ENBE600018
3 CREDITS
Learning Objectives:

Able to apply biochemicalreaction engineering processes in solving bioprocess problems

Syllabus:

Review of catalysts and biocatalysts; Enzyme classification and activity; Biocatalyst immobilization techniques; Factors affecting biocatalysis performance; The kinetics of ordinary reactions and the kinetics of biocatalytic reactions; Enzyme production and recovery product techniques; Application of biocatalysis in industry; Non-elementary homogeneous reaction; Enzymatic reaction; Cell Review; Kinetics of cell growth; Respiration, Photosynthesis, Biosynthesis; Displacement through cell membranes; Stoichiometry of cell growth & energy requirements

Prerequisites:

Kimia Fisika (Physical Chemistry)

Textbooks:
1. James E. Bailey, David F. Ollis, Biochemical Engineering Fundamentals, McGraw-Hill International Editions, second edition, 1986.
2. Douglas S Clark, Harvey W Blanch, Biochemical Engineering, Marcel Dekker Inc, 1997.

SEPARATION

ENBE600019
3 CREDITS
Learning Objectives:

Able to apply the concepts of separation techniques in the biological production system.

Syllabus:

Separation concept; The concept of mass transfer; Distillation; Absorption and Stripping; Extraction; Leaching; Membrane Process; Ion Exchange; Crystallization; Bubble and Foam Separation; Chromatography; Ultrafiltation and Reverse osmosis; Dialysis membrane membrane; Separation process selection strategy

Prerequisites:

Peristiwa Perpindahan (Transport Phenomena)

Textbooks:
1. Warren L. McCabe, Julian C. Smith, Peter Harriot. Unit Operation of Chemical Engineering, Mc. Graw Hill. 1993
2. Coulson and Richardson's Chemical Engineering: Chemical Engineering Design v. 6 (Coulson & Richardson's chemical engineering) by R.K. Sinnott. Butterworth-Heinemann Ltd

BIOPROCESS UNIT OPERATION LAB I

ENBE600020
1 CREDITS
Learning Objectives:

Able to operate the process equipment and plan an activity or experiment, can analyze and explain the phenomena that occur in each practicum module activity

Syllabus:

Fluid Circuit Mechanics; Conduction heat transfer in multiple pipe systems; Filtration Process; The process of fluidization and its influence in the heat transfer system; Fermentation process in the Biofermentor reactor system;

Prerequisites:

Separasi, Mekanika Fluida dan Partikel, dan Teknik Reaksi Biokimia (Separation, Fluid Mechanics and Particles, and Biochemical Reaction Engineering)

Textbooks:
1. Buku Petunjuk Praktikum Proses dan Operasi Bioproses 1, DTK FTUI
2. Literatur untuk mata kuliah

BIOPROCESS SYSTEM SIMULATION

ENBE600021
3 CREDITS
Learning Objectives:

At the end of the lecture, students can design the stages of the solution of the problem given correctly

Syllabus:

Benefits and position of Bioprocess Simulation; Software requirements (Installation, Unit structure, Task, Economic, etc.); Simple system: Fermentation and Filtration; Registration of pure components available / not available in the software; Mixed component registration; Selecting Units; Case Study: Galactosidase

Prerequisites:

Komputasi Numerik (Numerical Computation)

Textbooks:
1. SuperPro Designer Manual, Intelligen, Inc.
2. Biorefineries – Industrial Processes and Products: Status Quo and Future Directions (Volume 1-2), by Birgit Kamm and Patrick R. Gruber.

BIOPROCESS UNIT OPERATION LAB II

ENBE600022
1 CREDITS
Learning Objectives:

Students are able to operate the process equipment and or experiment, can analyze and explain the phenomena that occur in each practicum module activity.

Syllabus:

Absorption process; Flow control; Wet Wetted Colum; Pressure Control; Biofilter / CO2 Biofixation

Prerequisites:

Separasi,Pengendalian Proses, Teknik Reaksi Biokimia (Separation, Process Control, Biochemical Reaction Engineering)

Textbooks:

Buku Petunjuk Praktikum Proses dan Operasi Bioproses 1, DTK FTUI

BIOREACTOR ENGINEERING

ENBE600023
3 CREDITS
Learning Objectives:

At the end of the lecture, students are able to design bioreactors.

Syllabus:

Ideal reactor; Stirred vessel reactor; Bubble column reactor; Silent/trickle bed reactors; Fluidization reactor;

Prerequisites:

Teknik Reaksi Biokimia (Biochemical Reaction Engineering)

Textbooks:
1. Blanch HW and DS Clark, Biochemical Engineering, Marcel Dekker Inc., New York, 1997.
2. Bailey JE and Ollis, Biochemical Engineering Fundamental, McGraw Hill Book Co., New York, 1986.
3. John Viladsen, Jens Nielsen, Gunar Liden, Bioreaction engineering fundamental, springer, 2011
4. K Schugerl, KH Bellgardt, Bioreaction Engineering Modelling and Control

BIOPROCESS EQUIPMENT DESIGN

ENBE600024
3 CREDITS
Learning Objectives:

Able to design biological process equipment.

Syllabus:

Distillation column, tray, and packing; Absorption, tray and packing columns; Adsorption, tray and packing columns; Batch and continuous extraction; Evaporation, filtration, crystallization, and centrifugation

Prerequisites:

Mekanika Fluida dan Partikel, Separasi, Perpindahan Kalor

Textbooks:
1. Kern, D. Q., "Process Heat Transfer", Mc.Graw-Hill International Book Company, 1984.
2. Wallace & Ludwig, Applied Process Design for Chemical and Petrochemical Plant, Vol. 2, Gulf Publishing Co.

BIO PRODUCT DESIGN

ENBE600025
4 CREDITS
Learning Objectives:

Able to theoretically design a factory/industry by explore information from books, journals and the internet to find the latest solutions in product and factory design with due regard to standards and regulations

Syllabus:

Understanding of consumer needs, product specifications, creating and selecting product concepts, product formulations, product manufacturing, supply chains, economics

Prerequisites:

Perancangan Alat Proses (Equipment Process Design), Ekonomi Teknik (Engineering Economics)

Textbooks:
1. Cussler, L., G. D. Moggridge, 2011, Chemical Product Design, Cambridge University, 2 edition
2. Ulrich K. T., Eppinger S. D., 2003, Product Design and Development, 3rd ed., McGraw-Hill
3. Seider W. D., Seader J. D., Lewin D. R., Soemantri Widagdo, 2008, Product and Product Design Principles. Synthesis, Analysis and Evaluation, Wiley and Sons Inc, 3 edition
4. Wesselingh, J.A., et al., 2007, Design and Development of Biological, Chemical, Food, and Pharmaceutical Products, John Wiley & Sons.

PROCESS CONTROL

ENBE600026
3 CREDITS
Learning Objectives:

Able to design a single loop control system and connect the dynamics of the process with performance.

Syllabus:

Introduction to Process Control; Objectives and Benefits of Control; Principles of Mathematical Modeling; Process Control Modeling and Analysis; Dynamic Behavior of a Typical Process System; Empirical Model Identification; Feedback loop; PID controller; PID Control Settings; Stability Analysis;

Prerequisites:

Neraca massa dan energi, Komputasi Numerik (Mass and Energy Balance, Numerical Computation)

Textbooks:
1. T. Marlin, Process Control: Designing Processes and Control Systems for Dynamic Performance, 2nd Edition, McGraw-Hill, New York, 2000.
2. Carlos A. Smith, Armando B. Corripio, Principles and Practice of Automatic Process Control, John Wiley & Sons, 1985, ISBN 0-471-88346-8 2.
3. D. E Seborg, T. F. Edgar, D. A. Mellichamp, Process Dynamics and Control, John Wiley & Sons, 1989, ISBN 0-471-86389-0 3.
4. Ogata, Katsuhiko, Teknik Kontrol Automatik (Sistem Pengaturan), Jilid 1, Penerbit Erlangga, 1985, Bandung.
5. Bequette, R. W., Process Dynamics: Modeling, Analysis, and Simulation, Prentice Hall, 1998.
6. Luyben, William L., Process Modeling, Simulation and Control for Chemical Engineers, Second Edition, McGraw-Hill International Edition, 1990.
7. Kuo, Benjamin C., Automatic Control Systems, Sixth Edition, Prentice-Hall International Editions, 1991.
8. Stephanopoulos, George, Chemical Process Control: An Introduction to Theory and Practice, Prentice-Hall International, 1984

INDUSTRIAL PROJECT MANAGEMENT
ENBE600027
2 CREDITS
Learning Objectives:

Able to apply project management concepts in their field of work well.

Syllabus:

Concept of Project-Production; Project Life Cycle; Project Selection; Project Planning; Project Implementation; Project Completion & Evaluation

Prerequisites:

Ekonomi Teknik (Engineering Economics)

Textbooks:

Suharto, Imam, Manajemen Proyek, 1990

PLANT DESIGN
ENBE600028
4 CREDITS
Learning Objectives:

Able to theoretically design a factory/industry by explore information from books, journals and the internet to find the latest solutions in product and factory design with due regard to standards and regulations

Syllabus:

Conceptual design of processes/plants, process development flow diagrams, heuristic synthesis and analysis of processes, process simulations, rule of thumb design of process tools and construction meters, heat/process integration, plant layouts, and economic analysis

Prerequisites:

Pengendalian Proses, Perancangan Alat Proses, Simulasi Sistem Kimia, Ekonomi Teknik (Process Control, Process Equipment Design, Chemical Process Simulation, Engineering Economics)

Textbooks:
1. Douglas, J. M., 1998, Conceptual Design of Chemical Processes, McGraw-Hill.
2. Seider W. D., Seader J. D., Lewin D. R., Sumatri Widagdo, 2008, Product and Product Design Principles. Synthesis, Analysis and Evaluation, Wiley and Sons Inc, 3 edition.
3. Turton, R., R. C. Bailie, W. B. Ehiting and J. A. Shaeiwitz, 1998, Analysis, Synthesis, and Design of Chemical Process, Prentice-Hall
4. Gavin Towler, R K Sinnott, 2012, Chemical Engineering Design: Principles, Practice and Economics of Plant and Process Design, Butterworth-Heinemann, Second Edition.
5. Peter, M. S, and K. D. Timmerhaus, Ronald West, and Max Peters, 2002, Plant Design and Economic for Chemical Engineering, 5 Edition, McGraw-Hill.
6. Biegler L. T, I. E, Grossmann and A. W. Westerberg, 1997, Systematic Methods for Chemical Process Design, Prentice-Hall.
7. Branan, C., 1998, Rule of Thumb for Chemical Engineers : A manual of quick, accurate solutions to everyday process engineering problems, 2nd edition, Gulf Publishing, Co.
8. Wallas, Stanley M. 1990, Chemical Process Equipment : Selection and Design, Buther Worths.
9. Ed Bausbacher, Roger Hunt, 1993, Process Plant Layout and Piping Design, Prentice Hall; 1 edition
10. CHEMCAD Manual, HEATEXET Manual, HYSYS/UNISIM ManualBerk, Z, Food Process Engineering and Technology, Academic Press, 2009
11. Lydersen BK, Bioprocess Engineering: System, Equipment and Facilities, John & Wiley & Sons, Inc., New York, 1993.
12. Peter, M. S. dan K. D. Timmerhaus, Plant design and Economic for Chemical Engineering, 4th Ed., McGraw Hill.
13. SuperPro Designer Manual. Intelligen, Inc

CAPITA SELECTA
ENBE600031
2 CREDITS
Learning Objectives:

Able to make a summary of the material presented by guest lecturers

Syllabus:

Held by inviting competent guest lecturers in the fields according to the needs in each study program (may vary in each semester)

Prerequisites:

Passed 90 Credits

Textbooks: -

Special Courses

INTERNSHIP
ENBE600029
2 CREDITS
Learning Objectives:

At the end of the lecture, students have real knowledge and experience in the field of oil and gas, petrochemical, pharmacy, oleochemical, and other chemical industries that involve aspects of technology, processes, operations, and management.

Syllabus: -

Prerequisites:

Already taken at least 110 credits (minimum D) with GPA 2,0

Textbooks: -

RESEARCH METHOD & SEMINAR
ENBE600030
2 CREDITS
Learning Objectives:

Able to determine the right method for research activities as well as express ideas, processes, and results of scientific research verbally and in writing

Syllabus:

Introduction, techniques to identify problems and form hypotheses, logical and critical thinking, scientific writing techniques, research proposal writing techniques, research design techniques, presentation techniques, data collection techniques, analyze and present the results.

Prerequisites:

Already taken at least 90 credits (minimum D) with IPK 2,0

Textbooks:
1. Handout
2. Research proposal format from various institutions

UNDERGRADUATE THESIS
ENBE600032
5 CREDITS
Learning Objectives:

Able to analyze and solve chemical technology problems and present them in oral and written forms in the form of scientific papers.

Syllabus:

Materi skripsi sesuai dengan Syllabus penelitian yang diambil

Prerequisites:

Metodologi Penelitian dan Seminar

Textbooks:
1. Pedoman Teknis Penulisan Tugas Akhir Mahasiswa Universitas Indonesia.
2. IEEE Citation Reference.
3. Ivan Stojmenovic, "How To Write Research Articles in Computing and Engineering Disciplines," IEEE Transactions on Parallel And Distributed Systems, Vol. 21, No. 2, February 2010.
4. Buku petunjuk praktis pelaksanaan MK. Skripsi, Depok, 1999.

Elective Courses in Odd Semester

OLEOCHEMICAL INDUSTRY
ENCH800014
3 CREDITS
Learning Objectives:

Able to know the various processes that commonly used in the oleochemical industry, and able to make a plan to develop the produce of oleochemicals from vegetable oils.

Syllabus:

Fatty acids, biodiesel, paints and polymers, detergents, soaps, fatty alcohol, glycerin, oils and fats, oil and greese, the development of oleochemicals, vegetable oil processing, vegetable oil technology in the process.

Prerequisites:

Organic Chemistry

Textbook:
1. Oleochemical Manufacture and Applications by Frank D. Gunstone, Richard J. Hamilton. Blackwell

FOOD TECHNOLOGY
ENCH800015
3 CREDITS
Learning Objectives:

Able to understand the processes of making food in the food industry, which includes the selection, handling, and processing of raw materials, the operating unit of food production, packaging, storage, and control of the process from the beginning stage to the end.

Syllabus:

Introduction, physical properties of raw materials, the basic concepts of energy and mass transfer, reaction kinetics, process control. Mixing, filtration, centrifugation, extraction and membrane processes, adsorption and ion exchange column, with the temperature settings, drying, preservation, packaging, food storage, and hygiene.

Prerequisites: -

Textbook:
1. Zeki Berk, Food Process Engineering and Technology, Academic Press, Elsevier 2009
2. Food Technology: an introduction by Anita Tull. Oxford University Press, 2002
3. Introduction to Food Engineering by R. Paul Singh, R. Paul Singh, and Dennis R. Heldman.
4. Academic Press
5. Introduction to Food Process Engineering by P. G. Smith. Springer
6. Fundamentals of Food Process Engineering by Romeo T. Toledo. Springer

PROTEIN ENGINEERING
ENCH800016
3 CREDITS
Learning Objectives:

Able to determine protein engineering strategies for the benefit of separation, biocatalysts and medic.

Syllabus:
Introduction, Protein docking methods, Protein tagging strategies, Gen synthesis design, Enzyme stabilization, Molecular exploration, Protein engineering, Case study.

Prerequisite:

Organic Chemistry

Textbooks:
1. Protein Engineering in Industrial Biotechnology, Lilia Alberghina, Harwood academic publishers, 2005
2. Proteins: Biotechnology and Biochemistry by Dr. Gary Walsh. Wiley
3. Protein engineering and design by Sheldon J. Park, Jennifer R. Cochran. CRC Press
4. Protein Engineering and Design by Paul R. Carey. Academic Press
5. Protein Engineering: Principles and Practice. Wiley-Liss

HERBAL TECHNOLOGY
ENCH800017
3 CREDITS
Learning Objectives:

Able to explain the development of herbal technology, herbal separation technology, herbal formulation basis, herbal regulation, and distinguish with other pharmaceutical products

Syllabus:

Definition and basic concepts of herbs, herbal materials, herbal separation technology, herbal formulations, herbal regulation.

Prerequisites:

Organic Chemistry

Textbook:

The Complete Technology Book on Herbal Perfumes & Cosmetics by H. Panda. National Institute of Industrial Research 2003

COMPOSITE MATERIAL
ENCH800018
3 CREDITS
Learning Objectives:

Able to: Explain the characteristics of composite materials and compare it with conventional materials; Explain the manufacturing process, and research development of composite materials.

Syllabus:

The position of composite materials in materials science in general, common characteristics of composite materials, the type of composite based on the composition, the types of polymer matrix and reinforcement, the role of surface treatment in the strength of composite materials, manufacturing processes, durability, the process of splicing and repair of composite materials, code and standards for application of composite materials, the development of composite materials research.

Prerequisites:

Organic Chemistry

Textbook:
1. Fiber-reinforced Composites (Materials Engineering, Manufacturing and Design), P. K. Mallick, Marcel Dekker, Inc., 1993.
2. Handbook of Plastics, Elastomers, and Composites, 3rd ed., Charles A. Harper, McGraw-Hill, 1996.
3. Reinforced Plastics - Theory and Practice, 2nd ed., M. W. Gaylord, Chaners Books, 1974.

APPLIED THERMODYNAMICS
ENCH800019
3 CREDITS
Learning Objectives:

Students are able to analyze problems of thermodynamics based on a thorough review including fundamental aspects of thermodynamics, experimental, and green chemistry, based on current information from scientific journals

Syllabus:

The case study of industrial thermodynamic, example cycle processes, phase equilibrium, and chemical reaction equilibrium to process and product engineer; friendly solvents such as supercritical CO2 and ionic liquid

Prerequisites:

Chemical Engineering Thermodynamics

Textbook:
1. References relevant to a given problem
2. Mulia, K dan Wulan, PPDK, Buku Teks Termodinamika Kimia

DINAMIC SYSTEM
ENCH800020
3 CREDITS
Learning Objectives:

Able to build dynamic models of process systems, biological, industrial, social and economic.

Syllabus:

Introduction to dynamical systems, causal loops, model and validation, analysis, case study.

Prerequisites:

Numerical Computation

Textbook:
1. Forrester, J. W., 2002, Principles of Systems, Productivity Press
2. Goodman, Michael R., 1998, Study Notes in System Dynamics, Productivity Press
3. Richardson, George P. and Pugh III, Alexander L., 1999, Introduction to System Dynamics Modeling, Pegasus Communications
4. Andersen, David, etc., Introduction to Computer Simulation - A System Dynamics: Systems Thinking and Modeling for a Complex World, McGraw-Hill

THERMODYNAMICS PROPERTIES OF HYDROCARBON
ENCH800021
3 CREDITS
Learning Objectives:

Able to predict the magnitude of thermodynamic properties of hydrocarbons and the phase condition, either manually or using software calculations.

Syllabus:

Introduction to hydrocarbon thermodynamics properties, basic thermodynamic concepts, P-V-T data correlations, physical properties of hydrocarbon fluids, computing aided thermodynamics properties, the vapor-liquid behavior of two-phase systems, water-hydrocarbon system behavior, product specifications in the disposal lease of hydrocarbon

Prerequisites:

Chemical Engineering Thermodynamics

Textbook:
1. Wayne C. Edmister, Byung Ik Lee, Applied hydrocarbon thermodynamics, Volume 1, Gulf Publishing Company (1988), Houston, Texas.
2. John M. Campbell, Gas Conditioning and Processing, Vol. 1, 8th Edition Campbell Petroleum Series 2001.

LUBRICANT TECHNOLOGY
ENCH800022
3 CREDITS
Learning Objectives:

Able to explain the working principles of lubrication, lubricant function, and several parameters of the quality and lubricant classification, lubricant chemical, and its production technology, either mineral lubricant, synthesis and vegetal.

Syllabus:

Principles of lubrication on friction and wear phenomena on the two surfaces of solid objects are moving together; mode lubrication: hydrodynamic and elastohydrodynamic; lubricants: mineral, synthetic, and vegetable; additives, formulations, degradation, contamination, and maintenance of lubricants; latest development of lubricant technology.

Prerequisites:

Organic Chemistry

Textbook:
1. E. Richard Booster, Handbook of Lubricant: Theory and Practice of Tribology, Vol. I, Vol. II, Vol. III, CRC Press (1984), Inc., Boca Raton, Florida
2. Mervin H. Jones, Industrial Tribology: The Practical Aspect of Friction, Lubricant, and Wear, Elsevier Scientific Publishing Co., New York, 1983.

3. J. Halling, Principle of Tribology, Macmillan Press Ltd., London, 1978
4. Handout

CRYOGENIC TECHNOLOGY

ENCH800023
3 CREDITS
Learning Objectives:

Able to explain the various processes to liquefy gas in cryogenic technology

Syllabus:

History and development of cryogenic, cryogenic scope of work. Refrigeration and liquefaction of natural gas, air, oxygen, nitrogen, helium, neon, and argon.

Prerequisites:

Chemical engineering thermodynamics

Textbook:
1. Timmerhaus, K.D., Cryogenic Process Engineering, Plenum Press 1989, New York.
2. Barron, Randall. Cryogenic Systems, McGraw Hill, 1985, New York.

COMBUSTION TECHNOLOGY

ENCH800024
3 CREDITS
Learning Objectives:

Able to explain the phenomenon of combustion and resolve the problems that rendered correctly.

Syllabus:

chemical kinetics and combustion, the flame, premix flame, diffusion flame, the combustion process applications.

Prerequisite:

Transport Phenomena, Chemical Reaction Engineering 1, Chemical Engineering Thermodynamics

Textbook:
1. Warnatz, J., Maas, U. dan Dibble, R.W., Combustion: Physical and Chemical Fundamentals, Modeling and Simulation, Experiments, Pollutant Formation, 2nd ed., Springer, Heidelberg, 1999.
2. Turns, S.R., An Introduction to Combustion: Concepts and Applications, 2nd ed, McGraw-Hill, 2000.
3. Glassman, I., Combustion, Academic Press, 1997.
4. El-Mahallawy dan el-Din Habik, S., Fundamental and Technology of Combustion, Elsevier, 2002.
5. Combustion, T. J. Poinsot and D. P. Veynante, in Encyclopedia of Computational Mechanicsedited by Erwin Stein, Ren´e de Borst and Thomas J.R. Hughes, 2004 John Wiley & Sons, Ltd.
6. Introduction to Combustion, Concepts and Applications, Stephen R. Turns, 2nd edition, McGraw Hill, 2000
7. Introduction to Combustion Phenomena, A. Murty Kanury, Gordon and Breach Science Publishers, 1975
8. Heat Transfer from Burners, Charles E. Baukal, in Industrial Burners Handbook, edited by Charles E. Baukal, CRC Press, 2004.

PLASMA AND OZONE TECHNOLOGY

ENCH800025
3 CREDITS
Learning Objectives:

Able to explain the physics and chemistry phenomena of plasma formation and release of electromagnetic energy and the use of plasma and ozone technology.

Syllabus:

Basic phenomena and physical-chemical processes of gases that are given an electrical charge (corona discharge), the generation process or formation of ozone, role and use of plasma technology and ozone in chemical engineering processes, the potential of ozone technology in control technology environmental pollution, the ozone generator module manufacturing equipment.

Prerequisite:

Physics Electricity Magnetism

Textbook:
1. E. T. Protasevich: "Cold Non-Equilibrium Plasma", Cambridge International science Publishing, Cambridge, 1999.
2. Rice, R. G., and M. E. Browning: "Ozone Treatment of Industrial Water water", Notes Data Corporation, Park Ridyl, 1981.
3. Metcalf & Eddy, Inc. (Tchobano-glous, G., and FL Burton): "Wastewater Engineering: Treatment, Disposal, and Reuse", McGraw-Hill Book. Co., Singapore, 1991.

HETEROGENEOUS CATALYST

ENCH800026
3 CREDITS
Learning Objectives:

Able to explain the phenomenon of basic concepts heterogeneous catalysts and its application

Syllabus:

The general property of catalyst, thermodynamic of the reaction with catalyst, the distribution of the catalyst based on the type of reaction, the core function is active, the method of selecting catalysts for certain reactions, characterization of the corresponding want to know the nature of the target, the catalyst test methods, methods of development of the catalyst, and reaction products.

Prerequisites:

Chemical Reaction Engineering 1

Textbook:
1. Nasikin M, Susanto BH, "Katlaisis Heterogen", UI Press, 2010
2. Satterfield, C. N., heterogeneous Catalysis in Industrial Practice, McGraw-Hill Inc., New York, 1991.
3. Rase, F. R., Commercial Catalyst, CRC Press, New York, 1991
4. Richardson, T, J., Principles of Catalyst Development, Plenum Press, New York, 1989
5. Thomas J.M. And WJ Thomas, Principles and Practice of Heterogeneous Catalysis, VCH, Weinhem, Germany, 1997
6. Emmet, R. H., Catalysis, Reinhold Publishing Corporation, New York, 1961

SUSTAINABLE ENERGY

ENCH800027
3 CREDITS
Learning Objectives:

Able to explain the relationship of energy with a social aspect, economic and environmental and sustainability concepts, and able to analyze the performance of techno-economy and the continuity, especially fossil energy system, new, and renewable.

Syllabus:

Concept of sustainability and sustainable energy, energy hierarchy, energy linkages with economic, environmental and social, fossil energy/fuels and Impacts, global climate change and its mitigation, conversion, transportation/distribution and storage, the analysis method of energy sustainability: LCA, sustainability index, hydrogen and fuel cells and nuclear energy, solar energy (PV and thermal), wind and ocean, hydropower, bioenergy, geothermal energy, energy efficiency and conservation, carbon capture, and storage

Prerequisites:

Chemical Engineering Thermodynamics or Biochemical Engineering

Textbook:
1. Jefferson W. Tester, et al., Sustainable Energy: Choosing Among Options, MIT Press, 2005.
2. Godfrey Boyle, et al., Energy Systems and Sustainability: Power for a Sustainable Future, Oxford University Press, 2003.
3. E. Cassedy S, Prospects for Sustainable Energy: A critical assessment, Cambridge University Press, 2000.
4. DeSimone et al., Eco-Efficiency. The Business Link to Sustainable Development, MIT Press, 1997.
5. D. Elliot, Energy, Society, and Environment, Technology for a sustainable future, Rouledge, 1997
6. Miller, G. T., Environment Science. Sustaining Earth, Wardworld Publish Co. 1993

RISK MANAGEMENT
ENCH800028
3 CREDITS
Learning Objectives:

Able to explain and apply risk management in a risk assessment.

Syllabus:

Introduction to the risk, the basic principles and guidelines concerning risk, risk management standards, risk assessment, risk analysis, risk analysis and simulation, simulation of the risk with Montecarlo method, the risk of using software simulation crystal ball.

Prerequisites: -

Textbook:

J. F. A. Stoner, Management, 1986

ELECTROCHEMICAL TECHNOLOGY
ENCH800029
3 CREDITS
Learning Objectives:

Able to understand the basic principles of electrochemical technology and apply them in the design of electrochemical systems for various applications.

Syllabus:

Basic electrochemical principles and electrochemical cell concepts; electrochemical cell thermodynamics (Nernst equation, Pourbaix diagram, etc.); electrochemical cell kinetics (the mechanism of electrochemical redox reactions, Marcus theory, Butler-Volmer model, etc.); polarization/ overpotential on electrochemical cells (ohm polarization, activation polarization, concentration polarization, etc.); the phenomenon of mass transfer in electrochemical cells (migration, diffusion, convection, etc.); electrochemical analysis (voltammetry, chronoamperometry, AC impedance, etc.); electrode-electrolyte interface phenomena (double layer theory, surface capacitance, ion adsorption, etc.); semiconductor electrodes (photoelectrochemical); and various electrochemical applications (fuel cells, solar cells, batteries, etc.)

Prerequisite:

Physical Chemistry, Thermodynamics of Chemical Engineering, Chemical Reaction Engineering 1

Textbook:
1. Keith B. Oldham dan Jan C. Myland. Fundamentals of Electrochemical Science, Academic Press, Inc., 1st Edition, London, 1994.
2. Richard G. Comption dan Craig E. Banks. Understanding Voltammetry, 3rd Edition, World Scientific, London, 2018
3. Norio Sato. Electrochemistry at Metal and Semiconductor Electrodes, 1st Edition, Elsevier Science & Technology, Oxford, 1998.
4. Marcel Pourbaix. Atlas of Electrochemical Equilibria in Aqueous Solutions, 2nd Edition, NACE International, Brussels, 1974
5. Allen J. Bard, Martin Stratmann, and all authors. Encyclopedia of Electrochemistry, 1st Edition, *John Wiley & Sons*, New York 2007

EXTRACTION & ISOLATION FOR NATURAL PRODUCTS TECHNOLOGY
ENCH800030
3 CREDITS
Learning Objectives:

Able to compare various principles that relate to extraction technology and isolation of natural materials; Determine extraction and / or isolation techniques appropriate for certain natural materials; Developing process skills to solve problems related to the field of extraction technology and natural material isolation

Syllabus:

Natural substances and secondary metabolites, Variety of natural material products, Selection and preparation of materials for extraction, Selection and preparation of materials for isolation, Natural material extraction techniques, Fractionation techniques and isolation of natural materials

Prerequisite: -

Textbook:
1. Rydberg, Cox, & Musikas. Solvent Extraction Principles and Practice 2nd Edition. Marcel Dekker, Inc. 2004.
2. Meireles, M. Angela A. Extracting Bioactive Compounds for Food Products: Theory and Applications. CRC Press – Taylor & Francis Group, LLC. 2009.
3. Rostagno, Mauricio A. & Prado, Juliana M. Natural Product Extraction: Principles and Applications. RSC Publishing. 2013.

SPECIAL TOPIC 1
ENCH800031
3 CREDITS

NATURAL GAS PROCESSING
ENCH800033
3 CREDITS
Learning Objectives:

Able to design natural gas refineries for piped gas, pressurized natural gas, or LNG if given a fluid composition that reaches the surface of the reservoir.

Syllabus:

Introduction and terms in Natural Gas Processing; Physical Properties of Hydrocarbon Fluid; Hydrocarbon Water System; Hydrate; Dew Point Control Unit; AGRU; Absorption Dehydration Unit; Adsorption Dehydration Regeneration Unit; Heavy Hydrocarbon Recovery Unit; LNG Processing

Prerequisites:

Chemical Process Simulation

Textbook:
1. Maddox, R.N. dan Morgan, D.J., Pengondisian dan pemrosesan gas, Vol 4: Mengolah gas dan sulfur pemulihan, Campbell Petroleum Series, 1998.
2. Kohl, A. dan Nielsen, R., pemurnian gas, Edisi ke-5, Gulf Publishing Company, 1997.
3. Kidnay, A.J. dan Parrish, W.R., Fundamentals of natural gas processing, Taylor & Francis, 2006
4. Gas Conditioning and Processing Vol. 1
5. Gas Conditioning and Processing Vol. 2

Elective Courses in Even Semester

PACKAGING AND STORAGE TECHNOLOGY
ENCH800034
3 CREDITS
Learning Objective:

Students are able to describe characteristics, packaging and storage food technology, the relation between storage and packaging with quality of food, describe factors affecting deviation of food qualities as well as able to choose storage methods and packaging types which is appropriate to food materials.

Syllabus:

Hydratase, material storage technology and food products, deviation of food material qualities, microbial contaminant, purpose and function of food packaging, interaction between food packaging and packaging material types

Prerequisite : -

Textbook :
1. Examining Food Technology by Anne Barnett. Heinemann Secondary,1996
2. Julianti, Sri. The Art of Packaging. Gramedia Pustaka Utama. 2014.
3. Han, Jung H., et al. Innovations in Food Packaging. Elsevier. 2005.

BIOINFORMATICS
ENCH800035
3 CREDITS
Learning Objective:

Are able to explore database and programs to be applied in genetic engineering sectors, proteomic etc

Syllabus:

Database, genomics, genetic molecular, phylogeny, protein structure, metabolism and tissues

Textbook:
1. Bioinformatics by Shalini Suri. APH Publishing, 2006
2. Bioinformatics: A Primer by Charles Staben and Staben. Jones & Bartlett Publishers, 2005

DRUGS AND COSMETICS TECHNOLOGY
ENCH800036
3 CREDITS
Syllabus:

Definition of drugs and cosmetics, types of skins and characteristics, cosmetic types, ethics and regulation of drugs and cosmetics, new drug development technology, process technology in drug and cosmetics industries, packaging technology of drugs and cosmetics technology.

Prerequisite:

Organic Chemistry

Textbook:
1. Handbook of Cosmetic Science and Technology by Andre O. Barel, Marc Paye, Howard I. Maibach. INFRMA-HC 2009
2. Biodesign: The Process of Innovating Medical Technologies by Stefanos Zenios, Josh Makower , Paul Yock , Todd J. Brinton, Uday N. Kumar, Lyn Denend, Thomas M. Krummel.

PETROLEUM PROCESSING
ENCH800037
3 CREDITS
Learning Objectives:

Able to explain petroleum characteristics and its refined product and the stages of the process from various petroleum processing technologies.

Syllabus:

Introduction terminology, oil composition, thermal properties of petroleum, chemical processing of petroleum processing, distillation, hydrogenation and dehydrogenation, cracking processes, the processes of reforming, gas processing and petroleum light products, product improvement.

Prerequisites:

Fluid and Particle Mechanics, Thermodynamics, Mass Transfer.

Textbook:
1. James G. Speight, The Chemistry and Technology of Petroleum, 5th Edition. CRC Press, 2014.
2. Mark J. Kaiser, Arno de Klerk, James H. Gary and Glenn E. Handwerk, Petroleum Refining: Technology, Economics, and Markets, 6th Edition. CRC Press, 2019.
3. D. S. J. Jones, Elements of Petroleum Processing, John & Sons Wiley

PETROCHEMICAL PROCESSING
ENCH800038
3 CREDITS
Learning Objectives:

Able to explain the development of petrochemical products and raw material potential, upstream / downstream petrochemical production lines (olefin center, aromatic center, and the pathways of methane) and the major production processes of several petrochemical industries through methane, olefins and aromatics; able to analyze the impact of industrial processes and petrochemical products to the environment.

Syllabus:

History of the general petrochemical products development and raw material potential, the scope of the petrochemical industry, petrochemical classification process, the type and processing raw materials into petrochemical products, the details of various petrochemical industry: olefins center, aromatics and the center line of methane, industrial and environmental impact of products petrochemicals.

Prerequisites:

Organic Chemistry

Textbook:
1. Martyn V. Twigg, “Catalyst Handbook”, 2nd Ed., Wolfe Pub. Ltd.
2. Lewis T. Hatch, Sami Matar, “From Hydrocarbon to Petrochemical”.
3. Wells, Margaret G., “Handbook of Petrochemicals and Processes”, Gower Publishing Company Ltd., 1991.

4. Pandjaitan Maraudin, Industri Petrokimia dan Pengaruh Lingkungan, Gadjah Mada University Press, 2002.

PHOTOCATALYSIS TECHNOLOGY
ENCH800037
3 CREDITS
Learning Objectives:

Able to understand the basic concepts and photocatalysis and apply them in the various simple daily problem, especially related to environment, health, and energy.

Syllabus:

The basic concept photocatalysis processes, thermodynamics and kinetics of photocatlytic process, semiconductor photocatalyst materials, the basic parameters of photocatlytic process, Photocatalyst Nanomaterial Engineering, photocatlytic applications for degradation of organic pollutants and heavy metals, photocatalysis applications for self-cleaning and anti fogging, photocatalysis applications for anti-bacterial and cancer therapy, photocatalysis applications for engineering 'daily life tools', photocatalysis applications in renewable energy sector, solar detoxification engineering with photocatalysis, intensification of photocatalysis process.

Prerequisites:

Chemical Reaction Engineering 1

Textbook:
1. M. Schiavello, Heterogeneous Photocatalysis, John Wiley & Sons, 1997.
2. A. Fujishima, K. Hashimoto, and T. Watanabe, TiO2 Photocatalysis: Fundamentals and Applications, BKC Inc. Japan, 1999.
3. J.B. Galvez, et.al., Solar Detoxification, Natural Sciences, Basic and Engineering Sciences, UNESCO.
4. M. Kaneko, I. Okura, Photacatalysis Science and Technology, Springer USA, 2002.
5. C.A. Grimes, G.K. Mor, TiO2 Nanotube Arrays: Synthesis, Properties, and Applications, Springer, New York, 2009.
6. Paper-paper dan bahan lain dari berbagai Jurnal Ilmiah dan website.

EXPLORATION AND PRODUCTION OF HYDROCARBON
ENCH800040
3 CREDITS
Learning Objectives:

Students are able to explain the economic concept of natural gas and analyze the 4e economy.

Syllabus:

Introduction of hydrocarbon, life cycle of field development, hydrocarbon form and hydrocarbon property and reservoir, hydrocarbon exploration: geology, geophysics, and drilling, field appraisal, reservoir development, drilling development, hydrocarbon production, HSE, hydrocarbon economy and lease, coal and hydrocarbon unconventional (CBM, Shale gas, and Hydrate Gas)

Prerequisites:-

Textbook:
1. Frank Jahn et all, 2008, Hydrocarbon Exploration and Production, Developments in Petroleum Science, second edition
2. Babusiaux et al., 2004, Oil and Gas Exploration and Production. Reserves, Cost and Contracts, IFP-Technip,
3. M. Kelkar, 2008, Natural Gas Production Engineering, PennWell Publications
4. Norman J. Hyne, 2001, Nontechnical Guide to Petroleum Geology, Exploration, Drilling and Production, Pennwell Books, 2 edition.

POLLUTION PREVENTION
ENCH800041
3 CREDITS
Learning Objectives:

Able to explain the concepts of pollution prevention and able to design the waste treatment system.

Syllabus:

Introduction to the concept of pollution prevention, wastewater treatment outline and preparation, wastewater treatment in physical, biological, and chemical as well as the operating unit, bioremediation, bioseparation and biodegradation, advanced oxidation processes, the handling of waste gas, waste handling B3, solid waste handling, effluent treatment, gas, is unconventional.

Prerequisites:

Chemical Reaction Engineering 1.

Textbook:
1. Freeman, H. M., Industrial Pollution Prevention Handbook, McGraw-Hill, New York, 1995.
2. Eckenfelder, W. W., Jr.., Industrial Water Pollution Control. 3rd ed. McGraw-Hill International Editions, New York, 2000.
3. Metcalf & Eddy. (Revised by Tchobanoglous, G. & F. L. Burton). Waste Water Engineering: Treatment, Disposal, Reuse, 3rd ed., McGraw-Hill, Singapore, 1991.
4. Heinson R. J. & R. L. Cable. Source and Control of Air Pollution. Prentice Hall. New Jersey. Of 1999.
5. Legislation on the prevention of pollution and waste management.
6. Journals, the Internet.

MICROALGAE CULTIVATION AND DEVELOPMENT TECHNOLOGY
ENCH800042
3 CREDITS
Learning Objectives:

Able to have insight into the use of microalgae from the cultivation process to its conversion into products of high economic value; able to develop the utilization of microalgae by using a variety of technologies that are currently developing.

Syllabus:

Introduction to microalgae, microalgae cultivation process, microalgae harvesting techniques, the process of extracting microalgae into algal oil and its residues, economic analysis of the development and utilization of microalgae.

Prerequisites: -

Textbook:
1. Richmond, Amos, et al. 2013. Handbook of Microalgal Culture: Applied Phycology and Biotechnology, 2nd Ed. John Wiley and Sons
2. E.W. Becker. 1994. Microalgae: Biotechnology and Microbiology. London, Cambridge University Press.

UTILITIES AND PLANT MAINTENANCE
ENCH800043
3 CREDITS
Learning Objectives:

Able to explain the strategy of plant and utility maintenance.

Syllabus:

Plant maintenance strategy: maintenance program, maintainability, reliability, planning and scheduling

Prerequisite:

Chemical Engineering Thermodynamics

Textbook:
1. Dhillon, B.S., Engineering Maintenance: A Modern Approach, CRC Press, 2002.
2. Higgins, L.R., Mobley, R.K. dan Smith, R., Maintenance Engineering Handbook, McGraw-Hill, 2002.
3. Sanders, R.E., Chemical Process Safety, Elsevier, 2005.
4. Palmer, D., Maintenance Planning and Scheduling Handbook, McGraw-Hill, 1999.

TRANSPORTATION AND UTILIZATION OF NATURAL GAS

ENCH800044
3 CREDITS
Learning Objectives:

Able to analyze several options for the use of natural gas for both energy and feedstocks

Syllabus:

Overview of natural gas: nature and quality, historical milestones, environmental aspects, international issues, and structure of the natural gas industry; transportation and storage of natural gas in the gas phase and liquid phase; natural gas utilization: gas as fuels, gas to synfuels and chemicals, gas to wires/power

Prerequisite: -

Textbook: -

MIXING TECHNOLOGY

ENCH800045
3 CREDITS
Learning Objectives:

Able to understand the basic principles of mixing technology and apply them in the design of mixing systems for various applications in industry.

Syllabus:

Definition of mixing, basic principles and basic concepts of mixing; mixing and mixing mechanism, mixing thermodynamics, mixing fluid flow, friction in mixing, etc.), types of mixing (gas-liquid, liquid-liquid, liquid-solid, suspension, emulsification), mixing techniques (agitation, blending, mixing, particle size reduction, sear etc.), mixing equipment both batch and continuous (mixer type, drainage type, etc.), mixing monitoring and control. Examples of the application of blending in the chemical, pharmaceutical, cosmetic and food industries.

Prerequisites:

Physical Chemistry, Fluid Mechanics and Materials Science

Textbooks:
1. Handbook of Industrial Mixing: Science and Practice edited by Edward L. Paul, Victor A. Atiemo-Obeng, Suzanne M. Kresta, John Wiley and Sons Inc. Publication (2003).
2. Food Mixing: Principles and Applications, edited by P. J. Cullen, Ireland, John Wiley and Sons Inc. Publication (2007).
3. Pharmaceutical Blending and Mixing 1st Edition by P. J. Cullen (Editor), Rodolfo J. Romañach (Editor), Nicolas Abatzoglou (Editor), Chris D. Rielly, John Wiley and Sons Inc. Publication (2015)..

PROBLEM SOLVING SKILLS

ENCH800046
3 CREDITS
Learning Objectives:

Able to develop an understanding of the Problem Based Learning (PBL) learning method in order to be able to direct their own learning (independent learning), communicate effectively and work in groups; able to develop the ability to think critically, creatively, innovatively and have the intellectual ability to solve problems effectively both individually and in groups

Syllabus:

Introduction to PBL, individual problem-solving concepts, problem-solving concepts in groups

Precondition: -

Textbooks:
1. Woods, D. R., 1994, Problem based learning: How to gain the most from PBL, McMaster University, Hamilton, ON L8S 4L8.
2. Journal or articles related to each PBL problem.

POLYMER TECHNOLOGY

ENCH800047
3 CREDITS
Learning Objectives:

Able to develop an understanding of the basic principles of polymer synthesis and characterization, so that they can understand, solve polymer problems found in daily life and in industry, and can keep abreast of developments in the latest polymer technology.

Syllabus:

The concept of polymers, Synthesis and kinetics of polymerization, Polymer solutions, Characterization, Plastic manufacturing processes.

Prerequisite:

Organic Chemistry

Textbooks:
1. Billmeyer, F.W, 2011, **Textbook** of Polymer Science,3rd edition, John Wiley & Sons Inc.
2. Young, R.J. and Lovell, P.A, 2011, Introduction to Polymers, R.J.Lovell, 3rd edition, CRC Press. Taylor & Francis Group, Boca Raton, FL 33487-2742.
3. Seymour, R.B, 1989, Polymers for Engineering Applications, ASM International.
4. Crawford, R.J, 1998, Plastic Engineering, 3rd edition, Butterworth-Heinemann, Woburn, MA 01901-2041.
5. Woods, D. R., 1994, Problem based learning: How to gain the most from PBL, McMaster University, Hamilton, ON L8S 4L8.
6. Journal or articles related to each PBL problem.

GENETICALLY MODIFIED ORGANISM

ENCH800048
3 CREDITS
Learning Objectives:

Students are able to plan the design of transgenic organisms for purposes in the fields of food, pharmacy and health, energy, or the environment as one of the supporting knowledge in Bioprocess Technology courses

Syllabus:

Gene expression and function, genome, introduction and development of GMO organisms, genome modification techniques, methods of analyzing GMO organisms, GMO organisms in food, GMO organisms in pharmacy and health, GMO organisms in energy, GMO organisms in the field the environment, and the latest research and applications related to GMO organisms.

Prerequisite:

Genetic Engineering

Textbooks:
1. Harvey Lodish, Arnold Berk, Chris A. Kaiser and Monty Krieger. W. H. Molecular Cell Biology. 6th edition. FreemanS
2. T. A. Brown. 2010. Gene Cloning and DNA Analysis. 6th edition. Willey Blackwell: Hongkong.
3. Jurnal ilmiah terbaru terindeks scopus

DRUG CONTROLLED RELEASED TECHNOLOGY
ENCH800049
3 CREDITS
Learning Objective:

Able to describe the principle of control drug release or bioactive compound for medical purposes and utilize the principle to apply control drug released technology

Syllabus:

Polymeric biomaterial that is easily degradable, various methods to drug encapsulation and bioactive compounds in nano/microsphere, diffusion and permeation, the strategy of control released, case study

Prerequisite:

Organic Chemistry

Textbook:
1. Juergen Siepmann et al. (ed.) Fundamentals and Applications of Controlled Release Drug Delivery, Springer
2. Clive Wilson and Patrick Crowley (ed.) Controlled Release in Oral Drug Delivery, Springer
3. Hong Wen and kinam Park (ed.) Oral Controlled Release Formulation Design and Drug Delivery, Wiley, 2010.
4. WM Saltzman, Drug Delivery: Engineering Principles for Drug Therapy, Oxford University Press, 2001.
5. Nissim Garti, Delivery and *controlled release of bioactives in foods and nutraceuticals*, CRC Press, 2008.

SPECIAL TOPIC 2
ENCH800050
3 CREDITS

BIOMASS TERMOCHEMICAL CONVERSION TECHNOLOGY
ENCH800051
3 CREDITS
Learning Objectives:

Able to understand the chemical characteristics of biomass and the basic principles of thermo-chemical biomass conversion technology and its application in the design of biomass thermo-chemical conversion systems to produce fuels and chemicals.

Syllabus:

Chemical characteristics of biomass, biomass classification, thermo-chemical conversion through pyrolysis (fast pyrolysis, slow pyrolysis, co-pyrolysis, hydrodeoxygenation, catalytic pyrolysis, catalytic co-pyrolysis, pyrolysis reactor), thermo-chemical conversion through biomass gasification, thermo-chemical conversion through biomass ligation , physical and chemical analysis of biomass feed and biomass thermo-chemical conversion products, pyrolysis for the manufacture of biofuels and chemicals, biomass gasification for the manufacture of synthetic gases, liquefaction of biomass for the manufacture of biofuels.

Prerequisites:

Organic Chemistry, Heat Transfer, Chemical Reaction Techniques 1

Textbooks:
1. Robert C. Brown, Thermochemical processing of biomass: conversion into fuels, chemicals and power, 2nd edition, Wiley Series in Renewable Resources, 2019
2. Mark Crocker, Laurie Peter, Ferdi Schuth, Tim Z. Zhao, Heinz Frei, Thermochemical conversion of biomass to liquid fuels and chemicals, RSC Publishing, 1st edition, 2010
3. James Clark and Fabien Deswarte, Introduction to chemicals from biomass, 2nd edition, John Wiley and Sons, 2015
4. Piet Schenkelaars, Value-added chemicals from biomass, Pira International Ltd, 2012

BASIC COMPUTER PROGRAMMING
ENCH800052
3 CREDITS

Learning Objectives:

Able to formulate and solve cases using logical concepts and programming algorithms and able to construct simple programs consisting of consecutive instructions in Python and MATLAB.

Syllabus:

Introduction: Why should one learn to write programs; Variables, expressions, and statements; Conditional executions; Functions; Iteration; Strings; Files; Lists; Dictionaries; Tuples; Using Python for numerical integration with the Simpson's rule, to solve root finding problem employing the secant method, to solve ordinary differential equation; Introduction to MATLAB/GNU Octave; Numerical methods with MATLAB/GNU Octave; Application of MATLAB/GNU Octave in transport phenomena and chemical reaction engineering.

Prerequisites:

Textbooks:
1. Constantinides, A. dan Mostouvi, N., 1. Numerical Methods for Chemical Engineers with MATLAB Applications, Prentice Hall, 1999.
2. Davis, M.E., Numerical Methods and 2. Modeling for Chemical Engineer, John Willey & Sons, New York, 1984.
3. Rice, G.R. dan Duong D.D., Applied 3. Mathematics and Modeling for Chemical Engineers, John Willey & Sons, New York, 1995.
4. Tosun, I., Modeling in Transport Phenomena: 4. A Conceptual Approach, Elsevier, 2002.

PEMODELAN TEKNIK BIOPROSES
ENCH800053
3 CREDITS
Learning Objectives:

Able to develop mathematical equations from biochemical process systems; able to solve mathematical equations that describe biochemical process systems.

Syllabus:

An explicit method for solving ordinary differential equations; Finite difference method for solving ordinary & partial differential equations; Empirical Model; Phenomenological model for multi-component separation systems;

Phenomenological model for chemical reaction systems; Phenomenological model for reactor systems

Prerequisites:

Komputasi Numerik (Numerical Computation)

Textbooks:
1. Constantinides, A. dan Mostouvi, N., 1. Numerical Methods for Chemical Engineers with MATLAB Applications, Prentice Hall, 1999.
2. Davis, M.E., Numerical Methods and 2. Modeling for Chemical Engineer, John Willey & Sons, New York, 1984.
3. Rice, G.R. dan Duong D.D., Applied 3. Mathematics and Modeling for Chemical Engineers, John Willey & Sons, New York, 1995.
4. Tosun, I., Modeling in Transport Phenomena: 4. A Conceptual Approach, Elsevier, 2002.

BIOPROCESS ENGINEERING DRAWING
ENCH800054
3 CREDITS
Learning Objectives:

Able to manually draw process flow diagrams, P&ID and plant layouts, recognize the use of software for drawing, understand, and be able to read the meaning of images.

Syllabus:

Introduction to drawing techniques; Basics of drawing technique; Block Process Flow Diagram; Symbols basic symbols of equipment Chemical industry and process flow; Process Flow Diagram (PFD); Equipment symbols, pipes, instrumentation; Piping and Instrumentation Diagram (P&ID); Software for drawing; Plant Plots & Plant Layouts; Piping Route and Isometric Drawing; Spool Drawing and Bill of Materials (BOM). Bill of Quantity (BOQ)

Prerequisites: -

Textbooks:
1. W. Boundy, Engineering Drawing, McGraw-Hill Book Company
2. Colin Simmons & Dennis Maguire, Manual of Engineering Drawing, Edward Arnold
3. ISO 1101, Mechanical Engineering Drawings, International Organization for Standardization
4. Japanese Industrial Standard, Technical Drawing for Mechanical Engineering, Japanese Standard Association.
5. Warren J. Luzadder, Fundamentals of Engineering Drawing, Prentice-Hall, Inc

Undergraduate Program in Industrial Engineering

Program specification

1.	**Awarding Institution**	Universitas Indonesia	
2.	**Host Institution**	Universitas Indonesia	
3.	**Faculty**	Engineering	
4.	**Program Tittle**	Undergraduate Program in Industrial Engineering	
5.	**Vision and Mission**	The vision of the industrial engineering undergraduate program of the Universitas Indonesia is to be the leading study program in Indonesia in developing the field of industrial engineering to design, improve and install a complex and integrated industrial system through a systematic problem-solving process by using analytical, computational and experimental methods to improve productivity and sustainable quality. The mission of the industrial engineering undergraduate program of the Universitas Indonesia is to implement an industrial engineering higher education program with international awareness, supported by internationally competitive research and provide adaptive, useful, and professional community service to support Indonesia's sustainable development.	
6.	**Class**	Regular, parallel, international, Fast Track	
7.	**Final Award**	Bachelor of Engineering	
8.	**Accreditation / Recognition**	Accreditation Excellent by BAN-PT and international Assessment by AUN-QA	
9.	**Language(s) of Instruction**	Indonesian and English	
10.	**Study Scheme (Full Time / Part Time)**	Full Time	
11.	**Entry Requirements**	High School graduate/equivalent or D3/Polytechnic graduate and pass the entrance exam	
12.	**Study Duration**	Scheduled for four years	
	Type of Semester	Number of Semester	Number of weeks / semester
	Regular	8	16
	Short (optional)	3	8
13.	**Aims of the study program** 1. Apply industrial engineering knowledge to design, improve, and install integrated industrial systems to enhance the organization's global competitive advantage. 2. Provide professional skills and knowledge to succeed in the preferred profession. 3. Provide the ability to work effectively and ethically as a leader, team member, and as an individual to make better improvement in the organization.		
14.	**Graduate Profile:** An industrial engineer that has roles in designing, improving, and installing a complex and integrated industrial system through a systematic problem-solving process using various analytical, computational, and experimental tools and methods to improve productivity and quality.		

15.	**Expected Learning Outcomes:** Bachelor of Industrial Engineering has expected learning outcomes as follow: 1. The ability to apply mathematics, science, and engineering principles 2. The ability to design and implement research and research projects, as well as analyzing and interpreting data. 3. The ability to design, implement and improve the performance of an integrated system, component, or process to meet realistic constraints such as economics, environment, social, politics, law, ethics, human factors, health and safety, manufacturing feasibility, and sustainability 4. The ability to identify, formulate, and solve engineering problems. 5. The ability to use modern and required techniques, skills, and tools in engineering practice 6. The ability to be active in a multi-disciplinary team. 7. The ability to work professionally and have ethical responsibilities 8. Has a broad understanding of the impact of engineering problem-solving in global, economic, environmental, and social contexts. 9. The ability to study independently and continuously (lifelong learning) 10. The ability to communicate using spoken and written languages in Indonesian and English for both academic and non-academic activities (UI's competence) 11. The ability to use information and communication technology (UI's Competence) 12. The ability to identify a variety of entrepreneurial efforts that are characterized by ethical innovation and self-sustained (UI's competence) 13. The ability to critical, creative, and innovative thinking and has the intellectual curiosity to solve problems at individual and group levels (UI's competence) 14. The ability to provide alternative solutions to various problems that arise in the community, nation, and state of Indonesia (UI's competence).		
16.	**Curriculum composition**		
No.	**Types of teaching eyes**	**Credits**	**Percentage**
I	Compulsory courses at the university level	18	12,5%
II	Compulsory courses at the faculty level	19	13,2%
III	Compulsory courses at the study program level	85	59,00%
IV	Elective courses	15	10,4%
V	Special courses (internship and undergraduate thesis)	7	4,9%
	Total	144	100%
	Total Credits for Graduation		**144 sks**

Job Prospects

Graduates of industrial engineering Universitas Indonesia are directed to have strong and systematic problem-solving skills with a multi-disciplinary approach in an industrial engineering scientific framework. The science of Industrial Engineering itself is unique engineering filed because it involves a multi-disciplinary approach. Graduates of this study program have been working on manufacturing and public and private services industries in the field of production management, human resources, maintenance systems, logistics and supply chain management, finance and banking, management, and I.T. consulting services.

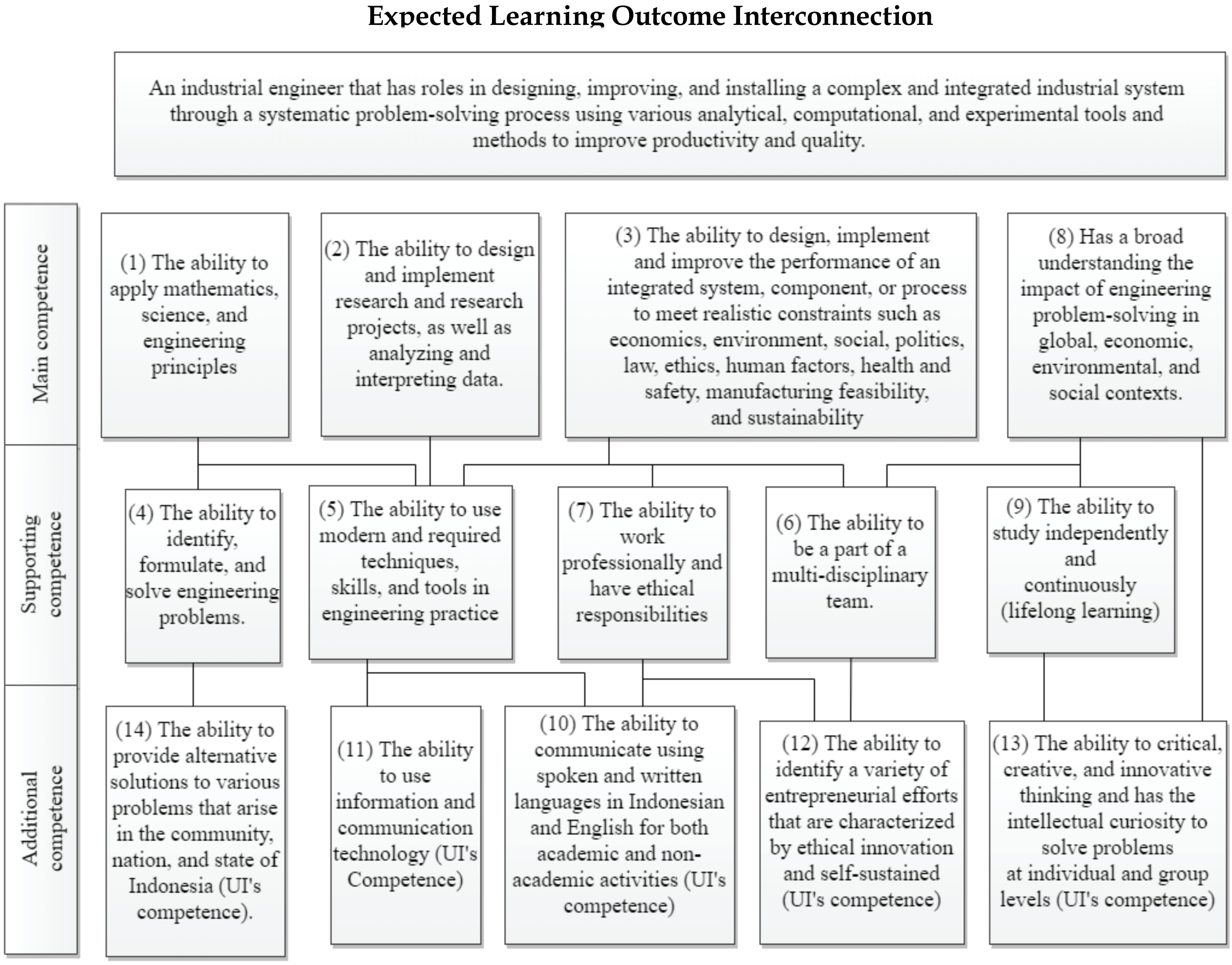
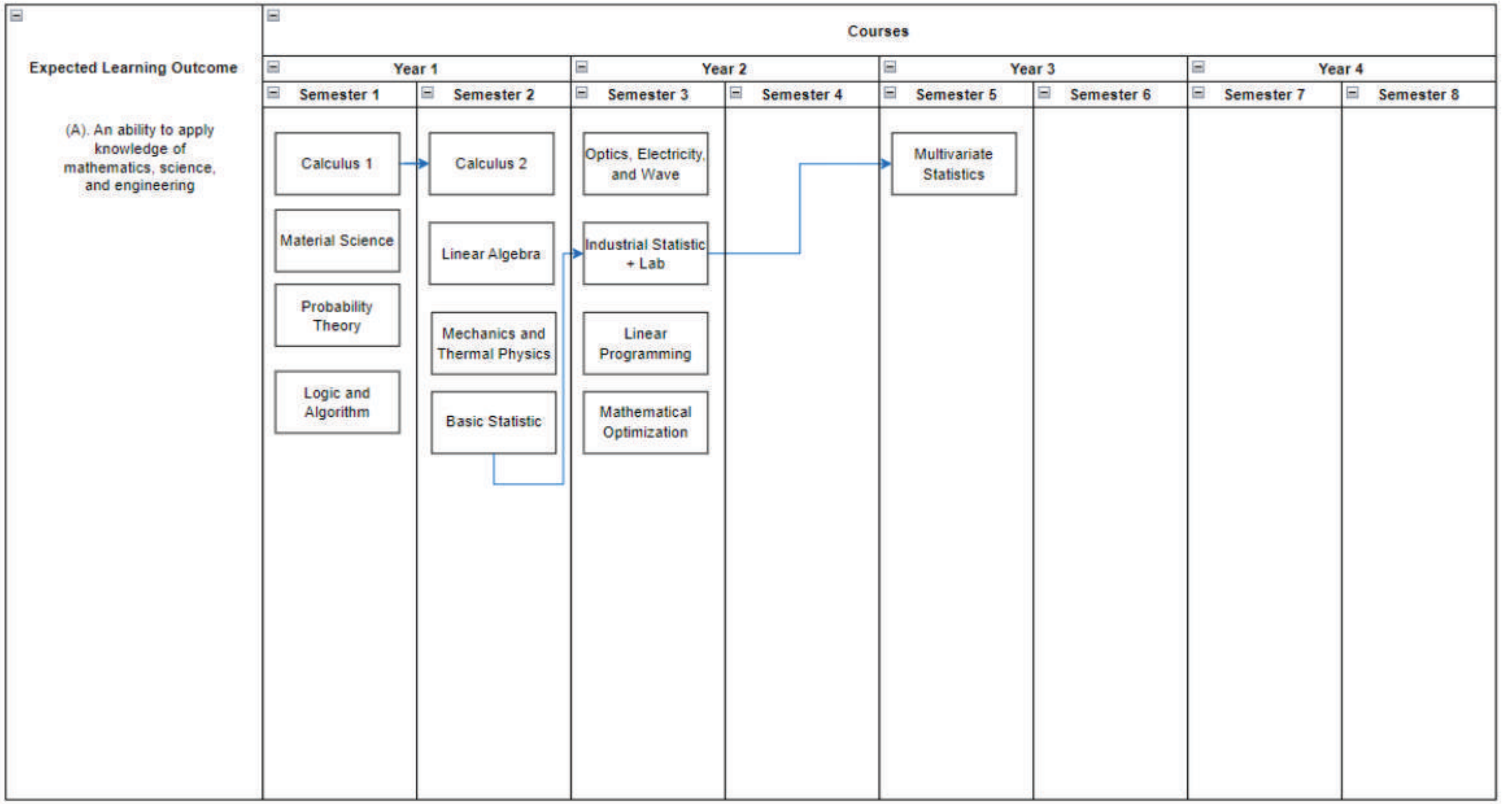
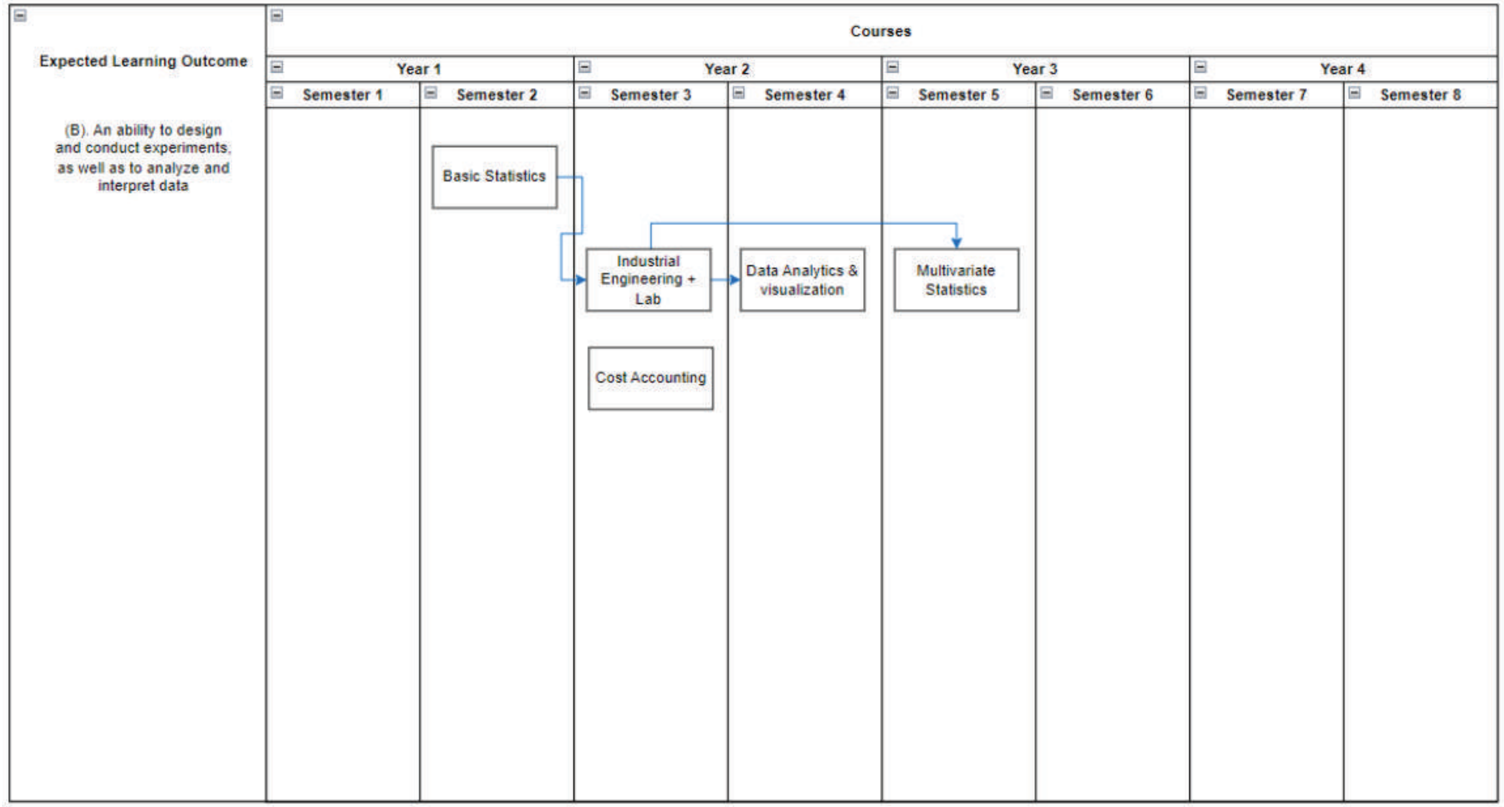
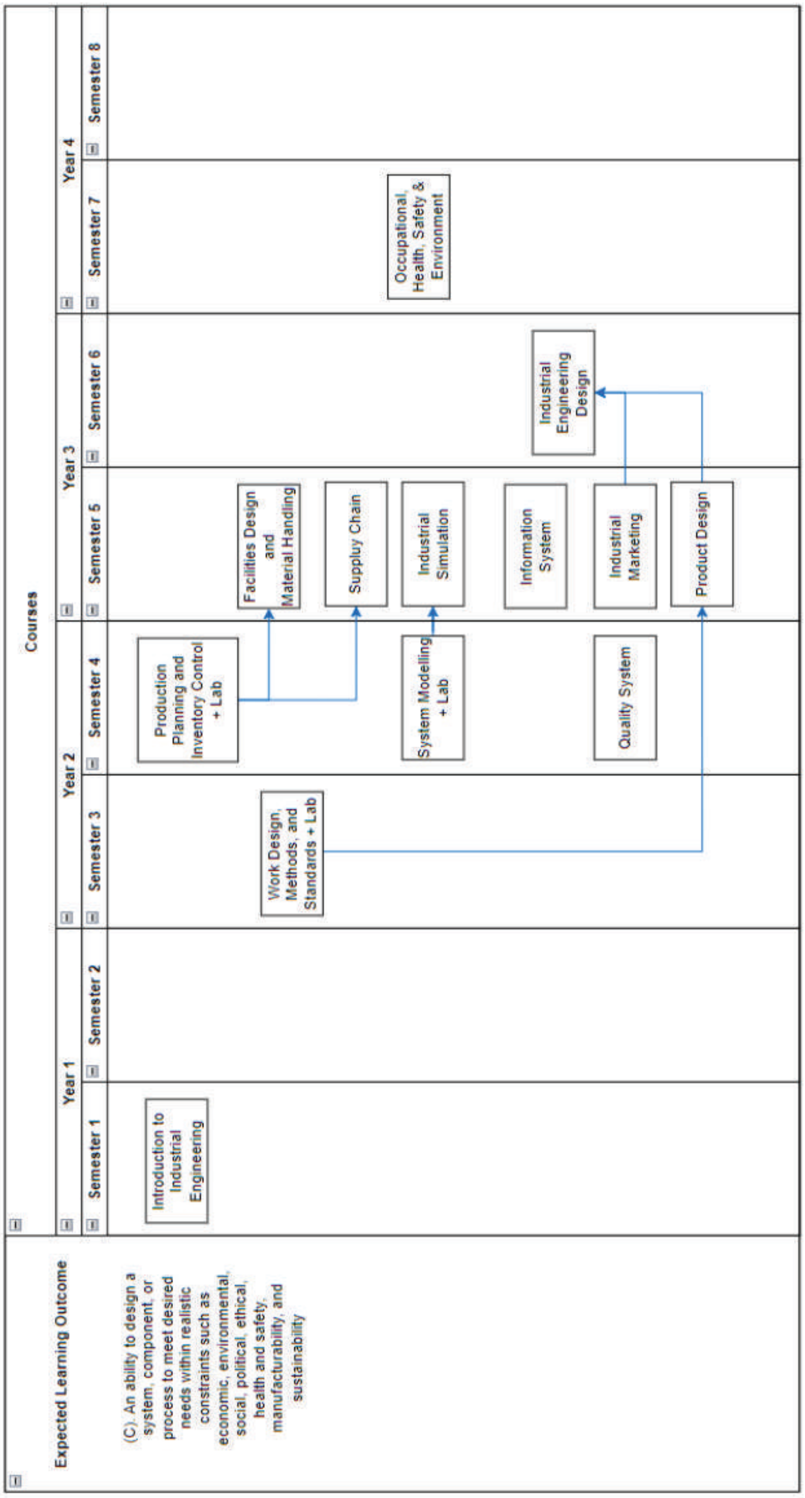


Fig. 1 Competencies Network for Industrial Engineering Study Program

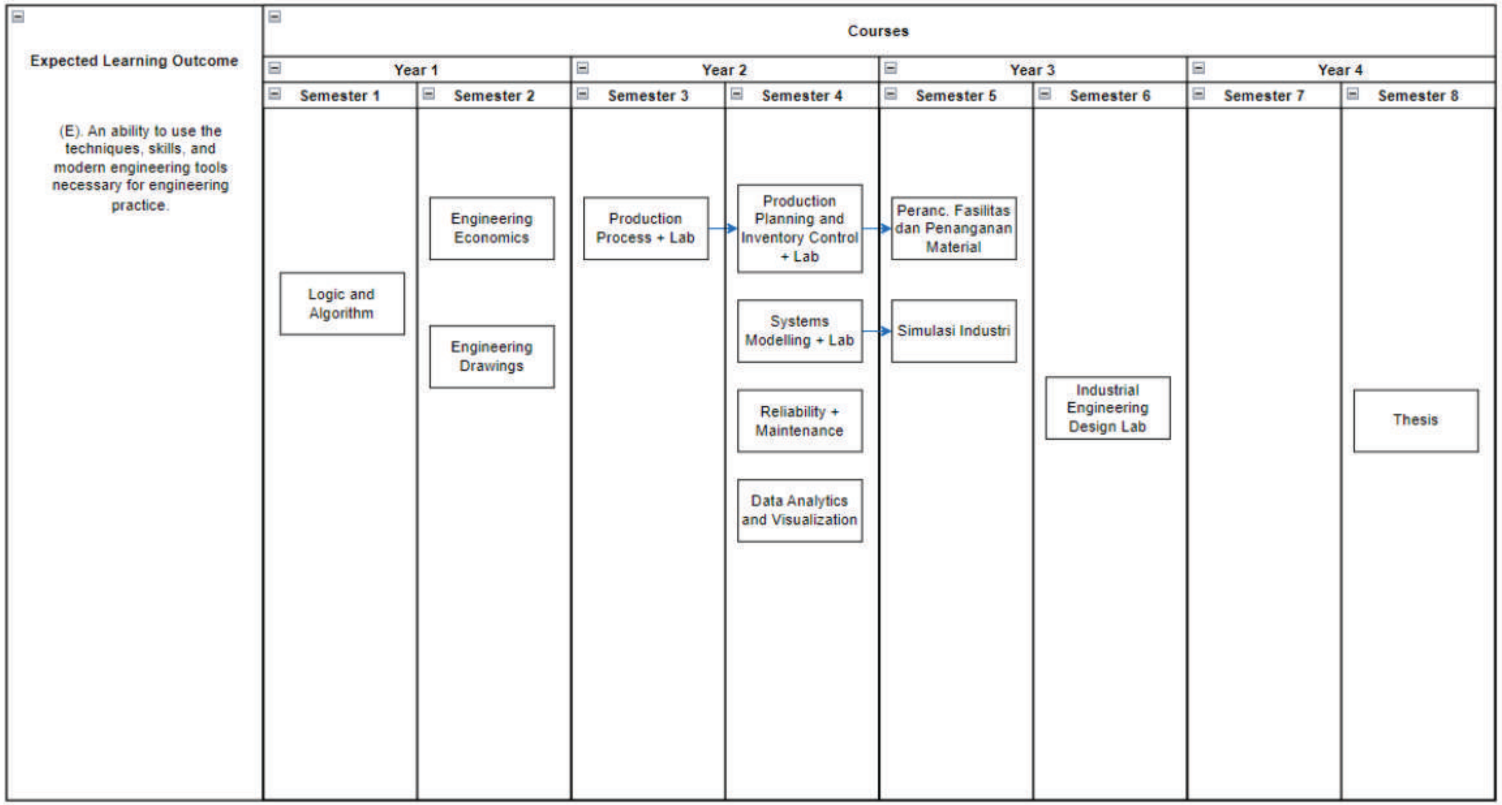
Flowchart of courses to attain the expected learning outcomes in the Bachelor of Industrial Engineering




Expected Learning Outcome
Courses
Year 1
Year 2
Year 3
Year 4
Semester 1
Semester 2
Semester 3
Semester 4
Semester 5
Semester 6
Semester 7
Semester 8
(B). An ability to design and conduct experiments, as well as to analyze and interpret data
Basic Statistics
Industrial Engineering + Lab
Data Analytics & visualization
Multivariate Statistics
Cost Accounting


Expected Learning Outcome
(C). An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
Courses
Year 1
Year 2
Year 3
Year 4
Semester 1
Semester 2
Semester 3
Semester 4
Semester 5
Semester 6
Semester 7
Semester 8
Introduction to Industrial Engineering
Work Design, Methods, and Standards + Lab
Production Planning and Inventory Control + Lab
System Modelling + Lab
Quality System
Facilities Design and Material Handling
Suppluy Chain
Industrial Simulation
Information System
Industrial Marketing
Product Design
Industrial Engineering Design
Occupational, Health, Safety & Environment

Expected Learning Outcome	Courses							
	Year 1		Year 2		Year 3		Year 4	
	Semester 1	Semester 2	Semester 3	Semester 4	Semester 5	Semester 6	Semester 7	Semester 8
(D). An ability to identify, formulate, and solve engineering problems.	Material Science		Mechanic Engineering	Human Factor in Engineering & Design + Lab Operation Research Organizational Design and Industrial Psychology Reliability and Maintenance	Industrial Project Design			Thesis


Expected Learning Outcome
(E). An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
Courses
Year 1
Year 2
Year 3
Year 4
Semester 1
Semester 2
Semester 3
Semester 4
Semester 5
Semester 6
Semester 7
Semester 8
Logic and Algorithm
Engineering Economics
Engineering Drawings
Production Process + Lab
Production Planning and Inventory Control + Lab
Systems Modelling + Lab
Reliability + Maintenance
Data Analytics and Visualization
Peranc. Fasilitas dan Penanganan Material
Simulasi Industri
Industrial Engineering Design Lab
Thesis

Expected Learning Outcome	Courses							
	Year 1		Year 2		Year 3		Year 4	
	Semester 1	Semester 2	Semester 3	Semester 4	Semester 5	Semester 6	Semester 7	Semester 8
(F). An ability to function on multi-disciplinary teams.		MPKT S					Occupational, Health, Safety & Environment Internship	

Expected Learning Outcome	Courses							
	Year 1		Year 2		Year 3		Year 4	
	Semester 1	Semester 2	Semester 3	Semester 4	Semester 5	Semester 6	Semester 7	Semester 8
(G). An understanding of professional and ethical responsibility.	Religion						Internship	

Expected Learning Outcome	Courses							
	Year 1		Year 2		Year 3		Year 4	
	Semester 1	Semester 2	Semester 3	Semester 4	Semester 5	Semester 6	Semester 7	Semester 8
(H). Has a broad understanding on the impact of engineering problem solving in global, economic, environmental, and social contexts.	Introduction to Econmics	Engineering Economics Introduction to Industrial Engineering		Quality Systems			Special Topics in Industrial Engineering Occupational, Health, Safety & Environment	

Expected Learning Outcome	Courses							
	Year 1		Year 2		Year 3		Year 4	
	Semester 1	Semester 2	Semester 3	Semester 4	Semester 5	Semester 6	Semester 7	Semester 8
(I). An ability to study independently and continuously (lifelong learning)							Special Topics in Industrial Engineering	Thesis

Expected Learning Outcome	Courses							
	Year 1		Year 2		Year 3		Year 4	
	Semester 1	Semester 2	Semester 3	Semester 4	Semester 5	Semester 6	Semester 7	Semester 8
(J). An ability to communicate using spoken and written languages in Indonesian and English for both Academic and non-Academic activities	English Religion						Internship	Thesis

Expected Learning Outcome	Courses							
	Year 1		Year 2		Year 3		Year 4	
	Semester 1	Semester 2	Semester 3	Semester 4	Semester 5	Semester 6	Semester 7	Semester 8
(K). An ability to use information and communication technology		Integrated MPKT			Information Systems			

Expected Learning Outcome	Courses							
	Year 1		Year 2		Year 3		Year 4	
	Semester 1	Semester 2	Semester 3	Semester 4	Semester 5	Semester 6	Semester 7	Semester 8
(L). An ability to identify a variety of entrepreneurial efforts, characterized by ethnical innovation and self-sustained						Industrial Engineering Design		

Expected Learning Outcome	Courses							
	Year 1		Year 2		Year 3		Year 4	
	Semester 1	Semester 2	Semester 3	Semester 4	Semester 5	Semester 6	Semester 7	Semester 8
(M). An ability to perform critical, creative, and innovative thinking and has an intellectual curiosity to solve problems at individual and group levels		Integrated MPKT				Industrial Engineering Design		

Expected Learning Outcome	Courses							
	Year 1		Year 2		Year 3		Year 4	
	Semester 1	Semester 2	Semester 3	Semester 4	Semester 5	Semester 6	Semester 7	Semester 8
(N). An ability to provide alternative solutions to various problems that arise in the communities, nation, and Indonesia		Integrated MPKT				Industrial Engineering Design		

Fig. 2 Course Mapping for Expected Learning Outcome

Course Flowchart

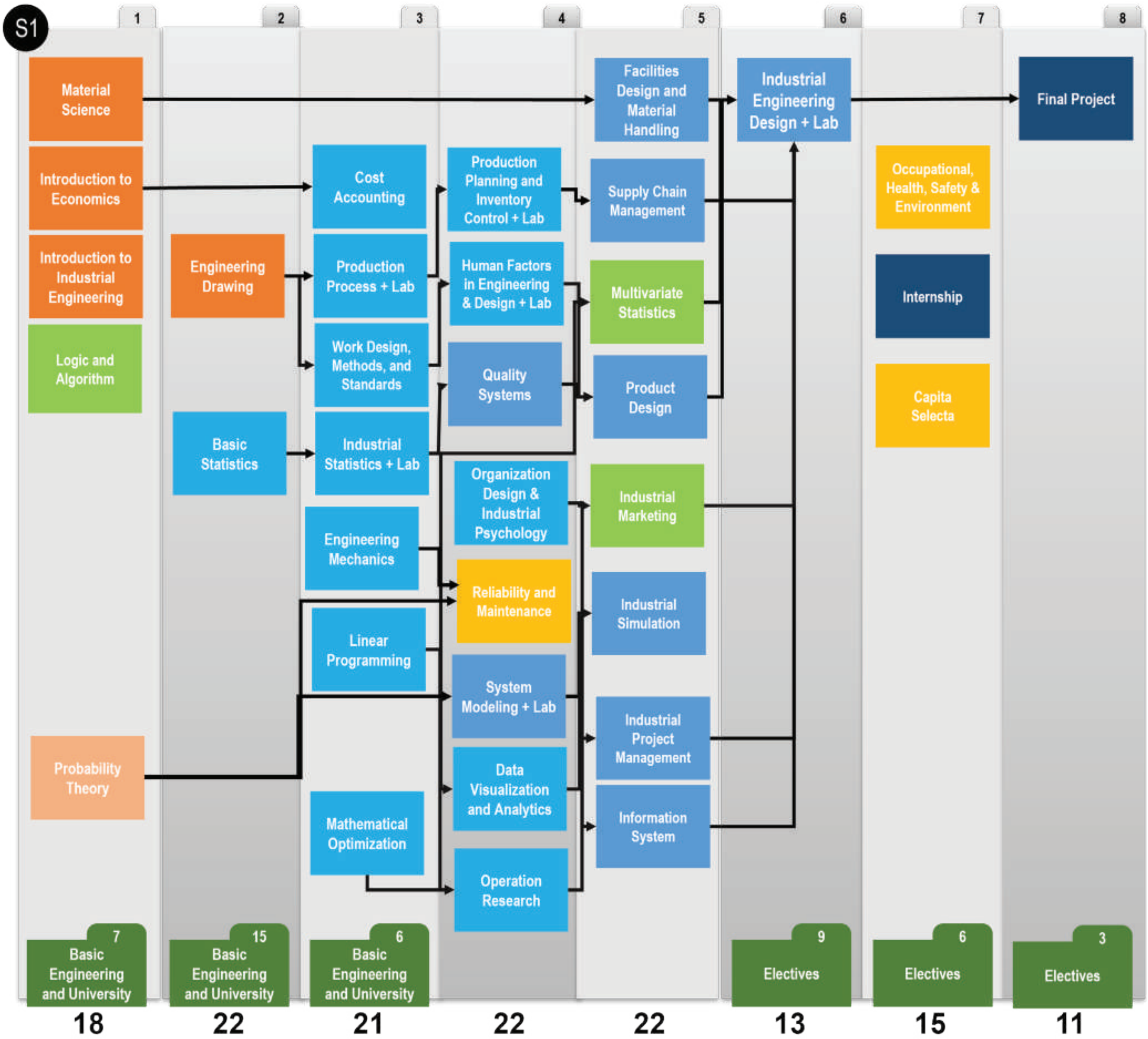


Fig. 3. Course Diagram to attain the competency of Bachelor program in Industrial Engineering

Curriculum Structure Reguler/Parallel Class Undergraduate Industrial Engineering

Code	Subject	SKS
	1st Semester	
UIGE600003	English	2
ENGE600001	Calculus 1	3
ENIE601001	Introduction to Industrial Engineering	2
ENIE601002	Introduction to Economics	2
ENIE601003	Material Sciences	2
UIGE600004	Religion	2
ENIE601004	Probability Theory	2
ENIE601005	Algorithm and Computation	3
	Subtotal	**18**
	2nd Semester	
ENGE600004	Linear Algebra	4
ENGE600005	Mechanics and Thermal Physics	3
UIGE600006	MPKT S	5
ENIE612006	Engineering Drawing	2
ENIE612007	Basic Statistics	2
ENGE610011	Engineering Economics	3
ENGE610002	Calculus 2	3
	Subtotal	**22**
	3rd Semester	
ENGE600007	Optics, Electricity and Wave Physics	3
ENIE603008	Engineering Mechanics	2
ENIE603009	Work Design, Methods, and Standards + Lab	3
ENIE603010	Production Process + Lab	3
ENIE603011	Industrial Statistics + Lab	3
ENIE603012	Linear Programming	3
ENIE603013	Mathematical Optimization	2
ENIE603014	Cost Accounting	2
	Subtotal	**21**
	4th Semester	
ENIE604015	Production Planning and Inventory Control + Lab	3
ENIE605016	Quality Systems	3
ENIE604017	Human Factor in Engineering & Design + Lab	3
ENIE604018	Operations Research	3
ENIE604019	Organizational Design and Industrial Psychology	3
ENIE604020	Systems Modeling + Lab	
ENIE604021	Reliability and Maintenance	2
ENIE604022	Data Analytics and Visualization	2
	Subtotal	**22**
	5th Semester	
ENIE615023	Facilities Design and Material Handling	3
ENIE615024	Product Design	2
ENIE615025	Industrial Project Design	3
ENIE615026	Supply Chain System	3
ENIE615027	Industrial Simulation	3
ENIE615028	Information Systems	3
ENIE615029	Multivariate Statistics	3
ENIE615030	Industrial Marketing	2
	Subtotal	**22**
	6th Semester	
ENIE616031	Industrial Engineering Design	3
ENIE616032	Industrial Engineering Design Lab	1
	Electives	3
	Electives	3
	Electives	3
	Subtotal	**13**
	7th Semester	
ENIE617033	Internship	2
ENGE610012	Occupational, Health, Safety & Environment	2
ENIE617034	Special Topics in Industrial Engineering	2
	Electives	3
	Electives	3
	Electives	3
	Subtotal	**15**
	8th Semester	
ENIE608035	Final Project in Industrial Engineering	5
	Electives	3
	Electives	3
	Subtotal	**11**
	Total	**144**

Course Structure for International Class of Industrial Engineering

Code	Subject	SKS
	1st Semester	
UIGE610003	English	2
ENGE610001	Calculus 1	3
ENIE611001	Introduction to Industrial Engineering	2
ENIE611002	Introduction to Economics	2
ENIE611003	Material Science	2
UIGE610004	Religion	2
ENIE611004	Probability Theory	2
ENIE611005	Logic and Algorithm	3
	Subtotal	**18**
	2nd Semester	
ENGE610004	Linear Algebra	4
ENGE610005	Mechanics and Thermal Physics	3

UIGE610006	MPKT S	5
ENIE612006	Engineering Drawing	2
ENIE612007	Basic Statistics	2
ENGE610011	Engineering Economics	3
ENGE610002	Calculus 2	3
	Subtotal	**22**
	3rd Semester	
ENGE610007	Optics, Electricity and Wave Physics	3
ENIE613008	Engineering Mechanics	2
ENIE613009	Work Design, Methods, and Standards + Lab	3
ENIE613010	Production Process + Lab	3
ENIE613011	Industrial Statistics + Lab	3
ENIE613012	Linear Programming	3
ENIE613013	Mathematical Optimization	2
ENIE613014	Cost Accounting	2
	Subtotal	**21**
	4th Semester	
ENIE614015	Production Planning and Inventory Control + Lab	3
ENIE615016	Quality Systems	3
ENIE614017	Human Factor in Engineering & Design + Lab	3
ENIE614018	Operations Research	3
ENIE614019	Organizational Design and Industrial Psychology	3
ENIE614020	Systems Modeling + Lab	3
ENIE614021	Reliability and Maintenance	2
ENIE614022	Data Analytics and Visualization	2
	Subtotal	**22**
	5th Semester	
ENIE615023	Facilities Design and Material Handling	3
ENIE615024	Product Design	2
ENIE615025	Industrial Project Design	3
ENIE615026	Supply Chain System	3
ENIE615027	Industrial Simulation	3
ENIE615028	Information Systems	3
ENIE615029	Multivariate Statistics	3
ENIE615030	Industrial Marketing	2
	Subtotal	**22**
	6th Semester	
ENIE616031	Industrial Engineering Design	3
ENIE616032	Industrial Engineering Design Lab	1
	Electives	3
	Electives	3
	Electives	3
	Sub Total	**13**
	7th Semester	
ENIE617033	Internship	2
ENGE610012	Occupational, Health, Safety & Environment	2
ENIE617034	Special Topics in Industrial Engineering	2
	Electives	3
	Electives	3
	Electives	3
	Subtotal	**15**
	8th Semester	
ENIE618035	Final Project in Industrial Engineering	5
	Electives	3
	Electives	3
	Subtotal	**11**
	Total	**144**

Transition Policy from the 2016 to the 2020 Curriculum

1. New curriculum 2020 will be applied effectively from Odd Semester 2020/2021. In principle, after curriculum 2020 is implemented, then only courses from this new curriculum will be opened.
2. The enforcement of the transitional period is one year, i.e., in Even Semester Year 2020 / 2021 and Odd Semester Year 2021 / 2022. During this transition period, if a course in curriculum 2020 is in odd semester while in previous curriculum in even semester (vice versa), then this course can be held (if necessary) in each semester of Year 2020 / 2021.
3. For students who have not passed the compulsory courses in curriculum 2016, they are required to take the same or equivalent course in curriculum 2020. Equivalence courses can be seen in the table below. All courses in the curriculum 2016 that are not listed in equivalence table have not changed, both in names and credits.
4. When there is a change in the number of course credits, then the number of graduation credits that be counted in, is the number of credits when it was taken. If a student took the same or equivalent courses whose credits or names have changed, then it will be acknowledged under a new name or a new credit. (Please course equivalence table).
5. When a compulsory subject in the curriculum 2016 is deleted and there is no equivalence in the curriculum 2020 then:

a. For students who have passed these subjects, the credits that are achieved will be counted in the calculation of graduation 144 credits.
b. For students who did not pass these courses, they can take new compulsory courses or choose elective subjects in the curriculum 2020 to complete 144 credits. This selected course(s) will be counted as elective one(s), even though this course is originally a compulsory subject in the Curriculum 2020.

No	Name of the Course in 2016 Curriculum	Credits in 2016	Name of the Course in 2020 Curriculum	Credits in 2020
1	Plant Layout	3	Facilities Design and Material Handling	3
2	Product Design + Lab	3	Product Design	2
3	Maintenance System	2	Reliability and Maintenance	2
4	Industrial Simulation + Lab	3	Industrial Simulation	3
5	Project Management	2	Industrial Project Design	3
6	Supply Chain Management	3	Supply Chain Systems	3
7	Industrial Engineering Design + Lab	3	Industrial Engineering Design	3
			Industrial Engineering Design Lab	1

Course Syllabus of University Subjects

INTEGRATED CHARACTER BUILDING

UIGE6000061/UIGE6100061
5 credits

Syllabus :

The Integrated Character Building is part of the Higher Education Personality Development Lecture which is held for students which contains elements of the internalization of basic life values, interaction/relationship skills, nationality and academic skills as the basis for student personality to carry out learning according to scientific disciplines.

MPKT is carried out in the form of a series of learning activities outside the formal class. activities carried out include participation in lectures/seminars, internships, field work practices, social work, sports and/or arts activities and other forms of activities that have the main goal of equipping students with soft skills and proven by portfolio documents. The form of this learning activity is different from the MPKT courses that have been carried out at the previous UI.

The material provided at MPKT aims to form a human thinking pattern with values and morals to create a human personality by having critical, logical, creative, innovative thinking, and having intellectual curiosity and an entrepreneurial spirit. The material provided includes 9 UI values, national, state and citizen values based on Pancasila. Solving problems in science, technology, health, and humans as natural managers by using reasoning and utilizing Information and Communication Technology (ICT) to achieve the final objectives of this module.

Lecture activities are carried out using an online student-centered learning (SCL) approach which can use the following methods: experiential learning (EL), collaborative learning (CL), problem-based learning (PBL), question-based learning, and project based learning. The use of these various methods is carried out through group discussion activities, independent assignment exercises, presentations, writing papers in Indonesian and interactive discussions in online discussion forums. The language of instruction in this lecture is Indonesian.

Graduate Learning Outcomes :

- CPL 1: Able to use spoken and written language in Indonesian and English both for academic and non-academic activities (C3, A5)
- CPL 2: Have integrity and are able to think critically, creatively, and innovatively and have intellectual curiosity to solve problems at the individual and group level (C4, A3)
- CPL 3: Able to provide alternative solutions to various problems that arise in the community, nation, and country (C4, A2)
- CPL 4: Able to take advantage of information communication technology (C3)
- CPL 5: Able to identify various entrepreneurial efforts characterized by innovation and independence based on ethics (C2, A5)

Course Learning Outcomes :

- CPMK 1: After completing this course, students are able to apply self-regulated learning characteristically in studying critically, logically, creatively, innovatively through analysis of societal problems, nation, state, and Pancasila ideology based on self-understanding as individuals and members. the community by using good and correct Indonesian and the latest information and communication technology (C4, A4)
- CPMK 2: Able to identify various entrepreneurial efforts characterized by innovation and independence based on ethics (C2, A5)
- CPMK 3: After completing this course, students are able to apply self-regulated learning characteristically in pursuing integrated and comprehensive knowledge through analysis of science problems, technology based on the role of nature manager by using good and correct Indonesian and information technology and current communications. (C4, A4)
- CPMK 4: After completing this course, students are able to plan creative activities to solve problems in society and the world of work/industry by showing creativity, critical thinking, collaborative self-discipline using good and correct Indonesian as well as the latest information and communication technology (C5, A5)

Prerequisite : -

ACADEMIC WRITING

UIGE610002
2 credits
The Objectives :

To activate students, English so that they will be able to communicate effectively in English;

To enable students to develop the learning strategies and study skills needed to finish their study successfully and o continue learning on their own after taking the MPK program (to develop independent learners)

Main Competencies :

- Listen to, understand and take notes of key information in academic lectures of between 5-10 minutes length;
- Improve their listening skills through various listening materials and procedures;
- Speak confidently, ask questions in and contribute to small group discussions;
- Use different reading strategies needed to the effective readers;
- Improve their reading skills through extensive reading material;
- Develop skills in connecting ideas using appropriate transitions and conjunctions;
- Work as part of a group to prepare and deliver a 25-minute presentation on an academic topic using appropriate organization, language and visual aids;
- Write a summary of a short academic article;
- Write an expository paragraph;
- Write a short essay.

Learning Method : Active learning, Contextual language learning, small group discussion.

Prerequisite :

1. Students Learning Orientation/Orientasi Belajar Mahasiswa (OBM)

ENGLISH

UIGE600003
2 credits

Learning Objectives :

After attending this subject, students are expected to capable of use English to support the study in university and improve language learning independently.

Syllabus :

Study Skills : (Becoming an active learner, Vocabulary Building: word formation and using the dictionary Listening strategies Extensive reading) Grammar: (Revision of Basic grammar Types of sentences Adjective clauses, Adverb clauses Noun clauses, Reduced clauses) Reading: (Reading skills: skimming, scanning, main idea, supporting ideas, Note-taking Reading popular science arti-cle, Reading an academic text) Listening: (Listening to short conversations, Listening to a lecture and notetaking, Listening to a news broadcast, Listening to a short story) Speaking: (Participating in discussions and meetings, Giving a presentation) Writing: (Writing a summary of a short article Describing graphs and tables, Writing an academic paragraph, Writing a basic academic essay (5 paragraphs).

ISLAMIC STUDIES

UIGE6000010/UIGE610005
2 credits
General Instructional Objectives :

The cultivation of students who have concern for social, na-tional and countrys issues based on Islamic values which is applied in the development of science through intellectual skills.

Learning Objectives :

Course participants are expected to do the following when faced with a problem or issue which they must solve :

1. Analyze the problem based on the Islamic values they adopted;
2. Analyze the problem by implementing active learning stages;
3. Discuss and express their thoughts and ideas by using proper and correct Indonesian language in discussion and academic writing.

Syllabus :

Islam history: the meaning of Islam, the characteristic of Islam, the sources of Islamic teachings, Muhammad SAW as prophet and history figure, introduction of Islam in Indonesia, the teaching essence of Islam: the basic principle of Islam teachings, the unity of Allah, worship prac-tice in live, eschatology and work ethics, human's basic rights and obligation, social structure in Islam: sakinah mawaddah and ramhah family, the social implication of family life, Mosque and the development of Islam, zakat and the economic empowerment of the people, Islam society, Science: reason and revelation in Islam, Islam's motivation in development of science, science characteristics, source of knowledge, IDI (each Faculty and Department/Study Program).

CATHOLIC STUDIES

UIGE6000011/UIGE610006
2 credits
General Instructional Objectives :

To help deliver students as intellectual capital in implementing lifelong learning process to become scientists with mature personality who uphold humanity and life.

Be scholars who believe in God according to the teachings of Jesus Christ by continuing to be responsible of his faith in life in church and society.

Syllabus :

Almighty God and the God teachings; Man, Morals, science technology and art; harmony between religions; Society, Culture, Politics, Law: the substance of theses studies will be addressed by integrating the four dimensions of the teachings of the Catholic faith: the personal dimension, the dimension of Jesus Christ, the dimension of the Church, and Community dimension. Dimensions are implemented in the following themes: People, Religion, Jesus Christ, the Church, and Faith in the society.

CHRISTIAN STUDIES

UIGE6000012/UIGE610007
2 credits
General Instructional Objectives :

Cultivating students with comprehensive Christian knowledge and teaching in the midst of the struggle and the fight of the nation while also discussing the student's participation in line with the study to help improve and build our country.

Learning Objectives :

Course participants are expected to do the following when faced with a problem or issue which they must solve:

1. Analyze the problem based on the Christian values
2. Analyze the problem by implementing active learning stages
3. Discuss the problem by using proper and correct Indonesian language

Syllabus :

History (Historical terms): Status of the Bible, the existence of God and Morality, Christ the Savior, the Holy Spirit as existence reformer and outlook on the world: Faith and Knowledge of Science, Church and service, Ecclesiology, Spiritual and enforcement of Christian Human Rights and the world of ethics: Christian Ethics, Christian and worship, Christianity and politics, Christian love and social reality: Christian Organizations, Students and Service, Christian and expectations.

HINDU STUDIES

UIGE6000013/UIGE610008
2 credits

Syllabus :

Hindu religion, Hindu history), Source and scope of Hinduism (the Veda as the source of Hindu religion teachings, the scope of the teachings in Hindu religion), The concept of the God (Brahman) according to the Veda, the Path to Brahman (Catur Marga Yoga, Mantra and Japa), Human Nature (The purpose of human life, Human's duties, obligations, and responsibilities both individually or collectively), Ethics and morality (Principles teaching, self-control), in-depth understanding of the scripture (deep understanding of the Bhagawadgita, deep understanding of the Sarasamuschaya), The Role of Hinduism in science, technology, and art (Hinduism benefits in science and technology in accordance with each department, benefit / the role of Hinduism in the arts), Cohesion and community's prosperity /independence (Benefits of unity in the religious plurality, independent community (kerthajagathita) as a common goal, Tri Pitakarana), Culture as an expression of Hindu religious practice, Contribution to the Hindu religion teachings in the political life of nation and country, laws and

the enforcement of justice, Awareness of and obeying the Rita / Dharma.

BUDDHIST STUDIES
UIGE6000014/UIGE610009
2 credits

Syllabus :

Almighty God and the God Study (Faith and piety, Divine Philosophy/Theology), Human (Human Nature, Human Dignity, Human Responsibility), Moral (Implementation of Faith and Piety in everyday life), Science, Technology and Art (Faith, Science and Charity as a unity, the Obligation to study and practice what you are taught, Responsibility for nature and environment), harmony between religion (religion is a blessing for all mankind, the essence of the religious plurality and togetherness), community (the role of religious society in creating a prosperous independent society, the responsibility of religious society in the realization of human rights and democracy), Culture (the responsibility of religious society in the realization of critical thinking (academic), work hard and fair), Politics (Religion contribution in the political life of nation and country), Law (Raise awareness to obey and follow God's law, the role of religion in the formulation and enforcement of law, the function of religion in the legal profession).

KONG HU CU STUDY
UIGE6000015/UIGE610010
2 credits

Course Syllabus of Faculty Subjects

CALCULUS 1
ENGE600001/ENGE610001
3 credits
Course Learning Outcomes:

Able to use the basic concepts of calculus related to -a function of one variable, the derivative and integration of the function of one variable in order to solve its applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, basic engineering, and engineering specialization to be used in solving complex engineering problems.

Syllabus :
Introduction, Functions and Limits, The Derivative, Applications of the Derivative, The Definite Integral, Applications of The Definte Integral, Transcendental Functions, Techniques of Integration, Indeterminate Forms and Improper Integrals.

Prerequisite: None

Textbooks:

Main reference:
D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., Pearson, Prentice Hall, 2007.

Additional eferences:
1. George B. Thomas Jr., Thomas' Calculus Early Transcendental, 12th ed., Addison–Wesley Pearson, 2009.
2. Howard Anton, Calculus, 10th ed., John Wiley and Sons, 2012.

CALCULUS 2
ENGE600002/ENGE610002
3 SKS
Course Learning Outcomes:

Students are able to use the concepts of sequences, series, conic sections, and the basic concepts of calculus which involve the function of two or three variables to solve their applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus: :
Infinite sequences and infinite series, Test for convergence of positive series and alternating series, Power series and operation on operations, Taylor and MacLaurin series, Conic sections , Calculus in polar coordinates, Derivatives, limits, and continuity of multi-variables functions, Directional derivatives and gradients, Chain Rule, Tangent planes and Approximations, Lagrange multipliers. Double integrals in Cartesian coordinates and polar coordinates, triple integrals in Cartesian coordinates, cylindrical coordinates and spherical coordinates, Applications of double and triple Integral.

Prerequisite: Calculus 1

Textbooks:
1. D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., PEARSON, Prentice Hall, 2007.
2. Thomas, Calculus Thirteenth Edition Volume 2, Erlangga, 2019.

CALCULUS
ENGE600003/ENGE610003
4 SKS
Course Learning Outcomes:

Students are able to use the basic concepts of calculus involving functions of one to three variables to solve their applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :

Introduction, Functions and Limits, Derivatives, Derived Applications, Indeterminate Integral, Integral Applications, Infinite Row, and Series. Derivatives with many variables, Duplicate Integral (2 and 3), Duplicate Integral Application.

Prerequisite: None

Textbooks:

Main :
D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., Pearson, Prentice Hall, 2007.

George B. Thomas Jr., Thomas' Calculus Early Transcendental, 12th ed., Addison – Wesley Pearson, 2009.

LINEAR ALGEBRA
ENGE600004/ENGE610004
4 SKS
Course Learning Outcomes:
Students are able to calculate linear system problems to solve engineering problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :

Linear Systems and matrix equations, Determinants, Euclid

vector spaces, Common vector spaces, eigenvalues and eigenvectors, inner product spaces, Diagonalization and General Linear Transformation.

Prerequisite: None

Textbooks:
1. Elementary Linear Algebra, Howard Anton & Chris Rorres, 11th edition, 2014
2. Gilbert Strang, Introduction to linear algebra 3rd edition Wellesley Cambridge Press, 2003

MECHANICAL AND HEAT PHYSICS
ENGE600005 / ENGE610005
3 credits
Course Learning Outcomes:

Able to explain the basic concepts of mechanics and thermodynamics, and be able to apply them to understand natural phenomena and human engineering, including their applications.

Graduate Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus:

Units, Magnitudes and Vectors, Motion Along Straight Lines, Motion in Two and Three Dimensions, Newton's Laws of Motion, Applications of Newton's Laws, Kinetic Energy, and Work, Potential Energy and Energy Conservation, Center of Mass, Linear Momentum, Rotation, Rolling Motion, Torque, Angular Momentum, Oscillation, Mechanical and Sound Waves, Gravity, Statics and Elasticity, Fluid Mechanics, Temperature, Heat, Law I Thermodynamics, Ideal Gas and Kinetic Theory of Gas, Heat Engine, Entropy, and Law II Thermodynamics.

Prerequisite: none

Textbooks:
1. Halliday, Resnick, and Walker, Principles of Physics 10th Edition, Wiley, 2014.
2. Serway Jewett, Physics for Scientists and Engineers 9th Edition, Thomson Brooks / Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008

ELECTRICAL MAGNETIC, OPTICAL AND WAVE PHYSICS
ENGE600007 / ENGE610007
3 credits
Course Learning Outcomes:

Students are able to apply the basic concepts of electrical physics, magnetism, waves, and optics to solve problems in the engineering field.

Graduate Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus:

Unit, Magnitude, Vector, Electric Charge, Electric Field, Gauss Law, Electric Potential, Capacitance, Electric Current, Resistance, Direct Current, Magnetic Field Due to Electric Current, Magnetic Field Source, Induced GGL, Inductance, Alternating Current, Electromagnetic Waves, Light Properties and Propagation, Optical Geometry.

Prerequisite: none

Textbooks :
1. Halliday, Resnick, and Walker, Principles of Physics 9th Edition, Wiley, 2011.
2. Serway Jewett, Physics for Scientists and Engineers 9th Edition, Thomson Brooks / Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008.

BASIC CHEMISTRY
ENGE600009 / ENGE610009
2 credits
Course Learning Outcomes:
Students are able to analyze the principe of basic chemistry for application in engineering.

Graduates' Learning Outcomes:
Able to apply mathematics, science, and basic engineering to be used in solving complex engineering problems.

Syllabus:

Material and measurements, atoms, molecules and ions, stochiometry, water phase reactions and solution stochiometry, thermochemistry, chemical equilibrium, acid and base equilibrium, electrochemistry, chemical kinetics, and chemical applications.

Prerequisite: none

Textbooks :
1. Ralph H. Petrucci, General Chemistry: Principles and Modern Applications, 8th Ed. Prentice Hall Inc., New York, 2001.
2. John McMurry, Robert C. Fay, Chemistry (3rd ed.), Prentice Hall, 2001.
3. Raymond Chang, Williams College, Chemistry (7th ed.), McGraw-Hill, 2003.

ENGINEERING ECONOMY
ENGE600011 / ENGE610011
3 credits
Course Learning Outcomes:

Students are able to analyze the economic and financial feasibility of making economic practice decisions.

Graduate Learning Outcomes:

Able to apply the principles of technical management and decision making based on economic considerations, in individual and group, as well as in project management.

Syllabus:

Introduction to Engineering Economics, Time Value of Money, Combining Factors, Interest Rates, Money Worth Analysis, Rate of Return Analysis, Effects of Inflation, Benefit Cost & Break-Even Point Analysis, Sensitivity Analysis, Depreciation, Tax Analysis, Cost Estimation & Allocation, Capital Budgeting & Replacement Analysis.

Prerequisite:
1. Civil Engineering : -
2. Environmental Engineering : -
3. Naval Engineering : -
4. Industrial Engineering : must pass the introductory Economic course and have completed 38 credits
5. Chemical Engineering : -
6. Bioprocess Engineering : -

Textbooks:
1. Blank, Leland and Tarquin, Anthony. 2018. Engineering Economy 8th Ed. McGraw Hill.

2. Park, Chan S. 2016. Contemporary Engineering Economics 6th Ed. Pearson. Upper Saddle River.
3. White, Case and Pratt. 2012. Principles of Engineering Economic Analysis 6th ed. John Wiley and Sons.

STATISTICS AND PROBABILISTICS
ENGE600010 / ENGE610010
2 credits
Course Learning Outcomes:

Students are able to handle quantitative data/information starting from the descriptive stage (collection, organization, and presentation) to the inductive stage, which includes forecasting and drawing conclusions based on the relationship between variables for decision making.

Graduate Learning Outcomes:
1. Apply descriptive statistics and probability theory to data processing and serving
2. Apply probability distribution to data processing and serving
3. Apply the principles of sampling and estimation for decision making
4. Apply hypothesis test samples for decision making

Syllabus:

Introduction to Statistics for Engineering Studies, Probability Theory, Dasar Basic concepts and definitions, Distribution Probability, Sampling, Estimation, Hypothesis testing, Hypothesis test 1 sample at an average value, Regression

Prerequisite: none

Textbooks :
1. Harinaldi, Basic Principles of Statistical Engineering and Science, Erlangga, 2004
2. Montgomery, DC., And Runger, GC., Applied Statistics and Probability for Engineers, John Wiley Sons, 2002

HSE PROTECTION
ENGE600012 / ENGE610012
2 credits
Course Learning Outcomes:

Upon completion of this subject students are expected to be able to carried out hazard identification, and characterization, to propose appropriate methods for risk reduction and mitigation, and to design safety management system. The student is also expected to improve their awareness on industrial safety and health, and understanding on safety regulation framework and standards as well as environmental program.

Graduate Learning Outcomes:
1. Students are expected to understand safety, health and environmental aspect as an integral part of fundamental principal in engineering code of ethics.
2. Students are expected to be able to carry out process of risk assessments by considering risk factors in the impact of hazards on people, facilities, and the surrounding community and environemt.
3. Students are expected to understand the regulatory framework and standard related to the stages of life cycle of machine, building structure, construction, and process.
4. Students are able to design and propose an effective hazard communication, management and engineering control, and risk mitigation through an engineering assignment project.
5. Students are able to identify the knowledge required to perform risk assesment, investigation and design improvement through a multidisiplinary case of incident and accident.

Syllabus:

Introduction to SHE Regulation and Standards, SHE Perception (Risk and Environment), Identification, Assessment and Management, Construction, machinery and Noise hazards, Process safety hazard and analysis technique, Fire and explosion hazard, Electrical hazard, Toxicology in the Workplace, Ergonomy Aspect, Hazard communication to employees, Environmental Protection, Case studies, Safety Health and Environment audits.

Prerequisite: none

Textbooks :
1. Charles A. Wentz, Safety, Health and Environmental Protection, McGraw Hill, 1998.
2. Asfahl, C.R., Rieske, D. W., Sixth Edition Industrial Safety and Health Management, Pearson Education, Inc., 2010.
3. United Kingdom - Health and Safety Executive, http://www.hse.gov.uk/
4. National laws and regulations related to the K3 Management System and the Environment.
5. Related Journal (http://www.journals.elsevier.com/safety-science/) etc, related standards and publications.

Courses at Industrial Engineering Study Program

INTRODUCTION TO INDUSTRIAL ENGINEERING
ENIE601001
2 credits
Learning Objectives :

Able to provide introduction and view of basic concepts on the scope of the science of industrial engineering that can be applied in the real world either in the manufacturing industry or services.

Syllabus:

The history and development of industrial engineering disciplines, industrial engineering and systems, production systems, work measurement, location and layout of facilities, operation methods, material movement, distribution and route determination, production planning, and controlling quality control.

Prerequisite: -

Teaching Book:
1. Groover, M. P. (2007). Fundamentals of modern manufacturing: materials processes, and systems. John Wiley & Sons.
2. Kibbe, R. R., Neely, J. E., Meyer, R. O., White, W. T., Bonkoski, M., & Bradshaw, P. (2006). Machine tool practices. Pearson Prentice Hall.
3. Wayne C. Turner et al. (1993). Introduction to Industrial Engineering, third volume (translation), Prentice-Hall.
4. De Garmo Ernest Paul, Black, J. T., & Kosher, R. A. (1990). Materials and processes in manufacturing. Macmillan.

INTRODUCTION TO ECONOMICS
ENIE601002
3 credits
Learning Objectives :

Able to explain the principles and problems in economic sciences, both microeconomics and macroeconomics.

Syllabus:

Ten Principles of Economics, Thinking Like an Economist, The Market Forces of Supply and Demand, Elasticity and Its Application, Consumers, Producers, and The Efficiency of Markets, The Costs of Production, Firms in Competitive Markets, Measuring a nation's Income, Production and Growth, Saving, Investment, and the Financial System, Tools of Finance, The Monetary System, Open-Economy Macroeconomics: Basic Concepts, Aggregate Demand, and Aggregate Supply

Prerequisite: -

Teaching book:
1. Mankiw, N. G. (2014). Principles of Economics. Cengage Learning.
2. Kishtainy, N., et al. (2012). The Economics Book: Big Ideas, Simply Explained. Dorling Kindersley Ltd.
3. Kishtainy, N. (2014). Economics in Minutes: 200 Key Concepts Explained in an Instant. Quercus Publishing.
4. Economic development-related journals.

MATERIAL SCIENCE
ENIE601003
2 credits
Learning Objectives :

Students are expected to understand the processing, characteristics, and application of engineering materials. Structure and bonding in materials, material processing for all types of engineering materials, as well as a basic concept in materials testing.

Syllabus:

Overview of Materials, Crystal Structure, Defects in Solids, Diffusion, Mechanical properties and Strengthening, Mechanism, Failure, Phase Diagram, and Equilibrium, Material Selection, Measurement and Inspection, Ceramics, Polymers, Composites, Electrical Properties, Semiconductors and Growth, Biomaterials.

Prerequisite: -

Teaching book:

Callister Jr, W. D., & Rethwisch, D. G. (2012). Fundamentals of Materials Science and Engineering: an integrated approach. John Wiley & Sons.

PROBABILITY THEORY
ENIE602002
3 credits
Learning Objectives :

Able to explain the principles of probability and application in solving problems concerning industrial engineering.

Syllabus:

Introduction to probability, sample and event space, conditional probability, Bayes theorem, random variables, discrete and continuous random variable, cumulative distribution functions, expectations, combined probability distribution, introduction to Bernoulli and Poisson processes, several discrete probability distributions, several continuous probability distributions, Central Limit Theorem,

Prerequisite: -

Teaching Book:
1. Walpole, R. E., Myers, R. H., Myers, S. L., & Ye, K. (2012). Probability and Statistics for Engineers and Scientists, 9th Edition, Pearson.
2. Devore, J. L. (2016). Probability and Statistics for Engineering and the Sciences. Cengage Learning.
3. Montgomery, D. C., & Runger, G. C. (2011). Applied statistics and probability for engineers. John Wiley & Sons.
4. Dekking, F. M. C. Kraaikamp, H. P. Lopuhaa, and L. E. Meester, A Modern Introduction to Probability and Statistics: Understanding Why and How, Springer, London, 2005

LOGIC AND ALGORITHMS
ENIE603004
3 credits
Learning objectives:

Able to implement computational techniques, i.e., the ability to use advanced functions in spreadsheets, the ability to perform simulations by using spreadsheets, the ability to solve mathematical programming models with Solver in Excel, the ability to use automation in spreadsheets, the ability to describe computer algorithms, design, and analysis of algorithm and the ability to use one of the computer programming languages.

Syllabus:

Advanced functions in the spreadsheet, Monte Carlo simulation, Solver in a spreadsheet Macros and VBA, Flow chart and pseudocode, Java, or Python basics.

Prerequisite: -

Teaching Book:
1. Walkenbach, J. (2010). Excel 2010 Power Programming with VBA (Vol. 6). New York: Wiley.
2. Sedgewick, R., & Wayne, K. (2007). Algorithms and data structures. Princeton University, C.O.S., 226.

ENGINEERING DRAWING
ENIE602002
2 credits
Learning Objectives :

Able to draw objects on 2 and 3 dimensions based on the principles of engineering either manually, as well as in a virtual environment.

Syllabus:

Introduction to drawing techniques, orthographic projection images, perspective drawing, Axonometric projection (Isometric), drawing assembly, AutoCAD, Autodesk Inventor.

Prerequisite: -

Teaching book:

Robertson and Bertling. (2013). How to Draw. Design Studio Press

BASIC STATISTICS
ENIE603006
2 credits
Learning objectives:

Able to summarize, present, interpret and analyze data and information to support a valid and reliable conclusion in the decision-making situation in which there are elements of uncertainty and variation.

Syllabus:

Introduction to statistical and data analysis, descriptive statistics, sampling theory, central limit theorem, introduction to inference statistics, estimation, hypothesis testing, Linear regression analysis and correlation, Nonparametric method.

Prerequisite: probability theory

Teaching Book:
1. Walpole, R. E., Myers, R. H., Myers, S. L., & Ye, K. (2012). Probability and Statistics for Engineers and Scientists, 9th Edition, Pearson.
2. Devore, J. L. (2016). Probability and Statistics for

Engineering and the Sciences. Cengage Learning.
3. Montgomery, D. C., & Runger, G. C. (2011). Applied statistics and probability for engineers. John Wiley & Sons.
4. Harinaldi. (2006) *Statistical Principles for Engineering and science*. Brian G.

ENGINEERING MECHANICS

ENIE613008
2 credits
Learning objectives:

Able to apply mathematical technique and graphic from vector analysis and physical principles that required for static balance.

Syllabus:

Force Vectors, Particle Balance, Force Resultant, Structure Analysis, Internal Forces, Friction, Centre of Gravity and Centroid, Inertia Moment.

Prerequisite: Mechanics and Thermal Physics

Teaching Book:
1. Meriam, J. L., & Kraige, L. G. (2012). Engineering mechanics: dynamics (Vol. 2). John Wiley & Sons.
2. Hibbeler, R.C. (2013). Engineering Mechanics: Statics. 13th Edition. Pearson Prentice Hall

WORK DESIGN, METHODS, AND STANDARDS + LAB

ENIE603003
3 credits
Learning objectives:

Course participants can measure, analyze, design, and increase the effectiveness and efficiency of human work through methods improvements and work standards.

Syllabus:

Introduction and a general introduction to work planning Analysis, *Problem Solving Tools, Operation Analysis, Man-Machine chart, and Flow Process chart, Manual Work Design, Workplace, Equipment, and Tool design, work Environment design, Time study, Lab, Performance Rating and Allowances, Standard Data, work Sampling, Predetermined Time study, Wage Design, Training and Learning Curves.*

Prerequisite: Probability theory

Teaching Book:
1. Andris, F., & Benjamin, N. (2004). *Standard and Work Design Method*. Mcgraw-Hill, New York & London.
2. MacLeod, D. (2006). *The Ergonomics Kit for General Industry*. C.R.C. Press.
3. Ralph, M. B. (1980). *Motion and Time Study: Design and Measurement of Work*. John Wiley and Sons.

PRODUCTION PROCESS + LAB

ENIE603005
3 credits
Learning objectives:

Able to know the basics of production process related to the type of material used, the process of production processes related to the manufacturing process based on the materials used and machining processes and tools used.

Syllabus:

The basics of production processes, casting process, plastic forming process, Metal forming process, Metal plate forming process, production process for Wood Working, Theory and explanation of machining process, the theory, and technology of sculpture and cutting, practicum of Wood Working Process module, theory and grinding process, basic theory and concepts of C.N.C., practicum module Metal Working Process, machining and operation Machining, cutting process of material with a coitional machine, theory and welding process.

Prerequisite: Introduction to Industrial engineering

Teaching Book:
1. Groover, M. P. (2007). Fundamentals of modern manufacturing: materials processes, and systems. John Wiley & Sons.
2. Kibbe, R. R., Neely, J. E., Meyer, R. O., White, W. T., Bonkoski, M., & Bradshaw, P. (2006). Machine tool practices. Pearson Prentice Hall.
3. E. Paul DeGarmo, J. Black, A. Kohser. (1988) *Material and Processes in Manufacturing*, 7th edition. Macmillan.
4. S. Kalpakjian (1989). *Manufacturing Engineering and Technology*. Addison Wesley.
5. Boothroyd, G., and Knight, W. (1989). *Fundamentals of Machining and Machine Tools*, 2nd edition, Dekker.
6. Lab Module

INDUSTRIAL STATISTICS + LAB

ENIE604011
3 credits
Learning objectives:

Able to explain various statistical methods in the branch *of Design of Experiments* (D.O.E.), to be able to design experiments and *statistics Quality Control* (S.Q.C.), that follow the assumptions and rules of statistics so that the conclusions taken can be used as a basis in the decision making process.

Syllabus:

Experimental design, inferential statistics, *Analysis of Variance* (ANOVA), *Randomized Complete Block Design (RCBD), Latin Square, General factorial Designs, 2k Design, Random models, and Mixed models, Nested Design*, Introduction to *Statistics Quality Control (S.Q.C.), Control Chart.*

Prerequisite: Basic Statistics

Teaching Book:
1. Montgomery, Douglas C. (2013). Design and analysis of experiments 8th Edition. John Wiley & Sons.
2. Montgomery, Douglas C. (2009). Statistical Quality control 6th Edition. New York: John Wiley & Sons.
3. Walpole, R. E., Myers, R. H., Myers, S. L., & Ye, K. (2012). Probability and Statistics for Engineers and Scientists, 9th Edition, Pearson.

LINEAR PROGRAMMING

ENIE6130012
3 credits
Learning objectives:

Capable of designing a problem-solving solution by implementing mathematical models for engineering and management issues.

Syllabus:

Introduction to Linear Program, Simplex, Duality and Sensitivity Analysis, Transportation Problem, Assignment Problem, Network Problem, Integer Programming, Multi-Goal Mathematical Programming, Network.

Prerequisite: -

Teaching Book:
1. Hillier, F. S. (1967). Introduction to Operations Research: Frederick S. Hillier and Gerald J. Lieberman. Holden-Day.
2. Winston, W. L., & Goldberg, J. B. (2004). Operations Research: Applications and Algorithms (Vol. 3).

BelmonteCalif Calif: Thomson/Brooks/Cole.
3. Taha, H. A. (2011). Operations Research: An Introduction (Vol. 790). Pearson/Prentice Hall.

MATHEMATICAL OPTIMIZATION

ENIE613013
2 credits
Learning objectives:

Able to model, analyze, and solve the problems related to industrial systems by using nonlinear complex mathematical models.

Syllabus:

Integer and Combinatorial Optimization, Convex Optimization, Semi-definite Programming, Robust Optimization, Stochastic Programming, Graphs, and Network Optimization

Prerequisite: Logika dan Algoritma

Teaching Book:
1. Discrete Mathematics and Its Applications – Kenneth H. Rosen, McGraw-Hill
2. Kandiller, Levent, 2007. Principles of Mathematics in Operations Research, Springer Science + Business Media, LLC
3. Bazaraa, M.S., Sherali, H.D., and Shetty, C.M., 2006. Nonlinear Programming, Theory and Algorithms, Wiley-Interscience..

COST ACCOUNTING

ENIE603004
2 credits
Learning objectives:

Course participants understand accounting principles and can calculate accounting problems systematically and present them as a financial report. They should also be able to analyze and evaluate the conditions of the company based on those reports.

Syllabus:

Introduction to accounting and accounting standards used in Indonesia, accounting cycles, financing structures, introduction to depreciation systems, cost analysis in production volumes, *Activity Based Costing*, budget processes, budgets, and their assumptions, cost control mechanisms.

Prerequisite: Introduction to Economic sciences

Teaching Book:
1. Blocher, E.J., Stout, D.E., Cokins, G. Cost Management, a Strategic Emphasis 5th edition. McGraw Hill

PRODUCTION PLANNING AND INVENTORY CONTROL + LAB

ENIE604012
3 credits
Learning objectives:

Able to design, implement and evaluate production planning and inventory control system that is integrated with production flow supervision, production scheduling, and internal processes resulting in a high-quality product at the right time and low price.

Syllabus:

Introduction to production planning and control of inventories, demand forecasting, aggregate planning & disaggregated and production master schedule, material management: Material needs planning, Inventory control, labor scheduling, production line balance, and production scheduling, enterprise resource planning system.

Prerequisite:

Teaching Book:
1. Arnold, Tony, et. al., Introduction to Materials Management, Pearson, 2012
2. Chapman, Stephen M., The Fundamentals of Production Planning and Inventory Control, Pearson, 2006
3. Chase., et. al., Operations and Supply Chain Management, Irwin McGraw-Hill, 14E, 2014
4. Davis, Robert P., et. al., Study Guide to The Professional Engineers' Examination for Industrial Engineers, 2nd Ed., IIE Press, 198

QUALITY SYSTEM

ENIE605020
3 credits
Learning objectives:

Able to design a quality improvement system that can guarantee and improve the quality of products and processes continuously based on fact (number) with a mathematical approach (statistics) considering the national and international quality standards.

Syllabus:

3 Pillars of quality: continuous improvement, customer focus and total participation, PDCA concept, seven tools and seven new tools, process mapping techniques, standard roles, internal standards(S.O.P., WI) and external (ISO, JIS), Lean Six Sigma.

Prerequisite: Human factors in engineering design

Teaching Book:
1. A. Al. (2002). The Six Sigma Way Team Fieldbook, McGraw-Hill, New York
2. Katsuya Hosotani (2000). Q.C. Problem Solving Approach: Solving Workplace Problems the Japanese Way, 3A Corporation, Tokyo
3. Tague, Nancy R. (2015) The Quality Toolbox. ASQ Quality Press. Milwaukee. Wisconsin.

HUMAN FACTORS IN ENGINEERING AND DESIGN + LAB

ENIE600008
3 credits
Learning objectives:

Being able to have knowledge and expertise in the science of human factors that encompasses the physical, cognitive, and environmental aspects of students as a basis for designing and improving the quality of products, processes, workstations, and organizations.

Syllabus:

Introduction to human factors in engineering and design, Physical ergonomics, Anthropometry applied (Applied Anthropometry), Human Information Processing, Signal Detection Theory, user interface design, Cognitive test, lighting and climate, noise and vibration, Safety in Human Factors: Hazard Identification and Analysis

Prerequisite: Work planning, working methods, and standards + practicum

Teaching Book:
1. Sanders, M.S. and McCormick, E.J. (1993). Human Factors in Engineering and Design, 7th edition. McGraw-HillTambahan:
2. Tillman, B. and Tillman, P. and Rose, R.R. and Woodson, W.E. (2016). Human Factors and Ergonomics Design Handbook, 3th edition. McGraw-Hill Education
3. Stanton, N.A. and Hedge, A. and Brookhuis, K. and Salas, E. and Hendrick, H.W. (2004). Handbook of Human Factors and Ergonomics Methods. CRC Press

OPERATIONS RESEARCH

ENIE603007
3 credits
Learning objectives:

Able to have knowledge and expertise to use mathematical optimization models that can be transformed into deterministic and stochastic in solving problems of engineering and management.

Syllabus:

Dynamic programming (deterministic), dynamic programming (stochastic), Markov chain, decision analysis, game theory, Nonlinear programming, queue theory, optimization simulation

Prerequisite: Linear Programming

Teaching Book:
1. Ahuja, Magnanti, and Orlin, Network Flows: Theory, Algorithm, and Application. 1993
2. Taylor III, Introduction to Management Science, 11th edition, 2013
3. Any relevant and useful web page(s)

ORGANIZATIONAL DESIGN AND INDUSTRIAL PSYCHOLOGY

ENIE603004
3 credits
Learning objectives:

Capable of designing a team-based organizational structure with a division of roles and job descriptions. Course participants can analyze the influencing factors of designand organization management in the industry, including human capital assets.

Syllabus:

Introduction to organizational and industrial psychology, understanding and insight into industrial and organizational psychology, workforce selection and placement, labor training and development, occupational conditions and occupational psychology, corporate leadership, organizational and working groups, organizational development and culture, work weighing

Work motivation, job satisfaction, stress, and occupational safety, consumer psychology.

Prerequisite: Introduction to Industrial engineering

Teaching Book:
1. Griffin, R. W., & Moorhead, G. (2011). Organizational behavior. Nelson Education.
2. DeCenzo, D. A., Robbins, S. P., & Verhulst, S. L. (2016). Fundamentals of human resource management. John Wiley & Sons.

SYSTEM MODELING AND LAB

ENIE605020
3 credits
Learning objectives:

Able to choose and model the right modeling approach based on scope, type, limitation of various approaches modeling and simulation system according to the general modeling and simulation methodology.

Syllabus:

Modeling concepts, the general methodology of system Modeling: conceptualization, development, Simulation and analysis of simulated results, examples of cases of modeling, validation and verification of discrete modeling, user-requirement methodology, report drafting techniques, and presentation of modeling results.

Prerequisite: Basic statistics, probability theory

Teaching Book:
1. Bankes, S. C. (1993). Exploratory Modeling and The Use of Simulation for Policy Analysis. RAND Note
2. Chermack, T. J. (2011). Scenario Planning in Organizations, Berrett-Koehler Publishers Inc.: San Fransisco.
3. Harrell, C. et al (2000). Simulation Using Promodel, McGraw-Hill Higher Education New York
4. Harrell, C. et al (2000). Promodel Complete User Guide, McGraw-Hill Higher Education New York
5. Martelli, A. (2014). Models of Scenario Building and Planning: Bocconi on Management, Palgrave Macmillan: Milan.
6. Render, B., Stair, R., Hanna, M. (2019). Quantitative Analysis Management:
7. Reid & Sanders (2012). Operations Management: An Integrated Approach, 5th Edition: Supplement C: Waiting Line Models
8. Siebers, P. O., Macal, C. M., Garnett, J., Buxton, D., & Pidd, M. (2010). Discrete-event simulation is dead, long live agent-based simulation! Journal of Simulation, 4(3), 204-210.
9. Walck C. (2007) Hand-book on statistical distributions for experimentalists. University of Stockholm

RELIABILITY AND MAINTENANCE

ENIE604014
2 credits
Learning objectives:

Course participants understand the important aspects of the maintenance system management and the type of approach that is currently used in the industry. Capable of designing equipment maintenance or machine-based scheduling *preventive Maintenance* concept.

Syllabus:

Reliability. Organizing for Maintenance Operations. Paperwork Control. Maintenance Job Planning and Scheduling. Maintenance Work Measurement and Standards. Preventive Maintenance Measuring and Appraising Maintenance Performance. Total Productive Maintenance. Maintenance Management in Action

Prerequisite:

Teaching Book:
1. Charles E. Ebelling. (Ed. 8 -2010). An Introduction to Reliability and Maintanability Engineering. Waveland Press, Illinois

DATA ANALYTICS AND VISUALIZATION

ENIE604022
2 credits
Learning objectives:

Being able to explain data better, presents clear evidence of the findings to the intended audience, and tells the data story and clearly describes the points you want to convey through the graph.

Syllabus:

Introduction to Data Analytics And Visualization, Data-Driven Organization, Data Ingestion, And Data Quality, Mining Frequent Itemset, Finding Similar Item, Clustering, Value of Visualization, Information Visualization, Data For Data Graphics, Design Principles, Storytelling, Multivariate Displays, Visualization of Multidimensional Data, Visualization of Networks, Tools/Systems For Data Analytics And Visualization

Prerequisite: Industrial Statistics + practicum

Teaching Book:

1. Zuo, Zhiya., and Once, Jan Carlo. Python Tutorial Series. GitHub. https://github.com/zhiyzuo/python-tutorial.
2. Introduction to Data Science Fall 2015. University of California Berkeley https://bcourses.berkeley.edu/courses/1377158.
3. James, G., Witten, D., Hastie, T., & Tibshirani, R. (2021). An introduction to statistical learning: with applications in R. Springer.
4. Borwankar, Nitin., and Cooper, Philip. Open Data Science Training. GitHub. https://github.com/nborwankar/opendatasci
5. Masino, Aaron., and Ozdemir, Sinan. machine_learning. GitHub. https://github.com/masinoa/machine_learning

FACILITIES PLANNING AND MATERIAL HANDLING
ENIE615023
3 credits
Learning objectives: able to design factory layout and its facilities that optimize material movement and minimize costs.

Syllabus:

Design function, the outline of planning procedures, process design, Material Flow planning, Analytical Engineering, relationship planning between activities, production, and manufacturing services, calculation, of space area, allocation of areas, material transporting equipment, preparation of plant building. Factory site Selection.

Prerequisite: production planning and Inventory Control

Teaching Book:

1. Heragu, S. (2016). *Facilities Design 4th edition*. Boca Raton, FL: C.R.C. Press.
2. Apple, J.M. (1977). *Plant Layout and Material Handling*. New York: The Ronald Press Company.
3. Tompkins, J. A., White, J. A., Bozer, Y. A., & tanchoco, J.M.A. (2010). *Facilities Planning 4th edition*. Danvers: John Wiley & Sons, Inc.

PRODUCT DESIGN
ENIE605024
2 credits
Learning objectives:

Able to design a new product-service concept in the form of minimum viable product based on a market research.

Syllabus:

Ideation, Strategic Brand Management, Costumer Needs Identification, Product Specification, Product Concept, Testing the Concept, Product Architecture, Design for Manufacturing, Design for Assembly, Prototyping, Product Development Project

Prerequisite: Human Factors in Engineering and Design + Lab

Teaching Book:

1. Ulrich, Karl T.; Steven D. Epingger. 2008. Product Design Development. 3rd Edition. New York, NY: McGraw Hill
2. Bralla, James G. 1996. Design for Excellence. New York, NY: McGraw-Hill
3. Kahn, Kenneth B. 2013. The PDMA Handbook of New Product Development. Hoboken, NJ: Willey
4. Dieter, George E. 2000. Engineering Design. 3rd edition. New York, NY: McGraw Hill

INDUSTRIAL PROJECT DESIGN
ENIE600023
3 credits
Learning objectives:

Able to design the scheduling of industrial projects and their allocation of resources effectively and efficiently.

Syllabus:

System theory, PMDA Organization project, project resources, staff organization and project team, time Management, *Critical Path Method*, PERT, Project graphs, cost control.

Prerequisite: Introduction to Industrial Engineering and Engineering Economics

Teaching Book:

1. Apple, James M. Plant Layout and Materials Handling, Third Edition. Wiley, 1977.
2. Blumberg, Donald F. Introduction to Management of Reverse Logistics and Closed Loop Supply Chain Processes. CRC Press, 2004.
3. Chapman, Steve, & Arnold, Tony K. Introduction to Materials Management, Eight Edition. Pearson, 2016.
4. Cooper.Winning at New Products. 4th Edition.2017
5. Fiksel, Joseph. Design for Environment: A Guide to Sustainable Product Development, Second Edition. McGraw-Hill, 2011.
6. Grieves, Michael, Product Lifecycle Management: Driving the Next Generation of Lean Thinking. McGraw-Hill, 2005.
7. Kezner, Harold. Project Management: A Systems Approach to Planning, Scheduling, and Controlling, 10th Edition. John Wiley and Sons, 2009.
8. Killi, Steinar Westhrin. Additive Manufacturing: Design, Methods, and Processes. Pan Standford Publishing, 2017.
9. Newnan, Donald G., Eschenbach, Ted G., P. Lavelle, Jerome. Engineering Economic Analysis 13th Edition. Oxford University Press, 2017.
10. Osterwalder, Alexander & Pigneur, Yves. Business model generation: A handbook for visionaries, game changers, and challengers. John Wiley & Sons, 2010.
11. Salvendy., Gavriel. Handbook of Human Factors and Ergonomics. Wiley, 2012
12. Shtub, Avraham & Cohen, Yuval. Introduction to Industrial Engineering, Second Edition. CRC Press, 2017.
13. Simchi-Levi, David, Philip, Kaminsky, Simchi-Levi, Edith. Designing and Managing the Supply Chain: Concept, Strategies, and Case Studies, Third Edition. McGraw-Hill, 2007.
14. Trott, Paul, Innovation Management and New Product Development. 5th Edition. 2015.
15. Ulrich & Eppinger. Product Design and Development. 5th Edition. McGraw-Hill. 2017

SUPPLY CHAIN SYSTEMS
ENIE616026
3 credits
Learning objectives:

Able to determine effective and efficient supply chain system design solutions based on product, market, and customer characteristics.

Syllabus:

Inventory management and *Risk Pooling*, network Planning, supply contracts, information roles in supply chains, supply chain integration, distribution strategies, strategic alliances, outsourcing strategies.

Prerequisite: Production planning and Inventory Control

Teaching Book:
1. Simchi-Levi, D., Kaminsky, P., Simchi-Levi, E., & Shankar, R. (2008). Designing and managing the supply chain: concepts, strategies, and case studies. Tata McGraw-Hill Education.
2. Chopra, S., & Meindl, P. (2007). Supply chain Management. Strategy, planning & operation. In Das summa summarum des Management (pp. 265-275). Gabler.

INDUSTRIAL SIMULATION

ENIE605020
3 credits
Learning objectives:

Able to design computer simulation based on complex industrial systems and to implement feasibility analysis based on the simulation.

Syllabus:

Continuous Modeling Concept, Continuous Modeling Methods, Causal Loop Diagram, Stock-Flow Diagram, Behaviours over Time, Scenario Development, Model Verification and Validation.

Prerequisite: Pengantar Teknik Industri dan Ekonomi Teknik

Teaching Book:

1. Tennent, J., & Friend, G. (2011). Guide to business modelling (Vol. 89). John Wiley & Sons.
2. Benninga, S. (2014). Financial Modeling (MIT Press). Bessis, J.(1998) Risk Management in Banking John Wiley & Sons Ltd.
3. Proctor, K. S. (2004). Building financial models with Microsoft Excel: A guide for business professionals (Vol. 269). John Wiley & Sons.
4. Sengupta, C. (2004). Financial modeling using excel and VBA (Vol. 152). John Wiley & Sons.
5. Knaflic, C. N. (2015). Storytelling with data: A data visualization guide for business professionals. John Wiley & Sons.
6. L Day, A. (2009). Mastering Risk Modelling.
7. Powell, S. G., & Baker, K. R. (2009). Management science: The art of modeling with spreadsheets. Wiley.
8. Walsh, C. (2008). Key management ratios: the 100+ ratios every manager needs to know. Pearson Education.

INFORMATION SYSTEM

ENIE605028
3 credits
Learning objectives:

Able to plan an information system by paying attention to the flow of existing information to achieve a competitive company. The initial information system is created through database management that will generate important information and analysis that will support the decision making to be taken.

Syllabus:

Introduction to management information systems. MIS/IT as a competitive advantage. I.T. and Electronic Commerce. Database and database management. System Analysis and Design. M.I.S. and its relationship with R.Q.M. and Q.S. CBIS. Accounting Information System. Decision Support System. Executive Information System. Marketing, Manufacturing Information System. Financial, Human Resource Information System.

Prerequisite: organization and Industrial psychology

Teaching Book:
1. Management information system / Raymond Mcleod, Jr. George P. Schell, - 10th ed., Pearson Prentice Hall, 2008
2. Management information system managing the digital firm / Kenneth C. Laudon, Jane P. Laudon, - 16th ed., Pearson, 2020

MULTIVARIATE STATISTICS

ENIE803433
3 credits
Learning objectives:

Able to design research, build a research model, analyze data, and interpret research results using proper multivariate methods and data set characteristics.

Syllabus:

Introduction to Multivariate methods, Data characteristics, exploratory factor analysis, multiple regression analysis, double discriminant analysis, logistic regression, conjoin analysis, cluster analysis, multidimensional scaling, Correspondence Analysis, structured Equation Model (Introduction), confirmatory factor analysis, structured equation model testing, multiple variant analysis.

Prerequisite: Industrial Statistics

Teaching Book:

Hair, et al. (2014). *Multivariate Data Analysis*. To Pearson.

INDUSTRIAL MARKETING

ENIE615030
2 credits
Learning objectives:

Students can conduct market research based on *marketing mix* and perform segmentation analysis, *targeting*, and *positioning* of a *brand* in a digital marketing ecosystem

Syllabus:

Marketing strategies and plans, information collection and demand forecasting, market research, market analysis, Business Analytics, *Brand Equity and Positioning*, pricing strategies, Digital marketing.

Prerequisite: organization and Industrial psychology

Teaching Book:
1. Kotler, P., Keller, K. L., & Manceau, D. (2012). Marketing Management. 14Eedition. NewJersey: Prentice Hall.
2. Kotler, P., Kartajaya, H., & Setiawan, I. (2021). Marketing 5.0: Technology for Humanity. John Wiley & Sons.

INDUSTRIAL ENGINEERING DESIGN + LAB

ENIE600023 - ENIE606032
3 + 1 credit
Learning objectives:

Able to design an effective and efficient solution in the form of integrated services and manufacturing products following the needs and characteristics of the industry in the studied; the solution was developed in a structured design team that works with professionals and has ethical responsibilities.

Syllabus:

Product lifecycle, project management for product development, *Canvas Business model*, ergonomic design, Alpha and Beta Prototyping, financial model, *design for manufacturing, design for environment,* distribution system, recycling system.

Prerequisite: Product design, Perancangan Organisasi, Tata Letak Pabrik, Perancangan Proyek Industri, Akuntansi Biaya, Ekonomi Teknik, PPIC

Teaching Book:
1. Apple, James M. Plant Layout and Materials Handling, Third Edition. Wiley, 1977.
2. Blumberg, Donald F. Introduction to Management of Reverse Logistics and Closed Loop Supply Chain Processes. CRC Press, 2004.
3. Chapman, Steve, & Arnold, Tony K. Introduction to Materials Management, Eight Edition. Pearson, 2016.
4. Cooper.Winning at New Products. 4th Edition.2017
5. Fiksel, Joseph. Design for Environment: A Guide to Sustainable Product Development, Second Edition. McGraw-Hill, 2011.
6. Grieves, Michael, Product Lifecycle Management: Driving the Next Generation of Lean Thinking. McGraw-Hill, 2005.
7. Kezner, Harold. Project Management: A Systems Approach to Planning, Scheduling, and Controlling, 10th Edition. John Wiley and Sons, 2009.
8. Killi, Steinar Westhrin. Additive Manufacturing: Design, Methods, and Processes. Pan Standford Publishing, 2017.
9. Newnan, Donald G., Eschenbach, Ted G., P. Lavelle, Jerome. Engineering Economic Analysis 13th Edition. Oxford University Press, 2017.
10. Osterwalder, Alexander & Pigneur, Yves. Business model generation: A handbook for visionaries, game changers, and challengers. John Wiley & Sons, 2010.
11. Salvendy., Gavriel. Handbook of Human Factors and Ergonomics. Wiley, 2012
12. Shtub, Avraham & Cohen, Yuval. Introduction to Industrial Engineering, Second Edition. CRC Press, 2017.
13. Simchi-Levi, David, Philip, Kaminsky, Simchi-Levi, Edith. Designing and Managing the Supply Chain: Concept, Strategies, and Case Studies, Third Edition. McGraw-Hill, 2007.
14. Trott, Paul, Innovation Management and New Product Development. 5th Edition. 2015.
15. Ulrich & Eppinger. Product Design and Development. 5th Edition. McGraw-Hill. 2017

SPECIAL TOPIC IN INDUSTRIAL ENGINEERING
ENIE617034
2 credits
Learning objectives:

Able to explain the development of industry and its engineering, business opportunities, and the problems faced in general.

Syllabus:

Held by inviting a competent guest lecturer in the field to suit the needs of each course (can be different in each Semester).

Prerequisite: -

Teaching Book: -

Special Lecture

INTERNSHIP
ENIE617033
2 credits
Learning objectives:

Able to explain the application of various scientific engineering industry in the world of employment and reflecting on what has been studied during the lecture

Syllabus:

Prerequisite: refer to internship standard procedure

Teaching Book: -

FINAL PROJECT IN INDUSTRIAL ENGINEERING
ENIE608035/ENIE618035
5 credits
Learning Objectives :

Able to raise the problem and opinion in a scientific discussion systematically, clearly, and correctly. Able to compile ideas/solutions/opinions in scientific writing following the rules of scientific writing integrating science that has been studied.

Syllabus:

The science of Industrial engineering to solve a real-world case study

Prerequisite:

Teaching book:
1. Manual of the Universitas Indonesia thesis
2. Technical guideline for Universitas Indonesia student final assignment.
3. IEEE Citation Reference.
4. Ivan Stojmenovic, "How to Write Research Articles in Computing and Engineering discipline," IEEE Transactions on Parallel and Distributed Systems, Vol. 21, No. 2, February 2010.

Elective Courses

INTERPERSONAL SKILLS
ENIE605036
3 credits
Learning Objective(s):

Course participants are able to implement the principles of effective communication and behavior standard according to ethics and habits in a professional level of organization.

Syllabus:

Basics of Communication Science. Reading and Controlling Body Language. Listening and Inquiring Skill to Facilitate, Development of Presentation Materials, Presentation Preparation, Processing the Question and Answer Session, Formal Writing Skill (Proposal, Report, Letter, Correspondence, Manner), and Effective Reading.

Pre-requisite(s): -

Text Book(s):

1. Interpersonal Skills in Organizations, 7th Edition, Suzanne de Janasz and Karen Dowd and Beth Schneider. McGraw Hill. 2022

Additional References:

1. Human Relations: Interpersonal Job-Oriented Skills, 9 Edition, Andre J. DuBrin. Pearson Education Inc. Upper Saddle, New Jersey. 2007.
2. Interpersonal Skills for Leadership 2nd Edition. Susan Fritz, F. William Brown, Joyce Povlacs Lunde, dan Elizabeth A. Banset. Pearson Education – Prentice Hall. New Jersey. 2005
3. Human Relations in Business: Developing Interpersonal

and Leadership Skills. Michael G. Aamodt dan Bobbie L. Raynes. Thomson Learning, Belmont. 2001

PRODUCT LIFE CYCLE MANAGEMENT
3 credits
Learning Objective(s):

Course participants are able to understand the product life cycle and its role in creating company's innovation strategy.

Syllabus: Product Life Cycle Concept, Product Life Cycle Phase Management, PLM and Innovation Strategy, Product Development Strategy in Enterprise.

Pre-requisite(s): -

Text Book(s):
1. Innovation Management and New Product Development: Paul Trott, 5th Edition, 2012.
2. Strategic Management of Technological Innovation: Melissa A. Schiling, 3rd Edition, 2010.
3. Winning at New Products: Robert G. Cooper, 3rd Edition, 2011.
4. Product Design Development: Karl T.Ulrich & Steven D. Eppinger, 4th Edition, 2007

MACROERGONOMICS
3 credits
Learning Objective(s):

Students are expected to evaluate the design of a working system consisting of variables that interacts with hardware and software in internal physical environments, external environments, and organizational structures.

Topic:

Introduction to the ergonomic macro, methods and tools used in the analysis of work and design systems, introduction of integration of organizations in the context of productivity, safety, health and quality of work life.

Pre-requisite(s): Human Factors in Engineering and Design

Text Book(s):
1. Pengantar Makro Ergonomi
2. Kajian struktur sistem kerja
3. Metode makroergonomi: Macroergonomics Analysis of Structure (MAS)
4. Metode makroergonomi: Macroergonomics Analysis and Design (MEAD)
5. Metode makroergonomi: System Analysis Tools (SAT)
6. Metode makroergonomi: Participatory Ergonomics
7. Metode makroergonomi: Metode lain untuk mengevalu-asi desain sistem
8. Makroergonomi dan produktivitas
9. Metode makroergonomi: Kansei Engineering

FINANCE AND INVESTMENTS
3 credits
Learning Objective(s):

Course participants possess the knowledge about industrial finance and investments in general and multinational including international trading and finance.

Syllabus:

International Trade Theory, Trade Policies, Monetary and Payment System, Market and Exchange Mechanism, International Investment, Multinational Finance, Foreign Investment Analysis.

Pre-requisite(s):

Text Book(s):
1. Berk, Jonathan, and Peter DeMarzo, Corporate Finance, 2nd edition, Pearson, Boston, 2010.

INNOVATION MANAGEMENT
3 credits
Learning Objective(s):

Course participants are able to understand the concept and steps in developing innovation within organization.

Syllabus:

State of the art 'Innovation', Innovation Development Strategy, Country Innovation, Process Innovation, Innovation Development Procedure, Technology Empowerment to Develop Innovation.

Pre-requisite(s): -

Text Book(s):
1. Burgelman, R.A., Christensen, C.M., Wheelwright, S.C. 2009. Strategic management of technology and innovation. McGraw-Hill Irwin, Boston.
2. Schilling MA. 2013. Strategic management of technological innovation (4th ed.). McGraw-Hill: New York, NY.
3. Tidd, J., Bessant, J.R. 2014. Strategic innovation management. Wiley, Hoboken.

CUSTOMER RELATIONSHIP MANAGEMENT
3 credits
Learning Objective(s):

Course participants are able to understand the role and function of customer relationship management in improving organization's/company's competitiveness.

Syllabus:

Concept and Procedure of CRM Implementation in Organization, CRM Process Management, Managing Networks for CRM performance CRM Success Measurement, Best Practices of CRM Implementation, Managing supplier partner relationships, IT for CRM

Pre-requisite(s): Information System

Textbooks:
1. Francis Buttle and Stan Maklan. Customer Relationship Management, Routledge, Edition: Third.

LEAN OPERATIONS
3 credits
Learning Objective(s):

Course participants are able to understand the concept of effective manufacturing process.

Syllabus:

History and Concept of Lean Operations and Manufacturing, Strategy and Procedure of Lean Manufacturing Implementation, Toyota Production System

Pre-requisite(s): Production System

Text Book(s):
1. Wilson, L. (2009). How to Implement Lean Manufacturing, McGrawHill.
2. Askin, R.G., (2002). Design and Analysis of Lean Production System, John Wiley & Sons.
3. Pascal, D. (2007). Lean Production Simplified, Productivity Press.

RECONFIGURABLE MANUFACTURING SYSTEM
3 credits
Learning Objective(s):

Course participants are able to understand the concept of manufacturing facility analysis and planning and the differences compared to models of manufacturing system and supported with laboratory work.

Syllabus:

General RMS Characteristics, Enabling Technologies and Reconfigurable Characteristics, Reconfigurable Machines.

Pre-requisite(s): Production System

Text Book(s):

1. Meyers, F.E., Stephens, M.P. (2005). Manufacturing Facilities Design and material Handling, 3rd Ed. Prentice-Hall.

LINEAR AND STOCHASTIC PROGRAMING

3 credits
Learning objectives:

Students understand and master the theory and fundamentals of linear and stochastic programming, capable of using advanced techniques in linear and stochastic programing and can apply both linear and stochastic programming and use the software to solve linear and stochastic programming problems and tools.

Syllabus:

Introduction, The geometry of Linear Models, The Simplex Method, Duality Theory, The Interior point Method, Modeling Languages, Sensitivity Analysis, Advanced Models and Methods, Two-stage Stochastic Optimization, Chance-Constrained Programming.

Prerequisite: -

Teaching Book:
1. D. Bertsimas and J.N. Tsitsiklis, Introduction to Linear Optimization, Athena Scientific (1997).
2. John R. Birge and Francois Louveaux. Introduction to Stochastic Programming (Springer Verlag, 1997).
3. Alexander Shapiro, Darinka Dentcheva, and Andrzej Ruszczynski. Lectures on Stochastic Programming – Modeling and Theory (SIAM, 2009)

QUEUING THEORY

3 credits
Learning objectives:

Students understand and master simple queue models, network queues and cycle queues. Students are also expected to master the completion techniques of the queue model and translate the real issue into the queue model.

Syllabus:

Introduction, Simple Markovian model, Advanced Markovian model, Networks, Series, Cyclic Queues, Networks, Series, Cyclic Queues, Fluid Models, Stability and Optimization, Traffic, Dependency.

Prerequisite: -

Teaching Book:
1. Leonard Kleinrock, "Queueing Systems Volume I: Theory", New York: Wiley, 1975.
2. Donald Gross, John F. Shortle, James M. Thompson and Carl M. Harris, "Fundamentals of Queueing Theory", New York: Wiley, 2008

DATA MINING

3 credits
Learning Objective(s):

Course participants are able to organize the extraction, process, and data analysis in a right way to make decisions.

Syllabus:

Concept and Process of Data Mining, Algorithm in Data Mining, Data Mining Application in Organization.

Pre-requisite(s): Statistics and Probability, Industrial Statistics.

Text Book(s):

1. Nisbet, R. (2009). Handbook of Statistical Analysis and Data Mining Applications, Elsevier.

SYSTEMS ENGINEERING

3 credits
Learning Objective(s):

Course participants are able to understand the basics of system engineering management in industries to be able to cultivate a design process, installation, management and termination of a complex system.

Syllabus:

Concept and methodology of industrial system engineering. System Life-Cycle: Concept –Development – Production – Benefit and Support – End of System. Vee-Model. Processes in System Life Cycle: Technical Process. Project Process. Organization Process and Acquisition Process of Goods and Services. System Value and Life Cycle Costing. The Role of Modeling and Simulation in System Engineering.

Pre-requisite(s): System Modeling

Text Book(s):
1. Cecilia Haskins, CSEP, Kevin Forsberg, CSEP and Michael Krueger, CSEP. *Systems Engineering Handbook: A Guide For System Life Cycle Processes And Activities*, version 3.1, 2007
2. Kossiakoff, Alexander and William N. Sweet. *Systems Engineering Principles and Practice*. John Wiley & Sons. Hoboken – New Jersey, 2003.
3. ISO/IEC 15288 Standard for Systems Engineering. International Organization Standard (ISO).

ENTERPRISE COMPETITIVENESS ANALYSIS

3 credits
Learning Objective(s):

Course participants are able to analyze company's internal and external factors for setting up company strategy for achieving competitive advantage through value innovation and strategic position and capabilities development.

Syllabus:

Understanding Industry Profitability, The Vertical Boundaries of the Firm, Strategic Positioning for Competitive Advantage, Leveraging Market Power to Grow, Risk Management, Competitor and Competition, Competitive Intelligence

Textbooks:
1. Besanko, David. 2007. Economics of Strategy, Willey, 4th edition.
2. Sharp, S. 2009. How to minimize risk, avoid surprise, and grow your business in a changing world. John Willey.
3. Porter, M. 2008. The Five Competitive Forces That Shape Strategy. Harvard Business Review
4. Porter, M. 1998. Competitive Strategy: Techniques for Analyzing Industries and Competitors. Free Press.
5. Carbal, Luis. 2000. Introduction to Industrial Organization, MIT Press

ADVANCED OPTIMIZATION

3 credits
Learning Objective(s):

Course participants are able to design and implement various heuristic and meta-heuristic optimization algorithms to solve problems in industrial engineering field.

Syllabus:

Introduction to Optimization. Complexity Theory. Basics of Heuristic. Hill Climbing Algorithm. Greedy Algorithm, Simulated Annealing, Tabu Search, Genetic Algorithm, Challenge Counter Techniques, Multi-destinations metaheuristic.

Pre-requisite(s): Operation Research

Textbook:
1. Zbigniew Michalewicz,. David B. Fogel (2004). *How to Solve It: Modern Heuristics*, Springer.
2. Essentials of Metaheuristics, Sean Luke (2009). *Essentials of Metaheuristics,* Lulu, available at http://cs.gmu.edu/~sean/book/metaheuristics/
3. Andries P. Engelbrecht (2007) *Computational Intelligence, An introduction*, John Wiley & Sons, England.

HUMAN DIGITAL MODELING AND SIMULATION

3 credits
Learning objective(s):

Course participants are able to model digital human and simulate it to obtain more effective and efficient work design

Syllabus:

Anthropometry, Human Factors and Ergonomics in Healthcare, Ergonomics Modelling & Usability Evaluation, Human Factors, Ergonomics and Safety in Manufacturing and Service Industries. Introduction to Jack Software and Motion Capture.

Pre-requisite(s): Human Factors in Engineering & Design

Textbooks:-
1. Introduction to Human Digital Modeling
2. Application of Human Digital Simulation
3. Principles of Biomechanics
4. Predictive Modeling
5. Jack Simulation Software (concepts, tutorials and case studies
6. Basic Principles of Cognitive Ergonomics
7. Usability Testing Methods: Value Proposition, User Interview, Task Analysis, Card Sorting, Focus Groups, Questionnaires of SUS, QUIS, UEQ, PANAS, Eye tracking
8. Human Centric Innovation
9. Game Thinking
10. Metode IDEEAS

DECISION UNCERTAINTIES AND RISK

3 credits
Learning objective(s):

Course participants are able to analyze risks and uncertainties based on statistical tools accurately to make decision

Syllabus:

Concept and Decision-Making Process, Uncertainty Theory, Risks Analysis Prerequisites: Statistics and Probability, Industrial Statistics

Prerequisite(s): Statistics and Probability

Textbooks:

1. Parmigiani, G. (2009). *Decision Theory: Principles and Approaches*, John Wiley.

2. Yoe, C. (2011). Principles of risk analysis: decision making under uncertainty. CRC press.

DESIGN THINKING

3 credits
Learning objectives:

Students understand the principles of design thinking and understand how implementation and benefits in the process of designing, decision making and problem solving

Syllabus:

Philosophy of Design Thinking, Steps and Phases in Design Thinking, Design Centric Culture, User Centric Design, Lean UX, Design Thinking and Problem Solving

Prerequisite: -

Teaching Book:
1. The Effective Change's Manager Handbook, Richard Smith et al., 2014, APMG International.
2. HBR Must Read Change Management, John P. Kotter, 2007, HBR.

BUSINESS PROCESS REENGINEERING

3 credits
Learning objective(s):

Course participants are able to design a system by using business process reengineering which could measure and assure the quality and speed of an organization's operation process based on facts by using mathematical approaches, simulations and information stream compared to worldwide best-practice.

Syllabus:

Reengineering: The Path to Change, Rethinking Business Process, Business Process Reengineering, BPR in Service Industry, Manufacturing Industry and Information Technology, BPR methodology, Business Process Simulation, Business Process Management.

Pre-requisite(s): Introduction to Industrial Engineering

Textbooks:
1. Rengineering Corporation , Michael Hammer & James Champy, Harper-London (2006)
2. Business Process Change – Reengineering Concepts, Methods and Technologies, Varun Grover & William J. Kettinger, Idea Group Publishing (1998)
3. Business Process Reengineering A Complete Guide - 2021 Edition, The Art of Service (2021)
4. Business Process Reengineering – Text and Cases, R Radhakrisnan, PHI - New Delhi (2010) 5. Business Process Reengineering: A Consolidated Methodology, Subramanian Muthu , Larry Whitman , S. Hossein
5. Cheraghi, Proceedings of the 4 th Annual International Conference on Industrial Engineering Theory, Applications, and Practice, 1999 U.S. Department of the Interior (1999)
6. The Practical Guide to Business Process Reengineering using IDEF0, Feldmann Clarence.G, (1998), Donet Publishing New York
7. Managing Business Process Flows, Anupindi, R., Chopra, S., Deshmukh, S. D., Van Mieghem, J. A., & Zemel, E., Upper Saddle River, NJ: Prentice Hall. (1999).
8. Business Process Mapping: Improving Customer Satisfaction, J. Mike Jacka, Paulette J. Keller, Wiley; 2nd edition (2009)
9. Process Mapping: How to Reengineer your Business Process., Hunt, Daniel.V., (1996), John Wiley and Sons Inc, New York
10. Process Innovation , Reengineering work through information technology, Davenport, Harvard Business

School Press 2004
11. Enterprise Ontology: Theory and Methodology. Jan L. Dietz. Springer Berlin Heidelberg (2006).

HEURISTIC METHODS IN OPTIMIZATION

3 credits
Learning objective(s):

Course participants are able to design heuristic and meta-heuristic algorithms to solve optimization problems with single or multiple objectives. Course participants are also able to design parallel and hybrid metaheuristic algorithm. These meta-heuristic algorithms would be implemented in a programming language.

Syllabus:

Introduction, Single-Solution Based Metaheuristics, Population-Based Metaheuristics, Population-Based Metaheuristics, Metaheuristics for Multiobjective Optimization, Hybrid Metaheuristics, Parallel Metaheuristics.

Textbooks:

1. El-Ghazali Talbi, Metaheuristics: From Design to Implementation, Wiley:2009

CONSTRAINT PROGRAMMING

3 credits
Learning objective(s):

Course participants are able to build a constraint programming model, and to understand how solver constraint programming works and its advance methods in increasing efficiency.

Syllabus:

Propositional Logic, Modeling problems as SAT, Automated Reasoning: preliminaries, Resolution, Systematic Search, Stochastic Local search, Constraint Satisfaction Problems, Search Algorithms, Constraint type, Advanced technique, Modeling.

Textbooks:
1. Rina Dechter, Constraint Processing, 2003, Morgan Kauffmann.
2. Edward Tsang, Foundations of Constraint Satisfaction. Books On Demand: 2014.

STATISTICAL LEARNING

3 credits
Learning objectives:

Students are able to explain the *machine learning* Framework and apply a *supervised learning* with a focus on regression and classification.

Syllabus:

Linear and polynomial regression, logistic regression and linear discriminant analysis; cross-validation and the bootstrap, model selection and regularization methods (ridge and lasso); nonlinear models, splines and generalized additive models; tree-based methods, random forests and boosting; support-vector machines. Some unsupervised learning methods are discussed: principal components and clustering (k-means and hierarchical).

Prerequisite:

Teaching Book:

1. James, G., Witten, D., Hastie, T. and Tibshirani, R., 2013. An introduction to statistical learning (Vol. 112, p. 18). New York: springer.

INTELLIGENT PRODUCT-SERVICE SYSTEM

3 credits
Purpose of Learning:

Students are able to explain the framework of the product system-intelligent services and then propose a form of implementation improvement on the given case study.

Syllabus:

Digital Marketing, ICT-based consumer needs analysis, *Value Proposition, Stakeholders Management, crowdsourcing*

Prerequisite:

Teaching Books:

1. Van Halen, C., Vezzoli, C. and Wimmer, R., 2005. Methodology for product service system innovation: how to develop clean, clever and competitive strategies in companies. Uitgeverij Van Gorcum.

CIRCULAR ECONOMY FOR BUSINESS AND SUPPLY CHAIN

3 credits
Learning objectives:

Students are able to design business models and supply chain models built on the basis of a circular economic concept that is characterized by the imputation of material inputs, waste, energy by ensuring material and energy within a closed system loop

Syllabus:

Introduction to the circular economy, history of concept development, sustainable issues, *Butterfly Diagram, Economy Sharing, Closed-Loop Supply Chain, Reuse-remanufacturing-Recycling,* Products Durability

Prerequisite: -

Teaching Book:

1. Weetman, C., 2016. A circular economy handbook for business and supply chains: Repair, remake, redesign, rethink. Kogan Page Publishers.

SERVICES SYSTEMS ENGINEERING

3 credits
Learning objectives:

Students can understand the specificity of the service sector in terms of initial design, management, measurement methods of quality of performance of workers, and the method of measuring customer satisfaction, starting from service encounter, to the needs of managers in the service sector to combine marketing, technology, workers and information to be able to compete.

Syllabus:

Introduction to service engineering, new services development, technology on services, establishment of service companies, operations management services, quality services, capacity planning and Model queuing, forecasting demand on services, inventory management services.

Prerequisite:-

Teaching Book:

1. Cecilia Haskins, CSEP, Kevin Forsberg, CSEP and Michael Krueger, CSEP. SYSTEMS ENGINEERING HANDBOOK: A GUIDE FOR SYSTEM LIFE CYCLE PROCESSES AND ACTIVITIES, version 3.1, 2007
2. Kossiakoff, Alexander and William N. Sweet. Systems Engineering Principles and Practice. John Wiley & Sons. Hoboken-New Jersey, 2003.

3. ISO/IEC 15288 Standard for Systems Engineering. International Organization Standard (ISO).

LEAN LOGISTICS

3 credits

Learning objectives:

Students are able to evaluate manufacturing and logistics systems and propose improvements using the lean approach.

Syllabus:

Introduction, 7 *Waste, Lean Manufacturing, lean Supply Chain, lean Six Sigma, Toyota Production Systems*

Prerequisite:

Teaching Book:

Baudin, M., 2005. Lean logistics: the nuts and bolts of delivering materials and goods. CRC press.

FORECASTING METHOD

3 credits

Learning objectives:

Students are able to use forecasting methods to historical data available and choose the best forecasting method in favor of decision making.

Syllabus:

Introduction, *Sales and Operation Planning,* historical Data, *Moving averages, Winter Method,* ARIMA, error

Prerequisite:

Teaching Book:

1. Makridakis, S., Wheelwright, S.C. and Hyndman, R.J., 2008. Forecasting methods and applications. John wiley & sons.

TECHNOLOGY ADOPTION-BASED SYSTEM DYNAMICS

3 credits

Learning objectives:

Students are able to compile, analyze results and present a continuous model of technological adoption process using dynamic system modeling to evaluate the impact of technological adoption on complex systems

Syllabus:

Theory of Planned Behavior, Technology Acceptance model, Bass Diffusion model, diagram system, causal Loop Diagram, Stock-Flow diagram, model formulation, model testing, scenario analysis

Prerequisite:-

Teaching Book:

1. Public Policy Analysis : New Developments. Warren E. Walker, Wil A. H. Thissen . Springer. 2014.
2. Thinking in Systems: A Primer. Donella H. Meadows and Diana Wright. Chelsea Green Publishing. 2008
3. Powersim Studio 2003 Reference Guide. Powersim SA. 2003

AGENT BASED MODELING

3 credits

Learning Objectives:

Students understand the concepts and methodology of agent-based modeling as well as using agent-based modeling tools to create simple models.

Syllabus:

The basic concept of Agent-based modeling, Exploration of a wide variety of ABM cases historically, conceptualization model: ODD Overview, Design Concepts and Details, model development, Verification, validation and replicationofL Mode, scenario analysis

Prerequisite:-

Teaching Book:

1. Introduction to Agent-Based Modeling: Modeling Natural, Social, and Engineered Complex Systems with NetLogo. Uri Wilensky, William
2. Rand. The MIT Press. 2015
3. AnyLogic in Three Days: Modeling and Simulation Textbook. Ilya Grigoryev
4. Chapter 7: Documenting Social Simulation Models: The ODD Protocol as a Standard. Volker Grimm, Gary Polhill, and Julia Touza.in B.
5. Edmonds and R. Meyer (eds.), Simulating Social Complexity: Understanding Complex Systems, Springer-Verlag Berlin Heidelberg 2013

MODEL-BASED DECISION MAKING

3 credits

Learning objectives:

Students are able to apply a variety of management models that include frameworks, methods and management tools to solve problems that arise in conducting system engineering and presenting the solution well

Syllabus:

Model Based Decision Making, Mental Model, Frameworks as a Model, Models and Tools for Questioning Structure, Tools for Generating Alternatives, Tools for Prioritizing, Tools for Deployment, Tools for Monitoring and Control, Case Study Analysis

Prerequisite:

Teaching Book:

1. Figuera, J., Greco, S., Ehrgott, M. (2005). Multi Criteria Decision Analysis: State of the Art Surveys. Kluwer Academic Publishers.
2. Ragsdale, C. (2004). Spreadsheet Modeling & Decision Analysis. SouthWestern Colege Publisher.

SERVICE MANAGEMENT

3 credits

Learning objectives:

Students are expected to understand the basic concept of service management that exists in the service industry and manufacturing industry, making service management as one of the operations that will support the enterprise to be superior to compete from the others**.**

Syllabus:

Introduction, concept value in service management, service strategy, information technology.

Prerequisite:

Teaching Book:

1. Service Management An Integrated Approach to Supply Chain Management and Operations / Cengiz Haksever, Barry Render, 2013
2. Service Science The Foundations of Service Engineering and Management / Robin G. Qiu, 2014
3. Service Management / Prof. H. R. Appannaiah, DR. P. N. Reddy, DR. H. V. S. Raghavan, 2010.

HUMAN FACTORS IN INTELLIGENT

TRANSPORT SYSTEM

3 credits

Learning objectives:

Students are able to design vehicle and transportation systems involving human factors, related to their needs and limits by recognizing the basic-based vehicle design principles of human factors involving the function – the design functions to be a good and accountable design approach according to the needs of the user.

Syllabus:

Vehicle types, vehicle parts, general vehicle user characteristics, selection specifications, Concept design

Prerequisite:

Teaching Book:

1. Barfield, Woodrow; Thomas A. Dingus. 1997. Human Factors in Intelligent Transportation Systems. 1st Edition. Florida: CRC Press.
2. Sanders, M.S. and McCormick, E.J. (1993). Human Factors in Engineering and Design, 7th edition. Mc Graw-Hill

Additional:

1. Nemeth, Christopher P. 2004. Human Factors Methods for Design (Making Systems Human-Centered). 1st Edition. Florida: CRC Press.
2. Castro, Candida. 2009. Human Factors of Visual and Cognitive Performance in Driving. 1st Edition. Florida: CRC Press.

CHANGE MANAGEMENT

3 credits

Learning objectives:

Students are able to provide answers through strategy recommendation and change Management Activity series in accordance with the needs and characteristics of the industry.

Syllabus:

Pengantar *Change Management, Case Studies of Change Management Success Factors, The Dimensions of Change, Preparing for Organisational Change, Seven Steps to Change – A Systematic Approach, Implementing Change Management*

Prerequisite:-

Teaching Book:

1. The Effective Change's Manager Handbook, Richard Smith et al., 2014, APMG International.
2. HBR Must Read Change Management, John P. Kotter, 2007, HBR.

INTRODUCTION TO TECHNOPRENEURSHIP

3 credits

Learning objectives:

Students are able to explain the steps in starting a digital *start up* and designing the *canvas business model*

Syllabus:

Introduction to technology entrepreneurship, *business model Canvas,* case study, *pitching*, *venture capital,* failure of digital *start up*

Prerequisite:

Teaching Book:

1. Mankani, D., 2003. Technopreneurship: The Successful entrepreneur in The new economy. Pearson/Prentice Hall.

MARITIME LOGISTICS

3 credits

Learning objectives:

Students are able to design, analyze, and improve the performance of the maritime logistics system in general, and container terminals as well as scheduled cruise (liner) in particular.

Syllabus:

Maritime Economy, containerization, scheduled sailing, Berth Allocation problem, Quay Crane allocation problem, Stacking problem, Stowage Planning, Integration phase, Intermodality, Synchomodality, LPG supply chain, Fuel supply chain, Integtation phase.

Prerequisite: -

Teaching Book:

1. Notteboom, T. E., Pallis, A. a., De Langen, P. W., & Papachristou, A. (2013). Advances in port studies: the contribution of 40 years Maritime Policy & Management. Maritime Policy & Management, 40(7). https://doi.org/10.1080/03088839.2013.851455
2. Levinson, M. (2006). The Box: How the Shipping Container Made the World Smaller and the World Economy Bigger. Princeton:Princeton University Press.
3. Song, D. W., & Panayides, P. M. (2015). Maritime Logistics: a Guide to Contemporary Shipping and Port Management.
4. Mangan, J., Lalwani, C., Butcher, T., & Javadpour, R. (2012). Global Logistics and Supply Chain Management (2nd ed.). Chihester:John Wiley & Sons, Ltd.
5. International Chamber of Commerce. (2020). Incoterms 2020: ICC Rules for the Domestic and International Trade Terms. Paris.
6. Rodrigue, J.-P., Comtois, C., & Slack, B. (2013). The Geography of Transport Systems (Third Edit). London: Routledge. https://doi.org/10.1080/10630732.2011.603579
7. Kap, H. K., & Gunther, H.-O. (Eds.). (2007). Container Terminals and Cargo Systems: Design, Operations Management, and Logistics Control Issues. Berlin: Springer Berlin Heidelberg.
8. Meisel, F. (2009). Seaside Operations Planning in Container Terminals. https://doi.org/10.1007/978-3-7908-2191-8
9. Lee, S. W., Song, D. W., & Ducruet, C. (2008). A tale of Asia's world ports: The spatial evolution in global hub port cities.Geoforum, 39(1), 372–385. https://doi.org/10.1016/j.geoforum.2007.07.010
10. Mulder, J., & Dekker, R. (2014). Methods for strategic liner shipping network design. European Journal of Operational Research, 235(2), 367–377. https://doi.org/10.1016/j.ejor.2013.09.041

SUSTAINABLE MANUFACTURING AND INNOVATION

3 credits

Learning Objective(s):

Course participants are able to understand the environmental and sustainability aspects of manufacturing process and their roles in increasing the competitiveness of enterprise and innovation development.

Syllabus:

Concept and Sustainability Process in manufacturing process. Green Manufacturing (Remanufacturing, Reuse, Recycling), Renewables and Resource Utilizations, Green Logistics and SCM, Eco-Innovation, Best Practices in Sustainable Manufacturing.

Pre-requisite(s): Production System

Text Book(s):

1. Allen,D.T (2012). Sustainable Engineering Concepts, Design and Case Studies, Prentice Hall
2. Cooper. Robert G dan Edgett,Scott J.Edget , (2005), New Product Development,Product Development Institute, Canada.
3. Hermasolilla,J.G (2009). Eco-Innovation When Sustainability and Competitiveness, Shake Hands.
4. Jovane, F (2010) The Manufacture Roa : Towards Competitive and Sustainable High-Adding Value Manufacturing, Springer

ENERGY MANAGEMENT

3 credits

Learning objectives:

Students understand the principles of energy management including energy supply and demand so that students can cultivate a "sense" of the importance of energy and include it as a factor in decision making.

Syllabus: Energy and civilization, energy sources and sustainability, future of energy, economic analyst and life cycle cost, life cycle analysis, lighting, ventilation and cooling system, sustainable transportation system, effective energy management program, effective energy Management program, Modeling policies and energy planning

Prerequisite: -

Teaching Book:

1. John Randolph and Gilbert M. Masters, Energy for Sustainability, Technology, Planning, Policy. Island Press, 2008
2. Barney L. Capehard, Wayne C. Turner, and William J. Kennedy, Guide to Energy Management 6th ed. CRC Press, the Fairmont Press, 2008
3. Wayne C. Turner and Steve Doty, Energy Management Handbook 6th ed. CRC Press, the Fairmont Press, 2007
4. Politic of Energy, 2007
5. Papers and related publications

INTRODUCTION TO DATA SCIENCE

3 credits

Learning objectives:

Students understand and master the data collection and processing techniques, as well as the extraction techniques from existing data, especially in the field of industrial engineering.

Syllabus:

Introduction, variable and Operator type, *Loops* and *Arrays,* object and class, Data sorting, *asymptotic Notation, recurrences, quicksort, Randomized algorith*

Prerequisite:-

Teaching Book:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithm", The MIT Press, Cambridge, Massachusetts London, England

NUMERIC METHODS AND APPLICATIONS

3 credits

Learning objectives:

The students understand in Logic the numerical engineering equipment to solve various problems in the form of mathematics and physics that are widely encountered in engineering and even social and economic sciences. Tough solutions become very easy through dynamic system approaches that introduce iterating techniques or those in computer science do looping techniques. Therefore, it takes the systematic steps according to the way the computer thinks logic in achieving the solution. Various examples of applications are devoted to solving the problems of industrial engineering.

Syllabus:

Function theory, such as looking for an average number, the influence of linearization function of many ranks, looking for root or point-zero functions, interpolation and extrapolation; calculating the area and volume of an object without form with a numerical approach based on integration formula; solves the system of equations with many variables, including the simulation of the equation system models

Prerequisite: -

Textbooks:

1. Burden, Richard L. dan J Douglas Faires dan Albert C. Reynolds. 1981. Numerical Analysis. Boston: Prindle, Weber and Schmidt.
2. Hombeck, Robert W. 1975. Numerical Methods. New York: Quantum Publishersd, Inc
3. Chapra, Steven C dan Raymond P. Canale. 2002. Numerical Methods for Engineers. Boston: McGraw Hill Co.
4. McCalla, Thomas Richard. 1967. Introduction to Numerical Methods and Fortran Programming. New York: JohnWiley & Sons

Course Structure for Bachelor and Master Fast Track student in Industrial engineering

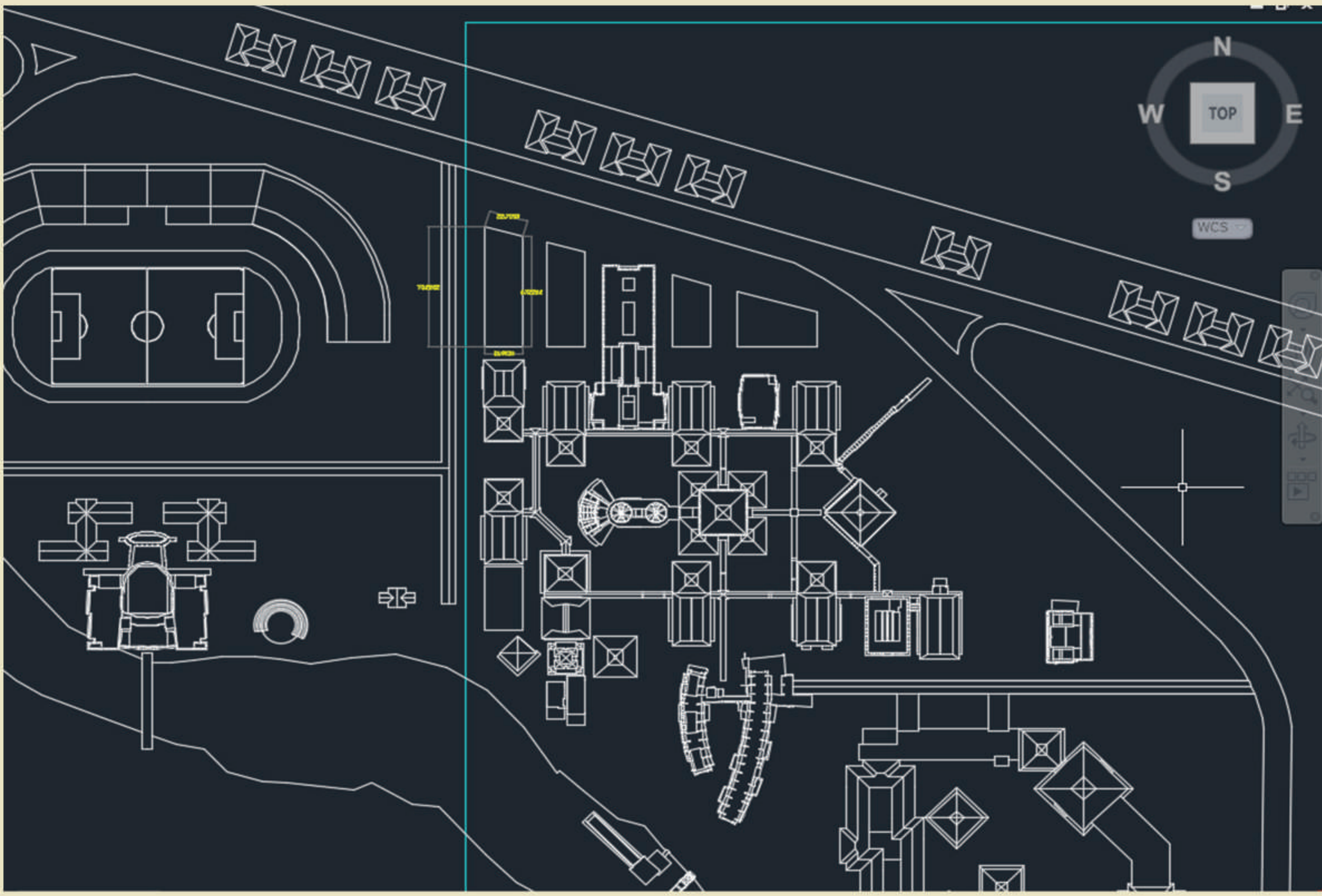
Code	Subject	SKS
	7th Semester	
ENIE801001	Systems Thinking	3
ENIE801004	Advanced Operation Research	3
ENIE801003	Operation Management	3
ENIE801002	Industrial Systems Engineering	3
	Subtotal	**12**
	8th Semester	
ENIE801005	Research Methodology	2
ENIE801006	Advanced Statistics	3
	Mandatory Course for Track	3
	Mandatory Course for Track	3
	Subtotal	**11**
	9th Semester	
	Mandatory Course for Track	3
	Elective Course for Track	3
	Elective Course for Track	3
ENIE800007	Research Proposal	2
	Subtotal	**11**
	10th Semester	
ENIE800008	Publication	2
ENIE800009	Thesis	4
	Subtotal	**6**

Course Structure for Bachelor, Master and Doctoral Fast Track Student in Industrial engineering

Code	Subject	SKS
	7th Semester	
ENIE607034	Special Topics in Industrial Engineering	2
ENIE801001	Systems Thinking	3
ENIE801002	Industrial Systems Engineering	3
ENIE801003	Operation Management	3
ENIE801004	Advanced Operations Research	3
	Subtotal	**14**
	8th Semester	
	Research Methodology	2
ENIE801005	Advanced Statistics	3
ENIE801006	Mandatory Course for Track	3
	Mandatory Course for Track	3
	Subtotal	**11**
	9th Semester	
	Mandatory Course for Track	3
	Elective Course for Track	3
ENIE801007	Elective Course for Track	3
	Thesis Proposal	2
	Subtotal	**11**
	10th Semester	
ENIE800008	Publication	**2**
ENIE800009	Thesis	**8**
ENIE900004	Research Proposal	**6**
	Subtotal	**16**
	11th Semester	
ENIE900006	Publication – International Conference	**4**
	Subtotal	**4**
	12th Semester	
ENIE900007	Research Result Examination	**10**
	Subtotal	**10**
	13th Semester	
ENIE900008	Publication 2 – International Journal	**8**
	Subtotal	**8**
	14th Semester	
ENIE900010	Doctoral Promotion	**6**
	Publication III – International Journal	**8**
	Subtotal	**14**

CHAPTER 5

Professional Program



Professional Program

Architect

Program Specification

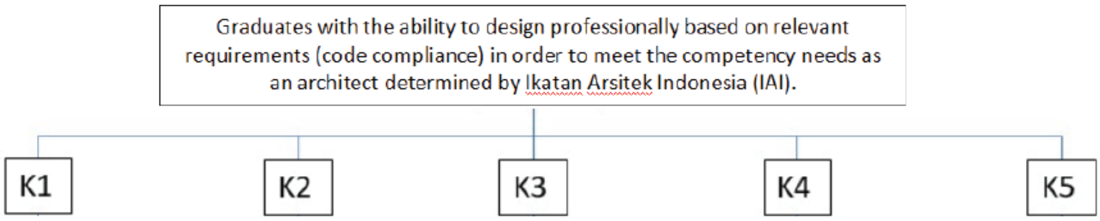
1.	**Awarding Institution**	Universitas Indonesia	
2.	**Teaching Institution**	Universitas Indonesia	
3.	**Faculty**	Engineering	
4.	**Program**	Professional Program for Architect	
5.	**Vision and Mission**	Vision: "To be a high-quality architectural Institution that receives national and international recognition, to foster graduates with good design knowledge and skills as professional architects that have professional ethics and sensibility to environment sustainability." Mission: Organizing professional architectural education programs that: 1. generates creativity and design innovation with a sustainable approach 2. responds to the changing social, cultural and technological conditions 3. prepares graduates to become professional architects	
6.	**Class**	Regular	
7.	**Degree Offered**	Arsitek (Ar.)	
8.	**Accreditation / Recognition**	Accredited from BAN-PT	
9.	**Language(s) of Instruction**	Bahasa Indonesia	
10.	**Study Scheme (Full Time / Part Time)**	Full Time	
11.	**Entry Requirements**	Graduated from Undergraduate Architecture Program	
12.	**Duration of Study**	1 year	
	Semester	Total Semester	Weeks/Semester
	Regular	2	16-17
	Short (optional)	-	-
13.	**Aims of the study programme** 1. Mastering code of ethics and code of conduct for Architect; 2. Mastering Architect professional services to community, such as making preliminary design, permit documents, design development to complete construction documents; 3. Mastering the principles of professional architect service administration; 4. Mastering code of conformity regarding professional services to client, local regulations and other disciplines related to building construction.		
14.	**Profile of Graduates:** Graduates with the ability to design professionally based on relevant requirements (code compliance) in order to meet the competency needs as an architect determined by Ikatan Arsitek Indonesia (IAI).		
15.	**Expected Learning Outcomes (ELO):** 1. Able to create architectural design that complies to codes related to services to clients, compliance to local building codes, and technical aspects building structure and construction, mechanical and electrical. 2. Able to manage architectural consultation service that comprises of preliminary design, building permit, and design development. 3. Able to integrate knowledge of ethical codes and architects' professional codes of conduct into professional practice. 4. Able to integrate knowledge on theory of architecture and sustainability into professional practice. 5. Able to explain the principles of consultation administration and project management.		
16.	**Course Composition**		

No.	Type of Courses	Credits	Percentage
I	University General Subjects	0	0%
II	Basic Engineering Subjects	0	0%
III	Architecture Core Subjects	21	87,5%
IV	Electives	3	12,5%
	Total	24	100%
	Total Credits for Graduation		**144 sks**

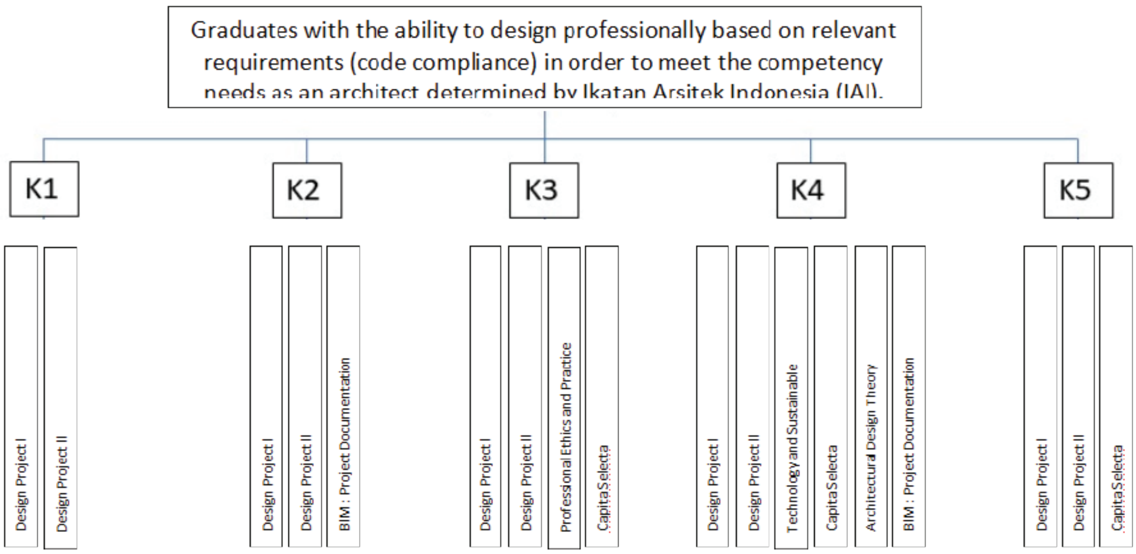
Job Opportunity

Graduates of this program can work in various fields within the construction industry, as architects or supervisors implementing construction. Then they can also work as researchers and lecturers in educational institutions related to architecture. In addition graduates can also work in the fields of urban design, real estate, building maintenance, building feasibility audits, appraisers for project feasibility studies, building managers, housing and settlements and the environment, working in industry of materials and building elements, and working in the government sectors in matters of building management, building construction and relating to the built environment.

NETWORK OF COMPETENCIES



DETAIL NETWORK OF COMPETENCIES



Course Diagram for Achieving ELO in the Professional Program for Architect

ELO	SEMESTER 1	SEMESTER 2
(1)Able to create architectural design that complies to codes related to services to clients, compliance to local building codes, and technical aspects building structure and construction, mechanical and electrical.	DESIGN PROJECT I	DESIGN PROJECT II
(2) Able to manage architectural consultation service that comprises of preliminary design, building permit, and design development.	DESIGN PROJECT I	DESIGN PROJECT II BIM : PROJECT DOCUMENTATION
(3) Able to integrate knowledge of ethical codes and architects' professional codes of conduct into professional practice.	DESIGN PROJECT I PROFESSIONAL ETHICS AND PRACTICE	DESIGN PROJECT II CAPITA SELECTA
(4) Able to integrate knowledge on theory of architecture and sustainability into professional practice.	DESIGN PROJECT I TECHNOLOGY AND SUSTAINABLE ENVIRONMENT	DESIGN PROJECT II CAPITA SELECTA ARCHITECTURAL DESIGN THEORY BIM : PROJECT DOCUMENTATION
(5) Able to explain the principles of consultation administration and project management.	DESIGN PROJECT I	DESIGN PROJECT II CAPITA SELECTA

Course Structure Professional Program for Architect

Code	Subject	SKS
	1st Semester	
ENAR701001	Design Project 1	6
ENAR701003	Professional Ethics and Practice	3
ENAR701004	Technology & Sustainable Environment	3
	Sub Total	**12**
	2nd Semester	
ENAR702002	Design Project II	6
ENAR702005	Architectural Design Theory	3
	Elective*	3
	Sub Total	**12**
	Total	**24**

*Student can also take required and elective courses available in Master of Architecture Program or other programs at the Department which are equal to courses for the Professional Program.

Elective Courses

Code	Subject	Credit
ENAR700006	BIM: Project Documentation	3
ENAR700007	Capita Selecta	3

Syllabus Professional Program for Architect

Design Project I
ENAR701001
6 SKS
Learning Objectives:

Students can demonstrate a professional skill in architecture technical drawing, applicable to various design stages and construction schemes. Students show confidence to perform the responsible design skill, respectful to social, cultural, historical, environmental, and economic values. Adequate knowledge of tectonic is necessary as proof of evidence of the design buildability. Understanding legal aspects of architecture services shall lead architects to take good care of their client's needs under lawful performances.

Syllabus:

Professional ethics; relationship of architect and the client is focused on understanding, expression or presentation of ideas and service to clients as outlined in preliminary design products; understanding of local building codes; producing Bill of Quantity (BQ); administration of architecture consultation including the preparation of contracts and payment for services; the role of Building Information Modeling (BIM) in design practice.

Prerequisites: -

References:

1. Hall, Dennis J (ed), Architectural Graphic Standards (12th edition), American Institute of Architects, 2016
2. Emmitt, Stephen, Design Management for Architects, (2nd edition), Wiley-Blackwell, 2014
3. Kensek, Karen, and Douglas Noble, Building Information Modeling: BIM in Current and Future Practice, John Wiley & Sons, 2014
4. Holzer, Dominik, The BIM Manager's Handbook: Guidance for Professionals in Architecture, Engineering and Construction, John Wiley & Sons, 2016
5. Ching, D.K, and Barry S.Onouye, Douglas Zuberbuhler, Building Structure Illustrated (2nd edition). John Wiley & Sons, 2014.
6. American Institute of Architects, The Architect's Handbook of Professional Practice (15th edition), 2013
7. RIBA Handbook for Practice Management (9th edition), 2013
8. Schittich, C, In Detail, Cost-Effective Building, Economic Concepts and Constructions, Birkhauser, 2007
9. Buku Pedoman Hubungan Kerja antara Arsitek dengan Pengguna Jasa, Ikatan Arsitek Indonesia
10. Undang – undang Nomor 6 Tahun 2017 tentang Arsitek
11. Undang – undang Nomor 2 Tahun 2017 tentang Jasa Konstruksi
12. Undang – undang Nomor 11 Tahun 2010 tentang Cagar Budaya
13. Undang – undang Nomor 28 Tahun 2002 tentang Bangunan Gedung
14. Peraturan Pemerintah Nomor 15 Tahun 2021 tentang Peraturan Pelaksanaan UU Nomor 6 Tahun 2017 tentang Arsitek
15. Peraturan Pemerintah Nomor 16 Tahun 2021 tentang Peraturan Pelaksanaan UU Nomor 28 Tahun 2002 tentang Bangunan Gedung
16. Peraturan Menteri PUPR Nomor 14 Tahun 2017 tentang Persyaratan Kemudahan Bangunan Gedung
17. Peraturan Menteri PUPR Nomor 11 Tahun 2014 tentang Pengelolaan AIr Hujan pada Gedung dan Persilnya
18. Peraturan Menteri PUPR Nomor 02 Tahun 2015 tentang Bangunan Gedung Hijau
19. Peraturan Menteri PUPR Nomor 18 Tahun 2010 tentang Pedoman Revitalisasi Kawasan
20. Peraturan Menteri PU Nomor 26 Tahun 2008 tentang Persyaratan Teknis Sistem Proteksi Kebakaran pada Bangunan Gedung dan Lingkungan
21. Peraturan Menteri PU Nomor 30 Tahun 2006 tentang Pedoman Teknis Fasilitas dan Aksesibilitas pada Bangunan Gedung dan Lingkungan
22. Peraturan Daerah Provinsi DKI Nomor 1 Tahun 2014 tentang Rencana Detail Tata Ruang dan Peraturan Zonasi
23. Peraturan Daerah Provinsi DKI Nomor 7 Tahun 2010 tentang Bangunan Gedung
24. Peraturan Gubernur Provinsi DKI Nomor 118 Tahun 2020 tentang Izin Pemanfaatn Ruang
25. Peraturan Gubernur Provinsi DKI Nomor 135 Tahun 2019 tentang Pedoman Tata Bangunan
26. Peraturan Gubernur Provinsi DKI Nomor 200 Tahun2015 tentang Akses Pemadam Kebakaran
27. Peraturan Gubernur Provinsi DKI Nomor 38 Tahun 2012 tentang Bangunan Gedung Hijau

28. Peraturan Kepala Dinas DKI Jakarta (Perkadis) Nomor 3 Tahun 2014
29. Pedoman Detail Teknis Ketatakotaan Pemerintah Daerah Provinsi DKI Jakarta 1995

Professional Etchics and Practice
ENAR701003
3 SKS
Learning Objectives:

Student should be able to demonstrate understanding of architects as profession and normative aspects of professional practice; Student should be able to understand the relationship between formal architecture education in university and further professional process to become architect, according to national and international agreement.

Syllabus:

Architect profession, architectural project, architectural firm; description about architectural practice where professional ethics become the main guide for conduct.

Professional ethics: understanding of law implication, code of ethics, professional code of conduct; knowledge on the existing resources to understand the emerging issues in architectural practice. Relationship with professional regulation: Regulation and code of ethics used by Ikatan Arsitek Indonesia (IAI), and international recommendation/policy which is agreed by all the members of Union Internationale des Architectes (UIA).

Pre-requisites: -

References:
1. Kode Etik Ikatan Arsitek Indonesia (IAI)
2. Dokumen *Union Internationale des Architectes (UIA)*
3. Landasan Etika Profesi

Technology and Sustainable Environment
ENAR701004
3 SKS
Learning Objectives:

Students should be able to perform an analysis on various approaches and strategies in building technology and the design of built environment towards sustainable environment.

Syllabus:

Environmental sustainable building technology principles; building technology, engineering, construction process, and building sevice and their impact on environmental sustainability; relationship among climate, built environment, construction, energy consumption and human well-being; application of building technology strategy in design project that complies with relevant building and environmental standard and regulation.

Pre-requisites:

References:

1. Kifert, Charles J, Sustainable Construction, Green Building Delivery, John Wiley & Sons Inc, New Jersey, 2013
2. Sarte, S Bry, Sustainable Infrastructure, The Guide to Green Enhgineering and Design, John Wiley & Sons Inc, New Jesey, 2010
3. Slessor, Catherine, Sustainable Architecture and High Technology, Eco Tech, Thames & Hudson, 1997
4. Stephen, Bougolah, Holcine & Shapler, Environmental, Technology and Sustainability, Taylor & ign and el 2006 Delivery, John Wiley, London, 2010
5. Laden, Gerhard Haus, DE Saldanka, Michael, Liedl, Peter, Climate Skin, Building Skin Concept that can do more with less energy, Birkhauser, Basel.
6. Meisel Arie, LEED Materials, A Resource Guide to Green Building, Princeton Press, New York, 2010
7. Applebay Paul, Integrated Sustainable Design of Buildings, Earthscan, London, 2011
8. Williams Daniel E, Sustainable Design, Ecology, Architrecture and Planning, John Wiley & Sons Inc, New Jersey, 2007

Design Project II
ENAR702002
6 SKS
Learning Objectives:

Students shouLd be able to understand and apply the knowledge of design presentation techniques, ethics, code of compliances relating to the preliminary design through design development for the purposes of building permit, project administration and project management at consultant which relate to the production and documentation of drawings, details, and building specification; Students should be able to demonstrate knowledge of various building materials.

Syllabus:

Professional ethics; relationship between architect and engineer and other related experts which is focused on collaborative work, application of engineering standard which is demonstrated in complete tender document including working drawings, technical specification and implementation, and budget planning; the role of Building Information Modeling (BIM) in design practice.

Pre-requisite: -

References:

1. Hall, Dennis J. (ed), Architectural Graphic Standards (12th edition), American Institute of Architects, 2016
2. Emmitt, Stephen, Design Management for Architects, (2nd edition), Wiley-Blackwell, 2014
3. Kensek, Karen, and Douglas Noble, Building Information Modeling: BIM in Current and Future Practice, John Wiley & Sons, 2014
4. Holzer, Dominik, The BIM Manager's Handbook: Guidance for Professionals in Architecture, Engineering and Construction, John Wiley & Sons, 2016
5. Ching, D.K, and Barry S.Onouye, Douglas Zuberbuhler, Building Structure Illustrated (2nd edition). John Wiley & Sons, 2014.
6. American Institute of Architects, The Architect's Handbook of Professional Practice (15th edition), 2013
7. RIBA Handbook for Practice Management (9th edition), 2013
8. Schittich, C, In Detail, Cost-Effective Building, Economic Concepts and Constructions, Birkhauser, 2007
9. Buku Pedoman Hubungan Kerja antara Arsitek dengan Pengguna Jasa, Ikatan Arsitek Indonesia
10. Undang – undang Nomor 6 Tahun 2017 tentang Arsitek
11. Undang – undang Nomor 2 Tahun 2017 tentang Jasa Konstruksi

12. Undang – undang Nomor 11 Tahun 2010 tentang Cagar Budaya
13. Undang – undang Nomor 28 Tahun 2002 tentang Bangunan Gedung
14. Peraturan Pemerintah Nomor 15 Tahun 2021 tentang Peraturan Pelaksanaan UU Nomor 6 Tahun 2017 tentang Arsitek
15. Peraturan Pemerintah Nomor 16 Tahun 2021 tentang Peraturan Pelaksanaan UU Nomor 28 Tahun 2002 tentang Bangunan Gedung
16. Peraturan Menteri PUPR Nomor 14 Tahun 2017 tentang Persyaratan Kemudahan Bangunan Gedung
17. Peraturan Menteri PUPR Nomor 11 Tahun 2014 tentang Pengelolaan AIr Hujan pada Gedung dan Persilnya
18. Peraturan Menteri PUPR Nomor 02 Tahun 2015 tentang Bangunan Gedung Hijau
19. Peraturan Menteri PUPR Nomor 18 Tahun 2010 tentang Pedoman Revitalisasi Kawasan
20. Peraturan Menteri PU Nomor 26 Tahun 2008 tentang Persyaratan Teknis Sistem Proteksi Kebakaran pada Bangunan Gedung dan Lingkungan
21. Peraturan Menteri PU Nomor 30 Tahun 2006 tentang Pedoman Teknis Fasilitas dan Aksesibilitas pada Bangunan Gedung dan Lingkungan
22. Peraturan Daerah Provinsi DKI Nomor 1 Tahun 2014 tentang Rencana Detail Tata Ruang dan Peraturan Zonasi
23. Peraturan Daerah Provinsi DKI Nomor 7 Tahun 2010 tentang Bangunan Gedung
24. Peraturan Gubernur Provinsi DKI Nomor 118 Tahun 2020 tentang Izin Pemanfaatn Ruang
25. Peraturan Gubernur Provinsi DKI Nomor 135 Tahun 2019 tentang Pedoman Tata Bangunan
26. Peraturan Gubernur Provinsi DKI Nomor 200 Tahun2015 tentang Akses Pemadam Kebakaran
27. Peraturan Gubernur Provinsi DKI Nomor 38 Tahun 2012 tentang Bangunan Gedung Hijau
28. Peraturan Kepala Dinas DKI Jakarta (Perkadis) Nomor 3 Tahun 2014
29. Pedoman Detail Teknis Ketatakotaan Pemerintah Daerah Provinsi DKI Jakarta 1995

Architectural Design Theory

ENAR702005
3 SKS
Learning Objectives:

Students are able to perform critical analysis to architectural ideas in classic and contemporary architectural literature, and able to identify the relationship between theory and practice in architectural design practice.

Syllabus:

The development in the mechanism of generating architecture from classical architecture to contemporary architecture; current ideas on the discourses of architectural design theoru and practice; multidisciplinary approach (art, mathematics, natural sciences, social sciences) in architectural theory and design.

Pre-requisite:-

References:

1. Stephen Cairns, Greig C Crysler, Hilde Heynen. The SAGE Handbook of Architectural Theory. SAGE Publications, 2012.
2. Michael Hays, Architecture Theory since 1968, MIT Press, 1998.
3. Kate Nesbitt, Theorizing a New Agenda of Architecture: An Antology of Architectural Theory 1965-1995. Princeton Architectural Press, 1996.
4. Charles Jenks & Karl Kropf, Theories and Manifestos of Contemporary Architecture. John Wiley and Sons, 1997.
5. Vitruvius. The Ten Books on Architecture, trans by M. H. Morgan. New York: Dover Publications, 1960.
6. D'Arcy Thompson, On Growth and Form. 1961.
7. Aaron Betsky & Erik Adigard, Architecture Must Burn. Gingko Press, 2000.
8. A+P Smithson. Irenee Scalbert, Towards a Formless Architecture: The House of the Future, 1999.

BIM: PROJECT DOCUMENTATION

ENAR700006
3 SKS
Learning Objectives:

Student should be able to use Building Information Modeling tool in the design, development, and documentation of architectural design.

Syllabus:

Introduction to BIM in architecture; model development, information and database handling, analysis and documentation.

Pre-requisites: -

References:
1. Eastman, C., Eastman, C.M., Teicholz, P. and Sacks, R., *BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors*. John Wiley & Sons, 2011
2. Kensek, K, and Noble, D., *Building Information Modeling: BIM in Current and Future Practice*, John Wiley & Sons, 2014
3. Holzer, D, *The BIM Manager's Handbook: Guidance for Professionals in Architecture, Engineering and Construction*, John Wiley & Sons

Capita Selecta

ENAR700007
3 SKS
Learning Objectives:

Students should be able to expand their knowledge on various topics that support the mastery of professional architecture competence.

Syllabus:

Selected topics that are relevant to the mastery of professional architecture competence and the development of architecture knowledge

Prerequisite: -

References: Relevant references to the topic offered.

Professional Program for Engineers

Program Specification

1.	**Awarding Institution**	Universitas Indonesia	
2.	**Teaching Institution**	Universitas Indonesia	
3.	**Faculty**	Engineering	
4.	**Program**	Professional Education Program for Engineers	
5.	**Vision and Mission**	**Vision :** To Produce Professional engineers who are dignified, have a high entrepreneurial spirit, and competencies that are following the requirements set both at national and international level. **Mission :** a. Carrying out Professional Education Programs following engineering principles, ethics, and professional standards; b. Encourage competence, technical skills, and professional responsibilities starting from the stage Design up to implementation in various engineering profession activities; c. Equipping managerial skills and a dignified entrepreneurial spirit.	
6.	**Class type**	Regular, RPL	
7.	**Final Award**	Insinyur (Ir)	
8.	**Accreditation Status**	Accredited BAN-PT: B	
9.	**Language of Instruction**	Indonesia	
10.	**Study Scheme (Full Time / Part-Time)**	Full Time	
11.	**Entry Requirements**	Pass the entrance exam (SIMAK-UI), and Graduate (S1) from the field of Engineering and its equivalent RPL: additional requirements in the form of work experience of more than 5 years and have a portfolio of engineering practice	
12.	**Study Duration**	Regular: Scheduled for 1 year RPL: Scheduled for 1 semester	
	Semester Type	Number of semester	Number of weeks/semesters
	Special	2	16
13.	**Aims of the programme:** To produce engineers who can master the code of ethics and the behavior of engineers; mastering engineering technical skills including developing designs and completing various technical and tender documents; and mastering the code of compliance, whether it concerns services to clients, compliance with regulations, and engineering issues such as safety, environment and sustainability		
14.	**Profile of Graduates:** Professional graduates who are able to solve problems in the engineering field based on technology in accordance with professional ethics		
15.	**Expected Learning Outcomes (ELO - KKNI Level 7) :** a. Able to manage engineering resources under its responsibility comprehensively by utilizing science and technology to produce technical steps in the strategic development of the organization in its field of work. b. Able to research to make strategic decisions with full accountability and responsibility for all aspects under the responsibility of their area of expertise. c. Able to solve problems with science and technology. d. Generate added value and benefits for the community in the field of engineering through monodisciplinary and multidisciplinary approaches.		

16.	Classification of Subjects		
No.	**Types of Subjects**	**Credits**	**Percentage**
I	Code of Ethics and Ethics of Engineers	2	8.3%
II	Professionalism	2	8.3%
III	Health, Safety and the Environment	2	8.3%
IV	Engineering Practices	12	50%
V	Case Studies	4	16.6%
VI	Seminar, Workshop and other Dissemination	2	8.3%
	Total	24	100%
17.	**Total Credits for Graduation**		**24 Credits17**

Career Prospects and Job Opportunities

Graduates from this study program can work in various industrial sectors and fields, including energy and power generation, information technology, construction, chemical, electronics, oil & gas, telecommunications, education and other related industries. Graduates who have worked previously have the opportunity to advance to a higher career path. Participants who have been declared to have passed the Professional Engineer Study Program obtain an Engineer Degree from a Higher Education and are entitled to use the professional engineer title which is abbreviated as “Ir” and can then take the Professional Engineer Competency Test conducted by professional associations. Certificate of Competence as a professional engineer and Engineer Registration Certificate (STRI).

Process of Equalizing Recognition of Prior Learning (RPL) Portfolio with Regular Program Courses

The process of equalization so that the equivalent of the RPL track with the regular track can be seen in Figure 1 with activities that can be evaluated based on a portfolio consisting of:

- Engineering Ethics
- K3L
- Engineering Professionalism
- Case study
- Seminar

The engineering practice activities are carried out in their respective workplaces with field supervisors. While the process of supervising the preparation of the final project report is carried out in campus (can be online or offline).

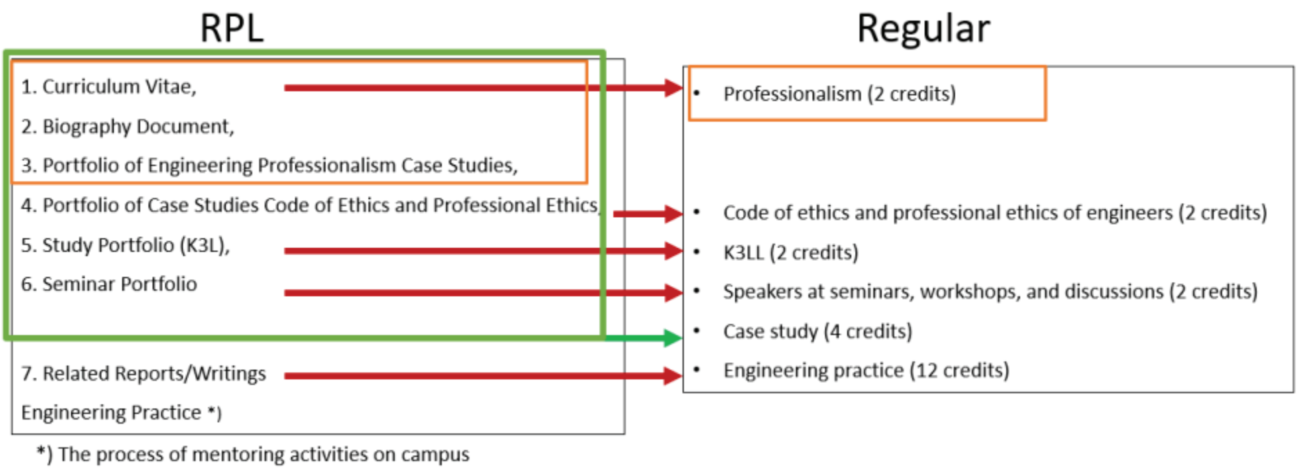
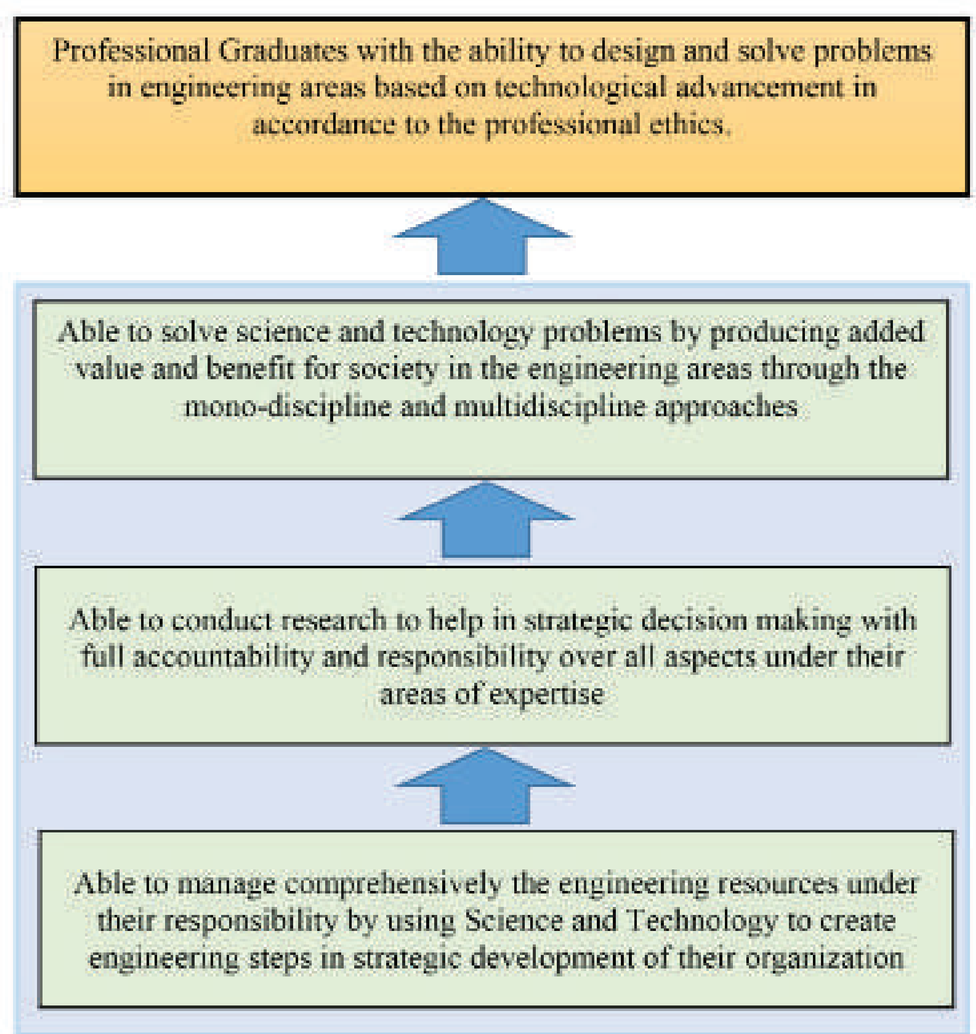
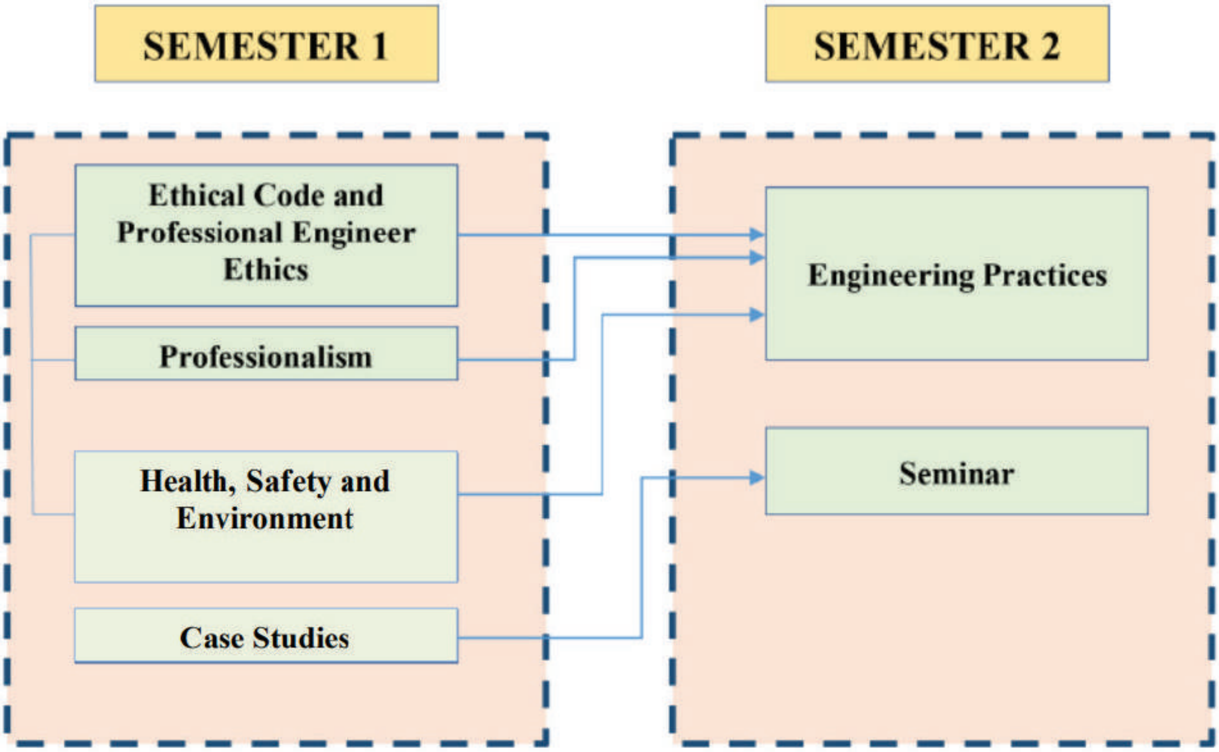


Figure 1. Equalization Scheme of RPL track with Regular track Learning Outcomes (ELO)

Expected Learning Outcomes (ELO)



Curriculum Flow Diagram
Professional Program for Engineers



Course Structure Professional Program for Engineers

Code	Subject	SKS
	1st Semester	
ENIR701001	Code of Ethics and Ethics of Engineers	2
ENIR701002	Professionalism	2
ENIR701003	Health, Safety and Environment	2
ENIR701004	Case Study	4
	Sub Total	**10**
	2nd Semester	
ENIR702005	Engineering Practices	12
ENIR702006	Seminar	2
	Sub Total	**14**
	Total	**24**

Syllabus Professional Education Program for Engineers

Code of Ethics and Ethics of Engineers
ENIR701001
2 CREDITS

Course Learning Outcomes :

1. Understanding the meaning of professional, professionalism,ethical code, and code of rules for engineering behavior.
2. Understanding competency and engineering body of knowledge.
3. Recognizing engineer ethics responsibility, sensitivity, and care on duty, function, responsibility, and accountability.
4. Understanding the Indonesia Engineer Ethics Code
5. Able to discuss the dilemma faced during decision making process in regards to Engineering Ethics Code
6. Able to increase conscience sensibility in handling ethical issues in engineering
7. Able to prepare decision making draft in addressing engineering ethics cases (formulize, prepare supporting data, prepare the choice of a solutions and recommendations).

Syllabus :

Preliminary; Understanding of Ethics and Engineering; Catur Karsa - Sapta Dharma; Various Professional Ethics and Ethics; Professional Certification Standards; Regulations and Regulations in the field of Engineering; Case studies related to ethical code practices; Discussion and Presentation

Prerequisite : -

Textbooks :

1. Charles E. Harris "Engineering Ethics Concepts and Cases", Fourth Eddition, Wadsworth, Cengage Learning, 2009.
2. Charles B. Fleddermann, "Engineering Ethics", University of New Mexico, Prentice Hall, 2012.
3. R.S. Naagarazan, Professional Ethics and Human Values, New Age International (P) Limited, Publisher, 2006

Professionalism
ENIR701002
2 CREDITS
Course Learning Outcomes :

1. Understand how to implement planning and design to give added value.
2. Understand in respect of health, safety, and environmental preservation.
3. Understand the influence of technical and non-technical factors and the implementation of professional ethics in the implementation of work.
4. Understand the Engineering Standard.
5. Understand how to conduct data analysis and evaluation.
6. Able to recognize the ability, weakness and strength of work space.
7. Able to work together in a team in a limited period of time.
8. Able to perform feasibility and appropriateness selection for decision making process.
9. Able to communicate and coordinate.

Syllabus :

1. Definition of professionalism
2. The characteristics of professionalism and professional code of ethics
3. Professionals in various fields of engineering as well as certificates of expertise.
4. Several regional and global professional organizations and professional engineer standards in various engineering fields
5. Some management standards: Quality Management Standards (ISO 9000); Production Management System (TQM, SixcSigma); Occupational Safety and Health Management Standards, OSHAS 18000; Environmental Management Standard (ISOc14000)
6. Various regulations related to the profession and engineering work, including regarding copyright, the scope of copyright, copyright protection, IPR
7. Case studies and the ability to identify technical problems, find out methods of solving problems, make work plans including providing professional solutions related to professional ethical dilemmas

Prerequisite : -

Textbooks :

1. Bennett, F. Lawrence. The Management of Engineering: Human, Quality, Organizational, Legal, and Ethical Aspects of Professional Practice. New York: John Wiley &Sons, Inc., 1996
2. Harris JR., Charles E., et.al. Engineering Ethics : Concepts and Cases. Belmont : Wadswort
3. Fleddermann, Charles B. Engineering Ethics. Upper Saddle River, NJ. : Prentice Hall - Engineering Source, 1999
4. Accreditation Board for Engineering and Technology. 2000. Annual Report.New York, 2000

5. Etika Enjiniring Ed. 2 Penerbit Erlangga

Safety, Health, and Environment
ENIR701003
2 CREDITS
Course Learning Outcomes :

1. Able to identify the purpose of each safety, health, work safety and environment policy, procedures,and benefit in their line of work.
2. Able to demonstrate their understanding on the background of investigation concept and report system by using the ICS (Incident Command System) method.
3. Able to do evaluation based on behavior industry in implementing predetermined investigative procedures.
4. Able to provide insight on "Emergency Preparedness Process & System Concept", thus enabling them to prepare Emergency Preparedness System in their work.
5. Able to understand the stages needed to be taken in implementing the Health, Safety and Environmental and Work Safety and what should be done in each stages.
6. Have an awareness in the form of responsible behavior in carrying out health, safety and work

Syllabus :

K3L Management Systems; New Paradigm SHE Management; Risk Management; Fire Management; Lost Control Management; Behavior Management; Safety Audit dan Inspection; Incidents Investigation; Emergency Response Management; Chemical Hazards; Ergonomic and Work Physiology; Physical Dangers in Industry; Safety Engineering; Industrial Psychology; Industrial Toxicology; Industrial Ventilation; Industrial Hygiene Basic.

Prerequisite : -

Textbooks :

1. International Safety Rating System (ISRS7) Omega Workbook Best Practice Process Assessment.
2. Manajemen Pengendalian Kerugian edisi ketiga, Frank E. Bird. Jr, George L. Germain, & M Douglas Clark
3. Risk Reduction and Emergency Preparedness, WHO six year sztrategy for the health sector and community development

Case Studies
ENIR701004
4 CREDITS
Course Learning Outcomes :

1. Encouraged to have analytical abilities towards practical engineering issues arising.
2. Able to independently develop ideas and solutions and implement their theoretical knowledge in solving problems.
3. Able to prepare themselves in handling crisis situation in various professional engineering/industry environment (in accordance to UU-11).
4. Able to comprehend multidiscipline communication and have an appreciation to other discipline.
5. Understand the core problem and essence and how to address engineering problems.

Syllabus :

Preliminary; Introduction and definition of case studies; Method of selecting and determining case studies; Systematic preparation of case study reports; Case study 1 presentation (code of ethics & professional ethics of engineers); Case study 2 presentation (engineering professionalism); Exposure to case study 3 (K3L in the field of engineering); Final discussion of case study results.

Prerequisite : -

Textbooks :

1. Donohue, E. Willian, Krasner, Leoanard. (1995), Handbook of Psychological Skills Training. Boston: Allyn and Bacan.
2. Santrock, J. Jhon. 1993. Adolescence : An Introduction. Wisconsin:
3. Undang-undand Republik Indsonesia Nomor 11 Tahun 2014 Tentang Keinsinyuran

Engineering Practices
ENIR702005
12 CREDITS
Course Learning Outcomes :

1. Understand the engineering philosophy through experience by conducting on the job training.
2. Understand the trend on engineering science through their experience in their on the job training.
3. Have an understanding on industry system or engineering system through the use of said systems in their industry or company where the students conduct their on the job training.
4. Able to solve problems in their on the job training.
5. Able to write complete report on how appropriate engineering report in accordance with the desired term of reference by the end user of the engineering service.
6. Able to present and communicate their engineering results as part of their on the job training outputs.

Syllabus :

Work as an "engineer" under the supervision of professional engineers in the company/industry and try to record various matters related to the philosophy of engineering, the direction and development of engineering, and the industrial system referred to by the company; Also playing a role in solving problems in the company under the supervision of professional engineers in the company where the practice works; Conduct presentation and communication from the results of practical work reports.

Prerequisite : -

Textbooks :

1. Fleddermann, c., B., 2006. Etika Enjiniring. Edisi kedua, Percetakan PT Gelora Aksara Pratama, judul asli 'Engineering Ethics' second ed. Penterjemah Bob Sabran dan Shirley Affandy, Penerbit Erlangga.
2. Post, J.E., Frederick, W.C., Lawrence, A.T., and Weber, J., 1996. Business and Society - Corporate Strategy, Public Policy, Ethics. Eight edition,McGraw- Hill Inc.
3. Barrie, D.S., Paulson, B. C., Sudinarto, 1993. Manajemen KonstruksiProfessional, Penerbit Erlangga Jakarta.
4. Keraf, S., 1996. Pasar Bebas Keadilan dan Peran Pemerintah Telaah AtasEtika Politik Ekonomi Adam Smith. Penerbit Kanisius Yogyakarta.

5. Persatuan Insinyur Indonesia, 2004. Bakuan Kompetensi InsinyurProfessional PII, Jakarta.
6. Suyitno, B.M., 2004. Etika Profesi, PII Cabang Surakarta.
7. Wigjosubroto, S., 1999. Etika Professional Pengalaman dan Permasalahan.Badan Kejuruan Mesin PII Jakarta.

Seminar
ENIR702006
2 CREDITS
Course Learning Outcomes :

1. Understand the Term of Reference (TOR) as speaker in seminar, workshop, or discussion.
2. Understand the requested general theme and the subtheme.
3. Able to compile materials.
4. Able to convey said materials consecutively and structurally within the allocated time frame.
5. Able to understand and answer questions.
6. Able to have a discussion and communicate

Syllabus :

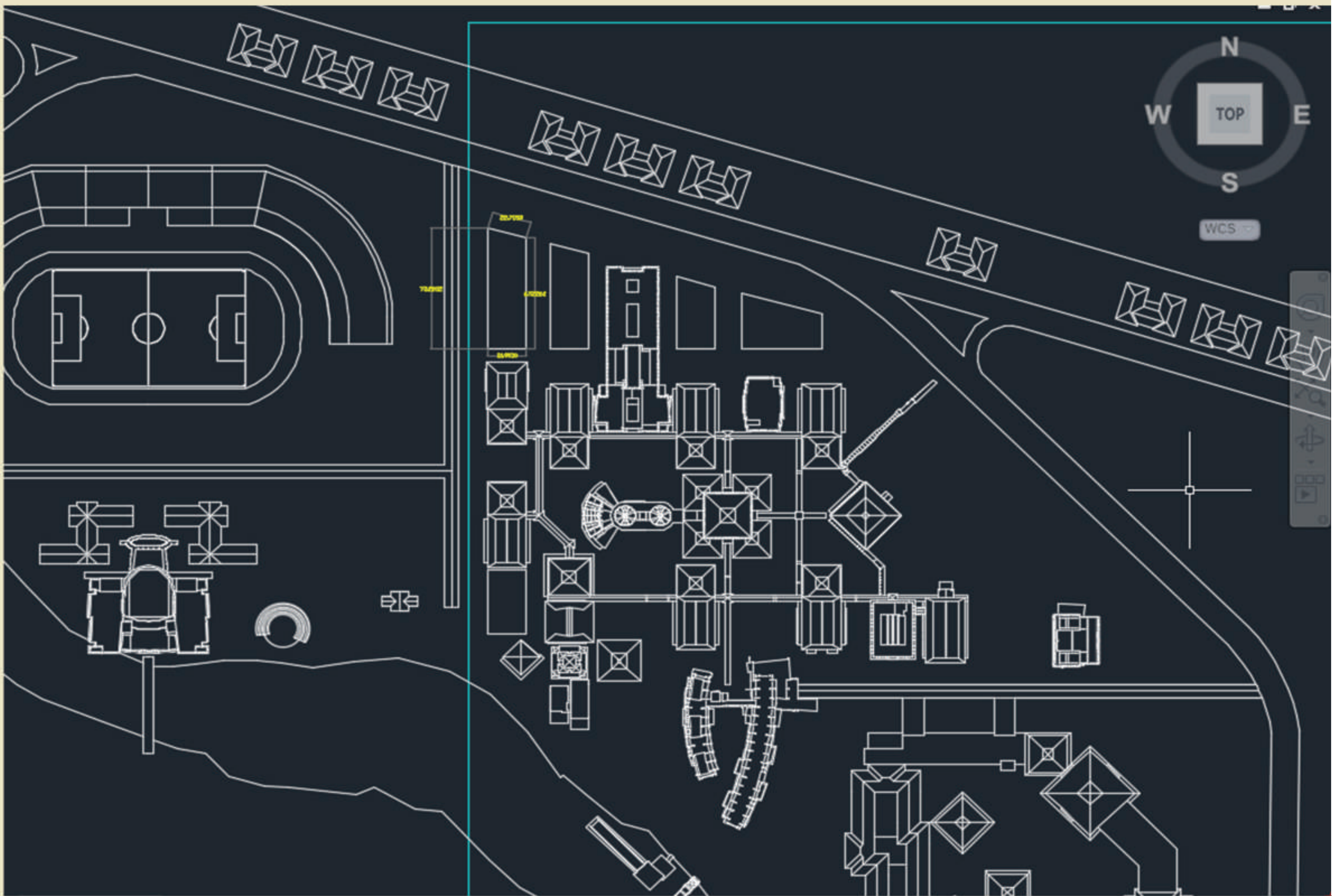
Conduct public dissemination activities related to engineering aspects. Activities can take the form of presentations as resource persons at seminar forums, symposia, panel discussions, workshops, conferences or public lectures.

Prerequisite : -

Textbooks :

CHAPTER 6

Master Program



Master Program

Energy System Engineering

Program Specification

1.	**Awarding Institution**	Universitas Indonesia	
2.	**Teaching Institution**	Universitas Indonesia	
3.	**Faculty**	Engineering	
4.	**Program Title**	Master Program in Energy System Engineering	
5.	**Vision and Mission**	**Vision :** Becoming an excellent Master's Program in Energy Systems Engineering at an international level. **Mission :** To provide students with interdisciplinary knowledge in energy systems engineering that covers technical, economic, environmental, and policy aspects.	
6.	**Class type**	Special Class	
7.	**Final Award**	MT	
8.	**Accreditation Status**	BAN-PT (accredited Very Good or "Baik Sekali")	
9.	**Language of Instruction**	Indonesia	
10.	**Study Scheme (Full Time / Part-Time)**	Full Time	
11.	**Entry Requirements**	Pass the entrance selection test (SIMAK-UI), and Bachelor (S1) graduates from the field of Engineering, Natural Sciences, and Economy (including Business and Management)	
12.	**Study Duration**	Scheduled for two years	
	Semester Type	Number of semester	Number of weeks/semesters
	Reguler	4	16
13.	**Aims of the programme:** The Master's Program in Energy Systems Engineering aims to produce graduates capable of designing, analyzing, and applying energy systems to solve problems in the energy sector by utilizing a or interdisciplinary approach.		
14.	**Profile of Graduates:** A Master in Energy System Engineering can design energy systems and formulate energy policy to support sustainable development at national and international levels.		
15.	**Expected Learning Outcomes (ELO) :** Master's Program in Energy Systems Engineering has the following Expected Learning Outcomes: 1. Students can design technology and system on renewable and carbon-neutral energy. 2. Students can analyze energy economics and business model. 3. Students can formulate energy policy and planning. 4. Students can develop interdisciplinary research in energy systems engineering. 5. Students can understand professional and ethical responsibility.		
16.	**Classification of Subjects**		

No.	**Types of Subjects**	**Credits**	**Percentage**
I	Compulsory courses at the study program level	26	62%
II	Elective courses	16	38%
	Total	42	100%
	Total Credits for Graduation		**42 sks**

Job Prospects

Graduates of this study program can work on:

1. Business Institutions / Professionals.
2. Government Institutions, such as Kementerian Energi dan Sumber Daya Mineral (ESDM), Kementerian Badan Usaha Milik Negara (BUMN) and Kementerian Keuangan.
3. State-Owned Enterprises, such as Pertamina, PLN, and PGN.
4. Educational and research institutions.

Expected Learning Outcomes (ELO)

GRADUATE PROFILE:

A Master in Energy System Engineering can design energy systems and analyze energy policy to support sustainable development at national and international levels.

1. Students can design technology and system on renewable and carbon-
2. Students can analyze energy economics and business model.
3. Students can formulate energy policy and planning.
4. Students can develop interdisciplinary research in energy systems engineering.
5. Students can understand professional and ethical responsibility.

Flowchart of courses to attain the expected learning outcomes in the Master's Program in Energy Systems Engineering

Expected Learning Outcomes	Courses			
	Semester 1	Semester 2	Semester 3	Semester 4
Students can analyze the design and optimization of energy technologies based on renewable energies.	Sustainable Energy Systems Energy Technology	Materials for Energy Smart Grid and Distributed Power Generation Renewable Energy	Energy Storage System	
Students can evaluate energy planning, policies, and business model.	Advanced Engineering Mathematics	Energy Systems Modelling and Policy Analysis	Energy Regulations and Markets Energy Transition Economics Energy Planning and Policy	
Students can create comprehensive interdisciplinary study/research in energy systems engineering.		Pre-Thesis		Thesis Scientific Publication

Core courses

Elective courses

Course Structure Master Program in Energy System Engineering

Code	Subject	SKS
	1st Semester	
ENES801001	Advanced Engineering Mathematics	4
ENES801002	Sustainable Energy Systems	4
ENES801003	Energy Technology	4
	Sub Total	**12**
	2nd Semester	
ENES802004	Pre-Thesis	2
	Elective 1	4
	Elective 2	4
	Sub Total	**10**
	3rd Semester	
ENES803005	Energy Planning and Policy	4
	Elective 3	4
	Elective 4	4
	Sub Total	**12**
	4th Semester	
ENES804006	Master Thesis	6
ENES804007	Scientific Publications	2
	Sub Total	**8**
	Total	**42**

Elective Courses

Code	Subject	SKS
ENES802008	Energy Systems Modelling and Policy Analysis	4
ENES803017	Energy Transition Economics	4
ENES802012	Materials for Energy	4
ENES803020	Energy Storage System	4
ENES802013	Smart Grid and Distributed Power Generation	4
ENES802014	Renewable Energy	4
ENES803015	Energy Regulations and Markets	4
ENES802014	Renewable Energy	4
ENES803015	Energy Regulations and Markets	4

Students may take elective courses across departments within or outside the Faculty of Engineering. Taking these cross courses must be by following the Faculty of Engineering, Universitas Indonesia rules.

Syllabus Master Program in Energy System Engineering

Advanced Mathematics
ENES801001
4 CREDITS
Expected Learning Outcomes:

Students can evaluate energy planning, policies, and business model.

Course Learning Outcomes :

This course aims to provide students with mathematical-based analysis and modeling skills so that students are expected to be able to use various analytical tools (modeling) to perform calculations, analyses, and simulations related to energy.

Syllabus :

The Advanced Engineering Mathematics course provides analytical or modeling tools to support policymaking, generally based on mathematical equations and can be used to perform data analysis or simulations that are typically related to energy. The scope of the material taught includes the IO model, SAM, CGE, Econometric Model, Demand Model, Supply Model, Projection Model, and Optimization Model.

Prerequisite : -

Textbooks :

1. Bhattacharyya SC. Energy Economics Concepts, Issues, Markets and Governance. Springer London; 2019.
2. Munasinghe M, Meier P. Energy Policy Analysis and Modelling. Cambridge University Press; 1993. (Cambridge Energy and Environment Series).
3. Yusgiantoro P. Ekonomi Energi: Teori dan Praktik. LP3ES; 2000.

Sustainable Energy System
ENES801002
4 CREDITS
Expected Learning Outcomes:

Students can analyze the design and optimization of energy technologies based on renewable energies.

Course Learning Outcomes :

This course provides an overview of energy technology development, energy sources, and their usage today.

Syllabus :

This course includes Sustainable Energy, Estimation and Evaluation of Energy Sources, Technical Performance, Energy Systems, Fossil Fuels, Fossil Energy, Nuclear Energy, Biomass Energy, Transportation Services, Industrial Energy Use, Complex Systems Synergy, and Energy Selection.

Prerequisite :

Textbooks :

1. Everett B, Boyle G, Peake S, Ramage J. Energy Systems and Sustainability: Power for a Sustainable Future. OUP Oxford; 2011.
2. Tester JW, Drake EM, Driscoll MJ, Golay MW, Peters WA. Sustainable Energy Choosing Among Options. The MIT Press; 2005.

Energy Technology
ENES801003
4 CREDITS
Expected Learning Outcomes:

Students can analyze the design and optimization of energy technologies based on renewable energies.

Course Learning Outcomes :

The learning outcome of this subject is that students can explain the resources, processes, applications, and technologies related to energy conversion.

Syllabus :

The scope or syllabus taught in this course includes Power Generation and Distribution; Engine Heat and Heat Exchangers; Earth and Geothermal Energy; The Origins of Fossil Fuels; Fossil Energy; Solar energy; Solar Power Technology; Mass Transformation of Energy; Nucleosynthesis; Nuclear energy; Alternative Energy: Wind and Water; Energy, Economy and Environment; 21st Century Energy Blend.

Prerequisite : -

Textbooks :

1. Fanchi JR. Energy Technology and Directions for the Future. Academic Press; 2004.
2. Sulaiman SA (editor). Clean Energy Opportunities in Tropical Countries [Internet]. 1st ed. 2021. 2021.

Pre-Thesis
ENES802004
2 CREDITS
Expected Learning Outcomes:

Students can create comprehensive interdisciplinary study/ research in energy systems engineering.

Course Learning Outcomes :

The learning outcome of this subject is that students can study a topic scientifically and write a research proposal.

Syllabus :

This course includes an introduction, techniques to identify problems and arrange hypotheses, logical thinking, scientific writing methods, technical writing of research proposals, designing research techniques, presentation techniques, and techniques to collect, analyze, and present data.

Prerequisite : -

Textbooks :

1. Pedoman Teknis Penulisan Tugas Akhir Mahasiswa Universitas Indonesia, Keputusan Rektor Universitas Indonesia Nomor 2143/SK/R/UI/2017.

Energy Planning and Policy
ENES803005
4 CREDITS
Expected Learning Outcomes:

Students can evaluate energy planning, policies, and business model.

Course Learning Outcomes :

This course provides the concept of Energy Planning and Policy in solving energy system problems.

Syllabus :

This course covers the following topics: Introduction, Statistical Review on Energy Modelling, Model Use in Decision Making, Method for Model Evaluation, Communication Problem in Energy Policy Analysis, Modelling Energy Demand in Short and Middle Term, Energy Model and Technology Review, Electricity Development in the Future, Production Modelling, Price Production Decision, Analysis and Energy Demand Modelling, Using Energy Modelling for Business Decision, Model Comparison for Policy and Energy Planning, Validation Problem and Energy Model Assessment.

Prerequisite : -

Textbooks :

1. Kreyszig E. Advanced Engineering Mathematics. 10th ed. 2011. (Wiley).
2. Purwanto W, Nugroho Y, Dalimi R, Soepardjo AH, Wahid A, Supramono D, et al. Indonesia Energy Outlook and Statistics 2006. 2006.

Master Thesis
ENES804006
6 CREDITS
Expected Learning Outcomes:

Students can create comprehensive interdisciplinary study/ research in energy systems engineering.

Course Learning Outcomes :

Students can design and conduct research in energy systems engineering and present research results in oral and writing.

Syllabus :

Material based on the research topic

Prerequisite : -

Textbooks :

1. Pedoman Teknis Penulisan Tugas Akhir Mahasiswa Universitas Indonesia, Keputusan Rektor Universitas Indonesia Nomor 2143/SK/R/UI/2017.

Scientific Publication
ENES804007
2 CREDITS
Expected Learning Outcomes:

Students can create comprehensive interdisciplinary study/ research in energy systems engineering.

Course Learning Outcomes :

Students will be able to produce scientific writing on the results of studies or the research with a decent quality to be published in national or international dissemination forums.

Syllabus :

The rules of scientific writing; various modes of scientific writing; the argument formulation strategy in a scientific paper that clearly shows the position on existing knowledge; publication procedures in national/ international seminars/ conferences; publication procedures in internationally reputable journals; article review in internationally reputable journals.

Prerequisite : Master Thesis

Textbooks :

1. Relevant references to the research topic of the Master Thesis

Elective Courses

Energy Modelling and Policy Analysis

ENES802008
4 CREDITS
Expected Learning Outcomes:

Students can evaluate energy planning, policies, and business model.

Course Learning Outcomes :

The learning outcome of this subject is that students can analyze current energy policies and plan new policies based on technical, economic, and environmental aspects.

Syllabus :

This course includes a study on the various energy systems models, decision-making processes in policy and energy planning, and the use of energy models to analyze and plan energy systems.

Prerequisite : -

Textbooks :

1. Du P, Baldick R, Tuohy A. Integration of Large-Scale Renewable Energy into Bulk Power Systems. Springer International Publishing; 2017.
2. Meier P. Energy Systems Analysis for Developing Countries. Springer Berlin, Heidelberg; 1984.
3. Munasinghe M, Meier P. Energy Policy Analysis and Modelling. Cambridge University Press; 1993. (Cambridge Energy and Environment Series).

Renewable Energy

ENES802014
4 CREDITS
Expected Learning Outcomes:

Students can analyze the design and optimization of energy technologies based on renewable energies.

Course Learning Outcomes :

This course provides an overview of the definition and various renewable energy sources, the technology of renewable energy systems, the use of renewable energy in Indonesia and the world, and the economics of renewable energy.

Syllabus :

The Renewable Energy course provides an overview of the various renewable energy and the infrastructure relevant to each renewable energy. This course also discusses the status of the application of renewable energy in Indonesia and the world. An overview of the economics of renewable energy, such as the cost and revenue components.

Prerequisite : -

Textbooks :

1. Maczulak AE. Renewable Energy: Sources and Methods. New York, United States: Facts On File; 2010. (Green technology).
2. Sørensen B. Renewable Energy Physics, Engineering, Environmental Impacts, Economics and Planning. Academic Press; 2017.
3. Twidell J, Alexander J. Renewable Energy Resources. Routledge; 2021.

Materials for Energy

ENES802012
4 CREDITS
Expected Learning Outcomes:

Students can analyze the design and optimization of energy technologies based on renewable energies.

Course Learning Outcomes :

Students can analyze materials related to the energy field and their applications, use appropriate methods for material synthesis and characterization, and explain the electronic structure of materials used in the renewable energy field.

Syllabus :

This course includes the following topics: Introduction, the electrical characteristic of a material, material for solar energy, material for electrochemical energy, material for geothermal, wind, and hydropower, advanced material for energy harvesting, and future perspective.

Prerequisite : -

Textbooks :

1. Jha AR. Solar Cell Technology and Applications. Auerbach Publications; 2009.
2. Callister WD. Materials science and engineering an introduction [Internet]. John Wiley & Sons; 2003.
3. Sørensen B. Renewable Energy Physics, Engineering, Environmental Impacts, Economics and Planning. Academic Press; 2017.

Smart Grid and Distributed Power Generation

ENES802013
4 CREDITS
Expected Learning Outcomes:

Students can analyze the design and optimization of energy technologies based on renewable energies.

Course Learning Outcomes :

The learning outcomes of this subject are students can analyze and evaluate programming and protection of smart grid and distributed power generation, the concept of distribution, stability, and quality of generating networks.

Syllabus :

This course covers these topics: Introduction, What, Why, How, If and When is Smart Grid, Smart Grid more than Technology, From Smart Grid to Smart Energy Uses, Equity Implications of Smart Grid, Renewable Energy Prospects, Vision dan Mission of Smart Grid, Manifestation Potential Renewable and Distributed Power Plants, Rules of Microgrids, Renewable Energy Integration, Software Infrastructure and Smart Grid, Smart Pricing, Success in the Smart Grid, Effects of Smart EVs.

Prerequisite : -

Textbooks :

1. Sioshansi F. (editor) Smart Grid Integrating Renewable, Distributed and Efficient Energy. Academic Press; 2011.

Energy Regulations and Markets

ENES803015
4 CREDITS
Expected Learning Outcomes:

Students can evaluate energy planning, policies, and business model.

Course Learning Outcomes :

The learning outcome of this subject is students can explain the electric power system from an interdisciplinary point of view, which deals with policy, regulation, markets, and the economy.

Syllabus :

This course includes the following topics: Introduction, Understanding of the Electric Industry, Energy Competition, Regulation Levels for Transmission and Distribution, Competition Support, Load Balancing and Power Delivery, Ensuring Reliability in Superior Markets, Role of Countries in Electricity Regulation and Markets, Standard Cost Coverage, Rebuilding and Environmental Safety, Programs for Public Communities in Competitive Markets, Prospects of Restructuring.

Prerequisite : -

Textbooks :

1. Brennan TJ, Palmer KL, Martinez SA. Alternating Currents Electricity Markets and Public Policy. Routledge; 2002.

Energy Transition Economics

ENES803017
4 CREDITS
Expected Learning Outcomes:

Students can evaluate energy planning, policies, and business model.

Course Learning Outcomes :

The learning outcomes of this subject are students can explain theoretical and empirical topics related to the need, supply and price of energy, the environmental consequences on energy consumption and production, and the policies that affect these things.

Syllabus :

This course includes the following topics: Introduction, Energy Leading Economic Development, Policy for Economic and Energy Development, Energy Supply and Demand, Leading Economy: Case Study on Economic Development, Energy Conservation and Efficiency, Economy Crisis Infrastructure, Land Use and Energy Leading Economic Development, Building Urban Energy Center, Building Green Economy, Energy Flakes Revolution.

Prerequisite : -

Textbooks :

1. Robinson DJ. The Energy Economy: Practical Insight to Public Policy and Current Affairs. Palgrave Macmillan; 2015.

Energy Storage System

ENES803020
4 CREDITS
Expected Learning Outcomes:

Students can analyze the design and optimization of energy technologies based on renewable energies.

Course Learning Outcomes :

Students can explain the specific material used as energy storage, the basic principles of energy storage in the material, and choose the right and suitable material for a particular energy storage application.

Syllabus :

This course includes the following topics: Basic Principles of Batteries, Type of Battery, Battery Synthesis, Battery Capacity, Battery Application, and Battery Development Opportunities.

Prerequisite : -

Textbooks :

1. Bresser D, Passerini S. Handbook of Battery Materials. Second Edition; Edited by Claus Daniel and Jürgen O. Besenhard. Energy Technology. 2013 Oct 1;1(10):617–8.
2. Kiehne HA. Battery Technology Handbook. CRC Press; 2003.
3. Gulbinska MK. Lithium-ion Battery Materials and Engineering: Current Topics and Problems from the Manufacturing Perspective. 2014: Springer-Verlag London;
4. Warner J. The Handbook of Lithium-Ion Battery Pack Design. Elsevier Science; 2015.

Study Program Magister of Urban and Regional Planning

Program Specification

1.	**Degree Awarding Institution**	Universitas Indonesia	
2.	**University/Institution**	Universitas Indonesia	
3.	**Faculty**	Engineering	
4.	**Major Name**	Study Program Magister of Urban and Regional Planning	
5.	**Mission and Vision**	Vision: "to become the center for development of multidisciplinary science with a focus on the application of smart cities and urban economic development based on the noble values of Indonesia, in the field of urban and Regional Planning at the National and International Levels." Mission: 1. Prepare graduates who are capable of lifelong learning, able to adapt to the field of work, have a good morals and leadership qualities, able to compete on the international market. 2. Produce useful work in the field or Urban and Regional Planning through structured academic and research programs at the post-graduate level (master). 3. Prepare planners who have competence in accordance with their specific and prospective fields in an interdisciplinary perspective.	
6.	**Type of Class**	Regular	
7.	**Awarding Degree**	Magister Perencanaan Wilayah dan Kota (M.PWK.)	
8.	**Educational Accreditation**	BAN-PT: Accreditation B	
9.	**Language**	Bahasa Indonesia	
10.	**Learning Scheme (full/part time)**	Full Time	
11.	**Requirements**	Bachelor degree/equal	
12.	**Study Period**	Scheduled for 2 years	
	Type Semester	Total Semester	Weeks per Semester
	Reguler	4	17
	In between (optional)		
13.	**Aims of the programme:** 1. Creating urban planners that are able to support city residents to have a sustainable life (by optimizing existing resources), both in terms of social. Economic. health, cultural. Political. Ecological and security aspects. 2. Emphasize aspects of the application of information technology. Community participation and appropriate theory and practice in the planning process. 3. Increase understanding of human settlements and urban planning issues so they can provide for and anticipate the needs of their citizens.		
14.	**Profile of Graduates:** Masters in Urban and Regional Planning who are able to produce substantives. Technical and administrative qualified urban panners. Bu considering the impacts of interventions on a city scape in social, economic, cultural, political, and security aspects from time to time.		
15.	**Learning Outcomes (CPL):** Master in Urban and Regional Planning has the following learning outcomes: 1. Able to analyze the growth and development of the city with appropriate approaches and appropriate technologies; 2. Able to predict the needs of an increasing complex city; 3. Able to test plans and policies using various urban method and technologies in an effort to improve and maintain the quality of life of the population; 4. Able to evaluate plans activities that can improve services to underprivileged residents; 5. Able to propose research designs and conduct applied research in the field of urban planning; 6. Able to conclude urban planning solutions and their documents in solving urban problems.		

16.	Course Composition		
No.	**Type of Course**	**Credits**	**Percentage**
I	University Course		
II	Faculty Course		
III	Required Structural Course	20	47,8%
IV	Elective Course	12	28,5%
V	Special Course: Thesis	8	19,0%
VI	Publication	2	4,7%
	Total	42	100%
	Total SCS (Semester Credit System)		**42 Credits**

Job Prospects

Graduates of this study program can work in:

1. Government Institutions, such as Ministry of National Development Planning of the Republic of Indonesia/National Development of Planning Agency (BAPPENAS), The Ministry of Agrarian and Spatial Planning/National Land Agency (BPN) of the Republic of Indonesia, Regional Development of Planning Agency (BAPPEDA), State- Owned Company In all regions in Indonesia that uses urban and regional planning experts (Adhi Karya, Hutama Karya, etc.).
2. Private Business/Professional Institutions engages in urban planning. Both from Indonesia (Arkonin, etc.) and outside Indonesia (Aecom, dll)
3. State owned and private research institutes. Such as: LIPI, PULSE LAB Jakarta
4. Entrepreneur in Urban Planning

Network of Competencies

Figure 1. Course Diagram in Achieving Competencies for
Master Program in Urban and Regional Planning

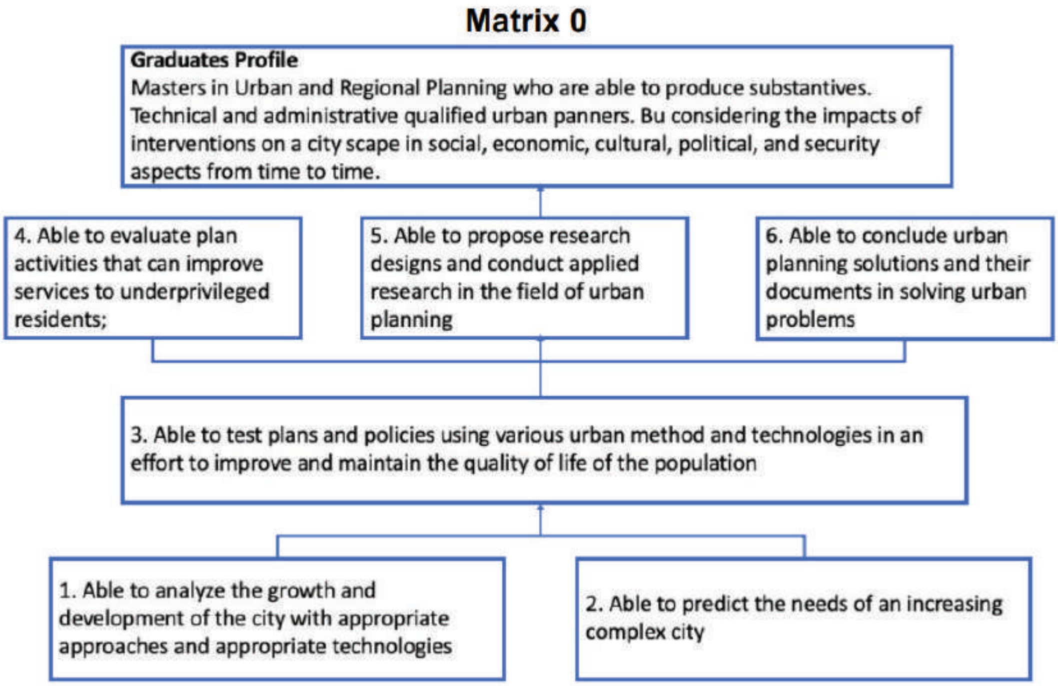


Table 1 Matrix 0 Study Program Master of Urban and Regional Planning

KKNI Level 8	General Competence	Outcome
1. Able to develop knowledge, technology, and or at in the field of science or professional practice through research, to produce innovative and tested works.	1. Able to analyze the growth of urban development with an appropriate technology approach; 2. Able to predict the needs of an increasingly complex city; 3. Able to conclude urban planning solutions and their documents in solving urban problems;	Theses. Papers, publication including thesis summary articles in journal format in the UI repository, Course Assignment report.
2. Able to solve problems of science, technology. And or art in the field of science through and inter or multidisciplinary approach.	4. Able to test plans and policies using various urban methods and technologies in an effort to improve and maintain the quality of life of the population.; 5. Able to plan activities that can improve services to underprivileged residents;	Course assignment report
3. Able to manage research and development that is beneficial to society and science. And is able to gain national and international recognition.	4. Able to propose research designs and conduct applied research in the field of urban planning.	Theses. Papers, publication including thesis summary articles in journal format in the UI repository.

Matrix 0A
ATTITUDE FORMULATION

Every graduate of academic. Vocational and professional education programs must have the following attitudes:

a. Fear God Almighty and be able to show a religious attituded;
b. Upholding human values in carrying out tasks based on religion, morals and ethics;
c. Contribute to the quality improvement of life in society, nation, state, and the progress of civilization based on Pancasila;
d. Act as citizens who are proud and live their homeland, have nationalism and a sense of responsibility to the country and nation;
e. Respects the diversity of cultures, views, religions, and beliefs, as well as the opinions or original findings of others;
f. Work together and have social sensitivity and concern for society and the environment;
g. Obey the law and discipline in the life of society and the state;
h. Internalize academic values, norms, and ethics;
i. Demonstrate a responsible attitude towards work in the field of expertise independently; and Internalize the spirit of independence, struggle, and entrepreneurship.

General Skills Formula

No	General Skills Formula for Master of Urban and Regional Planning (PWK)		Master Class Course
1.	Able to analyze growth and development of cities with appropriate approaches and technologies	Able to analyze community growth to understand developments that need to be planned	a. Urban and Regional Analysis b. Urban Planning Law
		Able to use appropriate approaches to analyze urban development	c. Planning Method and Theory d. Urban Theory and History e. Urban Housing and Settlement Theory
2.	Able to predict the needs of an increasingly complex city	Able to analyze urban infrastructure and transportation needs	a. Transport Planning and Policy b. Spatial Data Digitalization c. Project Investment and Finance d. Infrastructure Asset Management e. Transportation System f. Logistics Transportation
		Able to analyze urban spatial needs	g. Urban Design Theory h. Urban Studio i. Housing policy
		Able to analyze urban environmental management needs	j. Energy Efficient Building k. Water Resources Management l. Sustainable Infrastructure m. Watershed *(DAS)* Health Audit n. Data Management and Analysis o. Environmental Audit p. Life Cycle Analysis (LCA)
3.	Able to test plans and policies using a variety of urban methods and technologies to improve and maintain the quality of life of the population;	Able to use methods to test and evaluate city plans and policies	a. Urban Planning Law b. Housing Policy c. Water Resources Management d. Sustainable Infrastructure e. Energy Efficient Building f. Architecture And Sustainability Workshop
		Able to test efforts to improve the quality of life of city dwellers	g. Urban Studio h. Plan Making studio
4.	Able to plan activities that can improve services to underprivileged residents;	Able to propose activities that can improve services to underprivileged residents	a. Housing Policy b. Plan Making studio
		Able to produce draft regulations to improve services to citizens	c. Urban Planning Law d. Urban Studio

5.	Able to propose research designs and conduct applied research in the field of urban planning;		a. Thesis b. Scientific publications
6.	Able to conclude urban planning solutions and their documents in solving urban problems.	Able to produce city design that can solve urban problems	a. Urban Physical Planning b. Urban Studio c. Urban Planning Studio
		Able to formulate the system needed to plan the city	d. Housing Policy e. Property Workshop f. Water Resources Management g. Sustainable Infrastructure h. Infrastructure and Regional Development
		Able to formulate urban planning documents using appropriate methods to solve city needs from various economic, social, cultural, technological, and ecological aspects	i. Planning Method and Theory j. Plan Making Studio

Matrix 1

Table 2 Matrix 1 Master of Urban and Regional Planning

Group Level	Main Competencies	Supporting Competencies	Other Competencies
Basics and Personality			
Knowledge field	1. Able to analyze the growth and development of cities with appropriate approaches and technologies; 2. Able to predict the needs of an increasingly complex city		
Craftsmanship	3. Able to test plans and policies using various urban method and technologies in an effort to improve and maintain the quality of life of the population 4. Able to conclude urban planning solutions and their documents in solving urban problems. 5. Able to plan activities that can improve services to underprivileged residents	6. Able to propose research designs and conduct applied research in the field of urban planning;	
Work Behavior	7. Able to test and evaluate plans and policies using various urban methods and technologies in an effort to improve and maintain the quality of life of the population 8. Able to plan activities that can improve services to underprivileged residents		
Social life			

Matrix 2
Master's Study Program in Urban and Regional Planning

Table 3 Study Program Master of Urban and Regional Planning

No	Learning Objectives	Learning Experience		Main Substances and Sub-topics	Media and Technology	Course	Indicator	Assessment
		Sub-Objectives	Activity Method					
1	Able to analyze the growth and development of cities with appropriate approaches and technologies	Able to analyze community growth to understand developments that need to be planned	Lectures, Independent Assignments, Analysis, Literature Reviews, Observations, Discussions	Urban planning analysis method, using primary and secondary data; Defines a region; Analyze the demographic, social, and economic conditions of the region.	Laptop, LCD, Whiteboard, Internet	Urban and Regional Analysis	Students are able to perform and review various techniques, data sources, and skills to analyze the area from an economic, social and spatial perspective.	Written Examinations, Written Assignments, Presentations
			Lectures, Independent Assignments, Analysis, Literature Reviews, Discussions	legal framework in planning, the legal balance between the government's interest in promoting public welfare through land use regulation and the interest of private property owners in optimizing personal enjoyment and property value	Laptop, LCD, Whiteboard, Internet	Urban Planning Law	Students are able to use the legal framework in which planning takes place. In addition, students are also expected to emphasize the role of urban planning law in preparing local government responses to social, economic, and physical planning between local governments, central government, the private sector, and the community.	Written Examinations, Written Assignments, Presentations
		Able to use appropriate approaches to analyze urban development	Lectures, Independent Assignments, Literature Reviews, Case Studies, Discussions	A general outline of the city's history and human efforts to plan it; Connections between urban change, urban planning, and the forces of society that shape them; Aspects of urban theory and studies with current planning practice; Current debates about cities and their planning in historical contexts; Formulate questions for in-depth	Laptop, LCD, Whiteboard, Internet	Planning Method and Theory	Students are able to explain classical and contemporary planning theory, theoretical tools for planning analysis, intellectual dialogue through critical reading, information discussion and writing assignments	Written Examinations, Written Assignments, Presentations

				exploration in coursework and subsequent research.				
			Lectures, Independent Assignments, Literature Reviews, Discussions	Engineering theory, policy, politics, and narrative in planning; The evolution and interrelationships between major planning approaches and theoretical perspectives on them, including comprehensive (rational) planning (incremental, strategic, communicative planning), advocacy and equity planning, and radical/rebel planning; Professional planning codes of ethics, their strengths, and their limitations.	Laptop, LCD, Whiteboard, Internet	Urban Theory and History	Students are able to explain the origin and evolution of cities, the process of urbanization, planning efforts in the 19th century, international influences, and urban issues such as segregation between races, housing market differences, and urban sprawl.	Written Examinations, Written Assignments, Presentations
			Lectures, Independent Assignments, Literature Reviews, Discussions	Impact of housing development planning	Laptop, LCD, Whiteboard, Internet	Urban Housing and Settlement Theory	Able to analyze the impact of housing development planning in urban areas	Written Examinations, Written Assignments, Presentations
2	Able to predict the needs of an increasingly complex city	Able to analyze urban infrastructure and transportation needs	Lectures, Independent Assignments, Case Studies & Observations, Discussions	Transportation Policy Formulation; framework for assessing policy transportation - land use, accessibility, air pollution, noise, accidents and sustainability. Transport planning and policy and interaction with spatial planning. Institutional arrangements for transportation planning and management. Risk, uncertainty and complexity in determining transportation policy. Transport policies at the local, regional, metropolitan and national levels; logistics transportation policy	Laptop, LCD, Whiteboard, Internet	Transport Planning and Policy	Able to bring out the uniqueness and originality of the proposal in the preparation of transportation policy	Written Examinations, Written Assignments, Presentations
			Lectures, Independent Assignments,	Introduction to spatial data digitalization. digital data components, general planning	Laptop, LCD, Whiteboard,	Spatial Data Digitalization	1. Able to analyze muti-source digital data	Written Examinations, Written

			Literature Revies & Case Studies, Discussions	knowledge, definition of spatial data digitization, types of digital data spatial, data digitization development methods	Internet		2. Able to use data interoperability 3. Able to develop spatial data processing skills	Assignments, Presentations
			Lectures, Independent Assignments, Literature Revies & Case Studies, Discussions	Fundamentals of engineering economics; basics of technical economic analysis; decision making in engineering economics; inflation, depreciation, tax and sensitivity analysis; introduction to project funding; project funding structure; project funding sources; risk in project funding; project funding modeling; introduction to sharia-based project financing.	Laptop, LCD, Whiteboard, Internet	Project Investment and Finance	1. Being able to implement the principles of project financing in analyzing the risks associated with the financing of projects and to evaluate project funding 2. Ability to analyze cases of cases of investment and financing of projects in the real world	Written Examinations, Written Assignments, Presentations
			Lectures, Independent Assignments, Literature Revies & Case Studies, Discussions	Infrastructure asset management, asset evaluation, asset valuation, optimization in asset management, asset allocation, risk management on infrastructure assets	Laptop, LCD, Whiteboard, Internet	Infrastructure Asset Management	Able to identify and analyze infrastructure asset management processes; Able to explain infrastructure asset management and provide illustrations of asset management implementation on infrastructure to achieve sustainability in the infrastructure sector	Written Examinations, Written Assignments, Presentations
			Lectures, Independent Assignments, Case Studies and Reviews, Discussions	Transportation System Components, operating system, demand and supply	Laptop, LCD, Whiteboard, Internet	Transportation System	Students are able to analyze the components of the transportation system from various dimensions, as well as the latest issues related to the Indonesian and global transportation system; Students are able to design transportation systems that include operating, supply and demand systems that meet sustainability aspects.	Written Examinations, Written Assignments, Presentations
			Lectures, Independent	Transport Policy	Laptop, LCD,	Logistics Transportation	Able to bring out the uniqueness and originality of the proposal in	Written Examinations,

			Assignments, Case Studies and Reviews, Discussions		Whiteboard, Internet		the preparation of transportation policy	Written Assignments, Presentations
		Able to analyze urban spatial needs	Lectures, Independent Assignments, Literature Revies & Case Studies, Discussions	Review of the understanding of urban design. Historical studies and discourses on what is meant by "good city" through the views of theorists, among others: cosmological beliefs, formalists, functionalists, picturesque, organics, utopians, livability, ecological. questioning the "performance dimension" in urban design theory and understanding the relationship between urban design and perceptual/visual/social dimensions. Once students are introduced to the theoretical view, in this section they will explore different ways of interpreting and understanding the urban environment. Discussions about how urban environments mean different things to different people, depending on their cultural, economic, racial and gender backgrounds. Brief review of the relationship between urban design activities and the political-economic context of the urban development process.	Laptop, LCD, Whiteboard, Internet	Urban Design Theory	Students can explain various theories and paradigms in urban planning thinking.	Written Examinations, Written Assignments, Presentations
			Lectures, Independent Assignment, Group Assignment, Analysis & Observations,	The site chosen is a piece of road or an area that is quite complex as far as possible and has a variety of elements and city elements so that it can provide opportunities for students to do "multiple analyses". Understand and apply the idea of “place making” in the private and public spheres, open spaces and	Studio, Panel, Drawing Tables, Model, Laptop LCD, Internet	Urban Studio	Students can apply urban design rules in stages, starting from arranging elements of urban spatial planning to compiling control devices for urban space use, with case studies of strips or mixed-use areas. Students are also equipped with the basics of urban design	Written Examinations, Written Assignments, Presentations

				buildings, to realize individual and community/public needs. Critically examine in a wider scale and context various types of city plans and regulations including master plans, zoning, UDGL, etc.			applications using the results of an in-depth and sharp analysis of regional contexts and issues.	
			Lectures, Independent Assignments, Case Studies & Observations, Discussions	Indonesia as an archipelagic country: developing country, economic disparity, and the formation of cities; Urbanization, migration: demographic characteristics of Indonesia; the constitution of society; Housing demand & supply (formal & informal sector); State politics and housing policy: Typology of housing provision in Indonesia (legal aspects; consumption mode; production mode); Housing economy and finance; land policy; Housing technology; Housing policies in Asian countries	Laptop, LCD, Whiteboard, Internet	Housing Policy	Students are able to explore housing policy as a set of concepts that underlie the implementation of the housing sector in a country, including among others: understanding, objectives, characteristics, motives, scope, and implementation. Discussing housing policy and its relation to political, social, economic, cultural, and environmental aspects and their impact on housing management practices, including in the scope of architecture and the city.	Written Examinations, Written Assignments, Presentations
		Able to analyze urban environmental management needs	Lectures, Independent Assignments, Discussions	Renewable energy, Climate and site, solar geometry, passive cooling, shading, natural & artificial light and solar cells.	Laptop, LCD, Whiteboard, Internet	Energy Efficient Building	Students understand the theoretical principles of energy-efficient building technology and can apply them to design climate-responsive and energy-efficient buildings	Written Examinations, Written Assignments, Presentations
			Lectures, Independent Assignments, Analysis and Case Studies, Discussions	Students are equipped with the ability to understand: 1. aspects of the principles and policies of water resources management (in Indonesia) and their developments; 2. aspects and models of integrated water resources management (IWRM) both on a national and national scale international; 3. management aspects based on government regulations and policies	Computer, LCD, Whiteboard, Internet	Water Resources Management	Able to work independently or work together in teams to carry out assessments (evaluating complex design processes or results) on various aspects of the scope of Water Resources Management in solving water resources problems and able to present the results of the assessment in the form of written documents that	Written Examinations, Written Assignments, Presentations

				related to 3 (three) pillars of natural resource management, namely Utilization, Control of Water Damage, Conservation; 4. supporting aspects of water resources management which include hydro-economy; 5. Natural resource management case (or project), selected in a WPSA (Water Resources Management Area) or river basin			systematic and able to communicate orally	
			Lectures, Independent Assignments, Case Studies and Reviews, Discussions	Introduction to sustainable infrastructure, Sustainable development, definition of sustainable infrastructure, elements of general planning knowledge, aspects of sustainable infrastructure pre-planning, development impacts, need for sustainable urban infrastructure development	Computer, LCD, Whiteboard, Internet	Sustainable Infrastructure	Able to span the impact of infrastructure development. Able to formulate sustainable infrastructure needs Able to analyze aspects of infrastructure development	Written Examinations, Written Assignments, Presentations
			Lectures, Independent Assignments, Case Studies and Reviews, Discussions	Land Use Planning, Land Conservation, Water Borders, Ideal Site Design, Erosion & Sedimentation Control, Rain Management, Liquid Waste Management, Stakeholder Awareness.	Laptop, LCD, Whiteboard, Internet	Watershed *(DAS)* Health Audit	1. Able to apply a rapid assessment of the health of a watershed based on the Center for Watershed Protection method, 2. Able to categorize watershed health status based on impermeable land cover, water quality, and benthic macro diversity, and 3. Able to provide follow-up recommendations for improving watershed health	Written Examinations, Written Assignments, Presentations
			Lectures, Independent Assignments, Case Studies and Reviews, Discussions	Elements of general planning knowledge, the purpose and meaning of data management and analysis, types of data management and analysis, methods of data analysis and management	Laptop, LCD, Whiteboard, Internet	Data Management and Analysis	Students are able to develop data management technique. Able to use econometric analysis Able to formulate data-based decisions	Written Examinations, Written Assignments, Presentations

			Lectures, Independent Assignments, Case Studies and Reviews, Discussions	Definitions, principles, concepts and environmental policies in Environmental Auditing. Legal Basis for Environmental Audit Policies and Regulations. Basic Principles of Environmental Auditing (Defining the main issues and scope of the audit). Understanding ISO 1400: Improved Environmental Management and Sustainable Development. A study of the Environmental Management Plan/RKL and Environmental Management Plan/RPL. Basic Principles of Auditing (Basic principles, procedures, hierarchies and processes in environmental auditing). Types of Audits (Revenue audits, waste audits, process audits). Audit Method (procedure for determination, weight, importance and valuation in environmental audit). Audit Documents. Audit Case Studies (case document studies).	Laptop, LCD, Whiteboard, Internet	Environmental Audit	Able to conduct audits and develop environmental audit reports	Written Examinations, Written Assignments, Presentations
			Lectures, Independent Assignments, Case Studies and Reviews, Discussions	Overview Integrated Solid Waste Management, concept of sustainable solid waste management, development of IWMS (case studies and analysis), elements of IWM, solid waste generation and composition, waste collection, central sorting, biological treatment, thermal treatment, landfilling, material recycling, model: STAN 2, Prognosis, and IWM 2	Laptop, LCD, Whiteboard, Internet	Life Cycle Analysis (LCA)	Able to use a set of models to conduct an assessment of sustainable solid waste management	Written Examinations, Written Assignments, Presentations
3	Capable to test the plans and policies by using various methods and urban technologies in an effort to increase	Capable to use methods to test and evaluate the urban policies and plans	Lecture, Individual Assignments, Studies and Case Study, Discussion	Legal framework in the planning, legal balance between Government's interests in promote the public wealth through the land use rules and private property owner's interests in optimizing the	Laptop, LCD, Whiteboard, Internet	Urban Planning Law	Students are capable to use the legal frameworks where the planning taken place. Besides, students encourage to emphasize the rules of urban planning law in arranging the	Written Examinations, Written Assignments, Presentations

	and defend the inhabitant's life quality			private leisure and their property values			Local Government's responses to the social, economic and physical planning between the Local Government, Private Sectors and people	
			Lecture, Individual Assignments, Studies and Case Study, Discussion	Indonesia as an archipelago; developed country, economic gap and city formation; Urbanization, migration, Indonesian demographic characteristics ; people's constitution ; Housing demand and offer (formal and informal sector); State's politics and housing policies ; Housing provision typologies in Indonesia (legal aspects ; consumption methods ; production mode) ; Finance and economic housings ; Land policies ; Housing technologies ; Housing policies in Asian countries	Laptop, LCD, Whiteboard, Internet	Housing Policy	Students are capable to explore the housing policies as set of concepts that underlies the housing sector enforcements in a country, covers : Understanding, objectives, characteristics, motives, scopes and the implementations. Discuss the housing policy and its relations with the political, social, economic, cultural and environmental aspects and its impacts to the housing practices, including within the architecture and city scopes	Written Examinations, Written Assignments, Presentations
			Lecture, Individual Assignments, Studies and Case Study, Discussion	Students are given skill provisions to understand : 1. Principal aspects and water resources management policies (in Indonesia) and its developments 2. integrated aspects and models of water resource management (IWRM) both national and scale internationally; 3. management aspects based on government regulations and policies related to 3 (three) pillars of SDA management, namely Utilization, Damaged Power Control Water, Conservation; 4. supporting aspects of water resource management which include hydro economy; 5. SDA management case (or project), selected in a WPSA	Computer, LCD, Whiteboard, Internet	Water Resources Management	Able to work independently or work together in teams to assess (evaluate complex processes or design results) on various aspects of the scope of Water Resources Management (MSDA) in solving water resource problems and able to present the results of such assessments in the form of systematic written documents and able to communicate them orally	Written Examinations, Written Assignments, Presentations

				(Water Resources Management Area) or river area				
			Lecture, Individual Assignments, Studies and Case Study, Discussion	Introduction to water management for urban areas in spatial planning and city infrastructure; Types of resources, water allocation and availability of water; critical water quality and water use in an infrastructure perspective; Water quality and load urban waste in relation to causality and health risks; account load of solid waste pollution and liquid waste; Capacity and load assignment on surface water; Calculation of Total Maximum Daily Load (TMDL) on the body water; Technological and policy interventions in water and waste quality control urban areas; Water quality modeling (QUAL2E, Epanet, Aquatox); Case implementation water quality management for urban use software.	Computer, LCD, Whiteboard, Internet	Urban Water and Waste Quality Managemeng	Students are able to predict (C5) the capacity and load on surface water with water quality modeling software.	Written Examinations, Written Assignments, Presentations
			Lecture, Individual Assignments, Discussion	Renewable energy, Climate and site, solar geometry, passive cooling, shading, natural & artificial light and solar cells.	Laptop, LCD, Whiteboard, Internet	Energy Efficient Building	Students understand the principles of energy-efficient building technology theory and can apply them to design climate-responsive and energy-efficient buildings	Written Examinations, Written Assignments, Presentations
		Able to test and evaluate efforts to improve the quality of life of the city's residents	Lecture, Individual Assignments,, Group Assignments, Analysis & Observation,	The results of the analysis will develop and apply the theory of building technology in a small-scale design research project.	Studio, Panel, Drawing Table, Model, Laptop,	Architecture and Sustainability Workshop	Students can develop and apply building technology theory in a small-scale design research project.	Presentation Examinations, Weekly Assignments

			Literature Studies, Discussion		LCD, Internet			
			Interactive Lecture Designing Practices Case Study Analysis & Observation Discussion	The site chosen is a piece of road or area that is as complex as possible and have a diversity of elements and elements of the city so as to provide opportunities for students to multiple analyses. Understanding and implementing the idea of "place making" in the private realm public, open spaces and buildings, to realize the needs of individuals and community/public. Critically reviewed in a broader scale and context of different types city plans and regulations including master plan, zoning, UDGL, etc.	Studio, Panel, Drawing Table, Model, Laptop, LCD, Internet	Urban Studio	Students can apply the rules of urban design gradually, ranging from organizing elements of urban layout to putting together a control device for the use of city space, with case studies of strips or mixed-use areas. Students are also provided with the basic basis of urban design application by using the results of analysis conducted in depth and sharply on the context and issues of the region.	Presentation Examinations, Weekly Assignments
			Interactive Lecture Designing Practices Case Study Analysis & Observation Discussion	Contemporary and effective physical planning; Physical planning decision making process; Analysis of planning and make professional reports; Digital spatial data to create effective maps	Studio, Panel, Drawing Table, Model, Laptop, LCD, Internet	Plan Making Studio	Students are able to apply the principles of urban planning by considering the political constraints of planning, planning ethics, negotiation / facilitation / mediation techniques, scenarios, impact reviews, and evaluation of alternative solutions.	Written Examinations, Written Assignments, Presentations
4	Able to plan activities that can improve services to underprivileged residents.	Able to propose activities that can improve services to underprivileged residents	lecture, Independent task, Case Studies & Observations, Discussion	Indonesia as an archipelagic country: developing country, economic disparity, and the formation of cities; Urbanization, migration: demographic characteristics of Indonesia; the constitution of society; Housing demand & supply (formal & informal sector); State politics and housing policy: Typology of housing provision in Indonesia (legal aspects; mode of consumption; mode of production); Housing economics and finance;	Laptop, LCD, Whiteboard, Internet	Housing Policy	Students are able to explore housing policy as a set of concepts that underlie the implementation of the housing sector in a country, including among others: understanding, objectives, characteristics, motives, scope, and implementation. Discussing housing policy and its relation to political, social, economic, cultural, and environmental aspects and their impact on	Written examination, Written Assignments, Presentations

				land policy; Housing technology; Housing policies in Asian countries			housing management practices, including in the scope of architecture and the city.	
			lecture, Independent task, Group task, Analysis & Observation, Literature Review, Discussion	Contemporary and effective physical planning; Physical planning decision-making process; Planning analysis and make professional reports; Digital spatial data to create effective maps	Studio, Panel, Drawing Desk, Model, Laptop LCD, Internet	Plan Making Studio	Students are able to apply the principles of urban planning by considering the political constraints of planning, planning ethics, negotiation / facilitation / mediation techniques, scenarios, impact review, and evaluation of alternative solutions.	Presentation Examinations, Weekly Assignments
		Able to produce draft regulations to improve services to citizens	lecture, Independent Assignments, Analysis, Literature Review, Case Studies, Discussion	the legal framework in planning, the legal balance between the government's interest in promoting the general welfare through land use regulations and the interests of private property owners in optimizing their personal enjoyment and property value	Laptop, LCD, Whiteboard, Internet	Urban Planning Law	Students are able to use the legal framework in which planning takes place. In addition, students are also expected to emphasize the role of urban planning law in preparing local government responses to social, economic, and physical planning between local governments, central government, the private sector, and the community.	Written examinations, Written Assignments, Presentations
			lecture, Independent task, Analysis, Literature Review, Case Studies, Discussion	The selected site is a piece of road or an area that is as complex as possible and has a variety of urban elements so it can provide opportunities for students to perform multiple analyzes. Understand and apply the idea of "place making" in the private and public sphere, open spaces and buildings, to fulfil individual and community/public needs. Critically examine in a wider scale and context various types city plans and regulations including master plan, zoning, UDGL, etc.	Studio, Panel, Drawing Desk, Model, Laptop LCD, Internet	Urban Studio	Students can apply urban design rules in stages, starting from arranging elements of urban spatial planning to compiling control devices for urban space use, with case studies of strips or mixed-use areas. Students are also equipped with the basics of urban design applications using the results of an in-depth and sharp analysis of regional contexts and issues.	Written examinations, Written Assignments, Presentations

5	Able to propose research designs and conduct applied research in the field of urban planning		Independent task	Defining the issues discussed, clearly formulated research questions, objectives in conduct research. Theoretical footing, selection of strategies or methods, disclosure of facts and synthesis of material that leads to answers to research questions, conclusions.		Thesis	Students are able to complete research in accordance with the theme and scope that has been approved by	Written examinations, Written Assignments, Presentations
			Independent task	The rules of scientific writing; various modes of scientific writing; strategy for formulating arguments in scientific writings that clearly show a position against existing knowledge; publication procedures in national/international seminars/conferences; publication procedures in international reputable journals; review of articles in internationally reputed journals in the field of related to urban and regional planning.		Scientific Publication	Students are able to complete research according to the theme and scope that has been approved by the supervisor	Written examinations, Written Assignments, Presentations
6	Able to conclude urban planning solutions and their documents in solving urban problems	Able to produce city design that can solve urban problems	Interactive Lecture Designing Practice Case study Analysis & Observation Discussion	Contemporary and effective physical planning; Physical planning decision-making process; Planning analysis and make professional reports; Digital spatial data to create effective maps	Studio, Panel, Drawing Desk, Model, Laptop LCD, Internet	Urban Physical Planning	Students are able to explain the principles of physical planning and apply principles and methods in urban planning project assignments	Presentation Examinations, Weekly Assignments

			Interactive Lecture Designing Practice Case study Analysis & Observation Discussion	The selected site is a piece of road or an area that is as complex as possible and has a variety of urban elements so it can provide opportunities for students to perform multiple analyzes. Understand and apply the idea of “place making” in the private and public sphere, open spaces and buildings, to fulfil individual and community/public needs. Critically examine in a wider scale and context various types city plans and regulations including master plan, zoning, UDGL, etc.	Studio, Panel, Drawing Desk, Model, Laptop LCD, Internet	Urban Studio	Students can apply urban design rules in stages, starting from arranging elements of urban spatial planning to compiling control devices for urban space use, with case studies of strips or mixed-use areas. Students are also equipped with the basics of urban design applications using the results of an in-depth and sharp analysis of regional contexts and issues.	Presentation Examinations, Weekly Assignments
			Interactive Lecture Designing Practice Case study Analysis & Observation Discussion	Contemporary and effective physical planning; Physical planning decision-making process; Planning analysis and making professional reports; Digital spatial data to create effective maps	Studio, Panel, Drawing Desk, Model, Laptop LCD, Internet	Urban Planning Studio	Students are able to apply the principles of urban planning by considering the political constraints of planning, planning ethics, negotiation / facilitation / mediation techniques, scenarios, impact review, and evaluation of alternative solutions.	Presentation Examinations, Weekly Assignments
		Able to formulate the system needed to plan the city	lecture, Independent task, Case Studies & Observations, Discussion	Indonesia as an archipelagic country: developing country, economic disparity, and the formation of cities; Urbanization, migration: demographic characteristics of Indonesia; the constitution of society; Housing demand & supply (formal & informal sector); State politics and housing policy: Typology of housing provision in Indonesia (legal aspects; consumption mode; production mode); Housing economics and finance; land policy; Housing technology; Housing policies in Asian countries	Laptop, LCD, Whiteboard, Internet	Housing Policy	Students are able to explore housing policy as a set of concepts that underlie the implementation of the housing sector in a country, including among others: understanding, objectives, characteristics, motives, scope, and implementation. Discussing housing policy and its relation to political, social, economic, cultural, and environmental aspects and their impact on housing management practices, including in the scope of architecture and the city.	Written Examinations, Written Assignments, Presentation

			Interactive Lecture, Independent task, Group task, Discussion	Dreams & products; product (preferred): residential property, commercial/retail property, office building/work property; money issues/feasibility studies; products & users / lifestyle; management aspects of property products; Proposed (future) products: residential property, commercial/retail property, office building/work property; finance & management.	Laptop, LCD, Whiteboard, Internet	Property Workshop	Students apply the link between architecture and real estate activities in a small-scale project. Related to the innovation of places for human activities such as new building types, lifestyles, market segmentation, and others.	Presentation Examinations, Weekly Assignments
			lecture, Independent task, Analysis and Case Studies Discussion	Students are equipped with the ability to understand: 1. aspects of water resources management principles and policies (in Indonesia) and their developments; 2. aspects and models of integrated water resources management (IWRM) both on a national and international scale; 3. management aspects based on government regulations and policies related to 3 (three) pillars of natural resource management, namely Utilization, Control of Water Damage, Conservation; 4. supporting aspects of water resources management which include hydro-economy; 5. Natural resource management case (or project), selected in a WPSA (Water Resources Management Area) or river basin	Komputer, LCD, Whiteboard, Internet	Water Resources Management	Able to work independently or work together in teams to carry out assessments (evaluating complex design processes or results) on various aspects of the scope of Water Resources Management (MSDA) in solving water resources problems and able to present the results of the assessment in the form of written documents that systematic and able to communicate orally	Written Examinations, Written Assignments, Presentations
			lecture, Independent task, Analysis and Case Studies Discussion	Introduction to urban water management in urban spatial planning and infrastructure; Types of resources, water allocation and water availability; Critical of water quality and water use in infrastructure perspective; Water	Computer, LCDs, whiteboards, Internet	Urban Water and Waste Quality Management	Students are able to predict (C5) the carrying capacity and load on surface water with water quality modeling software.	Written Examinations, Written Assignments, Presentations

				quality and urban effluent load in causality and health risk relationship; Calculation of the pollution load of solid waste and liquid waste; Determination of the capacity and load on surface water; Calculation of Total Maximum Daily Load (TMDL) in water bodies; Technological and policy interventions in urban water and sewage quality control; Water quality modeling (QUAL2E, Epanet, Aquatox..); Application of water quality management cases for cities using software.				
			lecture, Independent task, Group task, Case Studies & Observations, Discussion	Preliminary; Regional Development Theory; Developing the Concept of Transport Spatial Planning and Strategic Areas; Determining the Area of Influence of Infrastructure; Urban and Rural Area Development; Development and Spatial Planning of Coastal Areas; Future Spatial Planning; Developing Economic Corridors; Regional Connectivity; ASEAN Regional Connectivity; Regional Development Financing; Infrastructure in Regional Development; Case study of Infrastructure in Regional Development;	Computer, LCDs, whiteboards, Internet	Infrastructure and Regional Development	1. Able to identify and analyze the infrastructure development of a region related to the regional economy 2. Be able to explain the conception of the relationship between planning and infrastructure development in an area and its relationship to the regional economy	Written Examinations, Written Assignments, Presentations
		Able to formulate city planning documents using appropriate methods to solve the needs of cities from various aspects of economic, social, ekonomi, sosial, cultural, technological, and ecological	lecture Self-Help Tasks, Literature Studies, Case Studies, discussion	General outline of the city's history and human efforts to plan it; The connection between city change, urban planning, and the strength of the communities that make up them; Aspects of urban theory and study with current planning practices; The current debate about the city and its planning in a historical context; Formulate questions for in-depth	Laptop, LCD, Whiteboard, Internet	Planning Method and Theory	Students are able to explain classical and contemporary planning theory, theoretical tools for planning analysis, intellectual dialogue through critical reading, information discussion and writing tasks	Written Examinations, Written Assignments, presentations

			exploration in courses and subsequent research.				
		Interactive Lecture Designing Practices Case Study Analysis & Observation discussion	Contemporary and effective physical planning; Physical planning decision making process; Analysis of planning and make professional reports; Digital spatial data to create effective maps	Studio, Panel, Desk Image, Model, LCD Laptop, Internet	Plan Making Studio	Students are able to apply the principles of urban planning by considering the political constraints of planning, planning ethics, negotiation / facilitation / mediation techniques, scenarios, impact reviews, and evaluation of alternative solutions.	Written Examinations, Written Assignments, presentations

Curriculum Structure Magister of Urban and Regional Planning

Code	Subject	SKS
	1st Semester	
ENUP80001	Planning Method and Theory	3
ENUP80002	Urban and Regional Analysis	3
ENUP80003	Urban Theory and History	3
ENUP80004	Urban Planning Law	3
	Sub Total	**12**
	2nd Semester	
ENUP80005	Urban Physical Planning	3
	Elective Course	3
	Elective Course	3
	Sub Total	**9**
	3rd Semester	
ENUP80006	Plan Making Studio	5
	Elective Course	3
ENUP80007	Pre-Thesis	4
	Sub Total	**12**
	4th Semester	
ENUP80008	Thesis	4
ENUP80009	Scientific Publication	2
	Elective Course	3
	Sub Total	**9**
	Total	**42**

List of Elective Courses

Code	Subject	SKS
Urban Spatial Planning		
ENAR800009	Urban Studio 1	5
ENAR800021	Urban Studio 2	5
ENAR800015	Urban Design Theory	3
ENAR800011	Property Workshop 1	5
ENAR800023	Property Workshop 2	3
ENAR800038	Housing Policy	3
ENAR800016	Urban Housing and Settlement Theory	3
ENUP80011	Data Management and Analysis	3
ENUP80012	Spatial Data Digitalization	3
Urban Environmental Planning		
ENAR800032	Energy Efficient Building	3
ENAR800013	Architecture and Sustainability Workshop 1	5
ENCV800401	Water Resources Management	3
ENCV803402	Watershed (DAS) Health Audit	3
ENCV802402	Advanced Water Building Design	3
ENCV802105	Environmental Audit	3
ENCV802202	Life Cycle Analysis (LCA)	3
ENUP80013	Sustainable Infrastructure	3
Infrastructure and Transportation Planning		
ENCV803602	Infrastructure Asset Management	3
ENUP80010	Infrastructure and Regional Development	3
ENCV801502	Transportation System	3
ENCV802502	Transport Planning and Policy	3
ENCV803508	Logistics Transportation	3
ENCV801601	Project Investment and Finance	3

Course Syllabus

Syllabus of Required Courses Program Master of Regional and Urban Planning

Planning Method and Theory
ENUP80001
3 Credits

Objectives :

Understand the theory of change, combining elements of engineering, policy, politics, and narrative for planning. Understanding evolution and interconnectedness between key planning approaches and theoretical perspectives on them, including comprehensive (rational) planning; additional, strategic, and communicative planning; advocacy and equality planning; and radical/rebel planning.

Syllabus:

Elements of general planning knowledge, purpose and meaning of planning, planning theory, planning timeframe, global dimension of planning, professional values and ethics, fairness, diversity and social justice, governance and stakeholder participation, and community members in planned change.

Preconditions: -

Textbooks:
1. Bracken, I. (2014). Urban planning methods: Research and policy analysis. Routledge.
2. Wang, X., & Hofe, R. (2008). Research methods in urban and regional planning. Springer Science & Business Media.
3. Ethics and Professional Conduct https://www.planning.org/ethics/ethicscode/ and APA Ethical Principles in Planning, https://www.planning.org/ethics/ethicalprinciples/.
4. Friedmann, John. (2005). Planning cultures in transition. In Comparative Planning Cultures, Bishwapriya Sanyal, ed. (pp. 53-68). Routledge.
5. Banerjee, T. (2005). Understanding planning cultures: The Kolkata paradox. In Comparative Planning Cultures, Bishwapriya Sanyal, ed. (pp. 169-188). Routledge.
6. Fainstein, Susan. 2010. “Introduction: Toward an Urban Theory of Justice,” in The Just City (pp. 1-22). Ithaca, NY: Cornell University Press

Urban and Regional Analysis
ENUP80002
3 Credits

Objectives :

Understand common methods of urban planning analysis, both using primary and secondary data. Have the knowledge and skills to define a region and describe and analyze the demographic, social, and economic conditions of a region.

Syllabus:

Defining and mapping regions, analyze demographic data, introduction to SPSS, measure economic data, collect and ethics primary data, quantitative data analysis.

Preconditions: -

Textbooks:

1. Marisa Zapata's Engaging the Future: Forecasts, Scenarios, Plans, and Projects.
2. Isserman, A. M. (2007). Forecasting to learn how the world can work. Engaging the future: Forecasts, scenarios, plans, and projects.

Urban Theory and History
ENUP80003
3 Credits

Objectives :

By the end of the course, students will be able to:

1. Understand generally about the history of cities and human effort in the development plan of the city;
2. Identify major events, movements, ideas, and people that have significantly influenced the city and the urban planning professions;
3. Create links between urban development, urban planning, and the power of society that shape a community in an urban area.
4. Create links between theoretical aspects and urban studies and current best practice in urban planning
5. Engage in current debates and/or discussion about cities and its historical plan.

Syllabus:

Introductory and The Early History of City; Industrialization, Major Urban Theory, and The Origins of Urban Planning; Modernism, Suburbanization, and City Conflicts; and Postmodernism, Economic Knowledge, and Globalization.

Preconditions: -

Textbooks:

1. Garvin, Alexander (2002). The American City: What Works and What Doesn't. New York: McGraw Hill. ISBN 978-0-07-137367-8. (A standard text for many college and graduate courses in city planning in America)
2. Brenner, N. and C. Schmid. 2015. "Towards a New Epistemology of the Urban?" City. 19 (2-3): 151-182.
3. The City in History, Lewis Mumford, 1961
4. Town Planning in practice, Raymond Unwin, 1909
5. "The City Shaped: Urban Patterns and Meanings Through History", Spiro Kostof, 2nd Edition, Thames and Hudson Ltd, 1999 ISBN 978-0-500-28099-7
6. The American City: A Social and Cultural History, Daniel J. Monti, Jr., Oxford, England and Malden, Massachusetts: Blackwell Publishers, 1999. 391 pp. ISBN 978-1-55786-918-0.
7. Garvin, Alexander (2002). The American City: What Works and What Doesn't. New York: McGraw Hill. ISBN 978-0-07-137367-8. (A standard text for many college and graduate courses in city planning in America)
8. Pow, C-P. 2012. "China Exceptionalism? Unbounding Narratives on Urban China." In Urban Theory Beyond the West, Edensor, T., and M. Jayne (Eds.). New York, NY: Routledge. (pp. 47-64).
9. Abu-Lughod, J.L. 1993. "The Islamic City: Historic Myth, Islamic Essence, and Contemporary Relevance." In Urban Development in the Muslim World, Amirahmadi, H. and S.S. El-Shakhs (Eds.). New Brunswick, NJ: Center for Urban Policy Research. (pp. 11-36)
10. King, A.D. 2015. "Colonialism and Urban Development." In Cities of the Global South Reader, Miraftab, F. and N. Kudva (Eds.). New York, NY: Routledge. (pp. 29-39).
11. Frank, A.G. 1989 (1966 reprint). "The Development of Underdevelopment." Monthly Review. 41 (2): 37-45.

Urban Planning Law
ENUP80004
3 Credits

Objectives :

Students will be able to use the legal framework in planning process. Students will be able to emphasize the role of urban planning law in formulating local government strategies to tackle the social, economic, and physical issues between local government, central government, the private sectore, and the local community.

Syllabus:

The legal framework in urban planning, the legal balance between government's interest in promoting the general welfare through land-use regulation and the interest of private property owners in optimizing their personal satisfaction and property value.

Preconditions: -

Textbooks:

1. Undang-Undang Nomor 26 Tahun 2007 Tentang Penataan Ruang
2. Undang-Undang Nomor 34 Tahun 2009 Tentang Pedoman Pengelolaan Kawasan Perkotaan
3. Peraturan Menteri Dalam Negeri Nomor 1 Tahun 2008 Tentang Pedoman Perencanaan Kawasan Perkotaan
4. Peraturan Menteri Dalam Negeri Nomor 1 Tahun 2007 Tentang Penataan Ruang Terbuka Hijau Kawasan Perkotaan

Urban Physical Planning
ENUP80005
3 Credits

Objectives :

By the end of the course, students will be able to:

1. Understand the contemporary and effective city planning.
2. Understand the physical city planning decision-making process
3. Learn how to use Adobe Software to communicate planning analysis and construct professional reports.
4. Learn how to use digital spatial data to create effective maps.

Syllabus:

Land use control, built environment, interpretation and map-making skills, pIntroduction to urban planning softwares, site-scale and regional-scale natural system analysis, socio-economic analysis, site engineered analysis, site layout, and small-scale area planning.

Preconditions:

Student has taken Design Methods, City and Regional Analysis, Theory and History of Urban, and Urban Planning Law

Textbooks:

1. Urban Development: The Logic Of Making Plans, Lewis D. Hopkins, Island Press, 2001. ISBN 978-1-55963-853-1
2. Planning for the Unplanned: Recovering from Crises in Megacities, by Aseem Inam (published by Routledge USA, 2005). ISBN 978-0-415-95130-2
3. Planning the Twentieth-Century American City, Christopher Silver and Mary Corbin Sies (Eds.), Johns Hopkins University Press, 1996
4. City Planning According to Artistic Principles, Camillo Sitte, 1889
5. Nino, F. S. (2016, October 20). The New Urban Agenda: Key Commitments. Retrieved October 23, 2017, from http://www.un.org/sustainabledevelopment/blog/2016/10/newur banagenda/
6. Gabbatt, A. (2017, August 28). What makes Houston so vulnerable to serious floods? Retrieved October 23, 2017, from http://www.theguardian.com/us-news/2017/aug/28/houston- harvey-risk-floods-analysis
7. Chapter 3: The City Image and Its Elements in Lynch, K. (1960). The image of the city (Vol. 11). MIT press.
8. Chapter 1: Framing the Land Use Planning Process in Berke, P., Godschalk, D. R., Kaiser, E. J., & Rodriguez, D. (2006). Urban land use planning. University of Illinois Press.
9. Miles, M. E., Berns, G. L., Eppli, M. J., & Weiss, M. A. (2007). Real estate development: principles and process: Urban Land Institute. Urban Land Institute.

- Chapter 3: Developers and Their Partners
- Chapter 13: Stage Three: The Feasibility Study Supplemental:

Plan Making Studio
ENUP80006
5 Credits

Objectives :

Students will be able to collect the required data, analyze the city as a system and/or organism. Students will be able to estimate the urban growth and the needs of urban development as well as to integrate various data into a reliable planning concept. In addition, student will be able to construct an informative report.

Syllabus:

Urban planning products, Urban Planning processes and procedures, Data and Planning, Digital Data Processing, Analysis and Projection Techniques in planning, Multilevel, cross-sector, and inter-actor planning concepts, Urban Planning Scenarios, Urban Development Priorities, Criticism and Innovation of City Planning.

Preconditions:

Student has taken Physical Planning at The City Scale

Textbooks:

1. Schwabish, Jonathan. 2017. Better Presentations: A Guide for Scholars, Researchers, and Wonks. Columbia University Press.
2. Ryser, Judith and Franchini, Teresa. International Manual of Planning Practice – ISOCARP Publication
3. AICP Code of Ethic and Professional Conduct.
4. Duhl, L.J. & Sanchez, A.K. 1999. Healthy Cities and The City Planning Process. WHO Publication
5. Speck, Jeff. 2018. Walkable City Rules: 101 Steps to Making Better Places. Island Press.
6. Toderian, Brian. 2019. 10 keys to making a great city plan. Planetizen Magazine. https://www.planetizen.com/node/80720/10-keys-making-great-city-plan
7. UN Habitat, 2015. International Guidelines of urban and territorial planning. https://www.uclg.org/sites/default/files/ig-utp_english.pdf
8. Kode Etik Perencana, IAP
9. Standar Kompetensi Kerja Nasional Indonesia (SKKNI), Permenakertrans No. 177/2015.
10. Permen ATR No. 1 dan No 16 Tahun 2018 tentang Pedoman Penyusunan RTRW dan RDTR/PZ
11. Permen PUPR No. 6 Tahun 2006 tentang RTBL Perkotaan

Thesis
ENUP80008
4 Credits

Objectives :

Able to find, study and communicate issues in a special study area related to architecture. Able to develop further skills in reading, research and writing a thesis. For the research thesis track: a thesis that no more than 20,000 words. For the thesis design track: the draft is accompanied by a thesis that no more than 10,000 words and a portfolio design that provides a comprehensive overview of the design process.

Syllabus:

Defining the issues discussed, clearly formulated research questions, the purpose of conducting the research. Theoretical base, choosing a strategy or method, revealing facts and synthesizing materials that lead to answers to research questions, conclusions.

Preconditions: Have taken the course

Textbooks:

Scientific Publication
ENUP80009
2 Credits

Objectives :

Students will be able to produce a scientific writing on the results of studies or the research with a decent quality to be published in national or international level dissemination forums.

Syllabus:

The rules of scientific writing; various modes of scientific writing; the argument formulation strategy in scientific writing that clearly shows the position on existing knowledge; publication procedures in national/international seminars/

conferences; publication procedures in international reputable journals; article review in internationally reputed journals in architecture-related fields.

Preconditions: -

Textbooks: -

Elective Course Description

Infrastructure and Regional Development
ENUP80010
3 Credits

Objectives :

1. Able to identify and analyze the infrastructure development of a region related to the regional economy.
2. Able to explain the concept of the relationship between planning and infrastructure development in an area and its relationship to the regional economy.

Syllabus:

Preliminary; Regional Development Theory; Developing the Concept of Transport Spatial Planning and Strategic Areas; Determining the Area of Influence of Infrastructure; Urban and Rural Area Development; Development and Spatial Planning of Coastal Areas; Future Spatial Planning; Developing Economic Corridors; Regional Connectivity; ASEAN Regional Connectivity; Regional Development Financing; Infrastructure in Regional Development;Case study of Infrastructure in Regional Development.

Preconditions:

Textbooks:

1. Bambang Susantono, Ph.D. Infrastructure and Regional Development in Indonesia. 2015. Delft Academic Press. ISBN: 978-90-6562-323-2.
2. Prof. Dr. Rahardjo Adisasmita, M.Ec. Ekonomi Tata Ruang Wilayah. 2014. Graha Ilmu. ISBN: 978-602-262-225-3.
3. Wong, Cecilia. Indicators for Urban and Regional Planning: The Interplay of Policy and Methods. 2006. The RTPI Library Series. ISBN: 0-415-27452-4.
4. Stevenson, Deborah. Cities and Urban Cultures. 2003. Open University Press. ISBN:0-335-20844-4.
5. Ed: Taylor, Peter J, Derudder, Ben, Saey, Pieter and Witlox, Frank. Cities in Globalization: Practices, Policies and Theories. Routledge Taylor and Francis Group. ISBN: 978-0-415-40984-1.

Data Management and Analysis
ENUP80011
3 Credits

Objectives :

1. Able to develop data management techniques from a city or a regional area
2. Able to use econometric analysis in urban and regional planning
3. Able to formulate data-base decisions as one of problem-solving approaches.

Syllabus:

This course introduces several types of data management and their management techniques in the context of urban and regional planning. This course includes econometric analysis of the integration of several data sources. This course assists urban planners in management-based decision-making and data analysis. This course involves Elements of general planning knowledge, the purpose and meaning of data management and analysis, types of data management and analysis, methods of data analysis and management.

Preconditions: Course Urban Planning Theories and Methods

Textbooks:

1. R. Legates. The City Reader, 2nd Ed. Routledge
2. Henri Pirenne. The Medieval Cities: Their Origins and The Revival Trade. Princeton University Press. 1969
3. Aristoteles. The Politics (especially Book III and Book VII). Penguin Classics. Revised Edition. 1981

Spatial Data Digitalization
ENUP80012
3 Credits

Objectives :

1. Able to analyze multi-source digital data related to urban and regional planning
2. Able to use data interoperability in supporting the assignments
3. Able to develop spatial data procession skills related to spatial data management

Syllabus:

This course also encourages students to use data interoperability and assists urban planners in developing spatial data skills, especially those based on digital spatial data. This course includes Digital data components, general planning knowledge, definition of spatial data digitization, types of digital data spatial, data digitization development methods

Preconditions: Course Urban Planning Theories and Methods

Textbooks:

1. Future Cities Lab (2015). URscape: Introduction
2. Mans, U., Giest, S., & Baar, T. (2018). Can Big Data Make a Difference for Urban Management? In T. Elmqvist, X. Bai, N. Frantzeskaki, C. Griffith, D. Maddox, T. McPhearson, et al. (Eds.), Urban Planet: Knowledge towards Sustainable Cities (pp.218-238). Cambridge: Cambridge University Press. doi:10.1017/9781316647554.013
3. ADB (2021). Link: https://events.development.asia/system/files/materials/2021/06/202106-penggunaan-data-spasial-untuk-perencanaan-kota-tangguh-pandemi_0.pdf
4. ISO 19115:2014

Sustainable Infrastructure
ENUP80013
3 Credits

Objectives :

1. Able to span the impact of infrastructure development in the context of sustainability
2. Able to formulate the needs of sustainable infrastructure towards sustainable cities
3. Able to analyse aspects of infrastructure pre-planning related to sustainability aspects (economic, social and

environment).

Syllabus:

An understanding of sustainability aspects in infrastructure planning related to urban development will be able to span the impacts of urban area development. This course analyses the need for sustainable city-based infrastructure development and discusses aspects of pre-planning and impact analysis. This course delivers understanding of sustainable development, definition of sustainable infrastructure, elements of general planning knowledge, aspects of sustainable infrastructure pre-planning, development impacts, need for sustainable urban infrastructure development.

Preconditions: Course Urban Planning Theories and Methods

Textbooks:

1. Graham Hughton, et.al, Sustainable Cities, Cromwell Press, 1995
2. Graham, P. Building Ecology. First Principles for a Sustainable Built Environment, Willey-Blackwell, 2012
3. Stephen Graham & Simon Marvin, Splintering Urbanism: Networked Infrastructures, Technological Mobilities, and the Urban Condition, 2001
4. R. Legates. The City Reader, 2nd Ed. Routledge

Urban Studio 1
ENAR800009
5 Credits

Objectives :

Provides the urban design principle's basics of analysis and skills in stages, starting from arranging elements of urban spatial planning to setting control tools for the use of urban space in a certain extent, with studio objects/cases like strips or mixed-used environments/areas. Students are introduced to the basics of urban design practice using the results of an in-depth and sharp analysis of regional contexts and issues.

Syllabus:

The selected site is a part of road or an area that is complex enough and has a variety of factors and city elements so that it can provide opportunities for students to do "multiple analysis". The students should understand and apply the idea of "place making" both in the private and public space, open spaces, and buildings, to be able to realize individual and community/public needs. Critical examination in a wider scale and context of various types of cities plans and regulations, including master plans, zoning, UDGL, etc., is also included in the course.

Preconditions: -

Textbooks:

1. Carmona, Matthew et.al, Public Spaces Urban Spaces. Oxford: Architectural Press, 2003
2. Gehl, Jan, How to Study Public Life, Copenhagen: Island Press, 2013
3. Hester, Randolph T., Design for Ecological Democracy, Cambridge, MA: The MIT Press, 2010
4. Shane, Graham, Recombinant Urbanism. Great Britain: John Wiley & Sons, 2005
5. Jacobs, Allan B., Looking at Cities. Cambridge, MA: Harvard University Press, 1985
6. Krier, Rob, Urban Space. New York: Rizzoli Int. Publication, 1970
7. Lynch, Kevin, Good City Form. Cambridge, MA: MIT Press., 1984
8. Larice, Michael, Urban Design Reader, London: Routledge, 2012
9. National Association of City Transportation Officials, Urban Street Design Guide, Copenhagen: Island Press, 2013
10. Rossi, Aldo, The Architecture of the City. Cambridge, MA: MIT Press, 1982

Urban Studio 2
ENAR800021
5 Credits

Objectives :

By taking advantage of the UI Depok campus location in a satellite city of Jakarta, the studio's main objective is to broaden students' insight, understanding, knowledge and skills (mastery) on the principles of sustainable urban design, learning from study case in Jakarta and/or Bodetabek areas. Students are encouraged to explore the complexities of urban problems faced by Jakarta as a megacity, including (for example) density, urbanization, flooding, energy, and climate change. It is hoped that these issues will be able to trigger student's creativity to produce innovative and scientifically justified city design, both from social and environmental perspective.

Syllabus:

Advancing from the Urban Design Studio 1, in this studio, students are asked to explore various aspects of urban design connectivity through re-designing mixed use (residential-commercial) project. Students are triggered to redesign an area that is undergoing a transition process because of the radical changes that are happening. The studio was organized with the initial premise that public spaces play an important role in creating a comfortable and lively city, but its design "platform" still needs to rely on user aspirations. This studio's challenge is the position of urban design that must give respect and attention to other aspects behind the architectural form and the physical condition of the city. In addition, in completing urban design projects, students are required to use "local character" as a keyword.

Preconditions: Completed Urban Design Studio 1

Textbooks:

1. Protzen, Jean-Pierre and Harris, David J., Universe of Design: Horst Rittel's Theories of Design and Planning, London and New York: Routledge (2010)
2. Rutz, Werner: Cities and Towns in Indonesia, Stuttgart: Gebruder Borntraeger (1987)
3. Ricky Burdett (Editor), Deyan Sudjic (Editor), 2010, Living in the Endless City: The Urban Age Project by the London School of Economics and Deutsche Bank's, Alfred Herrhausen Society, Phaidon Press
4. Ricky Burdett (Editor), Deyan Sudjic (Editor) 2008. the Endless City, Phaidon Press
5. Mohsen Mostafavi (Author), Gareth Doherty (Author), 2010, Harvard University Graduate, Ecological Urbanism, Lars Muller Publishers
6. Charles Montgomery (2014). Happy City: Transforming Our Lives Through Urban Design, Farrar Straus Giroux

7. Abeyasekere, S. (1987). Jakarta: A History, Oxford: Oxford University Press.
8. Certeau, M.D. (1984). The Practice of Everyday Life. Berkeley: University of California Press.
9. Silver, C. (2011). Planning the Megacity: Jakarta in the Twentieth Century. New York: Routledge
10. Tunas, D. (2008). The Spatial Economy in the Urban Informal Settlement. Netherland: International Forum on Urbanism

Urban Design Theory
ENAR800015
3 Credits

Objectives :

Describing how built-environment planning and design contribute to the establishmen of a good city through analysis of both traditional and contemporary urban design theory, as well as an analysis of how and under what circumstances urban design theory is formulated; Questioning how the idea of urban design may improve the physical character of the built-environment and why it is hoped that it will support improvement of the quality of life in cities and peri-urban areas; Conducting social and spatial analysis of the built environment; analyzing and criticizing the perceptual and performative aspects in urban design.

Syllabus:

Reviewing the understanding of urban design, including historical studies and discourses on what is meant by "good city" through the views of theorists, as follows: cosmological beliefs, formalists, functionalists, picturesque, organics, utopians, livability, and ecological. Questioning the "performance dimension" in urban design theory and understanding the relationship between urban design and perceptual/visual/social dimensions. Once students are introduced to the theoretical view, then they will explore different ways of interpreting and understanding the urban environment. Discussing about how urban environments mean different things to different people, depending on their cultural, economic, racial and gender backgrounds. Brief reviewing the relationship between urban design activities and the political-economic context of the urban development process.

Preconditions: -

Textbooks:

1. R. Legates, The City Reader, 2nd ed, Routledge, 1999
2. Henri Pirenne, The Medieval Cities: Their Origins and the Revival of Trade, Princeton University Press, 1969
3. Aristoteles, The Politics (especially Book III and Book VII), Penguin Classics, revised edition, 1981

Property Workshop 1
ENAR800011
5 Credits

Objectives :

Studying the relationship between architecture and real estate activities in a small-scale project. Related to the space innovation for human activities such as new building types, lifestyles, market segmentation, and others.

Syllabus:

The dream & the product; the products (precedence): residential property, commercial/ retail property, office building/ property for working; money matters/ feasibility study; the products & the users/ lifestyle; management aspects of a property product; The proposed products (future): residential property, commercial/ retail property, office building/ property for working; finance & management.

Preconditions: -

Textbooks:

Property Workshop 2
ENAR800023
5 Credits

Objectives :

Studying the relationship between urban architecture and real estate activities in a large-scale project which is related to urban management, public and private sectors role in urban development, repositioning and revitalizing an area, and others.

Syllabus:

(1) Private sector/commercial development project, about 50 ha area development. Product property (physical rules that apply). Project funding & procurement scheme: e.g. mortgages. Rights and obligations of developers & local governments (developer: on site, off site, pay cash, etc. Local government: tax holidays, incentives, city facilities, etc.). Implementation plan (rights & obligations + development time schedule)

(2) Development of urban facilities related to property development (public-private development): Investigation/ exploration of a public project through recovery opportunities by incorporating property development elements in it such as the development of educational areas /science center, MRT/ busway/tollway associated with property development along its route. Procurement of city facilities and infrastructure.

Preconditions:

Completed Real Estate Workshop 1

Textbooks:

Adjusting to the offered topic.

Housing Policy
ENAR800038
3 Credits

Objectives :

Able to explore policy as a series of concepts that underlie the implementation of the housing sector in the country, including among others: understanding, objectives, characteristics, motives, scope, and implementation. Discusses housing policy and its relation to political, social, economic, cultural, and environmental aspects and practices towards implementation practices, including in the scope of architecture and the city.

Syllabus:

Indonesia as an archipelagic country: developing country, economic disparity and urban formation; Urbanization, migration: Indonesia demographic characteristic; constitution of society; Housing demand & supply (formal & informal sectors); Politics of the state and housing policy: Typology of housing provision in Indonesia (legal aspect; mode of consumption; mode of production); Housing economy and finance; Land policy; Housing technology; Housing policy in Asian countries

Preconditions: -

Textbooks:

1. H Arendt, The Human Condition, The University of Chicago Press, 1958, pp. 7-17
2. M Heidegger tr by Albert Hofstadler, Kerper & Row, Poetry, Language, Thought, Publishing Inc., 1971, pp. 145-161
3. M Foucault, S. During (ed.), 'Space. Power and knowledge', The Cultural Studies Reader Second Edition, Routledge, 1999: 134-41
4. Henri Lefebvre translated by Donald Nicholson-Smith, The Production of Space, Blackwell, 1991, Chapter 1, pp. 26-52
5. P Bourdieu, Outline of A Theory of Practice, Cambridge University Press, 1977, pp. 72-95
6. M De Certeau tr by Steven F. Rendall, The Practice of Everyday Life, University of California Press, 1984, pp. 29-42 and 91-110
7. Kendig HalL, 'Housing Careers, Life Cycle and Residential Mobility : Implications for the Housing Market', Urban Studies, 1984, 21, 271-283
8. Michael Haan & Thomas Perks. 'The Housing Careers of Older Canadians: An Investigation Using Cycle 16 of the General Social Survey'. Canadian Studies in Population Vol. 35.2, 2008, pp. 223–242
9. K. D. Willis, Squatter Settlements, Elsevier Ltd, 2009
10. Brian Sullivan & Ke Chen. 'Design for Tenant Fitout: A Critical Review of Public Housing Flat Design in Hong Kong'. Habitat Intl. Vol 21. No 3, 1997, pp. 291-303
11. Leland Blank and Anthony Tarquin. Engineering Economy: Seventh Edition, McGraw Hills, 2012
12. B Harsman & J Quigley, Housing Markets & Housing Institutions in a Comparative Perspective". Housing Markets & Housing Institutions, Kluwer Academic, 1991, pp.1-29
13. Fashbir N Sidin, Housing Policy Systems in South and East Asia, Palgrave Macmillan, 2002, pp.161-176
14. John F.C Turner and Robert Fichter, Freedom to Build, Collier Mcmillan, 1972
15. John F.C Turner, Housing By People: Towards Autonomy in Building Environments, The Value of Housing, 1976, pp. 53-74.
16. A T Alamsyah, Menata pemukiman Pulau-Laut. Pidato Pengukuhan Guru Besar UI, 2008
17. Mayor Michael R Bloomberg and Amanda M.Burden, Coastal climate resilience, Urban waterfront adaptive strategies, Department of City Planning, 2013
18. A T Alamsyah, Regionalisme dalam Penataan Permukiman di Gugus Pulau Mikro, Disertasi, PSIL UI, 2006
19. Diposaptono, Subandono, Budiman, Hidup Akrab dengan Gempa dan Tsunami, Penerbit Buku Ilmiah Populer, 2008

Urban Housing and Settlement Theory
ENAR800016
3 Credits

Objectives :

Able to analyze the impact of housing development planning in urban areas.

Syllabus:

Housing problems in urban areas, study of typology and housing environment, construction methods and typology, economic studies and housing management, urban housing planning and design studies.

Preconditions: -

Textbooks:

1. Norma L. Newmark & Particia J. Thompson, Self, Space and Shelter: An Introduction to Housing. New York: Harper and Row, Publisher, Inc. 1977
2. John F.C. Turner, Housing by People: Towards Autonomy in Building Environments, Marion Boyars Publishers Ltd, 1976
3. Graham Towers, At Home in The City: An Introduction to Urban Housing Design, 2005
4. Paul Bachin & Maureen Rhoden. Housing: The Essential Foundations, Routledge, New York 2003
5. Abidin Kusno, Politik Ekonomi Perumahan Rakyat dan Utopia Jakarta, 2012

Energy Efficient Building
ENAR800032
3 Credits

Objectives :

Students understand the theoretical principles of energy-efficient building and can apply them to design climate-responsive and energy-efficient buildings.

Syllabus:

Renewable energy, climate and sites, solar geometry, passive cooling, shading, natural & artificial light, and solar panels.

Preconditions: -

Textbooks:

1. Donal Watson, The Energy Design Handbook, The American Institute of Architecture Press, 1993
2. Klaus Daniels, The Technology of Ecological Building, English translation by Elizabeth Schwaiger, Birkhauser Verlag, Berlin 1994
3. Norbert Lechner, Heating Cooling Lighting, 2nd edition, translated, PT Raja Grafindo Persada, 2007

Architecture and Sustainability Workshop 1
ENAR800013
5 Credits

Objectives :

Students can develop and apply building technology theory in a small-scale design research project.

Syllabus:

Preconditions: -

Textbooks:

1. Dominique Gauzin-Muller, Sustainable Architecture and Urbanism, Birkhausser, 2002
2. Earl R. Babbie, The Practice of Social Research, Belmont: Wadsworth Publ. Co.Inc, 1973
3. Giancolli DC. General Physics, Prentice Hall Inc, 1984
4. James Ambrose, Simplified Design for Building Sound Control, John Wiley & Sons, 1995

5. Leslie L Doelle and Lea Prasetio, Akustik Lingkungan, Erlangga, 1993
6. KE Watt, Understanding the Environment, UC Press, 1982
7. SFPE Handbook, Society of Fire Protection Engineering.

<u>Water Resources Management</u>
ENCV800401
3 Credits

Objectives :

Students are able to work independently or work together in teams to carry out assessments (evaluating complex design processes or results) on various aspects of the scope of Water Resources Management in solving water resource problems and be able to present the results of the assessment in the form of systematic documents and able to communicate orally.

Syllabus:

Students are trained with the ability to understand:

1. Aspects of water resources management principles and policies (in Indonesia) and their developments;
2. Aspects and models of Integrated Water Resources Management (IWRM) both on a national and international scale;
3. Aspects of management based on government regulations and policies related to 3 (three) pillars of natural resource management, namely Utilization, Control of Water Damage, Conservation;
4. Supporting aspects of water resources management which include hydro-economy;
5. Natural resource management case (or project), selected in a Water Resources Management Area or river basin

Preconditions: -

Textbooks:

1. Regulation of the Minister of Public Works. Number: 11A/PRT/M/2006 about the Criteria and Determination of River Basin.
2. IWRM Resources. http://www.gwp.org/en/The-Challenge/IWRM-Resources/
3. GWP IWRM ToolBox: Useful Tool for Academia. http://www.gwp.org/gwp-inaction/ news-and-Activities/GWP-IWRM-ToolBox-A-useful-tool-for-academia-/
4. Mays, Larry W., 1996. Water Resources Handbook. McGraw-Hill. TEKNIK SIPIL PROGRAM MAGISTER 149
5. Loucks, Eric D., 1998. Water Resources and the Urban Environment. ASCE.
6. Several national, provincial, and regional regulations and policies related to Water Resources Management.

<u>Watershed (DAS) Health Audit</u>
ENCV803402
3 Credits

Objectives :

1. Able to apply a rapid assessment of the health of a watershed based on the Center for Watershed Protection method,
2. Able to categorize watershed health status based on impermeable land cover, water quality, and diversity of macrozoobenthos, and
3. Able to provide follow-up recommendations for improving watershed health.

Syllabus:

1. Land Use Planning,
2. Land Conservation,
3. Borders of Waters,
4. Ideal Tread Design,
5. Erosion & Sedimentation Control,
6. Rain Management,
7. Liquid Waste Management,
8. Stakeholder Concern.

Preconditions: -

Textbooks:

<u>Environmental Audit</u>
ENCV802105
3 Credits

Objectives :

Able to conduct audits and prepare environmental audit reports

Syllabus:

Definitions, principles, concepts and environmental policies in Environmental Auditing. Legal Basis for Environmental Audit Policies and Regulations. AL Basic Principles (Defining main issues and audit scope). Understanding ISO 1400: Improved Environmental Management and Sustainable Development. Review of the Environmental Management Plan and Environmental Management Plan. Basic Principles of Auditing (Basic principles, procedures, hierarchies and processes in environmental auditing). Types of Audits (Revenue audits, waste audits, process audits). Audit Method (procedure for determination, weight, importance and valuation in environmental audit). Audit Documents. Audit Case Studies (case document studies).

Preconditions: -

Textbooks:

1. “Audit and Reduction Manual for Industrial Emissions and Wastes”; United Nations Environment Programme, Industry and Environment Office, United Nations Industrial Development Organization. ISBN: 92-807-1303-5
2. “Moving Ahead with ISO 14000”, Improving Environmental Management and Advancing Sustainable Development; edited by: Philip A. Marcus & John T. Willig, Wiley Series in Environmental Quality Management John Wily & Sons, Inc, 1997, ISBN 0-471-16877-7.
3. “Panduan Audit Sistem Manajemen Mutu dan/atau Lingkungan”; SNI 19-19011-2005. Badan Standardisasi Nasional

<u>Life Cycle Analysis (LCA)</u>
ENCV802202
3 Credits

Objectives :

Able to use a set of models to conduct an assessment of sustainable solid waste management.

Syllabus:

Overview Integrated Solid Waste Management, concept of sustainable solid waste management, IWMS (case studies and analysis) development, element of IWM, solid waste generation and composition, waste collection, central sorting, biological treatment, thermal treatment, landfilling, material recycling, model: STAN 2, Prognosis, and IWM 2.

Preconditions: -

Textbooks:

1. Integrated Solid Waste Management, Geroge Tchobanoglous, Hilary Theisen, Samuel A. Vigil, McGraw Hill International Edition, 1993.
2. Handbook of Solid Waste Management, George Tchobanoglous, Frank Kreith, McGraw Hill, 2002.
3. Integrated Solid Waste Management: A Life Cycle Inventory, Forbes McDougall, Peter White, Marina Franke, Peter Hindle, Blackwell Science, 2001.

Infrastructure Asset Management
ENCV803602
3 Credits

Objectives :

1. Able to identify and analyze infrastructure asset management processes.
2. Able to explain infrastructure asset management and provide illustrations of asset management implementation on infrastructure to achieve sustainability in the infrastructure sectors.

Syllabus:

Infrastructure asset management, asset evaluation, asset valuation, optimization in asset management, asset allocation, risk management on infrastructure assets.

Preconditions: -

Textbooks:

1. Rice, M. R, DiMeo, R.A., Porter, M.P. (2012) Nonprofit Asset Management. John Wiley & Sons, Inc.
2. Schneeweis, T., Crowder, G. B., Kazemi, H. (2010) The New Science of Asset Allocation. John Wiley & Sons.

Transportation System
ENCV801502
3 Credits

Objectives :

Students can analyze the components of the transportation system from various dimensions, as well as the latest issues related to the Indonesian and global transportation systems; Students can design transportation systems that include operating, demand, and supply systems that meet the needs.

Syllabus:

Overview of the transportation system. Characterization and categorization of transportation systems for single mode and dual mode. Factors (influence) in the transportation system (planning, design, investment, operation, maintenance). Demand system (Sistem Permintaan). Supply System (Sistem Pasokan). Issues of equality, accessibility, environment, economy and disability.

Preconditions: -

Textbooks:

1. Grava, S., 2003. Urban Transportation System, McGraw-Hill.
2. Manheim, M., 1979. Fundamentals of Transportation Systems Analysis. Vol 1: Basic Concept 1st ed., The MIT Press.
3. Blunden, W. and Black, J., 1984. The Land-Use / Transport System 2nd ed., Pergamon-Press

Transportation Planning and Policy
ENCV802502
3 Credits

Objectives :

Able to bring out the uniqueness and originality of the proposal in creating the transportation policy.

Syllabus:

Transportation Policy Formulation; framework for assessing transport policy – land use, accessibility, air pollution, noise, accidents and sustainability. Transport planning and policy and interaction with spatial planning. Institutional arrangements for transportation planning and management. Risk, uncertainty and complexity in determining transportation policy. Transport policies at the local, regional, metropolitan and national levels; logistics transportation policy

Preconditions: -

Textbooks:

1. Schiller, P., Bruunm, E. and Kenworthy, J., 2010. An Introduction to Sustainable Transportation: Policy, Planning 1st ed., Routledge.
2. Morichi, S. and Acharya, S.R., 2013. Transport Development in Asian Megacities: A New Perspective, Springer.
3. Rodrigue, J.-P., Comtois, C. and Slack, B., 2009. The Geography of Transport Systems 3rd ed., Routledge.
4. Stopher, P. and Stanley, J., 2014. Introduction to Transport Policy: A Public Policy View, Edward Elgar Pub.

Logistics Transportation
ENCV803508
3 Credits

Objectives :

Able to bring out the uniqueness and originality of the proposal in creating the transportation policy

Syllabus:

Transportation Policy Formulation; framework for assessing transport policy – land use, accessibility, air pollution, noise, accidents and sustainability. Transport planning and policy and interaction with spatial planning. Institutional arrangements for transportation planning and management. Risk, uncertainty and complexity in determining transportation policy. Transport policies at the local, regional, metropolitan and national levels; logistics transportation policy

Preconditions: -

Textbooks:

1. Schiller, P., Bruunm, E. and Kenworthy, J., 2010. An Introduction to Sustainable Transportation: Policy, Planning 1st ed., Routledge.
2. Morichi, S. and Acharya, S.R., 2013. Transport Development in Asian Megacities: A New Perspective,

Springer.

3. Rodrigue, J.-P., Comtois, C. and Slack, B., 2009. The Geography of Transport Systems 3rd ed., Routledge.
4. Stopher, P. and Stanley, J., 2014. Introduction to Transport Policy: A Public Policy View, Edward Elgar Pub.

Project Investment and Finance
ENCV801601
3 Credits

Objectives :

Able to determine advanced concepts and appropriate principles to provide solutions to complex problems in the field of specialty in accordance with the practice of Civil Engineering (ELO 4 – Technical Specialization)

Syllabus:

Preconditions: -

Textbooks:

1. Leland Blank, Anthony Tarquin. Engineering Economy, 7th edition. McGraw Hill. 2012
2. Finnerty, John D. (2007). Project Financing: Asset-Based Financial Engineering. John Wiley & Sons, Inc., ISBN-13: 978-0-470-08624-7
3. Gatti, Stevano. (2008). Project Finance in Theory and Practice. Elsevier. Academic Press

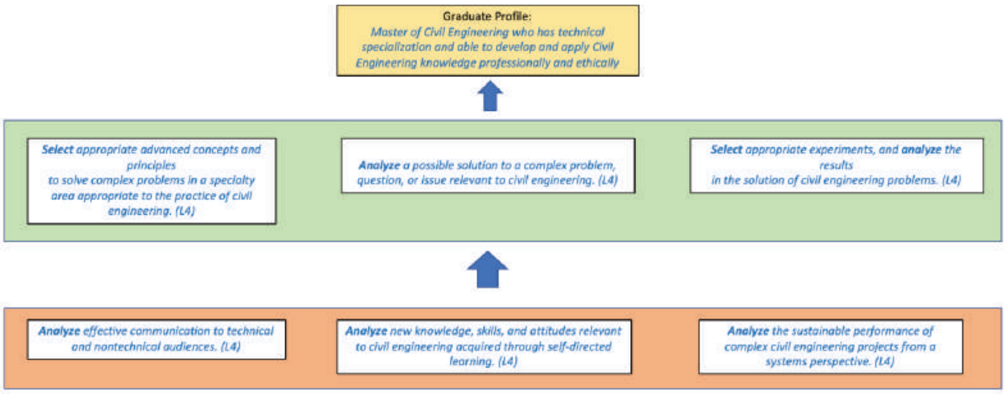
Master in Civil Engineering

Program Specification

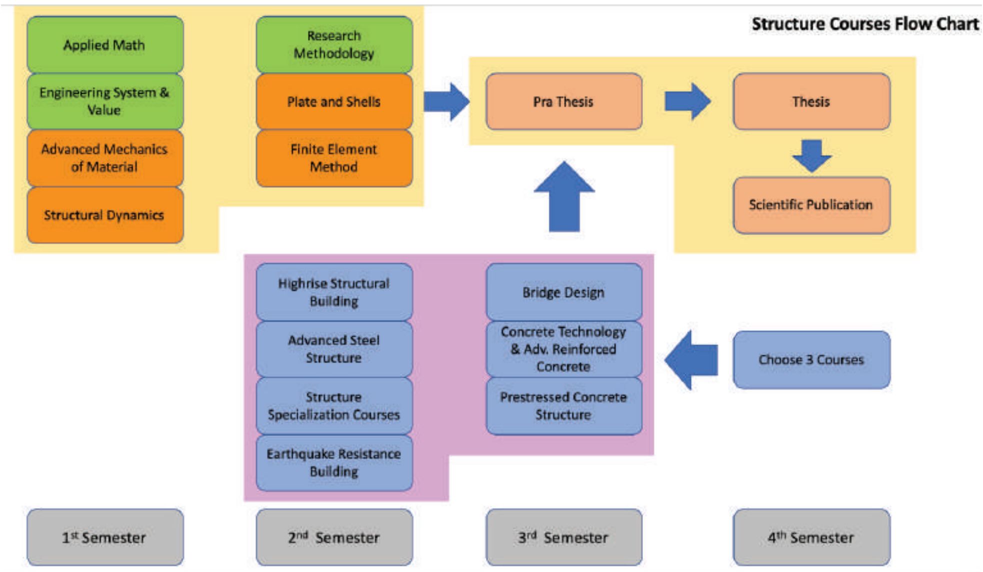
1.	**Awarding Institution**	Universitas Indonesia	
2.	**Teaching Institution**	Faculty of Engineering University Indonesia	
3.	**Programme Tittle**	Graduate Program in Civil Engineering	
4.	**Class**	Regular	
5.	**Final Award**	Magister Teknik (M.T.)	
6 .	**Accreditation / Recognition**	BAN-PT: A – accredited ; Assessed by AUN-QA	
7.	**Language(s) of Instruction**	Bahasa Indonesia and English	
8.	**Study Scheme (Full Time / Part Time)**	Full Time	
9.	**Entry Requirements**	Bachelor Degree (S1) – Engineering, Mathematics and Science; Pass the Master Degree Entrance Exam	
10.	**Study Duration**	Designed for 2 years	
	Type of Semester	Number of Semester	Number of weeks / semester
	Regular	4	16
	Short (optional)	1	8
11.	**Graduate Profiles:** Master of Civil Engineering who has technical specialization and able to develop and apply Civil Engineering knowledge professionally and ethically		
12.	**Expected Learning Outcomes:** 1. Problem Recognition and Solving: Select appropriate advanced concepts and principles to solve complex problems in a specialty area appropriate to the practice of civil engineering. (L4) 2. Experiment: **Select** appropriate experiments, and **analyze** the results in the solution of civil engineering problems. (L4) 3. Technical Specialization: **Select** appropriate advanced concepts and principles to solve complex problems in a specialty area appropriate to the practice of civil engineering. (L4) 4. Sustainability: **Analyze** the sustainable performance of complex civil engineering projects from a systems perspective. (L4) 5. Communication: **Analyze** effective communication to technical and nontechnical audiences. (L4) 6. Lifelong Learning: **Analyze** new knowledge, skills, and attitudes relevant to civil engineering acquired through self-directed learning. (L4)		
13.	**Classification of Subjects**		

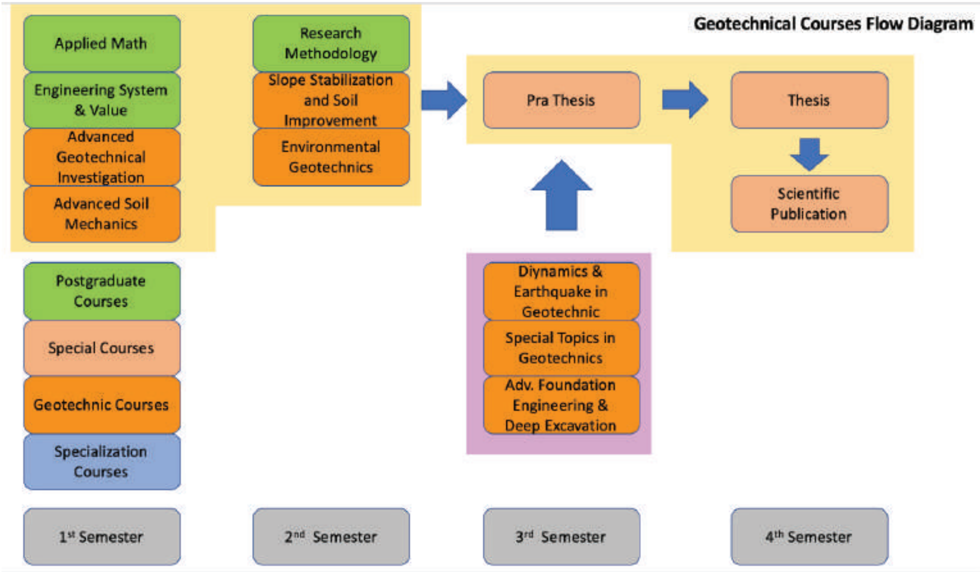
No.	Classification	Credit Hours (SKS)	Percentage
i	**Study Program Subjects**	**9**	**22%**
ii	**Specialization Subjects**	**12-21**	**30-53%**
iii	**Elective Subjects**	**3-9**	**7.5-22.5%**
iv	**Pre-Thesis, Thesis, Scientific Publications**	**10**	**25%**
	Total	**40**	**100 %**
	Total Credit Hours to Graduate		**40 Credits**

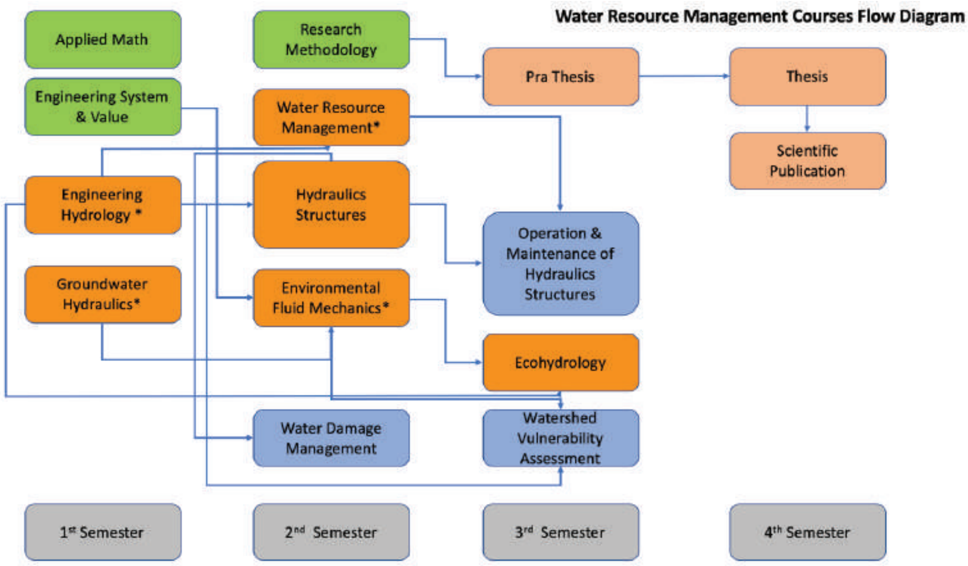
Learning Outcomes

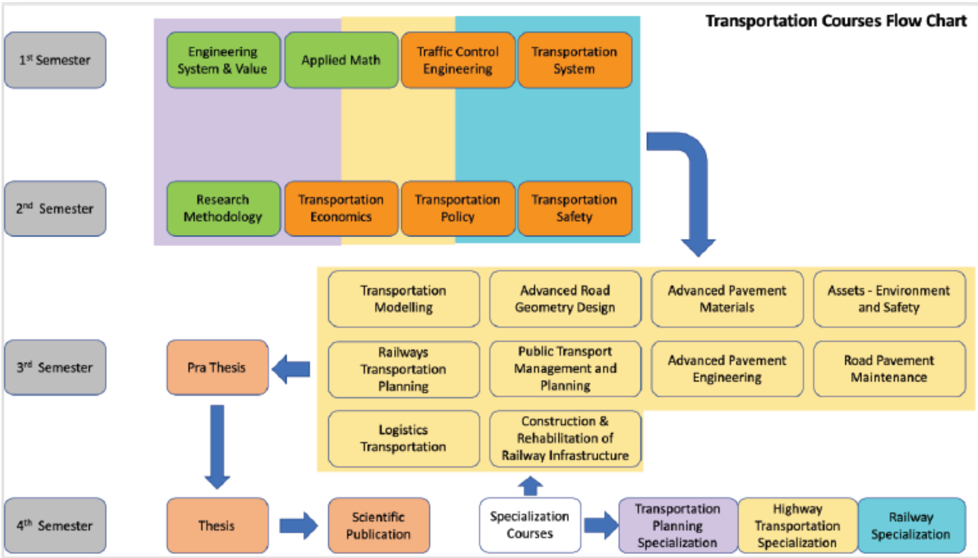


Flow Diagram of Subjects – Graduate Program on Civil Engineering

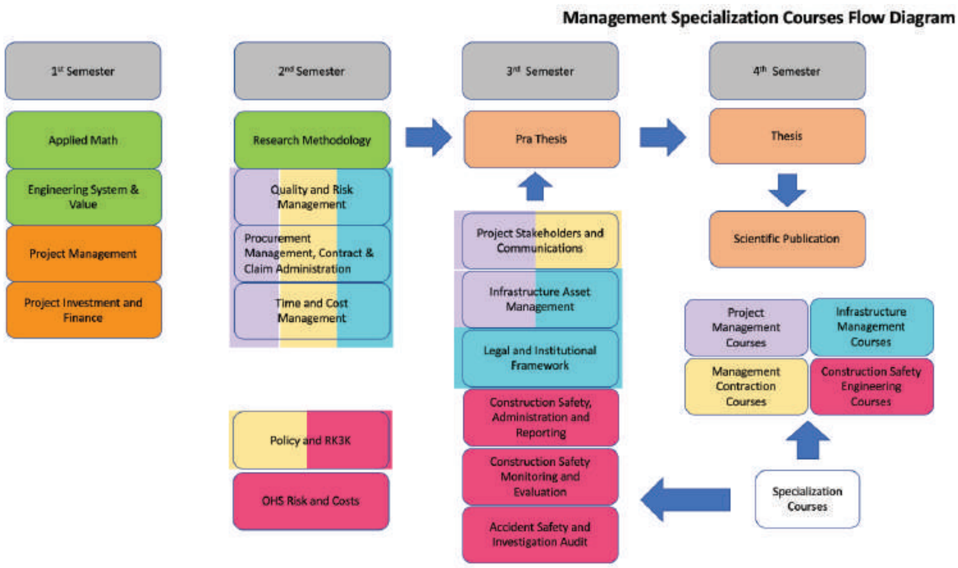



Geotechnical Courses Flow Diagram
Applied Math
Engineering System & Value
Advanced Geotechnical Investigation
Advanced Soil Mechanics
Research Methodology
Slope Stabilization and Soil Improvement
Environmental Geotechnics
Pra Thesis
Thesis
Scientific Publication
Diynamics & Earthquake in Geotechnic
Special Topics in Geotechnics
Adv. Foundation Engineering & Deep Excavation
Postgraduate Courses
Special Courses
Geotechnic Courses
Specialization Courses
1st Semester
2nd Semester
3rd Semester
4th Semester


Water Resource Management Courses Flow Diagram
Applied Math
Engineering System & Value
Engineering Hydrology *
Groundwater Hydraulics*
Research Methodology
Water Resource Management*
Hydraulics Structures
Environmental Fluid Mechanics*
Water Damage Management
Pra Thesis
Operation & Maintenance of Hydraulics Structures
Ecohydrology
Watershed Vulnerability Assessment
Thesis
Scientific Publication
1st Semester
2nd Semester
3rd Semester
4th Semester



Transportation Courses Flow Chart
1st Semester
2nd Semester
3rd Semester
4th Semester
Engineering System & Value
Applied Math
Traffic Control Engineering
Transportation System
Research Methodology
Transportation Economics
Transportation Policy
Transportation Safety
Transportation Modelling
Advanced Road Geometry Design
Advanced Pavement Materials
Assets - Environment and Safety
Pra Thesis
Railways Transportation Planning
Public Transport Management and Planning
Advanced Pavement Engineering
Road Pavement Maintenance
Logistics Transportation
Construction & Rehabilitation of Railway Infrastructure
Thesis
Scientific Publication
Specialization Courses
Transportation Planning Specialization
Highway Transportation Specialization
Railway Specialization



Management Specialization Courses Flow Diagram
1st Semester
2nd Semester
3rd Semester
4th Semester
Applied Math
Engineering System & Value
Project Management
Project Investment and Finance
Research Methodology
Quality and Risk Management
Procurement Management, Contract & Claim Administration
Time and Cost Management
Policy and RK3K
OHS Risk and Costs
Pra Thesis
Project Stakeholders and Communications
Infrastructure Asset Management
Legal and Institutional Framework
Construction Safety, Administration and Reporting
Construction Safety Monitoring and Evaluation
Accident Safety and Investigation Audit
Thesis
Scientific Publication
Project Management Courses
Infrastructure Management Courses
Management Contraction Courses
Construction Safety Engineering Courses
Specialization Courses

Curriculum Structure of Graduate Program on Civil Engineering

Code	Subject	SKS
	1st Semester	
ENCV 801 101	Applied Mathematics	3
ENCV 801 102	Engineering System and Value	3
	Structural Courses	
ENCV 801 201	Advanced Material Mechanics	3
ENCV 801 202	Structural Dynamics	3
	Geotechnical Courses	
ENCV 801 301	Advanced Soil Mechanics	3
ENCV 801 302	Advanced Geotechnic Investigation	3
	Water Resource Management Courses	
ENCV 801 401	Groundwater Hydraulics	3
ENCV 801 402	Engineering Hydrology	3
	Transportation Courses	
ENCV 801 501	Traffic Engineering and Control	3
ENCV 801 502	Transportation Systems	3
	Construction Management Courses	
ENCV 801 601	Project Investment and Finance	3
ENCV 801 602	Project Management	3
	Total credits Semester 1 Major - Structure	12
	Total credits Semester 1 Major - Geotechnic	12
	Total credits Semester 1 Major - Water Resource Management	12
	Total credits Semester 1 Major - Transportation	12
	Total credits Semester 1 Major - PM / CM / IM / CSEM	12
	2nd Semester	
ENCV 802 103	Research Metodology	3
	Structural Courses	
ENCV 802 201	Plate and Shell	3
ENCV 802 202	Finite Element Method	3
ENCV 802 203	High Rise Building Structure	3
ENCV 802 204	Advanced Steel Structure	3
ENCV 802 205	Special Topics on Structural Engineering	3
ENCV 802 206	Earthquake Resistance Building Structure	3
	Geotechnical Courses	
ENCV 802 301	Slope Stabilization and Soil Improvement	3
ENCV 802 302	Environmental Geotechnics	3
ENCV 802 303	Numerical Methods in Geotechnical Engineering	3
	Water Resource Management Courses	
ENCV 802 401	Water Resources Management	3
ENCV 802 402	Water Infrastructure Design	3
ENCV 802 403	Water Infrastructure Observation Maintenance Operational System	3
ENCV 802 404	Environmental Fluid Mechanics	3
	Transportation Courses	
ENCV 802 501	Transportation Economics	3
ENCV 802 502	Transportation Planning and Policy	3
ENCV 802 503	Transportation Safety	3
	Project Management Courses and Infrastructure Management Courses	
ENCV 802 601	Project Time and Cost Management	3
ENCV 802 602	Project Quality and Risk Management	3
ENCV 802 603	Procurement, Contract Administration and Claim	3
	Construction Management Courses	
ENCV 802 601	Project Time and Cost Management	3
ENCV 802 602	Project Quality and Risk Management	3
ENCV 8026 03	Procurement, Contract Administration and Claim	3
ENCV 802 604	Policy and Safety plan in Construction	3
	Construction Safety Engineering Management Courses	
ENCV 802 605	Risk and Cost of Safety	3
ENCV 802 604	Policy and Safety plan in Construction	3
	Total credits Semester 1 Major - Structure	12
	Total credits Semester 1 Major - Geotechnic	12
	Total credits Semester 1 Major - Water Resource Management	15
	Total credits Semester 1 Major - Transportation	12
	Total credits Semester 2 Major - Project Management	12
	Total credits Semester 2 Major - Construction Management	15
	Total credits Semester 2 Major - Infrastructure Management	12
	Total credits Semester 2 Major - Construction Safety Engineering Management	9
	Total credits Semester 2 Major - Environmental Engineering	12
	3rd Semester	
ENCV 800 104	Pre - Thesis	2
	Structural Courses	
ENCV 803 201	Bridge Structure	3
ENCV 803 202	Advance Reinforce Concrete Technology	3
ENCV 803 203	Prestressed Concrete Structure	3

ENCV 803 204	Offshore Structure	3
	Geotechnical Courses	
ENCV 803 301	Adv. Foundation Engineering & Deep Excavation	3
ENCV 803 302	Dynamics & Earthquake in Geotechnics	3
ENCV 803 303	Special Topics in Geotechnics	3
	Water Resource Management Courses	
ENCV 803 401	Ecohydrology	3
ENCV 803 402	Watershed Vulnerability Assessment	3
ENCV 803 403	Water Damage Management	3
	Transportation Courses	
ENCV 803 501	Transportation Model	3
ENCV 803 502	Public Transportation Planning and Control	3
ENCV 803 503	Advanced Road Geometric Design	3
ENCV 803 504	Advanced Road Pavement Engineering	3
ENCV 803 505	Advanced Road Pavement Materials	3
ENCV 803 506	Road Preservation Strategy	3
ENCV 803507	Railway Transportation Planning	3
ENCV 803 508	Logistic Transportation	3
ENCV 803 509	Environmental-Asset and Safety	3
ENCV 803 510	Railway Infrastructure Construction and Rehabilitation	3
	Infrastructure Management Courses	
ENCV 803 601	Legal and Institutional Framework	3
ENCV 803 602	Infrastructure Asset Management	3
	Construction Management Courses	
ENCV 803 603	Project Stakeholder and Communication	3
	Construction Safety Engineering Management Courses	
ENCV 803 604	Construction Safety Plan, Administration and Report	3
ENCV 803 605	Construction Safety Monitoring and Control	3
ENCV 803 606	Safety Audit and Accident Investigation	3
	Total credits Semester 1 Major - Structure	10
	Total credits Semester 1 Major - Geotechnic	10
	Total credits Semester 1 Major - Water Resource Management	10
	Total credits Semester 1 Major - Transportation	10
	Total credits Semester 2 Major - Project Management	10
	Total credits Semester 2 Major - Construction Management	7
	Total credits Semester 2 Major - Infrastructure Management	10
	Total credits Semester 2 Major - Construction Safety Engineering Management	13
	Total credits Semester 2 Major - Environmental Engineering	7
	4th Semester	
ENCV 800 105	Thesis	6
ENCV 800 106	Scientific Publications	2
	Total credits Semester 1 Major - Structure	6
	Total credits Semester 1 Major - Geotechnic	6
	Total credits Semester 1 Major - Water Resource Management	6
	Total credits Semester 1 Major - Transportation	6
	Total credits Semester 1 Major - PM / CM / IM / CSEM	6
	Total	**40**

Course Syllabus of Graduate Program on Civil Engineering

Applied Math
ENCV 801 101
3 Credits

Competence in Curriculum: Prior knowledge for problem recognation & solving

Learning Objectives :

1. Students should be able to implement procedures to find solutions of differential equations, equations which are common in civil science discipline, both analytically and numerically

Syllabus: Introduction: Role of mathematics in the civil engineering disciplines, review procedures to solve systems of equations and numerical procedure for calculating differential and integral; Differential equations classification; Analytical solutions of linear differential equations; Ordinary differential equation numerical solution: Predictor-corrector method, Runge-Kutta Method; Partial differential equation numerical solution: finite difference method, finite element method.

Prerequisites:

Text Books:
1. Erwin Kreyszig (2011) Advanced Engineering Mathematics Tenth Edition, John Wiley & Sons, Inc.
2. Chapra, Steven C.; Canale, Raymond P. (2015) Numerical Methods for Engineers, Seventh Edition, McGraw-Hill
3. Michael D. Greenberg (1998) Advanced Engineering Mathematics Second Edition, Prentice Hall

Engineering System & Value
ENCV 801 102
3 Credits
Competence in Curriculum: Prior knowledge for problem recognation & solving

Learning Objectives : Able to evaluate system engineering including analysing, simulating and optimizing to produce a better designed and more valuable system engineering.

Syllabus: Course Overview; Introduction to Systems Definitions & Concepts; Introduction to Sustainability Development; Optimization and Reliability, Design & Operation, Decision Making; Issues on Human, Organizational and Technology; Value Engineering and Innovation; New Product Development; System Dynamic and Simulation (MCS)

Prerequisites:

Text Books:
1. M.A. Berawi, (2014), Aplikasi Value Engineering pada industri konstruksi, UI Press, Jakarta.
2. M.A. Berawi (2015), Rekayasa Inovasi Mega Proyek Infrastruktur, UI Press Jakarta.
3. Value World, Journal of Society of American Value Engineers (SAVE International), USA.
4. Kaufman, JJ & Woodhead, RM (2006), Stimulating Innovation in products and Services, John & Willey Interscience.
5. Blanchard, B S (1997*). System Engineering Management*, Wiley-Interscience
6. Buede, DM (2009), The Engineering Design of Systems: Models and Methods, Wiley-Interscience
7. Ulrich, Karl T. and Eppinger, Steven D (2004) *Product Design and Development*, 3rd Edition, McGraw-Hill, New York

Research Methodology
ENCV 802 103
3 Credits

Competence in Curriculum: Prior knowledge for research/experiment dan WA10 (communication)

Learning Objectives :
1. Able to explain the thinking concept of research method and apply them in selecting the appropriate research methodology and in preparing the research proposal
2. Able to explore the uniqueness and originality of the proposed research (uniqueness of civil engineering problems)

Syllabus: Methodological principles, research characteristic and process, quantitative and qualitative research paradigm, scientific method, problem statement, construct hypotheses, critical and logic thinking, research strategy, data collection techniques and analysis techniques, scientific paper, seminar drafting guidance with potential mentors

Prerequisites:

Text Books:
1. Nazir, Moh, Metode Penelitian, Ghalia Indonesia,2003
2. Keputusan Rektor UI No 628, Pedoman Teknis Penulisan Tugas Akhir Mahasiswa Universitas Indonesia, 2008
3. FTUI, Pedoman Penulisan Thesis, 2006
4. Yin.Robert k, Studi Kasus Desain dan Metode, Rajagrafindo Persada, 2008
5. Riduwan, Skala pengukuran variable-variabel penelitian, Alfabeta, 2002
6. Tan, W. (2008). *Practical Research Methods* (Third Edition ed.). Singapore: Prentice Hall

Pre-Thesis
ENCV 800 104
4 Credits

Competence in Curriculum: Prior knowledge for Research/Experiment, WA10 (communication) and WA12 (lifelong learning)

Learning Objectives: Students should be able to apply the knowledge from the specificity / specialization that has been gained in through developing the research proposal and preliminary studies, analyze the results and describe it orally (presentation) and written (pre-thesis book)

Syllabus: -

Prerequisites: Research Methodology

Text Books : -

Thesis
ENCV 800 105
6 Credits

Competence in Curriculum: Prior knowledge for WA2 (problem analysis), WA3 (design/development of solutions) , WA5 (modern tool usage), WA6 (the engineer and society), WA7 (environment and sustainability), WA9 (individual and team work) dan WA10 (communication) and WA12 (lifelong learning)

Learning Objectives :
1. Able to integrate the knowledge specificity of Civil Engineering in the design and implementation stage of the research to solve a problem, able to analyze and interpret research data to obtain valid conclusions
2. Able to explain the results of the research in the form of a scientific paper (thesis) and presentation

Syllabus: -

Prerequisites: Research Methodology and Pre-Thesis

Text Books:

Scientific Publication
ENCV 800 106
2 Credits

Competence in Curriculum: Prior knowledge for WA10 (communication)

Learning Objectives:
1. Students should be able to explain the results of his/her research in the scientific literature using a proper Indonesian / English language according to the intended standard of writing journals / proceedings.

Syllabus: -

Prerequisites: Thesis

Text Books:

Course Syllabus of Structure Specialization

Prestressed Concrete Structure
ENCV 803 203
3 Credits

Competence in Curriculum: Technical Specialization, Communication

Learning Objectives:

1. Students should be able to design pre-stressed concrete according to the standard regulations, in buildings and long span bridges using factored Strength (Load and Resistance Factored Design, LRFD), serviceability

Syllabus:

Prestressed material review and how to design for bending based on Serviceability Limit State Design (SLSD) method. Load and factored strength design in the aspect of bending, shear and torsion. Serviceability limit on the aspect of deflection. Statically indeterminate structure. Loss of prestressing force due to friction and wobbling, Elastic shortening of concrete, anchor slip, creep and shrinkage of concrete, along with the relaxation of prestressing steel. Analysis of the columns and beams prestressed meeting point; analysis of prestressed anchor zone. Application in buildings and long span bridges. external prestressing, and special applications in cable stayed bridge.

Prerequisites: -

Text Books:

1. SNI 03-2874-2002: "Tata cara perencanaan struktur beton untuk bangunan gedung", Badan Standardisasi Nasional, 2002.
2. SNI T-14-2004: "Perencanaan struktur beton untuk jembatan", Badan Standardisasi Nasional, 2004.
3. ACI 318-02 & ACI 318R-02: "Building code requirements for structural concrete and commentary", American Concrete Institute, 2002.
4. AASHTO: "Standard specifications for highway bridges", American Association of State Highway and Transportation Officials, 17th Edition, 2002.
5. Y. Guyon: "Limit state design of prestressed concrete", Applied Science Publishers, Essex, 1974.
6. A.S.G. Bruggeling: "Structural concrete; Theory and its application", A.A. Balkema, Rotterdam, 1991.
7. R. Chaussin, A. Fuentes, R. Lacroix, J. Perchat: "Prestressed concrete", Presses de l'Ecole National des Ponts et Chaussees, Paris, 1992.
8. T.Y. Lin, N.H. Burns: "Design of prestressed concrete structures", John Wiley & Sons, New York, 1992.
9. R. Walther, B. Houriet, W. Isler, P. Moia: "Cable stayed bridges", Thomas Telford, London, 1988.
10. ACI Committee 209, "Prediction of creep, shrinkage, and temperature effects in concrete structures", ACI-209R-92, ACI Manual of Concrete Practice.
11. F.X. Supartono: "Beton Pratekan", Seminar HAKI untuk Konstruksi Beton dan Baja berdasarkan SNI-2002, Pekanbaru, 5 Oktober 2004.
12. F.X. Supartono: "External prestressing for building structural repair", FIP International Symposium, Johannesburg, South Africa, 9 – 12 March 1997.
13. F.X. Supartono: "Jembatan cable stayed", Seminar jembatan cable stayed, Direktorat Jendral Binamarga, Jakarta, Maret 1996.
14. F.X. Supartono: "Jembatan segmental beton pratekan dengan cara kantilever", Short course "Perencanaan dan teknologi konstruksi jembatan", Semarang, 11 Maret 1996.

Structural Dynamics

ENCV 801 202
3 Credits

Competence in Curriculum: Technical Specialization

Learning Objectives: Students should be able to analyze civil engineering buildings subjected to dynamic forces.

Syllabus: Dynamic load types, structures and responses; structural modeling as a single-degree-of-freedom (SDOF) system; SDOF free vibration; SDOF Forced vibration: harmonic dynamic loads, periodic and erratic loads; Response analysis to SDOF using numerical integration method; generalization of SDOF; modelling of Multi-Degrees-of-Freedom (MDOF), static condensation applications; eigen problem; forced vibration on harmonic loading, spectra responses.

Prerequisites:

Text Books:

1. Chopra A.K., Dynamics of Structures, Prentice Hall, 1995
2. Clough R.W. Penzien J., Dynamic of Structures, McGraw-Hill, 1993

Earthquake Resistance Building

ENCV 802 206
3 Credits

Competence in Curriculum: Technical Specialization

Learning Objectives: Students should be able to analyze the effect of earthquakes on civil engineering buildings and able to design earthquake proof buildings

Syllabus: Introduction : aspects of earthquake, causes, fault, wave, damage mechanism, size of the earthquake; Characteristics of ground motion and response spectrum; Architectural Considerations on the earthquake resistant structural system; Building dynamic response; Equivalent Static Analysis: The principle of equivalent static seismic forces, Equivalent static procedure according to SNI standard; Advanced Equivalent Static Analysis: The principle of equivalent static seismic forces; Equivalent static procedure according to SNI standard; Lateral stability and drift design; Seismic design of floor diaphragms; The design concept of capacity and ductility in earthquake planning; Portal structural seismic design and detailing: beams, columns, beam-column joint; Advanced seismic Structure Design & detailing portal: beams, columns, beam-column joint; Advanced seismic Structure Design & detailing portal : beams, columns, beam-column joint; Shear wall structure seismic design and detailing; Advanced shear wall structure seismic design and detailing; Double structural seismic design and detailing: portal and sliding walls

Prerequisites:

Text Books:

1. Farzad Naeim, the Seismic Design Handbook, 1989
2. Paulay and Priestly, Seismic Design of Reinforced Concrete and Masonry Buildings, 1992.
3. Chopra, Dynamic of Structures, 1995.
4. BSN, Tata Cara Perencanaan Ketahanan Gempa untuk Bangunan Gedung, SNI 03-1726-2002
5. BSN, Tata Cara Perencanaan Struktur Beton untuk Bangunan Gedung, SNI 03-2843-2002
6. BSN, Tata Cara Perencanaan Struktur Baja untuk Bangunan Gedung, SNI 03-1729-2002

Finite Element Method

ENCV 802 202
3 Credits

Competence in Curriculum: Technical Specialization

Learning Objectives:

1. Able to apply finite element method (FEM) for 3-dimension elastic problem and 2-dimension solid elastic (plane stress and strain)
2. Able to use finite element method package, and create sub routine matrix of element strength.

Syllabus:

Introduction, FEM definition and concept, variation methods, Galerkin and Ritz solution, shape function, model displacement and mixed, one-dimensional element (lD) bars and beam of Euler Bernoulli, 2D isoperimetric element (plane stress, plain strain), 3D isoperimetric element, stiffness and time matrix, Gauss and Hammer numeric integration, application programming packages in 2D and 3D elastic problem, task of making subroutine elements (2D and 3D) and their incorporation in a PCFEAP (Personal Computer Finite element Analysis program) main program.

Prerequisite: Applied Mathematics

Reference Book:
1. Zienkiewicz, O.C., & R.L. Taylor, *The Finite Element Method*, voLl, 5th eds, McGraw Hill,2006
2. R.D. Cook, Malkus, M.E. P1esha, Concepts and Application of Finite Element Analysis, John Wiley and Sons, Inc., 4th eds, 2006
3. KATILI, Irwan, Metode Elemen Hingga untuk Pelat Lentur, UI Press-2003.
4. KATILI, Irwan, Metode Elemen Hingga untuk Analisis Tegangan, UI Press-2008

Advanced Mechanics of Material

ENCV 801 201
3 Credits

Competence in Curriculum: Technical Specialization

Learning Objectives:

Able to deeply analyze the structure response due to static load or temperature with considering material and structure properties in elastic and inelastic condition.

Syllabus: Mechanical properties of materials; Stress-strain theory; Temperature- stress strain relationship; Inelastic material properties; Application methods of energy; Torque; Asymmetric moment on straight beam; Central shear on beam with a cross section of thin walls; Curved beams; Beam over elastic foundation.

Prerequisite:

Reference Book:
1. Boresi A.P. et all, Advance 1. Mechanics of Material, John Wiley & Sons, Inc, 1993
2. R.C. Hibbeler, Mechanics of Materials, Prentice Hall, 2002

Advanced Steel Structure

ENCV 802 204
3 Credits

Competence in Curriculum: Technical Specialization

Learning Objectives:

Able to design steel structure component that includes connection design, girder plate, portal and composite structure on simple high-rise building using elastic and plastic method.

Syllabus: The calculation of continuous means with plastic method. Beam-Columns. Theory and Analysis of girders plate on building. Advance connection techniques. Portal and gable frame design. Steel composite structure and steel-concrete composite structures in simple high-rise buildings. Pre-stressed steel-concrete composite structures and application of Preflex system in building. Cold form section / Light Gage Member.

Prerequisite:

Reference Book:
1. Salmon C.G. and Johnson J.E., Steel Structures: Design and Behavior, Fourth Edition, Harper Collins Publishers, 1996
2. Bresler B. Lin T.Y., Scalzi J.B., Design of Steel Structures, John Wiley & Sons- Toppan Co., 1968
3. Segui William T., LRFD Steel Design, ITP-PWS Publishing Co., Boston, 1994
4. SNI-03-1729-2021, Badan Standarisasi Indonesia, Tata Cara Perencanan Struktur Baja untuk Bangunan Gedung, Standar, 2002

Concrete Technology & Adv. Reinforced Concrete

ENCV 803 202
3 Credits

Competence in Curriculum: Problem Recognition and Solving, Technical Specialization

Learning Objectives:
1. Able to identify modern and future concrete technology, especially high-performance and/or high-grade concrete,
2. Able to design high quality concrete mix to achieve specific performance according to applicable legislation, to be applied in high-rise buildings and long span bridges.
3. Able to design reinforced concrete structural components include shear walls, beams coupling, boundary elements, beam-column panel connection.

Syllabus:
- Modern and future concrete, technology, engineering and behavior according to SNI (DOE) and ACI; Abrams-FXS formulation; Feret and Bolomey formulations. Concrete rheology; FXS model for concrete rheology; Visco elastic behavior of concrete rheology and its application in creep and shrinkage of concrete; FXS models of non-Newtonian.
- Reinforced concrete design for bending, axial, shear and torsion and confined concrete structure.
- Various research and developments; comparison of conditions based on SNI, ACI and NZS
- Design: Ductile structure wall, beam coupling, boundary elements, connection panel of portal beams and columns; shear strength, adhesion and stiffness of connection panel; Mechanisms and behavior of elastic and inelastic. Diagonal press field theory; Modified compression field theory.
- Models strut and tie; and applications in the design of concrete structures.

Prerequisite:

Reference Book:
1. ACI: "ACI Manual of Concrete Practice", American Concrete Institute, 2015.
2. ACI Committee Report 363 R-92: "State of the Art Report on High Strength Concrete", 1992.
3. Ken W. Day: "Concrete Mix Design, Quality Control and Specification", E & FN Spon, 1995.
4. Krishna Raju: "Design of Concrete Mixes", CBS Publishers, 1985.
5. A.M. Paillere: "Application of Admixtures in Concrete", E & FN Spon, 1995.
6. T. Paulay and M.J.N. Priestley: "Seismic Design of Reinforced Concrete and Masonry Buildings", A Wiley-Interscience Publication, John Wiley & Sons, New York, 1992.
7. J.B. Mander: "Seismic Design of Bridge Piers", A Thesis submitted in partial fulfillment of the requirements for the Degree of Doctor of Philosophy in Civil Engineering at the University of Canterbury, University of Canterbury, Christchurch, New Zealand, 1983.
8. ACI Committee 318: "Building Code Requirements for Structural Concrete, ACI 318-14", American Concrete Institute, Detroit, 2014.
9. "International Building Code", International Code Council, 2015
10. Persyaratan beton structural untuk bangunan gedung, SNI 2847 : 2013
11. Beban minimum untuk perancangan bangunan gedung dan struktur lain, SNI 1727 : 2013
12. P.C. Cheung, T. Paulay and R Park: "Interior and Exterior Reinforced Concrete Beam-Column Joint of a Prototype Two-Way Frame with Floor Slab Design for Earthquake Resistance", Research Report 89-2, Department of Civil Engineering, University of Canterbury, Christchurch,

New Zealand, 1989.
13. M.P. Collins and D. Mitchell: "Prestressed Concrete Structures" Prentice Hall, Englewood Cliffs, New Jersey, 1991.
14. Mac Gregor, J.G., Reinforced Concrete: Mechanics and Design, 6th. Edition, Pearson, 2012

Offshore Structure

ENCV 803 204
3 Credits

Competence in Curriculum: Technical Specialization

Learning Objectives:

Able to design offshore buildings structures.

Syllabus: Types of offshore buildings; Construction and Structures of offshore building; Fixed and floating design, Strength and force calculations of offshore building; Safety requirements; Semi-submersible construction; Single Buoy Mooring; FPSO; Maintenance and Repair of offshore building.

Prerequisite: -

Reference Book:
1. Subrata Chakrabarti, Handbook of Offshore Engineering, Elsevier Science, 2005
2. Yong Bai, Marine Structural Design, Elsevier Science, 2003
3. Cliff Gerwick, Construction of Marine and Off-shore Structures, CRC Press 1999

Bridge Design

ENCV 803 201
3 Credits

Competence in Curriculum: Technical Specialization

Learning Objectives:
1. Able to analyze the development of bridge structure that includes determining the location and layout, know the structural system and types of steel and concrete bridge.
2. Able to design upper and lower bridge structure and plan the bridge construction method.

Syllabus: The development and history of bridge; Bridge location and layout; Load regulation on highways and railways; Bridge structural system: top and bottom structure and foundation and support, bridge type geometry; wooden bridge; steel bridge: rolled and plate girders, composite, orthotropic deck, bridge frame, arch, suspension, cable stay; concrete bridges: bridge plate, deck girder, box girder, pre-stressed segmental bridges, reinforced concrete frame, frame, arch, cable stay and pre-stressed bridge; substructures, pier and abutment; analysis and design of bridges: bridge load, load distribution on stringers, longitudinal beams and floor beams, pre-stressing effects, structural analysis and design; load on the substructure, soil pressure, seismic design; Design placement.

Prerequisite:

Reference Book:
1. MS Troisky, Planning and Design of Bridges, John Wiley & Sons, Inc, New York, 1994
2. SNI No. 1725-1989-F, Departemen Pekerjaan Umum, Pedoman Perencanaan Pembebanan Jembatan Jalan Raya
3. Departemen Pekerjaan Umum, Peraturan Perencanaan Teknik Jembatan – Bridge Management Systems, 1992,
4. RM Barker, JA Puckett, Design of Highway Bridges, based on AASHTO LRFD Bridge Design Specifications, John Wiley & Sons, New York, 1997
5. PP Xanthakos, Theory and Design of Bridges, John Wiley & Sons, New York, 1994
6. N Taly, Design of Modern Highway Bridges, The McGraw-Hill Company, Inc., New York, 1998
7. Mathivat, J., The Cantilever Construction of Prestressed Concrete Bridges, John Wiley & Sons, 1983
8. Prichard, B., Bridge Design for Economy and Durability, Concept for New, Strengthened and Replacement Bridges, Thomas Telford, London, 1992

Highrise Structural Building

ENCV 802 203
3 Credits

Competence in Curriculum: Technical Specialization

Learning Objectives:
1. Able to apply the procedures for design and technology of pre-stressed concrete according to the standard regulations that apply to buildings and long span bridge.
2. Able to apply procedures for the design-based methods of Load Design and PBKT factored strength, Load and Resistance Factored Design (LRFD), as well as the limits of serviceability on various aspects of strength, stability and deflections, as well as pre-stressed anchor zones.

Syllabus:

Definition, history, and basic concept of pre-stressed concrete; Typical use of pre-and posttensioning technology; Material properties of concrete and soft reinforcing steel and pre-stress. Pre-stresses losses; Analysis of bending due to the workload (section are not linear elastic fractured); Ultimate strength of pre-stressed concrete cross section; Design of pre-stressed concrete cross section; Design of flexible cross section; Camber and deflection; Pre-stressed continuous beam analysis; Shear strength in pre-stressed beams; Bond and anchorage of pre-stressing steel; Applications for pre-stressed concrete slab. Application of pre-stressed concrete on bridge. Criteria for design of high-rise buildings; Load: gravity, wind and earthquakes; System Structure: Retention of gravity and lateral bracing; Modeling and Analysis. Frame planning (concrete and steel) and sliding walls and double system.

Prerequisite:

Reference Book:
1. SNI 03-2874-2002:"*Tatacara Perencanaan Struktur Beton untuk Bangunan Gedung*", Badan Standarisasi Nasional, 2002
2. *Building Code Requirements for Structural Concrete (ACI 318-05)*, Reported by ACI Committee 318
3. Lin, T.Y. & Burn, *Design of Prestressed Concrete Structures*, Third Edition, John Wiley & Sons, 1982
4. Nilson, A., *Design of Prestressed Concrete*, 2nd Edition, John Wiley & Sons, 1987
5. Edward G. Nawy, *Prestressed Concrete, A Fundamental Approach*, 2nd edition, Prentice Hall, 1996
6. Podolny, W. and Muller, JM., *Construction and Design of Prestressed Concrete Segmental Bridges*, John Wiley & Sons, 1982
7. *Tata Cara Perencanaan Struktur Baja untuk Bangunan Gedung*, SNI 03-1729-2002, BSN, 2002
8. *Specification for Structural Steel Buildings*, ANSI/AISC 360-05
9. *Seismic Provision for Structural Steel Buildings*, ANSI/AISC 341- 05
10. Prequalified Connections for Special and Intermediate Steel Moment Frames for Seismic Applications, ANSI/AISC 385-05

Plate and Shells

ENCV 802 201
3 Credits

Competence in Curriculum: Technical Specialization

Learning Objectives:
1. Able to apply finite element method to analyze and designing of plate and shells structure.

Syllabus: Plates: Plates formulation; Plate element with shear deformation; Kirchoff element; Test validation and performance of plate element; Shell: geometric description, the principle of virtual work and forms variation, isoperimetric elements, facet-plan element type; Design and analysis of shell structure; concept of plate and shell structures, type and shape of the structure shells, Some aspects of FEA for shell structure, Design and analysis: roof structure; cylindrical shell, gable HP, Folded Plate, Dome; Structure of tank with circular pre-stressing; silos and bunkers**.**

Prerequisite: -

Reference Book:
1. I. Katili, Metode Elemen Hingga untuk Pelat Lentur, Penerbit Universitas; 2003
2. David P. Billington, Thin Shell Concrete Structures, Second Edition, McGraw Hill Book Company, New York, 1982

Special Topics in Structural Engineering
ENCV 802 205
3 Credits

Competence in Curriculum: Technical Specialization

Learning Objectives:
1. Knowing the latest technology or topics on structure specificity as well as the development of structural knowledge in the future.

Syllabus: Selected topics in structure specificity.

Prerequisite:

Reference Book: Selected Journal/Book

Course Syllabus of Geotechnics Specialization

Advanced Soil Mechanics
ENCV 801 301
3 Credits

Competence in Curriculum: Problem Recognition and Solving

Learning Objectives: Able to formulate the behavior of kinds of soil and soil condition.

Syllabus:

Critical state of soil mechanics; Effects of testing on soil shear strength; Effective stress and total stress approach; Loading and unloading; Short-term and long-term behavior; Further consolidation; The use of horizontal drainage. Unsaturated soil mechanics; Differences in behavior of saturated and unsaturated soil; Soil constitutive model.

Prerequisite:

Reference Book:
1. Soil Mechanics, 7th Ed., R.F. Craig, 2004.
2. Muni Budhu. Soil Mechanics 3rd Edition. 2011
3. Braja M. Das. Principal of Geotechnical Engineering 6th Edition. 2010
4. Potts & Zdravkovic, Finite Element in Geotechnical Engineering. 1999.

Advanced Geotechnical Investigation
ENCV 801 302
3 Credits

Competence in Curriculum: Problem Recognition and Solving, Experiment/Research

Learning Objectives:
1. Able to formulate complex geotechnical investigation program

Syllabus:

General introduction of Advanced Experimental Laboratory that associated with Geotechnics; introduction, understanding and usage of test results using a Dilatometer, Pressuremeter, Plat Bearing, Swelling, Geotechnical instrumentation, Centrifuge, Triaxial UU/CU/CD, Long-Term Consolidation, Triaxial Cyclic. Further introduction and testing in the laboratory by means of triaxial CU and swelling; as well as field tests with Pressuremeter.

Prerequisite:

Reference Book:
1. Geotechnical Engineering Portable Handbook; Robert W. Day, McGraw-Hill, 2000.
2. Geotechnical Engineering, S Joseph Spigolon, Phd, PE, McGraw-Hill, 2001.
3. American Society of Testing and Material Annual Book of ASTM standards, ASTM, 1989.
4. Soil Mechanics, 7th Ed., R.F. Craig, 2004.

Slope Stabilization and Soil Improvement
ENCV 802 301
3 Credits

Competence in Curriculum: Problem Recognition & Solving; Experiments/Research, Technical Specialization, Sustainability.

Learning Objectives:
1. Able to create synthesis of complex slope stabilization solution and the necessary strengthening.

Syllabus: Slope stability analysis of finite and infinite with method of fellinius, bishops, and other methods; Analysis of avalanches by using software; Avalanche hazard analysis and slope improvement / strengthening: soil nailing; strengthening retaining wall structure; Soil improvement: stabilization by mechanical means (dynamic compaction, vibro flotation / compaction) vertical drainage with sand post (sand pile and sand drained), stabilization with chemicals, injection method.

Prerequisite: Soil Mechanics

Reference Book:
1. Bowles, J.E., Foundation Analysis and Design, McGraw-Hill Book Co., Singapore.
2. Ingels, O.G. and Metcalf, J.B., Soil Stabilization, Butterworths, Australia.
3. Muni Budhu, Soil Mechanics & Foundations, 3rd Ed., John Wiley & Sons. Inc, 2011.
4. Soil Mechanics, 7th Ed., R.F. Craig, 2004.
5. Duncan & Wright, Soil Strength and Slope Stability. John Wiley and Sons. 2005.
6. Abramson, et al., Slope Stability and Stabilization Methods, 2nd Ed. John Wiley and Sons. 2002.

Environmental Geotechnics
ENCV 802 302
3 Credits

Competence in Curriculum: Problem Recognition & Solving, Sustainability; Technical Specialization

Learning Objectives:
1. Able to make synthesis of geotechnical solution from

complex environmental issue.

Syllabus:

Geotechnical aspects: landfill geotechnical structure, behavior and properties of garbage, geosynthetic applications for landfill, cover land, landfill geotechnical analysis and design, long-term behavior of landfills; Type of soil and groundwater pollution, contaminated soil sampling, transfer of contaminants in ground water, type of soil and groundwater containment, type of soil and groundwater remediation.

Prerequisite:

Reference Book:
1. Oweis, I.S., "Geotechnology of Waste Management, 2nd Ed." PWS Publishing Company, 1998.
2. Abramson, et al., Slope Stability and Stabilization Methods, 2nd Ed. John Wiley and Sons. 2002.

Numerical Method in Geotechnical Engineering
ENCV 802 203
3 Credits

Competence in Curriculum: Problem Recognition and Solving, Experiments and Research

Learning Objectives:
1. Able to determine, executing, and analyzing the result of complex geotechnics issue.

Syllabus:

Introduction to numerical methods in geotechnical engineering; Geotechnical considerations; Constitutive law for geological media; Finite element in linear and non-linear material; Stress strain law in elastic-plastic and elasto-visco-plastic condition; Soil mechanics model with critical conditions (critical states); Completion of finite difference method and finite element in the beam foundation and elastic plate; Analysis of consolidation on soft ground and seepage; Some historical case. Geotechnical case analysis using numerical methods, and interpret the analysis result.

Prerequisite: -

Reference Book:
1. Bowles, J.E., Foundation Analysis and Design, McGraw-Hill Book Co., Singapore.
2. PottS, D.M. and Zaravkovic, L., Finite Element Analysis in Geotechnical Engineering, Thomas Telford Ltc., London.
3. Naylon, D.J., and Pande, G. N., Simpson, B., and Tabb, R., Finite Elements in Geotechnical Engineering, Pineridge Press, Swansea, UK.
4. Desai, C.S., and Christian, J.T., Numerical Methods in Geotechnical Engineering, Mc-Graw-Hill Inc., USA.

Adv. Foundation Engineering & Deep Excavation
ENCV 803 301
3 Credits

Competence in Curriculum: Problem Recognition and Solving, Experiment/Research, Technical Specialization.

Learning Objectives:
1. Able to make synthesis of complex deep excavation solution

Syllabus:

Lateral deep foundations; Construction and analysis of diaphragm walls; Constitutive soil models and characteristics of compressible soil; Mat foundation application; The construction methods for large diameter bored pile; Interpretation result of loading test; Deep foundations lateral capacity; construction and analysis of diaphragm walls; Geotechnical work surveillance method.

Prerequisite:

Reference Book:
1. Geotechnical Engineering Portable Handbook; Robert W. Day, McGraw Hill, 2000.
2. Soil Mechanics in Engineering Practice; Terzaghi, K. & Peck, R.B., John Wiley and Sons Ltd, New York, 1967.
3. Foundation Analysis and Design; Bowles, J.E, McGraw-Hill Book Co. Singapore, 1997.
4. Foundation Engineering Handbook; Winterkorn, H.F. & Fang, H.Y., van Nostrand Reinhold, Ltd. 1975.
5. Analytical and Computer Methods in Foundation Engineering; Bowles, J.E, McGraw-Hill Inc., 1977.
6. Elements of Foundation Design, Smith, G.N, Pole, E.L, Granada Publishing Ltd., 1980.
7. Smith & Paul. Soil Mechanics & Foundation

Diynamics & Earthquake in Geotechnic
ENCV 803 302
3 Credits

Competence in Curriculum: Problem Recognition and Solving, Sustainability, Technical Specialization.

Learning Objectives:
1. Able to create synthesis solution of various problem of geotechnics against earthquake and able to formulate machine foundation solution.

Syllabus: Dynamic on soil; Basic vibration; Wave in elastic medium; Dynamic soil properties; Vibration foundation; Effect of earthquake on the ground; Seismic lateral earth pressure; Liquefaction; Engine foundation above pole; Vibration theory; Waves in an elastic medium; Dynamic properties of the soil; foundations and vibration. Introduction to the probabilistic analysis of earthquake hazard; Amplification analysis of ground earthquake; Liquefaction phenomenon; Slope stability analysis of earthquake; Analysis of lateral earth pressure due to earthquake. The introduction of soil improvement methods in order to lower the vibration and earthquake effects on the ground.

Prerequisite:

Reference Book:
1. S.L. Cramer, Geotechnical Earthquake Engineering, Prentice Hall, 1996.
2. Braja M. Das, Principles of Soil Dynamics, PWS-KENT Publishing Co., 1993
3. Chopra A.K., Dynamics of Structures, Prentice Hall, 1995

Special Topics in Geotechnics
ENCV 803 303
3 Credits

Competence in Curriculum: Problem Recognition & Solving, Experiments/Research, Technical Specialization**.**

Learning Objectives:
1. Able to formulate solutions for complex soil-structure interaction.
2. Able to formulate the behavior of different kinds of rocks and rock mass conditions.
3. Able to formulate solutions for slope stability of rock mass.

Syllabus:

General introduction: Soil Structure Interaction; Buried structure and sheet pile wall and shallow foundation; SSI modelling in Plaxis 3D program; 3D plaxis application on the sheet pile wall and pile group; The use of geotextile in high vacuum to accelerate the consolidation process; The use of other additives to enhance the strength of the soil; The use of high pressure to perform injection for structure test strength associated with the sub structure.

Prerequisite:

Reference Book:
1. Journal ASCE, yang berkaitan dengan Soil Strucuture Interaction
2. Canadian Geotechnical Journal yang berkaitan dengan Soil Structure Interaction
3. Journal ASCE yang berkaitan dengan Stabilisasi Tanah
4. Canadian Geotechnical Journal yang berkaitan dengan stabilisasi tanah
5. Non-destructive test

Course Syllabus of Transportation Specialization

Traffic Control Engineering
ENCV 801 501
3 Credits

Competence in Curriculum: Technical Specialization

Learning Objectives:
1. Students should be able to analyze traffic condition and characteristics using mathematical models and micro and macro modeling techniques as a tool for traffic flow analysis.

Syllabus: Introduction; Characteristics of Humans; Vehicles and traffic infrastructure in traffic analysis; Junction control; Traffic flow surveys; Volume of traffic characteristic. Characteristics of traffic flow speed. Analysis of traffic flow density. Queues analysis and bottle neck theory. Models of traffic flow; Analysis of shock wave traffic management.

Prerequisite:

Reference Book:
1. Mannering, F. and Kilareski, W., 1998. *Principle of Highway Engineering and Traffic Analysis*, Willey & Sons.
2. May, A.D., 1990. *Traffic Flow Fundamental*, United State of America: Prentice-Hall, Inc.
3. McShane, W., Roess, R. and Prassas, E., 1998. *Traffic Engineering*, Prentice-Hall, Inc.
4. Taylor, M.A.P. and Young, W., 1988. *Traffic Analysis: New Technology and New Solutions*, Hodder Arnold.
5. MKJI, 1997. *Manual Kapasitas Jalan Indonesia*, Kementrian Pekerjaan Umum.
6. Wohl, M. and Martin, B., 1967. *Traffic System Analysis for Engineers and Planners*, McGraw-Hill.

Transportation System
ENCV 801 502
3 Credits

Competence in Curriculum: Problem Recognition and Solving

Learning Objectives:
1. Able to analyze the components of transport system from various dimensions, as well as the latest issues related to the Indonesian and global transport system.
2. Able to design a transportation system that includes an operating system, which meets the demand and supply aspects of sustainability.

Syllabus: Transportation system overview. Characterization and categorization of transportation system for single and dual mode. (Influence) Factors in the transportation system (planning, design, investment, operation, maintenance). System Demand. Supply systems. Issues of equality, accessibility, environmental, economic and disability.

Prerequisite: Transportation Engineering

Reference Book:
1. Grava, S., 2003. *Urban Transportation System*, McGraw-Hill.
2. Manheim, M., 1979. *Fundamentals of Transportation Systems Analysis. Vol 1: Basic Concept* 1st ed., The MIT Press.
3. Blunden, W. and Black, J., 1984. *The Land-Use / Transport System* 2nd ed., Pergamon-Press

Transportation Economics
ENCV 802 501
3 Credits

Competence in Curriculum: Problem Recognition and Solving, Sustainability

Learning Objectives:
1. Able to use economy, social impact, in the process of problem solving of complex transportation.
2. Able to analyze the demand and supply of transport systems based on economic theory and behavior of the traveler.
3. Able to analyze the economic investment of transportation short-term and long-term project including measurement of the cost of externalities and financing aspects.

Syllabus:

Introduction to transport economics; Concept of demand and supply of transport systems. Spatial problems: movement, transport and location. Transport demand, costs and direct benefits of transport and recovery costs. External costs of transport: congestion, pollution, accidents and social impact. Transportation investment: the basics of pricing, subsidy, competence between transportation systems, understanding investment decisions (BCR, IRR and NPV).

Prerequisite:

Reference Book:
1. Kenneth Button, 2010., Transport Economics 3rd edition, Edward Elgar Publisher.
2. Stuart Cole, 2005, Applied Transport Economics. Policy, management & decision making 3rd edition, Kogan Page.
3. Quinet, E, Vickerman, R dan Vickerman RW, 2005. Principle of Transport Economic, Edward Elgar Publisher
4. McCarthy, P. 2007, Transportation Economics Theory and Practice: A Case Study Approach, 2nd edition, Blackwell Publishing

Transportation Planning and Policy
ENCV 802 502
3 Credits

Competence in Curriculum: Experiment/Research, Technical

Learning Objectives:
1. Able to bring the uniqueness and originality from suggestion of transportation policy arrangement.
2. Able to recommend and propose transportation policies taking into account the dimensions of equality, environment and economy

Syllabus: Transport Policy Formulation; framework for assessing transport policy - land use, accessibility, air pollution, noise, accidents, and sustainability. Planning and transport policies and interaction with layout. Institutional arrangements for transportation planning and management. Risks, uncertainties and complexities in setting transportation policy. Transport policy at the local, regional, metropolitan and national; logistics transport policy.

Prerequisite:

Reference Book:
1. Shciller, P., Bruunm, E. and Kenworthy, J., 2010. *An Introduction to Sustainable Transportation: Policy, Planning* 1st ed., Routledge.
2. Morichi, S. and Acharya, S.R., 2013. *Transport Development in Asian Megacities: A New Perspective*, Springer.
3. Rodrigue, J.-P., Comtois, C. and Slack, B., 2009. *The Geography of Transport Systems* 3rd ed., Routledge.
4. Stopher, P. and Stanley, J., 2014. *Introduction to Transport Policy: A Public Policy View*, Edward Elgar Pub.

<u>Transportation Safety</u>
ENCV 802 503
3 Credits

Competence in Curriculum: Problem Recognition and Solving, Sustainability

Learning Objectives:
1. Students able to design prevention program and transportation safety measures, road transportation (C5) and perform simple road transport audit.

Syllabus:

Introduction: The problem of road safety in Indonesia, road safety policy, and the introduction of road safety engineering. Data accidents: Development of road traffic accident data. The factors that cause accidents: factors of road users, vehicles factor and road and environment factor. Analytical approaches: starting point, macroscopic study, multivariate study and evaluation of the effectiveness of efforts to improve road safety. Handling of road engineering: the roadside hazard management, the protection system, safety at road works and the introduction of a road safety audit. Transport safety: the safety of railways, air transport safety and the safety of shipping.

Prerequisite: Has already taken Road Geometric Design or following matriculation subjects of Road Geometric Design in Strata 1.

Reference Book:
1. Fricker, J. and Whitford, R., 2004.Fundamentalsof Transportation Engineering: A Multimodal System Approach
2. Evans, L., 2004. *Traffic Safety*, Science Serving Society
3. Tjahjono, T., 2011. *Analisa Keselamatan Lalu Lintas Jalan*, Lubuk Agung.
4. Serial Rekayasa Keselamatan Jalan. Panduan Teknis 1. Rekayasa Keselamatan Jalan; Panduan Teknis 2. Manajemen Hazard Sisis Jalan; Panduan Teknis 3. Keselamatan di Lokasi Pekerjaan Jalan. Direktorat Jenderal Bina Marga, Kementerian Pekerjaan Umum Republik Indonesia. Tahun 2012

<u>Transportation Modelling</u>
ENCV 803 501
3 Credits

Competence in Curriculum: Problem Recognition and Solving

Learning Objectives:
1. Able to make a model based on transportation infrastructure network.

Syllabus:

Human characteristics; Vehicle and infrastructure in transportation analysis; Junction control; Traffic flow survey; Characteristics of: volume of traffic flow, traffic flow speed and density; Analysis of queue and bottlenecks theory; Traffic flow models; Shock wave analysis; Traffic Management.

Prerequisite: -

Reference Book: -

<u>Public Transport Management and Planning</u>
ENCV 803 502
3 Credits

Competence in Curriculum: Technical Specialization

Learning Objectives:
1. Students are able to plan and design public transport system operation.

Syllabus:

Overview of public transport systems. Regulatory Framework, Public Transport Category and Mode of Technology, Components of public transportation system. Modern and efficient public transport system. Institutional Aspects. Planning of public transport networks. Route and Corridor Selection of public transportation. Operational Design. Financial planning and pricing. Contract system mechanism

Prerequisite: Transportation Engineering, Transportation System

Reference Book:
1. Giannopoulos, G., 1990. *Bus Planning and Operation in Urban Areas: A Practical Guide*, Gower Pub Co.
2. Vuchic, V., 2005. *Urban Urban Transit; Operation, Planning and Economics*., Willey & Sons.
3. Bunting, M., 2004. *Makling Public Transport Work*, McGill-Queen's University Press.
4. ITDP, 2007. *Bus Rapid Transit Planning Guide*, Institute for Transportation & Development Policy

<u>Advanced Road Geometry Design</u>
ENCV 803 503[
3 Credits

Competence in Curriculum: Technical Specialization

Learning Objectives:
1. Able to design road geometry, road supporting facility, junction, geometric and parking facility with considering certain aspects regarding road safety.

Syllabus: Introduction: basic of road geometric design associated with cross-section of the road, visibility, horizontal alignment, vertical alignment and alignment harmonization. Special aspects of road design: climbing lane, safety ramp (escape ramp), crossing lane on railways. Crossroads: Design consideration, Priority crossing, roundabout, Intersection with traffic signal control devices and non-level intersection. Signs, markings and delineation: design considerations, sign design, markings and delineation. Safety fence: design considerations, types of safety fence, rigid safety fence design, semi-rigid and flexible. Termination railing and fencing transition, crash cushion / attenuator. Parking and terminal: design considerations, Parking design, public transport passenger terminal and cargo terminal.

Prerequisite: Has already taken Road Geometric Design or following matriculation subjects of Road Geometric Design in Strata 1.

Reference Book:
1. AASHTO, 2004. *A Policy on Geometric Design of Highways and Streets*, Amerincan Association of State and Highway Transportation Officials.
2. Lamm, R., 1999. *Highway Design and Traffic Engineering*

Handbook, McGraw-Hill.
3. Tjahjono, T., 2011. *Analisa Keselamatan Lalu Lintas Jalan*, Lubuk Agung.
4. DMRB, 2006b. *Geometric Design of Major/Minor Priority Junction*, Department for Transport, UK: Design Manual for Roads and Bridges, Vol 6, Sec 1.
5. DMRB, 2006c. *Geometric Design of Roundabout*, Department for Transport, UK: Design Manual for Roads and Bridges, Vol 6, Sec 1.
6. DMRB, 2006d. *Geometric Layout of Signal Controlled Junctions and Signalised Roundabouts*, Department for Transport, UK: Design Manual for Roads and Bridges, Vol 6, Sec 1.
7. DMRB, 2006e. *Layout of Grade Seperation Junction*, Department for Transport, UK: Design Manual for Roads and Bridges, Vol 6, Sec 2.
8. AusRoads, 2003. *Rural Road Design: A Guide to the Geometric Design of Rural Roads*, Australian Roads.
9. AusRoads, 2007. *Urban Road Design: A Guide to the Geometric Design of Major Urban Roads.*, Australian Roads.
10. NCHRP, 1992. *NCHRP Report 350: Recommended Procedure for the Safety Performance Evaluation of Highway Features*, National Cooperative Highway Research Program.
11. DIER Tasmania, 2005. *Road Safety Barrier Design: Guide Part A and B*, Transport Tasmania.

Advanced Pavement Engineering
ENCV 802 504
3 Credits

Competence in Curriculum: Technical Specialization

Learning Objectives:
1. Able to investigate and conduct flexible road pavement and rigid pavement experiments
2. Able to calculate the thickness of the pavement based on the principle of Mechanistic-Empirical Pavement Design by considering the nature and rheology of the material due to traffic loading and natural conditions in order to have a Long-Term Pavement Performance (LTPP)

Syllabus:
1. Review of various types of road pavement in terms of approach and basic planning analysis, various forming materials related to the nature and basic characteristics, the main factor of planning Strain stress analysis for bending pavement;
2. Stress and strain analysis for rigid pavement; Material characterization is based on modulus, physical characteristics and deformation;
3. Loading and types and characteristics of loading;
4. Use software to calculate pavement thickness. Flexible pavement design based on Empirical and Mechanistic principles;
5. Rigid pavement design

Prerequisite: Material Properties, Pavement Design

Reference Book:
1. Direktorat Jenderal Bina Marga, 2013. *Manual Desain Perkerasan Jalan. No 02/BM/2013*, Kementrian Pekerjaan Umum.
2. Huang, Y., 2004. *Pavement Analysis and Design* 2nd ed., Prentice-Hall, Inc.
3. Dawson, A., 2004. *Pavement Unbound*, Taylor and Francis.
4. Papagiannakis, A. and Masad, E., 2008. *Pavement Design and Materials*, Willey & Sons.
5. Correia, A. ed., 1993. Flexible Pavements. *Proceedings of the European Symposium Euroflex*

Advanced Pavement Materials
ENCV 803 505
3 Credits

Competence in Curriculum: Technical Specialization

Learning Objectives:
1. Being able to analyze the nature and characteristics of the material due to stress and strain as well as the technology of road pavement materials

Syllabus:
1. Asphalt concrete modeling: pavement response model and performance model.
2. Asphalt rheology: mixed asphalt rheology model, rheology of asphalt binding material characterization of damage resistance; Stiffness characterization: modulus characterization of asphalt and asphalt concrete materials;
3. Concrete asphalt damage models: deflection model, fatigue model;
4. Characteristics of asphalt concrete mixes :;
5. Stiffness characteristics, Deflection / wave characteristics;
6. Characteristics of fatigue and water content, load and temperature effects. The rheological model of asphalt binder and the use of modified binder;
7. Use of additives for improving the quality of asphalt and asphalt concrete: polymers, recycled materials. Waste and by product materials. Complex and resilient modulus of indirect tensile test, a developmental model in making concrete asphalt models

Prerequisite: Material properties, Pavement Structure Design

Reference Book:
1. Correia, A. ed., 1993. Flexible Pavements. Proceedings of the European Symposium Euroflex.
2. Huang, Y., 2004. Pavement Analysis and Design 2nd ed., Prentice-Hall, Inc.
3. oung, J., Mindness, S., Bentur, A. and Gray, R., 1997. The Science and Technology of Civil Engineering Materials, Prentice-Hall, Inc.
4. Kim, Y., 2008. Modeling of Asphalt Concrete 1st ed., McGraw-Hill

Road Pavement Maintenance
ENCV 803 506
3 Credits

Competence in Curriculum: Technical Specialization

Learning Objectives:
1. Students able to design road maintenance programs based on road and bridge preservation models on a network or regional scale through knowledge of inspection, evaluation, and pavement management.

Syllabus:
1. Problems in road maintenance
2. The description and definition of road maintenance uses a field manual to identify all types of pavement problems and their causes to get an accurate pavement evaluation.
3. Analysis and evaluation for project and network level pavement management and procedures for implementation

4. The method for calculating road conditions, pavement condition prediction
5. Road maintenance methods and criteria with project and network approaches and service cost analysis
6. Preventive maintenance programs or road preservation; asset management: frameworks, tools, programs, systems of sustainability,
7. Pavement maintenance and road maintenance management programs.
8. New technology in maintenance and materials for road maintenance.

Prerequisite: Pavement Structure Planning

Reference Book:

1. Shahin, M Yo, (2004), Pavement Management for Airports, Roads, and Parking Lots, Springer, 2007 isbn 0387234659, 9780387234656 Springer, 2007
2. David G. Peshkin, Todd E. Hoerner, Kathryn A. Zimmerman ,(2004), Optimal Timing of Pavement Preventive Maintenance Treatment Applications, Report 523, Transportation Research Board.
3. Garber, NJ., Hoel, LA., (2009), Traffic and Highway Engineering, Cengange Laerning, Canada.
4. Fwa, TF., (2004), The Handbook of Highway Engineering, CRC Press Taylor and Francis Group,

<u>Railways Transportation Planning</u>
ENCV 803 507
3 Credits

Competence in Curriculum: Technical Specialization

Learning Objectives:
1. Able to plan and design the construction of buildings above and below railways and at the base of the bridge.
2. Able to plan railways geometric
3. Know the strategy in constructing railways and its equipment with support from transportation and construction knowledge.

Syllabus: Introduction to the history of technological development of railways and train transportation system. Planning criteria; Speed and double load, classification and space limits the room for railways, railways structure (superstructure and substructure), Terms and conditions for level crossings. Geometric design of railways; width and gauge widening, connections, wedel, curved requirements and rail elevation. Equipment, retrofitting, ventilating equipment and other works in tunnel construction. Function of signs, signals, telecommunications, CTC, operational (one lane or two lanes, station design, goods emplacement and containers, classification, signals and traffic control systems, emplacement and station supporting facilities.

Prerequisite:

Reference Book:
1. Bonnett, C., 2005. *Practical Railway Engineering* 2nd ed., Imperial College Press
2. Subarkah, I., 1981. *Jalan Kereta Api*, Idea Dharma.
3. PJKA, 1985. *Perencanaan Konstruksi Jalan Rel: Peraturan Dinas No. 10*, Perusahaan Jawatan Kereta Api

<u>Logistics Transportation</u>
ENCV 803 508
3 Credits

Competence in Curriculum: Technical Specialization

Learning Objectives:

1. Able to assess the system of allocation and selection of logistics facility locations using knowledge of the planning framework of the transportation system of goods; and
2. Able to identify the city's logistics system and its regulatory strategy.

Syllabus: Introduction to logistics and distribution (logistics system components, logistics evolution, the role of logistics, national logistics systems); framework of logistics and distribution planning (modes of transportation, commodities, planning horizon, planning framework, integrated systems, maritime logistics, and intermodal transportation; distribution channels (physical vs trading distribution channels, channel types and structures, channel selection, physical networks, operational networks , strategic networks, logistics costs, theories about planning transportation demand for goods with a four step model, location model theories, theories about city logistics, last mile delivery.

Prerequisite:

Reference Book:

1. Rodrigue, J.P. (Copy right 1998-2013). The Geography of Transport Systems. http://people.hofstra.edu/geotrans
2. Daskin, M.S. (1995). Network and discrete location. Models, algorithms, and applications. John Wiley & Sons,Inc
3. Rushton, A., Croucher,P. and Baker, P. (2006). The Handbook of logistics and distribution management. United Kingdom: Kogan Page Limited
4. Goulias, K.G. (2003). Transportation Systems Planning. Methods and Applications. CRC Press
5. K.W. Ogden. (1992). Urban Goods Movement. A Guide to Policy and Planning. Ashgate Publishing Limited
6. Taniguchi , E. and Thompson, R. G. (2008). Innovations in City Logistics. Nova Science Publishers, Inc
7. Taniguchi, E., Thompson, R.G., Yamada,T. dan Duin, V.R. (2001). City logistics. Network modelling and intelligent transport systems. Oxford,UK : Pergamon

<u>Assets - Environment and Safety</u>
ENCV 803 509
3 Credits

Competence in Curriculum: WA1 (engineering knowledge), WA2 (problem analysis), dan WA4 (investigation)

Learning Objectives:
Students able to identify railway assets through understanding subsystems: the required infrastructure and facilities are linked to the operation of urban, inter-urban and freight / logistics railroads. Capable of analyzing the application of safety management systems including occupational health and the environment

Syllabus:

1. History of Railways
2. Introduction
3. Safety
4. Asset Management

Next is elaborated in the following lectures:

1. Infrastructure

2. Natural characteristic of Railway
3. Basic Operations of Railway (Train Planning and Scheduling, Signaling)
4. Business Process
5. Infrastructure and Facilities

Prerequisite:

Reference Book:

Construction & Rehabilitation of Railway Infrastructure
ENCV 803 510
3 Credits

Competence in Curriculum: Technical Specialization

Learning Objectives:
1. Know the construction method for railways repair, able to monitor and assess the necessary repair and maintenance of railways.

Syllabus:

Railways infrastructure construction: Geo technology for subgrade, embankment, train lane, and mechanization for track construction; Maintenance and repair of railways; General aspects in the maintenance of railways infrastructure, rail grinding and re-profiling, tamping machines, stone blowing, ballast profiling and stabilization, mechanized track maintenance train, ballast cleaner, formation rehabilitation technologies; Inspection methods, methods of monitoring and detection methods; Monitoring substructure, vehicle for recording railways conditions, railways condition recording system.

Prerequisite

Reference Book:
1. EAPA, 2014. *Asphalt in Railway Tracks*, European Ashpalt Pavement Association.
2. Gomes Correia, A., Momoya, Y. and Tatsuoka, F., 2007. *Design and Construction of Pavements and Rail Tracks – Geotechnical Aspects and Processed Materials*, Taylor and Francis (CRC Press).
3. Coenraad, E., 2001. *Modern Railway Track* 2nd ed., MRT-Production.
4. Waters, J. and Selig, E., 1995. *Track Geotechnology and Substructure Management*, Thomas Telford Publishing

Course Syllabus of Water Resources Management Specialization

Engineering Hydrology
ENCV 801 402
3 Credits

Competence in Curriculum: Technical Specialization, Communication, Lifelong Learning

Learning Objectives:

1. Assess the effectiveness of flood mitigation infrastructure in controlling water destructive force, based on the analysis of the results of reconstruction of hydrological design using deterministic and stochastic hydrological model (C5).
2. Self-organizing in independent and groups work, so as to demonstrate the mastery of course competencies in the form of a systematic written document and oral presentations that are effective and efficient (A4).

Syllabus:

Hydrological model system and classification; Hydrological phenomena in volume control, Work equation for various hydrological processes on volume control in the atmosphere; Work equation for various hydrological processes in the subsurface; Work equation for various hydrological processes on the surface; Basic and applied principles of hydrograph; Flood tracking through the dam; Flood tracking through channels; Hydrological statistics; Frequency analysis; Hydrology design; Hydrologic design reconstruction of water damage control infrastructure; Hydrology design effectiveness of water damage control infrastructure.

Prerequisite: Fluid Mechanics

Reference Book:
1. Bedient, Philip B. and Huber, Wayne C., 2002. Hydrology and Floodplain Analysis. Third Edition. Prentice-Hall, Inc. USA.
2. Chow, Ven Te, Maidment, David R. and Mays, Larry W., 1988. Applied Hydrology. McGraw-Hill Book Company, Singapore.

Groundwater Hydraulics
ENCV 801 401
3 Credits

Competence in Curriculum: Experiment/Research, Technical Specialization, Communication, Lifelong learning.

Learning Objectives:
1. Able to weighing the alternatives of land use establishment based on the formulation of the recharge / discharge characteristic and spatial distribution pattern of groundwater in an area.
2. Able to prepare a paper on the alternative of land use establishment in a region with the characteristics of the groundwater flow in the known area, and present it orally.

Syllabus: Concept of groundwater conservation; Role of groundwater flows quantification for civil engineering for conservation; Hydraulic head; Hydraulic conductivity; Calculation of flux (q) using Darcy's law; The law of mass conservation in a controlled volume space; Land property; General equation of groundwater flow, Radial flow formulation; Effect of pump network pumping on limited aquifer; Calculation of K and S value based on data from pumping tests; Formulations of the basic flow net theory equation; Flow net classical method application; Flowline concept application on the field; Regional groundwater; Numerical solution for differential equations; MODFLOW package usage; Project task

Prerequisite:

Reference Book:
1. Groundwater 3rd Edition, R. Allan Freeze and John A. Cherry, Prentice Hall, 1990
2. Applied Hydrogeology 2nd Edition, C.W. Fretter, Merril Publishing Co, 1988
3. Hidrolika Aliran pada Media Berpori, Hand out, Herr Soeryantono, 2014
4. Manual SEEP2D, ASRI
5. Manual Modflow, ASRI
6. Dynamics of Porous Media Edisi 1, Jacob Bear, Dover, 1988
7. Chapra, Steven C.; Canale, Raymond P. (2015) Numerical Methods for Engineers, Seventh Edition, McGraw-Hill

Environmental Fluid Mechanics
ENCV 802 404
3 Credits

Competence in Curriculum: Technical Specialization, Sustainability, Communication, Lifelong learning.

Learning Objectives:
1. Able to formulate equations of advection dispersion that accommodate chemical decay and precipitation in physics (sink / source),
2. Able to write a paper about the model of dispersion of pollutants in water surface and underground, and present it orally.

Syllabus:

Chemical and physical properties of contaminants and water; Conservative form of mass conservation equations; General solutions; Particular solution; Advection dispersion equation that change in space and time for perfectly mixed systems; Analytic solution system advection dispersion equations changing space and time for the system perfectly mixed systems; Numerical finite difference method; Numerical solution of advection dispersion equations that change in space and time for perfectly mixed systems; Advection dispersion equation system varies with time and space for the imperfect mixed system; Advection dispersion analytic equation solution that change in space and time for an imperfect mixed system; Numerical solution of advection dispersion equations that change in space and time for an imperfect mixed system.

Prerequisite:

Reference Book:
1. Chapra, Steven C. (1997) Surface Water-Quality Modeling, International Edition, McGraw-Hill
2. Fischer, Hugo B.; List, E. John; Koh, Robert C. Y.; Imberger, Jorge; Brooks, Norman H. (1979) Mixing in Inland and Coastal Waters, Academic Press, Inc.
3. Chapra, Steven C.; Canale, Raymond P. (2015) Numerical Methods for Engineers, Seventh Edition, McGraw-Hill

Water Resource Management
ENCV 802 401
3 Credits

Competence in Curriculum: Problem Recognition and Solving, Sustainability, Communication, Lifelong Learning.

Learning Objectives:
1. Able to work independently and in teams to assess (evaluate the process or complex design results) various aspects of Water Resources Management (MSDA) in solving the problem of water resources and is able to present the results of the assessment in the form of a written systematic document and able to present it verbally.

Syllabus:

Students are given the provision to understand: 1. The principles aspect and policy of water resources management (in Indonesia) and its development; 2. Aspects and models of Integrated Water Resources Management/IWRM for both national and international scale; 3. Management aspect based on regulation and government policy related to three (3) pillars of water resource management which is utilization, water destructive force controlling, and conservation; 4. Supporting aspects of water resources management which includes hydro economy; 5. Case management of water resources (or project) inside a Water Resource Management Area or basin.

Prerequisite: -

Reference Book:
1. Peraturan Menteri Pekerjaan Umum. Nomor: 11A/PRT/M/2006 tentang Kriteria dan Penetapan Wilayah Sungai.
2. IWRM Resources. http://www.gwp.org/en/The-Challenge/IWRM-Resources/
3. GWP IWRM Toolbox: Useful Tool for Academia. http://www.gwp.org/gwp-inaction/news-and-Activities/GWP-IWRM-ToolBox-A-useful-tool-for-academia-/
4. Mays, Larry W., 1996. Water Resources Handbook. McGraw-Hill.
5. Loucks, Eric D., 1998. Water Resources and the Urban Environment. ASCE.
6. Beberapa Peraturan dan Kebijakan Nasional, Provinsi, dan Daerah terkait Pengelolaan Sumber Daya Air.

Hydraulics Structures
ENCV 802 402
3 Credits

Competence in Curriculum: Problem Recognition and Solving, Communication, Lifelong Learning.

Learning Objectives:
1. Students are able to calculate the dimensions needed, evaluating the strength and stability of important waterworks that are in suppletion system through open channel, drainage and small reservoir and calculating the physical model dimension for various scale.

Syllabus: 1. Scope and definitions; 2. Suppletion system work principle through open channels: - weirs design, sluice gate, measuring building, dividing building; 3. The principle of drainage channels system; - Micro drainage channel network design; -Highway drainage design; 4. The design of complementary waterworks: Crossworks, diversions, drop structures), embankments, strengthening of the cliff and bridge wing (wing wall); 5. Type and working system of reservoirs: dimension requirements design, ogee and siphon spillway, pump; 6. Scale model and similitude.

Prerequisite: Fluid Mechanics, Hydraulics, Water Engineering 1, Water Engineering 2

Reference Book:
1. Ven T. Chow (1959) Open Channel Hydraulics (reprinted 2009)
2. Bureau of Reclamation (1987) Design of Small Dams, United States Department of The Interior

Ecohydrology
ENCV 803 401
3 Credits

Competence in Curriculum: Problem Recognition and Solving, Sustainability, Communication, Lifelong Learning.

Learning Objectives:
1. Able to assess the harmony between existing condition with green infrastructure concept, eco urban village, and environmental construction (Low Impact Development – LID).
2. Able to give recommendation based on 3 green infrastructure integration, eco urban village, and environmental construction (Low Impact Development – LID).

Syllabus: Green Infrastructure, Eco Urban Village, Low Impact Development

Prerequisite:

Reference Book:

Water Damage Management
ENCV 803 403
3 Credits

Competence in Curriculum: Experimentation, Sustainability

Introduction & Troubleshooting; Continuity; Communication

Learning Objectives:

Students who are able to work independently also in groups to conduct an assessment of various aspects related to damaged water (water related disasters) and are able to provide the results of the assessment in the form of written documents that are installed and able to communicate them verbally. (C5)

Syllabus:

1. Able to improve the life cycle
2. Able to repair types of disasters due to air damaging power
3. Able to analyze disaster risk
4. Able to determine the level of damage due to air damaging force
5. Able to determine mitigation methods to reduce the risk of catastrophic air disasters
6. Students who are able to determine efforts to control the destructive force of the air
7. Students who are able to manage damaged air

Prerequisite:

Reference Book:

Watershed Vulnerability Assessment

ENCV 803 402
3 Credits

Competence in Curriculum: Problem Recognition and Solving, Sustainability, Communication, Lifelong Learning.

Learning Objectives:
1. Able to apply health rapid assessment device of a watershed based on Center Method for Watershed Protection.
2. Able to categorize the health status of the watershed based on waterproof land cover, water quality, and macrobentos diversity, and
3. Able to provide recommendations for further action to improve the health of the watershed.

Syllabus: 1. Land use planning, 2. Soil Conservation, 3. Border Bodies of Water, 4. Ideal Design Tread, 5. Erosion & Sedimentation Control, 6. Rain Management, 7. Liquid Waste Management, 8. Stakeholders Concern

Prerequisite:

Reference Book:

Operation & Maintenance of Hydraulics Structures

ENCV 802 403
3 Credits

Competence in Curriculum: Problem Recognition and Solving, Sustainability, Communication, Lifelong learning.

Learning Objectives:
1. Able to perform waterworks technical audit that produce physical condition of waterworks.
2. Able to give follow up recommendation to expedite the operational of waterworks and preserve its sustainability.

Syllabus:

Students are given the provision of: 1. Suppletion system audit that covers: dam, sluice gate, measuring building, dividing building; 2. Drainage channel system audit that covers: micro drainage channel network; - road drainage; 3. Complimentary building that related to river audit: levee, retrofitting bridge cliff and wing, cross-structure, dodging-structure, threshold, crib; 4. Polder work system audit that includes reservoir, spillway and pump.

Prerequisite:

Reference Book:
1. Je Van Zyl (2014) Introduction to Operation and Maintenance of Water Distribution Systems EDITION 1, Water Research Commission
2. Suyono Sosrodarsono, Masateru Tominaga, 1994, Perbaikan dan Pengaturan Sungai, Pradnya Paramita, Jakarta
3. Desain of small (1987), United States Department of the Interior
4. Buku pedoman manual OP bendungan besar

Course Syllabus of Construction/Project/ Infrastructure /Construction Safety Engineering Specialization

Project Investment and Finance

ENCV 801 601
3 Credits

Competence in Curriculum: Problem Recognition and Solving

Learning Objectives:

1. Able to implement the principle of project funding in analyzing the risks associated with the projects financing and evaluate project funding.
2. Able to analyze cases of investment and projects financing in real world.

Syllabus:

Basics of engineering economics; Basics of engineering economic analysis; Decision-making in engineering economics; Inflation, depreciation, tax and sensitivity analysis; introduction of project funding; Structure of project funding; Sources of project funding; Risks in project financing; Project funding modelling; Introduction of sharia-based project funding.

Prerequisite:

Reference Book:
1. Leland Blank-Anthony Tarquin. Engineering Economy, 7th edition. McGraw Hill. 2012
2. Finnerty, J. D. (2007). Project Financing: Asset-Based Financial Engineering. John Wiley & Sons, Inc., ISBN-13: 978-0-470-08624-7
3. Gatti, S. (2008). Project Finance in Theory and Practice. Elsevier. Academic Press

Project Management

ENCV 801 602
3 Credits

Competence in Curriculum: Problem Recognition and Solving

Learning Objectives:
1. Ability to make synthesis (identification, evaluation, and implementation strategy) solution of the problems associated with the entire group knowledge on project management.
2. Able to applying the knowledge of concept of thinking in project management to analyze the problem in the project, acquire the solution and implement it.

Syllabus: Project management overview; Initiation and scope management; Time management; Cost management; Human Resource Management; Quality management; Communications management; Risk management; Management of procurement of goods and services; Execution & Control; Control & Closing.

Prerequisite:

Reference Book:

1. Kerzner, Harold, Project Management, John Wiley & Sons, Inc., 2006.
2. Project Management Institute, A Guide to Project Management Body of Knowledge, 2013
3. Baguley, Philip, Managing Successful Projects, Pitsman Publishing, 1995.
4. Barker, Stephen and Cole, Rob, Brilliant Project Management, Pearson Education Limited, 2007.
5. Barkley, Bruce T. and Saylor, James H., Customer-driven Project Management, McGraw-Hill, Inc., 1994.
6. Cleland, David I., Project Management – Strategic Design & Implementation, McGraw Hill, 1999.
7. Cleland, David I. ND King, William R. (ed), Project Management Handbook, Van Nostrand Reinhold, 1988.
8. Gilbreath, Robert D., Winning at Project Management, John Willey & Sons, Inc, 1986.
9. Grey, Stephen, Practical Risk Assessment for Project Management, John Willey & Sons, Inc., 1995.
10. Hollick, Malcolm, An Introduction to Project Evaluation, Longman Cheshire Pty Limited, 1993.
11. McGhee, Pamela and McAliney, Peter, Painless Project Management, John Willey & Sons, Inc., 2007.
12. Newton, Richard, Project Management Step by Step, Pearson Education Limited, 2006.
13. Nicholas, John M., Managing Business & Engineering Projects, Prentice-Hall, Inc., 1990.
14. O'Connell, Fergus, Fast Projects, Pearson Education Limited, 2007.
15. Project Management Institute, Project Management Journals.
16. Verma, Vijay K., Human Resource Skills for the Project Manager, Project Management Institute, 1996.
17. Verma Vijay K., Organizing Projects for Success, Project Management Institute, 1995.

Time and Cost Management

ENCV 802 601
3 Credits

Competence in Curriculum: Problem Recognition and Solving, Technical Specialization

Learning Objectives:

1. Able to make synthesis (identification, evaluation, and implementation strategy) solution of problems related to the management of time and costs in construction projects.
2. Able to arrange project scheduling, critical path analysis and how to manage the critical path.
3. Able to estimate the cost and arrange budget structure of a project, controlling, optimizing cash flow and calculating profit and loss in a project.

Syllabus:

Time Management:

Defining activities based on WBS and work packages; Relationship between activity, Activity sequence; Determining the activity of which may be done in parallel and must be done sequentially; Definition of the resources required to perform activities, including the competencies required; Time duration used for completing activities, Developing project schedule.

Cost Management:

Quantity surveyor task and cost estimator, Estimation process, budgeting, controlling, and earned value management (EMV).

Prerequisite: Have knowledge of: 1) Project integration management (project lifecycle, project change management, 2) Project scope management (scope statement, WBS, RAM, etc.)

Reference Book:

1. Skill and Knowledge of Cost Engineering, AACE 2004
2. Hougan, Gregory Effective Work Breakdown Structure, Management Concepts , ,
3. Boussabaine Halim A., Whole Life-cycle Costing, Risk and Risk Responses, , Blackwell Publishing
4. Potts, Keith, Construction Cost Management, , Taylor & Francis
5. Cost and Value Management in Projects, Ray R.Venkataraman, John Wiley and Sons
6. PMBOK, PMI, 5th edition, 2012, PMI
7. Control of Risk, A guide to the systematic management of Risk from Construction, CIRIA
8. Dell'Isola Alphonse Value Engineering Practical Application for design, construction, maintenance and Operation, RS Mean
9. Brooks, Martin, Estimating and tendering for construction works, Elsevier
10. Practice Standard for Earned Value Management, PMI
11. Smith, Jim & Jaggar, David Building Cost Planning for the design Team, , Elsevier, Butterworth-Heinemann
12. Kerzner, Harold, Project Management, John Wiley & Sons, Inc., 2006.
13. Project Management Institute, A Guide to Project Management Body of Knowledge, 2013

Quality and Risk Management

ENCV 802 602
3 Credits

Competence in Curriculum: Problem Recognition and Solving, Technical Specialization

Learning Objectives:

1. Able to make synthesis (Identification, Evaluation, and strategic implementation) solution of issue regarding quality and risk management in construction project.

Syllabus:

Definition and benefits of quality and risk management, as well as the influence of risk in achieving the quality of the project; Quality of the project which includes the identification of needs and standards so as to achieve the expected quality; Documenting project implementation process and evaluate the process and work result in accordance to plan; Evaluation of the project results and provide the innovation and know the issues regarding quality management; Risks that could cause failure in project quality achievement; Planning and potential risk identification during the project; Various methods and software to analyze the identified risks priorities; identification of various actions (risk response) in order to minimize the impact of risk; Supervision to know the indication of deviation with risk management approach; Application of risk management that has been used on various types of projects.

Prerequisite:

Reference Book:

1. Project Management Institute (2013), *A Guide to Project*

Management Body of Knowledge, 5th edition.
2. Wideman, R.M., *Risk Management. A Guide to Managing Project Risk and Opportunities*, 1992, Project Management Institute
3. AS/NZS ISO 3100:2009. *Risk Management – Principles and guidelines*. 2009. Standards New Zealand.
4. Kerzner, Harold (2010). Project Management Best Practices: Achieving Global Excellence, 2nd Edition. Hoboken, New Jersey: John Wiley & Sons, Inc.
5. Flanagan, R, George Norman. (1993). Risk Management and Construction. Oxford, Blackwell Scientific Publication.
6. Total Quality Management Handbook

Procurement Management, Contract & Claim Administration

ENCV 802 603
3 Credits

Competence in Curriculum: Problem Recognition and Solving, Technical Specialization

Learning Objectives:
1. Able to make synthesis (identification, evaluation, and implementation strategy) solution of problems related to procurement management, contract administration and claims on construction projects.
2. Able to manage project procurement as well as able to make the project contract.

Syllabus: Planning and procurement strategy; Contract planning; Tender evaluation and selection; Selection and arrangement of procurement procedures strategy; Type of contracts and arrangement of agreement in work contract; Contracts closing and litigation; Legal and regulatory aspects involved in procurement process; Legal and regulatory aspects involved in the process of contract administration; Validation of work contracts.

Prerequisite:

Reference Book:
1. Project Management Institute. (2013). *A Guide to the Project Management Body of Knowledge:* (4th ed.). Project Management Institute.
2. Huston, C. H., "Management of Project Procurement", McGraw-Hill, New York, 1996
3. Bower, D., "Management of Procurement". Thomas Telford, London, 2003
4. Clough, R.H "Construction Contracting" John Wiley and Sons, 1994
5. Lysons, K. "Purchasing", Pitman Publishing, 1996

Legal and Institutional Framework

ENCV 803 601
3 Credits

Competence in Curriculum: Problem Recognition and Solving

Learning Objectives:
1. Able to apply knowledge of various regulations and policies in the field of infrastructure to resolve the legal issues in the case of infrastructure projects.

Syllabus: State institutions related to infrastructure; Laws and regulations related to infrastructure; Authority of central and regional government; Contract law; Land law (the provision of land for construction of public interest), Law of corporation; GCG and corruption; Supporting law/related (business ethics, business competition, etc.); Case study of legal aspects related to infrastructure.

Prerequisite:

Reference Book:
1. UUD 1945 and Amendments;
2. Jimly Asshidiqie, *Konstitusi Ekonomi*, Penerbit Kompas, Jakarta, 2010.
3. Kementerian Perencanaan Pembangunan Nasional/ Badan perencanaan Pembangunan Nasional, *Kumpulan Peraturan Terkait Kerjasama Pemerintah dan Swasta (KPS),* Direktorat Pengembangan Kerjasama Pemerintah dan Swasta, Jakarta, 2012.
4. Fred B.G Tumbuan, *Indonesian Unincorporated Business Entities and the Limited Liability Company*, Penerbit PT. Eles Media Komputindo-Kompas Gramedia, Jakarta 2011.
5. Taryana Soenandar, *Prinsip-prinsip Unidroit sebagai Hukum Kontrak dan Penyelesaian Sengketa Bisnis Internasional*, Penerbit Sinar Grafika, Jakarta, 2004

Project Stakeholders and Communications

ENCV 803 603
3 Credits

Competence in Curriculum: Technical Specialization, Communication

Learning Objectives:

1. Able to identify and analyze the process of HR management and communication of construction projects

2. Able to manage the organization and human resources needed during the project;

Syllabus:

1. HRM organizational functions;
2. The scope and depth of HRM;
3. HR planning;
4. Develop the Human Resource Plan;
5. Project Organization;
6. Job Des, RAM / RACI, Job Analysis, Job value / position weight;
7. Acquire project team (Get the project team);
8. Procurement and placement of human resources;
9. Develop project team (Developing the project team);
10. The process of increasing competence;
11. Manage project team (Manage project teams);
12. Project Team Performance Evaluation;
13. Communication Management, Process, Document Flow; Project Performance Report;
14. Stakeholders Management;
15. Measurement and evaluation of project performance; Calculate Project Overhead Cost

Prerequisite:

Reference Book:

1. Project Management Institute (2013), A Guide to Project Management Body of Knowledge, 5th edition.
2. Kerzner, Harold (2010). Project Management Best Practices: Achieving Global Excellence, 2nd Edition. Hoboken, New Jersey: John Wiley & Sons, Inc.
3. Szymanski, Robert A. Szymanski, Donald P. Pulschen, Donna M. (1995) Computers and Information Systems.
4. Armstrong, Michael (2008), Strategic Human Resources

Management; A Guide to Action, 4th Edition, London: Kogan Page.

Infrastructure Asset Management

ENCV 803 602
3 Credits

Competence in Curriculum: Technical Specialization

Learning Objectives:

1. Able to identify and analyze the process of infrastructure asset management
2. Able to describe infrastructure asset management and give an illustration in implementations of asset management in an infrastructure to achieve sustainability in the infrastructure sector.

Syllabus: Infrastructure Asset Management, Asset evaluation, Asset valuation, Optimization in asset management, Asset allocation, Risk management in infrastructure assets.

Reference Book:

1. Rice, M. R, DiMeo, R.A., Porter, M.P. (2012) Nonprofit Asset Management. John Wiley & Sons, Inc.
2. Schneeweis, T., Crowder, G. B., Kazemi, H. (2010) The New Science of Asset Allocation. John Wiley & Sons, In

Construction Safety, Administration and Reporting

ENCV 803 604
3 Credits

Competence in the curriculum: Technical Specialization

Learning objectives :

1. Able to develop a strategy for implementing the Construction Safety Plan
2. Able to create a construction safety administration and reporting system

Syllabus:

1. Able to commit to the implementation of RK3K
2. Being able to determine the scope
3. Able to set indicators for implementation of RK3K
4. Able to determine the tasks and responsibilities of the work group implementing RK3K
5. Able to determine the resources needed
6. Able to develop a strategy for implementing RK3K
7. Can determine the format of the report
8. Able to prepare report results
9. Able to distribute report results

Prerequisite: -

Reference Book

1. Textbook : Sistem Manajemen Keselamatan pada Proyek Konstruksi
2. UU No 1 Tahun 1970
3. UU No 2 Tahun 2017
4. Permen PU No 21 / 2019
5. SE Mentri PU No 11 / 2019

Accident Safety and Investigation Audit

ENCV 803 606
3 Credits

Competence in the curriculum: Technical Specialization

Learning objectives :

1. Able to carry out audits on construction / infrastructure projects based on the prepared RK3K
2. Able to carry out K3 accident investigations
3. Able to prepare OHS Audit and Investigation documents

Syllabus:

1. Able to determine the objectives, scope and criteria of the audit Able to determine the scope
2. Able to determine the auditor officer
3. Able to review documents and audit preparations
4. Able to carry out audits
5. Able to prepare and communicate audit reports
6. Able to follow up on Audit results
7. Able to Identify K3 Construction investigation procedures
8. Able to identify unsafe actions on construction projects
9. Able to identify unsafe conditions of construction projects
10. Able to carry out K3 Construction inspection in accordance with agreed procedures
11. Able to prepare K3 Audit documents
12. Can compile K3 investigation documents

Prerequisite: -

Reference Book

1. Textbook : Sistem Manajemen Keselamatan pada Proyek Konstruksi
2. UU No 1 Tahun 1970
3. UU No 2 Tahun 2017
4. Permen PU No 21 / 2019
5. SE Mentri PU No 11 / 2019

Construction Safety Monitoring and Evaluation

ENCV 803 605
3 Credits

Competence in the curriculum: Technical Specialization

Learning objectives :

1. Able to carry out observation / monitoring strategies for K3 implementation in the Construction / Infrastructure Project based on the RK3K that has been prepared
2. Able to evaluate the K3 implementation process based on the approved RK3K
3. Able to document the approved RK3K monitoring and evaluation activities

Syllabus:

1. Able to set standards and indicators to assess the process of implementing OHS programs
2. Being able to collect data and make observations of the implementation of the activities / processes of the selected activities to be compared with the standards / indicators (both qualitative and quantitative) that have been determined
3. Able to observe changes in the environment and collect data for the assessment of the influence of the environment on the activities being carried out

4. Able to carry out data analysis and results sentiment to make judgments and conclusions about the process of implementing OHS
5. Able to take decisions to take action (including corrections and adjustments to activities, as well as re-planning).
6. Able to convey all the results of monitoring, control and follow-up to the parties concerned as a form of accountability and further decision making process.
7. Able to evaluate the K3 Construction implementation program
8. Able to check the completeness of the K3 Construction program
9. Able to reassess the appropriateness of the K3 Construction program
10. Able to review the suitability of the methods and systems used in the implementation of K3 Construction
11. Able to document the approved RK3K monitoring and evaluation activities

Prerequisite: -

Reference Book

1. Textbook : Sistem Manajemen Keselamatan pada Proyek Konstruksi
2. UU No 1 Tahun 1970
3. UU No 2 Tahun 2017
4. Permen PU No 21 / 2019
5. SE Mentri PU No 11 / 2019

OHS Risk and Costs

ENCV 802 605
3 Credits

Competence in Curriculum: Technical Specialization, Suitainability

Learning objectives :

1. Able to evaluate the structure of WBS structural structures in complex civil / infrastructure construction buildings
2. Able to do an analysis of risks and potential hazards that occur / have an impact on workplace accidents, and plan for control
3. Able to analyze targets and programs based on selected risk controls
4. Able to analyze resource requirements based on program goals that have been prepared
5. Able to analyze the costs required based on the goals of the K3 program
6. Able to make safety plan documents along with K3 costs

Syllabus:

1. Able to identify the system structure of WBS
2. Able to evaluate the WBS structural system
3. Able to develop a WBS structural system
4. Able to identify potential hazards and OHS risks
5. Able to analyze potential hazards and risks
6. Able to carry out risk control
7. Able to make targets of each risk control
8. Able to make a program of each target that is formed
9. Can identify the resources of each target and program that has been prepared
10. Able to analyze the resources of each target and program that has been prepared
11. Being able to analyze the unit price of resources that have been determined from the target program formed
12. Able to create a K3 cost structure
13. Able to make details of K3 costs
14. Able to make K3K plan documents and K3 costs

Prerequisite: -

Reference Book

1. Textbook : Sistem Manajemen Keselamatan pada Proyek Konstruksi
2. UU No 1 Tahun 1970
3. UU No 2 Tahun 2017
4. Permen PU No 21 / 2019
5. SE Mentri PU No 11 / 2019

Policy and RK3K

ENCV 802 604
3 Credits

Competence in the curriculum: Technical Specialization, Communication

Learning objectives :

1. Able to evaluate the application of SMK3 policies
2. Able to evaluate the WBS structural structure of complex civil engineering construction buildings
3. Able to analyze risks and potential hazards that occur / have an impact on workplace accidents, as well as plan their control
4. Able to analyze risks and potential hazards that occur / have an impact on workplace accidents, and plan for control

Syllabus:

1. Able to evaluate OHS policies based on Law No 1/1970
2. Able to evaluate OHS policies based on UUJK No 2/2017
3. Able to evaluate OHS policies based on ISO and OHSAS
4. Able to evaluate the policy guidelines for K3 standard procedures at the level of the construction company
5. Able to evaluate the WBS structural system for complex civil / infrastructure engineering buildings
6. Able to Arrange WBS structure up to level 6
7. Able to compile identifying potential risks / hazards based on the WBS structure that has been prepared
8. Able to analyze risk
9. Able to recommend controlling selected risks / hazards
10. Able to create OHS targets and work programs based on selected risk controls
11. Able to identify the resource requirements needed from the program objectives that have been prepared

12. Able to create WBS documents
13. Able to make risk documents and program targets
14. Able to make RK3K / safety plan documents

Prerequisite: -

Reference Book

1. Textbook : Sistem Manajemen Keselamatan pada Proyek Konstruksi
2. UU No 1 Tahun 1970
3. UU No 2 Tahun 2017
4. Permen PU No 21 / 2019
5. SE Mentri PU No 11 / 2019

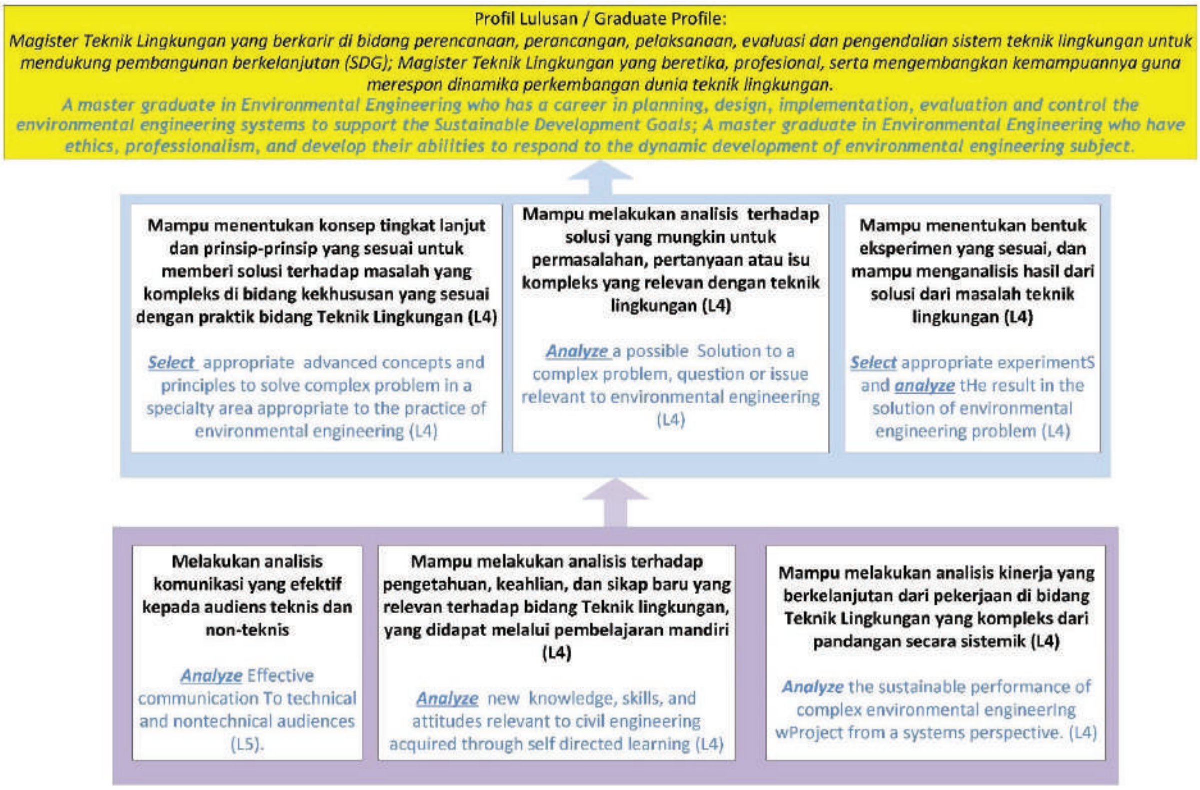
Graduate (Master) Program on Environmental Engineering

Program Specification

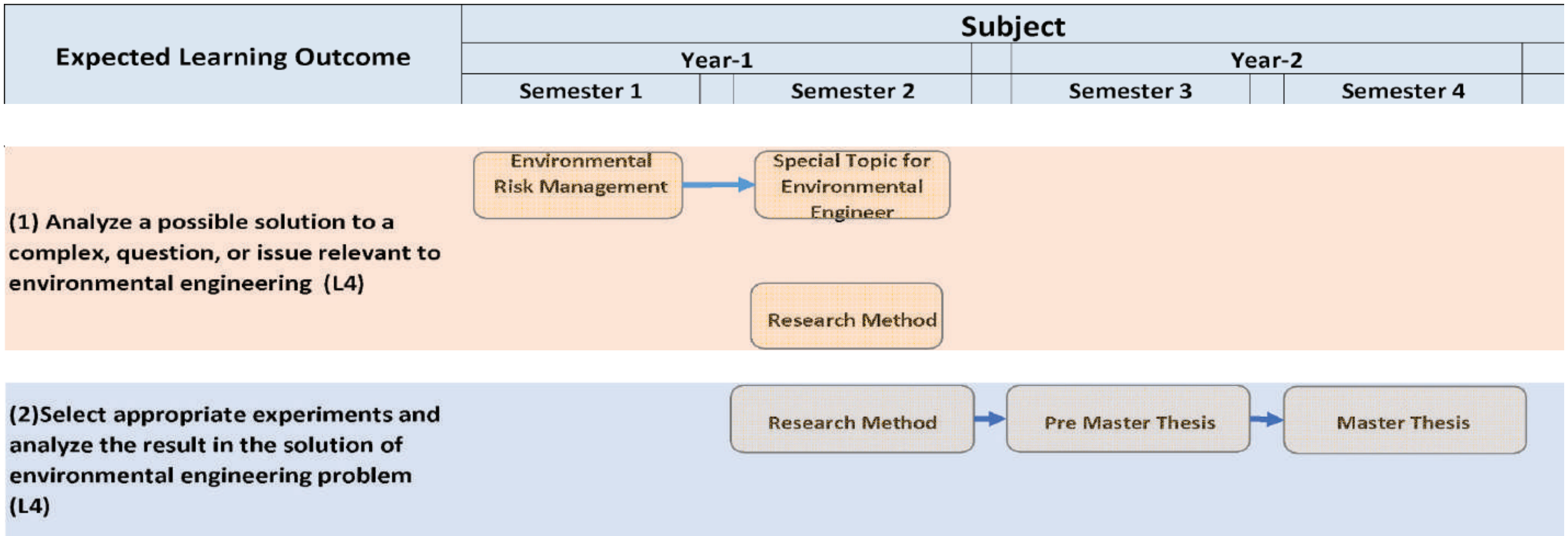
1.	**Awarding Institution**	Universitas Indonesia	
2.	**Teaching Institution**	Faculty of Engineering University Indonesia	
3.	**Programme Tittle**	Graduate Programme in Environmental Engineering	
4.	**Class**	Regular	
5.	**Final Award**	Graduate (Master) Program in Environmental Engineering (M.T)	
6 .	**Accreditation / Recognition**	Good	
7.	**Language(s) of Instruction**	Bahasa Indonesia	
8.	**Study Scheme (Full Time / Part Time)**	Full Time	
9.	**Entry Requirements**	Undergraduate (S1) or DIV graduates from university or Polytechnique with B accreditation from BAN-PT specified from science and technology major: A. Environmental Engineering B. Civil Engineering C. Chemical Engineering/ Bioprocess Engineering D. Chemistry E. Biology F. Nuclear Engineering G. Metallurgy Engineering H. HSE (Public Health)	
10.	**Study Duration**	Designed for 2 years	
	Type of Semester	Number of Semester	Number of weeks / semester
	Regular	4	16
	Short (optional)	1	8
11.	**Aims of the programme is :** to produce environmental engineering master graduate that able analyze in depth, designing complex product, process or system in the field of water engineering, solid waste, air pollution, also contributing in fulfilling the Sustainable Development Goals		
12.	**Profile of Graduates:** 1. Environmental Engineering Master graduate who has a career in planning, design, implementation, evaluation, and environmental engineering system to support Sustainable Development Goals (SDGs) 2. Environmental Engineering Master graduate with ethics, professionalism, and capable develop their abilities in response to the dynamic development environmental engineering field.		
13.	**Expected Learning Outcomes (ELO):** 1. Analyze a possible solution to a complex, question, or issue relevant to environmental engineering (L4) 2. Select appropriate experiments and analyze the result in the solution of environmental engineering problem (L4) 3. Select appropriate advanced concepts and principles to solve complex problem in a specialty area appropriate to the practice of environmental engineering (L4) 4. Analyze the sustainable performance of complex environmental engineering project from a system perspective (L4) 5. Analyze effective communication to technical and nontechnical audiences (L5) 6. Analyze new knowledge, skills, and attitudes relevant to environmental engineering acquired through self-directed learning (l4)		

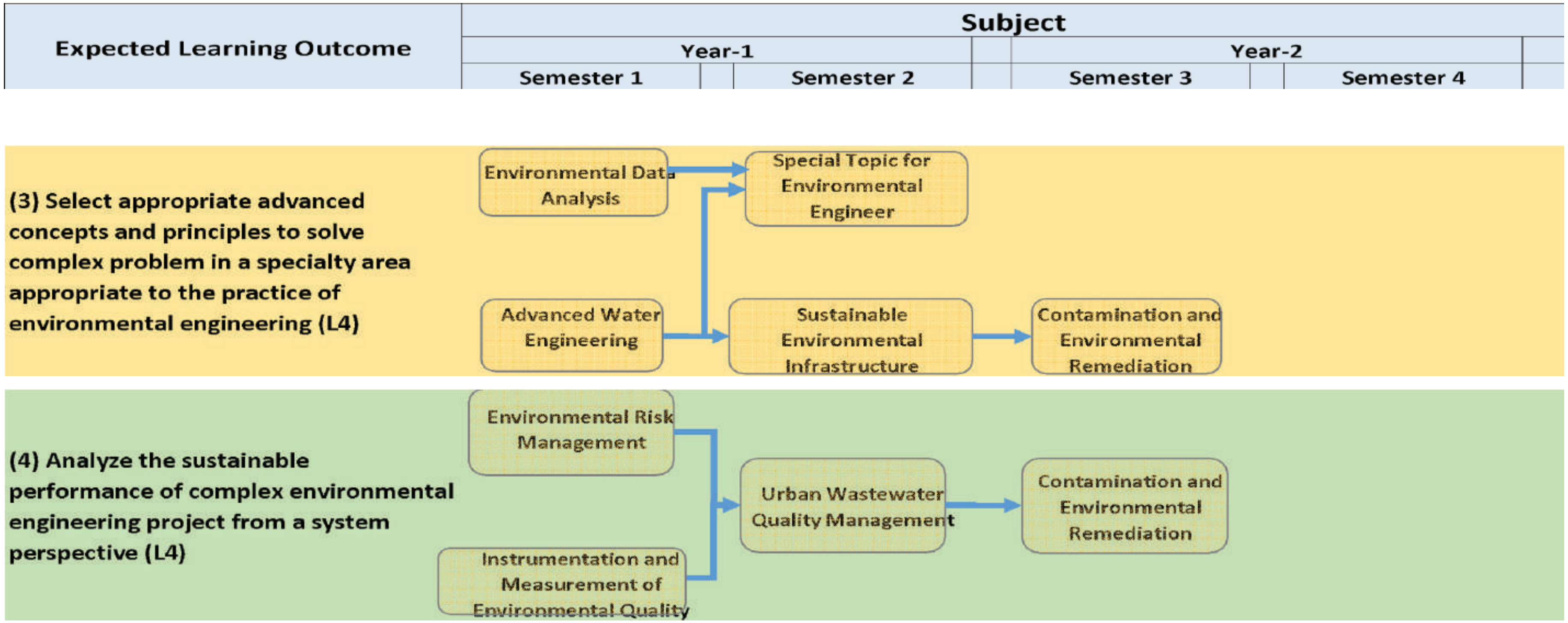
14.	Classification of Subjects		
No.	**Classification**	**Credit Hours (SKS)**	**Percentage**
i	University General Subjects	-	-
ii	Basic Engineering Subjects	-	-
iii	Core Subjects	12	30.0%
iv	Mata Kuliah Specialization	15	37.5%
v	Elective	3	7.5%
vi	Scientific Publication, Pre Master Thesis, Master Thesis	10	25.0%
	Total	40	100 %
	Total Credit Hours to Graduate		40 SKS

Learning Outcome



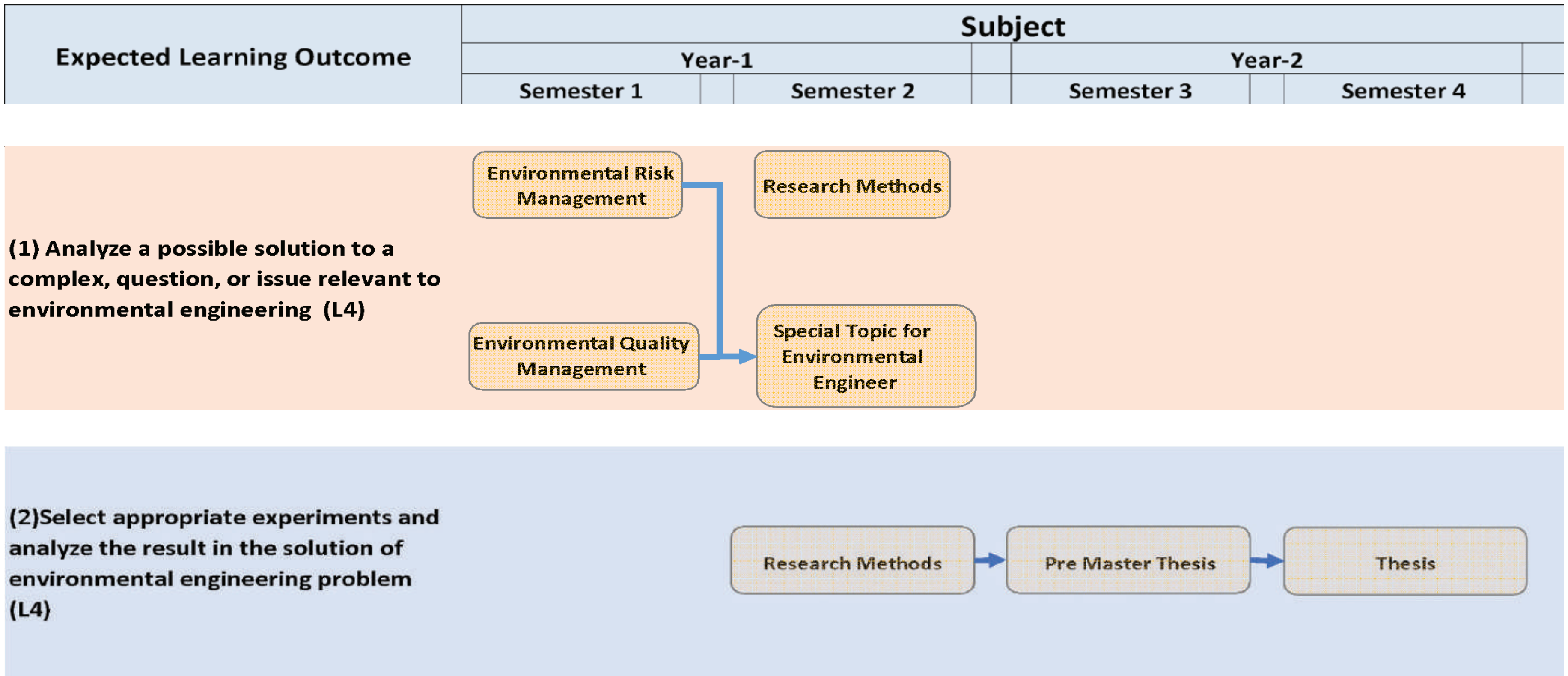
**Flow Diagram Of Subject to Reach ELO in Environmental Engineering Master Programme specialization :
Water Quality Technology and Engineering**

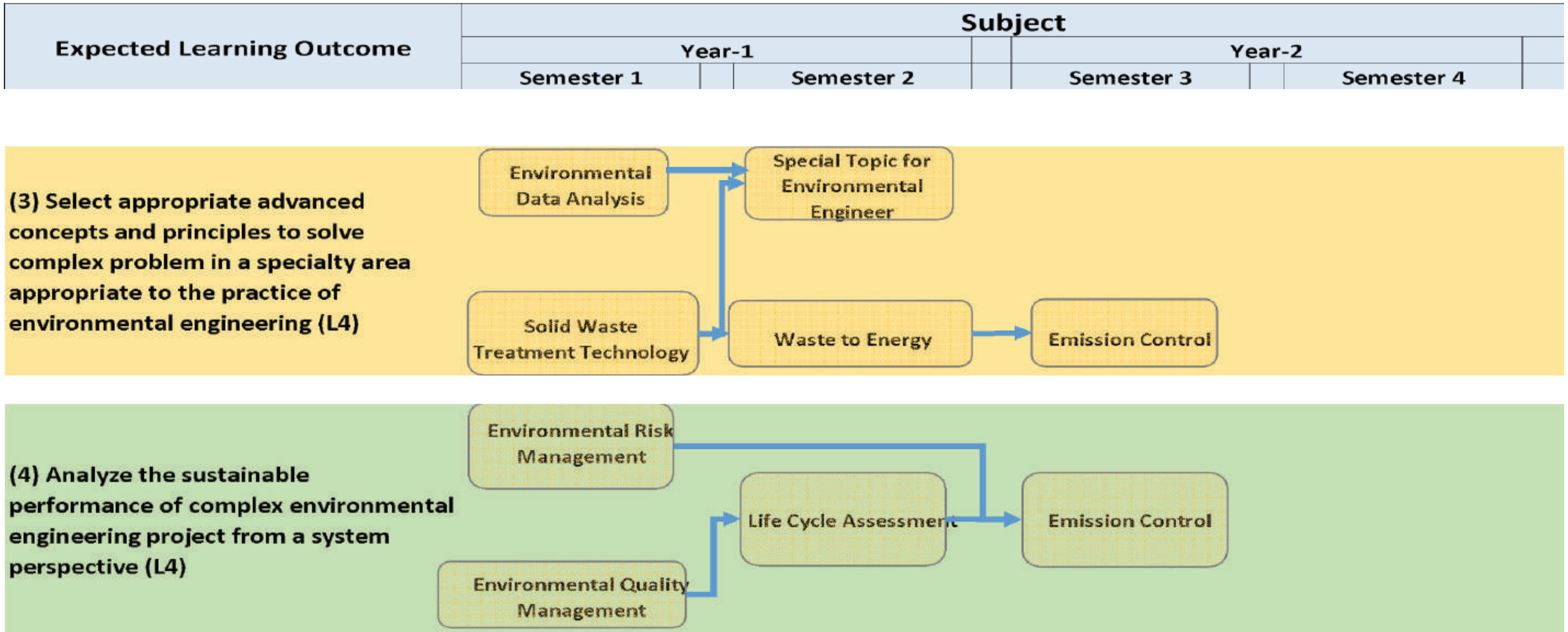



Expected Learning Outcome
Subject
Year-1
Year-2
Semester 1
Semester 2
Semester 3
Semester 4
(3) Select appropriate advanced concepts and principles to solve complex problem in a specialty area appropriate to the practice of environmental engineering (L4)
Environmental Data Analysis
Special Topic for Environmental Engineer
Advanced Water Engineering
Sustainable Environmental Infrastructure
Contamination and Environmental Remediation
(4) Analyze the sustainable performance of complex environmental engineering project from a system perspective (L4)
Environmental Risk Management
Instrumentation and Measurement of Environmental Quality
Urban Wastewater Quality Management
Contamination and Environmental Remediation

Expected Learning Outcome	Subject			
	Year-1		Year-2	
	Semester 1	Semester 2	Semester 3	Semester 4
(5). Analyze effective communication to technical and nontechnical audiences	Environmental Data Analysis		Pre Master Thesis	Scientific Publication
(6) Analyze new knowledge, skills, and attitudes relevant to environmental engineering acquired through self-directed learning (L4).			Pre Master Thesis	Master Thesis

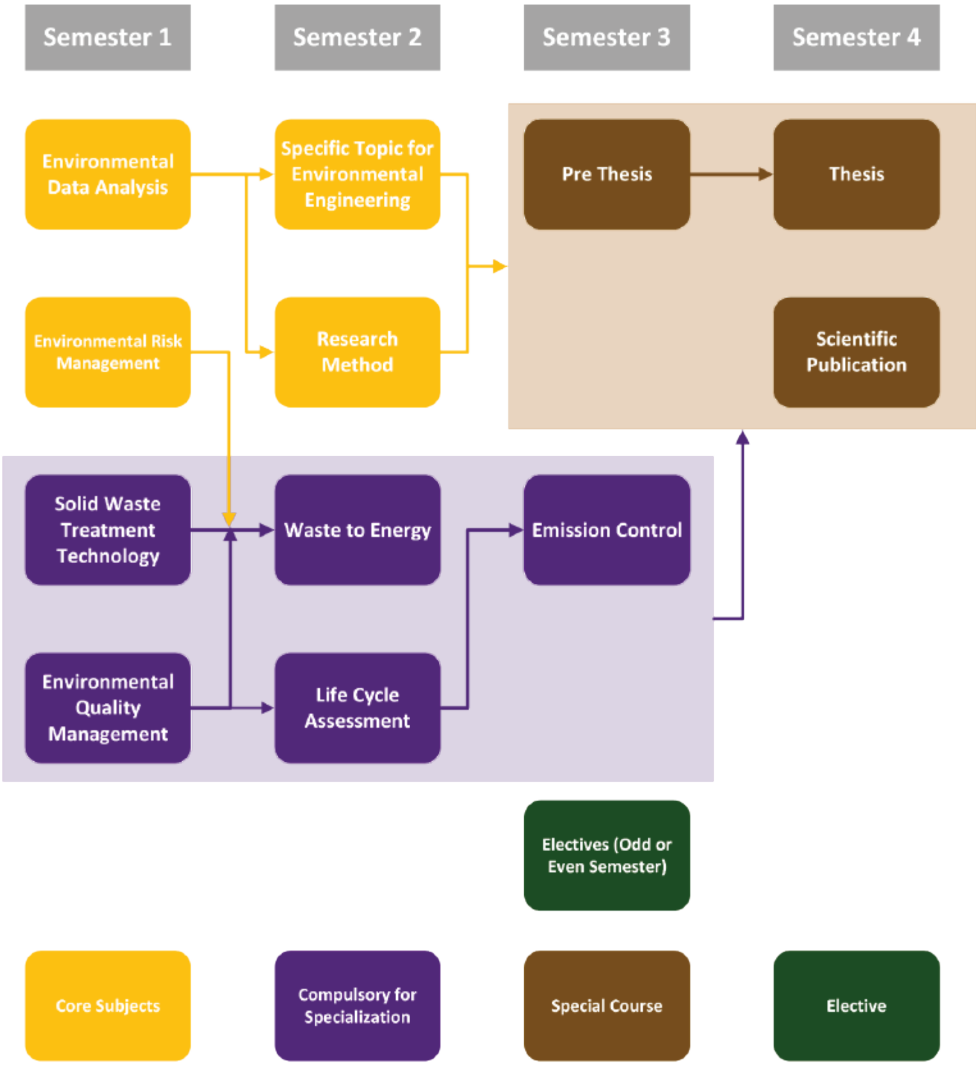
Flow Diagram Of Subject to Reach ELO in Environmental Engineering Master Programme specialization:
Environmental Quality Management



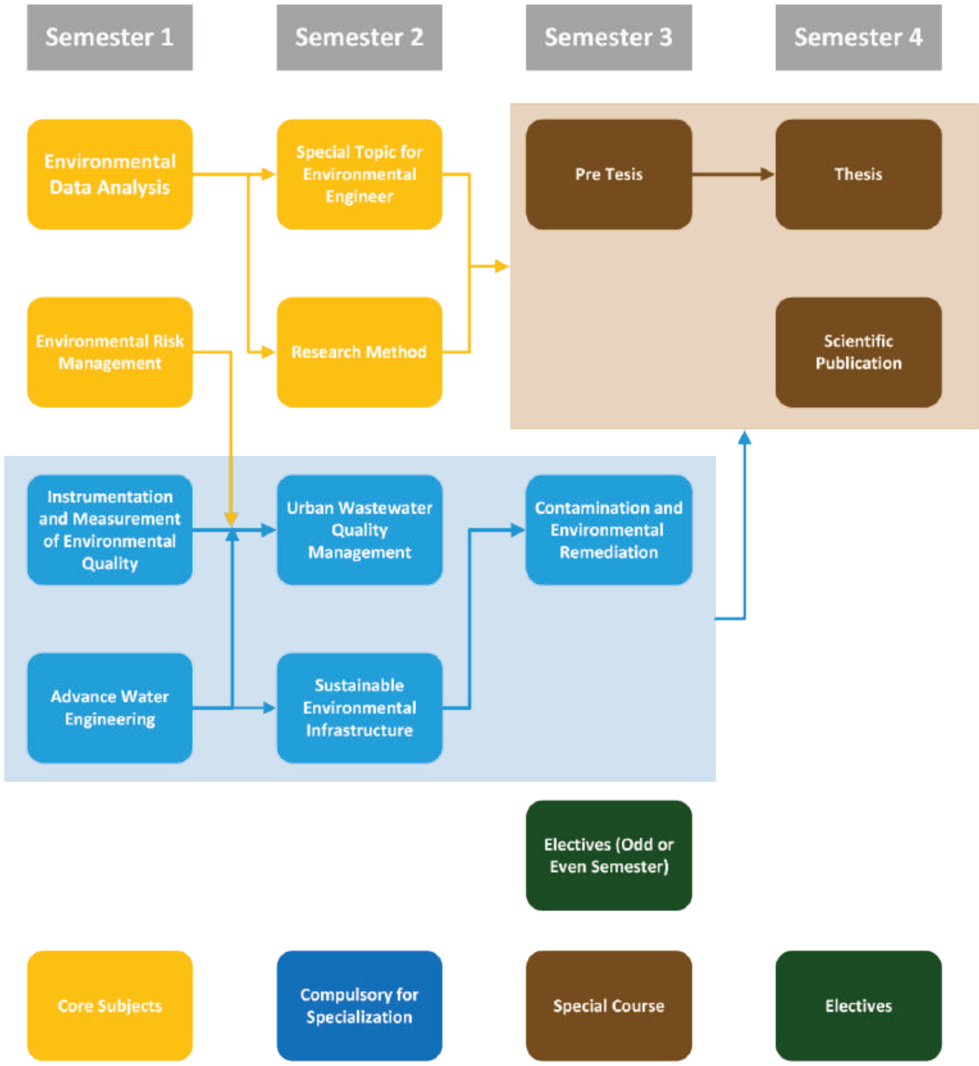

Expected Learning Outcome
Subject
Year-1
Year-2
Semester 1
Semester 2
Semester 3
Semester 4
(3) Select appropriate advanced concepts and principles to solve complex problem in a specialty area appropriate to the practice of environmental engineering (L4)
Environmental Data Analysis
Special Topic for Environmental Engineer
Solid Waste Treatment Technology
Waste to Energy
Emission Control
(4) Analyze the sustainable performance of complex environmental engineering project from a system perspective (L4)
Environmental Risk Management
Life Cycle Assessment
Emission Control
Environmental Quality Management

Expected Learning Outcome	Subject			
	Year-1		Year-2	
	Semester 1	Semester 2	Semester 3	Semester 4
(5). Analyze effective communication to technical and nontechnical audiences	Environmental Data Analysis		Pre Master Thesis	Scientific Publication
(6) Analyze new knowledge, skills, and attitudes relevant to environmental engineering acquired through self-directed learning (L4).			Pre Master Thesis	Master Thesis

Flow Diagram of Subjects in Environmental Engineering Master Programme
Environmental Quality Management specialization



Flow Diagram of Subjects in Environmental Engineering Master Programme
Water Quality Technology and Engineering specialization



Curriculum Structure in Environmental Engineering Master Programme

Subjects Code	Semester 1	SKS MKL	SKS TRKA
ENEV 801 101	Environmental Data Analysis	3	3
ENEV 801 102	Environmental Risk Management	3	3
ENEV 801 201	Environmental Quality Management	3	P
ENEV 801 202	Solid Waste Treatment Technology	3	P
ENEV 801 301	Advanced Water Engineering	P	3
ENEV 801 302	Instrumentation and Measurement of Environmental Quality	P	3
	Compulsory Course Environmental Quality Management	12	
	Compulsory Course Water Quality Technology and Engineering		12
Subjects Code	**Semester 2**	**SKS MKL**	**SKS TRKA**
ENEV 802 103	Research Method	3	3
ENEV 802 104	Special Topic for Environmental Engineer	3	3
ENEV 802 201	Waste to Energy	3	P
ENEV 802 202	Advanced Water Engineering	3	P
ENEV 802 301	Urban Wastewater Quality Management	P	3
ENEV 802 302	Sustainable Environmental Infrastructure	P	3
	Compulsory Course Environmental Quality Management	12	
	Compulsory Course Water Quality Technology and Engineering		12
Subjects Code	**Semester 3**	**SKS MKL**	**SKS TRKA**
ENEV 800 105	Pre Master Thesis	2	2
ENEV 803 201	Emission Control	3	P
ENEV 803 301	Contamination and Environmental Remediation	P	3
	Compulsory Course Environmental Quality Management	5	
	Compulsory Course Water Quality Technology and Engineering		5
	Elective	3	3
	Total	8	8
Subjects Code	**Semester 4**	**SKS MKL**	**SKS TRKA**
ENEV 800 106	Master Thesis	6	6
ENEV 800 107	Scientific Publication	2	2
	Total	8	8

Information :

MKL : Environmental Quality Management Specialization

TRKA : Water Quality Technology and Engineering

Elective Courses

Subjects Code	Elective Courser Odd Semester	SKS
ENEV 803 106	Environmental System Dynamics	3
Subjects Code	**Elective Courser Even Semester**	**SKS**
ENEV 802 105	Environmental Audit	3

Syllabus of Master Program on Environmental Engineering

Environmental Data Analysis

ENEV 801 101
3 Credits
Learning Outcomes:
1. Able to analyze environmental data by applying probabilistic distribution and Monte Carlo methods.
2. Able to correlate three variables or more by analyzing the multivariate in order to explain environmental phenomenon.

Competence in Curriculum:

1. Able to determine advanced concepts and appropriate principles to provide solutions to complex problems in Environmental Engineering field (ELO 3),
2. Conducting an analysis of effective communication to technical and non-technical audiences (ELO 5)

Syllabus:

Probability Distribution (1) probability distribution (discrete and continuous): normal distribution, Central Limit theorem, t-distribution and Fisher's F-distribution, gamma and other distributions. (2) Application of data analysis on the probability of distribution to the environment, such as the distribution of particle size, the detection limit of environmental analysis; Hypothesis test (1) Type I error, Type II error, level of significance, (2) Final test one and final test two. Parametric tests of significance to non-parametric tests and the Monte Carlo method (3) Application of hypothesis testing in the analysis of environmental data, such as adjusting environmental standards and so on; Regression analysis (1) Multiple regression - calculations from the field of regression, partial correlation and multiple correlation (2) nonlinear regression (3) Application of regression analysis in environmental data, such as calibration of environmental analysis; Time series (1) Introduction-meaning of the stochastic process: the whole random process, the balanced process, the auto-regression process and the unbalanced process; Principles of Component Analysis (1) Introduction to Analysis of Main-rotated components and complex empirical orthogonal functions, Uncommon decomposition values, Analysis of official relationships (2) Application of PCA in complex environmental data, such as identification of air pollution sources

Prerequisite:

Basic Statistic

References:

1. Linfield C. Brown and Paul Mac Berthouex, Jan 29, 2002, Statistics for Environmental Engineers
2. Ralph R B Von Frese, John W Olesik, CRC Press, Taylor & Francis Group, 2019, Introduction to Environmental Data Analysis for Scientists and Engineers
3. D.R. Helsel and R.M. Hirsch, September 2002, Statistical Methods in Water Resources

Environmental Risk Management

ENEV 801 102
3 Credits
Learning Outcomes:
Able to conclude and propose risk reduction strategies based on the diagnosis results of human health risks and ecological risks from the sources of activities that emit pollutants. The diagnosis is based on the concepts of toxicology, chemistry, ecology, statistics and epidemiology

Competence in Curriculum:

1. Able to analyze possible solutions to problems, questions or complex issues relevant to environmental engineering (ELO 1)
2. Able to carry out continuous performance analysis of work in the Environmental Engineering field from a systemic point of view (ELO 4)

Syllabus:

Introduction to Environmental Risk (Concepts, principles and uses of environmental risks; Typology of risks and their management methods; Techniques and methods of risk calculation; Integrated risk assessment), Ecological Risk Assessment (ERA) - Ecotoxicology (Introduction of ERA; ERA techniques and calculation methods), Human Risk Assessment (HRA) - Toxicology (Introduction of HRA; Techniques and calculation methods), Application of Environmental Risk Assessment in Industry (Chemical risk assessment in the environment; Application of environmental risk in cases of pollution in soil, water, air; Use of pollutant fate transport software)

Prerequisite: Environmental Chemistry

References:

1. Easton, Thomas. 2013. Taking Sides: Clashing Views on Environmental Issues 15th Edition. McGraw-Hill/ Dushkin.
2. Simon, Ted, 2016, Environmental Risk Assessment: A Toxicological Approach 1st Edition, CRC Press; 1 edition
3. EPA's Framework for Human Health Risk Assessment to Inform Decision Making, 2014
4. EPA's Risk-Screening Environmental Indicators (RSEI) Methodology, Version 2.3.4. 2015
5. Landis, W. Et.al., 2010. Introduction to Environmental Toxicology: Molecular Substructures to Ecological Landscapes, Fourth Edition 4th Edition.CRC Press
6. Hemond, H. and Fechner, E.J., 1999. Chemical Fate and Transport in the Environment 2nd Edition
7. Dupont, R. 2016. Pollution Prevention: Sustainability, Industrial Ecology, and Green Engineering, Second Edition 2nd Edition

Research Method

ENEV 802 103
3 Credits
Learning Outcomes:
1. Able to explain the concept of thinking in research methods and apply it on choosing the right research methodology and on preparing research proposals
2. Able to explore the uniqueness and originality of research proposals (uniqueness of civil engineering problems)

Competence in Curriculum:

1. Able to analyze possible solutions to problems, questions or complex issues relevant to environmental engineering (ELO 1)
2. Able determine the appropriate form of experimentation, and analyze the solutions of environmental

Syllabus: Methodology principles, characteristics and research processes, quantitative and qualitative research paradigms, scientific methods, problem statements, preparing hypotheses, logical and critical thinking, research strategies, data collection techniques and analytical techniques, scientific writing, guidance on the preparation of draft seminars with prospective supervisors.

Prerequisite:

References:

1. Nazir,Moh, Metode Penelitian, Ghalia Indonesia,2003
2. Keputusan Rektor UI No 628, Pedoman Teknis Penulisan Tugas Akhir Mahasiswa Universitas Indonesia, 2008
3. FTUI, Pedoman Penulisan Tesis, 2006
4. Yin.Robert k, Studi Kasus Desain dan Metode, Rajagrafindo Persada, 2008
5. Riduwan, Skala pengukuran variable-variabel penelitian,Alfabeta, 2002
6. Tan, W. (2008). Practical Research Methods (Third Edition ed.). Singapore: Prentice Hall

Special Topic for Environmental Engineer
ENEV 802 104
3 Credits
Learning Outcomes:
1. Able to explore (C4) the latest specific advanced environmental engineering problems through secondary data and / or primary data (observations, interviews, measurements, discussions, etc.) by considering public policies, social impacts and / or business objectives
2. Able to predict (C5) sustainable environmental engineering solutions to environmental engineering problems that are explored critically and innovatively

Competence in Curriculum:

1. Able to analyze possible solutions to problems, questions or complex issues relevant to environmental engineering (ELO 1)
2. Able to determine advanced concepts and principles that are appropriate to provide solutions to complex problems in the Environmental Engineering field (ELO 3)

Syllabus: Environmental problems on a global, regional and national scale, current air, water, solid waste and land management technologies, decision support support systems in technology selection, modeling use in decision making.

Prerequisite: Environmental Quality Management

References:

According to the selected advanced environmental engineering issues

Mandatory Courses of Environmental Quality Management

Environmental Quality Management
ENEV 801 201
3 Credits

Learning Outcomes: Able to assess and predict the environmental quality of water, air and soil and decide the appropriate method of environmental quality protection for environmental pollution problem (C5)

Competence in Curriculum:

1. Able to analyze possible solutions to problems, questions or complex issues relevant to environmental engineering (ELO 1)
2. Able to carry out continuous performance analysis of work in the Environmental Engineering field from a systemic point of view (ELO 4)

Syllabus: Physical and chemical aspects of pollutants in the aquatic environment, parameters and water quality standards (stream standard, effluent standard), index of aquatic environmental quality (Pollution Index, WQI, Storet), transport of pollutants in the aquatic environment (advection, diffusion, reaction,]] water quality protection methods.

Physical and chemical aspects of air pollutants, air quality parameters and quality standards (emission standards, ambient standards), air quality index (ISPU, AQI), air pollutant transport (gaussian method), air quality protection methods

Physical and chemical aspects of soil pollutants, polluted soil criteria, polluted soil index (Average Quality Index, Nemerow Pollution Index, Enrichment Factor), soil quality protection methods

Prerequisite: -

References:

1. Mary K. Theodore, Louis Theodore. 2010. Introduction to Environmental Management. CRC Press

Solid Waste Treatment Technology
ENEV 801 202
3 Credits

Learning Outcomes:

1. Able to apply the knowledge about solid waste treatment in the design process and processing operations
2. Able to communicate and work in the team

Competence in Curriculum: Able to determine advanced concepts and principles that are appropriate to provide solutions to complex problems in Environmental Engineering the field (ELO 3)

Syllabus:

Overview of Integrated Solid Waste Management: the concept of sustainable solid waste management, the development of IWMS (case studies and analysis), elements of IWM; physical, chemical, biological and solid waste generation characteristics; biological, mechanical, mechanical-biological processing; thermal processing, landfilling and coating technology; solid waste recirculation; field surveys, structural design and planning for operating units.

Prerequisite:

Integrated Solid Waste Management Planning

References:

1. Integrated Solid Waste Management, Geroge Tchobanoglous, Hilary Theisen, Samuel A. Vigil, McGraw Hill International Edition, 1993.
2. Handbook of Solid Waste Management, George Tchobanoglous, Frank Kreith, McGraw Hill, 2002.

Waste to Energy
ENEV 802 201
3 Credits

Learning Outcomes:

Able to identify problems related to energy in Indonesia, and analyze the use of waste as an energy source in order to determine the waste-to-energy technology.

Competence in Curriculum:

Able to determine advanced concepts and principles that are appropriate to provide solutions to complex problems in Environmental Engineering the field (ELO 3)

Syllabus:

Energy requirements and solid waste management; Characteristics of Solid Waste and Feedstock Preparation for Waste to Energy; Impact of Waste into energy on the environment and social; Biological Treatment Mechanical Technology and Mechanical Recovery Facility; Waste to energy technology (Thermal, physicochemical, biological); Air Pollution Control; Utilization of gas in the landfill as an energy source; LandGem Method

Prerequisite: -

References:

1. McBean, E.A., Rovers, F.A., Farquhar, G.J. 1995. Solid Waste Landfill Engineering and Design. Prentice Hall: USA.
2. Tschobanoglous, G. dan Kreith, F. 2002. Handbook of Solid Waste management. 2nd ed. McGraw-Hill USA.
3. Tschobanoglous, G; Theisen, H., dan Vigil, S. 1993. Integrated Solid Waste Management. McGraw-Hill USA.
4. Haug. R.T. 1993. The Practical Handbook of Compost Engineering. Lewis Publisher: USA.
5. Damanhuri,E. dan Padmi, T. 2016. Pengelolaan Sampah Terpadu. Penerbit ITB: Bandung, Indonesia.

Life Cycle Assessment

ENEV 802 202
3 Credits

Learning Outcomes:

Able to use a set of models to carry out an assessment of sustainable solid waste management.

Competence in Curriculum:

Able to carry out continuous performance analysis of work in the Environmental Engineering field from a systemic point of view (ELO 4)

Syllabus:

Overview Integrated Solid waste Management, sustainable solid waste management, IWMS development (case studies and analysis), elements of IWM, solid waste generation and composition, waste collection, central sorting, biological treatment, thermal treatment, landfilling, material recycling, models: STAN 2, Prognosis, and IWM 2

Prerequisite:

Integrated Solid Waste Management Planning

References:

1. Integrated Solid Waste Management, Geroge Tchobanoglous, Hilary Theisen, Samuel A. Vigil, McGraw Hill International Edition, 1993.
2. Handbook of Solid Waste Management, George Tchobanoglous, Frank Kreith, McGraw Hill, 2002.
3. Integrated Solid Waste Management: a Life Cycle Inventory, Forbes McDougall, Peter White, Marina Franke, Peter Hindle, Blackwell Science, 2001.
4. Integrated Solid Waste management : a Life Cycle Inventory, Forbes R. McDougall, Peter R. White, Marina Franke, Peter Hindle, The Blackwell Science, 2001.

Emission Control

ENEV 803 201
3 Credits

Learning Outcomes:

Able to analyze and evaluate the types and sources of greenhouse gas emissions caused by solid waste management activities and the methods to control them.

Competence in Curriculum:

1. Able to determine advanced concepts and principles that are appropriate to provide solutions to complex problems in the Environmental Engineering field (ELO 3)
2. Able to carry out continuous performance analysis of work in the Environmental Engineering field from a systemic point of view (ELO 4)

Syllabus:

Processes in managing solid waste that produce emissions, Greenhouse Gases, Inventory emissions, Control of emissions at the final waste processing site, landfill design for emissions control, control of emissions by using technology. Learning is done through interactive lectures, assignments and assistance. Learning activities are also conducted based on research. The scope of the study are solid waste and its management, emissions produced, and its prevention. Indonesian and English are used during the learning process.

Prerequisite:

Air Pollution

References:

1. Tchobanoglous, G., Thiessen, H., & Vigil, S. (2003). Integrated Solid Waste Management: Engineering Principles and Management Issues. Singapore: McGraw-Hill Inc.
2. Nevers, N.D., Air Pollution Engineering, McGraw-Hill, USA, 2000
3. US Environmental Protection Agency. (2015). LFG Energy Project Development Handbook

Mandatory Courses of Water Quality Technology and Engineering Specialization

Advanced Water Engineering

ENEV 801 301
3 Credits

Learning Outcomes: Able to choose and specify the types of physical, chemical, and / or biological treatment needed to recycle water or wastewater with nutrient removal / recovery as well as refractory / priority / emerging pollutant removal.

Competence in Curriculum:

Able to determine advanced concepts and principles that are appropriate to provide solutions to complex problems in the Environmental Engineering field (ELO 3)

Syllabus:

Development of water treatment technology; Challenges, trends and perspectives in the field of water treatment; Quality standards and impacts of nutrients (organic nitrogen, ammonia, nitrites and nitrates, phosphorus) in the environment; Alternative allowance and recovery nutrient technology;

Biological nutrient recovery processes; constructed wetlands; Water recycling; Potential and risks of water recycling; Regulation and quality of recycled water; Refractory / priority / emerging pollutant; Adsorption process; Membrane filtration process; Advanced oxidation processes (AOPs); Hybrid process for sustainable water treatment; System and processing level; Technology selection; Aspects of people's attitudes and perceptions; Techno-economic aspects.

Prerequisite:

References:

1. Qasim, S. R., Zhu, G. (2018). Wastewater treatment and reuse, theory and design examples. Volume 1, Post-treatment, reuse, and disposal. Taylor & Francis Group, LLC. CRC Press. ISBN: 13978-1-138-30094-1
2. Diaz-Elsayed, N., Rezaei, N., Guo, T., Mohebbi, S., & Zhang, Q. (2019). Wastewater-based resource recovery technologies across scale: A review. Resources, Conservation and Recycling, 145, 94–112. https://doi.org/10.1016/j.resconrec.2018.12.035
3. Grandclément, C., Seyssiecq, I., Piram, A., Wong-Wah-Chung, P., Vanot, G., Tiliacos, N., … Doumenq, P. (2017). From the conventional biological wastewater treatment to hybrid processes, the evaluation of organic micropollutant removal: A review. Water Research, 111, 297–317. https://doi.org/10.1016/j.watres.2017.01.005

<u>Instrumentation and Measurement of Environmental Quality</u>
ENEV 801 302
3 Credits

Learning Outcomes:

Able to choose the sampling method and instrumentation in appropriately analyzing environmental quality based on examples of environmental media and pollutant substances.

Competence in Curriculum:

Able to carry out continuous performance analysis of work in the Environmental Engineering field from a systemic point of view (ELO 4)

Syllabus:

Composite water samples, automatic water sampler, air sampling, high volume sampler, passive sampler, particulate matter measurement, noise measurement, gas concentration measurement, metal measurement using AAS and ICP-MS, measurement of organic pollutants with gas chromatography, morphological characterization of material environment (SEM, etc), analysis of interrelated environment parameters.

Prerequisite:

References: -

<u>Urban Wastewater Quality Management</u>
ENEV 802 301
3 Credits

Learning Outcomes:

Able to compare the effectiveness of various urban wastewater management strategies by using mathematical water quality modeling as a decision support system to maintain or improve water quality.

Competence in Curriculum:

Able to carry out continuous performance analysis of work in the Environmental Engineering field from a systemic point of view (ELO 4)

Syllabus:

Introduction to urban water management in spatial planning and urban infrastructure; Types of resources, designation of water, and availability of water; Statistical water quality; The role of water statistics in the management and modeling of water body quality; Critical water quality and water use in an infrastructure perspective; Water quality and urban waste loads in relation to causality and health risks; Calculation of pollution load of solid waste and liquid waste; Effectiveness of water pollution control plans; Determination of capacity and load in surface water; Calculation of Total Maximum Daily Load (TMDL) in water bodies; Technology and policy interventions in controlling the quality of urban water and waste; Capacity prediction with water quality modeling (QUAL2E, Epanet, Aquatox); Application of water quality management cases for urban areas using software

Prerequisite:

Environmental Chemistry, Domestic Wastewater Treatment Plant Design, Environmental Data Analysis

References:

1. Steven C. Chapra, Waveland Press, 2008, Surface Water-Quality Modeling
2. Roger A. Falconer, Routledge, 2018, Water Quality Modelling

<u>Sustainable Environmental Infrastructure</u>
ENEV 802 302
3 Credits

Learning Outcomes:

Able to understand and apply the principle of sustainability in the planning and management of natural resources, infrastructure and problem solving in the field of environmental engineering.

Competence in Curriculum:

Able to determine advanced concepts and principles that are appropriate to provide solutions to complex problems in the Environmental Engineering field (ELO 3)

Syllabus:

Various issues and trends in environmental management; History, background, targets and indicators of Sustainable development; The principle of sustainable infrastructure; Sustainable paradigms in the design process; Pillars / frameworks for sustainable infrastructure development; Green building concepts and criteria; Water supply and appropriate sanitation; Conservation and efficiency of water use; Water footprint; Water balance; Low impact development; Greenhouse Energy and Gas; Renewable energy; Energy efficiency; Green materials; Planning for a sustainable infrastructure cycle; Tools for measuring sustainability

Prerequisite:

References:

1. Ferrer, A. L. C., Thomé, A. M. T., & Scavarda, A. J. (2018). Sustainable urban infrastructure: A review. Resources, Conservation and Recycling, 128, 360–372. https://doi.org/10.1016/j.resconrec.2016.07.017
2. Charles J. Kibert.(2016). Sustainable Construction: Green Building Design and Delivery 4th edition. John Wilye & Sons, Inc.

3. S. Bry Sarte. (2010). Sustainable infrastructure: The Guide to Green Engineerng and Design. John Wiley & Sons, Inc.

Contamination and Environmental Remediation
ENEV 803 301
3 Credits

Learning Outcomes:

Able to prepare a design program for land remediation that is contaminated by the industrial activities or accidents

Competence in Curriculum:

1. Able to determine advanced concepts and principles that are appropriate to provide solutions to complex problems in the Environmental Engineering field (ELO 3)
2. Able to carry out continuous performance analysis of work in the Environmental Engineering field from a systemic point of view (ELO 4)

Syllabus:

Potential activities of contamination of B3 material to the environment (soil and groundwater); The types and forms of B3 pollutants; The pattern and characteristics of the trip and the spread of contaminants in the soil; Impacts and risks of pollutants to the environment; the method of eliminating the spread of contaminants in the soil; Methods for recovering land contaminated with B3 material; Physical, Chemical and Biochemical Recovery; Technical design of land and groundwater remediation; Economic and financial aspects for remediation projects; and examples of the case studies in the field.

Prerequisite:

Environmental Laboratory, Environmental Microbiology, Unit Operation and Process, Hazardous dan Industrial Waste Treatment

References:

1. Remediation Engineering: Design Concept, Suthan S., CRC Lewis Publisher, 1999;
2. Innovations in Ground Water and Soil Cleanup: From Concept to Commercialization, National Research Council. National Academy Press.1997;
3. Environmental Hydrogeology, Philip E. LaMoreaux[et al], CRC Press.2009;
4. Pengantar Prinsip Pengelolaan Limbah B3, Firdaus Ali,Global Enviro. 2011

Elective Courses

Environmental Audit
ENEV 802 105
3 Credits

Learning Outcomes:

Able to conduct audits and prepare environmental audit reports

Competence in Curriculum:

Able to carry out continuous performance analysis of work in the Environmental Engineering field from a systemic point of view (ELO 4)

Syllabus:

Definition, principles, concepts and environmental policies in the Environmental Audit. Legal Basis for Environmental Policy and Regulations. AL Principle (Determine the main issues and scope of the audit). ISO 1400 Understanding: Enhancing Environmental Management and Sustainable Development. Study on Environmental Management Plan / RKL and Environmental Management Plan / RPL. Basic Audit Principles (Basic principles, procedures, hierarchy and processes in environmental auditing). Types of Audits (Obedience Audit, Waste Audit, Process Audit). Audit Method (procedures for determining, weighting, importance and valuation in an environmental audit). Audit Documents. Audit Case Study (review of case documents).

Prerequisite:

References:

1. ”Audit and Reduction Manual for Industrial Emissions and Wastes”; United Nations Environment Programme, Industry and Environment Office, United Nations Industrial Development Organization. ISBN: 92-807-1303-5
2. ”Moving Ahead with ISO 14000”, Improving Environmental Management and Advancing Sustainable Development; edited by: Philip A. Marcus & John T. Willig, Wiley Series in Environmental Quality Management John Wily & Sons, Inc, 1997, ISBN 0-471-16877-7.
3. “Panduan Audit Sistem Manajemen Mutu dan/atau Lingkungan”; SNI 19-19011-2005. Badan Standarisasi Nasional.

Environmental System Dynamics
ENEV 803 106
3 Credits

Learning Outcomes:

1. Able to analyze the basic principles of the environment as a system with the interaction of environmental components (social, natural and artificial) (C4)
2. Able to predict the amount, concentration, level of danger and the impact of pollutants in the environment (C3)

Competence in Curriculum:

Able to carry out continuous performance analysis of work in the Environmental Engineering field from a systemic point of view (ELO 4)

Syllabus:

Basic understanding of environmental systems with natural, artificial and social environmental subsystems; The dynamics of the environmental system (integration of the basic principles of environmental science: interaction, interpedence, diversity, harmony and sustainability); The dynamics of the physical environment system (material and energy cycle, hydrological cycle, food chain and environmental pollution disturbance); Management model of the physical environment system (determining factors, media and the interaction of physical components of the environment in the environmental system); Social system management models (conflict management and environmental mediation); Systems theory (General Theoretical Distinctions, Misunderstandings, Strengths of Systems Theory, Systems Framework, General Systems Theory Principles, System Characteristics, Contingency Theory, The Learning Organization, Application of system dynamics), Dynamics Theory (Basic system behaviour, Exponential growth, Goal seeking, Oscillation, S-shaped growth, S-shaped with overshoot, Overshoot and collapse, Application of system dynamics) Theory Modeling System, (Model classification, Dynamical Systems, System analysis-System dynamics and thinking, Open Systems, General Systems Theory (GST), GST Traits, System Classification, Systems Analysis and Modelling, Activity Modelling (IDEFo), Case Study.

Prerequisite:

References:

1. FTyller Miller, Living in The Environment, McGraw-Hill, Singapore, 1994
2. Amy, The Polities of Environmental Mediation, Columbia University Press, 1987
3. Fisher dkk, Mengelola Konflik Ketrampilan dan Strategi Untuk Bertindak, The British Council, Jakarta, 2000

Special Courses

Pre Master Thesis

ENEV 800 105
2 Credits

Learning Outcomes:

Able to apply specificity knowledge / specialization that has been obtained in conducting initial research, analyzing the results and describing them verbally through presentation and seminar books

Competence in Curriculum:

Experiment, Communication, Lifelong Learning

Syllabus:

Prerequisite: Research Method

References:

Master Thesis

ENEV 800 106
6 Credits

Learning Outcomes:

1. Able to integrate Environmental Engineering knowledge in designing and conducting research in order to solve problems, analyze and interpret research data to obtain valid conclusions
2. Able to analyze and interpret research data to obtain valid conclusions
3. Able to describe and present the results of research in the form of scientific papers (Master Thesis)

Competence in Curriculum:

Research/Experiment, Communication, Lifelong Learning

Prerequisite: Research Method and Pre Master Thesis

References: -

Scientific Publication

ENEV 800 107
2 Credits

Learning Outcomes:

Able to explain the results of research in scientific writing using Indonesian / English that is good and correct according to the standards of writing journals / proceedings intended

Competence in Curriculum:

Conducting an analysis of effective communication to technical and non-technical audiences (ELO 5)

Syllabus: academic writing and effective writing

Prerequisite: Master Thesis

References: Relevant references to the research topic in the Master Thesis

Master Program in Mechanical Engineering

Program Specification

1.	**Awarding Institution**	Universitas Indonesia	
2.	**Organizer Institution**	Universitas Indonesia	
3.	**Faculty**	Engineering	
4.	**Study Programme**	Mechanical Engineering Masters Program	
5.	**Visi dan Misi Prodi**	VISI As a center of research and education services that excel in mechanical engineering MISI Carry out research and research-based education for the development of science and technology in the field of mechanical engineering, and conduct research and education that seeks its use to improve the level and quality of people's lives and humanity.	
6.	**Classes**	Reguler	
7.	**Final Award**	Magister Teknik (MT.)	
8.	**Accreditation / Recognition**	Accreditation of BAN-PT, with status A.	
9.	**Languages**	Bahasa Indonesia and English	
10.	**Study Scheme (Full Time / Part-Time)**	Full Time	
11.	**Entrance Requirements**	Bachelor in Engineering, Mathematics and Physics; and pass the entrance exam	
12.	**Duration of Study**	Designed for 2 years	
	Type of Semester	Number of semester	Number of weeks/semesters
	Reguler	4	17
	Short (opsional)	**1**	**8**
13.	**Aims of the programme:** 1. Producing Mechanical Engineering Masters Program graduates who meet the specified learning outcomes 2. Contribute to the development of scientific and mechanical technology 3. Contribute to improving the quality of society and industry		
14.	**Profile of Graduates:** Masters of Mechanical Engineering who is able to analyze and design energy systems, industrial machinery, building facilities, and the transportation industry in contributing to meeting the goals of sustainable development.		
15.	**Expected Learning Outcomes (ELO) :** 4. Able to develop logical, critical, systematic and creative thinking through scientific research, the creation of designs or works of art in the fields of science and technology that pay attention to and apply humanities in accordance with their fields of expertise, compile scientific conceptions and study results based on rules, procedures and scientific ethics in the form of a thesis or other equivalent form and uploaded on the university website, as well as papers that have been published in accredited scientific journals or accepted in international journals 5. Able to carry out academic validation or study according to their area of expertise in solving problems in the relevant society or industry through developing their knowledge and expertise 6. Able to arrange ideas, results of thought, and scientific arguments responsibly and based on academic ethics, and communicate them through the media to the wider community 7. Able to identify scientific fields that are the object of research and position them into a research map that is developed through an interdisciplinary or multidisciplinary approach 8. Able to take decisions in the context of solving problems in developing science and technology that pay attention to and apply humanities values based on analytical or experimental studies of information and data 9. Able to manage, develop and maintain a network of colleagues, colleagues within the wider research institute and community 10. Able to increase the learning capacity independently 11. Able to document, store, secure, and rediscover research data in order to ensure validity and prevent plagiarism 12. Able to be responsible to the community and to comply with professional ethics in solving technical problems 13. Able to carry out a lifelong learning process including access to knowledge related to current issues		

As a University of Indonesia student, every graduate of the Mechanical Engineering Masters program also has the following competencies:

1. Able to use information communication technology;
2. Able to think critically, creatively, and innovatively and have an intellectual curiosity to solve problems at the individual and group level;
3. Able to use spoken and written languages in Indonesian and English well for academic and non-academic activities;
4. Having integrity and being able to respect others;
5. Able to identify various entrepreneurial efforts characterized by innovation and independence based on ethics

In the Mechanical Engineering Masters Program 2020 Curriculum, there are 6 (six) Specialization programs that can be selected by students according to their academic abilities and interests, namely in the Specialization field:

1. Energy Conversion and Conservation
2. Fire and Building Safety Technology
3. Design and Manufacturing
4. Manufacturing and Automation Systems
5. Advanced Vehicle Engineering
6. Maritime Technology and Resources
7.

More specifically, in addition to the 10 items of competency as mentioned above, the graduates of the Master of Engineering Program will have competencies in accordance with their fields of specialization as follows:

1. Competence in the field of Energy Conversion and Conservation: Able to analyze, implement and design mechanical systems that utilize laws and current phenomena and technologies related to the field of Energy Conversion and conservation.
2. Competence in the field of Fire and Building Safety Technology: able to analyze, implement and design efficient building utility systems, and performance-based fire safety for buildings and industrial buildings.
3. Competence in the field of Design and Manufacturing: able to analyze, implement and design products and manufacturing processes and their assembly by integrating the latest design and manufacturing technology.
4. Competence in the field of Manufacturing and Automation Systems: able to analyze, implement and design manufacturing and automation systems used for the process of developing and manufacturing manufactured products by utilizing the latest manufacturing and automation technology.
5. Competence in the field of Advanced Vehicle Engineering: able to analyze, and design vehicle systems and heavy equipment for transportation, the construction industry, minerals and energy.
6. Competence in the field of Technology and Maritime Resources: able to analyze, and design systems and apply maritime technology that is appropriate for sustainable utilization of maritime resources.

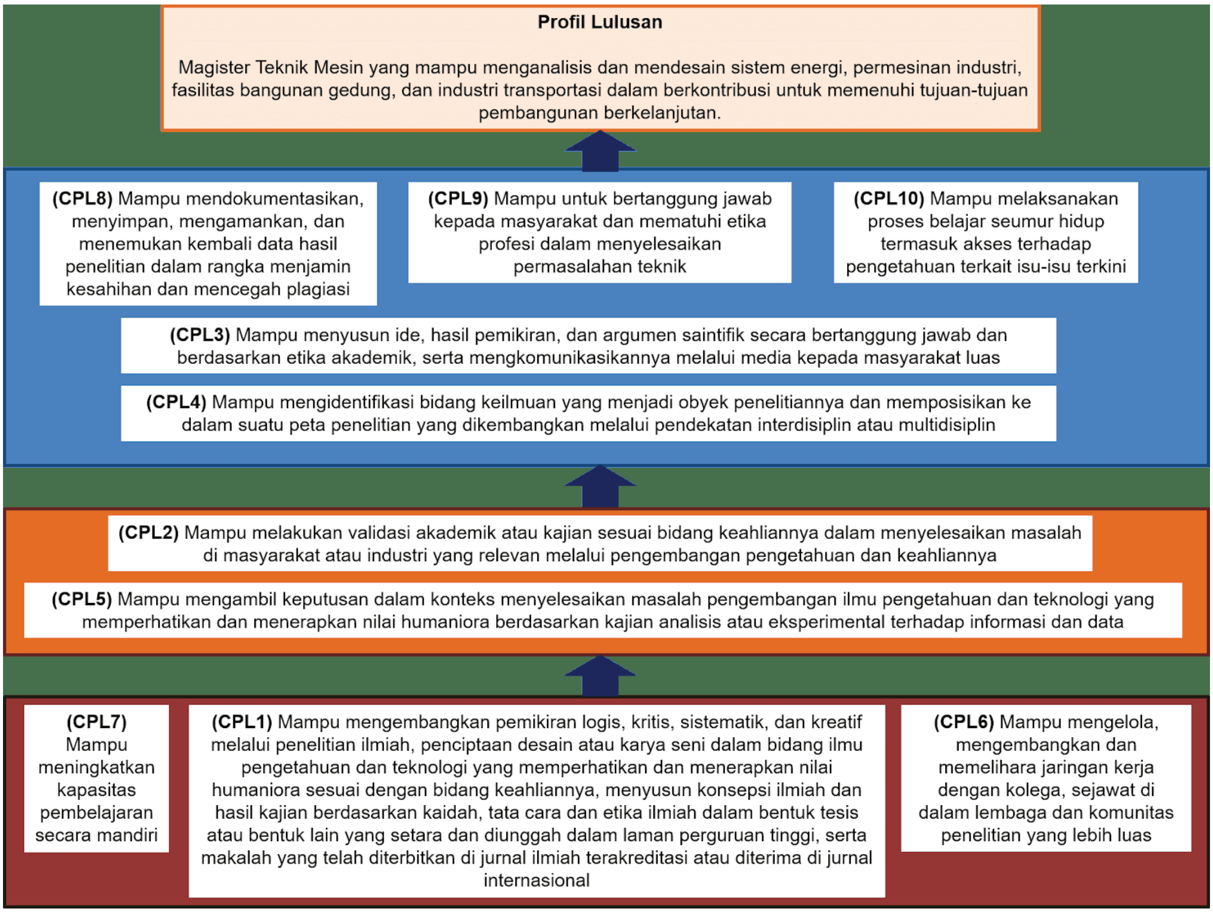
16. Composition of Subjects

No.	Classification	Credit Hours (SKS)	Percentage
i	**Study Program Mandatory Subjects**	**10**	**25,00**
ii	**Specialization Mandatory Subjects**	**16**	**40,00**
iii	**Elective Specialization Subjects**	**8**	**20,00**
iv	**Publication, Final Projects**	**6**	**15,00**
	Total	**40**	**100 %**
	Total Credit Hours to Graduate		**40 SKS**

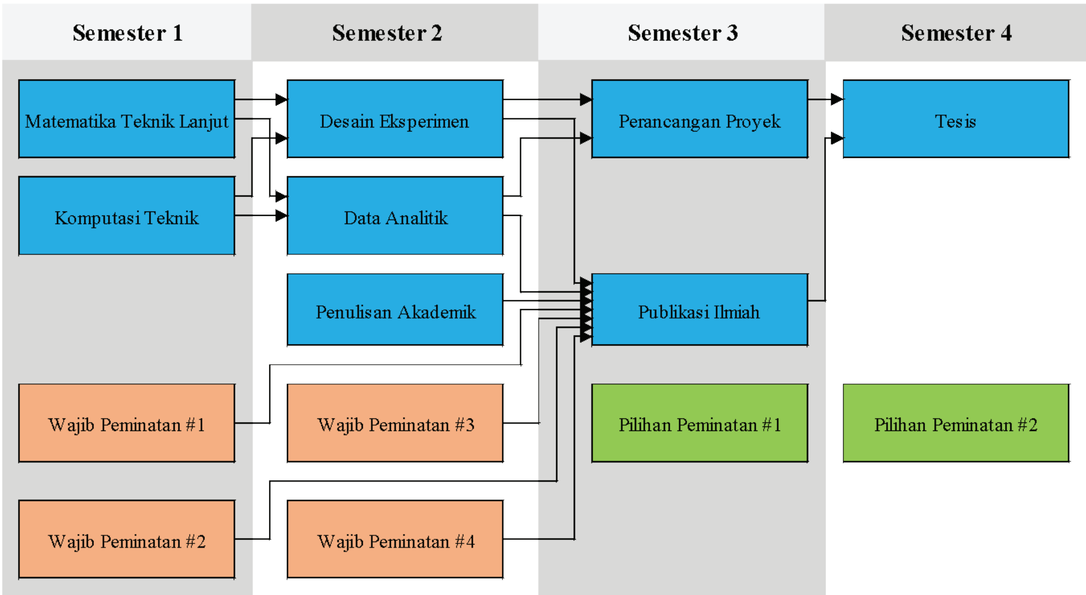
Job Prospects

Graduates of the Mechanical Engineering master's study program have devoted themselves to various fields such as the energy system industry, industrial machinery, transportation building buildings, educational and research institutions and other industries

Learning Outcomes, Mechanical Engineering Masters Program



Course Flowchart to Achieve Graduate Learning Outcomes



Capaian Pembelajaran	Tahun ke-1		Tahun ke-2	
	Semester 1	Semester 2	Semester 3	Semester 4
1. Mampu mengembangkan pemikiran logis, kritis, sistematik, dan kreatif melalui penelitian ilmiah, penciptaan desain atau karya seni dalam bidang ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan bidang keahliannya, menyusun konsepsi ilmiah dan hasil kajian berdasarkan kaidah, tata cara dan etika ilmiah dalam bentuk tesis atau bentuk lain yang setara dan diunggah dalam laman perguruan tinggi, serta makalah yang telah diterbitkan di jurnal ilmiah terakreditasi atau diterima di jurnal internasional	Matematika Teknik Lanjut →	Desain Eksperimen →	Perancangan Proyek →	Tesis

Capaian Pembelajaran	Tahun ke-1		Tahun ke-2	
	Semester 1	Semester 2	Semester 3	Semester 4
2. Mampu melakukan validasi akademik atau kajian sesuai bidang keahliannya dalam menyelesaikan masalah di masyarakat atau industri yang relevan melalui pengembangan pengetahuan dan keahliannya	Matematika Teknik Lanjut → Komputasi Teknik →	Data Analitik		

Capaian Pembelajaran	Tahun ke-1		Tahun ke-2	
	Semester 1	Semester 2	Semester 3	Semester 4
3. Mampu menyusun ide, hasil pemikiran, dan argumen saintifik secara bertanggung jawab dan berdasarkan etika akademik, serta mengkomunikasikannya melalui media kepada masyarakat luas	Wajib Peminatan #1 Wajib Peminatan #2	Penulisan Akademik Wajib Peminatan #3 Wajib Peminatan #4	Publikasi Ilmiah	

Capaian Pembelajaran	Tahun ke-1		Tahun ke-2	
	Semester 1	Semester 2	Semester 3	Semester 4
4. Mampu mengidentifikasi bidang keilmuan yang menjadi obyek penelitiannya dan memposisikan ke dalam suatu peta penelitian yang dikembangkan melalui pendekatan interdisiplin atau multidisiplin	Wajib Peminatan #1 Wajib Peminatan #2	Wajib Peminatan #3 Wajib Peminatan #4		

Capaian Pembelajaran	Tahun ke-1		Tahun ke-2	
	Semester 1	Semester 2	Semester 3	Semester 4
5. Mampu mengambil keputusan dalam konteks menyelesaikan masalah pengembangan ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora berdasarkan kajian analisis atau eksperimental terhadap informasi dan data	Komputasi Teknik	Data Analitik		Tesis

Capaian Pembelajaran	Tahun ke-1		Tahun ke-2	
	Semester 1	Semester 2	Semester 3	Semester 4
6. Mampu mengelola, mengembangkan dan memelihara jaringan kerja dengan kolega, sejawat di dalam lembaga dan komunitas penelitian yang lebih luas		Penulisan Akademik		

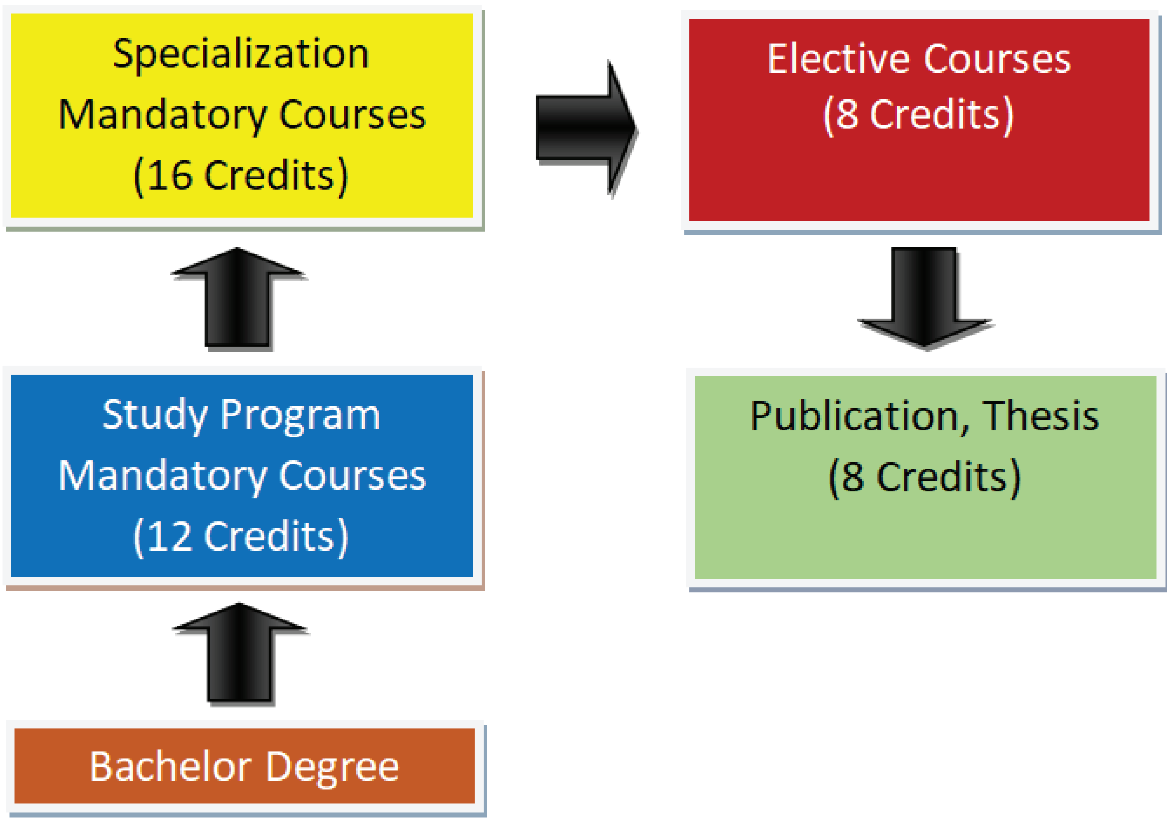
Capaian Pembelajaran	Tahun ke-1		Tahun ke-2	
	Semester 1	Semester 2	Semester 3	Semester 4
7. Mampu meningkatkan kapasitas pembelajaran secara mandiri			Pilihan Peminatan #1	Pilihan Peminatan #2

Capaian Pembelajaran	Tahun ke-1		Tahun ke-2	
	Semester 1	Semester 2	Semester 3	Semester 4
8. Mampu mendokumentasikan, menyimpan, mengamankan, dan menemukan kembali data hasil penelitian dalam rangka menjamin kesahihan dan mencegah plagiasi		Penulisan Akademik →	Publikasi Ilmiah →	Tesis

Capaian Pembelajaran	Tahun ke-1		Tahun ke-2	
	Semester 1	Semester 2	Semester 3	Semester 4
9. Mampu untuk bertanggung jawab kepada masyarakat dan mematuhi etika profesi dalam menyelesaikan permasalahan teknik			Perancangan Proyek	

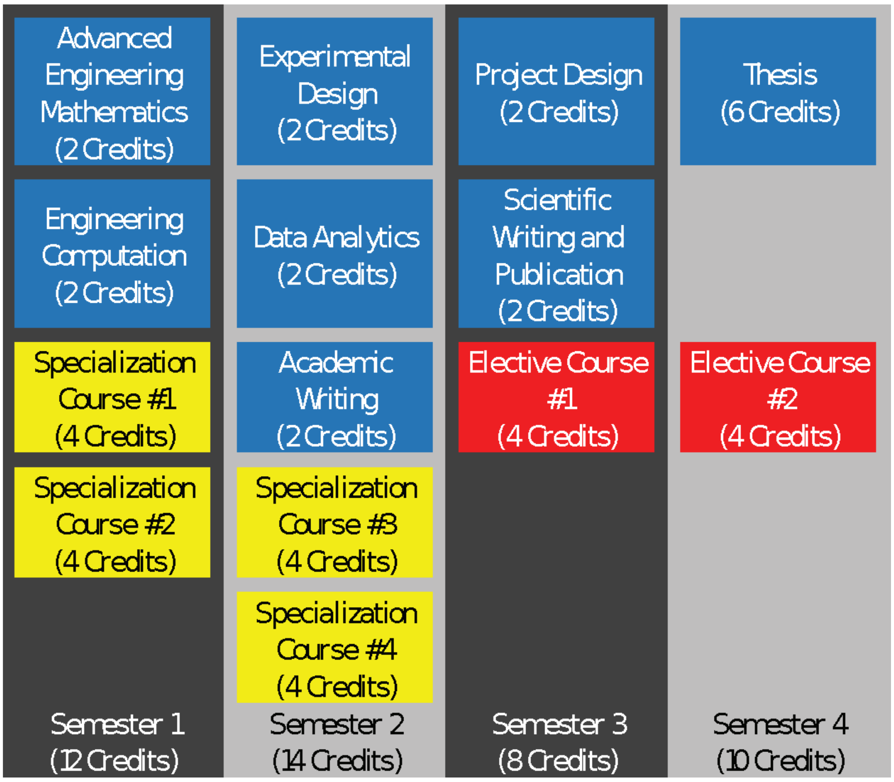
Capaian Pembelajaran	Tahun ke-1		Tahun ke-2	
	Semester 1	Semester 2	Semester 3	Semester 4
10. Mampu melaksanakan proses belajar seumur hidup termasuk akses terhadap pengetahuan terkait isu-isu terkini			Pilihan Peminatan #1	Tesis Pilihan Peminatan #2

Curriculum Structure



Subjects Flowchart

During the study period, students of the Mechanical Engineering Masters program can choose and arrange their courses flexibly according to the amount of credits in each course. The following are general scenarios for the subject flow diagram for the Mechanical Engineering Masters program:



Curriculum Structure of Mechanical Engineering Masters Program

Code	Subject	SKS
	1st Semester	
ENME801002	Advanced Engineering Mathematics	4
ENME802004	Engineering Computation	8
	Specialization Course #1	4
	Specialization Course #2	4
	Subtotal	**12**
	2nd Semester	
ENME802002	Experimental Design	2
ENME802006	Data Analytics	2
ENME802003	Academic Writing	2
	Specialization Course #3	4
	Specialization Course #4	4
	Subtotal	**14**
	3rd Semester	
ENME802007	Project Design	2
ENME800005	Scientific Publication	2
	Elective Course #1	4
	Subtotal	**8**
	4th Semester	
ENME800007	Thesis	6
	Elective Course #2	4
	Subtotal	**10**
	Total	**44**

Specialization in Energy Conversion and Conservation

Code	Subject	SKS
	1st Semester	
ENME801002	Advanced Engineering Mathematics	2
ENME802004	Engineering Computation	2
ENME801101	Advanced Thermodynamics	4
ENME801102	Advanced Fluid Dynamics and Heat Transfer	4
	Subtotal	**12**
	2nd Semester	
ENME802002	Experimental Design	2
ENME802006	Data Analytics	2
ENME802003	Academic Writing	2
ENME802103	Energy Optimization System	4
ENME803104	Thermal Power Generation	4
	Subtotal	**10**
	3rd Semester	
ENME802007	Project Design	2
ENME800005	Scientific Publication	2
	Elective Course #1	4
	Subtotal	**8**
	4th Semester	
ENME800007	Thesis	6
	Elective Course #2	4
	Subtotal	**10**
	Total	**44**

Elective Courses of Specialization in Energy Conversion and Conservation

Code	Subject	SKS
	3rd Semester	
ENME803105	Internal Combustion Engine	4
ENME803106	Applied Flow Measurement and Visualization	4
ENME803107	CFD Application	4
ENME803124	Energy Audit	4
ENME803196	Jet and Rocket Propulsion	4
	4th Semester	
ENME804109	Heat and Mass Transfer Engineering	4
ENME804110	Combustion Engineering	4
ENME804111	Aerodynamics Engineering	4
ENME803108	Refrigeration Engineering	4
ENME804112	Turbomachinery	4

Specialization in Fire and Building Safety Technology

Code	Subject	SKS
	1st Semester	
ENME801002	Advanced Engineering Mathematics	2
ENME802004	Engineering Computation	2
ENME802133	Fire and Building science	4
ENME801113	Ventilation and Air Conditioning System	4
	Subtotal	**12**
	2nd Semester	
ENME802002	Experimental Design	2
ENME802006	Data Analytics	2
ENME802003	Academic Writing	2
ENME802131	Fire Protection System	4
ENME802132	Building Mechanical and Electrical System	4
	Subtotal	**14**
	3rd Semester	
ENME802007	Project Design	2
ENME800005	Scientific Publication	2
	Elective Course #1	4
	Subtotal	**8**
	4th Semester	
ENME800007	Thesis	6

	Elective Course #2	4
	Subtotal	**10**
	Total	**44**

Elective Courses of Specialization in Fire and Building Safety Technology

Code	Subject	SKS
	3rd Semester	
ENME803134	Fire Dynamics and Modelling	4
ENME803115	Clean Room	4
ENME803116	Plumbing and Waste Water Treatment System	4
ENME803117	Building Environment Assessment	4
ENME803135	Fire Fighting Engineering and Strategy	4
ENME803136	Fire Safety Management in Building	4
ENME802103	Energy System Optimization	4
ENME804118	Mechanical system for Building	4
ENME804119	Accoustics	4
ENME804137	Fire Investigation Engineering	4
ENME804138	Fire Safety Analysis	4
ENME804133	Forest and Land Fires	4
ENME804139	Fire Protection in Process Industry	4

Specialization in Design and Manufacturing

Code	Subject	SKS
	1st Semester	
ENME801002	Advanced Engineering Mathematics	2
ENME802004	Engineering Computation	2
ENME801140	Materials and Manufacturing Processes	4
ENME801141	Product Design and Development Methodology	4
	Subtotal	**12**
	2nd Semester	
ENME802002	Experimental Design	2
ENME802006	Data Analytics	2
ENME802003	Academic Writing	2
ENME802142	Design and Manufacturing Technology Integration	4
ENME803143	Mechanical Failure	4
	Subtotal	**14**
	3rd Semester	
ENME802007	Project Design	2
ENME800005	Scientific Publication	2
	Elective Course #1	4
	Subtotal	**8**
	4th Semester	
ENME800007	Thesis	6
ENME800008	Elective Course #2	4
	Subtotal	**10**
	Total	**44**

Elective Courses of Specialization in Design and Manufacturing

Code	Subject	SKS
	3rd Semester	
ENME803144	Dynamics of Mechanical System	4
ENME803145	Composite Product Development	4
ENME803146	Finite Element and Multiphysics	4
ENME803147	Toy Production Design	4
ENME803161	Micromachining Process	4
ENME803154	Quality and Production Management System	4
ENME803174	**Risk Management**	**4**
	4th Semester	
ENME804148	Design for Manufacturing and Assembly	4
ENME804149	Noise and Vibration Control	4
ENME804162	Laser Assisted Process	4
ENME804155	**CAD/CAM**	**4**
ENME804156	**Manufacturing Performance Assessment**	**4**

Specialization in Manufacturing and Automation Systems

Code	Subject	SKS
	1st Semester	
ENME801002	Advanced Engineering Mathematics	2
ENME802004	Engineering Computation	2
ENME801150	Management of Manufacturing Information System	4
ENME801151	Manufacturing System and Processes	4
	Subtotal	**12**
	2nd Semester	
ENME802002	Experimental Design	2
ENME802006	Data Analytics	2
ENME802003	Academic Writing	2
ENME802152	Automation and Robotics	4
ENME803153	Machine Vision System	4
	Subtotal	**14**
	3rd Semester	
ENME802007	Project Design	2
ENME800005	Scientific Publication	2
	Elective Course #1	4
	Subtotal	**8**
	4th Semester	

ENME800007	Thesis	6
	Elective Course #2	4
	Subtotal	**10**
	Total	**44**

Elective Courses of Specialization in Manufacturing and Automation Systems

Code	Subject	SKS
	3rd Semester	
ENME803154	Quality and Production Management System	4
ENME803174	Risk Management	4
ENME803144	Dynamics of Mechanical System	4
ENME803145	Composite Product Development	4
ENME803146	Finite Element and Multiphysics	4
ENME803161	Micromachining Process	4
	4th Semester	
ENME804155	CAD/CAM	4
ENME804156	Manufacturing Performance Assessment	4
ENME804148	Design for Manufacturing and Assembly	4
ENME804162	Laser Assisted Process	4

Specialization in Advanced Vehicle Engineering

Code	Subject	SKS
	1st Semester	
ENME801002	Advanced Engineering Mathematics	2
ENME802004	Engineering Computation	2
ENME801163	Vehicle Engineering and Heavy Duty Equipment	4
ENME801164	Prime Mover and Powertrain System	4
	Subtotal	**12**
	2nd Semester	
ENME802002	Experimental Design	2
ENME802006	Data Analytics	2
ENME802003	Academic Writing	2
ENME802165	Vehicle Frame and Body Engineering	4
ENME803166	Vehicle Control System	4
	Subtotal	**14**
	3rd Semester	
ENME802007	Project Design	2
ENME800005	Scientific Publication	2
	Elective Course #1	4
	Subtotal	**8**
	4th Semester	
ENME800007	Thesis	6
	Elective Course #2	4
	Subtotal	**10**
	Total	**44**

Elective Courses of Specialization in Advanced Vehicle Engineering

Code	Subject	SKS
	3rd Semester	
ENME803167	Modern Vehicle Technology	4
ENME803195	Oil and Gas Drilling Equipment	4
ENME804168	Railway Vehicle Engineering	4
ENME804197	Handling and Construction Equipment	4
ENME804198	Aircraft Design and Performance	4

Specialization in Technology and Maritime Resources

Code	Subject	SKS
	1st Semester	
ENME801002	Advanced Engineering Mathematics	2
ENME802004	Engineering Computation	2
ENME801102	Advanced Fluid Dynamics and Heat Transfer (Maritime)	4
ENME801140	Materials and Manufacturing Processes (Maritime)	4
	Subtotal	**12**
	2nd Semester	
ENME802002	Experimental Design	2
ENME802006	Data Analytics	2
ENME802003	Academic Writing	2
ENME802181	Maritime Engineering and Management	4
ENME803182	Ocean Energy	4
	Subtotal	**14**
	3rd Semester	
ENME802007	Project Design	2
ENME800005	Scientific Publication	2
	Elective Course #1	4
	Subtotal	**8**
	4th Semester	
ENME800007	Thesis	6
	Elective Course #2	4
	Subtotal	**10**
	Total	**44**

Elective Courses of Specialization in Technology and Maritime Resources

Code	Subject	SKS
	3rd Semester	
ENME803183	Marine and Offshore Structure	4
ENME803184	Sea Transport and Port Management	4
ENME803185	Maritime Law and Regulation	4
ENME804192	**Supply Chain Technology**	**4**
ENME804193	**Cold Storage Technology**	**4**
	4th Semester	
ENME804186	Special Ship	4
ENME804187	Ship Production Management	4
ENME804189	Maritime Safety	4
ENME804190	Advanced Welding Engineering	4
ENME804191	Port Operation and Planning	4

Description of Courses

Advanced Engineering Mathematics
ENME801002
2 SKS
Learning Outcomes:

The purpose of this subject is to develop students' analytical skills. Students understand and are able to use advanced engineering mathematical concepts in solving applied engineering problems.

Topic:

Introduction to Differential Equations; Differential Equation Order 1; Differential Equation of Order 2; High Order Differential Equations; Vector Analysis; Differential Vector; Grad, Divergence and Curl Operations; Vector Integral; Laplace transform; Solving Differential Equations using Laplace Transform; Fourier transform; Convolution

Pre-requisite(s): -

References:

1. Chapra, Steven C. and Canale, Raymond P. Numerical Methods for Engineers 6th edition. New York: McGraw-Hill, 2010.
2. Kreyszig, Erwin. Advanced Engineering Mathematics 10th edition. Danvers: John Wiley & Sons, 2011.
3. Sedgewick R., Phillippe F, An Introduction to the Analysis of Algorithms, Addison Wesley.
4. Cheney W., Kincaid D., Numerical Mathematics and Computing, Cole Publishing

Engineering Computation
ENME802004
2 SKS
Learning Outcomes:

The purpose of this subject is that students know well and be able to apply the processes and methods (algorithms) of calculation (numerical and analytic) engineering in the real computer-based computing world and parameters that affect the speed and accuracy of the calculation results.

Syllabus :

Numerical Method: Equation roots, Numerical Diffential, Numerical Integral; Partial Differential Equation Solution. Introduction to Computer Applications: Algorithms and Algorithm Analysis; Computational Complexity; Types of Algorithms; Number Optimization and Representation; Overflow and Underflow; Error and Formula Error in Numerical; Root of Eq. Finite Divided Difference Method in calculating Equation Derivation; Numerical Integration; ODE and ODE systems in Computing Applications; Fast Fourier Transform; PDE in Computational Applications: Solutions of Elliptic, Parabolic, and Hyperbolic Equations with Numerical Methods; Application of Elliptic, Parabolic, and Hyperbolic PDE equation techniques; Monte Carlo in Computing Applications.

Pre-requisite(s): -

References:

1. Chapra, Steven C. and Canale, Raymond P. Numerical Methods for Engineers 6th edition. New York: McGraw-Hill, 2010.
2. Kreyszig, Erwin. Advanced Engineering Mathematics 10th edition. Danvers: John Wiley & Sons, 2011.
3. Sedgewick R., Phillippe F, An Introduction to the Analysis of Algorithms, Addison Wesley.
4. Cheney W., Kincaid D., Numerical Mathematics and Computing, Cole Publishing

Experimental Design
ENME802002
2 SKS
Learning Outcomes:

This course provides knowledge about the methods of planning, implementing and reporting research in the field of engineering so that it is able to apply standard scientific principles in the preparation of the final project in particular as well as in a scientific work that results from research in general. Through this subject, students are expected to be able to manage a study that starts from the planning stage, correctly applies the design and construction procedures of the apparatus, and applies instrumentation and measurement systems, executes and analyzes and interprets the data with appropriate statistical rules. In addition, students are also expected to be able to write scientific texts with good techniques, be able to make a bibliography correctly, find the right reference sources.

Syllabus:

Introduction: Introduction to Research Design; Approaches to Solving Problems (Problem Solving Approaches); Research Project Planning; Design and Application of Measurement Systems: Measuring System Functional Elements, Measurement System Performance Characteristics, System Accuracy (Uncertainty) Analysis; Design and Construction of Research Apparatus; Experimental Planning; Experiment Execution: Apparatus construction, Debugging apparatus, Datasheet and Logbooks; Data Analysis and Interpretation; Communication Engineering: Principles of Communication of Raw Engineering, Reports, Papers, and Research Results Articles. Introduction to Academic Writing; Rhetoric Analysis on Scientific Manuscripts, Critical Behavior and Arguments on Academic Writing, Techniques for Writing Scientific Manuscripts, Writing Scientific Manuscripts, Peer Review and Revision of Scientific Manuscripts, Finding Sources of Scientific References, Synthesis of Scientific Manuscripts, Delivering papers as a result of learning this course.

Pre-requisite(s) : -

References:

1. Montgomery, D.C., Design and Analysis of Experiments,

(5th ed.), John Wiley and Sons, Inc., New York, 2001
2. Coleman, H.W., Steele, G.W.Jr., Experimentation and Uncertainty Analysis for Engineers, (2nd ed.), John Wiley and Sons, Inc., New York, 1999
3. Doebelin, E.O., Engineering Experimentation: Planning, Execution, Reporting, McGraw-Hill, Inc., New York, 1995
4. Kirkup, Les., Experimental Method: An Introduction to the Analysis and Presentation of Data, John Wiley and Sons Australia, Ltd., Queensland, 1994
5. Lipson, C, Sheth, N.J., Statistical Design and Analysis of Engineering Experiments, Mc-Graw Hill Kogakusha, Ltd., Tokyo, 1973
6. Ross, V. A Brief Guide to Critical Writing. Philadelphia, PA : Critical Writing Program. 2015.
7. Graff, G., Birkenstein, C. As He Himself Puts It : The Art of Quoting "They Say / I Say" : The Moves That Matter in Academic Writing. New York. 2006
8. Rheingold, H. Net Smart : How To Thrive Online. Cambridge, Mass : MIT Press. 2012.

Data Analytics

ENME802006
2 SKS
Learning Outcomes:

Know how to identify, collect, and test multivariate data before conducting analysis. Can distinguish statistical analysis techniques available and determine which is most suitable for a particular purpose. Use appropriate techniques in analyzing data and in obtaining statistical summary results to help make management decisions. Verifying the results of the analysis with assumptions that will be considered in the analysis. Apply a variety of techniques to real data sequences using computer applications (eg MS Excel, Origin, Matlab, Tableau) and present the results in appropriate reports that are easily understood by non-statists.

Topic:

Review statistics and probabilities, Factor and Component Design experiments, multiple samples and estimates, Analysis of variance, models and diagnoses, Stepwise and Discriminant Regression, Canonical and Conjoining Analysis, and Non-parametric Statistics.

Pre-requisite(s): -

References:

1. A Modern Introduction to Probability and Statistics: Understanding Why and How by Dekking, Kraaikamp, Lopuhaa, and Meester.
2. Montgomery, D. C., & Runger, G. C. (2010). Applied statistics and probability for engineers. John Wiley & Sons.
3. Härdle, W., A. Werwatz, M. Müller, and S. Sperlich (2004). Nonparametric and Semiparametric Models. Springer.
4. Cox, T. F. (2005). An introduction to multivariate data analysis. London: Hodder Arnold.
5. Hair, Black, Babin, Anderson, and Tatham. Multivariate Data Analysis, 6th Edition. Prentice Hall.

Academic Writing

ENME802003
2 SKS
Learning Outcomes:

Student able to understand the basic academic writing to improve the capability of reading the scientific paper, reference and to write argumentation accurately with the proper and proficient language effectively. This course also study the critical thinking, propose the argumentation, formulate basic reasoning and how to deliver the idea with correct language. Student will study how to write the scientific paper with good technique, able to find and to make proper list of reference.

Syllabus:

Introductoin to academic writing, rhetoric analysis in scientific paper, act critically and argumentation in academic writing, academic writing techniques, draft scientific paper, peer review and scientific paper revision, find scientific resources, synthesis scientific paper, present the paper as a result from this course

Pre-requisite(s) : -

References:

1. Ross, V. *A Brief Guide to Critical Writing.* Philadelphia, PA : Critical Writing Program. 2015.
2. Graff, G., Birkenstein, C. As He Himself Puts It : *The Art of Quoting "They Say / I Say" : The Moves That Matter in Academic Writing.* New York. 2006
3. Rheingold, H. *Net Smart : How To Thrive Online.* Cambridge, Mass : MIT Press. 2012.

Project Design

ENME802007
2 SKS
Learning Outcomes:

Students are able to practice the design process of products, systems or services based on performance. Performance-based design is an approach in the design of energy systems, manufacturing systems, building systems and so on, which can be applied throughout the life cycle (life cyle) process by considering the fulfillment of physical, functional, environmental, financial, economic and psychological, social and psychological performance criteria. energy and so on. Students understand the performance-based design approach that allows the participation of stakeholders in various stages of design and development of products, services, systems or buildings. Thus it is expected to define the formulation of performance criteria that will be met by the results of the design during the service period. With the performance criteria that must be met, it is possible for alternative solutions to emerge in the design process so that the best solutions that can meet performance criteria such as cost / benefit analysis, life cycle assessment, optimization, assembly ease, compliance with safety criteria, ease of manufacture and so on. Students understand Performance Based Design to strengthen Final Project / Thesis work and scientific publications.

Topic:

Introduction to the process of thinking design, understanding problems, the process of formulating performance criteria with stakeholders, developing technical specifications for products / services, developing conceptual design, process calculations and simulations, material selection, dimensional analysis, cost and benefit analysis), life cycle assessment and optimization, manufacturing processes / construction processes, assembly, and performance testing.

Pre-requisite(s): -

References:

1. David G Ulman, the Mechanical Engineering Design Process 6th Edition, McGraw Hill, 2017.
2. Karl Ulrich and Steven Eppinger and Maria C. Yang, Product Design and Development 7th Edition, McGraw Hill, 2020.
3. Dejan Mumovic, Mat Santamouris, A Handbook of Sustainable Building Design and Engineering an Integrated Approach to Energy, Health and Operational Performance, 2nd Edition, 2018, Routledge, London
4. Brian J. Meacham (Editor), Performance-Based Building

Regulatory Systems Principles and Experiences, the Interjurisdictional Regulatory Collab oration Committee, 2010
5. Standar dan Jurnal Ilmiah terkait.

Scientific Publication

ENME800005
2 SKS
Learning Outcomes:

Students are able to develop logical, critical, systematic and creative thinking that has been carried out through scientific research and / or the creation of designs in the field of science and technology that pay attention to and apply the value of humanities in accordance with their fields of expertise, based on scientific conceptions and study results in accordance with the rules , scientific procedures and ethics written in papers published in accredited scientific journals or accepted in international journals under the guidance of one or more supervisors.

Syllabus: -

Pre-requisite(s): Experimental Design

References: International Journal

Thesis

ENME800007
6 SKS
Learning Outcomes:

Students are guided to apply the knowledge and knowledge they have previously learned to carry out the final project under the guidance of one or more supervisors. After attending this lecture, students are expected to be able to conceptualize the final project by applying existing theories. With guidance from the supervisor, students are expected to be able to design, integrate, implement, and analyze concepts and write research findings systematically and scientifically in the form of a final project book. Students are also expected to be present and defend their concepts and work in front of the examiners in the final project examination forum.

Syllabus: -

Pre-requisite(s): Has taken min 32 credits

References: Guidebook for thesis

Advanced Thermodynamics

ENME801101
4 SKS
Learning Outcomes:

Provide further understanding of the science of thermodynamics and its applications so that students are able to design and conduct a basic research mapun able to complete the analysis involves the calculation of the thermodynamic system correctly and systematically in order to find the best solution gentang effectiveness of the use of substances and energy, especially in the 'engineering design' by motto: 'Low entropy production', 'high thermal efficiency' and 'low pollution effect'.

Syllabus :

Basic Thermodynamics and Gas Dynamics, Equilibrium of Thermodynamics System, Thermodynamics properties of System, Thermodyamics of ideal gas mixture, review of chemical thermodynamics, review of chemical kinetics, conservation equation for multicomponent reaction system, pre-mixed laminar flames, method of measuring flame velocity (bunsen burner), flame quenching, flamability limit of premixed laminar flame, gaseous diffusion flame and combustion of single liquid droplet, combustion in compression ignition engine, combustion in spark ignition engine, combustion research in hydrocarbon oxygen mixture, engine research, combustion-generated emission, experimental method : preseure measurement and recording; temperature measurement and recording; combustion photography and flame speed detection; spectrographic method; chemical analysis technique (NDIR, FID, Gaschromatography).

Pre-requisite(s): -

References:

1. Holmann, J.P., Thermodynamics, Intl. Student Edition, McGraw Hill, 2005.
2. Kenneth Wark Jr. Thermodynamics, McGraw Hill, 2003.
3. Francis F. Huang, Engineering Thermodynamics, MaxWell Macmillan Intl. Edition, 2000.
4. H.D. Baehr, Termodynamik , Springer Verlag
5. K. Stephan, Termodynamik, Grundlagen und technishe Anwendung-en, Band 1, Band Springer Verlag.
6. Bejan, Adrian, Advanced Engineering Thermodynamics, Wiley – interscience, 2nd Edition, 1997

Advanced Fluid Dynamics and Heat Transfer

ENME801102
4 SKS
Learning Outcomes:

Enhance the ability of students in the study of fluid mechanics in more detail so as to conduct research or the application of science in industrial applications. Studying the mechanism of heat transfer in a control volume due to the existence of the temperature difference and concentration as well as the involvement of one, two or three phases at the time simultaneously.

Syllabus :

Viscous flow of Newtonian fluid, membrane boundary flow, Non-Newtonian Fluid Flow, Two- Multi Phase Flow, Particle Displacement Flow, Porous Media and Fluidized Beds, Turbulent Flow and Mixing, Jet, Chimney, Energy and Momentum Equatio, one-two-three dimension conduction heat transfer, heat transfer on extended surface.

Pre-requisite(s): -

References:

1. Frank P Incropere, David P De Witt, Fundamental heat and mass transfer, 5th Ed., John Wiley & Sons, 1996, New York
2. Holman JP, Heat Transfer, 9th, Mc Graw Hill, 2003.
3. Koestoer, RA, Perpindahan Kalor untuk Mahasiswa Teknik, Salemba Teknika, 2003.
4. Welty R James, Wicks Charless, Wilson Robert, Fundamentals of Momentum, Heat, and Mass Transfer, 3rd Ed. John Wiley & Sons, 1996, New York
5. Cengel, Yunus, Heat Transfer a Practical Approach, 2nd Ed. Mc Graw Hill, 2003, Singapore.
6. Kreith Frank, Bohn Mark, Principles of Heat Transfer, 6th Ed. Brooks/cole, 2001, USA
7. Abbott I R, Theory of Wing Section, Dover Publications.
8. Bird R B, Transport Phenomena, John Wiley & Sons.

Energy System Optimization

ENME802103
4 SKS
Learning Outcomes:

This course provides an understanding of mathematical modeling, simulation and optimization of energy systems through technical and economical approach. The course is intended to equip student with the ability to understand mathematical model, simulation and optimization of thermal systems.

Syllabus:

Workable System Design; Economical Evaluation; Determination of Mathematical Equations; Thermal Equipment Modeling; System Simulation; System Optimization: Objective Function, Constraints; Lagrange Multipliers: Lagrange multiplier to complete the optimiza- tion process; Dynamics, Geometric and Linear Programming; Mathematical Model of Thermodynamics Properties; Big System Simulation under Steady Condition; Big Thermal System Simulation; Calculation of Variables in Optimum Conditions.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanics

References:

1. Stoecker, W.F. Design of Thermal System, 3rd Edition, Mc.Graw Hill Book Co, 2011.
2. Boehm,R.F., Design of Analysis of Thermal System, John Wiley&Sons,1987.
3. Yogesh Jaluria, Design and Optimization of Thermal Systems, 2nd Edition, Mc.Graw Hill Book Co, 2007.

Thermal Power Generation

ENME803104
4 SKS
Learning Outcomes:

The course objective is to provide an understanding of the basic principles of power generation, and basic competency in the design and development of power generation systems.

Syllabus:

Industrial Power Plant and Steam System: Boiler, Steam Turbine, Gas Turbine; Cogeneration Engineering, Instrumentation and Main Tools; Performance and Reliability Factors; Economical Aspects, Environmental Aspects: Settings and Prevention.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanics

References:

1. Tyler G. Hicks, Power Plant Evaluation and Design Reference Guide, McGraw Hill, 1986.
2. Sill and Zoner, Steam Turbine Generator Process Control and Diagnostics, Wiley Higher Ed., 1996.
3. Saranavamuttoo et.al, Gas Turbine Theory, 6th Edition, Prentice Hall, 2008.
4. Black and Veath-Power plant engineering , Philips Keameh–Power generation handbook
5. Steam Generators by Babcock Willcock
6. Borman, G.L., and Ragland, K.W., Combustion Engineering, 2nd Edition, McGraw-Hill, Inc. 2011.

Internal Combustion Engine

ENME803105
4 SKS
Learning Outcomes:

Student is expected to have competency and expertise in the field of his interest of internal combustion engine working principle and theory and is able to design and do construction calculation.

Syllabus:

Actual Cycle of Internal Combustion Engine; Fuel System; Ignition and Combustion in Spark Ignition Engine and Compressed Ignition Engine; Some Basic Characteristics and Calculations; Basic Engine Design; Determination of Engine's Main Components; Kinematics and Dynamics Analysis of the Motion; Calculation and Planning of Lubrication and Cooling System.

Pre-requisite(s): Basic Thermodynamics

References:

1. Guzela L, Onder, C., Introduction to Modelling and Control of Internal Combustion Engines, 2nd Edition, Springer, 2014
2. Heywood, J., Internal Combustion Engines Fundamental, McGraw Hill, 2011
3. Taylor, C.F., Internal Combustion Engines, in Theory and Practice, M.I.T Press, England, 1985.
4. Khovakh, M., Motor Vehicle Engines, MIR Publisher, Moscow, 1971.

Applied Flow Measurement and Visualization

ENME803106
4 SKS
Learning Outcomes:

Applied flow diagnostic study measurement and visualization techniques which have wide application both in industry and laboratory. The course give basic competency for the student to be bale to understand various measurement and visualization methods and to design appropriate flow diagnostic system in process installation in industry or experimental set up in a scientific research activities which related to fluid flow.

Syllabus :

Statistics Diagnostic Flow, Calibration in Flow Measurement; Momentum Sensing Meter (orifice plate, venturi, nozzle meters); Positive Displacement Flow Meter (Nutating Disc, Sliding Vane, Gear meters, etc.); Electromagnetic and Ultrasonic Flow Meters; Compressible Flow Meter (Wet Gas and Wind Anemometer); Principles Local Velocity Measurement in Liquid and Gases; Hot Wire Anemometry; Based Laser Velocimetry (LDV, PIV); Principles of Flow Visualization, Flow Visualization conventional; Shadowgraphs and Schliern Technique; Interferometry Technique; Light Sheet Based Technique ; Image Processing and Computer Assisted Method.

Pre-requisite(s): Basic Fluid Mechanics

References:

1. Yang ,W.J, Handbook of Flow Visualization, Taylor and Francis. 2001
2. Baker, R.C., Flow Measurement Handbook: Industrial Designs, Operating Principles, Performance and Applications, Cambridge University Press, 2005

CFD Applications

ENME803107
4 SKS
Learning Outcomes:

Understanding the basic principles of CFD and having the basic knowledge in applying CFD (Computational Fluid Dynamic)

Syllabus:

Prediction-rule Principles, Numerical Solutions: Advantages and Disadvantages; Mathematical Description of Physical Phenomena; Basic Nature of Coordinates; Discretization Method; Volume-set Application on Heat Conduction Problem; Convection and Diffusion; Two-Dimension Discretization Equations; Three-Dimension Discretization Method; Special Procedure Needs; Some of Constraints Associated with the Representation of Pressure-gradient Factors, Continuity Equations Representation; Stayered Grid; SIMPLE Algorithm; Revision of SIMPLER algorithm; Final Solutions: Basic

Properties of Iterative Numerical Procedures; Sourceterm Linearization, Irregular Geometries, Preparation and Testing a Computer Programs.

Pre-requisite(s): Basic Fluid Mechanics, Engineering Programming

References:

1. Suhas V. Patankar, 1980, Numerical Heat Transfer and Fluid Flow, McGraw Hill.
2. C.A.J. Fletcher, 1996, Computational Techniques for Fluid Dynamics, 2nd edition, Springer Verlag
3. A.D. Gosman et al., 1985, COMPUTER AIDED ENGINEERING Heat Transfer dan Fluid Flow, John Wiley & Sons.

Energy Audit

ENME803124
4 SKS
Learning Outcomes:

This course focuses on the theory, techniques and practices of analyzing energy aspects of building operations and correlating a building envelope's interaction with the mechanical systems. Students will perform a detailed energy audit of a state-of-the-art commercial building design using energy modeling simulation software and develop energy conservation strategies, such as thermal stor- age, that can be applied to heating, cooling, and ventilating equipment to reduce utility bills. Students will apply supporting analytical data to develop operations and maintenance changes designed to improve energy efficiency and reduce operating cost.

Syllabus:

Energy Auditing Basics, Energy Accounting and Analysis, Understanding the Utility Bill, Energy Economics, Survey Instrumentation, The Building Envelope Audit, The Electrical System Audit, The Heating, Ventilating and Air-Conditioning Audit, Upgrading HVAC Systems for Energy Efficiency Verification of System Performance, Maintenance and Energy Audits, Self-Evaluation Checklists, World-class Energy Assessmeents, and Water Conservation.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanics

References:

1. Albert Thumann, William J. Younger, Terry Niehus, Handbook of Energy Audits, Eighth Edition, The Fairmont Press, 2010.
2. Moncef Krarti, Energy Audit of Building Systems: An Engineering Approach, Second Edition, CRC Press, Taylor & Francis Group, 2010.

Jet Propulsion and Rocket

ENME803196
4 SKS
Learning Outcomes:

Students understand the concept of thrust/propulsion related to the resistance to motion of aircraft or flying vehicles. (thrust required); understand the concepts and workings of gas turbine and rocket engines; understand the characteristics of the propulsion system of propellers (turboprop), turbofans, and jets (including rockets) on the performance of aircraft or other flying vehicles.

Syllabus :

The concept of the propulsion system which is influenced by the aerodynamic design of the aircraft (aircraft resistance and the 4 main forces of lift, weight, thrust and drag); How gas turbine and rocket engines work; Thrust characteristics of various types of aircraft propulsion systems, namely, propeller (turboprop), jet and turbofan.

References:

1. J. D. Anderson, Aircraft Performance and Design, McGraw-Hill.
2. Anthony Giampaolo, Gas Turbine Handbook: Principles and Practices, The Fairmont Press.
3. D. P. Mishra, Fundamentals of Rocket Propulsion, CRC Press.
4. Rolls Royce, The Jet Engine, Rolls Royce PLC.

Heat and Mass Transfer Engineering

ENME804109
4 SKS
Learning Outcomes:

The course objective is to provide understanding of the heat exchangers used in many industrial processes and power plants as the application of heat transfer. This course provides a basic competency to know main heat exchanger types and to understand and able to select suitable heat exchanger type for current applications. Student is also expected to understand basic factors in designing heat exchangers, to estimate size and price and know and choose the type of heat exchanger. Provide basic understanding and various parameters on the drying process so that students can perform calculations and analysis of various drying techniques and their applications. This course also provides the expertise so that students are able to do drying modeling, to design and analyze the system for various materials (solid and solvent) so that the drying process can be suitably selected for particular product.

Syllabus:

Heat Transfer Review; Type and Application of Heat Exchangers; Practgical Design of Shell and Tube Heat Exchanger (Thermal and Mechanical); Manufacturing Cost Estimation; Heat Exchangers; Operation and Monitoring of Heat Exchangers (Fouling And Vibration); Maintenance of Heat Exchangers; Corrossion on Heat Eschangers; Heat Exchanger Design Software; Presentation and Laboratory Practice of Heat Exchangers. Review Transfer Phenomena (Momentum, Heat and Mass); Drying Principles and Basics; Mathematical Modeling of Drying System; Classification and Selection of Dryer, Post-Harvest Drying and Storage of Grain; Rotary Drying; Vacuum Drying; Fluidized Bed and Spouted Bed Drying; Drum Dryer; Spray Drying, Freeze Drying; Conveyor Drying; Solar Drying; Enrgy Optimization in Drying System; Drying System Design.

Pre-requisite(s): Heat and Mass Transfer, Basic Fluid Mechanics

References:

1. Frank P Incropere, David P De Witt, Fundamental heat and mass transfer, 7th Ed.,John Wiley & Sons, 2011, New York
2. Holman JP, Heat Transfer, 10th, Mc Graw Hill,2009.
3. Smith Eric, Thermal Design of Heat Exchanger, John Wiley & Sons, 1996, New York
4. Welty R James, Wicks Charless, Wilson Robert, Fundamentals of Momentum, Heat, and Mass Transfer, 6th Ed. John Wiley & Sons, 2014, New York.
5. Cengel, Yunus, Heat Transfer a Practical Approach, 2nd Ed. Mc Graw Hill, 2003,Singapore.
6. Kreith Frank, Bohn Mark, Principles of Heat Transfer, 7th Ed. Brooks/cole, 2010, USA
7. Rohsenow Warren, Hartnett James, Cho Young, Handbooks of Heat Transfer, 3rd Ed., Mc Graw Hill, 1998, New

York.

Combustion Engineering
ENME804110
4 SKS
Learning Outcomes:

Combustion Engineering provide basic competency to investigate, analyze and learn about the process of combustion of fuel, and the nature and behavior of flame. The course provides basic understanding to apply the laws of basic aerothermochemistry in the engineering calculation of practical combustion engineering. The student is expected to be able to analyze the combustion behavior of a flame and to develop knowledge in the field of combustion engineering.

Syllabus:

Important Meaning of Combustion Study; Basic Reaction and Stoikhiometry of Combustion; Gas Fuel (BBG); Liquid Fuel, Solid Fuel; Basic Thermochemistry and Fluid Dynamics of Combustion; Principles of Conservation of Mass and Continuity; Turbulence Premixed Flame Structure; Detonation; Combustion Technology; Fixed-Bed Combustion, Suspension, Fluidized- Bed; Study on Flame and Combustion Technology; Minimum Temperature Self-ignition (Auto/ Self-Ignition); Flammability Limit; Fire spread, Fire Suppression Material, Combustion and the environment.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanic

Pre-requisite(s): -

References:
1. Turn, S.R., An Introduction to Combustion, 3rd Edition, McGraw-Hill, Inc. 2011
2. Borman, G.L., and Ragland, K.W., Combustion Engineering, 2nd Edition, McGraw-Hill, Inc. 2011.
3. Griffi ths, J.F., and Barnard, J.A., Flame and Combustion, 3rd Edition, Blackie Academic and Professional, 1995.
4. Glassman, I., Combustion, 5th Edition, Academic Press, 2014.
5. Warnatz, J., Maas, U., and Dibble R.W., Combustion, 2nd Edition, Springer-Verlag, 1998.

Aerodynamics Engineering
ENME804111
4 SKS
Learning Outcomes:

Aerodynamic Engineering is an advanced course of Fluid Mechanics which focusing on aeronautics applications. Through the course students is expected to be able to understand the fundamental principles and basic equations of aerodynamics and to apply them in the process of airfoil design and to understand performance characteristics of the airfoil. Student is able to understand the phenomenon of incompressible flow through the airfoil and finite wings. Student is expected to be able to have an understanding of subsonic and supersonic compressible flow phenomena through aerofoil and other compressible flow phenomena.

Syllabus:

Introduction on Aerodynamics; Basic and Principle Equations; Incompressible flow; Airfoil Aerodynamics Characteristics; Finite Wings; Incompressible Flow through Airfoil; Incompressible Flow through Finite Wings; Airfoil in Compressible Flow; Wings and Wings-Body Combination in Compressible Flow; Airfoil Design; Double Surface; Vortex Lift; Secondary Flow and Viscous Effect; Other Phenomena in Compressible Flow; Normal Shock Wave; Oblique Shock Wave; Expansion Wave; Supersonic Wave.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanics

References:
1. A.M. Kuethe and C.Y. Chow, Foundations of Aerodynamics, 5th Edition, John Wiley & Sons, Inc., 2009.
2. B.W. McCormick, Aerodynamics, Aeronautics, and Flight Mechanics, 6th Edition, John Wiley & Sons,Inc., 2010.
3. J Anderson, Fundamentals of Aerodynamics, 5th Edition, McGraw Hill, 2011.

Refrigeration Engineering
ENME803108
4 SKS
Learning Outcomes:

Refrigeration engineering course provides basic competency for the student to be able to do the simulation software to design a cooling system and equipments involved with a very close relationship with the Industrial and engineering users. Hence student will have understanding in design and development of cooling system and ability to evaluate and analyze its performance, especially on cold storage.

Syllabus:

Principles of Refrigeration and Heat Pump, Terminology and Units; Mechanical Vapor Compression Refrigeration Engine; Heat Trasnfer in Refrigeration System; ph Diagram Calculation in Refrigeration Cycle; Refrigeran, Lubricant, Salt and the Environment; Compressors; Condenser and Evaporator; Refrigeration Piping System and Equipments; Automatic Control System and Safety Equipments; Air Properties; Psychrometric and its process; Absorption Refrigeration; Alternative refrigeration Cycles (adsorption, gas compression, and ejector); Display Case, Prefabricated Cold Storage and Cold Storage, Cold Room Calculations.

Pre-requisite(s): Basic Thermodynamics

References:
1. ASHRAE Handbook of Fundamental, ASHRAE Atlanta, 1995.
2. Kuehn, Ramsey and Therkeld, Thermal Environmental Engineering, 3rd Edition, Prentice Hall, 1998.
3. Threkeld,JL., Thermal Environmental Engineering, Prentice Hall.
4. ASHRAE Handbook of Fundamental, ASHRAE Atlanta, 2001
5. ASHRAE Handbook of Refrigeration, ASHRAE, Atlanta, 2002.

Turbomachinery
ENME804112
4 SKS
Learning Outcomes:

Students understand the different types of construction of gas and steam turbines, and their characteristics and performance, including support equipment.

Syllabus :

Characteristics and types of steam and gas turbines to the generated power output, the calculation of its performance, power improvement, condenser performance, combined cycle plant, system vibrations in turbine construction.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanics

References: Thermische Stroomung Machine by Traupel

FIRE AND BUILDING SCIENCE
ENME802133

4 SKS
Learning Outcomes:

Students understand the basic and important parameters in the process of fire (fire), the phenomenon of fire dynamics and fire hazards. Students will also learn the science of fire both for indoors and outdoors. To strengthen understanding of fire science in buildings, students will also study building science, which relates to building requirements, which include safety, health, comfort, and ease of access for normal operating conditions and fire emergencies. The basic phenomenon of fires in nature that propagates to buildings or vice versa (wildland-urban interface or WUI fires) will also be studied in this lecture.

Syllabus :

Basic laws of aerothermochemistry such as combustion thermodynamics, fluid mechanics, heat transfer, combustion chemical reactions, rate of heat release, calculation of fire dynamics, flame and flame propagation indoors and outdoors. Building sciences relating to the fulfillment of safety, health, comfort, and ease of access requirements both under normal operating conditions and fire emergencies. This lecture course is also equipped with experimental activities in the laboratory to understand ignition behavior, premixed and non-premixed flame phenomena, combustion of solids and liquids, plumes formation, smoke production, flame and flame propagation, and fire dynamics in the room to represent fire conditions building.

Pre-requisite(s): -

References:
1. Drysdale, D., An Introduction to Fire Dynamics, John Wiley & Sons Ltd, 1985.
2. James G. Quintiere, Fundamentals of Fire Phenomena, John Wiley & Sons, Ltd ISBN: 0-470-09113-4, 2006
3. SFPE Handbook of Fire Protection Engineering 5th edition, Springer, 2016
4. Turn, S.R., An Introduction to Combustion 2nd Edition, McGraw-Hill, Inc. 2000.
5. Jens Pohl, Building Science: Concept and Application, Wiley-Blackwell, 2011.
6. Samuel Manzello, Encyclopedia of Wildfires and Wildland-Urban Interface (WUI) Fires, Springer, 2020.
7. Undang-Undang Bangunan Gedung Republik Indonesia, Peraturan terkait, dan SNI.

Ventilation and Air Conditioning System

ENME801113
4 SKS
Learning Outcomes:

This subject equips students with an understanding and basic competency in designing an air system with an increasing need for good air quality. Considering lately it is necessary to have more knowledge of the air conditioning system such as aspects of air flow velocity problems in the room, noise, odor, all of which are included in Indoor Air Quality (IAQ). This subject will also be given an understanding of the types of ozone friendly refrigerants including the technical implementation of retroophytic air conditioning systems.

Syllabus :

This subject equips students with an understanding and basic competency in designing an air system with an increasing need for good air quality. Considering lately it is necessary to have more knowledge of the air conditioning system such as aspects of air flow velocity problems in the room, noise, odor, all of which are included in Indoor Air Quality (IAQ). This subject will also be given an understanding of the types of ozone friendly refrigerants including the technical implementation of retroophytic air conditioning systems.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanics

References:
1. Ronald Howell, Harry J.Sauer, Jr and William J.Coad : Principles of HVAC, ASHRAE 1998.
2. Carrier : Handbook of HVAC
3. ASHRAE Standard
4. Overseas Vocational Training Association Employment Promotion Corporation : Fundamentals of refrigeration and Air Conditioning.

Fire Protection System

ENME802131
2 SKS
Learning Outcomes:

Students are able to understand the fire protection system both passive and active.

Syllabus :

Fire compartmentalization, Passive fire protection strategies, natural ventilation systems for controlling smoke and heat due to fire, fire resistant materials and their installation, integration of automatic fire protection systems for passive fire protection strategies, design of passive fire protection systems, fire modeling for the design of passive protection systems. This course will study various physical and chemical phenomena that are relevant to various hardware and software of a fire protection system such as automatic sprinklers, gas-shaped agents, foam systems and chemical powders. Fire protection installation system complies with applicable standards. Fire resistant material and installation.

Pre-requisite(s): -

References:
1. SFPE Handbook of Fire Protection Engineering 5th edition, Springer, 2016
2. Fire Protection Association, Passive Fire Protection Handbook, 2011
3. Tewarson A, Khan MM (1991) The Role of Active and Passive Fire Protection Techniques in Fire Control,
4. Suppression and Extinguishment. Fire Safety Science 3:1007–1017. doi:10.3801/IAFSS.FSS.3-1007
5. Jurnal dan standar terkait

Building Mechanical and Electrical System

ENME802132
4 SKS
Learning Outcomes:

Building Mechanical System is a subject that provides specialization and understanding expertise in mechanical systems systems found in modern buildings that are increasingly demanding from the sophistication, efficiency, and use of energy that is more efficient.

Syllabus:

Building Mechanical Systems in General; Plumbing System: SNI, Calculation, and Dirty Water Treatment; Energy Systems in Buildings; BuildingAutomation System; Fire Fighting Systems: Hydrant and Sprinkler System; Lifts and Escalators: Types of Lifts, Round Trip Time, Handling Capacities, Waiting Time, System Installation and Control; Types of Escalator Types, Applications and Installations.

Pre-requisite(s): Basic Thermodynamics

References:

1. Mechanical System for Building.
2. Handbook of HVAC.
3. ASHRAE Journal
4. NFPA
5. Mechanical Installation in Building.
6. SNI Plambing
7. SNI Hydrant, Sprinkler dan APAR.

Fire Dynamics and Modelling

ENME803134
4 SKS
Learning Outcomes:

Sudents understand the various stages of fires and provide basic knowledge methods and techniques applied in the analysis of fire development, and develop students' ability to critically analyze the methods of practical application. This course also aims to improve the ability to understand and analyze the fires model.

Syllabus:

Introduction to the process of combustion, premixed flame and diffusion flame, ignition and spread of fire, classification of fires and the influence of the geometry of the room. Calorimetry fire: heat release rate, mass loss rate and the relationship between time and heat release rate, the growth of fire in the room, as well as testing methods. The dynamics of the flame: fire plume and flame (flame), a high flame, the flame height correlation.

Pre-requisite(s): Basic Thermodynamics

References:
1. Dougal Dysdale, An Introduction to Fire Dynamics, 3rd Edition, John Wiley and Sons, 2011.
2. James G. Quintiere, Fundamentals of Fire Phenomena, John Wiley & Sons, Ltd ISBN: 0-470-09113-4, 2006
3. SFPE Handbook of Fire Protection Engineering 5th edition, Springer, 2016
4. Thierry POINSOT, Denis VEYNANTE, Theoretical and Numerical Combustion.
5. Jurnal dan standar terkait.

Clean Room

ENME803115
4 SKS
Learning Outcomes:

Provide an understanding of the basic knowledge of clean room systems and its application in buildings, hospital and pharmaceutical industries. Understanding of the concept of air cleanliness, ventilation and fresh air exchange, application of laminar flow, the air pressure in the chamber and measuring systems, validation and its control.

Syllabus:

Indoor environment: human psychological and physiological aspects, BEAM IAQ assessment; Air quality: air cleanliness, ambient air quality, rationale for standards; Indoor air pollutants: gaseous pollutants, airborne particulate, VOCs, radon, biological contaminants; Indoor air movement: air flow in confined and unconfined spaces, filtration systems; Instrumentation and measurement techniques; Control measures: improved IAQ by HVAC system design, removal of contaminants.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanics

References:
1. ASHRAE : HVAC Design Manual for Hospitals and Clinics Second Edition, 2013
2. W. Whyte, Clean Room Technology Fundamentals of Design, Testing and Operation, John Wiley & Sons Ltd., 2001
3. John D. Spengler, J.M.Samet, J.F McCarthy, Indoor Air Quality Handbook, McGrawHIll, 2001.

Plumbing and Waste Water Treatment System

ENME803116
4 SKS
Learning Outcomes:

Plumbing system is a subject that provides specialization expertise and understanding of plumbing systems found in modern buildings that are increasingly demanding in terms of sophistication, efficiency, and more efficient use of energy.

Syllabus :

Plumbing system in general, calculation of the need for clean water and hot water, water tanks, plumbing equipment units, pumps, water hammer applications, sewage treatment systems. A water treatment plumbing system for multi-storey buildings and dirty and sewage removal systems and foam pressure effects will be provided.

Pre-requisite(s): -

References:
1. Soufyan M. Noerbambang, Takeo Morimura, "Perancangan dan Pemeliharaan Sistem Plambing", Pradnya Paramita, 2009.
2. Louis S.Nielsen, "Standard Plumbing Engineering Design", McGraw-Hill, 1982,
3. IPC, "International Plumbing Code", International Code Council, 2009.
4. ASPE, "Plumbing Engineering Design Handbook-Volume 1 & 2", ASPE, 2004.
5. B.B. Sharp & D.B Sharp, "Water Hammer – Practical Solutions", Butterworth Heinemann, 2003.
6. Metcalf & Eddy, "Wastewater Engineering – Treatment and Reuse", McGraw-Hill Co.,2003.
7. Shun Dar Lin, "Water and Wastewater Calculation Manual", McGraw-Hill, 2007.
8. Michael Frankel, CPD, "Facility Piping Systems Handbook - For Industrial, Commercial, and Healthcare Facilities", McGraw-Hill, 2010.
9. 2012 Uniform Plumbing Code, IIAPMO 2012

Building Environment Assesment

ENME803117
4 SKS
Learning Outcomes:

Students are provided with an understanding to increase the awareness of environmental issues and the impact of buildings on the environment and be able to evaluate the ability of new and existing buildings to meet a wide range of environmental performance criteria.

Syllabus :

Global issues: electrical loading and equivalent CO2 production, ozone depletion and global warming, abusive use of natural resources; Local issues: demand of electricity, use of water, wastewater discharge, recycled material, local environmental impact; Building environmental assessment methods; Assessment of energy use; Energy audit; Indoor issues: indoor environmental quality factors, current legislation and standards; Pollutants in buildings; Indoor air quality; Health and safety; Safety audit; Health audit.

Pre-requisite(s): -

References:

1. Energy-Efficient Building Systems Green Strategies for Operation and Maintenance, Dr. Lal Jayamaha, McGraw-Hill, 2006.
2. Bradon, S.P., and Lombardi, P., (2005) Evaluating Sustainable Development in the Built Environment, Blackwell Science Ltd., Oxford.
3. An Environmental Assessment for Existing Building Developments. Version 5/03, May 2003
4. An Environmental Assessment for New Building Developments. Version 4/03, May 2003
5. Energy audit of building systems : An engineering approach, Moncef Krarti, 2nd edition,CRC Press Taylor & Francis Group, 2011

Fire Fighting Engineering and Strategy
ENME803135
4 SKS
Learning Outcomes:

This course will provide scientific and practical knowledge on all aspects of the techniques and strategies to effectively extinguish the fire source.

Syllabus :

Forcible Entry, Fire Extinguishing Technique (covers the types of extinguishing material), Fire Fighting of High Rise Building, Safe Work at Heights, Compartment Fires and Tactical Ventilation and Fire Communication and Mobilization Officer.

Pre-requisite(s): -

References:
1. Delmar Cengage Learning, Firefighter's Handbook: Essentials of Firefighting and Emergency Response 2nd edition, ISBN-13: 978-1401835750, Delmar Thomson Learning, 2004
2. SFPE Handbook of Fire Protection Engineering 5th edition, Springer, 2016
3. Jurnal dan standar terkait

Fire Safety Management in Building
ENME803136
4 SKS
Learning Outcomes:

This course will provide scientific knowledge concerning all aspects of Safety Management in Buildings.

Syllabus :

Fire Safety Management, Fire Hazard Identification, Making Plans Activity, Organizational Structure and Development of Human Resources, and Fire Control and Prevention in the building.

Pre-requisite(s): -

References:
1. Daniel E. Della-Giustina, Fire Safety Management Handbook, CRC Press, 2014
2. SFPE Handbook of Fire Protection Engineering 5th edition, Springer, 2016
3. Jurnal dan standar terkait

Mechanical System for Building
ENME804118
4 SKS
Learning Outcomes:

This subject equips students with basic understanding and competence in designing mechanical systems for buildings that include ventilation and air conditioning systems, plumbing, fire protection, and dirty water treatment.

Syllabus :

The form of the task of designing the utility system of a multi-storey building.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanics

References:
1. Stein, Benjamin, Reynolds, John S., Grondzik, Walter T., Kwok, Alison G., "Mechanical and Electrical Equipment for Building", John Wiley and Sons, 2006.
2. Gina Barney, "Elevator Traffic Handbook, Theory and Practice", Spon Press, 2003.
3. The American Society of Mechanical Engineers, (ANSI A.17.1-2000), "American National Standard Safety Code for Elevator, Dumbwaiters, Escalators and Moving Walks", ANSI A.17.1-1971

Acoustic
ENME804119
4 SKS
Learning Outcomes:

Provide a basic understanding of the concept of acoustic, acoustic systems in buildings as well as the concept of controlling the propagation of sound in the ventilation system and ventilation.

Syllabus :

Acoustic fundamentals: fundamental properties of sound and waves, sound propagation and transmission inside buildings and in air ducts; Acoustic design and planning: requirements for auditoria, lecture theatres, plant rooms and etc., directional and spacial impression, reverberation, echo, silencers, active noise control; Environment impact and local legislation; Vibration: acoustically driven vibration, control and transmission; Problem investigations: noise and vibration measurement, data analysis techniques, software packages.

Pre-requisite(s): -

References:
1. Acoustic Noise Measurement. J. R. Hassall (1979).
2. An Environmental Assessment for Existing Office Buildings. BRE (1993).
3. CIBSE Guide B12 Sound Control (1976).
4. Concert Halls and Theatres: How they sound. L. L. Beranek (1996).
5. Engineering Principles of Acoustics. D. D. Reynolds (1981).
6. Fundamentals of Acoustics. L. E. Kinsler, A. R. Frey, A. B. Coppens and J. V. Sanders (1982).
7. Handbook of Acoustics, M.J. Crocker, Wiley (1998).
8. ASHRAE HVAC System and Equioment, ASHRAE Atlanta, 2012
9. Noise Control in Building Services. A. Fry (1988).

Fire Investigation Engineering
ENME804137
4 SKS
Learning Outcomes:

This course will provide an understanding and scientific knowledge of fire investigation within the scope of the legislature regarding fire safety regulations.

Syllabus :

Compartment Fires, Flame Spread, Forensic Science, Laboratory Analytical Techniques, Modelling for helping the investigation, and case studies on fire.

Pre-requisite(s): -

References:
1. Drysdale, D., An Introduction to Fire Dynamics, John Wiley & Sons Ltd, 1985.
2. James G. Quintiere, Fundamentals of Fire Phenomena, John Wiley & Sons, Ltd ISBN: 0-470-09113-4, 2006
3. SFPE Handbook of Fire Protection Engineering 5th edition, Springer, 2016
4. Jurnal dan standar terkait

Fire Safety Analysis
ENME804138
4 SKS
Learning Outcomes:

Students have comprehensive knowledge of technical analysis related to the design of fire safety systems. These capabilities include the ability to identify and quantify fire risks and hazards, provide design options, develop design evaluation concepts, apply fire calculation and modeling methods, determine boundary conditions and constraints in design and analysis. relating to being able to evaluate the performance of a fire protection system and knowing and being able to plan the maintenance of a fire protection system.

Syllabus :

Development of performance-based fire protection system design, smoke management system design concepts, evacuation time analysis and life-saving facilities, fire safety in buildings, risk management, fire modeling and national and international regulations in the field of Fire Safety Engineering.

Pre-requisite(s): Basic Thermodynamics

References:
1. Dougal Dysdale, An Introduction to Fire Dynamics 3rd Edition, John Wiley and Sons, 2011.
2. SFPE Handbook of Fire Protection Engineering 5th edition, Springer, 2016
3. Rasbach, D.J., et al., Evaluation of Fire Safety, John Wiley and Sons, 2004.
4. A.H. Buchanan, Fire Engineering Design Guide, New Zealand, 2001.
5. SNI, ASTM, NFPA, rules and standards

Forest And Land Fire
ENME804133
4 SKS
Learning Outcomes:

Students have comprehensive knowledge about the understanding of forest fires, land fires, the basic concepts of forest and land fires, factors related to the occurrence of forest and land fires and their prevention and mitigation efforts. In the learning process students will learn various types of vegetation in tropical forests and peat; identify environmental factors such as availability of fuel capable, weather, topography, and human activity factors that influence ignition, smoldering, flammability, rate of heat release, rate of fire spread, rate of smoke production, and rate of potential fire hazard rating. Students will also learn various methods of early fire detection, calculation of heat release and emissions from forest and land fires, and efforts to prevent and handle forest and land fires.

Syllabus :

Tropical forests and peat in Indonesia, general understanding, types of forests in Indonesia, climatological conditions, and social environment. Statistics of forest fires in Indonesia and the world. Basic concepts and factors related to forest and land fires. Tropical peat in Indonesia, understanding, types, characteristics and hydrological environment. Weather factors, topography, vegetation types, topography and human activity factors in the process of forest and land fires. Characterization of potential, assessment of risks and dangers of forest and land fires: (ignition), flammability, rate of heat release, rate of fire spread, rate of production of hazardous fumes and gases, and fire hazard rating. Early detection techniques for fires by remote sensing (satellite imagery) in the form of hot spots, trace particulates, hazardous gas emissions, and haze. Forest and land fire prevention and prevention strategies. Laboratory scale practicum uses an integrated peat fire analyzer available at the Thermodynamics Laboratory to study peat fires propagation rates and the resulting emissions and extinguishing methods.

Pre-requisite(s): Basic Thermodynamics

References:
1. Laslo Pancel and Michael Kohl, Tropical Forestry Handbook, Second Edition, Springer-Verlag, 2016, ISBN 978-642-54600-6.
2. Mitsuru Osaki, Nobuyuki Tsuji, Tropical Peatland System, Springer – Japan, 2016.
3. National Wildfire Coordinating Group, Guide to Wildland Fire Origin and Cause Determination, PMS 412, NFES 1874, 2016.
4. SFPE Handbook of Fire Protection Engineering 5th edition, Springer, 2016
5. Jurnal Ilmiah terkait.

Fire Protection in Process Industry
ENME804139
4 SKS
Learning Outcomes:

This course will provide an understanding and scientific knowledge of fire protection systems in the process industry.

Syllabus :

Fire Hazard identification on Industry, Standard and applicable Law, Fire Protection in Industrial Processes, Evacuation Planning and Mitigation, and Modeling for Fire Hazard Prediction in Process Industries.

Pre-requisite(s): -

References:
1. A.H. Buchanan, Fire Engineering Design Guide, New Zealand, 2001.
2. SFPE Handbook of Fire Protection Engineering 5th edition, Springer, 2016
3. Jurnal dan standar terkait

Material and Manufacturing Processes
ENME801140
4 SKS
Learning Outcomes:

The course provides understanding and basic competence of theory, application method and product manufacturing processes that covers: working principle, process characteristics, process limitations, work and force due to the process, parameters that affects to the process and the relation of material with the process that needed for certain process.

Syllabus :

Manufacturing Process and Production Systems; Materials in Manufacturing; Theory and Method of Casting Processes; Theory and Method of Bulk Deformation Processes; Theory and Method of Metal Forming Processes; Theory and Method of Powder Metalurgy Processes; Theory and Method of Material Machining/ Cutting Processes; Theory and Method for Enhancing Manufactured Surface Quality; Theory and Method of Joining Processes; Theory and Method of Prototyping; Engineering Material Characteristics; The Relation between Process Characteristics and Material Characteristics; The Parameter Control of Process for Material; Assignment in Manufacturing Process and Material Selection for Market Needs.

Pre-requisite(s): -

References:

1. Michael Ashby dan Kara Jhonson, Materials and Design : Arts and science in material selection in product design,Butterowrth-Heinemann, 2002
2. Michael Ashby, Material selection in Mechanical Design, Butterworrth Heinneman,2005
3. John A. Schey, Introduction to Manufacturing Processes, McGraw-Hill, 1999
4. Degarmo, E. Paul, Materials and Processes in Manufacturing, Prentice Hall Int. Inc, 8th edition, 2005

Product Design and Development Methodology

ENME801141
4 SKS
Learning Outcomes: Provide an understanding and mastery of the theory and methodology of design and product development include: planning, concept development, system design, detailed design, testing and screening, production ramp-up, in a series of factors to consider overall product development.

Syllabus :

Product Planning: Needs Identification Methods; Product Selection Method (Feasibility Study); Business Specifications: Concept Development and Selection; Aspects of Engineering in Product Development and Manufacturing (Process, Material, Thermal, Durability) Non- Technical Aspects in Product Development and Manufacturing; basic Design for Manufacturing and Assembly; Calculation of Economics of Product Development.

Pre-requisite(s): -

References:

1. Karl T.Ulrich. Product Design and Development, 3rd edition, Mc.Graw Hill 2004.
2. Dieter, G.E., Engineering Design, 3rdedition, Mc.Graw Hill 2000

Designing and Manufacturing Technology Integration

ENME802142
4 SKS
Learning Outcomes:

Provide an understanding of competence and capability in designing and manufacturing process by utilizing peracangan / includes latest design and manufacturing system CAD / CAM and reverse engineering and prototype development to improve efficiency and accelerate the production process, reduce errors, improve quality and reduce production costs.

Syllabus :

System Overview of CAD / CAM; Hardware & Software Systems CAD / CAM: Geometric Modelling: Type a mathematical representation of the model curve, surface and solid 3D modeling methods and manipulation of 3D models; exchange of data within and between sistem-CAD/ CAM; CAD Laboratory Activity; Technology CNC; Tool Path Generation Method-CAM systems; Control 'quality of machining' (machined surface quality) in the system-CAM: Computer-Aided Process Planning CAPP; postprocessing; Practice CAM: 3D geometry measurements, principles and measurement based Coordinate Measuring Machine (CMM), the method of filtration data, the identification of boundary features, modeling and manipulation of point-based 3D models, 3D models for the modularization of the prototype, prototype and rapidprototyping method, discretization model, principles and application of SLS and SLM.

Pre-requisite(s): -

References:

1. Kunwoo Lee, *Principles of CAD / CAM / CAE,* Prentice Hall, 2003
2. Gandjar K, *Hand out CAD/ CAM*, DTMUI, 2007
3. Connie L. Doston, *Fundamentals of Dimensional Metrology,* Delmar Learning, 2006
4. Ali K. Kamrani. Emad A Nasr, *Rapid Prototyping : Theory And Practice,* Birkhauser, 2006
5. Patri K. Venivinod, Weyin Ma, *Rapid Prototyping : Laser Based and Other Technologies,* 2003.

Mechanical Failure

ENME803143
4 SKS
Learning Outcomes:

This course provides an understanding and competence about principles and modes of mechanical failure may occur and should be avoided so that should be considered in the design of mechanical, including buckling, Corrosion, fatigue, creep, melting, fracture, thermal, and wear.

Syllabus:

Theory and Buckling Mode (Torsional-lateral, Plastic, Dynamic), Theory and Corrosion mode (Metal, Non-Metal, Glass); Corrosion Prevention; Theory and Fatigue Failure Mode; Theory and creep mode; Theory and Melting Mode; Theory and Type of Fracture mode, Theory and the thermal failure mode; Theory and Wear mode; Failure Analysis and Prevention to: Buckling, Corrosion, Fatigue, creep, Melting, Fracture, Thermal, and Wear

Pre-requisite(s): Engineering Materials, Mechanical Design

References:

1. Jack A Collins, Materials Failure in Mechanical Design, Wiley - Interscience, 1993
2. S. Suresh, Fatigue of Materials, Cambridge University Press, 1998
3. M Jansenn, J. Zuidema, Fracture Mechanics, VSSD, 2006
4. Arthur J. McEvily, Metal Failures : Mechanisms, Analysis and Prevention, 2013

Dynamics of Mechanical System

ENME803144
4 SKS
Learning Outcomes:

Provide an understanding and competence in the principles and methods of dynamic analysis of mechanical systems as an important input in the design process to produce a mechanical system that has a better dynamic resistance and also know the effects they impose on other systems that interact.

Syllabus :

Kinematic Systems: Theory and Principles of Dynamic Systems: Dynamic Modeling Method: Block Diagrams and State-Variable Model: Analysis on Time-Domain System: Analysis of the Frequency-Domain System; Vibration; Stability: Dynamic Balance: Dynamic Analysis of Mechanical Components; Modeling and Analysis control system.

Pre-requisite(s): -

References:
1. Palm, Modelling, Analysis, and Controlof Dynamic Systems, Wiley, 2006
2. Harold Joseph dan Ronald Huston, Dynamicof Mechanical System, CRC, 2002
3. Palm, System Dynamics, McGraw-Hill,2007
4. Chapman, Stephen J., Essentials of Matlab Programming, Thomson Nelson, 2006

Composite Product Development

ENME803145
4 SKS
Learning Outcomes:

Provide expertise and competence to students in the field of designing and manufacturing of parts / mechanical construction using composite materials. This course provides an understanding of composite materials, including the characteristics, testing, manufacturing process, and special applications in the engineering field.

Syllabus:

Composite Type, Material, Properties, Mechanics; Knowledge and Characteristics of Fiber Composite, Strength, Hardness, and the composite thermal expansion; Theory of Combination Fiber and Matrix; Matrix Composite Characterization; Laminar Theory On Axis and Off Axis; Composite Product Design, Composite Fabrication Technique ; Testing Method; Future Applications.

Pre-requisite(s): Engineering Materials, Mechanical Design

References:
1. Brent Strong, Fundamentals Of Composites Manufacturing: Materials, Methods and Applications - Technology & Engineering – 2007
2. By Daniel Gay, Suong V . Hoa, Stephen W. TsaiTranslated by Stephen W Tsai Contributor Suong V. Hoa, Stephen W. Tsai, Composite materials: Design and application, 2nd : CRC Press 2007
3. Soemardi,T.P. Diktat Mekanika komposit, Fabrikasi dan Testing. FTUI.2003.
4. Composites ASM handbook No 21

Finite Element and Multiphysics

ENME803146
4 SKS
Learning Outcomes:

Provide a basic understanding and skills regarding the principles of modeling, solution techniques such as 'finite element method' and its application in cases of design and engineering analysis. The models studied included physical aspects of the problem in Thermal, elasticity (plates and shells), acoustic, and electromagnetic.

Syllabus :

The introduction of FEA (Finite Element Analysis); Fundamental FEA I (basic concepts and formulations FEA FEA) FEA Fundamentals II (failure modes, Dynamic Analysis, FEA Capabilities and limitations); Basic Finite Element Modeling: Modeling CAD for FEA; Building a Finite Element Model: Model simulation and interpretation of results; Thermal-Structural; Pressure-Structural; Electromagnetic-Thermal- Structural; Analysis of Thermal Actuator; Coating process: Key elements of Successful Implementation of Technology multiphysics; Introduction to CFD and Its Application.

Pre-requisite(s): -

References:
1. William B J Zimmerman, Multiphysics Modeling with Finite Element Methods, World Scientific Publishing, 2006
2. Barry H V Topping, A. Bittner, Engineering Computational Technology, Civil Comp Press, Edinburgh, UK, 2002.
3. Indra Siswantara, Catatan Kuliah Teknologi Multihysics, 2008

Design And Development Of Educational Products

ENME803147
4 SKS
Learning Outcomes:

Understand the basics and process of designing and developing educational products in the industry of teaching aids, educational products, and game aids.

Syllabus:

Brainstorming and expressing ideas and opinions, Innovation and Theme Development, Basics of Toy Product Design, Basic Engineering and Mechanical Design, Basic Theory for Sketching, Sketch Drawing Modeling Process, Design Aesthetics, Manufacturing Theory and Material Selection for Game Props, Basic Theory of Making Prototype, Portfolio Design, Presentation and Idea Pitching.

Pre-requisite(s): Engineering Materials, Mechanical Design

References:
1. Karl Urlich, Steven Eppinger, 2015, Product Design Development Flow, 6th Edition, McGraw Hill.
2. Donald A. Norman, 2005, Emotional Design, 1st Edition, Basic Books.
3. Michael Michalko, 2006, Thinkertoys : A Hanbook of Creative Thinking Techniques, 2nd Edition, Ten Speed Press.

Microfabrication and Precision Manufacturing

ENME803161
4 SKS
Learning Outcomes:

This course provides specialization expertise on micro fabrication processes that are widely used in the manufacture of MEMS (micro Electro mechanical system) at this time that has wide application of the biomedic system, sensors and micro-electronic devices (electronic devices). This course giving understanding of manufacturing techniques and basic structure mechanics in a product and also the micro-characterization of the process fabrication conducted in the laboratory. This course provides a basic competency of the principles in the design techniques which control the movement of the size or dimensions in a very small if compared with the size of the object that is designed and produced the correct design and the development machine and a precision mechanism

Syllabus:

Introduction to Engineering Micro Fabrication; Lithography: The design aspect, masks making, etching technique (And Wet Etching Dry Etching); Deposisi Engineering: Chemistry and Chemicals; Electroplating, Micromolding, Beam Processing; Microscaling consideration); Transport Processes and Metrology in the micro-scope; Lab Practice and Applications, Philosophy Precision Manufacturing; kinematic concept; Pro and contra Flexures Design; Materials for Precision Components; Self Calibration Concept; Manufacturing Process which is Important in Precision Manufacturing, Precision Instruments; Basic Concept of Tolerance on Dimensions and geometric.

Pre-requisite(s): Engineering Materials, Mechanical Design, Engineering Programming

References:

1. Madou, M.J. Fundamentals of microfabrication: the science of miniaturization, CRC Press, 2002.
2. McGeough, J (Ed.), Micromachining of Engineering Materials, Marcel Dekker, 2002, ISBN 0-8247-0644-7
3. Mainsah, E., Greenwood J.A. and Chetwynd D.G. Metrology and properties of engineering surfaces, Kluwer Academic Publ., 2010
4. Gardner J.W. and Hingle H.T. (Ed.) From Instrumentation to Nanotechnology, Gordon and Breach Science Publishers, 1991, ISBN 2-88124-794-.
5. Korvink J.G. and Greiner A. Semiconductors for Micro- and Nanotechnology – An Introduction for Engineers, WILEY-VCH Verlag GmbH, 2002, ISBN 3-527-30257-3.
6. Mark J. Jackson, Microfabrication and nanomanufacturing. Taylor and Francis, 2006

Quality and Production Management System

ENME803154
4 SKS
Learning Outcomes:

Provides knowledge, understanding and ability to perform management, analysis and improvement of production systems in the manufacturing industry with the principles of efficiency and effectiveness, and able to understand and implement and develop policies and procedures are needed to improve and control the various processes.

Syllabus :

Introduction to Manufacturing Systems, Manufacturing Principles, Resources, Production Process and Production Organization, Production Lay-Out, Design, Scheduling and Production Process Control; Productive Maintenance, Logistics and Inventory; Engineering Quality, Quality Control, Quality Function Deployment (QFD) , Total Quality Management; Quality Management System (8 Quality Management Principles, International Standard Quality Management System: ISO 9001, ISO 9004, ISO TS 16949, the International Management System Standard: ISO 14001, OHSAS 18001); System And Process Improvement: Cause - Effect Analysis, FMEA (Failure Mode and Effect Analysis), Lean Six Sigma.

Pre-requisite(s): Mechanical Design

References:

1. Hitomi, Katsundo. Manufacturing System Engineering. Taylor & Francis. 2001
2. TQM : A Cross Functional Prespective, Rao, CARR, Dambolena, Kopp, Martin, Rafii, Schlesinger, John Willey, 1996
3. TQM, Text, Cases and Readings, Joel E. Ross, St. Lucie Press 100 E. Linton Blvd Suite 403 B Delray Beach, FL 33483

Risk Management

ENME803174
4 SKS
Learning Outcomes:

Fast information flow and the presence of regulatory and supervisory concerns, management requires understanding and measuring risk. Risk management sets standards for combining different information, collecting data, calculating risk measures and creating timely reporting tools for management. This course directs students to understand how complex risks on a large scale can be measured and managed.

Syllabus:

Introduction to risk management, Value at Risk - VaR Risk measures for various asset classes, Monte Carlo Simulation, VaR Validation and Extremes, Regulatory Environment 25 years of risk related regulations, Multifactor models Discussion of multifactor analysis, Review of industry leading risk management systems, Operational Risk and its Basel II requirements.

Pre-requisite(s): -

References:

1. Jorion, Philippe, Value at Risk: The New Benchmark for Managing Financial Risk, 3rd edition, McGraw-Hill, 2007
2. Roger Lowenstein, When Genius Failed, Random House, 2000

Design for Manufacture and Assembly

ENME804148
4 SKS
Learning Outcomes:

Provide knowledge, understanding and competence in the product design process which is considering, including factor and oriented on: material, manufacturing capability and assembling process. Therefore the product is expected to have made ease of manufacture and assembly.

Syllabus:

Review of the materials selection and processes, product design for manual assembly, design for automated assembly, PCB design for manufacture and assembly, machining process design, injection molding, sheet metal forming processes, die-casting.

Pre-requisite(s): Engineering Materials, Mechanical Design

References: Boothroyd, Product Design for Manufacture and Assembly 3rd Ed, CRC Press, 2010

Noise and Vibration Control

ENME804149
4 SKS
Learning Outcomes:

This course provides competency to students to complete the issue of application of vibration on the mechanical structure of the construction, and plate or vessel (vessel), perform the calculation of vibration reducer system design, system and engine holder enhancing of production equipment. Finally students have to make basic vibration measurements; forecasts predicted the damage engine, the vibration analysis of the data signal and the vibration spectrum and carry out machine performance diagnosis based on data analysis of vibration data and other data related

Syllabus :

Mechanical vibration with Many Degrees Freedom; Vibration on the Structure Construction; Vibration on plate and body shell (Vibration Plate and Shell); Vibration Isolation; Designing Vibration Absorber; Engineering Vibration Measurement; Vibration spectrum analysis; Performance Diagnostic Machine.

Pre-requisite(s): Mechanical Vibration

References:

1. Jerry H.G., “Mechanical and Structural Vibrations”, John Wiley, 2004
2. Demeter G.F., “Mechanical and Structural Vibrations”, John Wiley, 1995
3. Kenneth G.M., “Vibration Testing: Theory and practice 2nd ed”, Wiley, 2008
4. Werner Soedel, “Vibrations of Shells and Plates”, 3rd edition – revised and expanded, Marcel Dekker, INC.,

2004
5. Randall R.B., "Frequency Analysis", Brüel & Kjær, 1987
6. Jens T.B., "Mechanical Vibration and Shock Measurement", Brüel & Kjær, 1980

Laser Assisted Process
ENME804162
4 SKS
Learning Outcomes:

Students are expected to understand knowledges related to fabrication process assisted by laser, and its direct application. Students can understand the science associated with the fabrication process that is assisted with laser technology, and the application and direct application of the fabrication process assisted by laser technology.

Syllabus :

Basics of Laser-based Manufacturing Technology; Laser-assisted Formation Process; the joining process with the help of laser technology; Laser Assisted Surface Engineering; Types of Lasers, Application of Laser Technology, Basics of laser interactions with materials and Classification of Material Processes with Laser Technology.

Pre-requisite(s): -

References:
1. A.M. Hasofer, V.R. Beck, I.D. Bennetts, Risk Analysis in Building Fire Safety Engineering, Elsevier Butterworth-Heinemann, 2007.
2. Ralph W King and John Magid, Industrial Hazard and Safety Handbook, ISBN: 978-0-408-00304-9
3. SFPE Handbook of Fire Protection Engineering 5th edition, Springer, 2016
4. Jurnal dan standar terkait

CAD/CAM
ENME804155
4 SKS
Learning Outcomes:

This lecture will discuss about technology of CAD, CAM, Integration of CAD / CAM application in the industry and the emphasis on: the principles modeling and surface curve geometry (Geometric modeling), design of 2D and 3D models with computer assisted. The principle of data exchange between CAD/CAM systems also tool path design using computer for prismatic and sculptured model. Lectures CAD / CAM are provided with the aim that students have the understanding and applying technology of CAD / CAM: starting the process from design to production process with the computers assistance.

Syllabus:

Overview of CAD / CAM System; Hardware & Software System of CAD / CAM; Interactive Tools and Computer Graphics Concepts, Geometric Modeling: Type & Representation of mathematical model Curve, Surface & Solid ; Data Exchange in CAD / CAM system; Manufacturing Processes: Manufacturing Process Review Type and Parameter Calculation machining, Lab. practice of CAD; CNC Technology; Tool Path Generation Method in the CAM system; Control 'quality of machinery' in the CAM system; Computer Aided Process Planning-CAPP; Postprocessing; Lab. practice of CAM.

Pre-requisite(s): Engineering Programming

References:
1. Kiswanto G., Handout CAD/CAM, Diktat kuliah, 2004.
2. Choi B. K., Jerard R. B., Sculptured Surface Machining,
3. Zeid, I., CAD/CAM Theory and Practice, McGraw-Hill, 2009.
4. Chang, T. -C., Computer Aided Manufacturing, 3rd ed, Prentice-Hall, 2005.
5. Korem, Y., Computer Control of Manufacturing Systems, McGraw-Hill

Manufacturing Performance Assessment
ENME804156
4 SKS
Learning Outcomes:

Provides knowledge about the basic concepts of performance assessment of manufacturing industry relating to product performance, process, manufacturing system and its relation to manufacturing excellence. At the end of this course, students are expected to understand the methodologies and assessment tools manufacturing performance and are able to identify, assess and analyze the performance of the manufacturing industry increase.

Syllabus:

Introduction, Traditional Performance Methodology & Tool: Dupont Financial Performance, Basic Performance Measurement process & tools: Data collection techniques, chart, graph & diagram, Process Improvement methodologies & tools: Process Capability, Measurement System Analysis (MSA), QFD, FMEA, six sigma & lean six sigma, Industry specific/ generic standards & best practices, Manufacturing Maturity model concept & measurements, Case study of Industrial performance Measurement (assignment & evaluation)

Pre-requisite(s): Engineering Materials, Mechanical Design

References:
1. US Departement of Energy, United Sates of America, Performance Based Management, 2005 Oak Ridge Associated Universities,. "How to Measure Performance, A Hand Book of Techniques and Tools"
2. "World Class Manufacturing Performace Measures"
3. Harold T.Amrine, John A.Ritchey, Prentice Hall International Edition, "Manufacturing Organization and Management"
4. Will Kaydos, Productivity Press Portland Oregon, " Measuring, Managing and Maximizing Performance"

Manufacturing Information System Management
ENME801150
4 SKS
Learning Outcomes:

Provides understanding of the theory, method and application of information technology systems, management, and development of the concept of knowledge-based information systems (Knowledge Management System) and capable to apply in the manufacturing industry.

Syllabus :

Introduction to Information Systems; State of The Art Utilization Information System; Theory and System Methodology; Database Management Systems; System Design I: Overview functionality, enabling Technology (Automated Solution Assessments Quality, Multi Data Representation, Database Technology and XML); Design System II: (Database Design, Information Input, Output Information); Case Study: Documentation automation and Reporting System for Manufacturing; Introduction Knowledge Base Engineering, Concepts and Methodology in the KBE (System Specialists, Neural Network); KBE application.

Pre-requisite(s): -

References:

1. Raymond McLeod Jr., *Strategic information Management : Challenges and Strategies in Managing Information System;* 3rd Edition, Butterworth-Heinnemen, 2003.
2. Cortada, James. *Total Quality Management,* McGraw Hill Book Co.
3. Ake, Kevin et al. *Information Technology for Manufacturing : Reducing Costs and Expanding Capabilities,* CRC Press, 2003.
4. Cecelja, Franco, *Manufacturing Information and Data System : Analysis Design and Practice,* Butterworth-Heinnemen, 2001.

Manufacturing System and Processes
ENME801151
4 SKS
Learning Outcomes:

Students are expected to know and be able to apply the conventional manufacturing process technology and non-conventional for the manufacture of a product and the parameters which inflence it are devoted to the metal forming processes, machining, rapid prototyping process. In addition, knowing, and understanding the existing production systems in the industry.

Syllabus :

Materials in Manufacturing: Theory and Method of Casting Process (Metal Casting); Theory and Method of Bulk Formation Processes: Theory and Method of Formation Process Material Sheet (Sheet Metal Forming): Theory and Methods of Powder Metallurgy Process (Powder Metalurgy); Theory and Methods for Machining Processes / Cutting Materials: Theory and Methods of Product Surface Quality Improvement process: Concepts and methods of manufacturing systems.

Pre-requisite(s): -

References:
1. Wagoner R., Chenot J.-L, *Fundamentals of Metal Forming*, John Wiley & Sons, Inc,2003
2. Degarmo P., *Materials and Process in Manufacturing*, Prentice Hall, 2004
3. Schey J., *Introduction to Manufacturing Process*, McGraw-Hill, 2004
4. Thomas E Vollman, *Manufacturing Planning and Control*, McGraw Hill 1997
5. Stanley B. Gershwin, *Manufacturing System Engineering*, Prentice Hall, 1993
6. John M. Nicholas, *Competitive Manufacturing Management*, 1997

Automation and Robotics
ENME802152
4 SKS
Learning Outcomes:

Automation and Robotics course discusses technology and application in the automation industry and the design and control the robot emphasizes: understanding the types of automation systems, particularly in the manufacturing industry and the mechanism, the design and development of automation system that emphasizes the 3 things: reliability, quality and cost and the understanding robot control system. Automation and Robotics Lectures given with the aim that students have an understanding in the implementation of technology Automation and Robotics, especially in the manufacturing industry.

Syllabus:

Automation System; Classification Type Manufacturing Automation machinery; Actuator; Sensor System; PLC Control System in the Manufacturing Automation machinery; Robotics: Definitions and Principles of Robot; Spatial Descriptions: Definitions and Principles, Methods and Applications Spatial descriptions; Forward Kinematics: Definition, Principles and The Forward Kinematics; Jacobians: Speed, explicit shape, definition and principle of inverse Kinematics; Dynamic: The form of explicit, Acceleration and inertia; Control system ronbotic: PID control, the Joint Space Control, Operational Control and Space Force Control; Robot Design Assignment.

Pre-requisite(s): Engineering Programming

References:
1. Craig J., Introduction to Robotics 3rd ed, Prentice Hall, 2004.
2. Heath L., Fundamentals of Robotics, Theory and Applications, Prentice Hall, 1985.
3. Koren Y., Robotics for Engineer, McGraw Hill, Intl Edition, 1985.
4. Lentz K. W. Jr., Design of Automatic Machinery, Van Nostrand Reinhold, 1985.
5. Schilling R. J., Mikell P., Fundamentals of Robotics, Analysis and Control, Prentice Hall, 2000.
6. Kiswanto G., Otomasi dan Robotika, Diktat Kuliah Departemen Teknik Mesin, 2004.

Machine Vision System
ENME803153
4 SKS
Learning Outcomes:

Machine Vision Industry Subjects provides the understanding and competency of the principles, methods and applications monitoring the production process by using visual-based camera technology, image processing, for the purpose of introducing the feature: product identification, selection and product screening, and quality control. With the completion of this course, students have the ability to apply and develop the visual method of monitoring the production process in the industry for the purpose.

Syllabus:

Basic Machine Vision Method: Binary Image, Binary Morphology and Gray-Scale, Texture analysis; Identification Method feature; image Processing Method Smart / Intelligent, Image Processing System (Prolog); Control Equipment / Instruments Interface (Instruments, Signal, Protocol, PLC) ; Method Introduction Color image; Machine Vision Applications.

Pre-requisite(s): Engineering Programming

References:
1. J.R. Parker, Algorithms for Image Processing and Computer Vision 2nd ed, Wiley, 2010
2. Butchelor B. G., Whelan P. F.,Intelligent Vision System for Industry, Springer, 2012
3. E.R. Davies, Machine Vision : Theory, Algorithm, Practicalities, Morgan Kauffman, 2004
4. Micheul S, Lawrence O'Gorman, Michael J S Practical Algorithms for Image Analysis : Description, Examples and Code, , Cambride Univ. Press, 2000
5. Rafael Gonzales, et.al, Digital Image Processing using Matlab, McGraw Hill, 2010.
6. A.S. Baskoro, Handout Sistem Machine Vision, Diktat kuliah, 2011.

Vehicle Engineering and Heavy Duty Equipment
ENME801163
4 SKS
Learning Outcomes:

This course provides the latest technology from the four-wheeled passenger vehicle, especially with covering all aspects of engineering in a vehicle. Lectures given vehicle engineering with the aim that students have basic competence to do the engineering on the four-wheeled passenger vehicle in particular.

Syllabus :

Vehicle Kinematics & Dynamics; mover and transmission system; Breaking Systems, Wheel and Suspension; Security System: Active and passive at the time experiencing issues.

Pre-requisite(s): -

References:
1. Bosch Automotive Handbook, Sixth Editions, 2006
2. Gillespie, Thomas D., Fundamentals of Vehicle Dynamics, 2004
3. Hei s ler, Heinz. Advanced Vehicle Technology, 2004
4. Hermann, Hans. SAE Handbook of Automotive Engineering, 2004
5. Miliken, William F., Douglas L. Milliken, Maurice Olley, Chassis Design : Principles and Analysis, 2004
6. Pacejka, Hans B. Tire & Vehicle Dynamics, SAE, 2006

Prime Mover and Power Train System
ENME801164
4 SKS
Learning Outcomes:

Students have the competency and skill in the principles and theory of prime mover including internal combustion motor, electric motor, hybrid motor which are connected to the powertrain system; understand and are able to calculate the construction and design.

Syllabus :

Combustion motor technology; reciprocating/rotary piston engine; electric motor technology (AC/DC motor); hybrid motor system; serial/parallel hybrid; transmission system: MT, AT, DCT, CVT; battery technology

Pre-requisite(s): -

References:
1. Heywood, J., Internal Combustion Engines Fundamental, McGraw Hill, 1989
2. Khovakh, M., Motor Vehicle Engines, MIR Publisher, Moscow, 1971.
3. Bosch Automotive Handbook, SixthEditions, 2006
4. Gillespie, Thomas D., Fundamentals ofVehicle Dynamics, 2004
5. Heiszler, Heinz. Advanced VehicleTechnology, 2004
6. Hermann, Hans. SAE Handbook ofAutomotive Engineering, 2004

Vehicle Frame and Body Engineering
ENME802165
4 SKS
Learning Outcomes:

Prrovide an understanding of various concepts related to vehicle frame design and analysis, such as: A brief understanding of the history of vehicle design development; Understanding of vehicle design and interactivity in the vehicle design and manufacturing process, including various types of vehicle structures and their uses; Understanding how loads can be analyzed simply and using a computer includes simple structural analysis that focuses on the processes involved in vehicle structure; Understanding of basic concepts related to vehicle body aerodynamics and the basic calculations needed to design vehicle body aerodynamics.

Syllabus :

The introduction of the latest innovations and breakthroughs in the automotive field and the development of the automotive industry. Understanding the concept of loading on vehicle structures, various types of vehicle frames, structural analysis using the Simple Structural Surface method and the method of computing the skeletal structure. Aerodynamic force, reduction of lift (reduction of drag). Stability and the concept of calculating vehicle body dynamics.

Pre-requisite(s): -

References:
1. Heinz Hei s ler, "Advance Vehicle Technology", Society of Automotive Engineers, Inc. ISBN 0 7680 10713.
2. Brian Cantor, Patrick Grant and Colin Johnston, "Automotive Engineering Lightweight, Functional, and Novel Materials", Taylor & Francis Group, 6000 Broken Sound Parkway NW, Suite 300, ISBN 978-0-7503-1001-7.
3. Giancarlo Genta, Lorenzo Morello, "The Automotive Chassis Vol. 1: Components Design", Springer Science+Business Media B.V., ISBN: 978-1-4020-8674-8 e-ISBN: 978-1-4020-8676-2.
4. David A. Crolla, "Automotive Engineering Powertrain, Chassis System and Vehicle Body", Butterworth-Heinemann is an imprint of Elsevier, Linacre House, Jordan Hill, Oxford OX2 8DP, UK ISBN: 978-1-85617-577-7.
5. Nick Tucker and Kevin Lindsey, "An Introduction to Automotive Composite", Rapra Technology Limited, ISBN: 1-85957- 279-0.
6. Jason C. Brown, A. John Robertson, and Stan T. Serpento, "Motor Vehicle Structures: Concepts and Fundamentals", Butterworth-Heinemann Linacre House, Jordan Hill, Oxford OX2 8DP, ISBN 0750651342
7. Liang Yun · Alan Bliault · Johnny Doo, WIG Craft and Ekranoplan, "Ground Effect Craft Technology", ISBN 978-1-4419-0041-8 e-ISBN 978-1-4419-0042-5, DOI 10.1007/978-1-4419-0042-5, Springer New York Dordrecht Heidelberg London.
8. Mat thew Huang , "Vehi c le Crash Mechanics", CRC Press LLC, International Standard Book Number 0-8493-0104-1.
9. Ahmed A. Shabana, Khaled E. Zaazaa and Hiroyuki Sugiyama, "Railroad Vehicle Dynamics a Computational Approach", CRC Press is an imprint of the Taylor & Francis Group, ISBN 978-1-4200-4581-9.

Vehicle Control System
ENME803166
4 SKS
Learning Outcomes:

Students understand the basic features of the vehicle control system that has the ability to;
- Describes a simple method for the analysis of vehicle suspension systems and components;
- Describes the vehicle suspension system design requirements and how to achieve it;
- Analyze the various factors and issues that affect the design of suspension of driving;
- Understand the mechanics of the vehicle wheel;
- Describes recent developments in control of the braking system and braking system design and material needs an efficient;
- Analyze the influence of the steering system characteristics to the vehicle motion

Syllabus :

Introduction of the role of vehicle suspension systems, factors that affect the design, definitions and terminology in vehicle suspension systems, suspension mobility mechanisms, different types of suspension, kinematics analysis, the analysis center of rotation (roll center analysis), geometric style as well as lateral, suspension components. The basis of the braking system. Regulation, function and terms of use brake system, brake system components and confiurations as well as the kinematics of the braking system. Consideration of adhesion force proportional to the brake system and braking effiiency. Deformation, lateral force and slip angle on the tire when the vehicle is running. Penikungan characteristics (cornering characteristics) according to Fiala theoretical approach to the mathematical model and the effect is due to air pressure in tires.

Pre-requisite(s): -

References:

1. Heinz Heisler, "Advance Vehicle Technology", Society of Automotive Engineers Inc. ISBN 0 7680 1071 3
2. Giancarlo Genta, Lorenzo Morello, "The Automotive Chassis Vol. 1: Components Design", Springer Science+Business Media B.V., ISBN: 978-1-4020-8674-8 e-ISBN: 978- 1-4020-8676-2.
3. Giancarlo Genta, Lorenzo Morello, "The Automotive Chassis Vol. 1: System Design", Springer Science+Business Media B.V., ISBN: 978-1-4020-8673-1 e-ISBN: 978-1- 4020-8675-5.
4. David A. Crolla, "Automotive Engineering Powertrain, Chassis System and Vehicle Body", Butterworth-Heinemann is an imprint of Elsevier, Linacre House, Jordan Hill, Oxford OX2 8DP, UK ISBN: 978-1-85617-577-7.

Modern Vehicle Technology

ENME803167
4 SKS
Learning Outcomes:

SStudents understand the concepts of manufacturing technology and vehicle control systems to: Analyze the current state of technological advances so that they can make fundamental changes in the design of sustainable vehicles; Designing processes to create automated control systems that assist vehicle control; Designing vehicles with electronic control systems that can improve vehicle performance; Describe the integration in vehicle control systems and the interaction of mechanical and electrical systems that can support the design and development of future vehicles

Syllabus:

Knock control, Linear solenoid idle speed control, Sequential fuel injection, Distributorless ignition, Self-diagnosis for fail-safe operation, Crankshaft angular position measurement for ignition timing, Direct mass air flow sensor, Variable valve phasing,teknologi kendaraan Hybrid Electric Vehicles and Electric Vehicle.

Pre-requisite(s): Engineering Programming

References:

1. Julian Happian-Smith, " An Introduction to Modern Vehicle Design", Butterworth- Heinemann Linacre House, Jordan Hill, Oxford OX2 8DP, ISBN 07506 5044 3.
2. Heinz Hei s ler, "Advance Vehicle Technology", Society of Automotive Engineers, Inc. ISBN 07680 1071 3.
3. Fuhs, Allen E., "Hybrid vehicles and the future of personal transportation", CRC Press, Taylor & Francis Group, ISBN-13: 978-1-4200-7534-2, ISBN-10: 1-4200- 7534-9.
4. Lino Guzzella and Christopher H. Onder, "Introduction to Modeling and Control of Internal Combustion Engine Systems", Springer-Verlag Berlin Heidelberg, ISBN 978-3-642-10774-0 e-ISBN 978-3-642- 10775-7, DOI 10.1007/978-3-642-10775-7, Library of Congress Control Number: 2009940323.
5. Iqbal Husain, "ELECTRIC and HYBRID VEHICLES Design Fundamentals", CRC PRESS Boca Raton London New York Washington, D.C., ISBN 0-203-00939-8 Master e-book ISBN, International Standard Book Number 0-8493-1466-6 (Print Edition), Library of Congress Card Number 2002041120.
6. Ali Emadi, "Handbook of Automotive Power Electronics and Motor Drives", Taylor & Francis Group, CRC Press is an imprint of Taylor & Francis Group, ISBN 0-8247-2361-9.
7. Nicolas Navet and Françoise Simonot- Lion, "Automotive Embedded Systems Handbook", CRC Press Taylor & Francis Group, 6000 Broken Sound Parkway NW, Suite 300, ISBN-13: 978-0-8493-8026-6, ISBN-10: 0-8493-8026-X
8. Paul Nieuwenhuis and Peter Wells, "The automotive industry and the environment A technical, business and social future", Woodhead Publishing ISBN 1 85573 713 2, CRC Press ISBN 0-8493-2072-0, CRC Press order number: WP2072.
9. Simon Tung, Bernard Kinker, and Mathias Woydt," Automotive Lubricant Testing and Advanced Additive Development", ASTM 100 Barr Harbor Drive PO Box C700, West Conshohocken, PA 19428-2959,ISBN: 978- 0-8031-4505-4.
10. James Larminie, John Lowry, "Electric Vehicle Technology Explained", Oxford Brookes University, Oxford, UK, Acenti Designs Ltd.,UK. ISBN 0-470-85163-5.

Oil and Gas Drilling Equipment

ENME803195
4 SKS
Learning Outcomes:

Provide an understanding of the implementation of basic knowledge of technical competence which is the core technology of oil and gas drilling equipment. The competencies expected of students who have taken this course are graduates who have added value related to technical knowledge of oil and gas drilling equipment and are ready and able to adapt easily in the world of the oil and gas industry in general and oil and gas drilling in particular. The expected learning objectives and outcomes are as follows: Students know the basic equipment and its functions and how each of these equipment is needed in oil and gas drilling operations; Students are able to explain oil and gas drilling operation techniques as well as various related aspects such as equipment used, safety issues, safety equipment, environmental issues, and emergency conditions; Students have a good understanding of drilling equipment and operations so that they can participate in oil and gas drilling operations in the world of work and are ready to improve their knowledge and skills while working

Syllabus:

Introduction to oil/gas wells, Oil/gas exploration, production and exploitation, drilling rigs, terminology and drilling problems of drilling, drilling fluids, oil and gas drilling systems, hoisting system equipment, rotating system equipment, circulatin system equipment, power system equipment, blowout prevention systems, well design, equipment and operations for safety and efficiency, processes and equipment for cementing, drilling preparation, drilling operations, problems in the drilling process (drill string vibration and whirling, collar failure, etc.) artificial lift methods and equipment, visits to the oil and gas drilling industry

Pre-requisite(s): Engineering Materials, Mechanical Design

References:

1. Don A. Gorman, Jerry W. Meyer, "Drilling Equipment and Operations", Action Systems Inc., Dallas, Texas – USA.
2. Adam T. Bourgoyne, Martin E. Chenevert, et. al., "Applied Drilling Engineering", Society of Petroleum Engineers,

Richarson, Texas – USA.
3. Nguyen J.P., "Drilling-Oil and Gas Field Development Techniques", Institut Français du Pétrole Publication, 1996
4. Kermit E. Brown, "The Technology of Artificial Lift Methods", Volume 2a, Petroleum publishing Co., 1980
5. Amanat U.C., "Oil Well Testing handbook", Elsevier, 2004
6. Amanat U.C., "Gas Well Testing handbook", Elsevier, 2004

Railway Vehicle Engineering
ENME804168
4 SKS
Learning Outcomes:

Provides the knowledge and design of rail vehicle.

Syllabus:

Engineering and economic analysis of rail vehicles; body structures and rail vehicles; structural analysis of flat car; coupler analysis; electrical and pressurized water; analysis and modeling of the bogie; axle; wheel; brake and pivot; suspension system and driving quality; dynamic load analysis; fatigue and cracks in rail vehicles; models of rail vehicles and track geometry; modeling components of rolling stock; response rail vehicle on the track tangent; lateral stability of the rail vehicle on the track tangent; response rail vehicle on a curved trajectory; wheel wear; rail vehicle dynamics.

Pre-requisite(s): Engineering Materials, Mechanical Design

References:: Simon Iwnicki, handbook of railway vehicle dynamics, CRC Press, Taylor & Francis Group, 2006.

Material Handling Equipment
ENME804197
4 SKS
Learning Outcomes:

Provides expertise and competence to students in the field of design and development of lifting equipment and construction equipment

Syllabus:

Introduction and Scope of Construction Equipment; Tractor, Bulldozer, Dump Truck and shovel; Construction Equipment Mechanical Concept; Heavy equipment system: Pneumatic and Hydraulic; Basic Machine-lifting machinery and materials transporter; Cranes, hoist and conveyor; forklift: Moving Walks, Escalators, and Elevators

Pre-requisite(s): Engineering Materials, Mechanical Design

References:
1. ASME. Handbook of Materials Handling.
2. Mc.Guiness. Mechanical and Electrical Equiment for Building.

Aircraft Design And Performance
ENME804198
4 SKS
Learning Outcomes:

Explain aircraft flying techniques, Explain the design concepts of an aircraft, Explain the design stages of an aircraft, Determine aircraft design requirements, Analyze aircraft performance, Analyze the advantages and disadvantages of an aircraft design.

Syllabus:

The evolution of aircraft design, design requirements of an aircraft, aircraft design concepts, aircraft aerodynamics, aircraft propulsion systems, aircraft performance in steady flight conditions, aircraft performance in accelerated flight conditions, aircraft design which includes aspects of aerodynamics and its components, the technique of flying an airplane.

Pre-requisite(s): Engineering Materials, Mechanical Design

References:
1. J. D. Anderson, Aircraft Performance and Design, McGraw-Hill
2. Daniel Raymer, Aircraft Design, American Institute of Aeronautics and Astronautics.
3. Mohammad H. Sadraey, Aircraft Design: A Systems Engineering Approach, Wiley.
4. John P. Fielding, Introduction to Aircraft Design, Cambridge.
5. Egbert Torenbeek, Advanced Aircraft Design: Conceptual Design, Analysis and Optimization of Subsonic Civil Airplanes, Wiley.

Maritime Engineering and Management
ENME802181
4 SKS
Learning Outcomes:

This course provides knowledge about technologies for ocean transportation and the application of ocean-based energy sources. This course also aims to equip students with understanding of maritime opportunities that can be developed with the use of technology.

Syllabus :

Classification of ship based on its function, aspects to consider in ship designing, history of development of off-shore structure, ocean environment, typesof off-shore structure: fixed design and floating design, mooring and anchoring system, force calculation of off-shore structure, FPSO

Pre-requisite(s): -

References:
1. Research Council National Research Council, NEW Mining in the Outer Continental Shelf and in the Deep Ocean, University Press of the Pacific, 2005
2. Arthur H. Johnson, Michael D. Max, William P. Dillon, Natural Gas Hydrate - Arctic Ocean Deepwater Resource Potential, Springer, 2013
3. Khaligh, Alireza and Onar, Omer C., Energy Harvesting: Solar, Wind, and Ocean Energy Conversion Systems, CRC Pr I Llc, 2009

Ocean Energy
ENME803182
4 SKS
Learning Outcomes:

This course provides knowledge about technologies and principles related to the design of renewable ocean energy system

Syllabus :

Introduction to renewable ocean energy, introduction to wind turbine, tidal system and tidal energy system, OTEC, ocean flows, methods of economic/financial assessment for off-shore renewable energy system,wind energy, momentum theory and the limit of wind power output, tidal flow and its conversion to mechanical energy, description of wave energy sources, instruments of wave energy and instruments for simulation.

Pre-requisite : -

References:
1. Twidell, J. and Weir, T., "Renewable Energy Resources. Second Edition", Taylor and Francis Group, 2006.
2. Boyle, G., "Renewable energy power for a sustainable

future, Second Edition", Oxford University Press, 2005.
3. Walker J and Jenkins N, "Wind Energy Technology", Wiley Unesco Energy Engineering Series, 1997.
4. Manwell JF, McGowan, JG and Rogers, AL., "Wind Energy explained: Theory, Design and Application", Wiley. 2nd Edition. ISBN0-470-01500-4, 2010
5. Cruz, J., "Ocean Wave Energy: Current Status and Future Perspectives", Springer-Berlin, 2007.
6. Falnes, J., "Ocean Waves and Oscillating Systems: Linear Interactions Including Wave-Energy Extraction", Cambridge University Press, Cambridge, 2002.
7. Baker AC, "Tidal Power", Peter Peregrinus Ltd, 1981.

Marine and Offshore Structure

ENME803183
4 SKS
Learning Outcomes:

Provides the knowledge, understanding of the theory and principles of building offshore include the type, function, and offshore construction technology and techniques in performing design structure.

Syllabus :

Types of Offshore; Construction and Offshore Structures; Calculation of Style and Power Offshore: Safety Requirements; Construction Semi-submersible; Single Buoy Mooring; FPSO; Offshore Maintenance and Repair.

Pre-requisite : -

References :

1. Cliff Gerwick, Construction of Marine and Off-shore Structures, CRC Press 1999
2. Subrata Chakrabarti, Handbook of Offshore Engineering, Elsevier Science, 2005
3. Yong Bai, Marine Structural Design, Elsevier Science, 2003

Sea Transport and Port Management

ENME803184
4 SKS
Learning Objective(s):

Provides the knowledge and understanding of various management approaches, maritime transport and port activities which also include risk factors, safety, and economy.

Syllabus :

Sea Transport Demand Trend: Marine Transportation Market Research; Inter Mode Transport System; System loading and unloading, Types of Sea Transport, Warehousing and Storage Cargo Systems, SystemsAgency, Survey Charge, Corporate Sailing economic calculation, Customs.

Pre-requisite : -

References :

1. P. Lorange, Shipping Management, Institution for shipping Research.
2. Patrick Alderton, Reeds Sea Transport : Operation and Management, Adlard Coles, 2008
3. Patrick Alderton, Port Management and Operations,Informa Business Publishing, 2005
4. Svein Kristiansen, Maritime Transportation : Safety management and Risk analysis, Butterworth-Heinemann, 2004
5. M. Stopford, Maritime Economics, Routledge, 1997
6. House, D.J, Cargo Work for Maritime Operation, Butterworth Heinemann, 2005

Maritime Law and Regulation

ENME803185
4 SKS
Learning Outcomes:

Provides knowledge and understanding of the laws and regulations on maritime activities both nationally and internationally.

Syllabus :

Introduction of maritime law; Regulation of Marine Pollution Prevention and Control; SOLAS; Prevention of Collisions Regulations; ISM Code; Statutory Rules; Passenger Ship Regulations; Tanker Regulations; Offshore Regulations: Accident Rescue Regulations; Other IMO rules. Accident prevention regulations; Risk assessment and analysis.

Pre-requisite : -

References:

1. International Convention for the Prevention of Pollution From Ships (MARPOL), International Maritime Organisation Publications
2. International Regulations for Preventing Collisions at Sea (COLREG), International Maritime Organisation Publications
3. International Convention for the *Safety of Life at Sea* (SOLAS), International Maritime Organisation Publications
4. International Safety Management Code (ISM Code) Guide Book, International Maritime Organisation Publications
5. Churchil R.R. dan Lowe A.V, The Law of the Sea, MUP 1999

Supply Chain Technology

ENME804192
4 SKS
Learning Outcomes:

Providing knowledge and understanding in the use of technology in managing the flow of goods with a focus on the transportation system and managing the flow of information between organizations in a supply chain.

Syllabus :

Introduction and introduction to supply chains, the role and function of transportation in supply chains, intermodal transportation, variability in transport lead time in supply chains, use of technology in supply chains (Artificial Intelligence, Advanced Analytics, Internet of Things, Intelligent Things, Conversational Systems)

Pre-requisite : -

References:

1. Ek Peng Chew. Advances in Maritime Logistics and Supply Chain Systems, World Scientific Publishing Company, 2011
2. Robert A. Novack. Transportation: A Global Supply Chain Perspective, South Western Educational Publishing, 2018
3. Geunes, J. Supply Chain Optimization, Springer, 2005.
4. Lehmacher. W. The Global Supply Chain: How Technology and Circular Thinking Transform Our Future, Springer International Publishing, 2017

Cargo Cooling Technology

ENME804193
4 SKS
Learning Outcomes:

Providing knowledge and understanding in the use of cooling and air conditioning equipment circulation technology; cold storage and low temperature logistics.

Syllabus :

Basic principles for estimating cold storage loads, calculation of cooling capacity for various types of cold storage, and other topics of evaporative cooling, principles for designing low-cost refrigeration bases.

Pre-requisite : -

References:

1. ERao, C.G. Engineering for Storage of Fruits and Vegetables: Cold Storage, Controlled Atmosphere Storage, Modifie Atmosphere Storage. Academic Press, 2015, ISBN: 0128033657,9780128033654

Special Ship Project

ENME804186
4 SKS
Learning Outcomes:

Provides the knowledge, understanding of ship design for special purposes.

Syllabus :

Typology and special ship purposes; Material to special Ship, Design Considerations; Calculation of loading; Calculation of Ship Quantities; Computation Structures: Propulsion Systems; Motion System; Safety and Navigation System; Stability Calculation.

Pre-requisite : -

References :

1. Lars Larsson dan Rolf Eliasson, Principles of Yacht Design, International Marine/Ragged Mountain Press, 2007
2. Dave Gerr, The Elements of Boats Strength, International Marine/Ragged Mountain Press, 1999
3. Norman L. Skene, dan Marnard Bray, Elements of Yacht Design, Sheridan house, 2001
4. Steve Killing dan Doug Hunter, Yacht Design Explained : A Sailors Guide to the Principles and Practices of Design, W.W Norton and Company, 1998
5. S. Sleight, Modern Boat Building, Conway Maritime Press.

Ship Production Optimization

ENME804187
4 SKS
Learning Outcomes:

Provides knowledge and understanding of the various shipyard management and technique.

Syllabus :

Shipyard Layout; Ship Process Production; Steel Stock Yard Planning; Crane Calculation: Jamorang Calculation At Each Stage Production: Make Work Schedule: Work Break Down Structure; Integrated Hull Outfitting and Painting; Advanced Outfiting; Group Technology Methods for Ship Production; Ship launching; Ship trials.

Pre-requisite : -

References :

1. D.J. Eyres, Ship Construction, Butterworth- Heinemann, 2007
2. R.Shenoi, Ship Production Technology, Univ. Of Southampton.
3. National Research Council, Shipbuilding Technology and Education, National Academy Press, 1996

Maritime Safety

ENME804189
4 SKS
Learning Outcomes:

Provides knowledge and understanding related to the safety via regulations, management, and development of any forms of maritime transportation technology.

Syllabus :

SOLAS: general provision, construction, safety equipment, communication radio, safety naviga- tion, freight, management for ship safety, MARPOL Annex I-V, maritime safety, threats from mari- time trading, threats from shipping, evolution of maritime safety, implementation of ISPS code, safety planning.

Pre-requisite(s): -

References:

1. Jones. S. Maritime Security: A practical Guide, the nautical institute 2012
2. Consolidate Edition, MARPOL, International Maritime Organization, 2006
3. Consolidate Edition, SOLAS, International Maritime Organization, 2004

Advanced Welding Engineering

ENME804190
4 SKS
Learning Outcomes:

Provide knowledge, understanding of the theories, principles and design as well as the assessment of the quality of welding and welding applications.

Syllabus:

Introduction, review of welding term and definition, welding process type, standard power source, Oxy-gas welding, Shield Metal Arc Welding (SMAW), Gas Tungsten Arc Welding (GTAW), Gas Metal Arc Welding (GMAW), Submerged Arc Welding (SAW), Flux Cored Arc Welding (FCAW), Resistance welding, Friction Stir Welding, Other welding process: laser, electron beam, plasma, Cutting and other edge preparation processes, surfacing and spraying, Brazing and soldering, Joining processes for plastics, ceramics and composites, Welding metal: Ferrous-based metal, non-ferrous-based metal, Material behavior during welding process, Testing materials and the weld joint, Non Destructive Examination (NDE), DT (Destructive Test), Heat treatment of base materials and welded joints, Basic of welding design, Residual stresses and distortion, Welding Symbol, Behavior of welded structures under different types of loading, Design of welded structures under static and dynamic loading, welding defects, Design of welded pressure equipment, Welding Performance Qualification Record (WPQR), Welding Procedure Specification (WPS), Welding automation.

Pre-requisite(s): -

References:

1. Sindo Kou, Welding Metallurgy, 2nd Edition, Wiley, 2002.
2. ASME Section IX, Welding and Brazing Qualifications
3. AWS D1.1., Structural Welding (Steel)
4. William A. Bowditch, Welding Fundamentals 5th Edition, Goodheart-Willcox, 2011.
5. Technical Manual TM 5-805-7. Welding Design, Procedures and Inspection Headquarters, Department of the Army.1985
6. Lloyds Register. Welding Procedures, Inspections and Qualifications.

Planning And Operational Port

ENME804191
4 SKS
Learning Outcomes:

Port Planning and Operations is a lecture that emphasizes the process of planning the layout and operation of ports in accordance with commodities managed based on the principle of green-port development. This course is Shipping Engineering Elective Courses, which are expected to provide a complete understanding for students in planning ports in the realm of sea transportation. After completing this lecture, students plan the layout and operation of the port in accordance with the principles of green-port development technology.

Syllabus :

Sea transportation: Facilities and commodities, Port functions in maritime transportation, types of ports and sea terminals, stages in port planning, integrated port planning principles, planning and design of port water areas., Conventional general cargo terminals, Container terminals, Oil & liquid gas terminals, Dry bulk cargo terminals, Green port developments, Conventional general cargo terminals, Container terminals, Oil & liquid gas terminals, Dry bulk cargo terminals, Green port developments.

Pre-requisite : Welding Engineering

References:

1. Ligteringen, (1999), Ports and Terminals, Faculty of Civil Engineering and Geosciences Department of Hydraulic and Geotechnic Engineering Section Hydraulic Engineering, Technische Universiteit Delft.
2. Velsink, H., (1994), Ports and Terminals: Planning and Functional Design, Faculty of Civil Engineering Hydraulic Engineering Group, Delft University ofTechnology.
3. Bose, J.W., (2011), Handbook of Terminal Planning, Springer-Verlag New York

Engineering Magister Through Fast Track Program

For students who wish and are able to continue their education program to the Masters level in Engineering through the Fast track program, a credit transfer can be made up to a maximum of 22 credits. The number of credits that can be transferred is 14 credits from the mandatory subjects and 8 credits from the 2 elective subjects @ 4 credits.

Specialization subjects and optional specialization subjects, so that credit can be transferred if the subject is in accordance with the subject in the choice of Specialization in Mechanical Engineering Masters Program.

Requirements for students to take part in the Fast Track program are as follows:

1. Expressing his intention to take part in the Fast Track Program, by writing an Application Letter to the Chairperson of the Department of Mechanical Engineering by including a Study Plan in the form of a lesson plan in Semester 6 to 8 (Undergraduate Engineering Program) and Semester 1 s.d. 4 (in the Master of Engineering Program) in accordance with the Specialization in the Master of Engineering Program, no later than at the end of Semester 5 of the Bachelor of Mechanical Engineering or Naval Architecture and Marine Engineering programs.
2. Have excellent academic grades, with a Grade Point Average (GPA) up to Semester 5, minimum 3.2, and have graduated from all Basic Subjects.
3. Has a person in charge and or a scholarship to complete his Bachelor of Engineering and Masters of Engineering with the Fast Track Scheme.
4. Students who take part in the Fast Track Program express their willingness to attend the Academic Program on a Full-Time basis.
5. If the Application for Fast Track Scheme can be approved by the Head of Department / Study Program, the student concerned will discuss together with the Academic Advisor for finalization of the Bachelor of Engineering (S1) and Masters of Engineering (S2) Study Plans.

Students of Engineering Undergraduate Program (S1) who have been approved with plans to continue their studies to the Masters Degree in Engineering (S2) by the Chair of the Department of Mechanical Engineering, need to immediately adjust their study plans in Semesters 7 and 8, especially in taking their S1 Elective Subjects by adjusting themselves with Obligatory and Elective Subjects at the Masters level in Engineering according to their specialization.

Transition Rules

1. The 2020 curriculum is implemented starting in the Odd Semester 2020/2021. In principle, after the 2016 Curriculum is implemented, only subjects in the 2020 Curriculum will be opened.
2. Class of 2019 and previously followed the 2020 curriculum with transitional rules.
3. A transitional period of 1 year, in the academic year 2020/2021, is implemented for subjects where the semester placement changes (from Even to Odd, or vice versa), if necessary, will be opened in both semesters during the transition period (Academic Year 2020 / 2021).
4. For students who have not passed the compulsory subjects in the 2016 Curriculum, are required to take the same or equivalent subjects in the 2020 Curriculum.
5. If there is a change in the credits of the course, the number of credits taken into account in graduation is the number of the credits at the time the course was taken. Same or equal subjects with different credits, if repeated or newly taken will be listed with a new name and calculated with new credits.

Table of Equality in S2 Mechanical Engineering Courses

No	Subjects in 2016 Curriculum	Credits 2016	Subjects in 2020 Curriculum	Credits 2020
1	Advanced Mathematics Engineering	4	Advanced Mathematics Engineering	2
2	-	-	Data Analytics	2
3	Research Design	2	Experimental Design	2
4	-	-	Project Design	2
5	Scientific Publication	2	Scientific Writing and Publication	2
6	Academic Writing	2	-	-
7	Thesis	8	Final Projects	4

Master Program in Electrical Engineering

Program Specification

1.	**Awarding Institution**	Universitas Indonesia	
2.	**Teaching Institution**	Universitas Indonesia	
3.	**Faculty**	Engineering	
4.	**Programme Title**	Master Program in Electrical Engineering	
5.	**Study Programme Vision and Mission**	**Vision** To become an institution which can give solutions to both national and global problems and challenges as well as being independent and excellent in South-East Asia **Mission** a. Organizing education based on good university governance concept in order to produce graduates who are knowledgeable, international minded, and have entrepreneurship skills b. Increasing facility, research funding, and participation in applied research and new findings which can give solutions to national and global problems c. Applying science and appropriate technology to support community services based on people and industrial needs	
6.	**Class**	Reguler, Special	
7.	**Final Award**	Magister Teknik (MT.)	
8.	**Accreditation / Recognition**	BAN-PT: A- accredited	
9.	**Language (s) of Instruction**	Bahasa Indonesia dan English (for International class)	
10.	**Study Scheme (Full Time / Part-Time)**	Full Time	
11.	**Entry Requirements**	Pass the entrance exam, and pass S1/d IV from electrical engineering study program, mechanical engineering, computer science, informatic engineering, mathematic, physics, and equivalent program	
12.	**Study Duration**	Designed for 2 years	
	Type of Semester	Number of semester	Number of weeks/semesters
	Reguler	4	16
	Short (opsional)	**1**	**8**
13.	**Aims of the programme:** "Producing master in electrical engineering graduates who can analyse problems, give solutions logically, systematically and practically supported by the use of appropriate method. The graduates also are wished to design and develop both software and hardware, and always being up-to-date to the development of technology"		
14.	**Profile of Graduates:** Magister of engineering who is able to analyze and design in-depth on products, process and technology system in complex electrical engineering based on professional ethics in contributing to sustainable development goals		
15.	**Expected Learning Outcomes (ELO) :** General Outcomes : 1. Able to generate scientific work effectively, both oral and written 2. Able to provide recommendations as solution to society based on professional ethics in electrical engineering 3. Able to develop themselves for continuous learning, following the development of science, technology and relevant contemporary issues in the field of electrical engineering. 4. Able to evaluate data by applying data analysis and processing methods. 5. Able to formulate problem solving in the field of electrical engineering using appropriate research methods. 6. Able to develop innovative technology of electrical engineering industry in the industrial era 4.0 Majoring in Power and Smart System 1. Able to specify technical and non-technical aspects in the formulation and utilization of the intelligent network-based electricity industry. 2. Able to recommend strategies to improve efficiency, quality, and power quality in electricity systems based on intelligent networks. 3. Able to integrate new and renewable energy power plants with smart electricity grid systems. 4. Able to assess strategies and risk mitigation in the development of power systems that are reliable, safe, and environmentally friendly.		

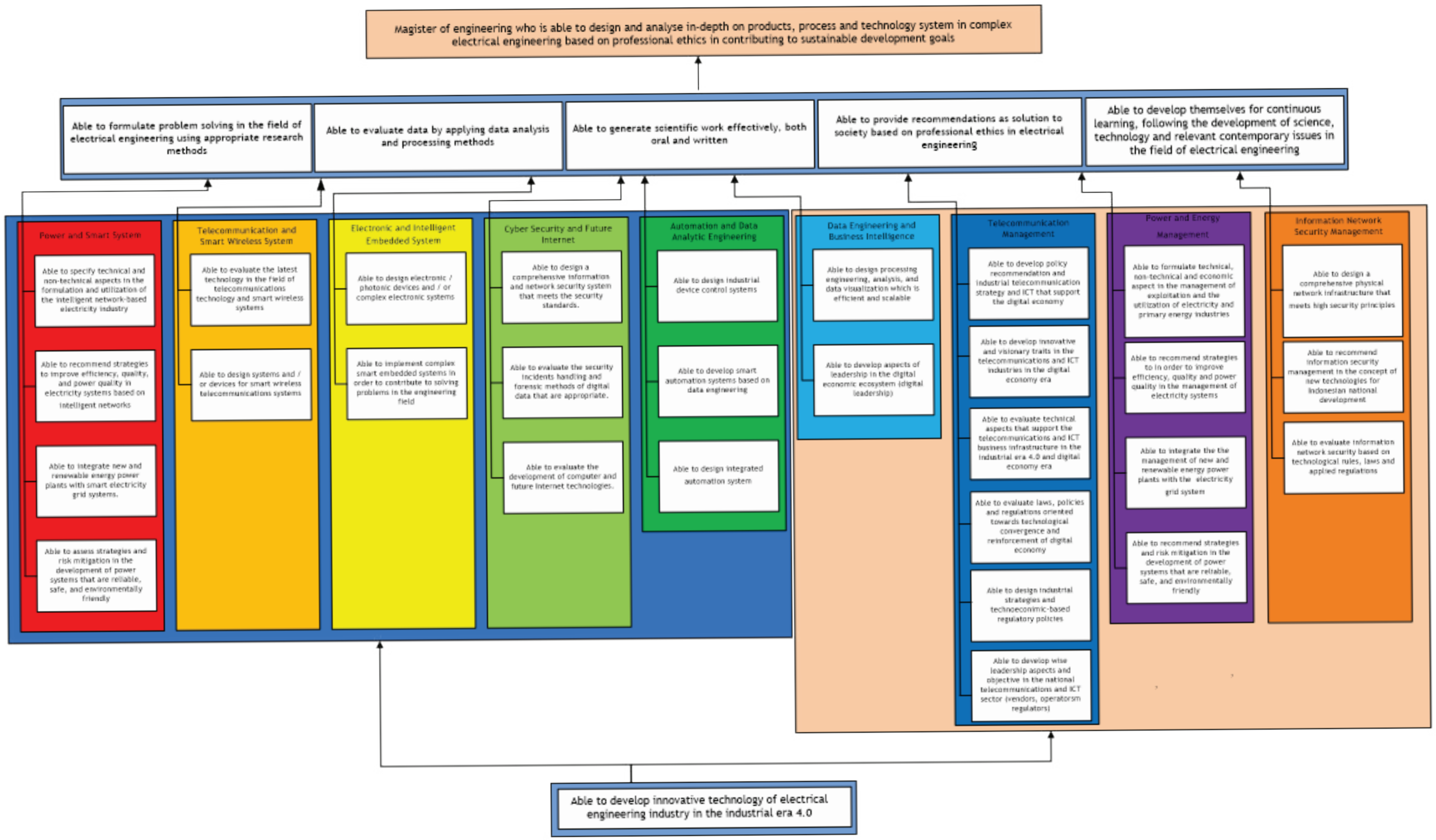
	Majoring in Telecommunication and Smart Wireless System 1. Able to evaluate the latest technology in the field of telecommunications technology and smart wireless systems 2. Able to design systems and /or devices for smart wireless telecommunications systems Majoring in Electronic and Intelligent Embedded System 1. Able to design electronic / photonic devices and / or complex electronic systems 2. Able to implement complex smart embedded systems in order to contribute to solving problems in the engineering field Majoring in Cyber Security and Future Internet 1. Able to design a comprehensive information and network security system that meets the security standards. 2. Able to evaluate the security incidents handling and forensic methods of digital data that are appropriate. 3. Able to evaluate the development of computer and future Internet technologies. Majoring in Automation and Data Analytic Engineering 1. Able to design industrial device control systems 2. Able to develop smart automation systems based on data engineering 3. Able to design integrated automation system Majoring in Data Engineering and Business Intelligence 1. Able to design processing engineering, analysis, and data visualization which is efficient and scalable 2. Able to develop aspects of leadership in the digital economic ecosystem (digital leadership) Majoring in Telecommunication Management 1. Able to develop policy recommendation and industrial telecommunication strategy and ICT that support the digital economy 2. Able to develop innovative and visionary traits in the telecommunications and ICT industries in the digital economy era 3. Able to evaluate technical aspects that support the telecommunications and ICT business infrastructure in the industrial era 4.0 and digital economy era 4. Able to evaluate laws, policies and regulations oriented towards technological convergence and reinforcement of digital economy 5. Able to design industrial strategies and technoeconimic-based regulatory policies 6. Able to develop wise leadership aspects and objective in the national telecommunications and ICT sector (vendors, operatorsm regulators) Majoring in Power and Energy Management 1. Able to formulate technical, non-technical and economic aspect in the management of exploitation and the utilization of electricity and primary energy industries 2. Able to recommend strategies to in order to improve efficiency, quality and power quality in the management of electricity systems 3. Able to integrate the the management of new and renewable energy power plants with the electricity grid system 4. Able to recommend strategies and risk mitigation in the development of power systems that are reliable, safe, and environmentally friendly. Majoring in Information Network Security Management 1. Able to design a comprehensive physical network infrastructure that meets high security principles 2. Able to recommend information security management in the concept of new technologies for Indonesian national development 3. Able to evaluate information network security based on technological rules, laws and applied regulations
16.	**Composition of Subjects**

No.	Classification	Credit Hours (SKS)	Percentage
i	**Core Subjects**	**21**	**47,7%**
ii	**Majoring Course**	**19**	**43,2%**
iii	**Optional Course**	**4**	**9,1%**
	Total	**44**	**100 %**
	Total Credit Hours to Graduate		**44 SKS**

Career Prospects

The graduates of this program have been employed in various industrial companies such as power engineering, IT, electronic, oil & gas, telecommunication and other related inductries. Some of graduates who have been employed before have opportunity to get promotion of career path to a higher level. Some occupation or job titles that are suitable for this program are electrical engineer, software engineer telecommunication engineer, process engineer, control engineer, instrumentation engineer, program manager, project manager, technical manager, regulator, professional lecturers and researchers.

Learning Outcomes Flow Diagram



FLOW DIAGRAM OF SUBJECTS

MAJORING IN POWER AND SMART SYSTEM

No.	Learning Outcomes	Semester 1	Semester 2	Semester 3	Semester 4
1	Able to evaluate data by applying data analysis and processing methods	Processing and data analysis			
2	Able to formulate problem solving in the field of electrical engineering with appropriate research methods	Research methodology			
3	Able to develop innovative capabilities in the electrical engineering industry in the industrial era 4.0			Entrepreneurship and Technology Innovation	
4	Able to produce scientific works effectively, both oral and written				Thesis Scientific Publications
5	Able to provide solutions to the community based on the professional ethics in the electrical engineering field				Thesis Scientific Publications
6	Able to improve self-development skill to study continuously, keep update with the latest developments in science, technology and relevant contemporary issues in the field of electrical engineering				Scientific Publications
7	Able to specify technical and non-technical aspects in the utilization of the intelligent network-based electricity industry	Electric Generation Operation and Control Electric Power and Environment	Dynamic Systems and Modeling Advanced Power Electronics Economics Energy and management		
8	Able to recommend strategies to improve efficiency, quality, and power quality in electricity systems based on intelligent networks	Electrical power system quality			
9	Able to integrate new and renewable energy power plants with smart electricity grid systems		Renewable energy and energy storage	Smart Energy System	
10	Able to assess strategies and risk mitigation on the development of power systems that are reliable, safe, and eco-friendly			Power System Planning	

MAJORING IN TELECOMMUNICATION AND SMART WIRELESS SYSTEM

No.	Learning Outcomes	Semester 1	Semester 2	Semester 3	Semester 4
1	Able to evaluate data by applying data analysis and processing methods	Processing and data analysis			
2	Able to formulate problem solving in the field of electrical engineering with appropriate research methods	Research methodology			
3	Able to develop innovative capabilities in the electrical engineering industry in the industrial era 4.0			Technological Innovation and Entrepreneurship	
4	Able to produce scientific works effectively, both oral and written				Thesis Scientific Publications
5	Able to provide solutions to the community in accordance with professional ethics in the electrical engineering field				Thesis Scientific Publications
6	Able to improve self-development skill to study continuously, keep update with the latest developments in science, technology and relevant contemporary issues in the field of electrical engineering				Scientific Publications
7	Able to evaluate the latest technology in the field of telecommunications technology and smart wireless systems	Signal Processing and Applications Modern Telecommunications System Modern Radar System	Terahertz and optic Systems	Technological quality of services and experience Computational Intelligence for communication engineering	
8	Able to design systems and / or devices for smart wireless telecommunications systems		Sensor Communication System smart RF design Modern Antenna Techniques		

MAJORING IN ELECTRONIC AND INTELLIGENT EMBEDDED SYSTEM

No.	Learning Outcomes	Semester 1	Semester 2	Semester 3	Semester 4
1	Able to evaluate data by applying data analysis and processing methods	Processing and data analysis			
2	Able to formulate problem solving in the field of electrical engineering with appropriate research methods	Research methodology			
3	Able to develop innovative capabilities in the electrical engineering industry in the industrial era 4.0			Technological Innovation and Entrepreneurship	
4	Able to produce scientific works effectively, both oral and written				Thesis Scientific Publications
5	Able to provide solutions to the community in accordance with professional ethics in the electrical engineering field				Thesis Scientific Publications
6	Able to improve self-development skill to study continuously, keep update with the latest developments in science, technology and relevant contemporary issues in the field of electrical engineering				Scientific Publications
6	Able to design electronic / photonic devices and / or complex electronic systems	Digital Microelectronic circuit design photonic device Green electronic devices	Nanoelectronic Sensor dan Actuator Advanced analog electronic circuits Opto-electronics instrumentation		
7	Able to implement complex smart embedded systems to contribute to solving problems in the engineering field			IoT and smart Electronic system System on Chip	

MAJORING IN CYBER SECURITY AND FUTURE INTERNET

No.	Learning Outcomes	Semester 1	Semester 2	Semester 3	Semester 4
1	Able to evaluate data by applying data analysis and processing methods	Processing and data analysis			
2	Able to formulate problem solving in the field of electrical engineering with appropriate research methods	Research methodology			
3	Able to develop innovative capabilities in the electrical engineering industry in the industrial era 4.0			Technological Innovation and Entrepreneurship	
4	Able to produce scientific works effectively, both oral and written				Thesis Scientific Publications
5	Able to provide solutions to the community in accordance with professional ethics in the field of electrical engineering				Thesis Scientific Publications
6	Able to develop own-self through lifelong learning, keep updated with the latest advancement in science, technology and relevant contemporary issues in the field of electrical engineering				Scientific Publications
7	Able to design a comprehensive information and network security system that meets the applicable security standard rules.	Network security and reliability Network security and data protection	Applied Cryptography and Blockchain Technology		
8	Able to evaluate the security incidents handling and forensic methods of digital data that are appropriate.		Security operation and Incident Handling Network and Digital Forensics	Security Risk Assesment and Analysis	
9	Able to evaluate the development of computer and future Internet technologies.	Advanced network computer systems	Convergence Information Network NG	Cyber Threat Intelligence and Incident Analysis	

MAJORING IN AUTOMATION AND DATA ANALYTIC ENGINEERING

No.	Learning Outcomes	Semester 1	Semester 2	Semester 3	Semester 4
1	Able to evaluate data by applying data analysis and processing methods	Processing and data analysis			
2	Able to formulate problem solving in the field of electrical engineering with appropriate research methods	Research methodology			
3	Able to develop innovative capabilities in the electrical engineering industry in the industrial era 4.0			Technological Innovation and Entrepreneurship	
4	Able to produce scientific works effectively, both oral and written				Thesis Scientific Publications
5	Able to provide solutions to the community based on the professional ethics in the electrical engineering field				Thesis Scientific Publications
6	Able to improve self-development skill to study continuously, keep update with the latest developments in science, technology and relevant contemporary issues in the field of electrical engineering				Scientific Publications
7	Able to recommend industrial device control systems	Industrial Electric Drive System Mechatronicsystem modeling and control			
8	Able to develop smart automation systems based on data engineering		Advanced smart data computation smart system monitoring and data engineering	Advanced Machine Learning for the Autonomous System	
9	Able to design an integrated automation system	System optimization and optimal control	Coordinated and networked control system special topics on automation data engineering	Industrial Cyber Automation and Security	

MAJORING IN DATA ENGINEERING AND BUSINESS INTELLIGENCE

No.	Learning Outcomes	Semester 1	Semester 2	Semester 3	Semester 4
1	Able to evaluate data by applying data analysis and processing methods	Processing and data analysis			
2	Able to formulate problem solving in the field of electrical engineering with appropriate research methods	Research methodology			
3	Able to develop innovative capabilities in the electrical engineering industry in the industrial era 4.0			Technological Innovation and Entrepreneurship	
4	Able to produce scientific works effectively, both oral and written				Thesis Scientific Publications
5	Able to provide solutions to the community based on the professional ethics in the electrical engineering field				Thesis Scientific Publications
6	Able to improve self-development skill to study continuously, keep update with the latest developments in science, technology and relevant contemporary issues in the field of electrical engineering				Scientific Publications
7	Able to design efficient, scalable data processing, analysis and visualization techniques	Business analytic and visualization Imaging Technology and Computer Vision	Big Data Technology and Architechture Advanced Artificial Intelligence Applied Data Engineering	Enterprise Cyber Threat Analysis	
8	Able to develop aspects of leadership in the digital economic ecosystem (digital leadership)	Digital Enterprise Software Architechture	Ethics and Professionalism	Advanced IT Project Management	

MAJORING IN TELECOMMUNICATION MANAGEMENT

No.	Learning Outcomes	Semester 1	Semester 2	Semester 3	Semester 4
1	Able to evaluate data by applying data analysis and processing methods	Processing and data analysis			
2	Able to formulate problem solving in the field of electrical engineering with appropriate research methods	Research methodology			
3	Able to develop innovative capabilities in the electrical engineering industry in the industrial era 4.0			Technological Innovation and Entrepreneurship	
4	Able to produce scientific works effectively, both oral and written				Thesis Scientific Publications
5	Able to provide solutions to the community based on the professional ethics in the electrical engineering field				Thesis Scientific Publications
6	Able to improve self-development skill to study continuously, keep update with the latest developments in science, technology and relevant contemporary issues in the field of electrical engineering				Scientific Publications
7	Able to develop telecommunications and ICT industry policy and strategy recommendations that support the digital economy	Management of Telecommunications System and Digital Business	Special Topics of Technology and Innovation Strategic Management and Technoeconomic Ecosystem and Digital Economic Law, Regulation and Telecommunications Policy	Capita Selecta Technological Innovation and Entrepreneurship	
8	Able to develop innovative and visionary traits in the telecommunications and ICT industries in the digital economy era	Manajemen Sistem Telekomunikasi dan Bisnis Digital	Ecosystem and Digital Economic	Advanced IT Project Management	
9	Able to evaluate the technical aspects that support telecommunications and ICT business infrastructure in the industrial era 4.0 and the era of the digital economy	Trend of Digital Technology	Telecommunications Convergence Service and Infrastucture Special Topic of Technology and Innovation	Internet of Things (IoT) and future network technology	
10	Able to evaluate laws, policies and regulations oriented towards technological convergence and strengthening of the digital economy		Law, Regulation and Telecommunications Policy Ecosystem and Digital Economic		
11	Able to design industrial strategies and technoeconomic-based regulatory policies.		Strategic management and technoeconomic	Capita Selecta	
12	Able to develop wise and objective leadership aspects in the national		Special Topic of Technology and Innovation	Capita Selecta Technological Innovation	

MAJORING IN POWER AND ENERGY MANAGEMENT

No.	Learning Outcomes	Semester 1	Semester 2	Semester 3	Semester 4
1	Able to evaluate data by applying data analysis and processing methods	Processing and data analysis			
2	Able to formulate problem solving in the field of electrical engineering with appropriate research methods	Research methodology			
3	Able to develop innovative capabilities in the electrical engineering industry in the industrial era 4.0			Technological Innovation and Entrepreneurship	
4	Able to produce scientific works effectively, both oral and written				Thesis Scientific Publications
5	Able to provide solutions to the community in accordance with professional ethics in the electrical engineering field				Thesis Scientific Publications
6	Able to improve self-development skill to study continuously, keep update with the latest developments in science, technology and relevant contemporary issues in the field of electrical engineering				Scientific Publications
7	Able to formulate technical, non-technical, management and economic aspects in the business, utilization and electricity industry including energy issues	Economic of Electric Utility Power Generation Control and Operation of Power Generation Plant	Dynamic system and modeling Strategic management Economics Energy and Management	Energy and Environment	
7	Able to recommend strategies to improve efficiency, quality and power quality in the electricity system			Electrical Power System Quality	
8	Able to integrate new and Renewable Energy power plants with the electricity grid system			Electric Power System Planning	
9	Able to recommend strategies and risk mitigation in the development of power systems and energy that is reliable, safe and eco-friendly		Strategic management		

MAJORING IN INFORMATION NETWORK SECURITY MANAGEMENT

No.	Learning Outcomes	Semester 1	Semester 2	Semester 3	Semester 4
1	Able to evaluate data by applying data analysis and processing methods	Processing and data analysis			
2	Able to formulate problem solving in the field of electrical engineering with appropriate research methods	Research methodology			
3	Able to develop innovative capabilities in the electrical engineering industry in the industrial era 4.0			Technological Innovation and Entrepreneurship	
4	Able to produce scientific works effectively, both oral and written				Thesis Scientific Publications
5	Able to provide solutions to the community in accordance with professional ethics in the electrical engineering field				Thesis Scientific Publications
6	Able to improve self-development skill to study continuously, keep update with the latest developments in science, technology and relevant contemporary issues in the field of electrical engineering				Scientific Publications
7	Able to design a comprehensive physical network infrastructure that meets high security principles	Information Network Infrastructure Computer Based Network Simulation Information Network Security			
7	Able to recommend information security management on the concept of new technologies for national development in Indonesia		Cyber Forensics Network and Application Security		
8	Able to evaluate information network security based on technological rules, laws and applicable regulations		Operations Security and Incident Management Security Assessment and Analysis	Security Risk Management and Regulation Cyber Threat Intelligence Analysis	

Core Subjects

Code	Subject	SKS
ENEE801001	Data Processing and Analytic	4
ENEE801002	Research Methodology	4
ENEE803003	Technology Innovation and Entrepreneurship	3

Majoring Course

Code	Subject	SKS
Majoring in Power and Smart System		
ENEE801101	Electric Generation Operation and Control	2
ENEE801102	Electric Power System Quality	2
ENEE801103	Electric Power and Environment	2
ENEE802104	Dynamic System and Modeling	2
ENEE802105	Economics Energy and Management	3
ENEE802106	Advanced Power Electronics	2
ENEE802107	Renewable Energy and Energy Storages	2
ENEE803108	Power System Planning	2
ENEE803109	Smart Energy System	2
Majoring in Telecommunication and Smart Wireless System		
ENEE801201	Signal Processing and applications	3
ENEE801202	Modern Telecommunication System	2
ENEE801203	Modern Radar System	2
ENEE802204	Modern Antenna Engineering	2
ENEE802205	Smart RF Design	2
ENEE802206	Terahertz and Optics System	2
ENEE802207	Sensor Communications System	2
ENEE803208	Technological Quality of Service and Experience	2
ENEE803209	Computational Intelligence for Communication Engineering	2
Majoring in Electronic and Intelligent Embedded System		
ENEE801301	Photonic Device	2
ENEE801302	Green Electronic Devices	2
ENEE801303	Digital Microelectronic Circuit Design	2
ENEE802304	Sensor and Actuators	2
ENEE802305	Nanoelectronic	2
ENEE802306	Advanced Analog Electronic Circuits	2
ENEE802307	Opto-Electronics Instrumentation	2
ENEE803308	System on Chip	2
ENEE803309	IoT and Smart Electronic System	3
Majoring in Cyber Security and Future Internet		
ENEE801401	Network Security and Reliability	2
ENEE801402	Advanced Network Computer Systems	2
ENEE801403	Network Security and Data Protection	2
ENEE802404	Applied Cryptography & Blockchain Technology	3
ENEE802405	Security Operation and Incident Handling	2
ENEE802406	Network & Digital Forensics	2
ENEE802407	Convergence Information Network NG	2
ENEE803408	Cyber Threat Intelligence and Incident Analysis	2
ENEE803409	Security Risk Assessment and Analysis	2
Majoring in Automation and Data Analytic Engineering		
ENEE801501	Mechatronic System Modeling and Control	2
ENEE801502	Industrial Electric Drive System	2
ENEE801503	System Optimization and Optimal Control	2
ENEE802504	Advanced Smart Data Computation	2
ENEE802505	Smart System Monitoring and Data Engineering	2
ENEE802506	Coordinated and Networked Control System	2
ENEE802507	Special Topics on Automation and Data Engineering	2
ENEE803508	Industrial Automation System and Security	3
ENEE803509	Advanced Machine Learning for Autonomous System	2
Majoring in Data Engineering and Business Intelligence		
ENEE801601	Digital Enterprise Software Architecture	2
ENEE801602	Business Analytic and Visualization	2
ENEE801603	Imaging Technology and Computer Vision	2
ENEE802604	Big Data Technology and Architecture	3
ENEE802605	Advanced Artificial Intelligence	2
ENEE802606	Applied Data Engineering	2
ENEE802607	Ethics and Professionalism	2
ENEE803608	Enterprise Cyber Threat Analysis	2
ENEE803609	Advanced IT Project Management	2
Majoring in Telecommunication Management		
ENEE801701	Management of Telecommunications System and Digital Business	3
ENEE801702	Trend of Digital Technology	3
ENEE802703	Law, Regulation and Telecommunications Policy	3

ENEE802704	Strategic Management and Technoeconomic	3
ENEE802705	Telecommunications Convergence Service and Infrastructure	2
ENEE802706	Ecosystem and Digital Economic	2
ENEE802707	Special Topic of Technology and Innovation	2
ENEE803708	Internet of Things (IoT) and Future Network Technology	3
ENEE803709	Capita Selecta	2
Majoring in Power and Energy Management		
ENEE801801	Control and Operation of Power Generation Plant	3
ENEE801802	Economic of Electric Utility Power Generation	3
ENEE802803	Dynamic Systems and Modeling	3
ENEE802804	Economics Energy and Management	3
ENEE802805	Strategic Managemen	3
ENEE803806	Electrical Power System Quality	2
ENEE803807	Electric Power System Planning	3
ENEE803808	Energy and Environment	3
Majoring in Information Network Security Management		
ENEE802901	Information Network Security	2
ENEE802902	Information Network Infrastructure	2
ENEE802903	Computer Based Network Simulation	2
ENEE803904	Network and Application Security	3
ENEE803905	Security Operations and Incident Management Security Operations and Incident Management	3
ENEE802906	Cyber Forensic	3
ENEE802907	Security Assessment and Analysis	3
ENEE803908	Cyber Threat Intelligence Analysis	2
ENEE803909	Security Risk Management & Regulation	3

Special Subjects

Code	Subject	SKS
ENEE804004	Publication	2
ENEE804005	Thesis	8

Course Structure Master Program in Electrical Engineering

Majoring in Power and Smart System

Code	Subject	SKS
	1st Semester	
ENEE801001	Data Processing and Analytic	4
ENEE801002	Research Methodology	4
ENEE801101	Electric Generation Operation and Control	2
ENEE801102	Electric Power System Quality	2
ENEE801103	Electric Power and Environment	2
	Sub Total	**14**
	2nd Semester	
ENEE802104	Dynamic System and Modeling	2
ENEE802105	Economics Energy and Management	3
ENEE802106	Advanced Power Electronics	2
ENEE802107	Renewable Energy and Energy Storages	2
	Elective Course	2
	Sub Total	**11**
	3rd Semester	
ENEE803003	Technology Innovation and Entrepreneurship	3
ENEE803108	Power System Planning	2
ENEE803109	Smart Energy System	2
	Elective Course	2
	Sub Total	**9**
	4th Semester	
ENEE804004	Thesis	8
ENEE804005	Scientific Publication	2
	Subtotal	**10**
	Total	**44**

Majoring in Telecommunication and Smart Wireless System

Code	Subject	SKS
	1st Semester	
ENEE801001	Data Processing and Analytic	4
ENEE801002	Research Methodology	4
ENEE801201	Signal Processing and applications	3
ENEE801202	Modern Telecommunication System	2
ENEE801203	Modern Radar System	2
	Sub Total	**15**
	2nd Semester	
ENEE802204	Modern Antenna Engineering	2

ENEE802205	Smart RF Design	2
ENEE802206	Terahertz and Optics System	2
ENEE802207	Sensor Communications System	2
	Elective Course	**2**
	Sub Total	**10**
	3rd Semester	
ENEE803003	Technology Innovation and Entrepreneurship	3
ENEE803208	Technological Quality of Service and Experience	2
ENEE803209	Computational Intelligence for Communication Engineering	2
	Elective Course	**2**
	Sub Total	**9**
	4th Semester	
ENEE804004	Thesis	8
ENEE804005	Scientific Publication	2
	Sub Total	**10**
	Total	**44**

Majoring in Electronic and Intelligent Embedded System

Code	Subject	SKS
	1st Semester	
ENEE801001	Data Processing and Analytic	4
ENEE801002	Research Methodology	4
ENEE801301	Photonic Device	2
ENEE801302	Green Electronic Devices	2
ENEE801303	Digital Microelectronic Circuit Design	2
	Sub Total	**14**
	2nd Semester	
ENEE802304	Sensor and Actuators	2
ENEE802305	Nanoelectronic	2
ENEE802306	Advanced Analog Electronic Circuits	2
ENEE802307	Opto-Electronics Instrumentation	2
	Elective Course	2
	Sub Total	**10**
	3rd Semester	
ENEE803003	Technology Innovation and Entrepreneurship	3
ENEE803308	System on Chip	2
ENEE803309	IoT and Smart Electronic System	3
	Elective Course	2
	Sub Total	**10**
	4th Semester	
ENEE804004	Thesis	8
ENEE804005	Scientific Publication	2
	Sub Total	**10**
	Total	**44**

Majoring in Cyber Security and Future Internet

Code	Subject	SKS
	1st Semester	
ENEE801001	Data Processing and Analytic	4
ENEE801002	Research Methodology	4
ENEE801401	Network Security and Reliability	2
ENEE801402	Advanced Network Computer Systems	2
ENEE801403	Network Security and Data Protection	2
	Sub Total	**14**
	2nd Semester	
ENEE802404	Applied Cryptography & Block-chain Technology	3
ENEE802405	Security Operation and Incident Handling	2
ENEE802406	Network & Digital Forensics	2
ENEE802407	Convergence Information Network NG	2
	Elective Course	2
	Sub Total	**11**
	3rd Semester	
ENEE803003	Technology Innovation and Entrepreneurship	3
ENEE803408	Cyber Threat Intelligence and Incident Analysis	2
ENEE803409	Security Risk Assessment and Analysis	2
	Elective Course	2
	Sub Total	**9**
	4th Semester	
ENEE804004	Thesis	8
ENEE804005	Scientific Publication	2
	Sub Total	**10**
	Total	**44**

Majoring in Automation and Data Analytic Engineering

Code	Subject	SKS
	1st Semester	
ENEE801001	Data Processing and Analytic	4
ENEE801002	Research Methodology	4
ENEE801501	Mechatronic System Modeling and Control	2
ENEE801502	Industrial Electric Drive System	2
ENEE801503	System Optimization and Optimal Control	2
	Sub Total	**14**
	2nd Semester	
ENEE802504	Advanced Smart Data Computation	2

ENEE802505	Smart System Monitoring and Data Engineering	2
ENEE802506	Coordinated and Networked Control System	2
ENEE802507	Special Topics on Automation and Data Engineering	2
	Elective Course	2
	Sub Total	**10**
	3rd Semester	
ENEE803003	Technology Innovation and Entrepreneurship	3
ENEE803508	Industrial Automation System and Security	3
ENEE803509	Advanced Machine Learning for Autonomous System	2
	Elective Course	2
	Sub Total	**10**
	4th Semester	
ENEE804004	Thesis	8
ENEE804005	Scientific Publication	2
	Subtotal	10
	Total	**44**

Curriculum of Electrical Engineering Department Special Class in Salemba

Majoring in Data Engineering and Business Intelligence

Code	Subject	SKS
	1st Semester	
ENEE801002	Data Processing and Analytic	4
ENEE801003	Research Methodology	4
ENEE801601	Digital Enterprise Software Architecture	2
ENEE801602	Business Analytic and Visualization	2
ENEE801603	Imaging Technology and Computer Vision	2
	Sub Total	**14**
	2nd Semester	
ENEE802604	Big Data Technology and Architecture	3
ENEE802605	Advanced Artificial Intelligence	2
ENEE802606	Applied Data Engineering	2
ENEE802607	Ethics and Professionalism	2
	Elective Course	2
	Sub Total	**11**
	3rd Semester	
ENEE803003	Technology Innovation and Entrepreneurship	3
ENEE803608	Enterprise Cyber Threat Analysis	2
ENEE803609	Advanced IT Project Managemen	2
	Elective Course	2
	Sub Total	**9**
	4th Semester	
ENEE804004	Thesis	8
ENEE804005	Scientific Publication	2
	Sub Total	**10**
	Total	**44**

Majoring in Telecommunication Management

Code	Subject	SKS
	1st Semester	
ENEE801001	Data Processing and Analytic	4
ENEE801002	Research Methodology	4
ENEE801701	Management of Telecommunications System and Digital Busines	3
ENEE801702	Trend of Digital Technology	3
	Sub Total	**14**
	2nd Semester	
ENEE802703	Law, Regulation and Telecommunications Policy	3
ENEE802704	Strategic Management and Technoeconomic	3
ENEE802705	Telecommunications Convergence Service and Infrastructure	2
ENEE802706	Ecosystem and Digital Economic	2
ENEE802707	Special Topic of Technology and Innovation	2
	Sub Total	**12**
	3rd Semester	
ENEE803003	Technology Innovation and Entrepreneurship	3
ENEE803708	Internet of Things (IoT) and Future Network Technology	3
ENEE803709	Capita Selecta	2
	Sub Total	**8**
	4th Semester	
ENEE804004	Thesis	8
ENEE804005	Scientific Publication	2
	Sub Total	**10**
	Total	**44**

Majoring in Power and Energy Management

Code	Subject	SKS
	1st Semester	
ENEE801001	Data Processing and Analytic	4
ENEE801002	Research Methodology	4
ENEE801801	Control and Operation of Power Generation Plant	3
ENEE801802	Economic of Electric Utility Power Generation	3

	Sub Total	**14**
	2nd Semester	
ENEE802803	Dynamic System and Modeling	3
ENEE802804	Economics Energy and Management	3
ENEE802805	Strategic Management	3
	Sub Total	**9**
	3rd Semester	
ENEE803003	Technology Innovation and Entrepreneurship	3
ENEE803806	Electrical Power System Quality	2
ENEE803807	Power System Planning	3
ENEE803808	Energy and Environment	3
	Sub Total	**11**
	4th Semester	
ENEE804004	Thesis	8
ENEE804005	Scientific Publication	2
	Sub Total	**6**
	Total	**40**

Majoring in Information Network Security Management

Code	Subject	SKS
	1st Semester	
ENEE801001	Data Processing and Analytic	4
ENEE801002	Research Methodology	4
ENEE801901	Information Network Security	2
ENEE801902	Information Network Infrastructure	2
ENEE801903	Computer Based Network Simulation	2
	Sub Total	**14**
	2nd Semester	
ENEE802904	Network and Application Security	3
ENEE802905	Security Operations and Incident Management	3
ENEE802906	Cyber Forensic	3
ENEE802907	Security Assessment and Analysis	3
	Sub Total	**12**
	3rd Semester	
ENEE803003	Technology Innovation and Entrepreneurship	3
ENEE803508	Cyber Threat Intelligence Analysis	2
ENEE803509	Security Risk Management & Regulation	3
	Sub Total	**12**
	4th Semester	
ENEE804004	Thesis	8
ENEE804005	Scientific Publication	2
	Sub Total	**10**
	Total	**44**

Transition Rules

1. The curriculum 2020 is implemented starting in the odd semester 2020/2021. In principle, after curriculum 2020 is implemented, only subjects in the curriculum 2020 will be opened.
2. The curriculum 2020 will be implemented from class of 2020 onwards. Class of 2019 and earlier will folloe curriculum 2020 with transitional rules.
3. An applied transitional period of 1 year, is in the academic year 2020/2021 for subjects that change the academic semester (from even to odd, or vice versa), if necessary, will be opened in both semester during the transition period (academic year 2020/201)
4. Students who have not passed the compulsory subjects in the curriculum 2016 are required to take the similar or quivalent subjects in the curriculum 2020. (Se the equality table of curriculum 2020 and 2016. ; courses in the curriculum 2016 which are not listed in the equality table mean that there is no changes, both in name and in the credits).
5. If there is a change in the credits course, the number of credits taken into graduation is that the the number of credits at the time the course was taken. Similar or equivalent courses will be counted in different credits, If repeated or newly taken will be listed with the new name and calculated with new credits.
6. If the compulsory subjects in the curriculum 2016 are removed and there is no equivalency in curriculum 2020, for the students who passed these courses, then they are still counted as compulsory credit courses for graduation. For students who have not passed the course, they can take take the new compulsory subjects.

The equality table Master Program in Electrical Engineering

Curriculum 2016			Curriculum 2020			Information
Courses	Credit	SMT	Courses	Credit	SMT	
Applied Mathematics	3	1	Processing and data analysis	4	1	Equivalent
Research Method	3	2	Metodologi Penelitian	4	1	Equivalent
Engineering Project Management and Economics	3	3	Technological Innovation and Entrepreneurship	3	3	Equivalent

Syllabus of Master Program in Electrical Engineering

Data Processing and Analytic
ENEE801001
4 Credits
Learning Outcomes:

Be able to evaluate data by applying AI/Big data analysis methods and able to create mathematical models to design optimum systems in the field of electrical engineering

Topic:

AI/Big data & methods: Hypothesis testing (ANOVA), regression, classification (KNN & Weighted KNN, SOM, LVQ, BPNN, SVM), Modeling & Design and optimization

Prerequisite:

Textbooks:
1. Laurene Fausett, "Fundamental of Neural Network", Prentice-Hall, 1994.
2. Douglas C. Montgomery, Design and Analysis of Experiments, 9th ed. Wiley, 2019
3. John D. Kelleher, Brian Mac Namee, and Aoife D'Arcy, Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, and Case Studies, The MIT Press, 2015.

Research Methodology
ENEE801002
4 Credits
Learning Outcomes:

Be able to explain research problems and the background, be able to explain research designs and the application, be able to apply standard scientific writing techniques in scientific publications, be able to examine important aspects in the research process such as literature studies, communication, be able to write the current research trend proposals in the field of electrical engineering

Topic:

Research Problem; Literature Review and Technical Reading; Attributions and Citations; Intellectual Property Rights; Ethics in Engineering Research; Technical Writing and Publishing; Research Management and Planning; Research Proposal

Prerequisite:

Textbooks:
1. Dipankar Deb, Rajeeb Dey, Valentina E. Balas, "Engineering Research Methodology: A Practical Insight for Researchers", Springer 2019.
2. C.R. Kothari, "Research Methodology: Methods and Techniques", New Age International, 2004
3. Pedoman Teknis Penulisan Tugas Akhir Mahasiswa UI

Technology Innovation And Entrepreneurship
ENEE803003
3 Credits
Learning Outcomes:

Students are able to develop innovative and visionary character in various industrial sectors in the digital economy era

Topic:

National and Sectoral Innovation Systems; Evolutionary Theory; R&D management; Technology Diffusion; Innovation in Service era 4.0; Globalization, national competitiveness and economic development; Science Technology and Innovation Policy; Intellectual Property and Standardization; Policies and Markets in the New Knowledge Economy era; Kano Model; Product and service design; Product and Service valuation; Entrepreneurship

Prerequisite:

Textbooks:
1. J. Fagerberg, D.C. Mowery, R.R. Nelson, "The Oxford Handbook of Innovation", Oxford University Press, 2006.
2. M.R. Milson, D. Wilemon, "The Strategy of Managing Innovation and Technology", Prentice Hall, 2007. 3. R. Mansell, C. Avgerou, D. Quah, R. Silverstone, "The Oxford Handbook of Information and Communication Technologies", Oxford University Press, 2007.

Majoring in Power and Smart System

Electric Generation Operation and Control
ENEE801101
2 Credits
Learning Outcomes:

After completing courses, students are able to operate geothermal and hydro power plants, distribution and power control systems.

Topic:

Commitment; Generation with limited energy supply; Hydrothermal Coordination; Production cost model; Control of generation; Power and energy exchange.

Prerequisite:

Textbooks:
1. A.J. Wood and B.F. Wollenberg, "Power Generation, Operation and Control", 2nd Edition, John Wiley & Sons Inc., 1996.

Electrical Power System Quality
ENEE801102
2 Credits
Learning Outcomes:

Be able to analyze the operating conditions of the electrical power system, under the steady-state condition and disruption due to swell voltage/sag voltage and harmonic distortion.

Topic:

Transient; Overvoltage; Undervoltage; Interruptions; Sags; Swells; Voltage Imbalance; Voltage fluctuations; Waveform distortion; Power frequency variations; Harmonic Distortion; Voltage Distortion vs Current; Harmonic vs Transient; Harmonic Control; Filter Design; Benchmarking power quality; Power distribution and power quality; Wiring and grounding; Power quality check.

Prerequisite:

Textbooks:
1. R.C. Dugan, M.F. Mc.Granaghan, S.Santoso, H.W. Beaty, "Electrical Power Sistem Quality", 2nd Edition, Mc.Graw Hill, 2002.

Electric Power and Environment
ENEE801103
2 Credits
Learning Outcomes:

At the end of the course, students will be able to analyze the effects of using green energy sources

Topic:

Global warming is caused by the use of fossil and non-fossil energy; Solving environmental problems nationally and globally; Implementation of the Kyoto Protocol in the form of a Clean Development Mechanism; CO2 trading.

Prerequisite:

Textbooks:

1. W.W. Nazaroff, L.A. Cohen, "Environment Engineering Science", John Wiley and Sons Inc., 2001.
2. R.A. Ristineu, J.J. Kroushaar, "Energi and Environment", John Wiley and Sons Inc., 2006.

Dynamic System and Modeling

ENEE802104
2 Credits
Learning Outcomes:

Be able to formulate the factors that influence the latest developments in the electricity system both technical and non-technical aspects

Topic:

Introduction to dynamic systems, feedback cycles, multivariable and multi-objective complex models, modeling and simulation, model design, change development, urban dynamics

Prerequisite: -

Textbooks:

Economics Energy And Management

ENEE802105
2 Credits
Learning Outcomes:

Be able to design an energy management system by applying supply/demand from the management side related to sources, both fossilized and non-fossilized

Topic:

Sources of Fossils and Non-Fossils; Power system management: including the generation, transmission and distribution of electricity; Supply management and supply management are known as Integrated Resource Planning.

Prerequisite: -

Textbooks:

1. J.M. Griffin, H.B. Steele, "Energi Economics and Policy", Academic Press New York, 1980.
2. Zuhal, "Ketenagalistrikan Indonesia", PT. Ganesha Prima, April 1995.

Advanced Power Electronics

ENEE802106
2 Credits
Learning Outcomes:

Be able to design applications in the field of high-power semiconductor devices in the industrial and military fields.

Topic:

Introduction to electric power systems and Power Semiconductor Switches; Rectifier Diode; Controlled rectifier; Inverters; Resonant Converters and Switching D.C. for power supply; Power Conditioners and Uninterruptible Power Supplies; Introduction to Motor Drives; D.C. Motor Drives; Synchronous Motor Drives; Residential; Electric utility industry and applications; Optimization of utility interface systems with electric power systems.

Prerequisite: -

Textbooks:

N. Mohan, T.M. Undeland, W.P. Robbins, "Power Electronics", 3rd Edition, John Wiley and Sons, 2003.

Renewable Energy and Energy Storages

ENEE802107
2 Credits
Learning Outcomes:

Be able to analyze the appropriate renewable energy system and design an optimal energy storage system both in terms of capacity and type of plant based on the condition of resource availability and changing load demands.

Topic:

Renewable energy is becoming increasingly important as a method of reducing environmental impacts that are far lower than conventional energy technologies. Topics to be discussed will focus on power system issues related to the integration of renewable energy resources into the electricity grid, including Photovoltaic Systems, Wind Power Systems, Heat and Combined Power (CHP), Solar Concentrates (CSP), Biomass, Hydropower, Fuel cells / fuel cells, as well as chemical energy storage systems in the form of batteries and mechanics such as flywheels

Prerequisite: -

Textbooks:

1. Gilbert M. Masters, "Renewable and Efficient Electric Power Systems", Wiley-Interscience, 1st Edition, 2004 Handout

Power System Planning

ENEE803108
2 Credits
Learning Outcomes:

Be able to analyze the demand identity of the estimated changes in economic variables and be able to estimate the reliability of the system in changing economic conditions.

Topic:

Estimated demand for increased electric power; Long-term electricity supply; Electricity generation (production) planning; Scheduling maintenance of power system generators; Strategic factors of Indonesia's electricity development; Prospects for electricity development in Indonesia; Electric power system development model; Optimization method.

Prerequisite: -

Textbooks:

1. X. Wang, J.R. McDonald, "Modern Power Sistem Planning", McGraw Hill Book Co., 1994.
2. Zuhal, "Ketenagalistrikan Indonesia", PT. Ganesha Prima, April 1995

SMART ENERGY SYSTEM

ENEE803109
2 Credits
Learning Outcomes:

Be able to make a holistic/integrated model of energy management system which includes electricity, heating, cooling, industry, buildings and transportation

Topic:

Introduction to Smart Energy Systems; The Impact of Energy Storage Technology and Renewable Energy Sources on an Energy Hub System; Storage of Solar Thermal Energy for the Housing Sector; Optimal Short-Term Scheduling of Photovoltaic-Powered Multi-Chiller Generators in the Presence of Demand Response Programs; cooling and heating systems in buildings, electric vehicles integrated with electricity networks, dynamic pricing

Prerequisite: -

Textbooks:

Behnam Mohammadi-Ivatloo, Farkhondeh Jabari, "Operation, Planning, and Analysis of Energy Storage Systems in Smart Energy Hubs", Springer; 1st edition, April 2018

Majoring in Telecommunication and Smart Wireless System

Signal Processing and Applications
ENEE801201
2 Credits
Learning Outcomes:

Be able to evaluate algorithms from signal processing platforms and use certain smart technology applications

Topic:

Signal Analysis; Frequency and Transient Response; Discrete FT - FFT, Z Transform, Correlation & Convolution; Digital Filter: FIR & IIR; Multi rate signal processing; Advanced transforms: DCT, WHT, Wavelet; Its Applications in signal Processing; Projects: Object Detection & Recognition; Wireless Communication; Radar System; Compression: Audio, Image and Video

Prerequisite: -

Textbooks:

1. Emmanuel C. Ifeachor & Barrie W Jervis, "Digital Signal Processing: A Practical Approach", Second Edition, Prentice Hall, 2002.
2. John G Proakis and Dimitris G. Manolakis, "Digital Signal Processing: Principles, Algorithms, and Applications", 3rd Edition, Prentice Hall, 2005.
3. Dadang Gunawan & Filbert Hilman Yuwono, "Pengolahan Sinyal Digital dengan Pengolahan MATLAB", Graha Ilmu, 2012.

Modern Telecommunication System
ENEE801202
2 Credits
Learning Outcomes:

Be able to evaluate the technical aspects of the radio communication technology platform system

Topic:

Trends in Telecommunications System, Deterministic Signal Analysis, Random Signal Analysis, Information Theory and Channel Coding, Digital Modulation and Demodulation, Spread Spectrum, Intersymbol Interference and Equalization, Fading Channel Analysis, Channel Modeling and Mobility Modeling, FFH, OFDM, MIMO and Channel Capacity , Traffic Modeling, Digital Satellite Communication Systems, Artificial Intelligence / Expert in Telecommunication Systems, Telecommunications Software Development and Process Modeling, 5G Mobile Technology (uRLLC, mMTC, eMBB). LTE Rail 15. Fiber Technology (FTTH, Radio over Fiber). The vision towards 6G. Internet Tactile. Terahertz and VLC (Visible Light Communications). HAPS (High Altitude Platforms). Fundamentals of Internet of Things (IoT). IoT management planning. LoRA, NB-IoT, Future Network Technology.

Prerequisite: -

Textbooks:

1. "Telecommunications Breakdown: Concepts of Communication Transmitted via Software-Defined Radio,"C. Richard Johnson Jr. and William A. Sethares, Pearson Prentice Hall, 2004, ISBN 0-13-143047-5
2. Software Engineering by Ian Sommer Ville 7th Edition
3. DigitalCommunications ,. Simon Haykin John Wiley & Sons
4. Modern Telecommunications: Basic Principles and Practices 1st Edition Martin J N Sibley, 2018

Modern Radar System
ENEE801203
2 Credits
Learning Outcomes:

Be able to evaluate the performance of modern radar systems

Topic:

Introduction and overview; Radar equations; Propagation effect and mechanism; Radar clutter; Target reflectivity and fluctuation models; Doppler phenomenon; Radar antenna, transmitter and receiver; Radar Processor; Radar signal processing: detection, false alarm, Doppler processing, radar measurement, tracking and imaging.

Prerequisite: -

Textbooks:

1. M.A. Richards, J. A. Sheer and W. A. Holm: "Principles of Modern Radar," Scitech Publishing, 2010
2. M. Skolnik: "Radar Handbook," Mc Graw-Hill, 2008

Modern Antenna Engineering
ENEE802204
2 Credits
Learning Outcomes:

Able to design modern antenna applications in support of the quality of modern society

Topic:

Introduction and review Maxwell's eqs in differential and integral form. Wave solution; Ideal dipole antenna and basic antena parameters. Microstrip antenna: basic properties, design consideration, widebanding, circular polarization, Microstrip Antenna miniaturization: fundamental limit, several techniques. Analysis of Array Antenna: linear, planar dan circular, Synthesis of Array Antenna. Microstrip antenna Array, Different type of planar antenna, applications of microstrip antenna.

Prerequisite: -

Textbooks:

1. Microstrip Antenna Design Handbook, Ramesh Garg et.al.
2. Microstrip and Printed Antennas: New Trends, Techniques and Applications, Debatosh Guha et.al., Wiley and Son 2011.
3. Practical Microstrip and Printed Antenna Design, Anil Pandey, Artech House, 2019

Smart RF Design
ENEE802205
2 Credits

Learning Outcomes:

Be able to design RF components for smart endurance systems

Topic:

Modern Wireless Telecommunication Technology, Single Radio Access Network Technology, Multiband RF Transceiver, Design of Transmitter, Design of Receiver, Smart RF Project Design

Prerequisite: -

Textbooks:

1. Matthew M. Radmanesh, "Advanced Rf & Microwave Circuit Design: The Ultimate Guide to Superior Design,"Artech House, 2003.
2. Ulrich L. Rohde and David P. Newkirk, "RF/Microwave Circuit Design for Wireless Applications," John Wiley and Sons, 2000
3. Qizheng Gu, "RF System Design of Transceivers for Wireless Communications," Springers, 2005

Terahertz And Optics System

ENEE802206
2 Credits
Learning Outcomes:

Able to evaluate the optical network communication components and the Terahertz system

Topic:

Introduction: networks and telecommunication; Types of fiber; Physical impairment, Overview of optical communication technology; Design of optical networks, THz Wireless Communications, Case Study

Prerequisite: -

Textbooks:

1. G. Keiser, Optical Fiber Communications, McGraw-Hill, 3rd ed., 2000.
2. R. Ramaswami, Sivarajan, k. and g. Sasaki, "Optical Networks: A Practical Perspective", 3rd Edition, Morgan Kaufman Publishers 2008, 2009, 2010.
3. B. Mukherjee, "Optical WDM Networks (Optical Networks)," Springer, 2006. ISBN: 0387290559.
4. D Saeedkia, Handbook of Terahertz Technology for Imaging, Sensing and Communications, Elsevier, 16 Jan 2013

Sensor Communication System

ENEE802207
2 Credits
Learning Outcomes:

Be able to design wireless sensor communication that will be applied in a variety of relevant services

Topic:

Introduction to Sensor, Sensor Network Architecture, Information Collection Technique, Radio Communication Technique, Network management technique, Multi-hop communication, Localization Techniques, Sensing/Observation Technique, Energy Management Engineering, Network and Information Security, Operating Systems, Programming, Design and experiment of sensor communication system applications

Prerequisite: -

Textbooks:

1. Building Wireless Sensor Networks: Theoretical and Practical Perspectives, karya Nandini Mukherjee, Sarmistha Neogy, Sarbani Roy.
2. Introduction to Wireless Sensor Networks, karya Anna Forster

Technological Quality Of Service And Experience

ENEE803208
2 Credits
Learning Outcomes:

Be able to evaluate QoE and QoS from technology applications

Topic:

Fundamental Concept of Service Quality. Technical and Non-Technical aspects in Quality measurements. Methods to measure QoE, QoS. Quality of Experience in 4G and 5G. Quality of Physical Experience (QoPE). Innovation Service towards 6G. Kano Model to improve Service quality. Case study.

Prerequisite: -

Textbooks:

1. Quality of Experience: Advanced Concepts, Applications and Methods, Sebastian Möller, Alexander Raake, Springer, 2014.
2. Quality of Service Mechanisms in Next Generation Heterogeneous Networks, ed. Abdelhamid Mellouk, John Wiley & Sons, 2013.

Computational Intelligence for Communication Engineering

ENEE803208
2 Credits
Learning Outcomes:

Be able to evaluate telecommunications systems that apply signal processing computiational intelligence

Topic:

Intro to Biomedical Systems; Bioelectric Signals and Electrode Theory; Biomedical Signal Processing (Signals system, Signal Transforms, Spectral Analysis and Estimation, Filters) and Feature Extraction; Computational Intelligence Techniques (Artificial Neural Networks, Support Vector Machines, Hidden Markov Models, Fuzzy Systems); Applications in Cardiology and Heart Disease Diagnosis, Electromyography Signals, Electroencephalogram Analysis, Gait and Movement Pattern Analysis.

Prerequisite: -

Textbooks:

1. Rezaul Begg, Daniel T.H. Lai, Marimuthu Palaniswami, "Computational Intelligence in Biomedical Engineering," Boca Raton, FL, USA: CRC Press (Taylor & Francis Group), 2008, ISBN 978-0-8493-4080-2.
2. Tavares, João Manuel R.S., Dey, Nilanjan, Joshi, Amit (Editors.), "Biomedical Engineering and Computational Intelligence," Proceedings of The World Thematic Conference—Biomedical Engineering and Computational Intelligence, 2018.
3. Charles S. Lessard, "Signal Processing of Random Physiological Signals," Morgan & Claypoo, 2006: 1 st Ed.
4. Klaus D. Toennies, "Advances in Computer Vision and Pattern Recognition: Guide to Medical Image Analysis," Springer-Verlag London, 2012, ISBN 978-1-4471-2750-5.

Majoring in Electronic and Intelligent Embedded System

Photonic Device
ENEE801301
2 Credits
Learning Outcomes:

Be able to design and analyze systems and optical devices

Topic:

Passive and active optical device designs for sensor and communication applications using software; Optical system design for a variety of telecommunications, biomedical and light sensor applications; Ray optics analysis, wave optics and quantum optics for various optical devices; Performance analysis of optical system applications: telecommunications, and several sensors.

Prerequisite: -

Textbooks:

1. Bahaa E. A. Saleh, Malvin Carl Teich, "Fundamentals of Photonics," A Wiley-Interscience publication Vol. 32, Wiley Series in Pure and Applied Optics, ISSN 0277-2493.

Green Electronic Devices
ENEE801302
2 Credits
Learning Outcomes:

Able to design organic LED devices and organic solar cell

Topic:

Introduction of lighting systems from time to time; Introduction of OLED technology; Types of OLEDs; OLED characterization; OLED fabrication techniques; Introduction of lighting systems from time to time; Introduction of Organic solar cell technology; Types of Organic solar cells; Characterization of Organic solar cells; Organic solar cell fabrication techniques

Prerequisite: -

Textbooks:

1. Cristian Ravariu, Dan Mihaiescu, "Green Elctronics," IntechOpen, ISBN 978-1-78923-304-9.

Digital Microelectronics Circuit Design
ENEE801303
2 Credits
Learning Outcomes:

Be able to design and analyze microelectronic circuits

Topic:

Digital circuit basic logic gates, Formation of logic functions, VLSI fabrication theory: coding. Optimization of logic functions, validation, Baseband system functions

Prerequisite: -

Textbooks:

1. Richard Jaeger, Travis Blalock, "Microelectronic Circuit Design," McGraw-Hill Higher Education, 2015, ISBN 978-1-25922-714-1

Sensors and Actuators
ENEE802303
2 Credits
Learning Outcomes:

Be able to apply sensors and actuators to an integrated system-

Topic:

Instrumentation of an engineering system, component interconnection and signal conditioning, performance specification and instrument rating parameters, estimation from measurements, analog sensor and transducers, digital and innovative sensing, mechanical transmission components, stepper motors, continuous drive actuators.

Prerequisite: -

Textbooks:

1. Clarence W. de Silva, Sensors and Actuators, CRC Press, 2016

Nanoelectronic
ENEE802305
2 Credits
Learning Outcomes:

Be able to design transistor devices based on tunneling phenomena and able to follow the latest developments in the electronics field

Topic:

Introduction to nanoscience and technology; Development of electronics from micro to nano; Device miniaturization effect; Extended traditional CMOS technology; Beyond traditional CMOS technology; Introduction to nanoscience and technology; Development of electronics from micro to nano; Device miniaturization effect; Extended traditional CMOS technology; Beyond traditional CMOS technology; Single electron transistor; Tunnel FET

Prerequisite: -

Textbooks:

1. Robert Puers, Livio Baldi, Marcel Van de Voorde, Sebastiaan E. van Nooten, "Nanoelectronics: Materials, Devices, Applications," John Wiley & Sons, 2017, ISBN 978-3-52734-053-8

Advanced Analog Electronics Circuits
ENEE802306
2 Credits
Learning Outcomes:

Be able to design advanced electronic circuits

Topic:

Operational Amplifiers; Oscillators; Phase Locked Loops; Short Channel Effects and Device Models; CMOS Processing Technology

Prerequisite: -

Textbooks:

1. Richard Jaeger, Travis Blalock, "Microelectronic Circuit Design, " McGraw-Hill Higher Education, 2015, ISBN 978-1-25922-714-1

Opto-Electronic Instrumentation
ENEE802307
2 Credits
Learning Outcomes:

Be able to design opto-electronic instrumentation systems for the measurement of various physical quantities

Topic:

The characteristic and phenomena of light, opto-electronic instrumentation systems, basic and various types of interferometers, fiber optic sensors, integration of various opto-electronic components to build instrumentation systems.

Prerequisite: -

Textbooks:

1. Measurement and Instrumentation Principles, Alan Morris
2. Fibre Optic Sensor, Francis T. Yu

System On Chip
ENEE803308
2 Credits
Learning Outcomes:

Be able to design an on-chip system by considering design methodology, design requirements, systems and supporting components, handoff procedures, and design infrastructure requirements.

Topic:

Introduction, system on chip (SOC, logic design and HDL on SoC, SOC synthesis, DFT design for SoC, SOC design verification, SOC physical design and verification, static time analysis, reference design.

Prerequisite: -

Textbooks:

1. Veena S. Chakravarthi , A Practical Approach to VLSI System on Chip (SoC) Design: A Comprehensive Guide, Springer International Publishing 2020.

IoT and Smart Electronic Systems
ENEE803309
2 Credits
Learning Outcomes:

Be able to design smart electronic systems for IoT applications

Topic:

IoT, Arm Mbed, IoT Enabling Technologies, Arm Mbed Development

Prerequisite: Sensor and Actuator

Textbooks:

1. Perry Xiao, Designing Embedded Systems and the Internet of Things (IoT) with the ARM Mbed, IEEE, 2018.

Majoring in Cyber Security and Future Internet

Network Security and Reliability
ENEE801401
2 Credits
Learning Outcomes:

In this course students learn security standards of creating a reliable network. After taking this course, students are able to design security standards for data storage and data communication in the network.

Topic:

Introduction to Security and Privacy, Classical Cryptosystems, Cryptanalysis, Stream and Block Ciphers, Modern Symmetric Key Crypto Systems, Public Key Cryptography, Public Key Cryptography, RSA and ElGamal, Diffie-Hellman, Hash functions, Digital Signatures, Key Management and Distribution, Web Security (SSL / TLS), Emerging Technologies, Ethics.

Prerequisite: None

Textbooks:

1. W. Stallings, "Cryptography and Network Security: Principles and Practice", 3rd Edition, Prentice Hall, 2003.
2. O. Goldreich, "Foundations of Cryptography: Basic Tools", Cambridge University Press, 2001.

Advanced Network Computer Systems
ENEE801402
2 Credits
Learning Outcomes:

In this course students learn the latest computer network systems and architecture. After taking this course, students are able to evaluate the performance of a computer architecture design, and are able to analyze the Internet of Things technology.

Topic:

Introduction to Computer Design, Instruction Set, Advanced Microarchitecture, Memory-Hierarchy Design, Thread-Level Parallelism, Data-Level Parallelism, Performance-tuning and Analysis of Modern Applications, Architecture Implementation Issues and Analysis, Data Communication Traffic, Lan Transport and Standards, Internet and Routing Protocols, Internetworking of Things (IoT).

Prerequisite: None

Textbooks:

1. Hennessy and Patterson, "Computer Architecture - A Quantitative Approach", 6th Edition, 2018.
2. Andrew Minteer, "Analytics for the Internet of Things (IoT)", Packt Publishing, 2017

Network Security and Data Protection
ENEE801403
2 Credits
Learning Outcomes:

In this course students learn security standards for various types and categories of data on the network. After taking this course, students are able to evaluate the security system of a particular data type, and are able to implement a data security system that is appropriate to the data type.

Topic:

Information Systems Security and Protection Objectives, Control at the Level of Management, Software Control, Access Control, Legal Aspects of the Security of Information Systems. Information Systems Security Planning, Network Security Threats, Defining a Security Policy, Protecting the Network and Operating System Services. Secure Data Storage. Monitoring the Performance of the System, Intrusion Detection Systems, Reestablishment of Network Systems.

Prerequisite: None

Textbooks:

1. Sébastien Ziegler, "Internet of Things Security and Data Protection", Springer, 2019

Applied Cryptography & Blockchain Technology
ENEE802404
2 Credits
Learning Outcomes:

In this course students learn cryptographic and blockchain technology and their applications. After taking this course, students are able to apply the cryptographic method and are able to evaluate the blockchain transaction system.

Topic:

Digital Trust, Assets, Transactions, Distributed Ledger Technology, Types of Network, Components of Blockchain or DLT, Ledger, Blocks, Blockchain, PKI and Cryptography, Private keys, Public keys, Digital Signature, Consensus, Byzantine Fault, Proof of Work, Poof of Stake, Security, Cryptocurrency, Digital Tokens.

Prerequisite: None

Textbooks:

1. Alan T. Norman, "Blockchain Technology Explained", 2017

Security Operation And Incident Handling
ENEE802405
2 Credits
Learning Outcomes:

After taking this course, students are able to handle risks and evaluate vulnerabilities, threats, and network security alerts, and are able to compare the objectives and common reasons for using various cybersecurity tools and technologies.

Topic:

Threat Management; Vulnerability Management; Cyber Incident Responses; Security Architecture and Tool Sets

Prerequisite: None

Textbooks:

1. CISCO CCNA Cyber Operation (CyberOps)
2. CompTIA Cybersecurity Analyst (CySA +)

Network and Digital Forensics
ENEE802406
2 Credits
Learning Outcomes:

In this course students learn digital forensics and networking. After attending this course, students are able to identify digital traces on the computers and the network, are able to recognize forms of attack from digital traces, are able to analyze digital traces and are able to collect legal evidence.

Topic:

Introduction to Digital Forensics and Networks; Windows-Based Computer Forensics; Linux Based Computer Forensics; Forensics in Computer Networks; Forensics on Mobile Devices.

Prerequisite: None

Textbooks:

1. E. Casey, "Digital Evidence and Computer Crime: Forensic Science, Computers, and the Internet", 3rd Edition, Academic Press, 2011.
2. J. Marcella Jr. and F. Guillossou, "Cyber Forensics: From Data to Digital Evidence", Wiley, 2012.

Convergence Information Network NG
ENEE802407
2 Credits
Learning Outcomes:

In this course students learn the 5G network architecture system along with the division of functions. After attending this course, students are able to analyze the 5G network architecture in the future network, and are able to analyze the functions on the network slices.

Topic:

Introduction to SDN and NFV, 5G, Software Defined Networking, Network Functions Virtualization, C-RAN, Network Slicing, Fronthaul and Backhaul Networks in 5G.

Prerequisite: None

Textbooks:

1. Kazmi, et. al., "Network Slicing for 5G and Beyond Networks", Springer, 2019
2. James M. Anderson, Patricia A. Morreale, "Software Defined Networking", CRC Press, 2014

Cyber Threat Intelligence And Incident Analysis
ENEE803408
2 Credits
Learning Outcomes:

After taking this course, students are able to deduce accurate perceptions about the company's security attitudes and threats, able to analyze the status of future risks by applying artificial intelligence.

Topic:

Introduction to Threat Intelligence, Cyber Threats and Kill Chain Methodology, Requirements, Planning, Direction, and Review, Data Collection and Processing, Data Analysis, Dissemination and Reporting of Intelligence

Prerequisite: None

Textbooks:

1. EC-Council Certified Threat Intelligence Analyst (C | TIA)

Security Risk Assessment and Analysis
ENEE803409
2 Credits
Learning Outcomes:

After taking this course, students are able to exploit vulnerabilities in networks, web applications, wireless, cloud, and databases, and are able to compile reports and recommendations on prevention strategies for discovered vulnerabilities

Topic:

Planning and Scoping, Information Gathering, Vulnerability Identification, Attacks and Exploits, Penetration Testing Tools, Reporting and Communication.

Prerequisite: None

Textbooks:

1. EC-Council Security Analyst (ECSA)
2. CompTIA PenTest +

Majoring in Automation and Data Analytic Engineering

Mechatronic System Modeling And Control
ENEE801501
2 Credits
Learning Outcomes:

Be able to describe the components and working principles of mechatronic systems, be able to describe the mathematical models of mechatronic systems, be able to apply the concept of mechatronic system modeling in simulations, be able to analyze the performance of mechatronic systems with controllers, able to recommend the design of mechatronic systems

Topic:

Mechatronic system design, mechatronic components, sensors, actuators, mechatronic system block diagrams, mathematical models (transfer function/state space), PID control design, control system simulation, system evaluation

Prerequisite: -

Textbooks:

1. Devdas Shetty, Ph.D., P.E., Richard A. Kolk, "Mechatronics System Design", Cangage Learning, 2011.
2. "Dynamics Of Mechatronics Systems: Modeling, Simulation, Control, Optimization and Experimental Investigations", World Scientific Publishing, 2017.

Industrial Electric Drive System

ENEE801502
2 Credits
Learning Outcomes:

Be able to explain the components in the electric drive system, able to explain the working principle of the drive system with various types of electric machines, able to apply the simulation method with MATLAB/Simulink on the electric drive system, able to analyze the performance of the electric drive system, able to recommend controllers on the electric drive system

Topic:

Basics of electric engine, AC engine, DC engine, electrical engine mathematical models, system simulation, power electronics for actuator systems, electric actuator control designs

Prerequisite: -

Textbooks:

1. Shaahin Filizadeh, "Electric Machines and Drives: Principles, Control, Modeling, and Simulation", CRC Press, 2013.
2. Muhammed Fazlur Rahman, Sanjeet K. Dwivedi, "Modeling, Simulation and Control of Electrical Drives", The Institute of Engineering and Technology, 2019.

System Optimization and Optimal Control

ENEE801503
2 Credits
Learning Outcomes:

Be able to state optimization problems in mathematical equations, able to apply optimization methods in the design of optimization systems.

Topic:

Various optimization problems and their application, optimization mathematical models, optimization mathematical methods (unconstrained, constrained, linear programming), optimal control problems, optimal control simulation design, optimal control system analysis

Prerequisite: -

Textbooks:

1. Hassan Bevrani, Mohammad Fathi, "Optimization in Electrical Engineering", Springer-Verlag, 2019.
2. Mark Levi, "Classical Mechanics With Calculus Of Variations And Optimal Control: An Intuitive Introduction", Orient Blackswan, 2016.
3. Aschepkov, L.T., Dolgy, D.V., Kim, T., Agarwal, R.P., "Optimal Control", Springer-Verlag, 2016.

Advanced Smart Data Computation

ENEE802504
2 Credits
Learning Outcomes:

Be able to explain the data engineering process, able to apply data analysis methods with ML and Deep Learning by using software, able to analyze the performance of various data analysis methods, able to choose the right data analysis method

Topic:

Machine learning (supervised, unsupervised), neural networks, training of multi layer neural network, classification, deep learning, convolution neural network

Prerequisite: -

Textbooks:

1. HIan Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2017

Smart System Monitoring And Data Engineering

ENEE802505
2 Credits
Learning Outcomes:

Be able to define the design requirements,able to implement the design of monitoring software, able to use a web application programming language in a monitoring system, able to do the analysis of the design results, able to recommend methods for developing a monitoring system

Topic:

Computer and network, client-server, internet protocol, data communication, design methodology, database, GUI, web application programming, database

Prerequisite: -

Textbooks:

1. Olayinka Omole,"Server Side development with Node.js and Koa.js Quick Start Guide", Packt, 2018.
2. Manuel Amunategui, Mehdi Roopaei, "Monetizing Machine Learning: Quickly Turn Python ML Ideas into Web Applications on the Serverless Cloud", Apress, 2018.

Advanced Smart Data Computation

ENEE802506
2 Credits
Learning Outcomes:

Be able to describe the concept of Networked and Coordinated Control System, able to formulate Networked and Coordinated Control System problems, able to implement Networked and Coordinated Control System simulation methods using MATLAB/Simulink, able to analyze the performance of Networked and Coordinated Control Systems via simulations, able to design Networked and Coordinated Control Systems System in certain applications

Topic:

Elements and concepts of Networked and Coordinated Control Systems, wireless control systems, system models, model analysis, controlling formulas in networks and coordination, stability and performance to control systems, simulations

Prerequisite: -

Textbooks:

1. Eduardo Paciencia Godoy, "Networked Control Systems", Nova, 2018.
2. Keyou You, Nan Xiao, Lihua Xie, "Analysis and Design of Networked Control Systems", Springer-Verlag, 2016.
3. Zhong-Kui Li, Zhisheng Duan, "Cooperative Control of Multi-Agent Systems: A Consensus Region Approach", CRC Press, 2014.

Special Topic on Automation and Data Engineering
ENEE802507
2 Credits
Learning Outcomes:

Be able to explain the needs of automation and data engineering applications in support of technological advancements, be able to analyze the impacts of automation and engineering technologies, be able to sort out automation and data engineering technologies according to application needs.

Topic:

Paper-based explanation and discussion, explanation from the automation and data engineering industry professionals, exploration of automation and data engineering technology issues

Prerequisite: -

Textbooks:

1. Journals

Industrial Automation System and Security
ENEE803508
3 Credits
Learning Outcomes:

Be able to describe SCADA systems (hardware and software), be able to identify the need for SCADA system development, be able to identify cyber security issues in system design, be able to identify current issues in industrial automation systems

Topic:

Process control, industry control, application integration control, SCADA, SCADA protocol, cyber security control system

Prerequisite: -

Textbooks:

1. Robert Radvanovsky, Jacob Brodsky, " Handbook of SCADA/Control Systems Security, Second Edition", CRC Press, 2016.
2. Tyson Macaulay, Bryan L. Singer, "Cybersecurity for Industrial Control Systems", CRC Press, 2012.

Advanced Machine Learning for Autonomous System
ENEE803509
3 Credits
Learning Outcomes:

Be able to portray autonomous systems, be able to analyze the performance of autonomous systems based on data, be able to recommend data analysis methods in autonomous system applications

Topic:

Autonomous system (definition, application), autonomous system components, data acquisition systems, data processing, data analysis

Prerequisite: -

Textbooks:

1. Prof. Hong Cheng, "Autonomous Intelligent Vehicles: Theory, Algorithms, and Implementation", Springer-Verlag, 2011.
2. Nilanjan Dey, Sanjeev Wagh, Parikshit N. Mahalle, Mohd. Shafi Pathan, "Applied Machine Learning for Smart Data Analysis", CRC Press, 2019.

Majoring in Data Engineering and Business Intelligence

Digital Enterprise Software Architecture
ENEE801601
2 Credits
Learning Outcomes:

Be able to design the most appropriate mitigation model according to the level of risk impact and the results of the analysis of the company's architecture

Topic:

Software engineering, Risk Management, Introduction to Enterprise Software Architecture (EA), EA structuring and modelling, enterprise engineering, Service orientation in Enterprise Engineering (SOA, SoEA): Technological infrastructure for Big Data handling in EA, Cloud computing opportunities for EA, Flexible (agile) business and information architectures (SoEA).

Prerequisite: -

Textbooks:

1. Boris Shishkov, "Designing Enterprise Information Systems: Merging Enterprise Modeling And Software Specification", The Enterprise Engineering Series, Springer, 2020.
2. 2. N Zarvić, R Wieringa., "Designing Enterprise Architecture Frameworks: Integrating Business Processes with IT Infrastructure", Apple Academic Press. 2016.
3. 3. Dominic Duggan, "Enterprise Software Architecture and Design: Entities, Services, and Resources cover", Quantitative Software Engineering Series,Wiley-IEEE Computer Society Pr, Year: 2012

Business Analysis and Visualization
ENEE801602
2 Credits
Learning Outcomes:

Be able to design an appropriate digital business model

Topic:

The S curve and the determinants of industry evolution, tools for exploring new markets, capturing value: uniqueness and complementary assets, Core concepts in network externalities, Respond to discontinuous technological change.

Prerequisite: -

Textbooks:

1. Ramesh Sharda, Dursun Delen, and Efraim Turban. "Business Intelligence: A Managerial Perspective on Analytics (3rd Edition) (3rd. ed.)". Prentice Hall Press, USA, 2013.

Image Technology and Computer Vision
ENEE801603
2 Credits
Learning Outcomes:

Be able to evaluate image processing methods for certain applications

Topic:

Image transformation, morphological operation, image filtering, feature characterization, edge detection, template matching, advanced topics in image processing, remote sensing, medical imaging

Prerequisite: -

Textbooks:

1. R.Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2010.
2. J.E. Solem, "Programming Computer Vision with Python: Tools and Algorithms For Analyzing Images", 1st Edition, O'Reilly, 2012.

Big Data Technology and Architecture
ENEE802604
3 Credits
Learning Outcomes:

Be able to evaluate Big Data processing systems

Topic:

Introduction, Evolution of Big Data Technologies, Data-driven Paradigm, Big Data Use Case, RDBMS – NoSQL, Data Warehouse-Lake-Virtualization, Data Analytics Life Cycle, Big Data Processing Architecture, Hadoop and its ecosystem, Apache Spark, Cloud Computing, Visualization

Prerequisite: -

Textbooks:

1. Arshdeep Bahga and Vijay Madisetti. "Big Data Science & Analytics: A Hands-On Approach (1st. ed.)", VPT, 2016.
2. 2. Somani, A. (Ed.), Deka, G. (Ed.). "Big Data Analytics". New York: Chapman and Hall/CRC, 2017.

Advanced Artificial Intelligence
ENEE802605
2 Credits
Learning Outcomes:

Be able to design a detection system for certain problems based on machine learning algorithms

Topic:

Basic of machine learning. Supervised learning: regression and classification. Unsupervised learning: clustering. Feature extraction for image and signals. Dimension reduction. Performance analysis

Prerequisite: -

Textbooks:

1. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow", O'Reilly, 2017
2. John D. Kelleher, Brian Mac Namee, and Aoife D'Arcy, "Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, and Case Studies", The MIT Press, 2015.

Applied Data Engineering
ENEE802606
2 Credits
Learning Outcomes:

Be able to evaluate Big Data processing systems

Topic:

Natural Language and Formal Language, N-grams and Language Models, POS Tagging, HMMs, Context-Free Grammars, Parsing, Representing Meaning, Semantic Analysis, Machine Learning Approaches to NLP, Summarization. Language Processing, Accessing Text Corpora and Lexical Resources, Processing Raw Text, Writing Structured Programs, Categorizing and Tagging Words, Learning to Classify Text, Extracting Information, Analyzing Sentence Structure, Building Featured-based Grammar, Analyzing the Meaning of Sentences

Prerequisite: -

Textbooks:

1. Steven Bird, Ewan Klein, and Edward Loper, "Natural Language Processing with Python", O'Reilly Media, Inc., 2009.
2. 2. Nitin Indurkhya and Fred J. Damerau, "Handbook of Natural Language Processing (2nd. ed.)". Chapman & Hall/CRC, 2010.

Ethics and Professionalism
ENEE802607
2 Credits
Learning Outcomes:

Be able to analyze the concepts of professionalism and ethics in the field of computer engineering

Topic:

Ethics; Job, profession and professional; Profession in information technology; Organization and code of Ethics of IT experts; cyber ethics; intellectual copyright; Internet crime

Prerequisite: -

Textbooks:

1. ACM Code of Ethics and Professional Conduct, https://www.acm.org/about-acm/acm-codeof-ethics-and-professional-conduct
2. Tavani, Herman t., "Ethics & Technology: Ethical Issues in an Age of Information and CommunicationTechnology", John Wiley & Sons, 2004

Enterprise Cyber Threat Analysis
ENEE803608
2 Credits
Learning Outcomes:

Be able to analyze the data and threat landscape of IT and cyber by applying artificial intelligence

Topic:

Introduction to Threat Intelligence, Cyber Threats and Kill Chain Methodology, Requirements, Planning, Direction, and Review Data Collection and Processing, Data Analysis, Intelligence Reporting and Dissemination.

Prerequisite: -

Textbooks:

1. Ali Dehghantanha, Mauro Conti, Tooska Dargahi, "Advances in Information Security Vol. 70: Cyber Threat

Intelligence", Springer, 2018.

2. CyberEdge Group, "The Threat Intelligence Handbook", CyberEdge Group, LLC 1997

Advanced IT Project Management
ENEE803609
2 Credits
Learning Outcomes:

Be able to design integrated systems based on computer engineering expertise

Topic:

Introduction; Fundamental of IT Project Management; IT Project Management; Building Great Software Development Teams; Tools for Great Software Development Teams

Prerequisite: -

Textbooks:

1. K. Schwalbe, "Information Technology Project Management", 7th Edition, Course Technology, 2013.
2. 2. W. S Humphrey, "Introduction to the Team Software Process, Addison Wesley, 2000.

Majoring in Telecommunication Management

Management of Telecommunications System and Digital Business
ENEE801701
3 Credits
Learning Outcomes:

Students are able to understand the basics of management and develop strategies in the digital industry by using Strategic Management theories

Topic:

Digital Economy paradigm. Big Data paradigm. ICT Trade Issue. Cretivity and Innovation in ICT. Technological management aspect for FINTECH industry. E-commerce. Social media platform. Strategic Management. HRD Management. Financial Management. Risk Management. Strategic choice. Canvas Model. Business Ethics. Case study in Telco industry. Key Management model (Porter Model, BSC, Benchmarking)

Prerequisite: -

Textbooks:

1. International Journals, White paper, Report with the topic of "Telco strategy" FR. David, "Strategic Management : Concepts", Prentice Hall.

Trend Of Digital Technology
ENEE801701
3 Credits
Learning Outcomes:

Students are able to understand the basic principles of telecommunications network technology and the latest technological developments that are relevant to the digital business ecosystem

Topic:

Fundamental digital communications system. Evolution Mobile Technology 1G-2G-3G-4G. The concept of 5G Mobile Technology (uRLLC, mMTC, eMBB). LTE Rel 15. Fiber Technology (FTTH, Radio over Fiber). NGN Next Generation Network. The vision towards 6G. Tactile Internet. Terahertz and VLC (Visible Light Communications). Satellite and HAPS (High Altitude Platforms). Human-centric Technology. Big Data Engineering. Cryptocurrency. Blockchain. Cybersecurity.

Prerequisite: -

Textbooks:

1. IEEE Transactions, Journals and Magazine, Accessed in IEEEXPlore, topic relevant to "Digital Communications Technology"
2. IEEE Conference Proceeding, Accessed in IEEEXPlore, topic relevant to "Digital Communications Technology"

Law, Regulation And Telecommunication Policy
ENEE802703
3 Credits
Learning Outcomes:

The competence built in this course is the ability of students to understand aspects of international and national law, telecommunications regulations and policies, and the standardization process in the Telecommunications industry.

Topic:

Fundamental theories for Policy making. Management of Technology. Managing Regulation. Traditional telco regulatory issues. Contemporary Converged Telco ICT Regulatory issues. International telecommunications organization. Indonesian telecommunications regulations and laws. The standardization process at ITU. International standardization body for the telecommunications industry. Case studies of telecommunications policies and regulations in Indonesia and the world.

Prerequisite: -

Textbooks:

1. ICT Regulation Toolkit, www.ictregulationtoolkit.org
2. C. Blackman, L.Srivastava, "Telecommunications Regulation Handbook: 10th Anniversary Edition", World Bank, 2011. https:// openknowledge.worldbank.org

Strategic Management and Technoeconomics
ENEE802704
3 Credits
Learning Outcomes:

Students are able to develop strategies based on technoeconomic and financial management concepts that are relevant in the telecommunications and digital industries

Topic:

Macroeconomic overview. Industrial revolution. Strategic Management. The importance of Vision and Mission. External Factor and Internal Factor evaluation. Strategy Analysis and Choice. Grand Strategy. SWOT Analysis. QSPM Method. Technoeconomic in telecommunications and digital industry. Financial and accounting for engineering. Understanding Financial Report. Feasibility Analysis. Technological forecasting; Engineering Economics. Corporate level strategy. Strategic leadership. Case study of Technoeconomic strategy in Industrial case and Government Policies. Cost analysis of the technological deployment.

Prerequisite: -

Textbooks:

1. FR. David, "Strategic Management:Concepts", Prentice Hall,

1. Leland T Blank, Anthony J Tarquin, "Basics of Engineering Economy", McGraw-Hill, 2014.

1. IEEE Conference Proceeding, Accessed in IEEEXPlore, topic relevant to "Technoeconomic"

Telecommunications Convergence Services and Infrastructure
ENEE802705
2 Credits
Learning Outcomes:

Students are able to develop strategies based on techno-economic concepts and Students are able to understand the principles of wireless and multimedia technology that shape the infrastructure and services of smart city convergence

Topic:

Wireless Communications Practice. Fundamental of Smart City. Mobile Technology for Smart City. Multimedia for smart city. Compression Technique and Applications. Quality of Service (QoS) and Quality of Experience (QoE). Quality of Perception (QoP). Multimedia Design. Interactive Multimedia System. Quality of Experience in 4G and 5G. Quality of Physical Experience (QoPE).

Prerequisite: -

Textbooks:

1. T. Rapaport, "Wireless Communications: Principles and Practice", Prentice Hall, 2009.
2. Smart City Emergence: Cases from Around the World, ed. L. Anthopolous, Elsevier, 2019

Ecosystem and Digital Economic
ENEE802706
2 Credits
Learning Outcomes:

Students are able to understand the changing paradigm of technology in the era of the digital economy and be able to explain the technical and non-technical aspects that shape the digital economic ecosystem

Topic:

ICT ecosystem. Telecommunications economics. Telecommunications Policy. Governance and State Organization in The Digital Era. Spectrum Pricing. Economic Valuation of Technology. ICT business models, policy impact, assessment, scenarios, socio-economic aspects of user adoption of new communication technologies. ICT productivity paradox ICT and telecom technology overviews, new economy, traditional telecommunication economics, ICT and sustainability and the importance of the intellectual property.

Prerequisite: -

Textbooks:

1. Handout

Special Topic of Technology and Innovation
ENEE802707
2 Credits
Learning Outcomes:

The competence built in this course is the ability of students to understand aspects of international and national law, telecommunications regulations and policies, and the standardization process in the Telecommunications industry.

Topic: -

Prerequisite: -

Textbooks:

1. Handout

Internet of Things (IoT) and Future Network Technology
ENEE803708
3 Credits
Learning Outcomes:

Students are able to design and analyze the performance of IoT technology and future networks in the industrial era 4.0.

Topic:

TMN Generic Model. eTOM. Traffic Management. Mobile Network Design. Frequency Planning. Fundamentals of Internet of Things (IoT). IoT management planning. LoRA, NB-IoT, Future Network Technology.

Prerequisite: -

Textbooks:

1. T. Plevyak, V. Sahin, "Next Generation Telecommunications Networks, Services and Management", Wiley-IEEE Press, 2010.
2. M. Guizaini, HH Chen, C.Wang, "The Future of Wireless Networks: Architectures, Protocols, and Services", CRC Press 2016

Capita Selecta
ENEE803709
2 Credits
Learning Outcomes:

Students are able to develop a vision of leadership and holistic insights for students by sharing knowledge with stakeholders in the telecommunications industry (operators,vendors) and government, including in the fields of convergence, macroeconomics, and microeconomics.

Topic: -

Prerequisite: -

Textbooks:

1. Handout

Majoring in Power and Energy Management

Control and Operation of Power Generation Plant
ENEE801801
3 Credits
Learning Outcomes:

After completing this course, students are able to operate geothermal and hydro power plants, distribution and power control systems and build a model of electricity production costs.

Topic:

Commitment; Generation with limited energy supply; Hydrothermal Coordination; Production cost model; Control of generation; Power and energy exchange.

Prerequisite: -

Textbooks:

1. A.J. Wood and B.F. Wollenberg, "Power Generation, Operation and Control", 2nd Edition, John Wiley & Sons Inc., 1996.

Economic of Electric Utility Power Generation

ENEE801802
3 Credits
Learning Outcomes:

At the end of the course, students are able to describe the operating methods of utility power generation efficiently without compromising business development.

Topic:

Introduction; Organizational Utility; Target accounting principles; Time and money value; Revenue requirements: fixed charge rate; Economic analysis methods; Electric utility system loads; Operating system; System stability: reserves, economic characteristics of generating units; Problems with total system analysis; Analysis of renewable energy and storage; Direct unit comparison; Future development.

Prerequisite: -

Textbooks:

1. W.D. Marsh, "Economics of Electric Utility Power Generation", Oxford University Press, 1980. ISBN-10: 019856130X, ISBN-13: 978- 0198561309
2. W.G. Sullivan, E.M. Wicks, J.T. Luxhoj, "Engineering Economy", 13th Edition, Pearson Education Ltd., 2006.

Dynamic System and Modeling

ENEE802803
3 Credits
Learning Outcomes:

Be able to formulate the factors that influence the latest developments in the electricity system both technical and non-technical aspects

Topic:

Introduction to dynamic systems, feedback cycles, multivariable and multi-objective complex models, modeling and simulation, model design, change development, urban dynamics

Prerequisite: -

Textbooks: -

Economics Energy And Management

ENEE802804
3 Credits
Learning Outcomes:

Be able to design an energy management system by applying supply/demand from the management side related to sources, both fossilized and non-fossilized

Topic:

Sources of Fossils and Non-Fossils; Power system management: including the generation, transmission and distribution of electricity; Supply management and supply management are known as Integrated Resource Planning.

Prerequisite: -

Textbooks:

1. J.M. Griffin, H.B. Steele, "Energy Economics and Policy", Academic Press New York, 1980.
2. Zuhal, "Ketenagalistrikan Indonesia", PT. Ganesha Prima, April 1995.

Strategic Management

ENEE802805
3 Credits
Learning Outcomes:

This course aims to embed the concept of strategic management to produce business excellence and industrial competitiveness. Students are expected to be able to understand applied theories and develop strategies relevant to the technology industry.

Topic:

The characteristics of strategy management; Strategy in practice; Evaluation of external factors; Internal factor analysis; Strategy and choice analysis; Evaluation and control strategies; Quality management; Global Strategy Strategy Management; Risk management; Business ethics; Strategy at the corporate level; Leadership strategy.

Prerequisite: -

Textbooks:

1. F.R. David, "Concepts of Strategic Management," 13th Edition, Prentice Hall, 2010.
2. M.A. Hitt, R.D. Ireland, R.E. Hoskisson, "Strategic Management: Concepts and Cases: Competitiveness and Globalization", 9th Edition, South-Western College Pub., 2010

Electrical Power System Quality

ENEE803806
2 Credits
Learning Outcomes:

Be able to analyze the operating conditions of the electrical power system, under the steady-state condition and disruption due to swell voltage/sag voltage and harmonic distortion.

Topic:

Transient; Overvoltage; Undervoltage; Interruptions; Sags; Swells; Voltage Imbalance; Voltage fluctuations; Waveform distortion; Power frequency variations; Harmonic Distortion; Voltage Distortion vs Current; Harmonic vs Transient; Harmonic Control; Filter Design; Benchmarking power quality; Power distribution and power quality; Wiring and grounding; Power quality check.

Prerequisite: -

Textbooks:

1. R.C. Dugan, M.F. Mc.Granaghan, S.Santoso, H.W. Beaty, "Electrical Power System Quality", 2nd Edition, Mc.Graw Hill, 2002.

Electric Power System Planning

ENEE803807
3 Credits
Learning Outcomes:

Be able to analyze the identity of the demand forecast of changes in economic variables and be able to estimate the reliability of the system in changing economic conditions.

Topic:

Estimated demand for increased electric power; Long-term electricity supply; Electricity generation (production) planning; Scheduling maintenance of power system generators; Strategic factors of Indonesia's electricity development; Prospects for electricity development in Indonesia; Electric power system development model; Optimization method.

Prerequisite: -

Textbooks:

1. X. Wang, J.R. McDonald, "Modern Power System Planning", McGraw Hill Book Co., 1994.

2. Zuhal, "Ketenagalistrikan Indonesia", PT. Ganesha Prima, April 1995.

Energy and Environment
ENEE803808
2 Credits
Learning Outcomes:

At the end of the course, students will be able to analyze the effects of using green energy source.

Topic:

Global warming is caused by the use of fossil and non-fossil energy; Solving environmental problems nationally and globally; Implementation of the Kyoto Protocol in the form of a Clean Development Mechanism; CO2 trading.

Prerequisite: -

Textbooks:

1. W.W. Nazaroff, L.A. Cohen, "Environment Engineering Science", John Wiley and Sons Inc., 2001.
2. R.A. Ristineu, J.J. Kroushaar, "Energy and Environment", John Wiley and Sons Inc., 2006.

Majoring in Information Network Security Management

Information Network Security
ENEE801901
2 Credits
Learning Outcomes:

In this course students will learn about the latest issues on privacy and security related to information systems. After completing this course, students are able to describe the protocols and models of a security system in communication. Students are also able to analyze network vulnerabilities and apply security systems on the network and the web. In addition, students will be able to carry out techniques of proof in cryptography.

Topic:

Introduction to Security and Privacy Issues Related to Information Systems; Principles of Confidentiality, Integrity, Availability, Identity and Authentication; Data Protocols and Integrity; Access Control; Safety Model; Cryptographic Systems and Protocols for Privacy; Network & Web Security; Intrusion Detection and Prevention; Vulnerability and Attack; Security Risk Analysis; Disaster Recovery Planning; Safety Regulations; Safety and ISO17799 Audit; Introduction to Cryptography; Encryption; Classic Encryption Techniques; Data Encryption and Block Password Standards; Advanced Encryption Standards; Pseudo-Random Generation; Digital Signatures; Two-Party Protocols and Zero-Knowledge.

Prerequisite: -

Textbooks:

1. R.R. Panko, "Corporate Computer and Network Security", Prentice Hall, 2004.
2. W. Stallings, "Cryptography and Network Security: Principles and Practice", 3rd Edition, Prentice Hall, 2003.
3. O. Goldreich, "Foundations of Cryptography: Basic Tools", Cambridge University Press, 2001.

Information Network Infrastructure
ENEE801902
2 Credits
Learning Outcomes:

This course introduces students to the basic concepts behind the design and scale of server farms using data centers and content switching technology. This course will discuss the principles and concepts that necessary to face the most common challenges faced during the planning, procurement, implementation and management of Internet and IP-based intranet server farms. In-depth analysis of data center technology with real scenarios will also be discussed. After completing this course, students will be able to design, implement and analyze server farm designs. Students will also be able to manage server farms.

Topic:

Introduction To Server Farms; Server Farm Protocols; Infrastructure Protocols; Security and Server Load Balancing; Data Center Design: Designing The Data Center Infrastructure; Integrating Security Into The Infrastructure; Performance Metrics of Data Center Devices; Data Center Administration and Management; State of the Art Data Center, Procurement.

Prerequisite: -

Textbooks:

1. M. Arregoces, M. Portolani, "Data Center Fundamentals", Cisco Press. 2004.
2. D. McCabe, "Network Analysis, Architecture and Design", 3rd Edition, Morgan Kaufman, 2007.
3. M. Lankhorst, "Enterprise Architecture at Work: Modeling, Communication and Analysis", 2nd Edition, Springer, 2009.
4. M. Liotine, "Mission-Critical Network Planning", Artech House, 2003.

Computer Based Network Simulation
ENEE801903
2 Credits
Learning Outcomes:

After completing this course, students are able to describe the role of network simulation in new protocol research on the internet and are able to implement and analyze network simulations by using NS (Network Simulator) to conduct research in networks.

Topic:

Introduction; Basic network simulation; NS Basics: OTCL, simple simulation examples (topology, events, marking flows, monitoring a queue), architecture (nodes, links, applications, protocols, packets, loss modules, math support); Event Scheduler; Network Components; Packet; Post Simulation: analyzing tracefile, queue monitor (examples); Best Practice in Network Performance Evaluation Techniques; Ns topology generation, OTCL and C ++, routing (unicast, multicast, network dynamics), multicast transport; NAM network animator; Further features (abstraction, multicast, RTP / RTCP, SRM, QoS, Scenario generation, test suites); Developing NS: Ns structure, OTCL linkage, adding new applications and agents, queue; New protocol for NS: Header file, C ++ code, necessary changes, the TCL code; Introduction to NS-3

Prerequisite: -

Textbooks:

1. J. F. Kurose and K. W. Ross, "Computer Networking, A Top-Down Approach Featuring the Internet", Addison Wesley, 2003

2. A. Law and W. Kelton, "Simulation Modeling and Analysis", McGraw-Hill, 2001.

3. R. Jain. "The Art of Computer Systems Performance Analysis: Techniques for Experimental Design, Measurement, Simulation, and Modeling", John Wiley and Sons, New York, 1991.

Network and Application Security

ENEE802904
3 Credits
Learning Outcomes:

In this course students will learn and practice securing applications and computer networks. After completing this course, students are able to describe the forms of security attacks on applications and computer networks, are able to analyze security problems in applications both desktop-based and web-based applications, and are able to implement security concepts on applications and computer networks.

Topic:

Introduction to Computer Application and Network Security; Network Penetration Detection; Web-based Application Penetration Detection; Penetration Detection on Wireless Networks; Safe Encoding in Java; Safe coding in PHP; Building a Secure Database.

Prerequisite: -

Textbooks:

1. G. McGraw, "Software Security: Building Security In", Pearson Education, Inc., 2006.

2. M. Zalewski, "The Tangled Web: A Guide to Securing Modern Web Applications", No Starch Press, 2011.

Security Operations and Incident Management

ENEE802905
3 Credits
Learning Outcomes:

After taking this course, students are able to handle risks and evaluate vulnerabilities, threats, and network security warnings, and are able to compare the objectives and common reasons for using various cybersecurity tools and technologies.

Topic:

Threat Management; Vulnerability Management; Cyber Incident Responses; Security Architecture and Tool Sets

Prerequisite: -

Textbooks:

1. CISCO CCNA Cyber Operation (CyberOps)

2. CompTIA Cybersecurity Analyst (CySA+)

Cyber Forensic

ENEE802906
3 Credits
Learning Outcomes:

In this course students will learn digital forensics and networking. After attending this course, students are able to identify digital traces on computers and on the network, able to recognize forms of attack from digital traces, able to analyze digital traces and able to collect legal evidence.

Topic:

Introduction to Digital Forensics and Networks; Windows-Based Computer Forensics; Linux Based Computer Forensics; Forensics in Computer Networks; Forensics on Mobile Devices.

Prerequisite: -

Textbooks:

1. E. Casey, "Digital Evidence and Computer Crime: Forensic Science, Computers, and the Internet", 3rd Edition, Academic Press, 2011.

2. A. J. Marcella Jr. and F. Guillossou, "Cyber Forensics: From Data to Digital Evidence", Wiley, 2012.

Security Assessment and Analysis

ENEE802904
3 Credits
Learning Outcomes:

After taking this course, students are able to exploit vulnerabilities inside the networks, web applications, wireless, cloud, and databases, and are able to write reports and recommendations on prevention strategies for discovered vulnerabilities

Topic:

Planning and Scoping; Information Gathering; Vulnerability Identification; Attacks and Exploits; Penetration Testing Tools; Reporting and Communication

Prerequisite: -

Textbooks:

1. EC-Council Security Analyst (ECSA)

2. CompTIA PenTest+

Cyber Threat Intelligence Analysis

ENEE803908
2 Credits
Learning Outcomes:

After taking this course, students are able to conclude accurate perceptions about the company's security attitudes and threats, able to analyze the status of future risks by applying artificial intelligence.

Topic:

Introduction to Threat Intelligence, Cyber Threats and Kill Chain Methodology, Requirements, Planning, Direction, and Review, Data Collection and Processing, Data Analysis, Dissemination and Reporting of Intelligence

Prerequisite: -

Textbooks:

1. EC-Council Certified Threat Intelligence Analyst (C|TIA)

Security Risk Management and Regulation

ENEE803909
2 Credits
Learning Outcomes:

This course introduces and explores the aspects of management, information network security standards and regulations. At the end of this course, students are expected to comprehend the principles of information security and be able to apply these principles to design solutions to manage information security risks effectively. Students are also expected to understand how to apply the principles of information network security management in a broad and contemporary context. Finally, students are able to manage information networks in accordance with professional standards, ethics, rules and regulations.

Topic:

Information Security Policy and Management; Management of Threats and Weaknesses in Information Networks; Incident and Risk Management; Crisis Management and Business Sustainability; Information Security Awareness and Culture and Information Network; Implementation Aspects of Information Network Security; Legal and Regulatory Aspects of Information Security; Information Security and Information Network Certification; SNI ISO/IEC 27001: 2009 Standard.

Prerequisite: -

Textbooks:

1. C.P. Pfleeger, and S.L. Pfleeger, "Security in Computing", 4th Edition, Prentice Hall, 2008.
2. M. Subramanian, "Network Management Principles & Practices", Pearson, 2010.

Master Program in Biomedical Technology

Program Specification

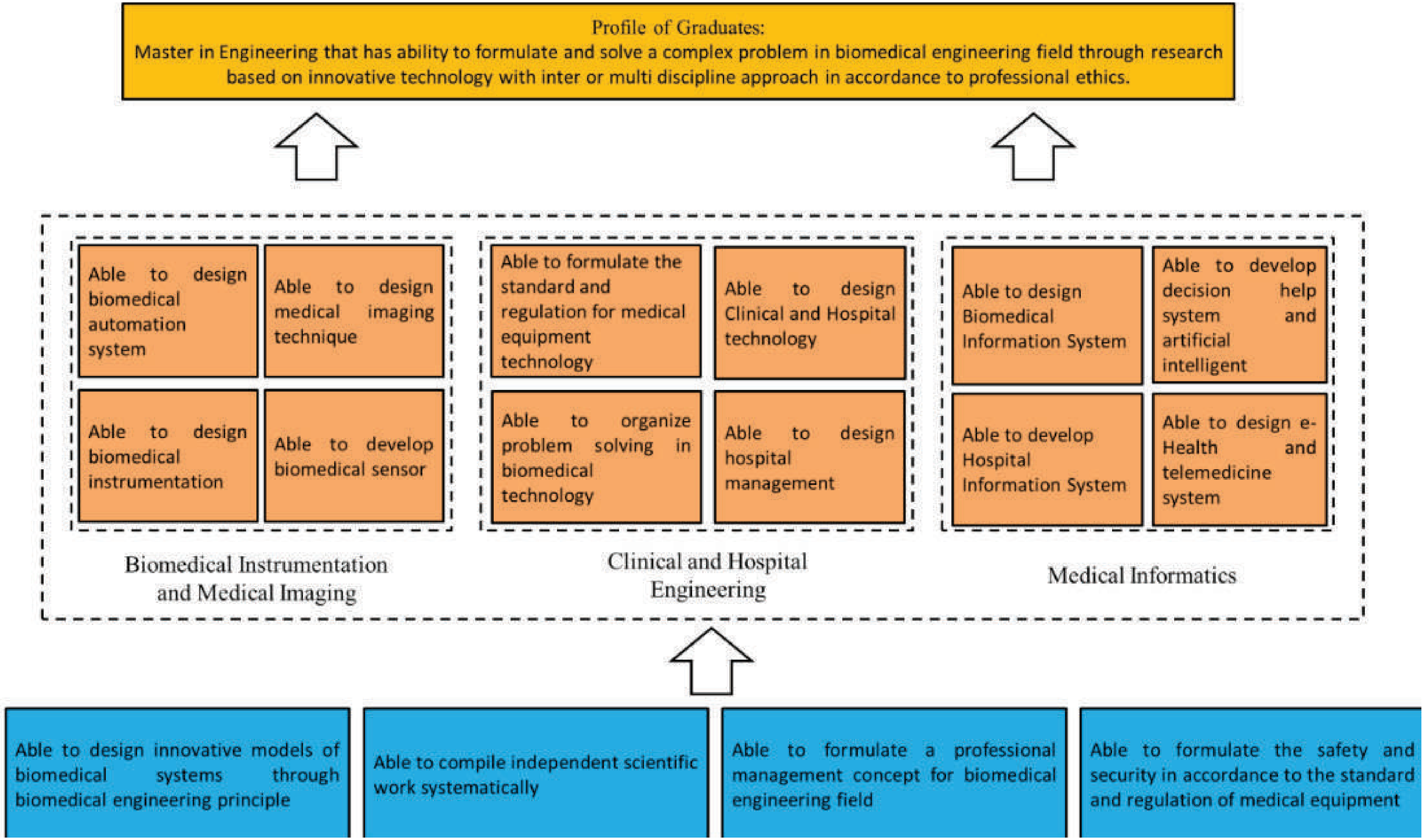
1.	**Awarding Institution**	Universitas Indonesia	
2.	**Teaching Institution**	Universitas Indonesia	
3.	**Faculty**	Engineering	
4.	**Programme Title**	Master Program in Biomedical Technology	
5.	**Program Vision and Mission**	To become a higher level study program in education, research and community service in the field of Biomedical Technology and be able to contribute to the development of Indonesian and Global society.	
6.	**Class**	Reguler	
7.	**Final Award**	Magister Teknik (M.T.)	
8.	**Accreditation / Recognition**	BAN-PT: Accreditation B	
9.	**Language (s) of Instruction**	Bahasa / English	
10.	**Study Scheme (Full Time / Part-Time)**	Full Time	
11.	**Entry Requirements**	Pass the entrance exam, graduate from Bachelor/Diploma 4 in Biomedical Engineering, Medical, Engineering, Science, Computer, Pharmacy, and other subjects of equal.	
12.	**Study Duration**	Designed for 2 years	
	Type of Semester	Number of semester	Number of weeks/semesters
	Reguler	4	16
	Short (opsional)	**1**	**8**
13.	**Aims of the programme:** Producing Masters who are able to design systems, components, or processes in the field of Biomedical Technology through the design, analysis, development and application of the latest technological concepts in dealing with problems in the field of biomedical technology.		
14.	**Profile of Graduates:** Master in Engineering that has ability to formulate and solve a complex problem in biomedical engineering field through research based on innovative technology with inter or multi discipline approach in accordance to professional ethics.		
15.	**Expected Learning Outcomes /Expected Learning Outcomes (ELO) :** Master in Biomedical Technology graduates are expected to have the following competence: 1. Able to design innovative models of biomedical systems through biomedical engineering principle (C6) 2. Able to compile independent scientific work systematically (C6) 3. Able to formulate a professional management concept for biomedical engineering field (C6) 4. Able to formulate the safety and security in accordance to the standard and regulation of medical equipment (C6) Beside the above competence, a Master in Biomedical Engineering should also have the following specialized competence: Specialization in Biomedical Instrumentation and Medical Imaging: 1. Able to design biomedical instrumentation (C6) 2. Able to develop biomedical sensor (C6) 3. Able to design biomedical automation system (C6) 4. Able to design medical imaging technique (C6) Specialization in Medical Informatics: 1. Able to develop Hospital Information System (C6) 2. Able to design e-Health and telemedicine system (C6) 3. Able to design Biomedical Information System (C6) 4. Able to develop decision help system and artificial intelligent (C6) Specialization in Clinical and Hospital Engineering: 1. Able to organize problem solving in biomedical technology (C6) 2. Able to design hospital management (C6) 3. Able to formulate the standard and regulation for medical equipment technology (C6) 4. Able to design Clinical and Hospital technology (C6)		

16.	Composition of Subjects		
No.	Classification	Credit Hours (SKS)	Percentage
I	Core Subjects	16	36,36%
II	Majoring Subject	12	27,27%
III	Special Subject	10	22,73%
IV	Elective Subject	6	13,64%
	Total	44	100 %
	Total Credit Hours to Graduate		44 Credits

Career Prospects

Graduates from Biomedical Engineering Study Program can work in various types of companies and health industries, information technology, education, government or regulator, and other industries related to health facilities, such as hospitals and health clinics.

Learning Outcomes



Course Flowchart for Master Program in Program Study of Biomedical Technology

Biomedical Instrumentation and Medical Imaging Specialization

No.	Learning Outcomes	Semester 1	Semester 2	Semester 3	Semester 4
1	Able to design innovative models of biomedical systems through biomedical engineering principle	Anatomy and Modelling in Physiology Design and Prototyping Biomedical System			Scientific Publication Thesis
2	Able to compile independent scientific work systematically	Research Methodology 1	Research Methodology 2		Scientific Publication Thesis
3	Able to formulate a professional management concept for biomedical engineering field	Project Management for Biomedical Engineering			
4	Able to formulate the safety and security in accordance to the standard and regulation of medical equipment	Patient Safety Standards and Regulations			
5	Able to design biomedical instrumentation		Biomedical Instrumentation		
6	Able to develop biomedical sensor		Biomedical Sensor		
7	Able to design biomedical automation system		Biomedical System Automation		
8	Able to design medical imaging technique		Medical Imaging and Image Processing		

Medical Informatics Specialization

No.	Learning Outcomes	Semester 1	Semester 2	Semester 3	Semester 4
1	Able to design innovative models of biomedical systems through biomedical engineering principle	Anatomy and Modelling in Physiology Design and Prototyping Biomedical System			Scientific Publication Thesis
2	Able to compile independent scientific work systematically	Research Methodology 1	Research Methodology 2		Scientific Publication Thesis
3	Able to formulate a professional management concept for biomedical engineering field	Project Management for Biomedical Engineering			
4	Able to formulate the safety and security in accordance to the standard and regulation of medical equipment	Patient Safety Standards and Regulations			
5	Able to develop Hospital Information System		Hospital Information System		
6	Able to design e-Health and telemedicine system		*e-Health* and Telemedicine		
7	Able to design Biomedical Information System		Computational Biology and Bioinformatics		
8	Able to develop decision help system and artificial intelligent		Decision Making System and Artificial		

Clinical and Hospital Engineering Specialization

No.	Learning Outcomes	Semester 1	Semester 2	Semester 3	Semester 4
1	Able to design innovative models of biomedical systems through biomedical engineering principle	Anatomy and Modelling in Physiology Design and Prototyping Biomedical System			Scientific Publication Thesis
2	Able to compile independent scientific work systematically	Research Methodology 1	Research Methodology 2		Scientific Publication Thesis
3	Able to formulate a professional management concept for biomedical engineering field	Project Management for Biomedical Engineering			
4	Able to formulate the safety and security in accordance to the standard and regulation of medical equipment	Patient Safety Standards and Regulations			
5	Able to organize problem solving in biomedical technology		Hospital Medical Equipment		
6	Able to design hospital management		Clinical Asset and Equipment Management System		
7	Able to formulate the standard and regulation for medical equipment technology		Hospital Engineering		
8	Able to design Clinical and Hospital technology		Design of Hospital and Healthcare Facilities		

Curriculum Structure

Majoring in Biomedical Instrumentation and Medical Imaging

Code	Subject	SKS
	1st Semester	
ENBE801001	Anatomy and Modelling in Physiology	3
ENBE801002	Research Methodology 1	2
ENBE801003	Patient Safety Standards and Regulations	3
ENBE801104	Design and Prototyping Biomedical System	3
ENBE801005	Project Management for Biomedical Engineering	**3**
	Subtotal	**14**
	2nd Semester	
ENBE802006	Research Methodology 2	2
ENBE802101	Biomedical Instrumentation	3
ENBE802102	Biomedical Sensors	3
ENBE802103	Medical Imaging and Image Processing	3
ENBE802104	Biomedical System Automation	**3**
	Subtotal	**14**
	3rd Semester	
	Elective Course	3
	Elective Course	3
	Subtotal	**6**
	4th Semester	
ENBE804007	Scientific Publication	2
ENBE804008	Final Project	8
	Sub Total	**10**
	Total	**44**

Majoring in Medical Informatics

Code	Subject	SKS
	1st Semester	
ENBE801001	Anatomy and Modelling in Physiology	3
ENBE801002	Research Methodology 1	2
ENBE801003	Patient Safety Standards and Regulations	3
ENBE801104	Design and Prototyping Biomedical System	3
ENBE801005	Project Management for Biomedical Engineering	**3**
	Subtotal	**14**
	2nd Semester	
ENBE802006	Research Methodology 2	2
ENBE802201	Hospital Information System	3
ENBE802202	Decision Making System and Artificial Intelligent	3
ENBE802203	e-Health and Telemedicine	3
ENBE802204	Computational Biology and Bioinformatics	**3**
	Subtotal	**14**
	3rd Semester	
	Elective Course	3
	Elective Course	3
	Subtotal	**6**
	4th Semester	
ENBE804007	Scientific Publication	2
ENBE804008	Final Project	8
	Sub Total	**10**
	Total	**44**

Majoring in Clinical and Hospital Engineering

Code	Subject	SKS
	1st Semester	
ENBE801001	Anatomy and Modelling in Physiology	3
ENBE801002	Research Methodology 1	2
ENBE801003	Patient Safety Standards and Regulations	3
ENBE801004	Design and Prototyping Biomedical System	3
ENBE801005	Project Management for Biomedical Engineering	**3**
	Subtotal	**14**
	2nd Semester	
ENBE802006	Research Methodology 2	2
ENBE802301	Hospital Medical Equipment	3
ENBE802302	Hospital Engineering	3
ENBE802303	Design of Hospital and Health-care Facilities	3
ENBE802304	Clinical Asset and Equipment Management System	**3**
	Subtotal	**14**
	3rd Semester	
	Elective Course	3
	Elective Course	3
	Subtotal	**6**
	4th Semester	
ENBE804007	Scientific Publication	2
ENBE804008	Final Project	8
	Sub Total	**10**
	Total	**44**

Transition Rules

1. Curriculum of 2020 is implemented starting in the Odd Semester 2020/2021. After Curriculum of 2020 is implemented, only subjects in Curriculum of 2020 will be opened.
2. Class of 2019 and previous class followed the Curriculum of 2020 with transitional rules.
3. A transitional period of 1 year, in the academic year 2020/2021, is implemented for subjects where the semester changes (from Even to Odd, or vice versa), if necessary, the class will be opened in both semesters during the transition period (Academic Year 2020 / 2021).
4. For students who have not passed the compulsory subjects in Curriculum of 2018 are required to take the same or equivalent subjects in the 2020 Curriculum.
5. If there is a change in the credit (SKS) for the course, the number of credit (SKS) taken in graduation is the number of the SKS at the time the course was taken. If students are repeated or newly taken same or equal subjects with different credit (SKS), will be listed with a new name and calculated with new credit (SKS).
6. If the compulsory subjects in Curriculum of 2018 are removed and there is no equivalence in Curriculum of 2020, students who have passed these courses, it will still be counted as compulsory subjects in the graduation calculation of 44 credits. For students who have not passed the course, they can take new compulsory subjects or elective courses in Curriculum of 2020 to complete 44 credits.

Equivalence Course in Masters in Biomedical Technology

No	Name of courses in the curriculum 2018	SKS 2018	Name of courses in the curriculum 2020	SKS 2020
1	Human Body Physiological System Modelling	3	Anatomy and Modelling in Physiology	3
2	Research Methodology	2	Research Methodology 1	2
3			Research Methodology 2	2
Required Specialization Courses				
4	Biomedical Instrumentation 1	3	Biomedical Instrumentation	3
5	Medical Imaging	3	Medical Imaging and Image Processing	3
6	Biomedical Instrumentation 2	3	-	
7	Special Topic on Biomedical Instrumentation	3	-	
8	Hospital Medical Equipment I	3	Hospital Medical Equipment	3
9	Hospital Medical Equipment II	3	Hospital Engineering	
10	Regulation and Policy of Clinical Technology	3	-	
11	Planning and Design of Health Service Building	3	Design of Hospital and Healthcare Facilities	3
12	Clinical Engineering Management System	3	Clinical Asset and Equipment Management System	3
13	Planning and Design of Health Service Utility	3	Healthcare Technology Management System	3
14	Hospital Information System and Medical Record	3	Hospital Information System	3
15	Medical Automation	3	-	
16	Telemedicine	3	e-Health and Telemedicine	3
17	Information System-Based Management Skill	3	Hospital Information Management	3
18	Medical Informatics Consultancy	3		
19			Computational Biology and Bioinformatics	3

Subject Syllabus

Study Program Obligatory Subject

Anatomy and Modelling in Physiology
ENBE801001
3 CREDITS
Learning Outcome:

After completing this course, students are able to:

1. Analyze the results of molecular computing related to the physiology of the human body (C4)
2. Design biomedical system models based on engineering principles in accordance with the anatomy and physiology of the human body (C6).

Syllabus:

Complexity of physiology, central dogma of molecular biology, introduction to bioinformatics, molecular docking, principles of data modeling and modeling, neural systems, bioelectric phenomena, system modeling, introduction to MATLAB simulink, and case studies.

Prerequisite: None

Reference Books:
1. Cobelli C and Carson ER, Introduction to Modeling in Physiology and Medicine. 1st ed. A volume in Biomedical Engineering. 2008
2. Thieman, W. J., M. A. Palladino, Introduction to Biotechnology, Pearson 2012
3. Ibrahim, K. S., G. Gurusubramanian, Zothansanga, R. P. Yadav, N. S. Kumar, S. K. Pandian, P. Borah, S. Mohan, Bioinformatics – A Student's Companion, Springer 2017
4. Tortora, G. J., Derrickson, B., Principles of Anatomy and Physiology, Wiley 2017
5. Enderle, J. D., Bioelectric Phenomena, Elsevier 2012
6. https://www.mathworks.com/support/learn-with-matlab-tutorials.html

Research Methodology 1
ENBE801002
2 CREDITS
Learning Outcome:

After completing this course, students will be able to formulate a research proposal (C6)

Syllabus:

Writing the formulation of the research problem and its background, SotA and Hypotheses, Data collection methods, abstracts, conclusions, and research proposals.

Prerequisite: None

Reference Book:
1. N1.ovikov, A. M. and D. A. Novikov. Research methodology from philosophy of science to research design. CRC Press. 2013
2. Deb, D., R. Dey, V. E. Balas. Engineering Research Methodology A Practical Insight for Researchers. Springer. 2019
3. John D. Enderle, David C. Farden, And Daniel J. Krause; Advanced Probability Theory for Biomedical Engineers; Morgan&Claypool; 2006
4. Kristina M. Ropella, Introduction to Statistics for Biomedical Engineers, Morgan&Claypool; 2007

Patient Safety Standards and Regulations
ENBE801003
3 CREDITS

Learning Outcome:

After completing this course, students will be able to formulate standards and regulations for medical devices that will be made for the needs of national, regional and international markets (C6).

Syllabus:

Overview Medical Device Standard & Regulation, WHO Global Model Regulatory Framework for Medical Devices including in vitro diagnostic medical devices, International Electrical Comission (IEC), Standar Nasional Indonesia (SNI), Intenasional Standard Organisation (ISO) Standard, Medical Device Directive (MDD) European Union, Food and Drug Agency (FDA) Medical Devices Regulation, Global Health Task Force (GHTF), Asean Medical Device Directive (AMDD), Good Manufacturing Product (CPAKB), Good Distribution Product (CDAKB), Preparing FDA Submission, Preparing CE Submission, Filing Marketing License for Medical Devices in Indonesia.

Prerequisite: None

Reference Book:
1. Fries, RC (editor) (2001). Handbook of Medical Device Design. New York, Bassel: Marcel Dekker Inc.
2. GHTF. International Medical Device Regulators Forum. https://www.imdrf.org/ghtf
3. SNI (2016). SNI ISO 13485:2016. Peralatan kesehatan – Sistem manajemen mutu – Persyaratan untuk tujuan regulasi
4. SNI. Alat Kesehatan. http://sispk.bsn.go.id/SNI/DaftarList#
5. WHO (2003). MEDICAL DEVICE REGULATIONS Global overview and guiding principles. Geneva: WORLD HEALTH ORGANIZATION.
6. WHO (2017). WHO Global Model Regulatory Framework for Medical Devices including in vitro diagnostic medical devices. Printed by the WHO Document Production Services, Geneva, Switzerland.

Design and Prototyping Biomedical System
ENBE801004
3 CREDITS
Learning Outcome:

After completing this course, students will be able to:

- Design a structured selection of design concepts (C4).
- Synthesize prototypes of selected design concepts (C5).

Syllabus:

Product development, Opportunity identification; Identify customer needs; Concept generation; Concept Screening; Concept Testing; Product Architecture; Industrial Design; Design for Manufacturing; Prototyping Development; Workshop Prototyping.

Prerequisite: None

Reference Book:
1. Karl T. Ulrich, Steven D. Eppinger, Maria Yang; 7th Edition, Irwin McGraw-Hill, 2019.
2. Product Prototyping: From Concept to Reality in a Weekend, David Feinleib, 2014, Appress Publishing
3. Prototyping and Modelmaking for Product Design, Bjarki Hallgrimsson, 2012, Laurence King Publishing, London, UK.

Project Management of Biomedical Engineering
ENBE802005
3 CREDITS

Learning Outcome:

- Students will able to design a professional management for biomedical engineering field
- Students will able to design project economics aspect, so students are expected to understand the basic theories to support feasibility analysis for investment and service development/application for biomedical technology.

Syllabus:

Organization in project management, characteristics of the project cycle and project phases, project management processes including project management during planning, execution (monitoring), and control, project scope (WBS), time management, cost management, Gant Chart, S curve, and analysis economy.

Prerequisite: None

Reference Book:

1. Project management institute. A Guide to the project management body of knowledge fifth edition. 2013
2. Kerzner, H. Project management A System Approach to Planning, Scheduling, and Controlling. Willey Ohio 2002
3. Newnan, D. G., T. G. Eschenbach, J. P. Lavelle. Engineering Economic Analysis. Oxford University Press: Oxford. 2004

Research Methodology 2
ENBE801006
2 CREDITS
Learning Outcome:

After completing this course, students will be able to compile scientific papers from research results (C6)

Syllabus:

How to get research topics (digging information), appropriateness of research topics, looking for references, mapping references and sota), how to do our research, simulation and experiment-based research, continuity of research objects with realization, research data processing, research proposal writing methods, and methods scientific writing.

Prerequisite: None

Reference Book:

1. Novikov, A. M. and D. A. Novikov. Research methodology from philosophy of science to research design. CRC Press. 2013
2. Deb, D., R. Dey, V. E. Balas. Engineering Research Methodology A Practical Insight for Researchers. Springer. 2019
3. John D. Enderle, David C. Farden, And Daniel J. Krause; Advanced Probability Theory for Biomedical Engineers; Morgan&Claypool; 2006
4. Kristina M. Ropella, Introduction to Statistics for Biomedical Engineers, Morgan&Claypool; 2007

Majoring Subject

Majoring in Biomedical Instrumentation And Medical Imaging

Biomedical Intrumentation
ENBE802101
3 CREDITS
Learning Outcome:

After completing this course, students will be able to design medium and high technology biomedical instrumentation designs in diagnostic and therapeutic services from patients in health care facilities (C6).

Syllabus:

Compression therapy, cryosurgery, auto spirometry device, test stress cardiopulmonary, LabVIEW, clinical chemistry analyzer, hematology analyzer, EEG, EMG, ECG, dan cardiac defibrillators.

Prerequisite: None

Reference Book:

1. Carr, J. J., & Brown, J. M. (2001). Introduction to Biomedical Technology (4th edition). New Jersey: Prentice Hall.
2. Enderle, J., Blanchard, S., & Bronzino, J. (2000). Introduction to Biomedical Engineering. San Diego, CA: Academic Press.
3. Wang, P., & Liu, Q. (2011). Biomedical Sensors and Measurement. Hangzhou, Heidelberg: Springer Berlin Heidelberg.
4. Webster, J. G. (2010). Medical Instrumentation: Application and Design (4th edition). New Jersey: John Wiley & Sons, Inc.

Biomedical Sensor
ENBE802102
3 CREDITS
Learning Outcome:

After completing this course, students will be able to design biosensors for medical applications (C6).

Syllabus:

The basis of the sensor which includes sensor characteristics, sensor calculation technology, and biocompatibility of the sensor, Physical sensor which includes resistance sensor, inductive sensor, capacitive sensor, piezoelectric sensor, magnetoelectric sensor, photoelectric, and thermoelectric sensor, optical sensor, Chemical sensor includes ion sensor , gas sensors, humidity sensors, sensor arrays, and sensor networks, and biosensors including catalytic biosensors, affinity biosensors, cell and tissue biosensors, biochips, and nano-biosensors.

Prerequisite: None

Reference Book:

1. Enderle J., Bronzino J. - Introduction to biomedical engineering-AP (2011).
2. Wang, P. Q. Liu. Biomedical Sensor and Measurement. Springer (2011)

Medical Imaging and Image Processing
ENBE802103
3 CREDITS
Learning Outcome:

After completing this course, students will be able to:

- Design (C6) medical imaging techniques for applications in the field of medicine.
- Recommend (C5) medical image processing techniques for applications in the field of medicine.

Syllabus:

Introduction to Medical Imaging Technologies (X-Ray and CT, MRI, Ultrasound, PET and SPECT, Electrical Impedance Tomography), Image formation and Reconstruction (Acquisition, Digitization, Image Reconstruction Methods), Image Enhancement (Fundamentals of enhancement techniques, Image enhancement with linear, nonlinear, fixed, adaptive, and pixel-based methods), Image Segmentation and Analysis (Fundamentals of Medical Image Segmentation, Image preprocessing and acquisition artifacts, Thresholding, Edge-based techniques, Region-based segmentation, Classification, Morphological Methods for Biomedical Image Analysis), Image Visualization (2-dimensional visualization, 3-dimensional visualization methods: surface rendering, volume rendering, Algorithm for 3-D visualization), Image Management (Fundamentals of Standards Compression Storage and Communication, Image archive and retrieval, three-dimensional compression), citra visual dan digital, transformasi citra, representasi warna, image enhancement (domain spatial), image enhancement (frequency domain), konvolusi dan korelasi, segmentasi citra, sifat fitur objek, image compression, pattern recognition, image restoration, image morphology.

Prerequisite: None

Reference Book:

Mandatory:
1. Joseph D. Bronzino, The Biomedical Engineering Handbook, Third Edition, "Medical Devices and Systems," CRC Press: 2006, Section II.
2. Avinash C. Kak and M. Slaney, "Principle of Computerized Tomographic Imaging," IEEE Press: 1999.
3. Isaac Bankman, "Handbook of Medical Imaging: Processing and Analysis Management," Academic Press: 2000, CA, USA.
4. E. S. Gopi, "Digital Signal Processing for Medical Imaging Using Matlab," Springer:2013, New York.
5. Medical Image Processing, Reconstruction and Restoration: Concepts and Methods, Jirí Jan, CRC Press: Taylor & Francis Group 2006, Boca Raton, FL, USA.

Addition:

6. Handbook of Medical Imaging, Vol. 2: Medical Image Processing and Analysis, M. Sonka & J.M. Fitzpatrick, SPIE Press, 2009, Washington, USA
7. Biomedical Image Processing, Thomas M. Deserno, Springer-Verlag Berlin Heidelberg, 2011
8. Biomedical Signal and Image Processing, Kayvan Najarian and Robert Splinter, CRC Press: Taylor & Francis Group 2012, Boca Raton, FL, USA.

Biomedical System Automation

ENBE803105
3 CREDITS
Learning Outcome:

After completing this course, students are able to:

1. Analyze stability, transient response and steady-state error in a control system (C4).
2. Recommend a control system design method (C5)
3. Design controllers in a biomedical system (C6)

Syllabus:

Introduction, discusses the definition of control systems, configurations, theoretical history and application examples; Mathematical models of systems in the biomedical field that can be designed for automated control systems; Mathematical model simulation using MATLAB/Simulink or SCILAB/Xcos; Derivation of mathematical models of continuous and discrete linear systems using linearization, laplace transform and z methods; Transient response, stability and steady state error (error at steady state); Frequency response analysis; Root positioning technique; PID controller design; Design of controllers for biomedical applications.

Prerequisite: None

Reference Book:
1. Automatic Control Systems in Biomedical Engineering, Springer Verlag, 2018
2. Control Systems Engineering 6th ed, John Wiley & Sons, 2011
3. Feedback Control of Dynamic Systems 7th, Pearson, 2015
4. Control Engineering: MATLAB Exercises, Springer Verlag, 2019
5. Control Theory In Biomedical Engineering: Applications in Physiology and Medical Robotics, Academic Pres, 2020.

Majoring in Medical Informatics

Hospital Information System

ENBE802201
3 CREDITS
Learning Outcome:

After completing this course, students will be able to develop hospital information systems (C6).

Syllabus:

Introduction to Health Care Information, Health Care Data Quality, Health Care Information Regulations, Laws, and Standards, Clinical Information Systems, Quality of Patient Care through the Use of Health Information Technology and System Acquisition, Technologies That Support Health Care Information Systems, Security of Health Care Information Systems, e-Security: Frameworks for Privacy and Security in E-Health Data Integration and Aggregation, Organizing Information Technology Services, IT Governance and Management, Management's Role in Major IT Initiatives, Assessing and Achieving Value in Health Care Information Systems.

Prerequisite: None

Reference Books:
1. K.A. Wager et al.. (2013). Health Care Information Systems: A Practical Approach for Health Care Management. Publisher: John Wiley & Sons.
2. J. Tan. (2005). E-Health Care Information Systems Jossey-Bass,.
3. J. Carnicero and A. Fernandes. (2012). eHealth Handbook for Managers of Healthcare Services and Systems, United Nations Publication ISBN: 978-84-695-4145-6

Decision Making System and Artificial Intelligence

ENBE802202
3 CREDITS
Learning Outcome:

After completing this course, students will be able to:

- Assess the results of intelligent decision support (C5).
- Design intelligent decision support based on the knowledge they have gained (C5).

Syllabus:

Intelligent Systems and Intelligent Decision Support Systems (IDSS) in Healthcare; Medical Diagnosis Applications with Deep Learning; IDDS in Medical Research; Data Mining-Based Intelligent Decision Support Systems.

Prerequisite: None

Reference Book:
1. Belciug S, Gorunescu F. Intelligent Decision Support Systems—A Journey to Smarter Healthcare. 1st

ed: Springer; 2020. [https://link.springer.com/book/10.1007/978-3-030-14354-1]
2. Berner ES. Clinical Decision Support Systems: Theory and Practice. 3rd ed: Springer; 2016. [https://link.springer.com/book/10.1007/978-0-387-38319-4]
3. Kose U, Deperlioglu O, Alzubi J, Patrut B. Deep Learning for Medical Decision Support Systems. 1st ed: Springer; 2021. [https://link.springer.com/book/10.1007/978-981-15-6325-6]
4. Sharda R, Delen D, Turban E. Analytics, Data Science, and Artificial Intelligence: Systems for Decision Support. 11th ed: Pearson; 2020. [https://www.pearson.com/us/higher-education/program/Sharda-Analytics-Data-Science-Artificial-Intelligence-Systems-for-Decision-Support-11th-Edition/PGM2067063.html]

Addition:
1. Hashizume M. Multidisciplinary Computational Anatomy: Toward Integration of Artificial Intelligence with MCA-based Medicine. 1st ed: Springer; 2022. [https://link.springer.com/book/10.1007/978-981-16-4325-5]
2. Kaklauskas A. Biometric and Intelligent Decision Making Support. 1st ed: Springer; 2015. [https://link.springer.com/book/10.1007/978-3-319-13659-2]
3. Suzuki K, Chen Y. Artificial Intelligence in Decision Support Systems for Diagnosis in Medical Imaging. 1st ed: Springer; 2018. [https://link.springer.com/book/10.1007/978-3-319-68843-5]

e-Health and Telemedicine
ENBE802203
3 CREDITS
Learning Outcome:

After completing this course, students will be able to:

1. Designing (C6) e-health and telemedicine systems.
2. Analyze to solve (C4) critically and creatively at the individual and group level in the health sector.

Syllabus:

Students will identify communication system technology for health applications, analyze the nature of electromagnetic waves and propagation in body-centric wireless communication (BWCS) technology and the effects of electromagnetic compatibility and interference (EMC / EMI), analyze wearable devices and implant models for communication as well as the concept of body area network (BAN), telemedicine, e-health, hospital information system (HIS) and wireless power transfer (WPT); and in the end students can design a communication application for the health sector simply through the development of hardware and software.

Prerequisite: None

Reference Books:
Mandatory:
1. H. Eren and J.G. Webster. (2016). Telehealth and Mobile Health, The e-Medicine, E-Health, M-Health, Telemedicine, and Telehealth Handbook Vol. II. CRC Press, Boca Raton, FL.
2. Mohamed K. Watfa. (2012). E-Healthcare Systems and Wireless Communications: Current and Future Challenges. Publisher: IGI Global.
3. Hebda T. & Czar P. (2013). Handbook of Informatics for Nurses & Healthcare Professionals (5th Edition). Pearson

Addition:
4. Gartee R. (2016).Electronic Health Records (3rd Edition). Pearson

Computational Biology and Bioinformatics
ENBE802204
3 CREDITS
Learning Outcome:

After completing this course, students will be able to design prototypes of computational biology and bioinformatics programs (C6).

Syllabus:

Computational concepts of biology and bioinformatics; Molecular central dogma; Genomics, transcriptomics, proteomics, as well as their relation to bioinformatics analysis; R and python languages for bioinformatics.

Prerequisite: None

Reference Books:
1. Claverie, J. M. & Notredame, C. 2011. Bioinformatics for Dummies. Wiley Publishing.
2. Wong KC. 2016. Computational Biology and Bioinformatics: Gene Regulation. CRC Press.
3. Judith Hurwitz, Alan Nugent, Fern Halper, Marcia Kaufman. 2013. Big Data for Dummies. John Wiley & Sons.
4. Lutz, M. 2013. Learning Python. O'Reilly Media.
5. Adler J. 2010. R in a nutshell: A desktop quick reference. O'Reilly Media.

Majoring in Clinical and Hospital Engineering

Hospital Medical Equipment
ENBE802301
3 CREDITS
Learning Outcome:

After completing this course, students will be able to organize general medical equipment technology for hospital needs.

Syllabus:

Major equipment used by health professional in Hospital. This study includes physiology principles for each clinical technology equipment, operation principles, main features, method for testing and evaluation for work display and equipment security, a review on the equipment population currently available in market. The clinical technology equipment that will be discussed in this session are as follow fundamental of medical instrumentation system; Vital sign monitoring; External defibrillator; Cardiac Defibrillator; Ventilator system; Anesthesia machine; Clinical laboratory equipment.

Prerequisite: None

Reference Books:
1. John G. Webster (ed.), Encyclopedia of Medical Devices and Instrumentation, A John Wiley & Sons, 2nd edition, 2006.
2. Myer Kutz, Biomedical Engineering and Design Handbook (Volume 1: Fundamentals), McGraw Hill, New York, 2nd edition, 2009.
3. Myer Kutz, Biomedical Engineering and Design Handbook (Volume 2: Applications), McGraw Hill, New York, 2nd edition, 2009.
4. Yadin David (ed.), Clinical Engineering, CRC Press, Washington DC, 2005.

Hospital Engineering
ENBE802302
3 CREDITS
Learning Outcome:

After completing this course, students will be able to make a design of technology / hospital infrastructure based on national and international bibliography (C6).

Syllabus:

Overview of Planning and Design of Hospital Utilities; Standards for Hospital Technology/Infrastructure; Regulations for Hospital Technology/Infrastructure; Hospital Electrical Installation System; Hospital Air Conditioning System; Hospital Active Fire Protection System; Hospital Building Automation System; Medical Gas and Vacuum Medical Installation System; Hospital Elevator/Elevator System; Hospital Clean Water System; Hospital Liquid Waste Treatment System; Hospital Solid Waste Treatment System; Telemedicine, Communication and Health Information Systems; Examples of Hospital Technology/Infrastructure Design; Planning and Design of Hospital Technology / Infrastructure.

Prerequisite: None

Reference Books:
1. ASHRAE. (2013). HVAC Design Manual for Hospitals and Clinics. 2 nd Edition. Atalanta: The American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc
2. FGI & AIA. (2006). Guidelines for Design and Construction of Health Care Facilities.
3. G.D. Kunders. (2010). Hospitals Facilities Planning and Management. New-Delhi: Tata McGraw-Hill Publishing Company Limited.
4. IHFG. (2017). Part B – Health Facility Briefing & Design: including Functional Planning Units. International Health Facility Guidelines
5. J.C.I (2015 Planning, Design, and Construction of Health Care Facilities. Joint Comission International. Printed in USA.
6. J.M. Currie. (2004). Book Section. An Overview of Healthcare Facilities Planning. New York: McGraw-Hill Digital Engineering Library.
7. KLHK. (2019). Pedoman Kriteria Teknologi Pengelolaan Limbah Medis Ramah Lingkungan. Jakarta: Tim Kementerian Lingkungan Hidup
8. NFPA. (2019). Health Care Facilities Code Handbook. 11 th Edition. Massachusetts: National Fire Protection Association

Design of Hospital and Healthcare Facilities
ENBE802303
3 CREDITS
Learning Outcome:

After completing this course, students will be able to design health service buildings and utilities based on national and international bibliography (C6).

Syllabus:

Planning, Design and Construction of Healthcare Facilities; Standards for Health Care Buildings and Utilities; Regulations for Health Care Buildings and Utilities; Planning and Design: Emergency Room; Planning and Design: Operating Room; Planning and Design: Intensive Care Room; Planning and Design: Inpatient Room; Planning and Design: Diagnostic Radiology Room; Example of Hospital Building Design: General & Typical Hospital; Technical Requirements for Hospital Electrical Installations; Medical Gas and Vacuum Medical Installation System; Hospital Active Fire Protection System; Hospital Clean Water System; Hospital Sewage Treatment System; Telemedicine, Communication and Health Information Systems.

Prerequisite: None

Reference Books:
1. FGI & AIA. (2006). Guidelines for Design and Construction of Health Care Facilities.
2. G.D. Kunders. (2010). Hospitals Facilities Planning and Management. New-Delhi: Tata McGraw-Hill Publishing Company Limited.
3. J.C.I (2015) Planning, Design, and Construction of Health Care Facilities. Joint Comission International. Printed in USA.
4. J.M. Currie. (2004). Book Section. An Overview of Healthcare Facilities Planning. New York: McGraw-Hill Digital Engineering Library.

Clinical Asset And Equipment Management System
ENBE802304
3 CREDITS
Learning Outcome:

After completing this course, students will be able to design management of asset safety and hospital equipment (C6).

Syllabus:

Hospital management and health services, medical equipment, public and outpatient hospital facilities, and other medical facilities. Hospital facilities generally such as emergency services, clinical laboratories, radiology services, diagnosis services, surgery services, childbirth services, as well as other medical services such as radiation therapy services, nuclear medicine, rehabilitation, therapy, and cardiac characterization laboratories.

Prerequisite: None

Reference Books:
1. Kunders, G.D., 2004, Hospitals: Facilities Planning and Management, Tata McGraw-Hill Education.
2. AIA, 2006, Guidelines for Design and Construction of Health Care and Facilities.

Special Course

Scientific Publication
ENBE804007
2 CREDITS
Learning Outcome:

After completing this course, students will be able to:

- Design scientific works with innovations from biomedical systems (C6).
- Present ideas / research results in the form of scientific papers in Indonesian or English properly and correctly following the writing rules of the intended journal (C6).

Syllabus:

Scientific writing systematics, the use of good and proper language in scientific writing, proofread, paper submission system, review process and scientific paper publishing.

Prerequisite: None

Reference Books:
1. Peraturan Dekan FTUI No. 2 Tahun 2022 tentang Panduan Penilaian Publikasi Ilmiah Bagi Mahasiswa Program Magister (S2) dan Program Doktor (S3) di Lingkungan

Fakultas Teknik Universitas Indonesia.
2. How to Write & Publish a Scientific Paper, Robert A. Day, Publisher: Oryx Press 5th Ed., 1998.
3. Technical Guidance for Universitas Indonesia Students' Final Project
4. IEEE - Publish a Paper with IEEE (www.ieee.org)

Thesis
ENBE804008
8 CREDITS
Learning Outcome:

After completing this course, students will be able to recommend alternative solutions to current problems in the field of biomedical technology through a research process (C5).

Syllabus: None

Prerequisite: Have taken and passed a minimum of 24 credits

Reference:
1. Pedoman Teknis Penulisan Tugas Akhir Mahasiswa Universitas Indonesia
2. IEEE Citation Reference
3. IEEE Transactions on Parallel and Distributed Systems, Vol. 21, No. 2, February 2010, "How To Write Research Articles in Computing and Engineering Disciplines"

Elective Course

Cell and Tissue Engineering
ENB803009
3 CREDITS
Learning Outcome:

After completing this course, students will be able to:

- Correlate (C4) various aspects related to cells, tissue engineering, and regenerative medicine related to human physiological conditions.
- Link (C6) case studies of degenerative and other diseases to regenerative medicine-principled cell and tissue engineering technologies that comply with health standards and regulations.

Syllabus:

Basic principles of cell technology and tissue engineering for regenerative medicine, cell physiology and body tissues, material types and properties, material degradation, biomaterial characterization and biocompatibility assays, in vitro cell and surface principles, scaffolding type and design, the latest technology of cells and tissue engineering for regenerative medicine, applications of tissue engineering and regenerative medicine in stem cell therapy, applications of tissue engineering and regenerative medicine for organ transplantation, as well as regulation, commercialization and ethics related to cell technology and tissue engineering for regenerative medicine.

Prerequisite: None

Reference:
Mandatory:
1. Lanza R, Langer R, Vacanti JP, Atala A. Principles of Tissue Engineering. 5th ed: Elsevier Academic Press; 2020. [https://www.sciencedirect.com/book/9780128184226/principles-of-tissue-engineering]
2. Wagner W, Elbert SS, Zhang G, Yaszemski M. Biomaterials Science: An Introduction to Materials in Medicine. 4th ed: Elsevier Academic Press; 2020. [https://www.sciencedirect.com/book/9780128161371/biomaterials-science]
3. Lanza R, Atala A. Essentials of Stem Cell Biology. 2nd ed: Elsevier Academic Press; 2014. [https://www.sciencedirect.com/book/9780124095038/essentials-of-stem-cell-biology]
4. Atala A, Lanza R, Mikos AG, Nerem R. Principles of Regenerative Medicine. 3rd ed: Elsevier Academic Press; 2019. [https://www.sciencedirect.com/book/9780128098806/principles-of-regenerative-medicine]
5. Orlando G, Keshavjee S. Organ Repair and Regeneration: Preserving Organs in the Regenerative Medicine Era. 1st ed: Elsevier Academic Press; 2021. [https://www.sciencedirect.com/book/9780128194515/organ-repair-and-regeneration]
6. Holnthoner W, Banfi A, Kirkpatrick J, Redl H. Vascularization for Tissue Engineering and Regenerative Medicine. 1st ed: Springer; 2021. [https://link.springer.com/referencework/10.1007/978-3-319-54586-8]

Addition:
1. Vishwakarma A, Karp J. Biology and Engineering of Stem Cell Niches. 1st ed: Elsevier Academic Press; 2017. [https://www.sciencedirect.com/book/9780128027349/biology-and-engineering-of-stem-cell-niches]
2. Fernandes TG, Diogo MM, Cabral JS. Engineering Strategies for Regenerative Medicine. 1st ed: Elsevier Academic Press; 2020. [https://www.sciencedirect.com/book/9780128162217/engineering-strategies-for-regenerative-medicine]
3. Eberli D, Lee SJ, Traweger A. Organ Tissue Engineering. 1st ed: Springer; 2021. [https://link.springer.com/referencework/10.1007/978-3-030-44211-8]
4. Gimble JM, Marolt Presen D, Oreffo ROC, Wolbank S, Redl H. Cell Engineering and Regeneration. 1st ed: Springer; 2020. [https://link.springer.com/referencework/10.1007/978-3-319-08831-0]
5. Ovsianikov A, Yoo J, Mironov V. 3D Printing and Biofabrication. 1st ed: Springer; 2018. [https://link.springer.com/referencework/10.1007/978-3-319-45444-3]

Hospital Information Management
ENB803010
3 CREDITS
Learning Outcome:

After completing this course, students will be able to develop a hospitalization information management system (C6).

Syllabus:

Health Care Delivery Systems, Health information management professionals, health care arrangements, electronic health records, content of patient records, numbering & filling system and record storage and circulation, indexes, registers, and data collections, legal aspects of health information management, and introduction to coding and reimbursement.

Prerequisite: None

Reference:
1. Green, M. A., Bowie, M. J. Essential of health Information Management. Principles and Practices 2nd edition. 2011. Delmar Cengage Learning

Healthcare Technology Management System
ENB803011
3 CREDITS
Learning Outcome:

After completing this course, students will be able to:

- Correlate (C4) various aspects related to health service management related to hospitalization.
- Design (C6) hospitalization management in accordance with health standards and regulations.

Syllabus:

The material to be studied includes the following topics: Clinical engineering: evolution of a discipline; Overview of engineering & engineering services; Introduction to Medical Technology Management Practices; Strategic planning; Quality & safety management in clinical engineering department; Risk factors, safety, and managemet of medical equipment; Inventory & asset management; Contract & vendor management; Technology needs assessment of medical technology; Technology acquisition; System maintenance management & technical support; Financial Management of Clinical Engineering Services; Personal Management;Cost-Effectiveness and Productivity; Clinical engineering program indicators.

Prerequisite: None

Reference:

1. Iadanza E. Clinical Engineering Handbook. 2nd ed: Elsevier Academic Press; 2020. [https://www.sciencedirect.com/book/9780128134672/clinical-engineering-handbook]
2. Jacques S, Christe BL. Introduction to Clinical Engineering. 1st ed: Elsevier Academic Press; 2020. [https://www.sciencedirect.com/book/9780128181034/introduction-to-clinical-engineering]
3. Miniati R, Iadanza E, Dori F. Clinical Engineering: from Devices to Systems. 1st ed: Elsevier Academic Press; 2016. [https://www.sciencedirect.com/book/9780128037676/clinical-engineering]

<u>Medical Information Consultation Technique</u>
ENB803012
2 CREDITS
Learning Outcome:

After completing this course, students will be able to design biomedical information systems (C6).

Syllabus:

Tools and techniques to learn and improve consulting skills, supervision systems, quality, and practical management, assess and manage risks according to special organ systems or populations, postoperative care and management according to the type of operation, postoperative general condition.

Prerequisite: None

Reference:

1. Moulton, Liz. 2016. The Naked Consultation. A Practical Guide to Primary Care Consultation second edition. CRC Press.
2. Jaffer, A. K., Grant, P. J. 2012. Perioperative Medicine. Willey-Blackwell

<u>Biostatistic Intermediate</u>
ENBE802013
2 CREDITS
Learning Outcome:

After completing this course, students will be able to analyze quantitative data and information, starting from the descriptive stage, which includes collecting, organizing, and presenting data by the scientific method, to the inductive or inferential stage, which includes the process of estimating and drawing conclusions based on available data and relationships between variables (C4).

Syllabus:

Descriptive statistical methods, probability and probability distribution, discrete probability distribution, continuous probability distribution, estimation theory, hypothesis test, regression and correlation method, design and analysis of techniques for epidemological studies, hypothesis test: person-time data, Planning Experiments partitioning variation and construction a model, ANOVA, interpretation analysis: from hypothesis tests to biology, category data, and nonparametric methods.

Prerequisite: None

Reference:

1. Budiarto, Eko. 2001. Biostatistika Untuk Kedokteran dan Kesehatan Masyarakat. Jakarta: EGC
2. Forthofer R. N., Lee E. S., Hernandez, M. 2007. Biostatistics. A Guide to Design, Analysis, and Discovery 2nd Edition. Elsevier. Academic Press
3. McCleery, R.H., T.A. Watt, T. Hart. 2007. Introduction to Statistics for Biology 3rd Edition. CRC Press
4. Rosner, B. 2015. Fundamentals of Biostatistics 8th Edition. Cengage Learning
5. Walpole, R.E., R.H. Myers, S.L. Myers., K. Ye. 2016. Probability & Statistics for Engineers & Scientists 9th Edition. Pearson

<u>Intelligent Medical Systems Engineering</u>
ENB803014
3 CREDITS
Learning Outcome:

After completing this course, students will be able to:

- Design machine learning-based medical decision support system software (C6)
- Evaluate machine learning technologies that process medical information/data (C5)
- Use Python programming language to implement machine learrning algorithms (C3)

Syllabus:

The basis of Artificial Intelligence (AI) with further emphasis on machine learning and applying it to medicine, health services, and medical equipment. This includes clinical risk stratification, phenotype and biomarker discovery, time series analysis of physiological data, disease progression modeling, and patient outcome prediction.

Prerequisite: None

Reference:

1. Oliver Theobald, Machine Learning for Absolute Beginners: A Plain English Introduction, Independently published, 2018
2. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2011
3. Joel Gruss, Data Science from Scratch, O'Reilly, 2015

<u>Health Economic Management</u>
ENB803015
2 CREDITS
Learning Outcome:

After completing this course, students will be able to:

- Understand the basic concepts, theories and methods of economics and their application in the health sector.
- Develop critical thinking on the application of health economics as a basis for determining policies / operations (evidence-based policies / practices).

- Live and commit to inherent values in health economics as part of welfare economics.
- Understand the basic concepts of theory and application of economics.
- Apply the science and methods of health economics in policy, planning, implementation, monitoring and evaluation of health programs / services and solving various kinds of health problems.

Syllabus:

Introduction to macro and microeconomic sciences; Introduction to health economics; Demand and Supply of health services; Public goods and Private goods (Health service commodities); Unique Characteristics of the Healthcare Industry; The basic concept of equality measures in the health sector; Health funding; Prepayment system as an alternative to health financing; The concept of costs and classification of costs and health services; Principles of program and health care cost analysis; Economic Evaluation in the Health Sector; Benchmarking the Development of Health Economics in islamic countries.

Prerequisite: None

Reference:

1. Culyer, T. (2012). The Humble Economist. York: York Publishing Services.
2. Drummond, M. (1992). Methods for the Economic Evaluation.
3. Mankiw, N. G. (2009). Macroeconomics: Seventh Edtion. New York: Worth Publishers.
4. Pyndick, R., & Rubinfeld, D. (2001). Microeconomics: Fifth Edition. New Jersey: Pearson Education, Inc.
5. Rahardja, P., & Manurung, M. (2016). Pengantar Ilmu Ekonomi (Mikroekonomi dan Makroekonomi). Depok: Fakultas Ekonomi Universitas Indonesia.
6. Weimer, D., & Vining, A. (2011). Policy Analysis. Canada: Person Education.

Biomedical Signal Processing
ENB803016
3 CREDITS
Learning Outcome:

After completing this course, students will be able to:

- Design medical signal processing methods.
- Design medical image processing methods.
- Applying signal and medical image processing methods using MATLAB software.

Syllabus:

Signal recognition, visual and digital imaging, image transformation, color representation, image enhancement (spatial domain), image enhancement (frequency domain), convolution and correlation, image segmentation, object feature properties, image compression, pattern recognition, image restoration, image morphology , Wavelet transformation.

Prerequisite: None

Reference:

1. Kayvan Najarian and Robert Splinter, “Biomedical Signal and Image Processing, 2nd Ed”, Taylor & Francis, 2012
2. Varun Bajaj, G. R. Sinha, Chinmay Chakraborty, “Emerging Trends in Biomedical Technologies and Health Informatics”,Taylor & Francis, 2022
3. Sridhar Krishnan, “Biomedical Signal Analysis for Connected Healthcare,” Academic Press, Elsevier, 2021.

Master Program in Metallurgy and Materials Engineering

Program Specification

1.	**Awarding Institution**	Universtas Indonesia Double Degree: Universitas Indonesia & partner universities	
2.	**Teaching Institution**	Universtas Indonesia Double Degree: Universitas Indonesia & partner universities	
3.	**Faculty**	Engineering	
4.	**Name of Study Program**	Graduate Program (Master) in Metallurgical and Materials Engineering	
5.	**Study Programme Vision and Mission**	Vision: To be a research-based center of excellence, as well as referral center for master level education and research in the field of metallurgical and materials engineering in national and global levels Mission: - Providing a master's education in metallurgy and material engineering. - Producing high quality master graduates with a strong academic background in process technology and material engineering. - Producing master graduates who are able to play an active and dynamic role in their community.	
6.	**Type of Class**	Reguler, Special	
7.	**Awarding Degree**	Magister Teknik (M.T.) Double Degree: Magister Teknik (M.T.) dan Master of Engineering (M.Eng.)	
8.	**Accreditation Status**	BAN-PT : A	
9.	**Language Course**	Bahasa (Indonesia) and English	
10.	**Study Scheme (Full Time / Part-Time)**	Full Time	
11.	**Entry Requirements**	Bachelor (S1) from the same degree, mechanical, chemical, or electrical engineerings, physics, chemistry or equivalent degree via matriculation	
12.	**Term of Study**	2 years	
	Type of Semester	Number of semester	Number of weeks/semesters
	Reguler	4	16
	Short (opsional)	**1**	**8**
13.	**Aims of the programme:** 1. Producing high quality master graduates characterized by having an in-depth analytical skills 2. Producing master graduates who are able to design complex products, processes and systems in the fields of metallurgical and material engineering 3. Producing master graduates who are able to play an active role and contribute to meet the goals of sustainable development		
14.	**Profile of Graduates:** Master of Engineering who has the ability to analyze in depth, designs products, processes, and complex systems in the field of Metallurgical and Material Engineering and contribute to meeting the goals of sustainable development		

15	**Expected Learning Outcomes (ELO):**

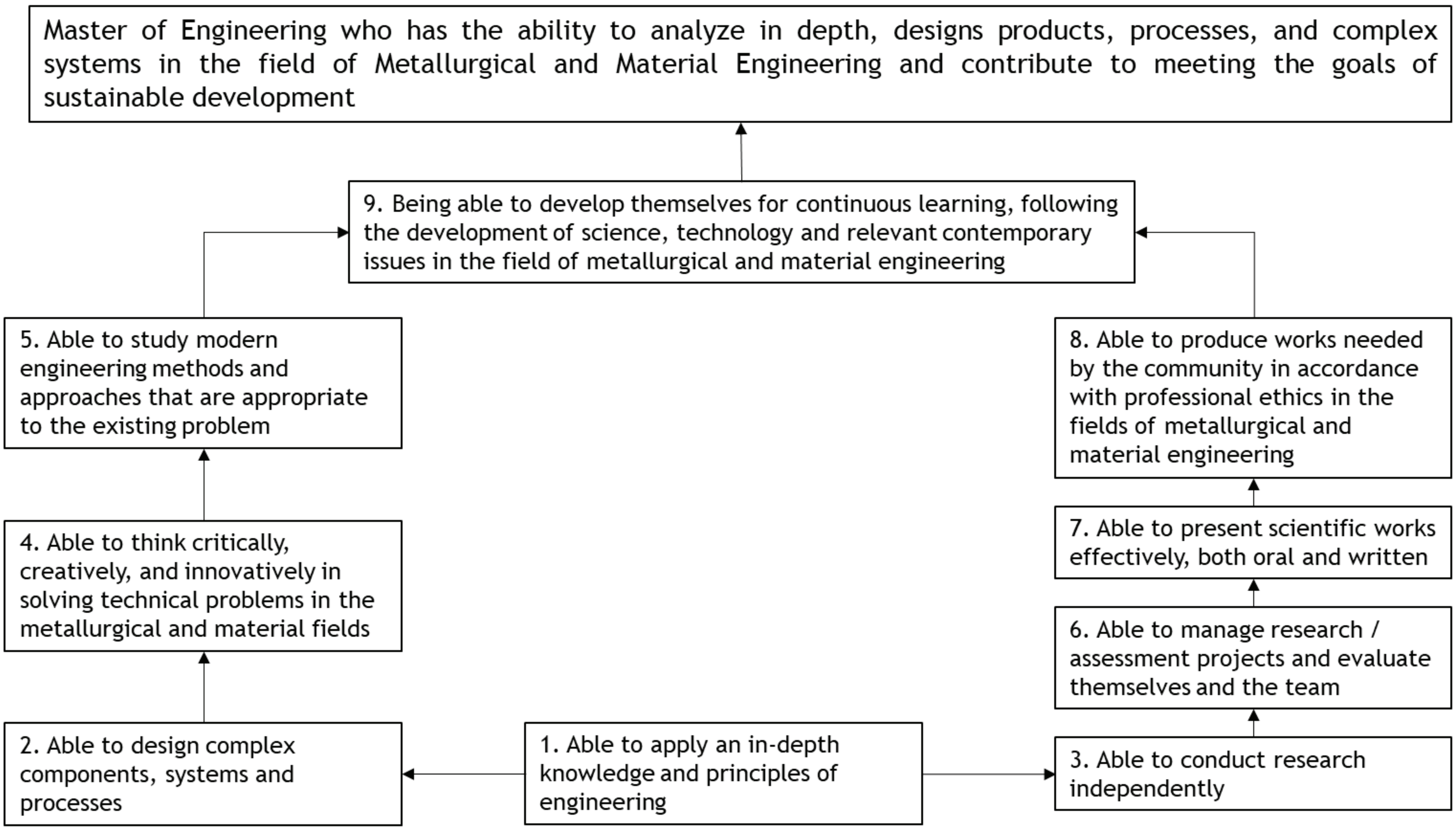
The Master of Metallurgy and Materials Engineering has the following learning outcomes:
1. Able to apply an in-depth knowledge and principles of engineering
2. Able to design complex components, systems and processes
3. Able to conduct research independently
4. Able to think critically, creatively, and innovatively in solving technical problems in the metallurgical and material fields
5. Able to study modern engineering methods and approaches that are appropriate to the existing problem
6. Able to manage research / assessment projects and evaluate themselves and the team
7. Able to present scientific works effectively, both oral and written
8. Able to produce works needed by the community in accordance with professional ethics in the fields of metallurgical and material engineering
9. Being able to develop themselves for continuous learning, following the development of science, technology and relevant contemporary issues in the field of metallurgical and material engineering

16.	**Composition of Subjects**		
No.	**Type of Courses**	**Credit Hours (SKS)**	**Percentage**
I	**Compulsory / Expertise Courses**	**20**	**45,45%**
II	**Specialization Courses**	**12**	**27,27%**
III	**Elective Courses**	**3**	**6,82%**
IV	**Seminar, Scientific Publication & Thesis**	**9**	**20,46%**
	Total	**44**	**100 %**
	Total Credit Hours to Graduate		**44 Credits**

Job Prospects

Graduates of this study program can work in various sectors both private, state-owned and government such as in the automotive industry, manufacturing, heavy equipment, mining, oil and gas, research and development fields such as Pertamina, LIPI, BATAN, BPPT, LAPAN, Ministry of Industry, and Ministry of Energy and Mineral Resources.

Expected Learning Outcome Matrix



Flowchart for Learning Outcome Achievement
Master Program in Metallurgical & Materials Engineering

Learning Outcome	Year 1		Year 2	
	Semester 1	Semester 2	Semester 3	Semester 4
1. Able to apply an in-depth knowledge and principles of engineering	Kinetics & Phase Transformations			
	Engineering Materials			
	Numerical Computation			
	Mechanics of Materials			
	Principle of Corrosion			
		Welding Metallurgy		
		Coating & Inhibition		
			Advanced Composites	
			Advanced Manufacture	
			Advanced Corrosion	
			Cathodic Protection	
2. Able to design complex components, systems and processes		Materials Selection & Design		
		Material Characterizations		
3. Able to conduct research independently		Research Methodology		

4. Able to think critically, creatively, and innovatively in solving technical problems in the metallurgical and material fields			Advanced Failure Analysis	
5. Able to study modern engineering methods and approaches that are appropriate to the existing problem		Research Methodology		
6. Able to manage research / assessment projects and evaluate themselves and the team				Scientific Publication
			Seminar of Research Proposal	Thesis
7. Able to present scientific works effectively, both oral and written				Scientific Publication
			Seminar of Research Proposal	Thesis
8. Able to produce works needed by the community in accordance with professional ethics in the fields of metallurgical and material engineering				Scientific publication
			Seminar of Research Proposal	Thesis
9. Being able to develop themselves for continuous learning, following the development of science, technology and relevant contemporary issues in the field of metallurgical and material engineering				Scientific publication
			Seminar of Research Proposal	Thesis

Curriculum Course Structure

Subject Distribution in Curriculum 2020

Semester 1	Semester 2	Semester 3	Semester 4
Kinetika & Transformasi Fasa / Kinetics & Phase Transformations	Disain & Pemilihan Material / Materials Selection & Design	Analisis Kerusakan Lanjut / Advanced Failure Analysis	Makalah Penelitian / Research Paper
Material Teknik / Engineering Materials	Karakterisasi Material / Materials Characterization	Praktikum Karakterisasi Material / Materials Characterizatio Laboratory	Tesis / Thesis
Komputasi Numerik / Numerical Computation	Metodologi Penelitian / Research Methodology	Seminar Proposal Penelitian / Seminar of Research Proposal	
Mekanika Material / Mechanics of Materials	Metalurgi Las / Welding Metallurgy	Komposit Lanjut / Advanced Composite	
Pripsip Korosi / Principle of Corrosion	Pelapisan & Inhibisi / Coating & Inhibition	Manufaktur Lanjut / Advanced Manufacture	
		Korosi Lanjut / Advanced Corrosion	
		Proteksi Katodik / Cathodic Protection	

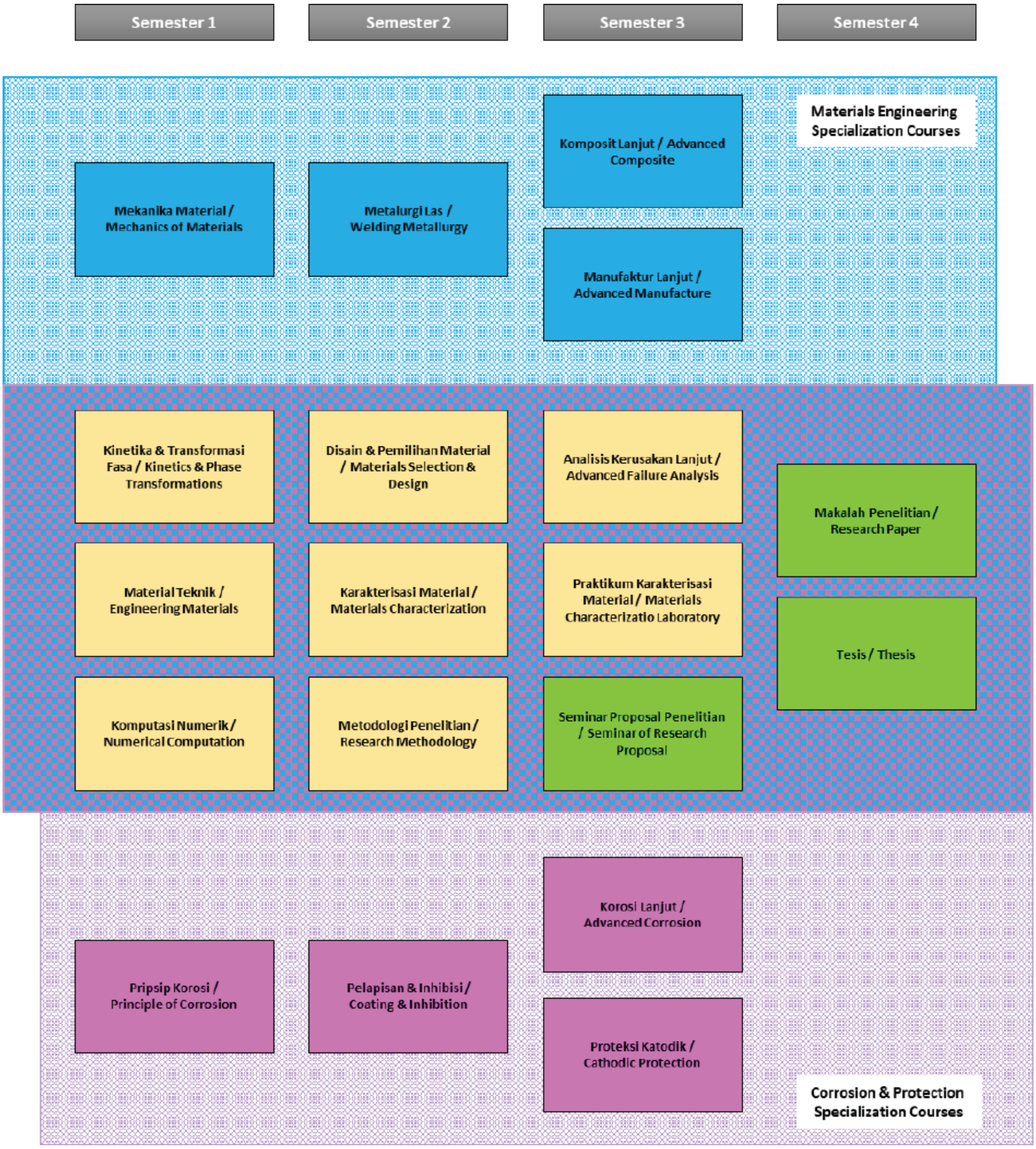
Compulsory / Expertise Courses

Materials Engineering Specialization Courses

Corrosion & Protection Specialization Courses

Research Topics

Subject Correlation in Curriculum 2020



Course Structure for Master Program Metallurgical & Materials Engineering

Compulsory / Expertise Courses

Code	Subject	SKS
	1st Semester	
ENMT801001	Kinetics & Phase Transformation	3
ENMT801002	Engineering Materials	2
ENMT801003	Numerical Computation	3
	Sub Total	**8**
	2nd Semester	
ENMT802006	Materials Selection & Design	3
ENMT802007	Material Characterization	3
ENMT802008	Research Methodology	3
	Sub Total	**9**
	3rd Semester	
ENMT803011	Advanced Failure Analysis	3
ENMT800013	Seminar of Research Proposal	1
	Sub Total	5
	4th Semester	
ENMT800018	Scientific publication	2
ENMT800019	Thesis	6
	Sub Total	6
	Total	**28**

Materials Engineering Specialization Courses

Code	Subject	SKS
	1st Semester	
ENMT801104	Mechanics of Materials	3
	Sub Total	**3**
	2nd Semester	
ENMT802109	Welding Metallurgy	3
	Sub Total	**3**
	3rd Semester	
ENMT803114	Advanced Composites	3
ENMT803115	Advanced Manufacture	3
	Sub Total	**6**
	4th Semester	
	Elective	3
	Sub Total	**3**
	Total	**15**

Corrosion & Protection Specialization Courses

Code	Subject	SKS
	1st Semester	
ENMT801205	Principle of Corrosion	3
	Sub Total	**3**
	2nd Semester	
ENMT802210	Coating & Inhibition	3
	Sub Total	**3**
	3rd Semester	
ENMT803216	Advanced Corrosion	3
ENMT803217	Cathodic Protection	3
	Sub Total	**6**
	4th Semester	
	Elective	3
	Sub Total	**3**
	Total	**15**

Electives Courses

Code	Electives	SKS
	1st Semester	
ENMT803920	Nano Technology	3
ENMT803921	Electronic Materials	3
ENMT803922	Polymer Products Manufacturing	3
ENMT803923	RBI & Integrity	3
	2nd Semester	
ENMT804924	Polymer Materials and Derivatives	3
ENMT804925	Advanced Extractive Metallurgy	3
ENMT804926	Advanced Surface Engineering	3
ENMT804927	Project Management	3

Transition Policy from Curriculum 2016 to Curriculum 2020

1. The Curriculum 2020 takes effect from the Second Term 2020/2021. After this curriculum is implemented, only the subjects in the Curriculum 2020 will be counted for the graduation: any subject in the Curriculum 2016 follows the transition rules.
2. Transition rules will be valid for 1 (one) year, starting from the Second Term of 2020/2021 until the First Term 2021/2022 for any subject changing in its place (from the first term to second term or vice versa). If it is necessary, the subject will be opened in both semesters.
3. Students who have not passed the compulsory subjects in the Curriculum 2016 are required to take the same or equivalent subjects in the Curriculum 2020.
4. If there is a change in the credit hours, the credits at the first time the subject taken will be considerred. The same or equivalent subjects with different credit hours, if repeated or newly taken, will be counted with the new name and credit hours.
5. The equivalence subjects for Curriculum 2016 and Curriculum 2020 can be seen in the Equivalency Table. Any unlisted subject in the Curriculum 2016 has been removed and is no longer offered.
6. If the compulsory subjects in the Curriculum 2016 are removed and there are no equivalencies in the Curriculum 2020:

a. For students who have passed the subjects, the subjects will be counted as compulsory credits with the same name and credit hours.

b. For students who have not passed the subjects, students can take new compulsory subjects or elective subjects with the new name and credit hours.

7. If the credit hour of a subject has been reduced while the student has already taken the subject required for the graduation, then the student is still allowed to graduate even though the total number of credits is less than the required one.

Equivalency of Curriculum 2016 and 2020

No	Curriculum 2019			Curriculum 2020		
	Code	Subject	Credit	Code	Subject	Credit
1	ENMT800016	Research Paper	2	ENMT800018	Scientific Publication	2
2	ENMT800019	Thesis	8	ENMT800019	Thesis	6
3	ENMT801001	Kinetics and Phase Transformation	3	ENMT801001	Kinetics and Phase Transformation	3
4	ENMT801002	Engineering Materials	2	ENMT801002	Engineering Materials	2
5	ENMT801003	Research Methodology and Computation	3	ENMT802008	Research Methodology	3
6	ENMT801104	Mechanics of Material	3	ENMT801104	Mechanics of Material	3
7	ENMT801205	Principle of Corrosion	3	ENMT801205	Principle of Corrosion	3
8	ENMT802006	Design and Material Selection	3	ENMT802006	Design and Material Selection	3
9	ENMT802007	Material Characterization	3	ENMT802007	Material Characterization	3
10	ENMT802109	Advanced Manufacture	3	ENMT803115	Advanced Manufacture	3
11	ENMT802210	Advanced Corrosion	3	ENMT803216	Advanced Corrosion	3
12	ENMT802211	Coating and Inhibition of Materials	3	ENMT802210	Coating and Inhibition of Materials	3
13	ENMT803012	Advanced Failure Analysis	3	ENMT803011	Advanced Failure Analysis	3
14	ENMT803113	Advanced Composite	3	ENMT803114	Advanced Composite	3
15	ENMT803114	Welding Metallurgy	3	ENMT802109	Welding Metallurgy	3
16	ENMT803115	Cathodic Protection	3	ENMT803217	Cathodic Protection	3
17	ENMT803919	Project Management	3	ENMT804927	Project Management	3
18	ENMT803920	Electronic Materials	3	ENMT803921	Electronic Materials	3
19	ENMT803921	Polymer Derivatives	3	ENMT804924	Polymer Materials and Derivatives	3
20	ENMT803922	Risk Based Inspection and Integrity	3	ENMT803923	Risk Based Inspection and Integrity	3
21	ENMT804923	Advanced Polymer Manufacturing	3	ENMT803922	Polymer Products Manufacturing	3
22	ENMT804924	Advanced Extractive Metallurgy	3	ENMT804925	Advanced Extractive Metallurgy	3
23	ENMT804925	Advanced Surface Engineering	3	ENMT804926	Advanced Surface Engineering	3
24	ENMT804927	Nanotechnology	3	ENMT803920	Nanotechnology	3

Note:
Other subjects that are not listed in this table do not change except for the subject code and curriculum code (full list is given in the SIAK-NG website)

Course Syllabus Master Program in Metallurgical and Materials Engineering

Compulsory / Expertise Courses

Kinetics & Phase Transformation

ENMT801001
3 SKS
Syllabus:

Introduction to thermodynamics, Thomson effects, diffusion, interface and energy / surface tension, grain growth kinetics, grain boundary movements, homogeneous and heterogeneous nucleation, continuous and lateral growth, alloy freezing, equilibrium freezing, non-equilibrium freezing, cellular freeze and dendritic freeze, constitutional super-cooling, eutectic freezing, eutectic structure, eutectic growth, rod and lamellar formation, impurity effects, interphase interfaces, coherent, semi-coherent and non-coherent, interface migration, sediment growth, kinetic transformation, recrystallization, grain formation, grain growth, age hardening, ferrite and austenite precipitation, pearlite reaction, bainite transformation, martensite transformation, spinodal transformation, tempering martensite, case studies.

Prerequisite: -

References:

- Porter, D. A and Easterling, K.E, Phase Transformation in Metals and Alloys, 3rd. ed., CRC Press, 2009.
- ASM, ASM Handbook Vol. 3, Alloy Phase Diagram, Ohio, 2010
- R.W. Cahn and P. Haasen (eds), Physical Metallurgy, North-Holland, 1996
- M. Flemings, Solidification Processing, McGraw Hill, New York, 1974

Engineering Materials

ENMT801002
2 SKS
Syllabus:

Atomic theory, atomic bonding, bonding system, crystal structure, structure and material properties. Iron material selection, classification of markings and specifications of steel, low alloy steel, heat treatable cabon steel and low alloy steel, tool steel selection, stainless steel selection, cast iron, non ferrous material selection. Smart materials, materials in organic: ceramics and glass, mechanical behavior of ceramics, polymer materials, plastic selection, polymerization and composite materials

Prerequisite: -

References:

- Bondan T. Sofyan, Pengantar Material Teknik, Penerbit Salemba Teknika, 2010
- W.D. Callister, Materials Science and Engineering: An Introduction, 6th ed., John Wiley & Sons, 2003
- William F. Smith, Introduction to Materials Science and Engineering

Numerical Computation

ENMT801003
3 SKS
Syllabus:

Introduction to computing, basic matlab, logical expressions, vectorization, controlling flow with if and while, loops in matlab, functions and m-files, test output, matlab programming, binary numbers, floating point numbers, precision of machines, linear equations , curve fitting, ordinary differential equations, statistical and data analysis processes

Prerequisite: -

References:

- Applied Numerical Methods with Matlab for Engineers and Scientists, Steven C. Chapra, Third Edition, McGraw-Hill, 2012.
- Numerical and Analytical Methods with MATLAB® for Engineers and Scientists, William Bober, CRC Press, 2014.
- Numerical Methods in Engineering with MATLAB, Jaan Kiusalaas, Cambridge University Press, 2005.

Materials Selection & Design

ENMT802006
3 SKS
Syllabus:

Classification of engineering materials, factors and systematic design and selection of materials, material selection criteria, material property charts and performance indexes, designs for corrosion resistance, designs for the use of high temperature materials and designs for wear and fatigue resistant materials , designs for plastics and composites and the selection of various types of steel.

Prerequisite: -

References:

- Hurst, Kenneth S., Engineering Design Principles, 1st Ed., Arnold, New York, 1999
- Pugh, Stuart, Total Design, Integrated Methods for Successful Product Engineering., Addison-Wesley Publisher Ltd., Edinburgh 1991
- Dym, Clive L and Patrick Little, Engineering Design, A-Project-Based Introduction, John Wiley and Sons, Inc., 2000
- Dieter, G. E., Engineering Design, A Material and Processing Approach, 2nd ed., McGraw Hill., 1991
- Ashby, M. F, Materials Selection in Mechanical Design, 2nd ed., Cambridge Uni. Press., Oxford, 1999

Material Characterizations

ENMT802007
3 SKS
Syllabus:

Introduction, testing procedures and standards, principles and advanced analysis methods for the chemical composition of engineering materials (AAS, OES, EDS, XPS), identification of crystal structures (X-ray diffraction), advanced metallography (SEM, EPMA, TEM), and thermal analysis (DTA, TGA, DSC and TMA).

Prerequisite: -

References:

- Davis H.E., G.E. Troxell, G.F.W. Hauck; The Testing of Engineering Materials; Mc Graw-Hill; 1982
- ASM; Mechanical Testing of Metal; 1983

- Lous Cartz, Non Destructive Testing; ASM International; 1995
- Vernon john; Testing of Materials; 1992
- Andreas Ohsner and Holm Altenbach; Properties and Characterization of Modern Materials; 2017
- Callister, William D. 2007. Materials Science and Engineering, John Wiley & Sons.
- Der Voort, Van. 1984. Metallography Principles and Practice, McGraw-Hill Book Company.
- Goodnew, Peter J; Humphrey, John. 2000. Electron Microscopy and Analysis, CRC Press
- Petzow, Gunter. 1991. Metallographic Etching, University Microfilms.
- ASM Handbook Vol 9 – Metallography and Microstructures, ASM International
- Zhang, Sam; Li, Lin; Kumar, Ashok. 2008. Materials Characterization Techniques, CRC Press.
- Schwartz, A.J.; Kumar, M.; Adams, B.L.; Field, D.P. 2009. Electron Backscatter Diffraction in Materials Science, Springer US

Research Methodology
ENMT802008
3 SKS
Syllabus:

Scientific understanding, research methodology, problem formulation, hypotheses, literature review, data collection and processing, preparation of research proposals and presentation of scientific papers;

Prerequisite: -

References:

- Willie Tan, “Practical Research Methods”, Prentice Hall, 2002.
- R. Kumar, Research Methodology, A Stepby-step Guide for Beginner, 3rd ed., SagePub, 2012

Advanced Failure Analysis
ENMT803011
3 SKS
Syllabus:

Definition & purpose of failure analysis, general material failure factors, general procedures in failure analysis techniques, classification of sources of failure, characteristics & mechanism of material failure, ductile fracture, brittle fracture, fatigue fracture, as well as failure.

Prerequisite: -

References:

- Wulpi, D. J., Understanding How Components Fail, ASM, 1998
- Charlie, R. B and Ashok, C., Metallurgical Failure Analysis, McGraw-Hill Inc., 1993
- French, D. N., Metallurgical Failure in Fossil Fired Boilers, John Wiley & Sons, 1983

Seminar of Research Proposal
ENMT800013
1 SKS

Syllabus:

Research proposal presented at the seminar in accordance with the proposals submitted in the thesis. The paper includes: Problems and hypotheses, methodology and discussion

Prerequisite: -

References: -

Scientific publication
ENMT800018
2 SKS
Syllabus:

The research results are written in a journal format and are published minimum in a national journals or in international proceedings.

Prerequisite: -

References: -

Thesis
ENMT800019
6 SKS
Syllabus:

The application / implementation of various courses that are followed in an integrated manner in a study in order to solve a problem in the field of metallurgical and material engineering. Research results are presented in the form of scientific reports and presented in front of a team of examiners.

Prerequisite: -

References: -

Materials Engineering Specialization Courses

Mechanics of Materials
ENMT801104
3 SKS
Syllabus:

Introduction to material mechanics, types of material failure, material engineering and selection, elastic deformation and strength theory, in-elastic deformation, metal and alloy processes, composites, ceramics and glass, polymers, stress and strain concepts, rheological models, plastic deformations, creep deformation, anisotropic material, material mechanical test theory, stress-strain properties, tensile behavior tendencies, interpretation of actual stress-strain, compression test, hardness, impact, bending and torque test, plane stress, plane strain, three-dimensional stress state, stress in the octahedral plane, complex strain states, general forms of failure criteria, criteria, fracture mechanics concepts, fracture toughness values, application of K values in design and analysis, stress based fatigue, load cycles, stress-time curves, average stresses, multiaxial stresses , fatigue crack growth, fatigue based on strain, strain vs. age, average stress effect, estimated age for structural components chtur and creep.

Prerequisite: -

References:

- Hibbeler, Russel C., Engineering mechanics,statics, 8th Ed., Macmillan Publishing Company,Inc.
- Hibbeler, Russel C., Mechanical of Materials,Prentice Hall International Inc., 1997
- Ferdinant L. Singer, Ilmu Kekuatan Bahan, Penerbit Erlangga, 1981

- Beer, F.P. and Johston, E.R., Mechanics of Materials, McGraw-Hill, 1983

Welding Metallurgy

ENMT802109
3 SKS
Syllabus:

Introduction to material joining, classification, basic principles and characteristics of electric arc welding processes, their advantages and limitations, classification & characteristics of welding machines and welding wires, fluxes and gases, welding parameters and heat input, basic principles of metallurgical welding, metal transfer in electric arc welding, welded joint microstructure, alloying effect, temperature changes in welds (HAZ), factors affecting the cooling rate of weld metal, weldability of ferrous metals (steel and its alloys, steel) stainless and cast iron & non-ferrous (Al, Cu, Mg, Ni, and alloys), welding defects and prevention, preheating & PWHT, and quality control of welds. Welding case studies.

Prerequisite: -

References:

- Larry F. Jeffus; Welding Principles and Applications
- Kou; Welding Metallurgy 2nd Edition; John Wiley and Sons; 2005
- Easterling; Introduction to Physical Metallurgy of Welding; Butterworth and Co; 1992
- David A. Grewell; Plastics and Composites Welding Handbook
- Alphonsus V.V. pocius; Adhesion and Adhesive Technology
- Winarto & Anis; Lecture notes; 2007

Advanced Composites

ENMT803114
3 SKS
Syllabus:

Concepts, definitions and classifications of composites, matrices and reinforcement, composite fabrication, mixed laws, interface and wetting theory, nano composites, composite mechanics, geometrical aspects in composites, laminae and laminates, elastic behavior, fiber edge effects, theory laminate, one-way lamina strength, laminate strength, short fiber composite strength, composite fracture energy and composite case studies.

Prerequisite: -

References:

- Hull, D., An Introdution to composite Materials, Cambridge Uni. Press, 1981
- Mattew, F.L. and R.D. Rawlings, Composite Materials: Engineering and Science, Chapman Hall, 1993
- Bryan Harris, Engineering Composites Materials, 2nd Eddtion, Institute of Materials Communication Ltd, 1999

Advanced Manufacture

ENMT803115
3 SKS
Syllabus:

Metal forming as part of the design and manufacturing process; general principles, phenomena and mechanisms related to metal casting; molds (sand, ceramics, metals), gating systems and simulations, freezing of cast iron and aluminum processes, liquid treatment for ferrous metals (inoculation, Mg treatment) and non-ferrous (modifiers, grain refiner), various casting methods cast defects (casting defects); general principles, phenomena and mechanisms for the formation of solid phase metals, through the processes of forging, rolling, extrusion, withdrawal, sheet metal forming, and thermo-mechanical treatment. Phenomenon and mechanism in powder metallurgy, metal powder fabrication and powder forming mechanism, powder characteristics and characterization, mechanical alloying, pre-compacting process, compacting, feed characteristics, sintering process and powder consolidation, full density processing, sintered equipment type and related aspects, application and use of powder metallurgical products. Case study of process selection and evaluation of manufacturing processes.

Prerequisite: -

References:

- Heine, R. W. et.al., Principles of Metal Casting, McGraw-Hill Pub., New Delhi, 1986
- Surdia, T. Teknologi Pengecoran Logam, P. Paramita, 1985
- John Campbell, Castings, Second Edition, Elsevier Butterworth-Heinemann, 2004

Principle of Corrosion

ENMT801205
3 SKS
Syllabus:

Electrochemical concepts: basis and application, definition of corrosion, form of corrosion, cost of corrosion, electrical concepts relevant to corrosion, relevant chemical and electrochemical concepts, prediction of corrosion trends thermodynamically, electrolytes, corrosion kinetics, over-potential (polarization), passivation , corrosion velocity measurements, metallurgical aspects, forms of corrosion, and combined potential theory, corrosion testing (weight loss coupon method, electrochemistry).

Prerequisite: -

References:

- Jones DA; Principles & Prevention of Corrosion; Mc Milan Pubs; 1992
- Fontana; Corrosion Engineering 3rd Ed; 1992
- Roberge Pierre R; Handbook of Corrosion Engineering; Mc Graw-Hill; 1999

Coating & Inhibition

ENMT802210
3 SKS
Syllabus:

Coatings: metallic coatings, metallic coatings' types and classifications, protection mechanisms, electroplating and electroless plating, anodizing, phosphating, chromatting, hot-dip galvanizing, service lie prediction, Organic Coating (paints), organic coating properties, classification and 'paints' formulations, protection mechanisms, surface preparation standards, application methods, coating defects and 'painting' failures. Inhibition; Types, classifications and mechanisms of inhibition (anodic, cathodic, and mixture inhibitors), corrosion inhibitor formulations in general, applications and limitations (for automotive, water cooling, systems)

Prerequisite: -

References:

- Jones DA; Principles & Prevention of Corrosion; Mc Milan Pubs; 1992
- Fontana; Corrosion Engineerng 3rd Ed; 1992
- Roberge Pierre R; Handbook of Corrosion Engineerin; Mc Graw-Hill; 1999

Advanced Corrosion
ENMT803216
3 SKS
Syllabus:

Introduction, dilute solutions and water, thermodynamic aspects of aqueous corrosion, corrosion kinetics, aqueous corrosion applications in the field (seawater corrosion, underground corrosion, corrosion in the soil environment), corrosion applications for metals other than iron, atmospheric corrosion, high temperature oxidation reactions, oxidation thermodynamics, oxide layer growth, oxide properties and characteristics, pilling-bedworth ratio, oxidation reaction rate, influence of oxygen corrosion pressure in specific environments, high temperature carburization, decarburization, metal dusting, hot corrosion, high temperature corrosion testing, material protection at temperatures high, high temperature resistant material, coating (aluminizing, chromizing, siliconizing). Case study of corrosion.

Prerequisite: -

References:

- Jones DA; Principles & Prevention of Corrosion; Mc Milan Pubs; 1992
- Fontana; Corrosion Engineerng 3rd Ed; 1992
- Roberge Pierre R; Handbook of Corrosion Engineerin; Mc Graw-Hill; 1999

Cathodic Protection
ENMT803217
3 SKS
Syllabus:

Basic theory of cathodic protection, protection criteria, cathodic protection system with sacrificial anode, material properties of sacrificial anode and its selection, cathodic protection application of sacrificial anode, cathodic protection system impressed current (ICCP), instrument for corrosion protection, cathodic protection in sea water environment, soil , and structure in concrete (cement), material classification, specific material and environmental relationships, design instructions for corrosion prevention, SS stainless steel and super duplex stainless steel resistance properties, corrosion resistance of commonly used engineering materials (cast steel, carbon steel, low alloy steel, nickel, aluminum, copper, zinc, titanium and its alloys, corrosion resistance of non-metal materials (rubber, plastic, composite, ceramic).

Prerequisite: -

References:

- Jones DA; Principles & Prevention of Corrosion; Mc Milan Pubs; 1992
- Fontana; Corrosion Engineering 3rd Ed; 1992
- Roberge Pierre R; Handbook of Corrosion Engineering; Mc Graw-Hill; 1999

Elective Courses

Nanotechnology
ENMT803920
3 SKS
Syllabus:

Definition and scope, solid surface physical chemistry, nanostructures (zero, one and two-dimensional: 0D, 1D, 2D), special nano materials, fabrication processes (lithography, nanolithography, soft-lithography, assembly), characterization (structural, physical and chemical) and applications (chemical sensors, biosensors, MEMS / Microelectromechanical systems, DNA chips, photonic crystals).

Prerequisite: -

References:

- Drexler, K. Eric (1986). Engines of Creation: The Coming Era of Nanotechnology. Doubleday. ISBN 978-0-385-19973-5.
- Drexler, K. Eric (1992). Nanosystems: Molecular Machinery, Manufacturing, and Computation. New York: John Wiley & Sons. ISBN 978-0-471-57547-4.
- Prasad, S. K. (2008). Modern Concepts in Nanotechnology. Discovery Publishing House. pp. 31–32. ISBN 978-81-8356-296-6.

Electronic Materials
ENMT803921
3 SKS
Syllabus:

The basic principles of semiconductor devices such as thermoelectric, piezoelectric, LED, solar cells. Basic integrated circuit process.

Prerequisite: -

References:

- Gordon McComb, Electronics for Dummies
- C. Hamaguchi, Basic Semiconductor Physics
- B.G. Yacobi, Semiconductor Materials – An Introduction to Basic Principles
- Stephen W. Fardo & Dale R. Patrick, Electricity and Electronic Fundamentals
- William J. Greig, Integrated Circuit Packaging, Assembly and Interconnections
- Vasilis F. Pavlidis and Eby G. Friedman, Three-Dimensional integrated Circuit Design

Polymer Product Manufacturing
ENMT803922
3 SKS
Syllabus:

Polymer production fabrication process (formulation, formation and finalization). The purpose and process of finalizing the types of polymer products (deflashing, smoothing and polishing, sawing and cutting, drilling, grinding and sanding, routing, milling & turning, tapping & threading, cleaning, annealing, assembling, and decoration). Types of assembly processes (mechanical joining, welding and adhesive bonding). Types of decoration processes (painting, plating, thermal spray coating, vacuum metalizing, hotstamping, coloring). Machine and process construction mechanism. Finalization process of making polymer products. Case studies on the fabrication process of product packaging (rigid and flexible), automotive, electronics and construction equipment.

Prerequisite: -

References:

- G. Challa, Polymer Chemistry – An Introduction, 1993, Ellis Horwood Limited series in Polymer Science, UK
- Young R.J. and Lovell P.A., Introduction to Polymers, 2nd edition, 1997, Chapman & Hall, Cambridge, UK
- Cheremisinoff N.P., Polymer Characterization – Laboratory Techniques and Analysis, 1996, Noyes Publication, New Jersey, USA
- Morton-Jones D.H., Polymer Processing, 1994, Chapman & Hall, UK

Risk Based-Inspection and Integrity
ENMT803923
3 SKS
Syllabus:

Definition & Definition: Asset Integrity & Risk Based Inspection. Policy: Production Level Policy and Health, Safety & Environment (HSE) Considerations. Strategy / Prioritization: Based on Priority Scale. Program Planning: Program Planning. Hazard / Threat Identification: Identification of Potential Threats. Damage Mechanism: Damage Mechanism. Probability of Failure: Failure Opportunity. Consequence of Failure: Consequences of Failure. Asset Register: Naming Facilities / Equipment. Risk Assessment: Risk Assessment. Program Implementation: Program Implementation. Data Compilation-Evaluation-Interpretation: Compilation, Evaluation & Interpretation of Data. Corrective Actions & Recommendations: Corrective actions & Recommendations. Inspection Interval: Inspection time period. Inspection Methods: Inspection Methods. Inspection Scope: Inspection Scope. Inspection Work package: Inspection Work Details.

Prerequisite: -

References:

- Chapter 008, Risk-Based Inspection Technique by Mohamed El-Reedy (Author) Publisher: Gulf Professional Publishing (17 July 2012) ASIN: B00DGSWO4S

Polymer Materials and Derivatives
ENMT803216
3 SKS
Syllabus:

Industrial strategic approaches in polymer derivatives material. General introduction in polymer derivaties (polyblends, polyalloys, thermoplastic elastomer, polymer matrix composites, liquid crystal polymer, conductive polymers, pyro and piezo polymers, shape memory polymers. Biodegradable polymer (definition, types, manufacturing process). Polymer material selection for polyblends and polyalloys synthesis. Process method selection (physics and chemical) for polymer alloying. Testing and evaluation of polymer alloying. Case studies.

Prerequisite: -

References: -

Advanced Extractive Metallurg
ENMT804925
3 SKS
Syllabus:

Waste characterization for process raw materials. Innovation of wet metallurgical processes (hydrometallurgy) and hot metallurgy (pyrometallurgy) for low-grade raw materials and energy efficiency: reaction mechanisms and applications, such as metal extraction with plasma, microwaves. Metal recycling process. Processing slag, dust and metallurgical ash particles. Processing and utilization of by-products (by product): slag utilization, cross processing, fly ash processing. Acquisition of metals from process wastes (such as tailings, residues, sludges): mineral processing from tailings, recovery of metals from red mud, recovery of metals from waste sludges. New technology for metal recycling.

Prerequisite: -

References:

- S. Ramachandra Rao, Resources Recovery and Recycling from Metallurgical Waste, waste Management Series vol. 7, Oxford, 2006.
- Related publications in journals e.g. Metallurgical and Materials Transaction, B; Journal of Metals, Hydrometallurgy, etc.

Advanced Surface Engineering
ENMT804926
3 SKS
Syllabus:

Basic surface engineering, conventional surface engineering, advanced surface engineering, surface coating, surface modification, thin film characterization

Prerequisite: -

References:

- Chattopadhyay et al, Green Tribology, ASM International, 2014.
- H.O. Pierson, Handbook of Chemical Vapor Deposition, Noyes Publication, 2000
- D.M. Mattox, Handbook of Physical Vapor Deposition, Elsevier, 2010
- J.P. Davim, Materials and Surface Engineering, Woodhead Publishing, 2012
- A.S. Hamdy, Handbook of Smart Coating for Materials Protection, Woodhead Publ, 2014

Project Management
ENMT804927
3 SKS
Syllabus:

The concept of project management system and system approach, engineering systems and procedures, basic planning,cost estimation and budgeting, project quality management, execution and project control,project organization, and context of project management, project communication, and project risk management.

Prerequisite: -

References: -

Master Program Materials Integrity Management

Program Specification

1.	**Awarding Institution**	Universtas Indonesia Double Degree: Universitas Indonesia & partner universities	
2.	**Teaching Institution**	Universtas Indonesia Double Degree: Universitas Indonesia & partner universities	
3.	**Faculty**	Engineering	
4.	**Name of Study Program**	Graduate Program (Master) in Materials Integrity Management	
5.	**Study Programme Vision and Mission**	Vision: As a center of excellence for research-based education as well as a center for reference and problem solutions in the field of material integrity management on a national and regional level in Southeast Asia Mission: - Providing access to education and research in the field of material integrity management for the public and industry. - Producing high-quality graduates with strong engineering skills with comprehensive capabilities in the field of material integrity management techniques and able to play an active and dynamic role in the national, regional, and international community. - Organizing quality tridharma activities that are relevant to national and global challenges. - Creating an academic climate that is able to support the realization of the vision of the study program.	
6.	**Type of Class**	Special	
7.	**Awarding Degree**	Magister Teknik (M.T.) Double Degree: Magister Teknik (M.T.) dan Master of Engineering (M.Eng.)	
8.	**Accreditation Status**	BAN-PT: Good	
9.	**Language Course**	Bahasa (Indonesia) and English	
10.	**Study Scheme (Full Time / Part-Time)**	Full Time	
11.	**Entry Requirements**	• Meet University Requirements (bachelor's degree graduate, register online and pass the screening exam) • Undergraduate Diplomas from foreign tertiary institutions must obtain equivalence from the Higher Education, Ministry of National Education • Able to read and write in English • Color blindness is free to entry.	
12.	**Term of Study**	2 years	
	Type of Semester	Number of semester	Number of weeks/semesters
	Reguler	4	16
	Short (opsional)	**1**	**8**
13.	**Aims of the programme:** 1. Produce graduates who can develop the science of material integrity management through research, professional practice to produce innovative and tested designs. 2. Produce graduates who are able to design, implement, evaluate and maintain a material integrity management system in a professional manner. 3. Produce graduates who are able to apply knowledge in the engineering field in the material integrity management system. 4. Produce graduates who are able to provide alternative solutions to various problems that arise in industrial societies, the nation and the state.		
14.	**Profile of Graduates:** Master of Engineering Management who has the ability to design, implement, evaluate and maintain an international quality material integrity management system and uphold professional values.		

15	**Expected Learning Outcomes (ELO):** 1. Able to develop the science of material integrity management through research, professional practice to produce innovative and tested designs. 2. Able to design, implement, evaluate and maintain a material integrity management system in a professional manner. 3. Able to apply engineering knowledge in material integrity management. 4. Able to identify, formulate and solve contemporary problems in the field of material integrity management. 5. Able to solve problems in the field of material integrity management through an interdisciplinary approach with other engineering fields. 6. Able to manage research in the field of material integrity management which has received national and international recognition. 7. Able to provide alternative solutions to various problems that arise in the industrial society, nation and state.

16.	**COURSES COMPOSITION**		
No.	**Type of Courses**	**Credit Hours (SKS)**	**Percentage**
I	**Compulsory / Expertise Courses**	**31**	**70,45%**
II	**Specialization Courses**	**0**	**0%**
III	**Elective Courses**	**4**	**9,09%**
IV	**Seminar, Scientific Publication & Thesis**	**9**	**20,46%**
	Total	**44**	**100 %**
	Total Credit Hours to Graduate		**44 Credits**

Job Prospects

Graduates of the Masters in Material Integrity Management can have careers as consultants / experts in RBI (Risk Based Inspection) and AIMS (Asset Integrity Management Systems), consultants in government agencies, consultants for the oil and gas industry, energy, petrochemical, manufacturing and related industries, Inspection managers, Control managers Quality, Safety manager and other related fields.

Expected Learning Outcome Matrix

Expected Learning Outcome Matrix

Graduate Profiles:

Master of engineering who is able to design, implement, evaluate and maintain an international quality material integrity management system and uphold the values of professionalism (C6)

Able to develop the science of material integrity management through research, professional practice to produce innovative and tested designs. (C6)

4. Able to identify, formulate and solve contemporary problems in the field of material integrity management. (C6)

6. Able to manage research in the field of material integrity management which has national and international recognition. (C6)

5. Able to solve problems in the field of material integrity management through an interdisciplinary approach with other engineering fields. (C4)

7. Able to provide alternative solutions to various problems that arise in industrial society, nation, and state. (C4)

2. Able to design, implement, evaluate, and maintain a material integrity management system in a professional manner. (C4)

3. Able to apply engineering knowledge in material integrity management. (C3)

Flowchart for Learning Outcome Achievement
Master Program in Materials Integrity Management

Learning outcomes	1st Year		2nd Year	
	1st Semester	2nd Semester	3rd Semester	4th Semester
1. Able to develop the science of material integrity management through research, professional practice to produce innovative and tested designs. (C6)		Asset Integrity Elements	Risk Based Inspection	
		Inspection Methods and Materials Testings		
2. Able to design, implement, evaluate, and maintain a material integrity management system in a professional manner. (C4)	Integrity System Engineering		Reliability Engineering	
3. Able to apply engineering knowledge in material integrity management. (C3)	Risk Management		Failure Analyses	
4. Able to identify, formulate and solve contemporary problems in the field of material integrity management. (C6)	Integrated Materials Engineering	Corrosion and Protections		
5. Able to solve problems in the field of material integrity management through an interdisciplinary approach with other engineering fields. (C4)			Piping and Mechanical Engineering	Theses
			Case Study I	Case Study II
			Precision Maintenance	Advanced HSE
				Stochastic Models for Risk Management
				Advanced of Life Cycles Assets

Learning outcomes	1st Year		2nd Year	
	1st Semester	2nd Semester	Semester 3	1st Semester
6. Able to manage research in the field of material integrity management which has national and international recognition. (C6)	Computing Methodology	Research Meteorology		
7. Able to provide alternative solutions to various problems that arise in industrial society, nation, and state. (C4)				Theses
			Seminar	Scientific Publication

Course Structure for Master Program Materials Integrity Management

Compulsory / Expertise Courses

Code	Subject	SKS
	1st Semester	
ENMI801001	Integrated Materials Engineering	3
ENMI801002	Integrity System Engineering	2
ENMI801003	Risk Management	3
ENMI801004	Computational Methods	3
	Sub Total	**12**
	2nd Semester	
ENMI802005	Corrosion and Protections	3
ENMI802006	Asset Integrity Elements	4
ENMI802007	Inspection Methods and Materials Testing	3
ENMI802008	Research Methodology	3
	Sub Total	**13**
	3rd Semester	
ENMI803009	Failure Analysis	3
ENMI803010	Risk Based Inspection	3
ENMI803011	Seminar Proposal	1
ENMI803012 - ENMI803015	Electives I	2
	Sub Total	9
	4th Semester	
ENMI800020	Scientific publication	2
ENMI800021	Thesis	6
ENMI804916 - ENMI804919	Electives II	2
	Sub Total	8
	Total	**44**

Electives Courses

Code	Electives	SKS
	1st Semester	
ENMI803912	Study Case I	2
ENMI803913	Reliability Engineering	2
ENMI803914	Precision Maintenance	2
ENMI803915	Mechanical and Piping Engineering	2
	2nd Semester	
ENMI804916	Study Case II	2
ENMI804917	Advanced Health, Safety and Environment	2
ENMI804918	Stochastic Model for Risk Management	2
ENMI804919	Advanced Life Cycle Asset Analysis	2

Course Syllabus Master Program in Materials Integrity Management

Compulsory / Expertise Courses

Integrated Materials Engineering
ENMI801001
3 Credits
CLO:

Students are able to apply material technology in engineering applications starting from the introduction of material structure and properties, material product selection and design, processing and quality assurance.

Syllabus:

Introduction to materials, material types and characteristics, material applications, crystallography, phase diagrams and material kinetics. Introduction to material manufacturing processes, heat treatment of materials, material treatment and splicing techniques as well as material design and selection.

Pre-requisites:

References:

- William D. Callister, Jr., David G. Rethwisch., Materials science and engineering: an introduction /–8th ed.
- William F. Smith, Introduction to Materials Science and Engineering

Integrity System Engineering
ENMI801002
3 Credits
CLO:

Students are able to synthesize the preliminary concept of Asset Integrity Management in the project.

Syllabus:

Introduction, Management responsibility, AIM Cycle, Failure mechanisms and modes, Asset selection and critical determination, inspection, testing and preventive maintenance.

Pre-requisites:

References:

- Guidelines for Asset Integrity Management, the American Institute of Chemical Engineers, 2017

Asset Integrity Element
ENMI802006
3 Credits
CLO:

Students are able to synthesize advanced concept of Asset Integrity Management in a project-based activity.

Syllabus:

Training in asset integrity and quality assurance, procedure, quality management, deficiency management, specific integrity management, implementation, metrics, audit and sustainable development, and tools.

Pre-requisites:

References:

- Guidelines for Asset Integrity Management, the American Institute of Chemical Engineers, 2017

Computing Methods

ENMI801004
3 Credits
CLO:

Students are able to apply model making in solving problems in the Materials Integrity Management field by using software.

Syllabus:

Introduction to computation, matlab basics, logical expressions, vectorization, flow control with if and while, loops in matlab, functions and m-files, test output, matlab programming, binary numbers, floating point numbers, machine precision, linear equations, curve fitting, ordinary differential equations, statistics and process data analysis.

Pre-requisites:

References:

- Applied Numerical Methods with Matlab for Engineers and Scientists, Steven C. Chapra, Third Edition, McGraw-Hill, 2012.
- Numerical and Analytical Methods with MATLAB® for Engineers and Scientists, William Bober, CRC Press, 2014.
- Numerical Methods in Engineering with MATLAB, Jaan Kiusalaas, Cambridge University Press, 2005.

Risk Management

ENMI801003
3 Credits
CLO:

Students are able to design an asset integrity and safety management communication system and be able to design a risk and safety management system implementation in an organization.

Syllabus:

Risk communication, rick communication report planning, case study and evaluation, risk management, standard and compliance, risk management components, analysis techniques and managerial systems.

Pre-requisites:

References:

- Lundgren, Regina E._ McMakin, Andrea H - Risk communication_ a handbook for communicating environmental, safety, and health risks-Wiley (2018) Wiley-IEEE Press
- (Process safety guidelines and concept books) Center for Chemical Process Safety (CCPS) - Bow ties in risk management _ a concept book for process safety-John Wiley & Sons (2018)
- Ian Sutton - Process risk and reliability management-Gulf Professional Publishing, Elsevier Inc (2015)

Inspection Methods and Materials Testing

ENMI802007
3 Credits
CLO:

Students are able to design inspection methods to analyze materials from their properties and be able to carry out characterization and testing of materials independently.

Syllabus:

Methods of material inspection in Integrity standards. Broken Testing. Introduction, testing procedures and standards, principles and advanced analysis methods for the chemical composition of engineering materials (AAS, OES, EDS, XPS), identification of crystal structures (X-ray diffraction), advanced metallography (SEM, EPMA, TEM), and thermal analysis (DTA, TGA, DSC and TMA).

Pre-requisites:

References:

- Davis H.E., G.E. Troxell, G.F.W. Hauck; The Testing of Engineering Materials; Mc Graw-Hill; 1982
- ASM; Mechanical Testing of Metal; 1983
- Lous Cartz, Non Destructive Testing; ASM International; 1995
- Vernon john; Testing of Materials; 1992
- Andreas Ohsner and Holm Altenbach; Properties and Characterization of Modern Materials; 2017
- Callister, William D. 2007. Materials Science and Engineering, John Wiley & Sons.
- Der Voort, Van. 1984. Metallography Principles and Practice, McGraw-Hill Book Company.
- Goodnew, Peter J; Humphrey, John. 2000. Electron Microscopy and Analysis, CRC Press
- Petzow, Gunter. 1991. Metallographic Etching, University Microfilms.
- ASM Handbook Vol 9 – Metallography and Microstructures, ASM International
- Zhang, Sam; Li, Lin; Kumar, Ashok. 2008. Materials Characterization Techniques, CRC Press.
- Schwartz, A.J.; Kumar, M.; Adams, B.L.; Field, D.P. 2009. Electron Backscatter Diffraction in Materials Science, Springer US

Research Methodology

ENMI802008
3 Credits
CLO:

Students are able to design independent research, analyze data, formulate methodologies and disseminate research results by following international research principles.

Syllabus:

Scientific understanding, research methodology, problem formulation, hypotheses, literature review, data collection and processing, preparation of research proposals and presentation of scientific papers.

Pre-requisites:

References:

- Willie Tan, "Practical Research Methods", Prentice Hall, 2002.
- R. Kumar, Research Methodology, A Stepby-step Guide for Beginner, 3rd ed., SagePub, 2012

Failure Analyses

ENMI802009
3 Credits
CLO:

Students able to analyze the failure of a material and prevent material failure with the principle of fracture mechanics.

Syllabus:

Definition & purpose of damage analysis, general material damage factors, general procedures in damage analysis techniques, classification of sources of failure, characteristics & mechanisms of material failure, ductile fracture, brittle fracture, fatigue fracture, and consequent failure and embrittlement.

Pre-requisites:

References:

- Wulpi, D. J., Understanding How Components Fail, ASM, 1998
- Charlie, R. B and Ashok, C., Metallurgical Failure Analysis, McGraw-Hill Inc., 1993
- French, D. N., Metallurgical Failure in Fossil Fired Boilers, John Wiley & Sons, 1983

Seminar

ENMI800011
1 Credits
CLO:

Students are able to express a problem and their opinions in the form of working papers / short papers / scientific papers and discuss in a scientific forum / seminar systematically, clearly, orderly and correctly.

Syllabus:

Working papers / papers submitted in the seminar are in accordance with the proposals submitted in the thesis. Papers include: Problems and hypotheses, methodology and discussion.

Pre-requisites:

References:

Scientific Publication

ENMI800020
2 Credits
CLO:

Students are able to disseminate their research results to seminars or leading scientific meetings.

Syllabus:

The research results are written in journal format and published at least in national journals or international proceedings.

Pre-requisites:

References:

Thesis

ENMI800021
6 Credits
CLO:

Students are able to write independent research results into a written work that follows applicable academic principles.

Syllabus:

Application / implementation of various courses that are followed in an integrated manner in a research to solve a problem in the field of Materials Integrity Management. The research results are presented in the form of scientific reports and presented in front of a team of examiners.

Pre-requisites:

References:

Corrosion and Protections

ENMI802005
3 Credits
CLO:

Students are able to identify the corrosion phenomenon and apply it in material engineering preventive measures and be able to design coating engineering on materials to improve the performance of the material. Students can analyze or synthesize cathodic protection methods as a way of controlling corrosion in aqueous (aqueous) environments. Students can also perform calculations and design a cathodic protection system that can be applied in practice. Apart from the Cathodic Protection method, also the method of design and material selection. Basic theory of cathodic protection, protection criteria, cathodic protection systems with sacrificial anodes, material properties of sacrificial anodes and their selection, application of sacrificial anode cathodic protection, impressed current cathodic protection systems (ICCP), instruments for corrosion protection, cathodic protection in marine, soil environments , and structures in concrete (cement), material classification, specific material and environmental relationships, design instructions for corrosion prevention, resistance properties of stainless steel and super duplex SS materials, corrosion resistance of commonly used engineering materials (cast steel, carbon steel, low alloy steel, nickel, aluminum, copper, zinc, titanium and their alloys, non-metal material corrosion resistance (rubber, plastic, composite, ceramic).

Syllabus:

The concept of electrochemistry: the basis and its application, definition of corrosion, form of corrosion, cost of corrosion, electrical concepts relevant to corrosion, relevant chemical and electrochemical concepts, prediction of the trend of corrosion by thermodynamics, electrolytes, corrosion kinetics, over-potential (polarization), passivation , measurement of corrosion velocity, metallurgical aspects, forms of corrosion, and combined potential theory, corrosion testing (weight loss coupon method, electrochemistry). Coating: metallic coating, metallic coating type and classification, protection mechanism, electroplating and electroless plating, anodizing, phosphating, chroming, hot-dip galvanizing, service lie prediction, Organic Coating (paints), organic coating properties, classification and formulations of 'paints', their protection mechanisms, standard of surface preparation, method of application, coating defects and 'painting' failures. Inhibition; Types, classification, and mechanism of inhibition (anodic, cathodic and mixed inhibitors), general corrosion inhibitor formulations, applications and limitations (for automotive, water cooling, systems).

Pre-requisites:

References:

- Jones DA; Principles & Prevention of Corrosion; Mc Milan Pubs; 1992
- Fontana; Corrosion Engineering 3rd Ed; 1992
- Roberge Pierre R; Handbook of Corrosion Engineering; Mc Graw-Hill; 1999
- Jones DA; Principles & Prevention of Corrosion; Mc Milan Pubs; 1992
- Fontana; Corrosion Engineering 3rd Ed; 1992
- Roberge Pierre R; Handbook of Corrosion Engineering; Mc Graw-Hill; 1999

Risk Based Inspection

ENMI803010

3 Credits
CLO:

Students are able to apply risk-based inspection methods.

Syllabus:

Definition & Definition: Asset Integrity & Risk Based Inspection. Policy: Policy on Production Level and Health, Safety & Environment (HSE) Considerations. Strategy / Prioritization: Based on Priority Scale. Program Planning: Program Planning. Hazard / Threat Identification: Identification of Potential Threats. Damage Mechanism: Damage Mechanism. Probability of Failure: Chance of Failure. Consequence of Failure: Consequence of Failure. Asset Register: Naming of Facilities / Equipment. Risk Assessment: Risk Assessment. Program Implementation: Program Implementation. Data Compilation-Evaluation-Interpretation: Compilation, Evaluation & Interpretation of Data. Corrective Actions & Recommendations: Corrective Actions & Recommendations. Inspection Interval: Inspection period. Inspection Methods: Inspection Methods. Inspection Scope: Scope of Inspection. Inspection Work package: Details of Inspection Work.

Pre-requisites:

References:

- Chapter 008, Risk-Based Inspection Technique by Mohamed El-Reedy (Author) Publisher: Gulf

Elective Courses

Case Study I
ENMI803912
2 Credits
CLO:

Students are able to build an Asset Integrity Management system in real cases.

Syllabus:

Students select a case study in their area of interest: the oil and gas industry which includes planning, commissioning, document preparation, maintenance, and reporting. Students choose a case study in their area of interest: The Petrochemical industry which includes planning, commissioning, document preparation, maintenance and reporting.

Pre-requisites:

References:

Case Study II
ENMI803912
2 Credits
CLO:

Students are able to build an Asset Integrity Management system in real cases.

Syllabus:

Students select a case study in their area of interest: the oil and gas industry which includes planning, commissioning, document preparation, maintenance, and reporting. Students choose a case study in their area of interest: The Petrochemical industry which includes planning, commissioning, document preparation, maintenance and reporting.

Pre-requisites:

References:

Reliability Engineering
ENMI803913
2 Credits
CLO:

Students are able to build an Asset Integrity Management system based on the Analysis of Reliability Techniques.

Syllabus:

Methods in Reliability Techniques, Statistics, Implementation.

Pre-requisites:

References:

- Ian Sutton - Process risk and reliability management-Gulf Professional Publishing, Elsevier Inc (2015)

Piping and Mechanical Engineering
ENMI803915
2 Credits
CLO:

Students are able to analyze mechanical and piping systems.

Syllabus:

Introduction to mechanical engineering and design. Introduction to mechanical engineering, principles of kinematics and kinetics of machines, friction and vibration, introduction to fluid mechanics, heat transfer, basic concepts of stress and strain analysis, principles of mechanical engineering problem solving. Introduction to piping engineering, components, piping instrumentation and equipment, piping flow diagrams, piping materials, piping design and engineering.

Pre-requisites:

References:

- Jonathan Wickert, Kemper Lewis, Introduction to Mechanical Engineering, 4th edition, Cengage Learning, 2016.
- Sanjay Kumar Gupta, Perfect knowledge of piping engineering, CreateSpace Independent Pub, 2015.

Master Program in Architecture

Program Specification

1.	**Degree Awarding University**	Universtas Indonesia
2.	**University/Institution**	Universtas Indonesia
3.	**Faculty**	Engineering
4.	**Major Name**	Master of Architecture
5.	**Vision and Mission**	Vision: "Establishing a high-quality Architecture Education Institution that receives national and international recognition, in order to foster future leaders who are critical, knowledgeable, and creative thinkers, with sensibility to local wisdom and environment sustainability." Mission: "Establishing the Architecture Education institutional system with excellent productivity towards the implementation of Tridarma in higher education."
6.	**Type of Class**	Reguler
7.	**Awarding Degree**	Magister Arsitektur (M. Ars.) / Master of Architecture
8.	**Educational Accreditation**	BAN-PT: Akredited A
9.	**Language**	Bahasa Indonesia
10.	**Learning Scheme (Full Time / Part-Time)**	Full Time
11.	**Requirements**	Bachelor degree
12.	**Study Period**	2 years

	Type of Semester	Number of semester	Number of weeks/semesters
	Reguler	4	17
	Short (opsional)		

13. Aims of the programme:
1. Education: Producing Master of Architecture graduates who master certain competencies in accordance with the level of education excellence and quality.
2. Research: Encouraging excellent research works, which are able to compete at regional and international levels.
3. Community Service: Encouraging the application of architectural knowledge to the community

14. Profile of Graduates:

Master of Architecture graduates who master knowledge of architecture according to their fields and able to demonstrate the state of the art and contribution both in their research and design methods.

15. Graduate Outcomes:

Master of Architecture graduates has following competencies:

1. Ability to independently conduct and manage an architectural research in relation to their fields.
2. Ability to synthesize knowledge and exploration methods of architectural phenomena and ability to solve architectural design problems.
3. Ability to position themselves as individual in relation to others and as part of the society, through behaving and thinking in support to the success of community life, teamwork, and act responsively to the surrounding environment.

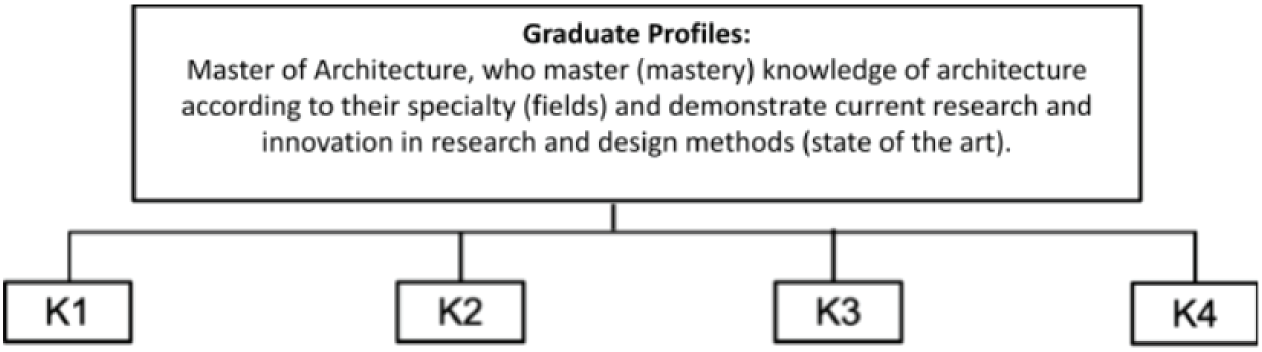
16. Course composition

No.	Type of Courses	Credit Hours (SKS)	Percentage
I	**University Course**		
II	**Faculty Course**		
III	**Required Structural Course**	**11**	**27,5%**
IV	**Specialization Course**	**13**	**32,5%**
V	**Elective Course**	**6**	**15%**
VI	**Special Course (Pre-Thesis, Thesis & Publication)**	**10**	**25%**
	Total	**40**	**100 %**
	Total SCS (Semester Credit System)		**40 Credits**

Job Prospects

Graduates can work in the business of architecture practitioners, academics, researchers, policy makers in government, entrepreneurs and activists in sectors related to human environment.

Network of Competencies



Detail Network of Competencies Graduates

GRADUATE PROFILE

K1	K2	K3	K4
• Advance Architecture Theory • Studio / Workshop Specialization 1 • Studio / Workshop Specialization 2 • Theories Peminatan • Topik Khusus Peminatan • Electives	• Advanced Research Method • Advanced Design Method • Applied Data Science • Pre-Tesis • Thesis	• Studio / Workshop Specialization 1 • Studio / Workshop Specialization 2	• Advance Architecture Theory • Advanced Research Method • Advanced Design Method • Studio / Workshop Specialization 1 • Studio / Workshop Specialization 2 • Specialization Theories • Applied Data Science • Pre-Thesis • Thesis

Course Diagram in Achieving Competencies for Master Program in Architecture

	1st Semester	2nd Semester	3rd Semester	4th Semester
(1) Able to construct advanced architectural knowledge according to specifity fields.	ADVANCED ARCHITECTURE THEORIES	COURSE THEORIES	PRE-THESIS	THESIS
		ADVANCED DESIGN METHODS	ELECTIVE	PUBLICATION
	STUDIO/WORKSHOP COURSE 1	STUDIO / WORKSHOP COURSE 2		
(2) Able to manage independent research in the field of architecture according to specifity fields.	ADVANCED ARCHITECTURE THEORIES	COURSE THEORIES	PRE-THESIS	THESIS
	ADVANCED RESEARCH METHODS	ADVANCED DESIGN METHODS		PUBLICATION
		APPLIED DATA SCIENCE		
	STUDIO/WORKSHOP COURSE 1	STUDIO WORKSHOP COURSE 2		
(3) Able to synthesize and integrate knowledge and methods in uncovering architectural phenomena and / or solving architectural design problems	ADVANCED ARCHITECTURE THEORIES	COURSE THEORIES	PRE-THESIS	THESIS
	ADVANCED RESEARCH METHODS	ADVANCED DESIGN METHODS		PUBLICATION
		APPLIED DATA SCIENCE		
	STUDIO WORKSHOP COURSE 1	STUDIO WORKSHOP COURSE 2		
(4) Able to be critical in his position as an individual related to relations between humans and parts of society, through behavior and ways of thinking to support the success of community life, teamwork, and act responsive to the surrounding environment.		COURSE THEORIES	PRE-THESIS	THESIS
			ELECTIVE	
	STUDIO WORKSHOP COURSE 1	STUDIO WORKSHOP COURSE 2	ELECTIVE	

Course Structure Master Program Architecture

Code	Subject	SKS
	1st Semester	
ENAR800001	Advanced Research Methods	3
ENAR800002	Advanced Architectural Theories	3
ENAR800008	Architectural Design Studio 1	5
ENAR800009	Urban Design Studio 1	5
ENAR800010	Urban Housing & Settlement Studio 1	5
ENAR800011	Property Workshop 1	5
ENAR800012	History & Theory Workshop 1	5
ENAR800013	Architecture and Sustainability Workshop 1	5
	2nd Semester	
ENAR800003	Advanced Design Methods	3
ENAR800004	Applied Data Science	2
ENAR800014	Architectural Design Theories	3
ENAR800015	Urban Design Theories	3
ENAR800016	Urban Housing and Settlement Theories	3
ENAR800017	Property Theories	3
ENAR800018	Architectural Theory and History	3
ENAR800019	Theory of Architecture and Sustainability	3
ENAR800020	Architectural Design Studio 2	5
ENAR800021	Urban Design Studio 2	5
ENAR800022	Urban Housing and Settlement Studio 2	5
ENAR800023	Property Workshop 2	5
ENAR800024	History and Theory Workshop 2	5
ENAR800025	Architecture and Sustainability Workshop 2	5
	3rd Semester	
ENAR800005	Pre-Thesis	4
	Elective	3
	Elective	3
	Sub Total	**10**
	4th Semester	
ENAR800006	Scientific Publication	2
ENAR800007	Thesis	4
	Sub Total	**6**
	Total	**40**

Elective Courses

Code	Subject	SKS
ENAR800026	Advanced Spatial Analysis	3
ENAR800027	Architecture and Text	3
ENAR800028	Coastal Architecture	3
ENAR800029	Ethnic Architecture	3
ENAR800030	Heritage Architecture	3
ENAR800031	Architecture, Media, and Context	3
ENAR800632	Energy Efficient Building	3
ENAR800133	BIM: Building Performance Analysis & Assessment	3
ENAR800334	Computational Design and Parametric Modelling	3
ENAR800135	Geometry and Architecture	3
ENAR800636	Independent Study	3
ENAR800337	Capita Selecta	3
ENAR800238	Housing Policy	3
ENAR800039	Everyday and Architecture	3
ENAR800040	Project Management	3
ENAR800041	Understanding Phenomenon: Plato to Derrida	3
ENAR800042	City Morphology	3
ENAR800043	City Planning	3
ENAR800044	Architecture Psychology	3
ENAR800045	Teaching Assistantship	3
ENAR800046	Special Topic on Architectural Design	3
ENAR800047	Special Topic on Urban Design	3
ENAR800048	Special Topic on Urban Housing and Settlement	3
ENAR800049	Special Topic on Property	3
ENAR800050	Special Topic on Architectural History, Theory and Criticism	3
ENAR800051	Special Topic on Sustainability	3

SUBJECT SYLLABUS

Syllabus of Required Courses

Advanced Research Methods
ENAR800001
3 Credits
Learning Objectives:

Student are able to synthesize research processes that emphasize on the method of inquiry (inquiry); Student are able to conclude the right research design to answer research questions; Student are able to formulate problems, research questions, and how to answer research questions.

Sub Learning Objectives:

Student are able to analyze the ontology and epistemology of a scientific concept; Student are able to conclude the differences in research logic in various research paradigms and their application in the formulation of research designs; Student are able to compose writings that meet the rules of scientific writing and appropriate writing style to convey a sequence of ideas or scientific ideas in accordance with their field of specialty; Student are able to analyze the relationship between models, theories, hypotheses, and research methods; Student are able to identify research questions; Student are able to formulate research designs that are in accordance with research questions and objectives in accordance with the field of specialty.

Syllabus:

Through this course, students are able to choose an appropriate approach for research in the field of architecture and the built environment. The target is that students are able to prepare architectural research proposals appropriately, with the following sub-targets: student are able to formulate research questions that can be carried out, compile literature reviews that are relevant to the research to be carried out, and identify methods of obtaining information needed to answer research questions. The discussion covers the process of thinking and research in architecture; terminology (ontological, psychological); architectural texts and stylistics; research questions, research arguments; research logic; assumptions and paradigms; research strategies and tactics; and procedures for preparing research proposals

Pre-requisites:

No prerequisites for master's students. Requires instructors' approval for undergraduate students.

References:

1. J.M. Bochenski, *The Methods of Contemporary Thoughts*, , Harper Torchbook, 1968
2. G. Broadbent, *Design in Architecture: Architecture and the Human Sciences,* David Fulton Publisher, 2000;
3. Sir Karl Popper, *The Logic of Scientific Discovery*, Routledge Classic, 2002
4. T. Y.Hardjoko, *Panduan Meneliti dan Menulis Ilmiah*, Departemen Arsitektur, 2005
5. F. Crews, *The Random House Handbook*, 3rd ed, Random House, 1980
6. Edward Tufte, *Envisioning Information*, Graphics Press, 1983
7. John Zeisel, *Inquiry by Design*: *Environment/Behavior/ Neuroscience in Architecture, Interiors, Landscape, and Planning,* W. W. Norton, 2006
8. Linda Groat & David Wang, *Architectural Research Methods*, John Wiley & Sons, 2002
9. Murray Fraser (Ed). *Design Research in Architecture*, Routledge, 2013
10. Philip Plowright, *Revealing Architectural Design: Methods, Frameworks, Tools*, Routledge, 2014
11. Bryan Lawson, *How Designers Think: The Design Process Desmystified,* Architectural Press, 2005
12. Hazel Clark dan David Brody (eds), *Design Studies: A Reader*, Berg, 2009.
13. Nigel Cross, *Designerly Ways of Knowing*, Birkhauser, 2007

Advanced Architectural Theories

ENAR800002
5 Credits
Learning Objectives:

Students are able to understand and critically examine ARCHITECTURE as a DISCIPLINE related to physical & metaphysical phenomena of the HUMAN built environment (space/place); Students are able to understand Architectural Theory as a trans-disciplinary study which includes, among others: design, urban design, history & theory of architecture, urban housing and settlements; property, building technology and sustainability; Students are able to explain their thoughts related to the Trans-Disciplined Architecture Theory both orally through presentations and scientific writings.

Sub Learning Objectives:

Students show their participation through attendance at each session; Students are able to compile data and present their thoughts through power point and posters; Students are able to communicate their thoughts through active discussions both in class and in groups; Students are able to write scientific writings/articles.

Syllabus:

This course examines ARCHITECTURE as a DISCIPLINE related to physical & metaphysical phenomena of the human environment (space/place), which grows into a certain Advanced or specialization; : design, urban design, history & theory of architecture, urban housing and settlements; property, building technology and sustainability; Students are able to explain their thoughts related to the Trans-Disciplined Architecture Theory both orally through presentations and scientific writings.

Learning Materials:

Introductory Session: Introduction to Architectural Theory; Architectural Design Theory; Urban Design Theory; Urban Housing and Settlement Theory; Property Theory; Session 5: History and Theory of Architecture; Session 6: Building Technology Theory and Sustainability.

Pre-requisites: -

References:

1. Christopher Alexander, Notes on the Synthesis of Form, Harvard University Press Publication, 1964
2. -----, The Appraisal of Real Estate 13th edition, Appraisal Institute, 2008
3. Andrew Ballantyne (ed.), Architecture Theory, A Reader in Philosophy and Culture, Continuum, 2005
4. S Bell et.al. Sustainability Indicators: Measuring the Immeasurabel?, Earthscan Publications Ltd, 2000
5. A Bertaud, The Regulatory Environment of Urban Land in Indonesia: Constrains Imposed on the Poor and Impact of World Bank's Urban Projects, Asia Technical Department, 2003
6. Ricky Burdet eds, Living in the Endless City: The Urban Age Project by the London School of Economics and Deutsche Bank's Alfred Herrhausen Society, Paidhon, 2011
7. Stephen Cairns, Greig C Crysler, and Hilde Heynen, The SAGE Handbook of Architectural Theory, Sage Publication, 2012
8. Adrian Forty, Words and Buildings, A Vocabulary of Modern Architecture, Thames and Hudson, 2000
9. Bernd Evers and Christof Thoenes (eds), Architectural Theory from the Renaissance to the Present, Taschen, 2003
10. Michael K Hays, Architecture Theory since 1968, MIT Press, 1998
11. Triatno Y Hardjoko, Urban Kampung. Its Genesis and Transformation into Metropolis, with particular reference to Penggilingan in Jakarta, VDM, 2009
12. Charles Jencks (eds.), Theories and Manifestoes, Academy Editions, 1997
13. Keith Jenkins, Re-thinkingHistory, Routledge, 1991
14. Paul Alan Johnson, The Theory of Architecture: Concepts, Themes & Practices, Van Nostrand Reinhold, 1994
15. Hanno-Walter Kruft, A History of Architectural Theory from Vitruvius to The Present, Princeton Architectural Press, 1994
16. M Larice and E Mcdonald (eds), Urban Design Reader, Routledge, 2006
17. Henri Lefebvre translated by Donald Nicholson-Smith, The Production of Space, Blackwell, 1991
18. Miko E Miles, Gayle Berens, and Marc A Weiss, Real Estate Development, Urban Land Institue, edisi terakhir
19. M Mostavi at all (eds.), Ecological Urbanism, Lars Muller Publisher, 2010
20. Kate Nesbitt (Ed), Theorizing, A New Agenda for Architecture, An Anthology of Architectural Theory, Princeton Architectural Press, 1996
21. Jean-Pierre Protzen and David J Harris, The Universe of

Design: Horst Rittel's Theories of Design and Planning, Routledge, 2010
22. W Rutz, Cities and Towns in Indonesia: Their Development, Current Positions and Functions with Regard to Administration and Regional Economy, Gebrunger Borttraeger, 1987
23. Christian Norbrg Schulz, Intentions in Architecture, MIT Press, 1968
24. D G Shane, Recombinant Urbanism: Conceptual Modeling in Architecture, Urban Design and City Theory, Academy Press, 2005
25. James D Shilling, Real Estate, Oncourse Learning, 2001
26. D'Arcy Thompson, On Growth and Form, Cambridge University Press, 1987

Architectural Design Methods

ENAR800003
3 Credits
Learning Objectives:

Student are able to produce research proposals that contain a synthesis of research and design relationships in research issues that are relevant to their specialty.

Sub Learning Objectives:

Student are able to analyze the relationship between research and design; Student are able to evaluate the process of developing a thesis from a research and/or design practice; Student are able to evaluate the process of building architectural arguments from a research and/or design practice; Student are able to synthesize design concepts and design approaches as the basis for research formulation and/or design practice; Student are able to formulate the relationship between research and design as the basis for the preparation of a design proposal or research proposal.

Syllabus:

Through this course, students are able to explain the relationship between research and design, as well as various design approaches that have developed in the architectural discipline. In addition, by taking this course, students are able to choose a design approach that is suitable for architectural research. The discussion in this course will cover the relationship between research and design (research by design, research for design, research into design); design research, the formulation of a design thesis; forms of architectural argumentation in design practice; programming; typology and type of architecture; development of representation and visualization techniques and their application in architectural research; the various design approaches that have developed within the architectural discipline; narrative-based, performative, computational design approach. It is expected that after taking this course, students will be able to critically manage independent research in the field of architecture in accordance with their specialities, based on the synthesis and integration of relevant knowledge and methods in uncovering architectural phenomena.

Learning Materials:

Introduction: Design and research; Theses statements; Architectural argumentation forms; Architectural programming; Types and typologies in architecture; Various design methods: narrative, computational, ecological, situationist, adaptive reuse; Proposals preparation based on statements.

Pre-requisites:

No preconditions for participants in the Master of Architecture Program. Need to get permission from the lecturer for participants in the Architecture Undergraduate Program.

References:

1. Linda Groat & David Wang, Architectural Research Methods, John Wiley & Sons, 2002
2. Raymond Lucas, Research Methods for Architecture, Lawrence King, 2016
3. Murray Fraser (Ed), Design Research in Architecture, Routledge, 2013
4. Ilpo Koskinen, et al, Design Research Through Practice: From the Lab, Field, and Showroom, Morgan Kaufmann, 2011
5. John Zeisel, Inquiry by Design: Environment/Behavior/ Neuroscience in Architecture, Interiors, Landscape, and Planning, W. W. Norton, 2006
6. Kate Nesbitt (Ed), Theorizing A New Agenda for Architecture: An Anthology of Architectural Theory 1965-1995, Princeton Architectural Press, 1996
7. Ulrich Conrads, Program and Manifestos on 20th Century Architecture, The MIT Press, 1964
8. Edward Tufte, Envisioning Information, Graphics Press, 1983
9. R Oxman and R Oxman, Theories of the Digital in Architecture, Routledge, 2014

Applied Data Science

ENAR800004
2 Credits
Learning Objectives:

Students are able to arrange the process of collection, creation, analysis, representation, and automation of data in architectural research based on the principles of scientific research methods.

Sub Learning Objectives:

Students are able to analyze data requirements and the stages of data processing in various ethical architectural researches; Students are able to conclude the process of collection and creation of various architectural data; Students are able to develop the process of analysis and representation of various architectural data; Students are able to design data processing processes in architectural research that utilizes simple digital automation processes.

Syllabus:

The Applied Data Science course is a mandatory knowledge for master students to be able to carry out architectural research. After following this course, students are expected to be able to plan and implement data processing processes in architectural research. This course introduces the character and variety of data in architectural research, building an understanding of the various stages in sorting, organizing, and analyzing various categories of data. In addition, this course also provides an introduction and application of various types of data visualization and representation as part of the analysis process, as well as providing an introduction and application of scripting as a form of data processing automation in architectural research. Students are given initial material which consists of three separate parts, such as the variety of data that can be collected, the variety of data analysis processes, and the automation of data organization. This material then becomes a trigger for students to apply the process of collecting, analyzing, and automating data in groups.

Learning Materials:

Definition and basis for organizing data in architectural research; Ethics of organizing data in architectural research; The process of collecting and developing measurement and calculation-based data in architectural research; The process of data collection and development based on modeling/ simulation in architectural research; The process of collecting and developing text-based data in architectural research; The process of collecting and developing visual-based data in architectural research; The process of collecting digital data and the ethics of using digital data in architectural research; The process of analyzing and visualizing data based on measurements and calculations in architectural research; The process of analyzing and visualizing text-based data and visuals in architectural research; The process of analyzing data based on complex measurements and calculations (multiple variables); The process of data visualization with a participatory method; The process of data analysis with simulation and modeling; Digital data visualization process in architectural research; Introduction to the importance of process automation in architectural research; Statistical-based architectural data analysis process with mixed methods; The process of scripting and prototyping as a form of automation in architectural research.

Pre-requisites: Have followed Advanced Architectural Theory

References:

1. Decoding the City: Urbanism in the Age of Big Data (Dietmar Offenhuber, Carlo Ratti (Eds.), 2014)
2. AD Smart Cities: A Spatialised Intelligence (Antoine Picon, 2015)
3. Bit by Bit: Social Research in the Digital Age (Matthew J Salganik, 2018)
4. Code: Between Operation and Narration (Andrea Gleiniger, Georg Vrachliotis (Ed.), 2012)
5. Computational Drawing: From Foundational Exercises to Theories of Representation (Carl Lostritto, 2019)
6. Doing Research In and On the Digital: Research Methods across Fields of Inquiry (Christina Costa, Jenna Condie (Ed.), 2018)
7. The Death of Drawing: Architecture in the Age of Simulation (David R. Scheer, 2014)
8. Visualizing Data: Exploring and Explaining Data in the Processing Environment (Ben Fry, 2007)

Pre-Thesis

ENAR800005
4 Credits
Learning Objectives:

Students are able to carry out research planning in the field of architecture according to their specialty.

Sub Learning Objectives:

Students are able to identify knowledge gaps and state of the arts in the field of specialty based on literature relevant to the research topic; Students are able to formulate research questions; Students are able to formulate appropriate research methods to answer research questions; Students are able to develop research proposals that meet the rules of scientific writing.

Syllabus:

The Pre Thesis stage prepares students to have the competencies of master of architecture graduates according to the IQF Level 8: a) Ability to develop knowledge in technology, and or art in their scientific fields or professional practice through research, to produce innovative and tested works; b) Ability to solve the problems of science, technology, and or art in the field of science through an inter or multidisciplinary approach; c) Ability to manage research and development that to be beneficial to society and science, and is able to gain national and international recognition. At the end of the pre-thesis stage, students will produce a research thesis proposal or a design thesis proposal that is ready to be followed up through research or design that shows a position on the state of the arts in its field of specialty and reflects an in depth thought at the mastery level towards architectural discipline.

Learning Materials:

Understanding the state of the art through a review of the relevant specialty literature; Understanding the formulation of research questions that have novelty and scientific contributions; Understanding the structured and efficient research methods in answering research questions.

Pre-requisites: Passed Advanced Design and Research Methods with minimum score is B

References:

1. I. Borden and K. Ruedi, *The Dissertation: An Architecture Students' Handbook*, Oxford University Press, 2000
2. T. Y. Hardjoko, *Panduan Meneliti dan Menulis Ilmiah*, Departemen Arsitektur Universitas Indonesia, 2005
3. L. Groat & D. Wang, *Architectural Research Methods*, John Wiley and Sons, 2002
4. F. Crews, *The Random House Handbook*, 3rd ed, Random House, 1980

Scientific Publications

ENAR800006
2 Credits
Learning Objectives:

Students are able to produce scientific writings from studies or research that meet the rules of scientific writing with a decent quality to be published in national journals or international level dissemination forums

Sub Learning Objectives:

Students are able to analyze the elements of scientific writing; Students are able to manage reference sources in accordance with the rules of scientific writing; Students are able to state the position of knowledge in their respective research; Students are able to compile scientific articles for publication/ dissemination of research results.

Syllabus:

This course is a compulsory subject for master students as part of the dissemination of research results. After taking this course, students are expected to be able to produce scientific writings on the results of studies or research with a quality that is appropriate to be published in national journals or international level dissemination forums.

Learning Materials:

Scientific publications in the discipline of architecture; Scientific writing rules; Various modes of scientific writing; Elements of scientific writing; Reference management; The process of preparing scientific writings; Strategy of argument formulation in scientific writing; Publication procedures in national/international seminars/conferences; Publication procedures in international reputable journals; Review of articles in internationally reputed journals in architecture-related fields.

Pre-requisites: Passed Advanced Design and Research Methods Methods.

References:

1. I. Borden and K. Ruedi, *The Dissertation: An Architecture Students' Handbook*, Oxford University Press, 2000
2. T. Y. Hardjoko, *Panduan Meneliti dan Menulis Ilmiah*,

Departemen Arsitektur Universitas Indonesia, 2005
3. L. Groat & D. Wang, *Architectural Research Methods*, John Wiley and Sons, 2002
4. N. Gough, *Blank Spots, Blind Spots, and Methodological Questions in Postgraduate Research*, 2002

Thesis

ENAR800007
4 Credits
Learning Objectives:

Students should be able identify, study, and communicate issues in a specific research area which relates to architecture. Able to develop advanced mastery in reading, research, and write a thesis. For thesis research section: provide a thesis not more than 20.000 words. For design thesis section: provide the design as well as thesis not more that 10.000 words and design portfolio that gives the whole picture on design research process.

Syllabus:

Defining issue to respond, research questions which are clearly formulated, and the objectives of the research. Theoretical based, strategy for choosing methods, investigation of facts and synthesis of materials which lead to the responses to research questions and the conclusion.

Pre-requisites: Passed Pre-Thesis

References:

1. I. Borden and K. Ruedi, *The Dissertation: An Architecture Students' Handbook*, Oxford University Press, 2000
2. T. Y. Hardjoko, *Panduan Meneliti dan Menulis Ilmiah*, Departemen Arsitektur Universitas Indonesia, 2005
3. L. Groat & D. Wang, *Architectural Research Methods*, John Wiley and Sons, 2002
4. F. Crews, *The Random House Handbook*, 3rd ed, Random House, 1980

Architectural Design Studio 1

ENAR800008
5 Credits
Learning Objectives:

Student are able to develop design flow and ideas for architectural space programs in accordance with related design methods.

Sub Learning Objectives:

Student are able to synthesize key ideas from the architectural theory literature relevant to the design scope; Student are able to develop design statements and typology-based programming as a further synthesis of the literature; Student are able to develop quality and/or system of architectural space based on synthesis of theory, design statements and programming into a creative and comprehensive design; Student are ble to apply various creative and appropriate representation techniques and media, consisting of manual and digital 2D and 3D media, to communicate design ideas

Syllabus:

Through this course, students are able to develop the ability to create space as an architectural design concept formulated as a specific design theme, with regional planning and sustainability considerations. In this studio, students explore typology-based design concepts, and explore the idea of sustainability in various contexts. Students have knowledge of urban spatial typology, building typology, programming needs and site analysis. Student are able to propose design ideas with themes and ideas of space in ecological ideas. Through this studio, students are able to carry out architectural researches: translating program into conceptual diagrams, layout, circulation, spatial integration through sketches, architectural drawings and models. The design needs to show tectonic exploration: the connection between tectonic themes and architectural typologies that are in harmony with the design concept. The design idea then developed by taking into account aspects of verbal and visual communication.

Learning Materials:

Reading synthesis on specific design theme; Precedent studies, analysis and synthesis; Programming, defining relationships and systems; Presentation of context study and individual design proposition; Development of spatial ideas; spatial scenario; micro-macro scenario; 6. 3D tectonic exploration and any necessary experiments; Design development; finalisation; Final design presentation.

Prerequisites: -

References:

1. Christopher Alexander, A Pattern Language, Oxford University Press, 1977
2. Peter Eisenman, Diagram Diaries, Thames & Hudson, 1999
3. William McDonough and Michael Braungart, The UpCycle: Beyond Sustainability – Designing for Abundance, Melcher Media: A Northpoint Press, 2013
4. Jean-Michel Kantor, "A Tale of Two Bridges: Topology and Architecture" in Nexus Network Journal, Volume 7, Issue 2, November 2005, pp 13-21
5. Works and thoughts of Zaha Hadid, Frank Gehry, Rem Koolhaas, Bernard Tschumi, Stephen Holl, Bjarke Ingels, Julien De Smedt, etc.

Urban Design Studio 1

ENAR800009
5 Credits
Learning Objectives:

Student are able to analyze, synthesize and integrate knowledge of urban design theory in revealing urban design phenomena; Student are able to apply urban design methods and rules in stages of urban design, starting from arranging urban elements to city control devices.

Sub Learning Objectives:

Student are able to understand the context of the site through tracing the characteristics of the area; Students are able to critically review various types of city plans and regulations including master plans, zoning, UDGL, etc.; Student are able to record all aspects and components of urban areas in the context of the case study, both artificial and natural components, and how these components affect users, such as the local community and the general community; Student are able to propose sustainable regional design alternatives from in-depth and critical analysis of the issues in the context of the site by considering the potential of the site; Students develop the skills in presenting urban design visually/graphically as well as verbally in mezo (urban design) and micro (urban space) scales; Student are able to propose creative ideas for urban design works by developing place making or public spaces with strong and inclusive characters; Student are able to present presentations in the form of sketches, diagrams, models and standard drawings (site plans, pieces, 3D) from 1:2000 to 1:500 scale and skills to produce urban design portfolios professionally

Syllabus:

This course equips students with the basics of analysis and skills in applying urban design rules, starting from arranging urban to control devices for the use of urban space to a certain extent, with the object/case of the studio being a strip or a transit-oriented area spot (TOD). Students are introduced to the basics of urban design applications using the results of an in-depth analysis of urban contexts and issues.

The site/area chosen is a piece of complex road or spot/area and has a variety of elements and city elements so that it can provide opportunities for students to carry out "multiple analyses", understand and apply the idea of "place making" in the private and public spheres, open space and buildings, to realize individual and community/public needs.

Prerequisites: -

References:

1. Carmona, Matthew et.al, Public Spaces Urban Spaces. Oxford: Architectural Press, 2003
2. Gehl, Jan, How to Study Public Life, Copenhagen: Island Press, 2013
3. Hester, Randolph T., Design for Ecological Democracy, Cambridge, MA: The MIT Press, 2010
4. Shane, Graham, Recombinant Urbanism. Great Britain: John Willeys & Sons, 2005
5. Jacobs, Allan B., Looking at Cities. Cambridge, MA: Harvard University Press, 1985
6. Krier, Rob, Urban Space. New York: Rizzoli Int. Publication, 1970
7. Lynch, Kevin, Good City Form. Cambridge, MA: MIT Press., 1984
8. Larice, Michael, Urban Design Reader, London: Routledge, 2012
9. National Association of City Transportation Officials, Urban Street Design Guide, Copenhagen: Island Press, 2013
10. Rossi, Aldo, The Architecture of the City. Cambridge, MA: MIT Press, 1982

Urban Housing and Settlement Studio 1

ENAR800010
5 Credits
Learning Objectives:

Student are able to design housing projects based on market mechanisms; the design program includes a market feasibility study, market economy, location and types of houses.

Sub Learning Objectives:

Students are able to examine the main concepts in the housing and settlements sector, such as house, home and dwelling; Students are able to analyze data on residential needs by programming and designing vertical houses; Students are able to design housing projects based on market mechanisms; the design program includes a market feasibility study, market economy, location and types of houses.

Syllabus:

In this course, students design housing projects based on market mechanisms; the design program includes a market feasibility study, market economy, location and types of houses.

Learning Materials:

The main concepts in the field of housing and settlements, such as house, home and dwelling; Analysis of residential needs data with vertical house programming and design; Designing housing projects based on market mechanisms; the design program includes a market feasibility study, market economy, location and types of houses.

Pre-requisites: -

References:

1. C A Doxiades, Ekistics: An Introduction to the Science of Human Settlements, Oxford University Press, 1968
2. John Macsai F.A.I.A. et. al., Housing, John Wiley & Sons, 1982.
3. Jörg Blume (ed.), Housing for the Future: Projects in Germany 1996, Inter -Nationes, 1996
4. Direktorat Jenderal Cipta Karya, Dep. PU, Pedoman Teknik Perencanaan Perumahan Flat dan Maisonette, 1981
5. DC Corporate Documentation, Real Estate Investment Calculations
6. The Dewberry Companies, Land Development: Planning, Engineering and Surveying, McGraw-Hill, 2004
7. Joshua Kahr and Michael C. Thomsett, Real Estate Market Valuation and Analysis. John Wiley & Sons, 2005

Property Workshop 1

ENAR800011
5 Credits
Learning Objectives:

Students should be able to learn the relation between architecture and real estate activate in a small scale project. Relating to the place innovation for human activity like new building type, lifestyle, market segmentation, et cetera.

Syllabus:

The dream & the product; the products (precedence): residential property, commercial/ retail property, office building/ property for working; money matters/ feasibility study; the products & the users/ lifestyle; management aspects of a property product; The proposed products (future): residential property, commercial/ retail property, office building/ property for working; finance & management.

Prerequisites: -

References: - Relevant references to the topic offered.

History and Theory of Architecture 1

ENAR800012
5 Credits
Learning objectives:

Students are able to conduct research on History and Architectural Theory in an interdisciplinary and multidisciplinary manner; Students are able to communicate thoughts related to History and Architectural Theory to the public in various forms of representation of communication media (written and virtual); Students are able to analyze, criticize an architectural phenomenon and formulate a synthesis; Students master various research methods in History and Architectural Theory related to Historiography, Representation and Material Culture aspects, which will have an impact on architectural expertise in the area of scientific publications, criticism and professional architects.

Sub Learning Objectives:

Students show their participation through attendance at each session; Students are able to compile data and present their thoughts through power point and posters; Students are able to communicate their thoughts through active discussions both in class and in groups; Students are able to apply architectural history research methods, including aspects of research triangulation in the analysis and synthesis stages; Students are able to make scientific writings/articles; Students are able to understand the profession as an Architectural Historian in Architectural History Research and Workshops.

Syllabus:

The course reviewed various research methods and approaches to History and Architectural Theory related to Historiography and Representation aspects. In this Semester the selected research relates to Film (Representation of City Architecture) and Material Culture (Design and Art).Students will be given various readings at the beginning of the topic that must be reviewed (literature review) and actively present the results of their analysis and research synthesis that reflect their critical thinking. Next, students look for issues based on the topics that have been given and use methods and approaches from the readings that have been given to conduct research on History and Architectural Theory. At the end of the research, students must communicate and publish the results of their research which also reflects their creative interpretation in the areas of scientific publication and criticism.

Learning Materials:

Task I: HISTORIOGRAPHY: History, Theory and Narrative; Task II: ARCHITECTURE and REPRESENTATION; Task III: Film/Movie and Representation of City Architecture

Prerequisites: -

References:

1. Iain Borden and David Dunster (eds), *Architecture and the Sites of History: Interpretations of Buildings and Cities*, Butterworth Architecture, 1995
2. E H Carr, *What is History?,* Penguin Books, 1961
3. Keith Jenkins, *Rethinking History*, Routledge, 1991
4. Hayden White, *Tropics of Discourse: Essays in Cultural Criticism,* The Johns Hopkins University Press, 1978
5. Hayden White, *"The Burden of History"*, *History and Theory,* Vol. 5, No. 2 , 1966 pp. 111-134
6. Mona Lohanda (ed), *Arsip dan Sejarah*, ANRI, 1980
7. G W F Hegel tr. J. B. Baillie, *Phenomenology of Mind,* 1910; 2nd ed. 1931
8. G W F Hegel tr. A. V. Miller, *Hegel's Phenomenology of Spirit,*Oxford University Press, 1977

Architecture and Sustainability Workshop 1
ENAR800013
5 Credits
Learning Objectives:

Students are able to manage advanced research related to the application of architectural principles and sustainability in design and the environment.

Sub Learning Objectives:

Students are able to explain the meaning and principles of the Module; Students are able to demonstrate the principles of sustainability related to modules; Students are able to identify sustainability issues in the design and its aspects; Students are able to develop the principle of sustainability in the design and its aspects; Students are able to manage advanced research related to the application of architectural principles and sustainability in design and the environment.

Syllabus:

Architecture and Sustainability Workshop 1 is 1 of 2 mandatory workshops on Masters in Architecture. Through this workshop, students are able to manage their own research related to design and the environment, by applying the principles of sustainable architectural design and with a building technology approach, economics and ecology with an emphasis on the application of sustainability principles in design and the surrounding environment, especially on the use of materials and utility systems. water, dirty water and garbage).

Learning Materials:

Module 1 (Architecture and Sustainability); Module 2 (Sustainable Construction and Materials); Module 3 (Water-Waste-Waste/Water-Wastewater-Waste (WWW))

Prerequisites: -

References:

1. Dominique Gauzin-Muller, *Sustainable Architecture and Urbanism*, Birkhausser, 2002
2. Earl R. Babbie, *The Practice of Social Research*, Belmont: Wadsworth Publ. Co.Inc, 1973
3. Giancolli DC. *General Physics*, Prentice Hall Inc, 1984
4. James Ambrose, *Simplified Design for Building Sound Control*, John Wiley & Sons, 1995
5. Leslie L Doelle and Lea Prasetio, *Akustik Lingkungan*, Erlangga, 1993
6. KE Watt, *Understanding the Environment*, UC Press, 1982
7. SFPE Handbook, *Society of Fire Protection Engineering.*

Architectural Design Theories
ENAR800014
3 Credits
Learning Objectives:

Students are able to formulate the role of theory as the basis for the practice of architectural design.

Sub Learning Objectives:

Student are able to analyze design activities as a process of thinking and synthesis; Student are able to analyze the basic framework of architectural design; Student are able to analyze the role of technological developments in architectural design; Student are able to synthesize the relationship between theory and practice of architectural design based on relevant design theory; Student are able to formulate the position of design practice based on relevant design theory.

Syllabus:

Developments in the mechanism of architectural formation from classical to contemporary architecture; current ideas in architectural design theory and practice; ideal ideas in architecture; multidisciplinary approach (art, mathematics, natural sciences, and social sciences) in architectural theory and design.

Learning Materials:

Design: What is design? Design thinking; Design as synthesis; Three major frameworks: Pattern-based design, Force-based design, Concept-based design; Architecture and digital technology; Digital design methods: computational design, parametric modelling; How theory informs design practice; Case studies of design practice informed by particular theories; Designer's position.

Prerequisities: Has attended The Advanced Architectural Theories subject

References:

1. Stephen Cairns, Greig C Crysler, Hilde Heynen. *The SAGE Handbook of Architectural Theory.* SAGE Publications, 2012.
2. Michael Hays, *Architecture Theory since 1968,* MIT Press, 1998.
3. Kate Nesbitt, *Theorizing a New Agenda of Architecture: An Antology of Architectural Theory 1965-1995.* Princeton Architectural Press, 1996.
4. Charles Jenks & Karl Kropf, *Theories and Manifestos of Contemporary Architecture.* John Wiley and Sons, 1997.
5. Vitruvius. *The Ten Books on Architecture*, trans by M. H. Morgan. New York: Dover Publications, 1960.
6. D'Arcy Thompson, *On Growth and Form*. 1961.
7. Aaron Betsky & Erik Adigard, *Architecture Must Burn.*

Gingko Press, 2000.
8. A+P Smithson. Irenee Scalbert, *Towards a Formless Architecture: The House of the Future*, 1999.

Urban Design Theories

ENAR800015
3 Credits
Learning Objectives:

Student are able to analyze criteria, indicators, and classifications in urban planning/design based on the theories or concepts; Student are able to map the context of future urban reconfiguration as part of the role of students as prospective urban designers/planners.

Sub Learning Objectives:

Student are able to explain urban theory and form based on the relationship of urban design/planning with architectural philosophy, power and national identity; Student are able to explain good city theory, evaluate current urban conditions and the paradigm of urban life in the 21st century; Student are able to explain the development of human habitat and cities in Indonesia; Students are able to explain elements, agents, transformations, and urban history, see the difference between theory and practice and see their relationship to other fields of knowledge; Students are able to analyze and evaluate the most up to date urban design paradigm; Student are able to critically describe cities that are in line with the SDGs and the New Urban Agenda (NUA) in the context of cities in Indonesia.

Syllabus:

Urban Design Theory course is a basic knowledge in urban planning/design that studies the theories, principles and processes of urban planning/design in Indonesia and other countries. Students are expected to be able to develop a holistic view of the city as the basis for their ability to design cities in three dimensions, and are encouraged to always be critical in understanding current issues and paradigms, either directly or indirectly, that will have an impact on future city design.

Prerequisites: Students have taken Advanced Architectural Theories.

References:

1. R. Legates, *The City Reader,* 2nd ed, Routledge, 1999
2. Henri Pirenne, *The Medieval Cities: Their Origins and the Revival of Trade*, Princeton University Press, 1969
3. Aristoteles, *The Politics* (especially Book III and Book VII), Penguin Classics, revised edition, 1981

Urban Housing and Settlement Theories

ENAR800016
3 Credits
Learning Objectives:

Student are able to construct advanced architectural knowledge in the Urban Housidng and Settlements as a "presence" (existence) which indicates spatial formation in space-time.

Sub Learning Objectives:

Students are able to examine the concept of settlements and urban housing as a social presence and its spatial implications in the city; Students are able to analyze housing and living activities from socio-political-economic-spatial aspects; constitution of urban society-production and reproduction of society; Students are able to provide critical arguments for settlement and urban housing issues in Indonesia.

Syllabus:

This course introduces students to the understanding of urban settlements as a "human presence" in the formation of space/time. Architecture is seen as an environment that is interpreted as part of the human presence in an effort to condition oneself, especially to aspects of the natural, socio-political-cultural physical environment; then humans are conditioned by the conditions they create. The Conditions are not only related to the nature of individual life but also in living in groups; Aristotle termed humans as zoo polikon which literally means social animals - social creatures.

Learning Materials:

The concept of housing and urban settlement as a social presence and its spatial implications in the city; housing activities from the socio-political-economic-spatial aspect; constitution of urban society-production and reproduction of society; The problem of urban housing and settlemetnt in developing countries and especially Indonesia.

Prerequisites: Has attended the Advanced Architectural Theories subject

References:

1. A T Alamsyah, *Regionisme dalam Penataan Permukiman di Gugus Pulau Mikro*, Disertasi, PSIL UI, 2006
2. P Bourdieu, *Outline of A Theory of Practice*, Cambridge University Press, 1977, pp. 72-95
3. Rod Burgess, *Petty Commodity Housing or Dweller Control?: A Critic of John Turner View on Housing Policy,* 1978
4. Michel De Certeau tr by Steven F. Rendall, *The Practice of Everyday Life*, University of California Press, 1984, pp. 29-42 and 91-110
5. M Foucault, *'Space. Power and knowledge,' S. During (ed.), The Cultural Studies Reader Second Edition*, Routledge, 1999, pp. 134-41
6. A Giddens, *The Constitution of Society*, University of California Press, 1984, pp. 1-28
7. A Gilbert and Ann Varley, *Landlord and Tenant Housing the Poor in Urban Mexico*, Routledge, 1991, chapter 7&8
8. M Haan & Thomas Perks, *'The Housing Careers of Older Canadians: An Investigation Using Cycle 16 of the General Social Survey,* Canadian Studies in Population Vol. 35.2, 2008, pp. 223–242
9. T Y Harjoko, *Penggusuran or Eviction in Jakarta: Solution Lacking of Resolution for Urban Kampung*, E-Proceedings, http://coombs.anu.edu.au/SpecialProj/ASAA /biennial-conference/2004/Harjoko-T-ASAA2004.pdf, 18.02.2013
10. M Heidegger tr by Albert Hofstadler, *Kerper & Row, Poetry, Language, Thought*, Publishing Inc., 1971, pp. 145-161
11. H L Kendig, *'Housing Careers, Life Cycle and Residential Mobility : Implications for the HousingMarket'*, Urban Studies, 1984, pp. 21, 271-283
12. Shilpa Ranade, *"The Way She Moves, Mapping the Everyday Production of Gender and Space in Mumbai",* Economic and Political Weekly, Vol. 42, No. 17, Apr. 28 – May 4 2007, pp. 1519-1526
13. B Sullivan & Ke Chen, *'Design for Tenant Fitout: A Critical Review of Public Housing Flat Design in Hong Kong'*, Habitat Intl. Vol 21. No 3, 1997, pp. 291-303
14. John F.C Turner, *Housing By People: Towards Autonomy in Building Environtments,* Marion Boyars Publishers Ltd, 2000, pp 53-74
15. K D Willis, *Squatter Settlements*, Elsevier Ltd, 2009

Property Theories

ENAR800017
3 Credits
Learning Objectives:

Students are able to select, analyze and conclude in an integrated manner the phenomenon of property area development by using the theory that has been studied; students are able to predict things that will happen if students plan to develop property areas.

Sub Learning Objectives:

Student are able to explain issues and problems; Students are able to obtain the material needed to understand the theory related to every issue and problem of property area development in depth; Student are able to analyze the material related to the main issues and problems of discussion; Student are able to make a summary in the form of presentation material for each subject and demonstrate verbal skills in explaining the theory; Student are able to write scientific papers related to issues and problems related to the development of selected property areas in an integrated manner.

Syllabus:

This course provides students with knowledge of issues and problems related to the implementation of property area development with broad spatial aspects, starting from the issue of land provision to calculation of the required financial resources as well as the scope of technical, environmental, social/cultural, legal discussions and economics/finance.

Learning Materials:

The main issues and problems of property area development; Open space and built space in the context of the property environment; The need for providing land to fulfill livelihood; Technical aspects for the development of property areas; Selection of the property area and its relation to accessibility and its issues and impacts; Availability and provision of infrastructure and utilities; The effect of visibility on consumer interest and property value increases; Spatial analysis of property space; Availability and provision of public facilities to the economic value of the property area; Provision of sports facilities and leisure facilities to the perception of potential consumers; The influence of policies (economic, financial, political and legal) on the development of property areas; Conventional financing for property area development; Non-conventional financing for the development of property areas; The effect of economic/financial policies (taxes/interest rates) on property development.

Prerequisites: Has attended the Advanced Architectural Theories.

References:

1. Michael Ball et.al, *The Economics of Commercial Property Markets*, Routledge, 1998
2. Sheman J Maisel, *Real Estate Investment and Finance*, McGraw-Hill, Inc., 1976
3. Hugh O. Nourse, *Managerial Real Estate Corporate Real Estate Asset Management*, Prentice Hall, 1990
4. Mark W. Patterson, *Real Estate Portfolios*, John Willey & Sons, Inc, 1995

Architectural Theory and History

ENAR800018
3 Credits
Learning Objectives:

Students are able to understand and analyze various theories related to historical architectural thinking (and architectural historigraphy) in the world and their developments, so that students can examine the theoretical and historical aspects of their respective research.

Learning Objectives:

Students are able to understand and be able to analyze various theories related to ideas about the history of architecture (and architectural historigraphy) in the world and their development and relevance in architectural issues; Connecting architectural theory and history with architectural phenomena as well as analyzing theoretical and historical aspects in their respective research and compiling them in scientific writings.

Syllabus:

This course studies architectural theories, especially since modern and post-modern times. Through discussion and case studies, this course underscores the interrelationships between architecture, people, and the context of socio-cultural, political, and technological developments in the world. Students are also expected to connect theory with historical architectural thoughts (and architectural historigraphy) in the world and its development, so that students can examine theoretical and historical aspects of their respective research.

Learning Materials:

Philosophy of Architectural Histories and Theories; History, Tradisi & Memory; Fenomenologi; Semiologi; Structuralism, Post-Structuralism (Deconstruction); Modern and Posmodern; Design; Colonialism and Poscolonialism; Gender in Architecture.

Prerequisites: Has attended the Advanced Architectural Theories subject

References:

1. Andrew Ballantyne (ed.), *Architecture Theory, A Reader in Philosophy and Culture,* Continuum, 2005
2. Homi K Bhabha, *The Location of Culture*, Routledge, 1994
3. Iain Borden, Barbara Penner; Jane Rendell, (Eds),*Gender Space Architecture: An Interdisciplinary Introduction (Architext)*, Routledge, 2000
4. Zeynep Celik, *Displaying The Orient: Architecture of Islam at Nine- teenth-Century World's Fairs,* University of California Press, 1992
5. Guy Debord translated by Donald Nicholson Smith, *The Society of the Spectacle*, Black & Red, 2004
6. M. Foucault, *The Archeology of Knowl- edge*, Vintage, 1982, Parts II & III
7. Terence Hawke, *Structuralism and Semiotics,* Routledge, 1997
8. Steven Holl, Juhani Pallasmaa, Alberto Perez-Gomez, *Questions of Perception: Phenomenology of Architecture,* William K Stout Pub, 2007
9. Keith Jenkins, *Re-thinking History*, Routledge, 1991
10. Neil Leach (ed.), *Rethinking Architecture: A Reader in Cultural Theory*, Routledge, 1998
11. Edward Said, *Orientalism,* Penguin, 1977
12. Panayotis Tournikiotis, *The Historiography of Modern Architecture,* The MIT Press, 1999

Architecture and Sustainability Theories

ENAR802622
5 Credits
Learning Objectives:

Provide an understanding of the principles of Architectural Theory in relation to a Sustainable Environment

Sub Learning Objectives:

Students are able to understand Architectural Theory according to the principles of sustainable building technology; Principles of Building Technology and Sustainability; Engineering and construction processes and building services and their impact on sustainability; The link between climate, the built environment, construction, energy consumption, and human well-being; Application of building technology strategy in design projects in the context of sustainable building standards/regulations and related environment; Acoustic.

Syllabus:

Understanding of the interrelationships and implications between Architectural Theory and sustainability aspects (three pillars: Environmental, Economic and Social)

Learning Materials:

Review The Science; Environmental, Technology & Sustainability; GBCI guidelines for new buildings, old buildings and interiors; Sustainable Architecture and High Technology; Sustainable Infrastructure, Construction, The Guide to Green Engineering and Design; Architectural Acoustics Introduction, History, Theory; Environmental acoustics; Building Skin: Concept, usage - thermal & acoustic.

Prerequisites: Has attended the Advanced Architectural Theories.

References:

1. Edward Allen, *Fundamentals of Building Construction: Material and Methods*, John Wiley and Sons, 1999
2. James Ambrose, *Simplified Design of Masonry Structures*, John Wiley and Sons, 1992
3. Wolfgang Schuller, *High Rise Building Structure,* Krieger Publishing Co, 1986
4. Benjamin Stein, *Building Technology: Mechanical and Electrical Systems*, John Wiley and Sons, 1995
5. DS Barrie, *Professional Construction Management*, Mc.Graw-Hill, 1986
6. J.M Boschenski, *The Methods of Contemporary Thought*, Herper and Row, 1968
7. Graham Haughton, et.al, *Sustainable Cities*, Cromwell Press, 1995
8. D. Chiras et.al, *Environmental Science: A Framework for Decision Making*, Cummings Publishing, 1985
9. Sears-Salinger, *Theormodynamics, Kinetic Theory and Statistical Thermodynamics*, Wesley, 1975

Architectural Design Studio 2

ENAR800020
5 Credits
Learning Objectives:

Student are able to develop design flow and ideas for architectural space programs in accordance with related design methods.

Sub Learning Objectives:

Student are able to synthesize key ideas from architectural theory literature relevant to the design scope; Student are able to develop design statements and programming based on reading the context related to further synthesis of the literature; Student are able to develop quality and/or architectural space systems based on theoretical synthesis, design statements and programming into a creative and comprehensive design; Student are able to apply various creative and appropriate representation techniques and media, consisting of manual and digital 2D and 3D media, to communicate design ideas.

Syllabus:

Through this course, students are able to explore and develop arguments for research-based architectural design concepts and design methods in an urban context. This course triggers the development of logical arguments based on design research, methods and designs in the studio which are related to design concepts, issues, keywords, design theories and programs in an urban context. Students are able to collect data based on external and internal determinants that make up the space. Based on this data, students are able to identify issues related to environmental sustainability and the tropical climate context, and program formulation as a spatial journey. Design exploration includes tectonic aspects related to the form, structure and building system. Student are able to compare the design based on typology and topology. Design ideas contain considerations of safety and health aspects, and are represented by mastering aspects of architectural expression including models, sketches, architectural drawings and digital media.

Learning Material:

Reading synthesis on specific design theme; Context issues exploration, analysis and synthesis; Programming, defining relationships and systems; Presentation of context study and individual design proposition; Development of spatial ideas; spatial scenario; micro-macro scenario; 3D tectonic exploration and any necessary experiments; Design development; finalisation; Final design presentation.

Prerequisites: -

References:

1. Dominique Hes, Chrisna Du Plessis, *Designing for Hope: Pathways to Regenerative Sustainability*, Routledge, 2014
2. Danilo Palazzo, Frederick Steiner, *Urban Ecological Design: A Process for Regenerative Places*, Island Press, 2012
3. S. Hernandez, C. A. Brebbia, W. P. De Wilde, editors, *Eco-Architecture III: Harmonisation between Architecture and Nature*, WIT Press, 2010
4. Manuel Castells, "*Space of Flows, Space of Places, Materials for a City of Urbanism in the Information Age.*", 2004
5. Jiat-Hwee Chang,"*Tropical Variants of Sustainable Architecture: A Postcolonial Perspective,*" *in The SAGE Handbook of Architectural Theory*, SAGE Publications, Ltd, 2012, pp 602-617
6. Fabiano Lemes de Oliveira, "*Eco-cities: The Role of Networks of Green and Blue Spaces*" Cities for Smart Environmental and Energy Futures, part of the series Energy Systems, 2013, pp 165-178
7. Michael Lindfield and Florian Steinberg, *Green Cities.* Asian Development Bank (ADB) Urban Development Series, November 2012

Urban Design Studio 2

ENAR800021
5 Credits
Learning Objectives:

Student are able to combine methods and rules of advanced city design in stages to design mixed used areas starting from arranging urban elements to city control devices; Student are able to convey design ideas and urban design products through various verbal and non-verbal media; Student are able to analyze, synthesize and integrate knowledge of urban design theory with knowledge of locality and variation of stakeholder in uncovering urban design phenomena in rapidly developing areas.

Sub Learning Objectives:

Student are able to demonstrate understanding of urban design strategies and concepts through analysis of relevant urban project precedents; Student are able to develop advanced analytical and methodological skills as the foundation of the design process; Student are able to propose sustainable regional design alternatives from in-depth, sharp and critical analysis of the issues that exist in the context of the site by considering the potential of the site; Student are able to demonstrate the ability to present presentations in the form of sketches, diagrams, models and standard drawings (site plans, pieces, 3D) from a scale of 1:2000 to 1:500; Student are able to demonstrate the ability to work individually and in collaboration (groups) in conducting regional studies; Student are able to detect theories/issues/themes needed to develop principles of ideas in a plan; Atudent are able to formulate various kinds of issues in urban space both from medium and large scale to be the basis for consideration in a city design process.

Syllabus:

The focus of this studio is the redesign of areas with high complexity; such as areas that experience rapid changes/ developments and tend to show heterogeneous (mixed) properties. In this studio humans must be the main element of urban design, so students are required to be sensitive to the interests of various communities (residents/local communities) and the public as well as various regional stakeholders such as local government, government/private institutions, and business actors/ business. The goal is to accommodate and understand the needs, demands and aspirations of all parties related to activities in the region. The tangible and intangible factors that students should pay attention to refer to Lynch (1984), such as: vitality, senses, fit, access and control. Students need to observe the area's infrastructure (transportation, utilities, public facilities/ facilities), as well as how the context of the built environment and the natural environment (green and blue zones) form. All these aspects must be analyzed critically by students as part of their exploration to develop ideas, narratives, and visions of sustainable urban design that are able to display a strong regional identity and character. After attending this studio, students have the basic skills needed to become a professional urban designer.

Prerequisites: Has attended the Urban Design Studio 1**.**

References:

1. Protzen, Jean-Pierre and Harris, David J., *Universe of Design: Horst Rittel's Theories of Design and Planning*, London and New York: Routledge (2010)
2. Rutz, Werner: *Cities and Towns in Indonesia*, Stuttgart: Gebruder Borntraeger (1987)
3. Ricky Burdett (Editor), Deyan Sudjic (Editor), 2010, *Living in the Endless City: The Urban Age Project by the London School of Economics and Deutsche Bank's,* Alfred Herrhausen Society, Phaidon Press
4. Ricky Burdett (Editor), Deyan Sudjic (Editor) 2008. *the Endless City*, Phaidon Press
5. Mohsen Mostafavi (Author), Gareth Doherty (Author), 2010, Harvard University Graduate, *Ecological Urbanism*, Lars Muller Publishers
6. Charles Montgomery (2014). *Happy City: Transforming Our Lives Through Urban Design*, Farrar Straus Giroux
7. Abeyasekere, S. (1987). *Jakarta: A History*, Oxford: Oxford University Press.
8. Certeau, M.D. (1984). *The Practice of Everyday Life*. Berkeley: University of California Press.
9. Silver, C. (2011). *Planning the Megacity: Jakarta in the Twentieth Century*. New York: Routledge
10. Tunas, D. (2008). *The Spatial Economy in the Urban Informal Settlement*. Netherland: International Forum on Urbanism

Urban Housing and Settlement Studio 2

ENAR800022
5 Credits
Learning Objectives:

Student are able to design housing planning and housing design for urban communities based on the principle of preference.

Sub Learning Objectives:

Students are able to examine the main concepts in housing and settlements, such as preferences, satisfaction, displacement, and housing adjustments; Students are able to analyze data on preferences, satisfaction, displacement, and home adjustment; Students are able to design housing plans and housing designs for urban communities based on the principle of preference.

Syllabus:

This course explores socio-economic issues related to the complexity of providing housing for urban communities; housing planning and design is based on the principle of preference.

Learning Materials:

The main concepts in the housing and settlements sector, such a preferences, satisfaction, displacement, and housing adjustment; Data analysis of preferences, satisfaction, displacement, and adjustment to housing; Design housing planning and design of housing for urban communities based on the principle of preference.

Prerequisities: Has attended Housing and Urban Settlement Studio 1.

References:

1. J M Bang, *Ecovillages: Practical Guide to Sustainable Communities,* New Society Publishers, 2005
2. J N Habraken, *Support: An Alternative to Mass Housing*, Prager Publishers, 1972
3. N Hamdi, *Housing Without Houses: Participation, Flexibility, Enablement,* Van Nostrand Reinhold, 1991
4. G Minke, *Building with Earth: Design and Technology of a Sustainable Architecture*, Publishers for Architecture, 2006
5. B Saini, *'Site Development and Sanitary Services', in H S Murison & J P Lea (eds.), Housing in Third World Countries Perspectives on Policy and Practice*, The Macmillan Press, Ltd., 1979, pp 89-95
6. N Sheridan, '*Energy for the Built Environment', op. cit., H S Murison & J P Lea*, pp 100-110
7. Tokyo Student Session, *Sustainable Design Book*, The 2005 World Sustainable Building Conference in Tokyo, Student Session23-29 September 2005, Tokyo, Japan
8. United Nations, *Guidebook on Biogas Development*, Energy Resourve Development Series No. 21, 1980

Property Workshop 2

ENAR800023
5 Credits
Learning Objectives:

Student are able to study the relationship between urban architecture and real estate activities in a large-scale project related to urban management, the role of the public and private sectors in urban development, repositioning and revitalizing an area, and others.

Syllabus:

(1) Private sector/commercial development project, in an area of 50 ha. Product properties and the physical rules that apply. Project funding & purchase scheme: e.g. mortgages. Rights and obligations of developers & local governments (developer: on site, off site, pay cash, etc. Local government: tax holidays, incentives, city facilities, etc.). Implementation plan (rights & obligations + development time schedule) (2) Development of urban facilities related to property

development (public-private development): Investigation/ exploration of a public project through recovery opportunities by incorporating elements of property development in it such as the development of educational areas /science center, MRT/ busway/tollway associated with property development along its route. Procurement of city facilities and infrastructure.

Prerequisites: Has attended Property Workshop 1

References: Relevant references to the topic offered.

History and Theory Workshop 2

ENAR800024
5 Credits
Learning Objectives:

Students are able to systematically compile a historical database of the Menteng and Kebayoran Baru areas; Students are able to communicate the History of Architecture through oral presentations; Students are able to criticize existing conservation policies and be able to propose a conservation recommendation; Students are able to conduct collaborative research to explore data and information related to regional archives (Case: Menteng and Kebayoran Baru).

Sub Learning Objectives:

Students show their participation through attendance at each session; Students are able to compile data and present their thoughts through power point and posters; Students are able to communicate their thoughts through active discussions both in class and in groups; Students are able to apply architectural history research methods, including aspects of research triangulation in the analysis and synthesis stages; Students are able to make scientific writings/articles; Students are able to understand the profession as an Architectural Historian in Architectural History Research and Workshops.

Syllabus:

The Architectural History Workshop 2 focuses on Historical Research and Architectural Theory in Indonesia related to the application of Architectural History of Human, Space, and Time. In this semester, the selected research relates to the Policy of Preserving Historic Areas, Historic City Landscapes and Indonesian Architectural Criticism. Students will be given various readings at the beginning of the topic that must be reviewed (literature review) and actively present the results of their analysis and research synthesis that reflect their critical thinking. Next, students look for issues based on the topics that have been given and use methods and approaches from the readings that have been given to conduct research on History and Architectural Theory. At the end of the research, students must communicate and publish the results of their research which also reflects their creative interpretation in the areas of scientific publication and criticism.

Learning Materials:

Module I: Policy for Preservation of Historic Areas; Module II: Historic Urban Landscapes – Historic Urban Landscapes; Module III: Criticism in Indonesian Architecture

Prerequisites: Has attended Advanced Architectural Theories.

References:

1. Nezar AlSayyad, Cinematic Urbanism: A History of the Modern from Reel to Real, Routledge, 2006
2. J. Bloomer, Architecture and the Text: the (s)crypts of Joyce and Piranessi (Theoretical Perspectives in Architectura), Yale University Press, 1995
3. Iain Borden, Jane Rendell, Intersections, Architectural Histories and Critical Theories, Routledge, 2000
4. Iain Borden, et.al (eds.), The Unknown Cities: Contesting Architecture and Social Space, The MIT Press, 2001
5. Iain Borden, et al. Strangely Familiar: Narratives of Architecture in the City, Routledge, 1996
6. Mike Davis, Ecology of Fear: Los Angeles and the Imagination of Disaster, Metropolitan Books, 1998
7. Nan Ellin, Architecture of Fear, Princeton Architectural Press, 1997
8. Murray Fraser. 'Dreams about Cities: REM and Koolhaas,' The Oxford Review of Architecture, vol. 2, 1997, p:76.
9. Bell hooks. Art on My Mind; Visual Politics, The New Press, 1995
10. Michael Keith and Steve Pile, Place and the Politics of, Routledge, 1993
11. Naomi Kleine, The Shock Doctrine: the Rise of Disaster Capitalism, Metropolitan Books, 2008
12. R. Koolhaas and B. Mau, S,M,L,XL, Office for Metropolitan Architecture (O.M.A.), 1995
13. Spiro Kostof (ed.), Architect, Oxford University Press, 1977
14. Intan Paramaditha, 'City and Desire in Indonesian Cinema' in Inter-Asia Cultural Studies: Runaway City/Leftover Spaces, vol. 12, no: 4, Routledge T&F, 2011, pp:500-512
15. A. Palladio tr by: Robert Tavernor & Richard Schofield, The Four Books on Architecture, MIT Press, 1997
16. Leonie Sandercock (ed.), Making the Invisible Visible, A Multicultural Planning History, University of California Press, 1998
17. Moira G Simpson. Making Representations Museum in the Post colonial Era, Routledge, 1996
18. R. Venturi, Complexity and Contradiction in Architecture, The Museum of Modern Art, 1966

Architecture and Sustainability Workshop 2

ENAR802623
5 Credits
Learning Objectives:

Students are able to manage advanced research related to the application of architectural principles and sustainability in design and the environment.

Sub Learning Objectives:

Students are able to explain the meaning and principles of the Module; Students are able to demonstrate the principles of sustainability related to modules; Students are able to identify sustainability issues in the design and its aspects; Students are able to develop the principle of sustainability in the design and its aspects; Students are able to manage advanced research related to the application of architectural principles and sustainability in design and the environment.

Syllabus:

Architecture and Sustainability Workshop Course 2 is 1 of 2 mandatory workshops on Masters in Architecture, in Sustainability. Through this workshop, students are able to manage their own research related to design and the environment, by applying the principles of sustainable architectural design, with a building technology approach, economics and ecology with an emphasis on applying the principles of sustainability to design and the surrounding environment, particularly in fire prevention systems and saving lives, thermal comfort and lighting.

Prerequisites: Module 1 (Fire Prevention and Life Saving Systems); Module 2 (Thermal Comfort); Module 3 (Lighting)

References:

1. James Cowan, Architectural Accoustics: Design Guide, McGraw-Hill, 2000

2. Frei Otto, Tensile Structure, MIT Press, 1997
3. Graham, P. Building Ecology, First Principles for A Sustainable Built Environment, ISBN 978-0-632-064137 (Publisher Willey-Blackwell, 2012)
4. Harold J. Rosen, The Professional Practice of Architectural Detailing, John Wiley & Sons, 1999
5. Gahijanti AS, Mekanika, Penerbit Salemba Teknik, 2000
6. Finarya Legoh dan Siti Handjarinto, Buku Ajar Akustik, 2002
7. Lechner, N. Heating Cooling Lighting: Sustainable Design Methods for Architects (Publisher: Willey, 2008)
8. Leonard, A. The Story of Stuff. (Publisher: Free Press, 2011)
9. Lippsmeier, G. Tropenbau Building in the Tropics (Publisher: Callwey, 1980)
10. Jain, A.K. Low Carbon City: Policy, Planning and Practice (Publisher: Discovery Publishing Pvt.Ltd., 2009)
11. McDonough, W. and Braungart, M. Cradle to Cradle: Remaking the Way We Make Things, ISBN: 0865475873 (Publisher: North Point Press, 2002)
12. Soeryani Moh ed, Lingkungan: Sumberdaya Alam dan Kependudukan dalam Pembangunan, UI Press, 1987
13. World Commission on Environment and Development. Our Common Future (Publisher: Oxford University Press, 1987)
14. Yeang, K. Eco Skyscrappers II ((Publisher The Image Publishing Group, 2011)

Elective Courses

Ethnic Architecture

ENAR800026
3 Credits
Learning Objectives:

Students are able to critically and creatively analyze and represent the phenomenon of ethnic architecture.

Sub Learning Objectives:

Student are able to define ethnic architecture and its scope; Student are able to explain (1) the basic concept of ethnicity and (2) the role of ethnicity as a form of ethnic architectural identity; Student are able to explain the concept of (1) traditional architecture; (2) vernacular architecture; Student are able to investigate related aspects in the ethnic architectural forms; Student are able to critically review ethnic architectural literature; Student are able to explain the importance of meaning in ethnic architecture; Student are able to identify various ways/methods of studying ethnic architecture

Syllabus:

The main learning objectives of this course are that students are able to critically explain the phenomenon of ethnic architecture, issues and ideas of the architectural tradition of an ethnic group, including its influencing aspects, such as socio-culture, which includes ethnicity, tradition, culture, symbols and myths; including the development of vernacular architectural ideas, both in traditional and contemporary context. This course supports students' ability to analyze an architectural tradition.

Learning Materials:

Ethnic Architecture and the scope of ethnic architecture; Ethnicity and Identity; Traditional architecture & vernacular architecture; Aspects that affect architectural form; Revealing Meaning of Vernacular Architecture; Symbolic Classification; Traditional/vernacular architecture in Indonesia

Prerequisites: -

References:

1. Amos Rapoport, House Form and Culture, Englewood Cliffs, 1960
2. N. Egenter, Architectural Anthropology, Structura Mundi, 1996
3. Roxanna Waterson, The Living House: An Anthropology of Architecture in Southeast Asia, Oxford University Press, 1990
4. E. Guidoni, Primitive Architecture, Harry N. Abrams, 1978
5. Paul Oliver (ed.), Sign, Symbol, and Shel- ter, The Over-look Press, 1977
6. J. Fox (ed.), Inside Austronesian House, The Australian National University, 1993
7. Djauhari Sumintardja, Kompendium Arsitektur. Yayasan Lembaga Masalah Bangunan, 1978
8. Bourdier & N.AlSayyad (eds), Tradition, Dwellings and Settlements: Cross-cultural Perspectives, University Press of America, 1989

Architecture and Text

ENAR800027
3 Credits
Learning Objectives:

Students are able to analyze and critique architectural works as a part of the fabric between the work itself, texts and the context of society including its relationship with theory, history and writing of architectural history.

Sub Learning Objectives:

Student are able to analyze architecture as a text that can be read and interpreted based on the relationship between the text and its context and certain methods of reading architectural works as text; Student are able to conclude the relationship between architectural works and texts through the application of the method of reading architecture as text

Syllabus:

This course is an introduction to architectural works as texts. How do we read architectural works as text? How do we read architectural works as the connection between architectural works and the architect's experience, local conditions, places, and so on? It is these kinds of questions that we will try to answer together in this course. Introduction to architectural works as text.

Learning Materials:

Analogies in text and language; Recent developments in architectural texts; Exercise in reading architectural texts; Exercise in reading architectural works as text; Exercise in Writing-Designing text and architecture; The world of authorship in architecture; Text and context; Writing architecture as text; Survey of a built architectural work and practice writing it; Writing-designing method of text and narrative architecture.

Prerequisites: -

References:

1. Roland Barthes, *Mythologies*, Vintage Classics, 2000
2. John D Caputo (ed.), *Deconstruction in a Nutshell: a Conversation with Jacques Derrida*, Fordham University Press, 1997
3. Umberto Eco, *A Theory of Semiotics*, Indiana University Press, 1976
4. Joel Gilberthorpe, *What is a Text?: on the Limits of a Text as an Object of Knowledge* (http://www.arts.mq.edu.au/documents/NEO_Article_5_2009_Joel_Gilberthorpe.pdf)

Coastal Architecture

ENAR800028
3 Credits
Learning Objectives:

Students are able to analyze and visualize an architectural design as an effort to anticipate problems in a coastal area.

Sub Learning Objectives:

Students are able to increase their understanding and describe the peculiarities of eco-anthroposystem living spaces and livelihoods in coastal areas that affect the sustainability of their architectural works; Students are able to increase awareness and narrate the relationship between time-space-biocultural changes and disaster risk in a coastal area with the development of environmental spatial planning and architecture; Students are able to improve the ability to write a study of problems in a particular coastal area as well as opportunities for architectural solutions into a paper in a sequential and systematic manner; Students are able to improve their ability to visualize an architectural idea as an effort to anticipate problems that may occur in a coastal area

Syllabus:

This course aims to increase students' understanding of the uniqueness of the eco-anthroposystem of living spaces and livelihoods in coastal areas that affect the sustainability of their architectural works; increase students' awareness about the relationship between changes in time-space-biocultural and disaster risk in a coastal area with the development of environmental spatial planning and architecture; improve the ability of students to write a case study in a particular coastal area as well as opportunities for architectural solutions into a paper in a coherent and systematic manner; and improve students' ability to visualize an architectural creation as an effort to anticipate problems that may occur in a coastal area.

Learning Materials:

Basic understanding of the definition of coastal architecture, the coastal of archipelagic area, waters and the interrelationship of islands and seas; Architectural typology in Architecture and Water associated with sustainable approach to buildings in the Coastal Zone; Functions, spatial planning, building facilities and architectural works in Indonesia's coastal areas; Environmental impact and disaster risk studies in coastal areas.

Prerequisites: -

References:

1. Abimanyu Takdir Alamsyah, *Regionisme dalam Penataan Permukiman di Gugus Pulau Mikro*, unpublished doctoral dissertation, PSIL Universitas Indonesia, 2006
2. Abimanyu Takdir Alamsyah, *Menata Permukiman Pulau-Laut, Mempertahankan Keberlanjutan Bertanahair Kepulauan*, Pidato pengukuhan Guru Besar Universitas Indonesia. Depok, 2009
3. Michael R. Bloomberg and Amanda M. Burden, *Urban Waterfront Adaptive Strategies in Waterfront Vision & Enhancement Strategy,* NYC Planning, 2013
4. Subandono Diposaptono and Budiman, *Tsunami*, Penerbit Buku Ilmiah Populer, 2006
5. Charles Moore and Jane Lidz, *Water + Architecture*, Thames and Hudson Ltd, 1994
6. Malcolm Newson, *Land, Water and Development: River Basin Systems and their Sustainable Development*, Routledge,1992
7. Koen Olthuis and David Keuning, *Float!. Building on Water to Combat Urban Congestion and Climate Change*, Frame Publishers, 2010
8. Djoko Pramono, *Budaya Bahari*, Gramedia Pustaka Utama, 2005
9. Alan P. Trujillo and Harold V. Thurman, *Essentials of Oceanography, Ninth Edition*, Pearson Education *Ltd, 2008*
10. Heather Vies and Tom Spencer, *Coastal Problems: Geomorphology, Ecology and Society at the Coast*, Edward Arnold, 1995
11. Ary Wahyono, AR Patji, SS Laksono, R. Indrawasih, Sudiyono dan Surmiati Ali, *Hak Ulayat Laut di Kawasan Indonesia Timur*, Media Presindo Yogjakarta, 2000

Energy Efficient Building

ENAR800029
3 Credits
Learning Objectives:

Students are able to design buildings with an Energy Saving approach

Sub Learning Objectives:

Students are able to conclude the meaning of comfort and health for residents; Students are able to classify green buildings in Indonesia; Students are able to demonstrate design strategies that take into account climatic conditions; Students are able to practice basic understanding in using EDGE applications; Students are able to demonstrate advanced utility systems in a building; Students are able to demonstrate the life-cycle of materials used in buildings; Students are able to demonstrate contemporary water conditions and the use of plants in a building; Students are able to optimize the application of Contemporary Green Building principles; Students are able to design buildings with an Energy Saving approach and run EDGE Software

Syllabus:

Energy Efficient Building Course summarizes knowledge about climate, ecology, building technology & utilities, renewable energy, with relevant design theories that students have previously learned. Enriched with the latest network-based applications, Energy-Efficient Building course deepens students' understanding of the principles of sustainable architecture; Renewable energy, Climate and site, solar geometry, passive cooling, shading, natural & artificial light and solar cells.

Learning Materials:

Psychometric Chart, Predicted Mean Vote; Koppen-Geiger climate classification, urban heat island, passive design; HVAC, active design; Embodied energy, life cycle assessment, life cycle cost assessment; Hydrologic cycle, water distribution network, rain water harvesting.

Prerequisites: -

References:

1. Donal Watson, The Energy Design Handbook, The American Institute of Architecture Press, 1993
2. Klaus Daniels, The Technology of Ecological Building, English translation by Elizabeth Schwaiger, Birkshauser Verlag, Berlin 1994
3. Norbert Lechner, Heating Cooling Lighting, Edisi kedua, terjemahan, PT Raja Grafindo Persada, 2007

Computational Design and Parametric

ENAR800030
3 Credits
Learning Objectives:

Students are able to compose and design various forms of three-dimensional modeling based on computational and parametric knowledge.

Sub Learning Objectives:

Students are able to develop modeling based on fundamental geometry knowledge; Students are able to develop parametric modeling with advanced geometric elements; Students are able to develop computational-based modeling with coding knowledge; Students are able to design an artifact with various computational knowledge.

Syllabus:

Through this course, students can use computing media as part of the design process by using a parameter-based modeling approach and computer programming. In this course, students are introduced to computational-based design instruments, parameter-based design approaches, algorithmic architecture and scripting tools. The course will be divided into three modules: the fundamental geometry module and three-dimensional modeling techniques based on CAD, a parametric modeling module with advanced geometric elements, and computational-based modeling with coding knowledge.

Learning Materials:

Modules on fundamental geometry and three-dimensional modeling techniques based on CAD; Parametric modeling module with advanced geometric elements (based on Grasshopper); Computational modeling module with coding/ scripting knowledge

Prerequisites: Memiliki kemampuan dasar dalam modeling berbasis NURBS dan CAD

References:

1. B Kolarevic, Architecture in The Digital Age: Design and Manufacturing, Spon Press, 2003
2. Mode Lab, n.d, Foundations: Grasshopper Primer Third Edition.
3. K Terzidis, Algorithmic Architecture, Routledge, 2006
4. R Oxman and R Oxman, Theories of the Digital in Architecture, Routledge, 2014

Housing Policy

ENAR800031
3 Credits
Learning Objectives:

Students are able to understand housing policy as a set of concepts that underlie the activities of providing housing in the scope of government that considers social, political, demographic, economic, and technological issues.

Sub Learning Objectives:

Students are able to explain the definition, motive, and purpose of housing policy (what); Students are able to explain who (who and whom) are involved in housing policy; Students are able to explain how housing policy is formulated by considering social, political, demographic, economic, and technological issues; Students are able to analyze housing policies that apply in several countries

Syllabus:

The course provides knowledge about a series of concepts, principles, and guidelines that underlie the practice of implementing the housing sector in a country, which is multidimensional. These dimensions include the socio-cultural demographics of a country as well as the political and economic systems adopted by certain countries. The implementation of housing policies can be in the form of strategies, regulations or programs that usually aim to regulate the allocation of resources: land, financing, institutions, technology and so on. After completing this course, students are expected to be able to critically examine housing policy, especially housing policy in Indonesia.

Learning Materials:

What: Definition, motives, and objectives of housing policy; Whom: Housing needs and demands with respect to population and households; Who: Housing offers and the parties and institutions that have jurisdiction over housing; How 1: Housing policy and ideological issues of a country's political economy; How 2: Housing policy and economic issues and housing finance; How 3: Housing policy and land issues and housing tenure status; How 4: Housing policy and technology issues and innovation in housing

Pre-requisites: -

References:

1. H Arendt, The Human Condition, The University of Chicago Press, 1958, pp. 7-17
2. M Heidegger tr by Albert Hofstadler, Kerper & Row, Poetry, Language, Thought, Publishing Inc., 1971, pp. 145-161
3. M Foucault, S. During (ed.), 'Space. Power and knowledge', The Cultural Studies Reader Second Edition, Routledge, 1999: 134-41
4. Henri Lefebvre translated by Donald Nicholson-Smith, The Production of Space, Blackwell, 1991, Chapter 1, pp. 26-52
5. P Bourdieu, Outline of A Theory of Practice, Cambridge University Press, 1977, pp. 72-95
6. M De Certeau tr by Steven F. Rendall, The Practice of Everyday Life, University of California Press, 1984, pp. 29-42 and 91-110
7. Kendig Hal L, 'Housing Careers, Life Cycle and Residential Mobility : Implications for the HousingMarket', Urban Studies, 1984, 21, 271-283
8. Michael Haan & Thomas Perks. 'The Housing Careers of Older Canadians: An Investigation Using Cycle 16 of the General Social Survey'. Canadian Studies in Population Vol. 35.2, 2008, pp. 223–242
9. K. D. Willis, Squatter Settlements, Elsevier Ltd, 2009
10. Brian Sullivan & Ke Chen. 'Design for Tenant Fitout: A Critical Review of Public Housing Flat Design in Hong Kong'. Habitat Intl. Vol 21. No 3, 1997, pp. 291-303
11. Leland Blank and Anthony Tarquin. Engineering Economy: Seventh Edition, McGraw Hills, 2012
12. B Harsman & J Quigley, Housing Markets & Housing Institutions in a Comparative Perspective". Housing Markets & Housing Institutions, Kluwer Academic, 1991, pp.1-29
13. Fashbir N Sidin, Housing Policy Systems in South and East Asia, Palgrave Macmillan, 2002, pp.161-176
14. John F.C Turner and Robert Fichter, Freedom to Build, Collier Mcmillan, 1972
15. John F.C Turner, Housing By People: Towards Autonomy in Building Environtments, The Value of Housing, 1976, pp. 53-74.
16. A T Alamsyah, Menata permukiman Pulau-Laut. Pidato Pengukuhan Guru Besar UI, 2008
17. Mayor Michael R Bloomberg and Amanda M.Burden, Coastal climate resilience, Urban waterfront adaptive strategies, Department of City Planning, 2013
18. A T Alamsyah, Regionisme dalam Penataan Permukiman di Gugus Pulau Mikro, Disertasi, PSIL UI, 2006
19. Diposaptono, Subandono, Budiman, Hidup Akrab dengan Gempa dan Tsunami, Penerbit Buku Ilmiah Populer, 2008

Everyday and Architecture

ENAR800032
3 Credits
Learning Objectives:

Student should be able to understnd the existence of everyday phenomena as an approach to architecture; should be able to define the position of architecture discipline in responsing to various phenomena of everyday living space.

Syllabus:

Understanding and historical background of the concept of the 'everyday' in architecture; domestic space; aesthetic in architecture and the 'everyday', the concept of an ideal city and its relation to the 'everyday'; cyber space and virtual space; the phenomenon of the 'everyday' in urban space: a participatory approach in architecture.

Prerequisites: -

References:

1. Steven Harris & Deborah Berke (eds.), Architecture of the Everyday, Princeton Architectural Press, 1997
2. Sarah Wigglesworth & Jeremy Till (eds.), The Everyday and Architecture, Architectural Design, 1998
3. Michel de Certeau, The Practice of Everyday Life, University of California Press, 1998
4. Malcolm Miles, The Uses of Decoration: Essays in the Architectural Everyday, Wiley, 2000
5. Jonathan Hill (ed), Occupying Architecture, Routledge, 1998
6. Margaret Crawford, et.al, Everyday Urbanism, Monacelli, 1999, Arnstein, Ladder of Citizen Participation, 1969

Understanding Phenomenon: Plato to Derrida

ENAR800033
3 Credits
Learning Objectives:

Students are able to understand the empirical and metaphysical linkages in understanding architectural phenomena, including the application of related principles and theories in architectural discourses and works.

Sub Learning Objectives:

Understanding the relationship between architecture and philosophical thought through Phenomenology; Able to explain the relationship between theory and architectural discourse by paying attention to related concepts.

Syllabus:

This course introduce student to philosophy in architecture, especially differences in knowledge and physical/empirical evidence and metaphysical explanations in understanding architectural phenomena; Furthermore, students are expected to be able to participate in discourse and demonstrate the principles of critical thinking related to differences in observations and thinking of each architectural phenomenon, especially in the application of these principles in a particular architectural case discourse. Students wil discuss the progress of philosophical thought through phenomenology and its impact on life, culture and architecture.

Learning Materials:

Architecture and understanding the phenomenon; Forms and forms in the fictitious and metaphysical world; Ontological understanding of 'what' and 'why'; debates; Plato and Khora; Husserl's phenomena and phenomenology; Situated bodies: phenomenology of space and place; Heidegger; Semiotics Sign; Myth; Simulacra and simulation; Deconstruction; Knowledge-Power.

Prerequisites: -

References:

1. R Barthes tr by Annette Lavers, Mythologies, Hill and Wang, 1972
2. J D Caputo (ed.), Decosntruction in a Nutshell: Conversation with Derrida, Fordham University Press, 1997
3. G Deleuze tr by Paul Patton, Difference and Repetition, Columbia University Press, 1994
4. J Derrida edited by Thomas Dutoit, On The Name, Edited by Thomas Dutoit. Stanford University Press, Stanford, 1993, chapter about Khōra
5. J Derrida tr by Gayatri Spivak, Of Grammotology, The John Hopkins University Press, 1974, Translator's Note by G. Spivak
6. M Heidegger, Language, Poetry and Thinking, Perennial Classic, 1971, chapter: Dwelling, Building and Thinking.
7. D Moran, Introduction to Phenomenology, Routledge, 2000
8. R H Popkin and Avrum Stroll, Philosophy Made Simple, Doubleday Compay, Inc., 1956

BIM: Building's Assesment and Analysis

ENAR800034
3 Credits
Learning Objectives:

Students are able to explore the principles of building technology and sharpen the analysis of building performance in relation to a sustainable environment

Sub Learning Objectives:

Students are able to detail the principles of sustainable building technology; Students are able to operate BIM-based software; Students are able to evaluate holistic eco-friendly principles in buildings.

Syllabus:

Introduction to BIM in architecture; model development, information and database management, building performance's documentation, analysis, and assessment.

Learning Materials:

Mastering the principles of BIM technology theories and applying it to analyze and assess the building performance through energy analysis modeling with a green architectural approach.

Analyzing and assessing building performance using BIM-based software.

Prerequisites: -

References:

1. Eastman, C., Eastman, C.M., Teicholz, P. and Sacks, R., BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors. John Wiley & Sons, 2011
2. Kensek, K, and Noble, D., Building Information Modeling: BIM in Current and Future Practice, John Wiley & Sons, 2014
3. Holzer, D, The BIM Manager's Handbook: Guidance for Professionals in Architecture, Engineering and Construction, John Wiley & Sons

Advanced Spatial Analysis

ENAR800035
3 Credits
Learning Objectives:

Geography and other social and environmental disciplines have association to spatial data - data that shows phenomena locations on the earth surface. Although the phenomena studied are often different, from the level of air pollution, the location of hospitals, the pattern of human populations, to the size of rainwater, what unites all of this data is the fact that they all have a location or position relative to the surface of the earth.

Syllabus:

Methods for analyzing spatial data have existed since the 1930s, but in the last two decades there have been several significant developments, triggered by computer technology and GIS development. This course explores methods for analyzing three important types of spatial data: point data, area data (polygons), and field data (continuous surfaces). We will consider how these methods work, their strengths and limitations, and the examples of practical and research problems where these methods can be applied. This ccourse also consists of labs involving ArcGIS and other software such as GeoDA, SatScan and R.

Prerequisites: -

References:

1. Lloyd, C. (2011). Local Models for Spatial Analysis, 2nd Edition. Boca Raton, FL: CRC Press.
2. Bahan bacaan tambahan merupakan artikel terterbit yang menggunakan metode analisa spatial dalam berbagai macam area aplikasi.

Architectural Psychology

ENAR600036
3 Credits
Learning Objectives:

Students are able to conclude the symptoms/problems of human interaction in the built environment using architectural psychological theories.

Sub Learning Objectives:

Students are able to analyze the relationship between human behavior and the environment; Students are able to analyze the embodiment of human values and human needs in the built environment; Students are able to analyze how humans perceive and process the results of perception of the built environment; Students are able to conclude the relationship between architectural and interior space with human behavior; Students are able to illustrate the results of the analysis through oral and written presentations.

Syllabus:

Architectural Psychology course is an elective course offered to master's students to provide an expanded insight into the role of architecture in meeting the human needs. After following this course, students are expected to be able to analyze the symptoms/problems of human interaction in the built environment using architectural psychology theories. Students are given initial material which consists of three separate parts: the relationship between humans and the environment, the embodiment of values and motivation in the built environment, perception and cognition, as well as various concepts that explain the relationship between spatial design and human behavior.

Learning Materials:

Background and scope of architectural psychology; Human and environmental relations; Values and motivation; Gestalt perception theory and ecological perception; Cognitive map; Proxemics: personal space, territoriality, privacy, crowding; Application of architectural psychology to various types of built environment; Post-occupancy evaluation

Prerequisite: -

References:

1. Bell, Fischer and Greene, Environmental Psychology, Harcourt Publisher, 1996
2. Bryan Lawson, The Language of Space, Architectural Press, 2001
3. Byron Mikellides, Architecture for People: Exploration in a New Humane Environment, 1980
4. Wolfgang F.E. Preisser, Harvey Z. Rabinowitz, Edward T. White, Post-Occupany Evaluation, Van Nostrad Reinhold, 1988
5. Dak Kopec, Environmental Psychology for Design , Fairchild Books, 2012

Urban Morphology

ENAR800037
3 Credits
Learning Objective:

Student are able to identify and critically review various main elements that foms a city in several levels/depth ranging from the most micro (buildings and spaces between buildings), roads and blocks, to regional/regional scales; Students are able to critically and accurately assess the city that will be their case study and are able to formulate their perspective on the morphology of a city in any context and wherever the city is located.

Sub Learning Objective:

Students are able to understand how the historical/ideological background influences the process of morphological formation by reviewing several cities in the world. The periodization starts from the city's embryonic period to the neoliberal era we face today; Students are able to understand the phenomenon of the metropolis/megalopolis which is analyzed in relation to various current issues related to ecology, energy and sustainability; Students are able to understand the phenomenon of informal urbanism that appears in big cities (especially in Jakarta) and the morphological characters that are influenced by local aspects of cities in Asia and Indonesia.

Sylabus:

Urban morphology course is a study of the process of city formation and the relationship between city components, with a focus on the composition and configuration of urban structures/patterns. The field of study is more emphasized in the form of geography, area (blocks and roads), buildings and spaces between buildings; which are formally/informally influenced by economic, social, cultural, political and economic conditions. After completing this course, students can analyze the morphology of a city according to the periodization of its development correctly.

Learning Materials:

Mandatory textbook on urban morphology; Selected videos relevant to the morphology of the city; Maps related to the covered topics.

Prerequisite: -

References:

1. Gallion, A. B., & Eisner, S. (1963). The Urban Pattern - City Planning and Design. New York: D. Van Nostrand Company, Inc.

2. Hardy, D. (2011). The Making of Hong Kong: From Vertical to Volumetric. London & New York: Routledge.
3. Kidokoro, T., & al, e. (n.d.). Sustainable Urban Regeneration.
4. Krier, R. (1979). Urban Space.
5. Marshal, S. (2004). Street and Patterns - The Structure of Urban Geometry.
6. Oliveira, V. (2016). Urban Morphology. Springer International Publishing.
7. Rose, J. F. (2016). The Well-Tempered City - What Modern Science, Ancient Civilizations, and Human Nature Teach Us About the Future of Urban Life. Harper Wave.
8. Rossi, A. (1984). Architecture of the City. London: MIT Press.
9. Rowe, C., & Koetter, F. (1984). Collage City. MIT Press.
10. Shelton, B. (1999). Learning from the Japanese City - West meets East in Urban Design. Taylor and Francis.
11. Silver, C. (2007). Planning the Megacity - Jakarta in the Twentieth Century. Routledge.
12. Tiwari, R. (2018). Connecting Places, Connecting People - A Paradigm of Urban Living in the 21st Century. New York: Routledge.

Heritage Architecture

ENAR800038
3 Credits
Learning Objectives:

An introduction to Heritage Architecture which includes both tangible and intangible aspects, as well as the 'Outstanding Universal Value' aspect of the Cultural Heritage Buildings and Cultural Heritage Areas. There will be discussions about critical issues related to heritage in architecture and cities. Introduction to preservation efforts includes: protection, development and reuse of buildings and cultural heritage areas.

Syllabus:

This course includes movie screenings and field trips to understand more about the precedents of heritage architecture in Indonesia and how heritage conservation efforts have been done so far.

This course is an elective subject that studies the architecture of the past in the context of present reality and the ongoing efforts to provide new life for the future generation. It includes Tradition, Memory, Authenticity, Value (Cultural Heritage Buildings - BCB), Sites (Cultural Heritage Sites - LCB), and Heritage Cities (Cultural Heritage Areas), with an emphasis on Cultural Heritage Buildings and the efforts made for Preservation / Conservation / Revitalization in it.

Prerequisites: -

References:

1. Diez, Fernando, 'Heritage', Cairns, Stephen, Crysler, Greig C., Heyne, Hilde. The SAGE Handbook of Architectural Theory. SAGE Publications, 2012, pp 274 – 86.
2. Rajagopalan, Mrinalini, 'Preservation and Modernity: Competing Pespectives, Contested Histories and the Question of Authenticity'. Cairns, Stephen, Crysler, Greig C., Heyne, Hilde. The SAGE Handbook of Architectural Theory. SAGE Publications, 2012, pp. 308 – 24.
3. Avila, Fidel Alejandro Meraz, 'Social Memory and Assimilation: The Conflictive conjunction of theories of conservation and architecture'.
4. Boyer, M. Christine. 'Collective Memory Under Siege: The Case of Heritage Terrorism'. Cairns, Stephen, Crysler, Greig C., Heyne, Hilde. The SAGE Handbook of Architectural Theory. SAGE Publications, 2012, pp. 325 – 38.
5. Brown, Robert and Maudlin, Daniel. 'Concept of Vernacular Architecture'. Cairns, Stephen, Crysler, Greig C., Heyne, Hilde. The SAGE Handbook of Architectural Theory. SAGE Publications, 2012, pp: 340 – 55.
6. Walker, Paul. 'Culture'. Cairns, Stephen, Crysler, Greig C., Heyne, Hilde. The SAGE Handbook of Architectural Theory. SAGE Publications, 2012, pp: 369 – 82.
7. Feilden, Bernard M. 'Introduction to architectural conservation' in Conservation of Historic Building (1994), pp: 1 – 22.
8. Larkham, Peter J. 'Conflict and Conservation' in Conservation and the City, Routledge, 1996, pp 3 – 30.
9. Amorim, Luiz et. Al. 'Preserving Space'. Proceedings 6th International Space Syntax Symposium, Istanbul, 2007 pp. 032-01 – 032-14.
10. Hayden, Dolores "Rediscovering An African American Homestead', in Hayden, Dolores, The Power of Place: Urban Landscapes as Public History (Cambridge, Massachusetts and London, England: The MIT Press, 1997), pp. 168 – 187.
11. Kehoe, Marsely von Langerke. 'The Paradox of Postcolonial Historic Preservation'.
12. Barthelemy, Jean. "The Architectural and Townspace Heritage As A Factor Influencing Trends in Development.'
13. Corten, Jean-Paul et.al. Heritage As An Asset for Inner-City Development: An Urban Manager's Guide Book, Ammersfoort: Cultural Heritage Agency, nai010 publishers.
14. Hayden, Dolores, The Power of Place: Urban Landscapes as Public History (Cambridge, Massachusetts and London, England: The MIT Press, 1997).
15. Larkham, Peter J., Conservation and the City, Routledge, 1996.
16. Pengantar Panduan Konservasi Bangunan Bersejarah Masa Kolonial, Pusat Dokumentasi Arsitektur dan Badan Pelestarian Pusaka Indonesia, 2011.
17. UU Cagar Budaya (UU No. 11 /2010 Tentang Cagar Budaya, UU No.28/2002 Tentang Bangunan Gedung dan PP No.39/2005 tentang Pelaksanaan UU No.28/2002, yang di dalamnya mencakup Pelestarian Bangunan Gedung, UU No. 26/2007 Tentang Penataan Tata Ruang).
18. Cultural Heritage Charters and Standard.
19. Asia Conserved, UNESCO, 2007.
20. Tjahjono, Gunawan (ed.), The Indonesian Heritage Series (Singapore: Archipelago Press, 1998).

Geometry and Architecture

ENAR800039
3 Credits
Learning Objectives:

Students are able to formulate geometric-based creative methods as critical tools of analysis and critical tools of making.

Sub Learning Objectives:

Students are able to conclude the various roles of geometry as the basis for architectural design methods; Students are able to criticize the role of classical and Euclidean aesthetic geometry as "critical tools of analysis"; Students are able to criticize architectural works based on knowledge of the role of contemporary geometry as "critical tools of analysis"; Students are able to formulate creative methods based on the process of geometric analysis and synthesis as "critical tools of making"

Syllabus:

The Geometry and Architecture course is an elective course offered to master's students to provide an expanded insight into design methods to support their ability in architectural design. After taking this course, students are expected to be able to analyze the various roles of geometry as the basis for architectural design methods, as well as formulate geometric-based creative methods as critical tools of analysis and critical tools of making. Students are given initial material which consists of three separate parts; the basic principles of geometry in the context of classical aesthetics, various applications of geometry in various spatial contexts, and the role of geometry as the basis for the development of contemporary architectural design.

Learning Materials:

Geometry, classical aesthetics and architecture; Euclidean and non-Euclidean geometry in architecture; Geometry and visual perception; Geometry in the context of Ideal Cities; Music, space and architecture; Topology and architecture; Geometry and technology; Natural geometry and architecture.

Prerequisites: -

References:

1. Vitruvius, Ten Books on Architecture, Dover Publications, 1960
2. Colin Rowe, Mathematics of an Ideal Villa, MIT Press, 1976
3. Peter Davidson & Donald L. Bates, Architecture after Geometry, Architectural Design, 1999
4. Irenee Scalbert, Archis, Towards a Formless Architecture: The House of the Future by A+P Smithson, Archis, 1999
5. D'Arcy Thompson, On Growth and Form, Dover Publications, 1992
6. Jane Jacobs, The Death and Life of Great American Cities, RandomHouse, 1961
7. Elizabeth Martin, Architecture as a Translation of Music in Pamphlet Architecture 16, Princeton Architectural Press, 1994

Project Management

ENAR800040
3 Credits
Learning Objectives:

Students are able to prepare Planning/Design Project Proposals using project management knowledge and able to sell ideas/ideas and convince the assignor through presentation activities.

Sub Learning Objectives:

Setting goals and objectives; Establishing project management related theory; Developing proposals based on 5 project management processes; Developing proposals based on 10 project management area of knowledge.

Syllabus:

The discussion material in the Project Management course is focused on discussing "management", "projects" and "project management". This Project Management course is designed as a learning tool for students to acquire modern project management knowledge. The course basically studies ten areas of project management consisting of three main elements of Project Management; cost, quality and time and seven fields of knowledge as supporting elements. The ten areas of project management are linked to the five project management processes.

Learning Materials:

Prerequisites: -

References:

1. PMI, *A Guide to Project Management Body of Knowledge (PMBOK Guides) 3 ed*, Project Management Institute, 2004
2. J.M Amos and B.R Sarchet, *Management for Engineers*, Prentice-Hall Inc,
3. D Sbarrie, *Professional Construction Management,* McGraw-Hill, 1986
4. D Cadman and L Austin-Crowe, *Property Development,* EF & N Spon, 1978

Urban Planning

ENAR800041
3 Credits
Learning Objectives:

Student should be able to understand history and theory of urban planning though historical survey and/or through key themes; should be able to understand (1) how urban space works (based on historical context) based on spatial planning research; (2) key paradigms in urban planning thinking. This course is arranged around principle that history of urban planning is a theory of urban planning that is bounded by planning ethics.

Syllabus:

The syllabus is arranged following a chronological order that is divided by 5 sections: (1) reflection towards design ideas, origin and design practice; industrial city and housing question; spatial order exploration; (2) Modernist City; Colonial and Post-Colonial experiments; (3) Sub-urban dream (legacy of American city planning); from ghetto to city role model (racial and ethnic control); (4) City and citizenship in different historical moments; spatial rules and arrangements (basic rules of design); urban crisis, urban management, and business city; building a world class city in global south; (5) compatible theories in design and justice; see design over neo-liberalism: paradigm occurs in planning.

Alternatively, the syllabus can also interrupt the chronological order and be arranged like a survey class that organizes its material into key themes, such as: Empire ; Colonial / Post-colonial; Modernity & Alternative Modernity; Pacific Rim Capitalism and Transnational Urbanism; Race / Ethnicity, Planning and Real Estate; City and Village; Marginality; Rebuilding the City; City Entrepreneur, Dystopia Planning and Post Urban.

Prerequisites: -

References:

1. Selected articles from Journal of Planning Theory & Practices; Cities, Space & Polity, International Journal on Urban Regional Research; Journal of Planning Education and Research; Journal of Urban Studies; Journal of Urban Forum; Journal of Urban History, Environment and Urbanization; Antipode; Journal of Planning Literature
2. Paul H. Gleye, "City Planning versus Urban Planning: Resolving Profession's Bifurcated Heritage," in Journal of Planning Literature, 2015, Vol 30(1), 3-17.
3. John Friedmann. Planning in the Public Domain: From Knowledge to Action, 1987
4. Peter Hall, Cities of Tomorrow: An Intellectual History of Urban Planning and Design in the Twentieth Century, Blackwell Publishing, 2002 (3rd ed)
5. Friedrich Engels, The Housing Question, Lawrence and Wishart, Ltd, 1942

6. Mike Davis, Planet of Slum, Verso, 2007
7. Dolores Hayden, Redesigning the American Dream: The Future of Housing, Work, and Family Life, W.W Norton & Company, 2007 (2nd ed)
8. Christine Boyer, Dreaming the Rational City: The Myth of American City Planning, MIT Press, 1986
9. Kermit C Parsons & David Schuyler (eds), From Garden City to Green City: The Legacy of Ebenezer Howard, Baltimore: The John Hopkins University Press, 2002
10. The Congress for the New Urbanism. 2001. Charter.
11. Robert Caro, The Power Broker: Robert Moses and the Fall of New York, Vintage, 1975
12. Marshall Berman, All That is Solid Melts into Air, Penguin Book, 1988
13. James Scott, Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed, Yale University Press, 1999
14. Nezar AlSayyad (ed), Forms of Dominance: On the Architecture and Urbanism of the Colonial Enterprise, Avebury, 1992
15. Lisa Peattie, Planning: Rethinking Ciudad Guayana, University of Michigan Press, 1987
16. James Holston, The Modernist City: An Anthropological Critique of Brasilia, University of Chicago Press, 1989
17. June Manning Thomas and Marsha Ritzdorf (eds), Urban Planning and the African American Community: In the Shadows, SAGE Publication, Inc, 1996
18. Kenneth T. Jackson, Crabgrass Frontier: The Suburbanization of the United States, Oxford University Press, 1987
19. St Clare Drake & Horace R. Cayton, Black Metropolis: A Study of Negro Life in a Northern City, University of Chicago Press, 1993.
20. Edward Banfield, Unheavenly City Revisited, Waveland Press, 1990
21. Susan S Fainstein & Scott Campbell, Reading in Planning Theory, Wiley-Blackwell, 2011
22. Lewis Mumford, The City in History: Its Origin, Its Transformation and Its Prospects, A Harvest/HBJ Books, 1961
23. Stephen Graham & Simon Marvin, Splintering Urbanism: Networked Infrastructures, Technological Mobilities, and the Urban Condition, 2001
24. Aihwa Ong & Ananya Roy (eds), Worlding Cities and the Art of Being Global, Wiley-Blackwell, 2011
25. Patsy Haley, E.A Silva, et.al, "Routledge Handbook on Planning Research Methods" Routledge, 2015.
26. Faranak Mirahtab, Cities in the Global South Reader, Routledge, 2014.

Teaching Assistanship

ENAR800042
3 Credits
Learning Objective:

Students are able to conclude various roles and activities as well as their objectives in the architectural learning process.

Sub Learning Objective:

Students are able to detail the learning material in the facilitated courses; Students are able to organize activities in the facilitated courses; Students are able to evaluate the process of participating in activities through written reports.

Sylabus:

Through this course, students can act as facilitators in one of the regular undergraduate program subjects, which aims for students to understand various approaches in the learning process that will be useful for a professional career in the future, both in the academic and non-academic fields. Through this course, students are expected to be able to learn fundamental aspects of the teaching and learning process, how to prepare for class and create assignments, facilitate discussions, make assessments and evaluations, and use learning tools in the classroom. This course also provides an understanding of the three main approaches in learning theory: behaviorism, cognitive construction and social construction in relation to knowledge, learning, motivation and instructional methods.

Learning basics; basic learning theories: behaviorism, cognitive constructivism and social constructivism; instructional methods and facilitation techniques in architectural learning; evaluation and assessment methods, management of design studios in architectural education.

Learning Materials:

Fundamental aspects of the teaching and learning process; Class preparation and development of assignment; Methods of facilitating discussion, making judgments and evaluations; Use of learning tools in the classroom; Understanding the main approaches in learning theory, such as behaviorism, cognitive construction and social construction in relation to knowledge, learning, motivation and instructional methods.

Prerequisite: -

References:

1. Heather Fry, Steve Ketteridge and Stephanie Marshall (eds.), A Handbook for Teaching and Learning in Higher Education: Enhancing Academic Practice (Third edition), Routledge, 2009.
2. David Nicol and Simon Pilling, Changing Architectural Education: Towards a New Professionalism, Taylor & Francis, 2000.
3. Rosie Parnell et al., Crit: An Architecture Student's Handbook, Routledge, 2007

Architecture, Media, and Context

ENAR800043
3 Credits
Learning Objectives:

Students discuss architecture as an embodiment of ideas and relates it to communication media and representation techniques such as images, photos and films on architectural works as well as the context of scale in understanding space.

Sub Learning Objectives:

Comparing the relationship between architecture, media and representational techniques in architecture through architectural precedents in the study of history, art and culture; Criticizing the relationship between architecture, media and the context of the used scale, through discussion of theory, history, and art that affect the quality of architectural design; Analyzing the relationship between architecture, media and context of scales such as miniature and urban scales

Syllabus:

The focus of this course is on how media operate in architecture and are used in a variety of contexts and scales. The student will be introduced to the history and theory of media and architecture, and explore the use of media in architecture and understand the relationship between architectural theory and practice and the meaning of space. In general, the discussion covers the use of media in art and architecture, media in the Renaissance & Classicism era, some observational techniques and new views on space, Collage & Montage in architecture, photography and representation in architecture, film and architecture, reading media contexts and scales such as miniatures and Megastructure, signs and semiotics in architecture and society of spectacle.

Learning Materials:

Media in Arts & Architecture; Media in the Classical & Renaissance Era; Collages & Montages; Representation of Architecture through Photography; Film & Architecture; Film & Architecture (Cinematic Spaces); Walter Benjamin The Work of Art; Reading Media & Scale: Miniature; Reading Media & Scale: Bigness + Megastructure + Curtain Wall; Society of Spectacles; Field Trip Understanding Media & Scale From Past to Present; Communicating Media & Scale: Sign and the Semiotic Dimension of Architecture;Media & Spectacle (Henri Lefebre)

Prerequisites: -

References:

1. Moore, Charles and Allen, Gerald. Dimensions. Space, shape & scale in architecture, (McGraw-Hill, 1977)
2. Colomina, Beatriz. “The Media House.” Assemblage, no. 27 (1995)
3. Jonathan Crary, Techniques of the observer: on vision and modernity in the nineteenth century, the MIT Press, 1992
4. Sergei M. Eisenstein, Yve-Alain Bois, and Michael Glenny. “Montage and Architecture.” Assemblage, no. 10 (1989).
5. Colin Rowe and Fred Koetter, “Collage city and the reconquest of time,” in Collage City (MIT Press, 1978), 118-149; “Excursis” (images): 151-177.
6. James Ackerman, “On the Origins of Architectural Photography” In Kester Rattenbury, Ed., This is Not Architecture: Media Constructions (New York: Routledge, 2002): 26-35.
7. Giuliana Bruno, “Site-seeing: Architecture and the Moving Image” Wide Angle 19:4 (1997): 8-24.
8. Benjamin, Walter. 1969. ‘The Work of Art in the Age of Mechanical Reproduction,’ Illuminations. Ed. H. Arendt. (New York: Schocken) pp. 217–251.
9. Susan Steward, “ Miniature,” in On Longing: Narratives of the Miniature, the Gigantic, the Souvenir, the Collection (John Hopkins U.P., 1984).
10. Rem Koolhaas, Delirious New York (New York: Monaceli Press, 1978).
11. Debord, Guy. 1994. The society of the spectacle. New York: Zone Books.
12. Baudrillard, Jean. 1994. Simulacra and Simulation, Ed. Sheila Faria Glaser, Michigan: University of Michigan Press.
13. Venturi, Denise Scott Brown, Steven Izenour, Learning From Las Vegas
14. Roland Barthes, “Semiology and Urbanism,” in Joan Ockman (ed), Architecture Culture 1943-1968 (New York: Rizzoli, 1993), pp. 412-418.
15. Henri Lefebvre, The Production of Space, Blackwell, 1991.

Independent Study

ENAR800044
3 Credits
Learning Objective:

Students are able to formulate architectural ideas based on a comprehensive study of the context of community.

Sub Learning Objectives:

Students are able to identify issues regarding context and society through extensive data collection; Students are able to develop architectural ideas based on the identification and analysis of issues that exist in the context and society; Students are able to communicate architectural ideas verbally and non-verbally.

Sylabus:

This course will provide students with the ability to have advanced architectural knowledge in various topics and apply it in the development of architectural intervention ideas.

Learning Materials:

The study of advanced architectural knowledge in a particular context; development of architectural intervention ideas based on in-depth study of the context and theoretical studies in related topics

Prerequisite: -

References: Relevant references to the topic offered.

Capita Selecta

ENAR800046
3 SKS
Learning Objectives:

Student are able to evaluate the role of architects in various contemporary architectural practices on a local and global scale.

Sub Learning Objectives:

Students are able to analyze the role of architects and problems in architectural practice; Students are able to analyze applicable regulations (codes) regarding service to clients, compliance with local building regulations, and technical problems related to building structures and construction, mechanical and electrical; Students are able to analyze the principles of administration, marketing and project management; Students are able to evaluate and compile insightful knowledge in various topics of knowledge that support the mastery of architectural professional abilities.

Syllabus:

An understanding of the topic that supports the mastery of a professional architect. Provide insight into the topics of professional architect practice.

Learning Materials:

Environmentally Sustainable Technology; Digital Advancement in Architecture; Architectural Restoration; Profession, Education, and Architectural Criticism; Structural system and Building Methods; Greenship; Collaboration with Foreign Architects; Construction Error.

Prerequisites: -

References: Relevant references to the topic offered.

Special Topic on Architectural Design

ENAR800046
3 Credits
Learning Objectives:

Students should be able to demonstrate knowledge on current architectural discourse and its implementation in architectural design.

Syllabus:

Studies on the development of contemporary architectural theories; the development of architectural design methods; the development of architectural representation techniques; the development in other relevant disciplines that have impacts of the development of architectural design theories and methods.

Prerequisite: -

References: Relevant references to the topic offered.

Special Topic on Urban Design

ENAR800047
3 Credits
Learning Objectives:

Students should be able to demonstrate knowledge on current urban design discourse and its implementation in urban design.

Sub Learning Objectives:

Students are able to analyze the practice of urban design architecture, as well as regional planning and its relationship to demographic factors, local and global resources; Students are able to express the social, cultural, political and economic context in which the built environment is located.

Syllabus:

Students should be able to demonstrate knowledge on current urban design discourse and its implementation in urban design.

Learning Materials:

Studies on the development of urban design theories; the development of urban design methods; studies on current issues that are relevant to urban design; the development in other relevant disciplines that have impacts on the development of urban design theories and methods.

Prerequisite: -

References: Relevant references to the topic offered.

Special Topic on Urban Housing and Settlement

ENAR800048
3 Credits
Learning objectives:

Student are able to construct advanced architectural knowledge in the urban Housing and settlement from the given phenomenon or case of urban settlements and housing.

Sub Learning objectives:

Students are able to apply transdisciplinary concepts to understand urban housing and settlement issues; Students are able to analyze using demographic concepts and theories in cases of urban housing and settlements in Indonesia; Students are able to analyze using classical and contemporary concepts, theories used and approaches to urban anthropology in cases of urban housings and settlements in Indonesia; Students are able to analyze using concepts and theories of community psychology in cases of urban housings and settlements in Indonesia; Students are able to apply the use of cartographic principles and analyze data as a basis for mapping in the context of urban housings and settlements in Indonesia; Students are able to provide critical arguments for urban housing and settlements issues in Indonesia

Syllabus:

This course introduces students to the concept of transdisciplinary as a perspective to understand the problems of settlements and urban housing in Indonesia. Demographics, urban anthropology, community psychology, and cartography will be used to analyze the housing and housing cases given.

Learning Materials:

Transdisciplinary knowledge as a perspective to understand urban housing and settlement issues; Demographic knowledge to analyze case problems in urban housing and settlemet; Knowledge of urban anthropology to analyze case problems in urban settlements and housing; Knowledge of community psychology to analyze case problems in urban housings and settlement; Knowledge of cartography to analyze case problems in urban housing and settlements; The problem of urban housing and settlements in Indonesia.

Prerequisite: -

References: Relevant references to the topic offered.

Special Topic on Property

ENAR800049
3 Credits
Learning objectives:

Students are able to choose, analyze and conclude the phenomenon of property area development that occurs or by using the theory that has been studied in an integrated manner; Students are able to predict things that will happen if students plan to develop property areas.

Sub Learning Objectives:

Students are able to explain issues and problems; Students are able to obtain the material needed to understand the theory related to every issue and problem of property area development in depth; Students are able to analyze the material obtained related to the main issues and problems of discussion; Students are able to make a summary in the form of presentation material for each subject and demonstrate verbal skills in explaining the theory used in the summary; Students are able to write scientific papers related to issues and problems related to the development of selected property areas in an integrated manner.

Syllabus:

This course provides students with knowledge of issues and problems related to the implementation of property area development with various spatial aspects, starting from the issue of land provision to calculation of the required financial resources as well as the scope of technical, environmental, social/cultural, legal discussions and economics/finance.

Learning Materials:

The main issues and problems of property area development; Open space and built space in the context of the property area development; The need for providing land to fulfill the livelihood activities; Technical aspects of property area development; Selecting location of the property area and its relation to accessibility and its issues and impacts; the availability and provision of infrastructure and utilities; The effect of visibility on consumer interest and property value increases; Spatial analysis of property space; Availability and provision of public facilities to the economic value of the property area; sports facilities and "leisure" facilities provisions to the perception of potential consumers; The influence of policies (economic, financial, political and legal) on the development of property areas; Conventional financing for property area development; Non-conventional financing (PPP) for the development of property areas; Effect of economic/financial policies (taxes/interest rates) on property development

Prerequisite: -

References: Relevant references to the topic offered.

Special Topic on Architectural History, Theory, and Criticism
ENAR800050
3 Credits
Learning Objectives:

Student should be able to construct advanced architectural knowledge in history and architectural theory from the given phenomenon or case.

Sub Learning Objectives:

Student should be able to analyze architectural theory and read architectural works critically as a part of interelation between the work itself, the text and the context of society; Students are able to provide critical arguments for the relationship between architectural works and political, social and cultural contexts, including their relationship to theory, history and the writing of architectural history.

Syllabus:

This course introduces students to the concept of transdisciplinary as a perspective to understand the built environment in Indonesia in relation to the history and theory of architecture. Theories related to anthropology, culture, urban, art, representation of space in various media such as films, museums and cartography will be used to analyze cases related to history and architectural theory including those related to traditional architecture, conservation, and design studies.

Learning Materials:

Studies of architectural history throughout various periods of time; the development of discourse on architectural history and theory; Case Studies

Prerequisite: -

References: Relevant references to the topic offered.

Special Topic on Sustainability
ENAR800051
3 Credits
Learning Objectives:

Students should be able to demonstrate knowledge on current discourse on sustainability and its implementation on architectural design.

Syllabus:

Studies on the development of theories on bulding technology and sustainable environment; studies on relevant issues of sustainability; architectural design innovative practice related to sustainability; innovation on building structure, construction, material and systems.

Prerequisite: -

References: Relevant references to the topic offered.

Curriculum Structure for Fast Track Program

Subject	SKS
Undergraduate Courses	
7th Semester	
Undergraduate Elective: Advanced Research Methods	3
Undergraduate Elective: Advanced Architectural Theories	3
Undergraduate Elective: (taken from Graduate Elective Course)	3
8th Semester	
Undergraduate Elective: Advanced Design Methods	3
Undergraduate Elective: Theory Peminatan	3
Total Transfer Credits	**15 SKS (34%)**
Graduate Courses	
1st Semester	
Graduate Required Course: Advanced Research Methods	3
Graduate Required Course: Advanced Architectural Theories	3
Graduate Elective	3
Sub Total	**9**
2nd Semester	
Graduate Required Course: Advanced Design Methods	3
Mata Ajar Peminatan S2 Theory Course	3
Studio/Workshop (Speciality) 2	5
Applied Data Science	2
Sub Total	**13**
3rd Semester	
Studio/Workshop (Speciality) 1	5
Pre-Thesis	4
Graduate Elective	3
Sub Total	**12**
4th Semester	
Thesis	4
Publication	2
Sub Total	**6**
Total Graduate Credits	**40**

Transition Rules

1. The 2020 curriculum is implemented starting in the Odd Semester 2020/2021. In principle, after the 2016 Curriculum is implemented, only subjects in the 2020 Curriculum will be opened.
2. Class of 2019 and previously followed the 2020 curriculum with transitional rules.
3. A transitional period is for one academic year of 2020/2021 and implemented for subjects where the semester placement changes (from Even to Odd, or vice versa), if necessary, will be opened in both semesters during the transition period (Academic Year 2020 / 2021).
4. If there is a change in the credits of the subjects, the number of credits calculated for graduation is the number of credits at the time the courses are taken. Same or equal subjects with different Credits, if repeated or newly taken will be listed with a new name and calculated with new Credits.
5. For students who have not passed the required courses in the 2016 Curriculum, are required to take the same or equivalent courses in the 2020 Curriculum. (Curriculum 2016 courses that are not listed in the Equality Table means that they have not changed, both the name and the size of their SKS).
6. Students who have not passed Advanced Design and Research Methods (4 credits) in the 2016 Curriculum must take Advanced Design Methods (3 credits) and Advanced Research Methods courses (3 credits) in the 2020 Curriculum to fulfill the required courses.
7. Students in 2019 and previously who have taken Thesis (8 credits) but not yet finished it due to Covid-19 can still take Thesis (8 credits) in odd semester during the transition period.

Table 8 Equivalence of 2016 Curriculum and 2020 Curriculum Master Program in Architecture

No	Course Name in 2016 Curriculum	Credits 2016	Course Name in 2020 Curriculum	Credits 2020
1	Advanced Design and Research Methods	4	Advanced Design Methods	3
			Advanced Research Methods	3
2	Thesis	6	Thesis (will be opened in odd semester transition period)	8

Master Program in Chemical Engineering

Program Specification

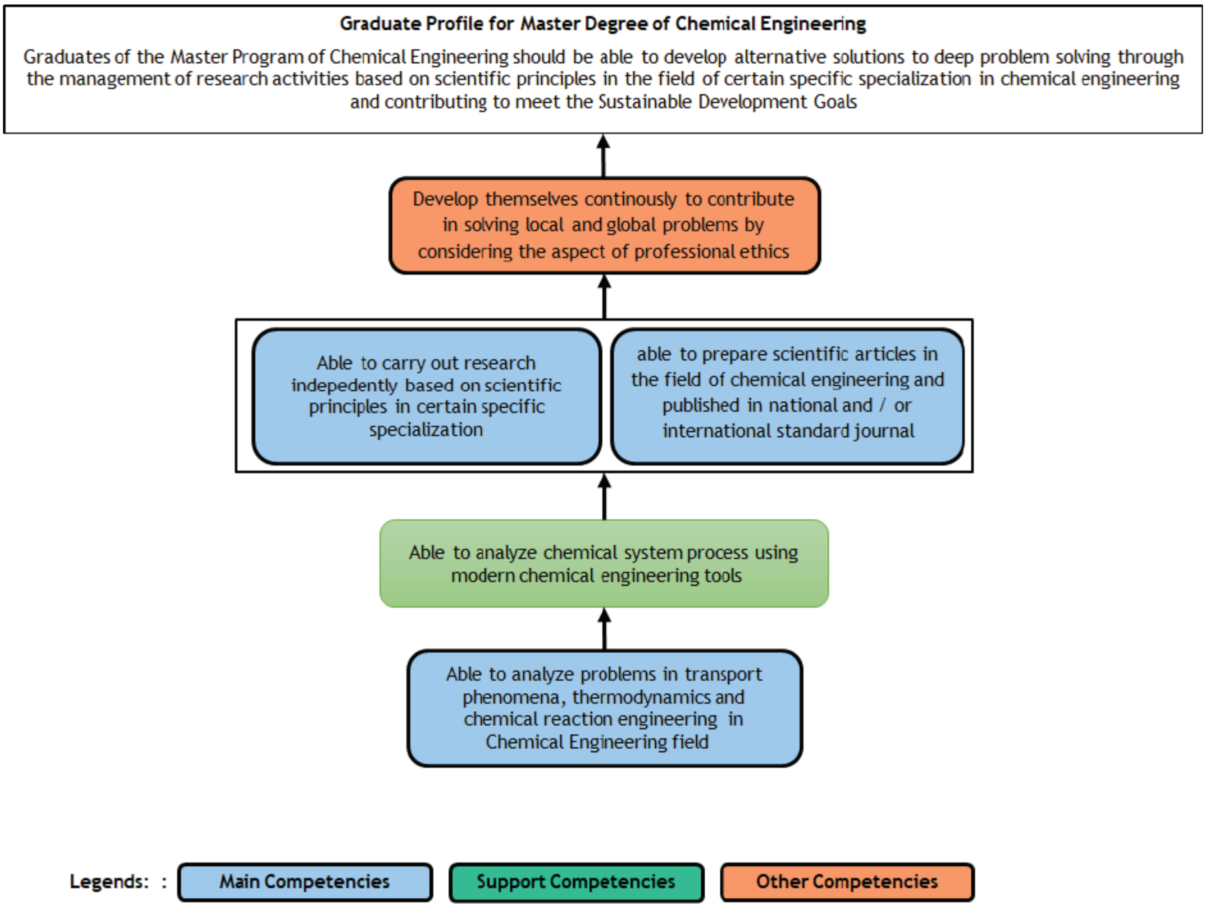
1.	**Awarding Institution**	Universtas Indonesia	
2.	**Host Institution**	Universtas Indonesia	
3.	**Faculty**	Engineering	
4.	**Program Title**	Master Program in Chemical Engineering	
5.	**Vision and Mission**	Vision Becoming a superior and competitive Chemical Engineering Study Program, through efforts to educate the nation's life to improve people's welfare, thus contributing to the development of Indonesian and world society Missions - Providing broad and fair access, as well as quality education and teaching in Chemical Engineering; - Organizing quality Tridharma activities that are relevant to national and global challenges; - Creating graduates of Chemical Engineering who are of high quality, noble character, and able to compete globally; - Creating an academic climate that can support the realization of the vision of the Department	
6.	**Class**	a. Regular b. Gas Management	
7.	**Final Award**	Magister Teknik (MT)	
8.	**Accreditation / Recognition**	BAN-PT: accredited A	
9.	**Language(s) Of Instruction**	Bahasa Indonesia	
10.	**Study Scheme (Full Time / Part-Time)**	Full Time	
11.	**Entry Requirements**	Bachelor degree / equivalent	
12.	**Study Duration**	4 (four) Semesters or 2 (two) Years	
	Type of Semester	Number of semester	Number of weeks/semesters
	Reguler	4	16
	Short (opsional)		
13.	**Aims of the programme:** The aim of the Master in Chemical Engineering program is to provide high-quality graduate-level education so that graduates have the knowledge, abilities, and experience in researching the latest topics in chemical engineering		
14.	**Graduate Profile:** The graduate who is able to develop alternative solutions to the problem deeply through the management of research activities based on scientific principles in the field of specific specialization in chemical engineering and contribute to meeting the Sustainable Development Goals (SDGs)		
15.	**Expected Learning Outcomes (ELO):** 1. Able to analyze problem-related to thermodynamics, transport phenomena, and chemical reaction engineering in the field of chemical engineering 2. Able to analyze chemical process system using modern computation tools 3. Able to manage research activities independently based on scientific principles in certain fields of specialization 4. Able to write and manage scientific articles in the field of chemical engineering and published in national or international publication 5. Able to develop themselves continuously to be able to contribute according to professional ethics in solving local and global problems		

16.	Course composition		
No.	Type of Courses	Credit Hours (SKS)	Percentage
I	Total Compulsory Credits	21	52,5%
II	Total Elective Credits	9	22,5%
III	Scientific Publication, Pra Thesis and Thesis	10	25,0%
	Total	40	100 %
	Total Credit Hours To Graduate		40 Credits

Employment Prospects

A Graduate of Master in Chemical Engineering study program at UI can be contributed in the following areas: in various industrial companies, research, and education institutions such as the chemical industries, oil and gas industries, engineering consultants, LIPI, Lemigas, and other related fields. Job names suitable for graduates of this program include process engineers, control engineers, program managers, project managers, technical managers, lecturers, and researchers. Some graduates have started working before graduating from the study program.

The Network of Expected Learning Outcome (ELO)



Mapping Table for Achieving ELO in the Chemical Engineering Master Program for Regular Class

Expected Learning Outcome (ELO)	Name of Course			
	1st Semester	2nd Semester	3rd Semester	4th Semester
Able to analyze problem related to thermodynamics, transport phenomena, and chemical reaction engineering in field of chemical engineering	Adv Chemical Eng Thermodynamics	Advanced Transport Phenomena Advanced Chemical Reaction Engineering		
Able to analyze chemical process system using modern computation tools	Natural Gas Processing	Advanced Chemical Engineering Modeling		
Able to manage research activities independently based on scientific principles in certain fields of specialization		Research Methodology	Pre Thesis	Thesis
Able to write and manage scientific articles in the field of chemical engineering and published in national or international publication				Scientific Publication
Able to develop themselves continuously to be able to contribute according to professional ethics in solving local and global problems	Sustainable Energy Elective 1		Elective 2 Elective 3	

Mapping Table for Achieving ELO in the Chemical Engineering Master Program for Gas Management Class

Expected Learning Outcome (ELO)	Name of Course			
	1st Semester	2nd Semester	3rd Semester	4th Semester
Able to analyze problem related to thermodynamics, transport phenomena, and chemical reaction engineering in field of chemical engineering	Adv Chemical Eng Thermodynamics			
Able to analyze chemical process system using modern computation tools	Natural Gas Processing	Natural Gas Economics		
Able to manage research activities independently based on scientific principles in certain fields of specialization			Pre Thesis	Thesis
Able to write and manage scientific articles in the field of chemical engineering and published in national or international publication				Scientific Publication
Able to develop themselves continuously to be able to contribute according to professional ethics in solving local and global problems	Sustainable Energy	System Eng Management.	Natural Gas Project Management	
	Elective 1	Elective 2	Health and Safety in Natural Gas Industry	
		Elective 3		

List of Courses for Chemical Engineering Master Program (Regular Class)

Code	Subject	SKS
	Compulsary Courses (21 Credits)	
ENCH800001	Adv Chemical Eng Thermodynamics	3
ENCH800003	Advanced Transport Phenomena	3
ENCH800004	Advanced Chemical Reaction Engineering	3
ENCH800005	Adv Chemical Eng. Modeling	3
ENCH800006	Research Methodology	3
ENCH800009	Natural Gas Processing	3
ENCH800027	Sustainable Energy	3
	Elective Courses (9 Credits)	
	Elective 1	3
	Elective 2	3
	Elective 3	3
	Special Courses (10 Credits)	
ENCH800007	Pre Thesis	2
ENCH800008	Thesis	6
ENCH800055	Scientific Publications	2
	Matriculation Courses for Non-Chemical Engineering Bachelor (13 Credits)	
ENCH600005	Numerical Computation	3
ENCH600010	Transport Phenomena	3
ENCH600013	Chemical Eng Thermodynamics	4
ENCH600019	Chemical Reaction Engineering 1	3

Curriculum Structure Master Program Chemical Engineering

Courses Structure of Master Program in Chemical Engineering for Regular Class

Code	Subject	SKS
	1st Semester	
ENCH800001	Adv Chemical Eng Thermodynamics	3
ENCH800027	Sustainable Energy	3
ENCH800009	Natural Gas Processing	3
	Elective 1	3
	Sub Total	**12**
	2nd Semester	
ENCH800003	Advanced Transport Phenomena	3
ENCH800004	Advanced Chemical Reaction Engineering	3
ENCH800005	Adv Chemical Eng. Modeling	3
ENCH800006	Research Methodology	3
	Sub Total	**12**
	3rd Semester	
ENCH800007	Pre-Thesis	2
	Elective 2	3
	Elective 3	3
	Sub Total	**8**
	4th Semester	
ENCH800008	Thesis	6
ENCH800055	Scientific Publication	2
	Sub Total	**8**
	Total	**40**

Courses Structure of Master Program in Chemical Engineering for Regular Class from Non-Chemical Engineering Bachelor

Code	Subject	SKS
	1st Semester	
Matrikulasi-ENCH600010	Transport Phenomena	-
Matrikulasi-ENCH600005	Numerical Computation	-
Matrikulasi-ENCH600019	Chemical Reaction Engineering 1	-
	Elective 1	3
	Elective 2	3
	Sub Total	**6**
	2nd Semester	
Matrikula-si-ENCH600013	Chemical Eng Thermodynamics	-
ENCH800003	Advanced Transport Phenomena	3
ENCH800004	Advanced Chemical Reaction Engineering	3
ENCH800005	Adv Chemical Eng. Modeling	3
ENCH800006	Research Methodology	3
	Sub Total	**12**
	3rd Semester	
ENCH800001	Adv Chemical Eng Thermodynamics	3
ENCH800027	Sustainable Energy	3
ENCH800009	Natural Gas Processing	3
ENCH800007	Pre-Thesis	2
	Elective 3	3
	Sub Total	**14**
	4th Semester	
ENCH800007	Thesis	6
ENCH800008	Scientific Publication	2
	Sub Total	**8**
	Total	**40**

List of Elective Courses

Code	Subject	SKS
	Elective for Odd Semester	
ENCH800014	Oleochemical Industry	3
ENCH800015	Food Technology	3
ENCH800016	Protein Engineering	3
ENCH800017	Herbal Technology	3
ENCH800018	Composite Material	3

ENCH800019	Applied Thermodynamics	3
ENCH800020	Dynamic System	3
ENCH800021	Thermodynamic Properties of Hydrocarbon	3
ENCH800022	Lubricant Technology	3
ENCH800023	Cryogenic Technology	3
ENCH800024	Combustion Technology	3
ENCH800025	Plasma and Ozone Technology	3
ENCH800026	Heterogeneous Catalytic	3
ENCH800028	Risk Management	3
ENCH800029	Electrochemical Technology	3
ENCH800030	Extraction Technology & Isolation for Natural Products	3
ENCH800031	Special Topic 1	3
ENCH800032	Biochemistry	3
	Elective for Even Semester	
ENCH800034	Storage and Packing Technology	3
ENCH800035	Bioinformatics	3
ENCH800036	Drugs and Cosmetics Technology	3
ENCH800037	Petroleum Processing	3
ENCH800038	Petrochemical Processing	3
ENCH800039	Photocatalytic Technology	3
ENCH800040	Hydrocarbon Exploration and Production	3
ENCH800041	Waste Management and Prevention	3
ENCH800042	Microalgae Cultivation and Development Technology	3
ENCH800043	Plant Utility and Maintenance	3
ENCH800044	Transportation and Utilization of Natural Gas	3
ENCH800045	Mixing Technology	3
ENCH800046	Problem Solving Skills	3
ENCH800047	Polymer Technology	3
ENCH800048	Genetically Modified Organism	3
ENCH800049	Controlled Drug Release Technology	3
ENCH800050	Special Topic 2	3
ENCH800051	Biomass Thermochemical Conversion	3
ENCH800052	Basic Computer Programming	3

List of Courses for Chemical Engineering Master Program (Gas Management Class)

Code	Subject	SKS
	Compulsary Courses (21 Credits)	
ENCH800001	Adv Chemical Eng Thermodynamics	3
ENCH800002	Health and Safety in Natural Gas Industry	3
ENCH800009	Natural Gas Processing	3
ENCH800010	Natural Gas Project Management	3
ENCH800011	Natural Gas Economics	3
ENCH800012	System Eng Management	3
ENCH800027	Sustainable Energy	3
	Elective Courses (9 Credits)	
	Elective 1	3
	Elective 2	3
	Elective 3	3
	Special Courses (Pre-Thesis, Thesis & Scientific Publication) (10 Credits)	
ENCH800006	Pre Thesis	2
ENCH800007	Thesis	6
ENCH800008	Scientific Publications	2

Courses Structure of Master Program in Chemical Engineering for Management Gas Class

Code	Subject	SKS
	1st Semester	
ENCH800001	Adv Chemical Eng Thermodynamics	3
ENCH800027	Sustainable Energy	3
ENCH800009	Natural Gas Processing	3
	Elective 1	3
	Sub Total	**12**
	2nd Semester	
ENCH800011	Natural Gas Economics	3
ENCH800012	System Eng Management.	3
	Elective 2	3
	Elective 3	3
	Sub Total	**12**
	3rd Semester	
ENCH800007	Pre Thesis	2
ENCH800010	Natural Gas Project Management	3
ENCH800012	Health and Safety in Natural Gas Industry	3
	Sub Total	**8**
	4th Semester	
ENCH800008	Thesis	6
ENCH800055	Scientific Publication	2
	Sub Total	**8**
	Total	**40**

List of Elective Courses

Code	Courses	Semester	SKS
ENCH800040	Hydrocarbon Exploration & Production	**1**	3
ENCH800028	Risk Management	**2**	3
ENCH800044	Transportation & Utilization of Natural Gas	**2**	3

Transition Guidance from Curriculum 2016 to 2020 for Master of Regular and Management Gas Classes

1. New curriculum 2020 will be applied effectively from Odd Semester 2020/2021. In principle, after curriculum 2020 is implemented, then only courses from this new curriculum will be opened.
2. For class 2019 and above will follow these transition rules.
3. The enforcement of the transitional period is one year. During this transition period, if a course in curriculum 2020 is in odd Semester while in the previous curriculum in even Semester (vice versa), then this course can be held (if necessary) in both semesters.
4. For students who have not passed the compulsory courses in curriculum 2016, are required to take the same course or equivalent in curriculum 2020.
5. When there is a change in the course credits, then the number of graduation credits counted in is the number of credits when it was taken. The same or equivalent courses, when are equated with different credits, if retaken, or just taken, will be acknowledged under a new name and credits.
6. When a compulsory subject in the curriculum 2016 is deleted, and there is no equivalence in the curriculum 2020 then: For students who have passed these subjects, the credits that are achieved will be counted in the calculation of graduation 40 credits. For students who did not pass these courses, they can take new compulsory courses or choose elective subjects in the curriculum 2020 to complete 40 credits.
7. In addition to changes in curriculum structure from 2016 to 2020, there are also the addition of several elective courses: Teknologi Elektrokimia), Teknologi Pencampuran (Mixing Technology), Teknologi Pengembangan dan Pemanfaatan Mikroalga (Microalgae Cultivation and Development Technology), Teknologi Ekstraksi dan Isolasi Bahan Alam (Extraction & Isolation Technology for Natural Products), Konversi Termokimia Biomassa (Biomass Termochemical Conversion Technology), Modifikasi Genetik Makhluk Hidup (Genetically Modified Organism), dan Dasar Pemrograman Computer (Basic Computer Programming)

Syllabus of Master Program in Chemical Engineering Department for Regular Class

Compulsory Courses

Advanced Chemical Engineering Thermodynamics
ENCH800001
3 CREDITS
Learning Objectives:

Able to understand the basics of thermodynamics, fluid properties, phase equilibrium and reaction and be able to apply it to solve problems of chemical engineering.

Syllabus:

Analysis of the system using the several forms of the first and second laws, the equation network of thermodynamic for thermodynamic properties, condition equation, fluid-phase equilibrium, chemical reaction equilibrium

Prerequisite: Chemical Engineering Thermodynamics

Textbook:
1. Kyle, B.G., Chemical and Process Thermodynamics, 2nd ed., Pretice Hall, 1992.
2. Hand-out Kuliah.
3. Smith J.M. dan van Ness, H.C., Introduction to Chemical Engineering Thermodynamics, 4th ed., McGraw-Hill, 1985.
4. Callen, H.B., Thermodynamics and An Introduction to Thermostatics, 2nd ed., John Wiley and Sons, 1985.

Advanced Transport Phenomena
ENCH800003
3 CREDITS
Learning Objectives:

Able to understand the transport phenomenon of momentum, mass and heat simultaneously and able to apply it at the unit processes that involve the flow of single-phase or multiple phases

Syllabus:

Review of the theory of transfer of momentum, mass and heat simultaneously; analysis and application of single-phase system: mixing and dispersion, mixer; analysis and application of a combination system of gas-liquid phase, gas-solid, liquid-liquid, liquid-solid, gas-liquid-solid

Prerequisite: Transport Phenomena.

Textbook:
1. Bird R.B., Stewart, W.E. dan Lightfoot, E.N., Transport Phenomena, John Wiley & Sons, 2002.
2. Tosun, I., Modellling in Transport Phenomena, Elsevier, 2002.
3. Griskey, R.G., Transport Phenomena and Unit Operation: A Combined Approach, John Wiley & Sons, 2002.
4. Brodkey, R.S. dan Hershey, H.C., Transport Phenomena: A Unified Approach, McGraw-Hill, 1988.

Advanced Chemical Reaction Engineering
ENCH800004
3 CREDITS
Learning objectives:

Able to analyze the phenomenon of chemical kinetics, the kinetics reaction data to determine the equation mechanistic reaction rate; able to design and analyze the performance of non-ideal homogeneous and multiphase chemical reactors.

Syllabus:

Thermodynamics of the reaction; definitions and basic concepts: the rate of reaction, the reaction rate equation, the Arrhenius equation: reaction modeling and data analysis for the determination of reaction rate equations; the introduction of gas-solid heterogeneous catalysts: a reduction in reaction rate equations and data of heterogeneous catalytic reactions of solid-gas; effects of diffusion and heat transfer in the catalytic reaction data interpretation. Design of batch reactor and CSTR (isothermal, non-isothermal) reactor design PFR and PBR (isothermal, non-isothermal) sphere and the membrane reactor design; design-solid heterogeneous catalytic reactors with interstage gas cooler/heater; design of reactors for multiple reactions and mss (multiple steady-state). Design of non-ideal reactor (residence time distribution).

Prerequisite: Chemical Reaction Engineering 2

Textbook:
1. Fogler, H.S., Elements of Chemical Reaction Engineering, Prentice-Hall, 4th Ed., 2006.
2. Smith, J.M., Chemical Engineering Kinetics, 3rd ed., 1981, McGraw-Hill.
3. Thomas, JM, and Thomas WJ., Principles and Practice of Heterogeneous Catalysis, VCH Weinheim, 1997.

Advanced Chemical Engineering Modelling
ENCH800005
3 CREDITS
Learning Objectives:

Able to develop physicochemical model systems in chemical processes and solve it by using numerical methods with the assistance of software program

Syllabus:

Emphirical modelling and physicochemical system in Chemical process ; linear and non linear algebra equation system, simple differential equation, initial problem value and limits problem value, partial differential equation.

Prerequisite: Numerical Computation

Textbook:
1. Bismo, S. dan Muharam, Y., Metode Numerik & Komputasi dengan FORTRAN dan Pascal, 2011.
2. Constantinides, A. dan Mostouvi, N., Numerical Methods for Chemical Engineers with MATLAB Applications, Prentice Hall, 1999.
3. Davis, M.E., Numerical Methods and Modeling for Chemical Engineer, JohnWilley & Sons, New York, 1984.
4. Rice, G.R. dan Duong D.D., Applied Mathematics and Modeling for Chemical Engineers, John Willey & Sons, New York,1995.
5. Tosun, I., Modeling in Transport Phenomena: A Conceptual Approach, Elsevier, 2002.

Research Methodology
ENCH800006
3 CREDITS
Learning Objectives :

Able to determine the appropriate method for research activities and produce the ideas, processes, and scientific research in writing and oral.

Syllabus:

Introduction, techniques to identify problems and arrange hypotheses, think logically, the techniques of scientific writing, technical writing research proposals, designing research techniques, presentation techniques, techniques to collect data, analyze it and present it.

Prerequisites: Students have to take a minimum of 12 credits (minimum value of D) with a GPA of 2.0

Textbook
1. Handout.
2. Research Proposal Format The preparation of various agencies

Natural Gas Processing
ENCH800009
3 CREDITS
Learning Objectives :

Able to design natural gas refineries for piped gas, pressurized natural gas, or LNG if given a fluid composition that reaches the surface of the reservoir.

Syllabus:

Introduction and terms in Natural Gas Processing; Physical Properties of Hydrocarbon Fluid; Hydrocarbon Water System; Hydrate; Dew Point Control Unit; AGRU; Absorption Dehydration Unit; Adsorption Dehydration Regeneration Unit; Heavy Hydrocarbon Recovery Unit; LNG Processing

Prerequisite

Chemical Process Simulation

Textbook :
1. Gas Conditioning and Processing Vol. 1
2. Gas Conditioning and Processing Vol. 2

Sustainable Energy
ENCH800027
3 CREDITS
Learning Objectives:

Able to explain the relationship of energy with a social aspect, economic and environmental and sustainability concepts, and able to analyze the performance of techno-economy and the continuity, especially fossil energy system, new, and renewable.

Syllabus:

Concept of sustainability and sustainable energy, energy hierarchy, energy linkages with economic, environmental and social, fossil energy / fuels and Impacts, global climate change and its mitigation, conversion, transportation / distribution and storage, analysis method of energy sustainability: LCA , sustainability index, hydrogen and fuel cells and nuclear energy, solar energy (PV and thermal), wind and ocean, hydropower, bioenergy, geothermal energy, energy efficiency and conservation, carbon capture and storage

Prerequisites: Chemical Engineering Thermodynamics or Biochemical Engineering

Textbook:
1. Jefferson W. Tester, et al., Sustainable Energy: Choosing Among Options, MIT Press, 2005.
2. Godfrey Boyle, et al., Energy Systems and Sustainability: Power for a Sustainable Future, Oxford University Press, 2003.
3. E. Cassedy S, Prospects for Sustainable Energy: A critical assessment, Cambridge University Press, 2000.
4. DeSimone et al, Eco-Efficiency. The Business Link to Sustainable Development, MIT Press, 1997.
5. D. Elliot, enerfy, Society, and Environment, Technology for a sustainable future, Rouledge, 1997
6. Miller, G. T., Environment Science. Sustaining Earth, Wardworld Publish Co. 1993

Special Courses

Pre-Thesis
ENCH800007
2 CREDITS
Learning Objectives :

Able to produce ideas, processes, and scientific research in writing and oral.

Syllabus:

Introduction, techniques to identify problems and arrange hypotheses, think logically, the techniques of scientific writing, technical writing research proposals, designing research techniques, presentation techniques, techniques to collect data, analyze it and present it.

Prerequisite: -

Thesis
ENCH800008
6 CREDITS
Learning Objectives :

Able to design, conduct, and analyze research in Chemical fields; present research result in oral and writing

Syllabus :

Thesis material based on research topic

Prerequisite:

Based on regulation

Textbook :
1. Petunjuk Penulisan Tugas Akhir UI

Scientific Publications
ENCH800055
2 CREDITS
Learning Objective : -

Syllabus : -

Prerequisite : -

Textbook : -

Matriculation

Numerical Computation
ENCH600005
Learning Objective :

Able to solve Mathematical problems by using numerical methods : method of calculat- ing root of a non-linear algebra equation, method of calculating a linear algebra equation system, methods of calculating non-linear algebra equation system, regression, numerical integration, numerical differentation.

Syllabus :

The solution of single non-linear algebra equation, solution of linear algebra equation system, solution of non linear algebra equations system, regression, numerical integration, numeri- cal differentation.

Prerequisite :

Calculus

Textbook :

1. Bismo, S. dan Muharam, Y., Metode Numerik &

Komputasi dengan FORTRAN dan Pascal, 2011.

2. Constantinides, A. 1. dan Mostouvi, N., Numerical Methods for Chemical Engineers with MATLAB Applications, Prentice Hall, 1999.

Transport Phenomena
ENCH600010
Learning Objective:

Students can identify and describe as well as analyze momentum, mass, and heat transfer phenomenon, through the application of macroscopic and microscopic balance.

Syllabus:

Viscosity and momentum transfer phenomenon, Velocity distribution of laminar flow, Thermal conductivity and energy transfer mechanism, Temperature and concentration distribution in solids and laminar flow, Diffusivity and mass transfer mechanism, Converter equation for isothermal system, Momentum transfer in turbulent flow, Mass and energy transfer in turbulent flow, Transfer between two phases, Macroscopic balance of isothermal and non-isothermal system, Macroscopic balance of multi-component system.

Prerequisite: -

Textbook:
1. R.B. Bird, W.E. Stewart dan E.N. Lightfoot, Transport Phenomena, John Wiley, 1965.
2. Tosun, I., Modeling in Transport Phenomena: A Conceptual Approach, Elsevier, 2002.
3. J.R. Welty et al., Fundamentals of Momentum, Heat and Mass Transfer, 3rd ed., Wiley, 2984.
4. Brodkey, R. S dan RC Herskey, Transport Phenomena, McGraw-Hill, 1998.

Chemical Reaction Engineering 1
ENCH600019
Learning Objective:

Able to comprehend the concept of chemical kinetics and catalysis

Syllabus:

Basic concepts of chemical reaction kinetics, chemical reaction thermodynamics, experiments and kinetics data, formulation of kinetic models, the estimation method of constant values of the kinetic model, the sensitivity analysis of the kinetics model, catalyst and the influence of external and internal diffusion of the chemical reaction rate, the effectiveness factor, the effect of heat displacement at the catalytic reaction.

Prerequisite:

Physical Chemistry

Textbook:
1. Fogler, H.S., Elements of Chemical Reaction Engineering, Prentice-Hall, 3rd Ed., 1999
2. Fogler, H. S., and LeBlanc, Strategies for Creative Problem Solving, Prentice-Hall, 1995.
3. Levenspiel, O., Chemical Reaction Engineering, 2nd Ed., John Wiley & Sons., 1972.
4. K. J. Leidler, Chemical Kinetics, 3rd ed., Parper Publish, 1987.
5. Widodo, W.P., Slamet, Diktat Kuliah Kinetika dan Perancangan Reaktor Kimia, TGP-FTUI, 2002.

Chemical Engineering Thermodynamics
ENCH600013
Learning Objective:

Able to explain the basic principles relating to the PVT and thermodynamic properties of pure and mixtures compounds, mass and energy balance, thermodynamic cycles, phase equilibrium and reaction, and be able to apply problem-solving strategies to resolve the thermodynamic problems in a group.

Syllabus:

Skills assessment: The first law of thermodynamics: energy, enthalpy, steam tables, mass and energy balance of steady state and non-steady system; second law of thermodynamics and cyclic processes: entropy signification, Rankine cycle and refrigeration cycle; thermodynamic properties of pure and mixed compounds: the amount of residual and partial molar quantities; Equilibrium: Raoult's law and liquid-vapor phase equilibrium, activity coefficients and coefficients fugacity no ideal system, the chemical reaction equilibrium and Le Chatelier's principle; Simulation process: module of thermodynamics properties, phase equilibrium module, and reaction equilibrium module .

Prerequisites: -

Textbook:
1. J. M. Smith, H.I.C. van Ness, and M. M. Abbott, Introduction for Chemical Engineering Thermodynamic, 5th ed., McGraw-Hill, 1996.
2. Donald R. Woods, Problem-based Learning: How to gain the most PBL, 1994, Mc-Master University, Hamilton, ON L8S 4L8.
3. Mulia, K dan Wulan, PPDK, Buku Ajar Termodinamika Teknik Kimia.

Elective Courses

Elective Courses in Odd Semester

Oleochemical Industry
ENCH800014
3 CREDITS
Learning Objectives:

Able to know the various processes that commonly used in the oleochemical industry, and able to make a plan to develop the produce of oleochemicals from vegetable oils.

Syllabus:

Fatty acids, biodiesel, paints and polymers, detergents, soaps, fatty alcohol, glycerin, oils and fats, oil and greese, the development of oleochemicals, vegetable oil processing, vegetable oil technology in the process.

Prerequisites:

Organic Chemistry

Textbook:

Oleochemical Manufacture and Applications by Frank D. Gunstone, Richard J. Hamilton. Blackwell

Food Technology
ENCH800015
3 CREDITS
Learning Objectives:

Able to understand the processes of making food in the food industry, which includes the selection, handling, and processing of raw materials, the operating unit of food production, packaging, storage, and control of the process from the beginning stage to the end.

Syllabus:

Introduction, physical properties of raw materials, the basic concepts of energy and mass transfer, reaction kinetics, process control. mixing, filtration, centrifugation, extraction and membrane processes, adsorption and ion exchange column, with the temperature settings, drying, preservation, packaging, food storage, and hygiene.

Prerequisites: -

Textbook:
1. Zeki Berk, Food Process Engineering and Technology, Academic Press, Elsevier 2009
2. Food Technology: an introduction by Anita Tull. Oxford University Press, 2002
3. Introduction to Food Engineering by R. Paul Singh, R. Paul Singh and Dennis R. Heldman. Academic Press
4. Introduction to Food Process Engineering by P. G. Smith. Springer
5. Fundamentals of Food Process Engineering by Romeo T. Toledo. Springer

Protein Engineering
ENCH800016
3 CREDITS
Learning Objectives:

Students are able to determine protein engineering strategies for the benefit of separation, biocatalysts and medic.

Syllabus:

Introduction, Protein docking methods, Protein tagging strategies, Gen synthesis design, Enzyme stabilization, Molecular exploration, Protein engineering, Case study.

Prerequisite: Organic Chemistry

Textbook:
1. Protein Engineering in Industrial Biotechnology, Lilia Alberghina, Harwood academic publishers, 2005
2. Proteins: Biotechnology and Biochemistry by Dr. Gary Walsh. Wiley
3. Protein engineering and design by Sheldon J. Park, Jennifer R. Cochran. CRC Press
4. Protein Engineering and Design by Paul R. Carey. Academic Press
5. Protein Engineering: Principles and Practice. Wiley-Liss

Herbal Technology
ENCH800017
3 CREDITS
Learning Objectives:

Able to explain the development of herbal technology, herbal separation technology, herbal formulation basis, herbal regulation, and distinguish with other pharmaceutical products

Syllabus:

Definition and basic concepts of herbs, herbal materials, herbal separation technology, herbal formulations, herbal regulation.

Prerequisites: Organic Chemistry

Textbook:
1. The Complete Technology Book on Herbal Perfumes & Cosmetics by H. Panda. National Institute of Industrial Research 2003

Composite Material
ENCH800018
3 CREDITS
Learning Objectives:

Able to: Explain the characteristics of composite materials and compare it with conventional materials; Explain the manufacturing process, and research development of composite materials.

Syllabus:

The position of composite materials in materials science in general, common characteristics of composite materials, the type of composite based on the composition, the types of polymer matrix and reinforcement, the role of surface treatment in the strength of composite materials, manufacturing processes, durability, the process of splicing and repair of composite materials, code and standards for application of composite materials, the development of composite materials research.

Prerequisites: Organic Chemistry

Textbook:
1. Fiber-reinforced Composites (Materials Engineering, Manufacturing and Design), P. K. Mallick, Marcel Dekker, Inc., 1993.
2. Handbook of Plastics, Elastomers, and Composites, 3rd ed., Charles A. Harper, McGraw-Hill, 1996.
3. Reinforced Plastics - Theory and Practice, 2nd ed., M. W. Gaylord, Chaners Books, 1974.

Applied Thermodynamics
ENCE800019
3 CREDITS
Learning Objectives:

Students are able to analyze problems of thermodynamics based on a thorough review including fundamental aspects of thermodynamics, experimental, and green chemistry, based on current information from scientific journals

Syllabus:

The case study of industrial thermodynamic, example cycle processes, phase equilibrium, and chemical reaction equilibrium to process and product engineer; friendly solvents such as supercritical CO_2 and ionic liquid

Prerequisites: Chemical Engineering Thermodynamics

Textbook:
1. References relevant to a given problem.
2. Mulia, K and Wulan, PPDK, Textbook of Chemical Thermodynamics

Dynamic System
ENCE800020
3 CREDITS
Learning Objectives:

Able to build dynamic models of process systems, biological, industrial, social and economic.

Syllabus:

Introduction to dynamical systems, causal loops, model and validation, analysis, case study.

Prerequisites: Numerical Computation

Textbook:
1. Forrester, J. W., 2002, Principles of Systems, Productivity Press
2. Goodman, Michael R., 1998, Study Notes in System Dynamics, Productivity Press
3. Richardson, George P. and Pugh III, Alexander L., 1999, Introduction to System Dynamics Modeling, Pegasus Communications
4. Andersen, David, etc., Introduction to Computer Simulation - A System Dynamics: Systems Thinking and Modeling for a Complex World, McGraw-Hill

Thermodynamic System of Hydrocarbon
ENCE800021
3 CREDITS
Learning Objectives:

Able to predict the magnitude of thermodynamic properties of hydrocarbons and the phase condition, either manually or using software calculations.

Syllabus:

Introduction to hydrocarbon thermodynamics properties, basic thermodynamic concepts, P-V-T data correlations, physical properties of hydrocarbon fluids, computing aided thermodynamics properties, the vapor-liquid behavior of two-phase systems, water-hydrocarbon system behavior, product specifications in the disposal lease of hydrocarbon

Prerequisites: Chemical Engineering Thermodynamics

Textbook:
1. Wayne C. Edmister, Byung Ik Lee, Applied hydrocarbon thermodynamics, Volume 1, Gulf Publishing Company (1988), Houston, Texas.
2. John M. Campbell, Gas Conditioning and Processing, Vol. 1, 8th Edition Campbell Petroleum Series 2001.

Lubricant Technology
ENCE800022
3 SKS
Learning Objectives:

Able to explain the working principles of lubrication, lubricant function, and several parameters of the quality and lubricant classification, lubricant chemical, and its production technology, either mineral lubricant, synthesis and vegetal.

Syllabus:

Principles of lubrication on friction and wear phenomena on the two surfaces of solid objects are moving together; mode lubrication: hydrodynamic and elastohydrodynamic; lubricants: mineral, synthetic, and vegetable; additives, formulations, degradation, contamination, and maintenance of lubricants; latest development of lubricant technology .

Prerequisites: Organic Chemistry

Textbook: -
1. E. Richard Booster, Handbook of Lubricant: Theory and Practice of Tribology, Vol. I, Vol. II, Vol. III, CRC Press (1984), Inc., Boca Raton, Florida
2. Mervin H. Jones, Industrial Tribology: The Practical Aspect of Friction, Lubricant, and Wear., Elsevier Scientific Publishing Co., New York, 1983.
3. J. Halling, Principle of Tribology, Macmillan Press Ltd., London, 1978
4. Handout

Cryogenic Technology
ENCE800023
3 CREDITS
Learning Objectives:

Able to explain the various processes to liquefy gas in cryogenic technology

Syllabus:

History and development of cryogenic, cryogenic scope of work. Refrigeration and liquefaction of natural gas, air, oxygen, nitrogen, helium, neon and argon.

Prerequisites: Chemical engineering thermodynamics

Textbook:
1. Timmerhaus, K.D., Cryogenic Process Engineering, Plenum Press 1989, New York.
2. Barron, Randall. Cryogenic Systems, McGraw Hill, 1985, New York.

Combustion Technology
ENCE800024
3 CREDITS
Learning Objectives:

Able to explain the phenomenon of combustion and resolve the problems that rendered correctly.

Syllabus:

Chemical kinetics and combustion, the flame, premix flame, diffusion flame, the combustion process applications.

Prerequisite: Transport Phenomena, Chemical Reaction Engineering 1, Chemical Engineering Thermodynamics

Textbook:
1. Warnatz, J., Maas, U. dan Dibble, R.W., Combustion: Physical and Chemical Fundamentals, Modeling and Simulation, Experiments, Pollutant Formation, 2nd ed., Springer, Heidelberg, 1999.
2. Turns, S.R., An Introduction to Combustion: Concepts and Applications, 2nd ed, McGraw-Hill, 2000.
3. Glassman, I., Combustion, Academic Press, 1997.
4. El-Mahallawy dan el-Din Habik, S., Fundamental and Technology of Combustion, Elsevier, 2002.
5. Combustion, T. J. Poinsot and D. P. Veynante, in Encyclopedia of Computational Mechanics, edited by Erwin Stein, Ren´e de Borst and Thomas J.R. Hughes, 2004 John Wiley & Sons, Ltd.
6. Introduction to Combustion, Concepts and Applications, Stephen R. Turns, 2nd edition, McGraw Hill, 2000
7. Introduction to Combustion Phenomena, A. Murty Kanury, Gordon and Breach Science Publishers, 1975
8. Heat Transfer from Burners, Charles E. Baukal, in Industrial Burners Handbook, edited by Charles E. Baukal, CRC Press, 2004.

Plasma and Ozone Technology
ENCE800025
3 CREDITS
Learning Objectives:

Able to explain the physics and chemistry phenomena of plasma formation and release of electromagnetic energy and the use of plasma and ozone technology.

Syllabus:

Basic phenomena and physical-chemical processes of gases that are given an electrical charge (corona discharge), the generation process or formation of ozone, role and use of plasma technology and ozone in chemical engineering processes, the potential of ozone technology in control technology environmental pollution, the ozone generator module manufacturing equipment.

Prerequisite: Physics Electricity Magnetism

Textbook:
1. E. T. Protasevich: "Cold Non-Equilibrium Plasma", Cambridge International science Publishing, Cambridge, 1999.
2. Rice, R. G., and M. E. Browning: "Ozone Treatment of Industrial Water wate", Notes Data Corroraion, Park Ridyl, 1981.
3. Metcalf & Eddy, Inc. (Tchobano-glous, G., and FL Burton): "Wastewater Engineering: Treatment, Disposal, and Reuse", McGraw-Hill Book. Co., Singapore, 1991.

Heterogeneous Catalyst
ENCE800026
3 CREDITS
Learning Objectives:

Able to explain the phenomenon of basic concepts heterogeneous catalysts and its application

Syllabus:

The general property of catalyst, thermodynamic of the reaction with catalyst, the distribution of the catalyst based on the type of reaction, the core function is active, the method of selecting catalysts for certain reactions, characterization of the corresponding want to know the nature of the target, the catalyst test methods, methods of development of the catalyst, and reaction products.

Prerequisites: Chemical Reaction Engineering 1

Textbook:
1. Nasikin M, Susanto BH, "Katlaisis Heterogen", UI Press, 2010
2. Satterfield, C. N., heterogeneous Catalysis in Industrial Practice, McGraw-Hill Inc., New York, 1991.
3. Rase, F. R., Commercial Catalyst, CRC Press, New York, 1991
4. Richardson, T, J., Principles of Catalyst Development, Plenum Press, New York, 1989
5. Thomas J.M. And WJ Thomas, Principles and Practice of Heterogenous Catalysis, VCH, Weinhem, Germany, 1997
6. Emmet, R. H., Catalysis, Reinhold Publishing Corporation, New York, 1961

Risk Management
ENCH800028
3 CREDITS
Learning Objectives:

Able to explain and apply risk management in a risk assessment.

Syllabus:

Introduction to the risk, the basic principles and guidelines concerning risk, risk management standards, risk assessment, risk analysis, risk analysis and simulation, simulation of the risk with Montecarlo method, the risk of using software simulation crystal ball.

Prerequisites:

Textbook:

J. F. A. Stoner, Management, 1986

Electrochemical Technology
ENCH800029
3 CREDITS
Learning Objectives:

Able to understand the basic principles of electrochemical technology and apply them in the design of electrochemical systems for various applications.

Syllabus:

Basic electrochemical principles and electrochemical cell concepts; electrochemical cell thermodynamics (Nernst equation, Pourbaix diagram, etc.); electrochemical cell kinetics (the mechanism of electrochemical redox reactions, Marcus theory, Butler-Volmer model, etc.); polarization/ overpotential on electrochemical cells (ohm polarization, activation polarization, concentration polarization, etc.); the phenomenon of mass transfer in electrochemical cells (migration, diffusion, convection, etc.); electrochemical analysis (voltammetry, chronoamperometry, AC impedance, etc.); electrode-electrolyte interface phenomena (double layer theory, surface capacitance, ion adsorption, etc.); semiconductor electrodes (photoelectrochemical); and various electrochemical applications (fuel cells, solar cells, batteries, etc.)

Prerequisites:

Physical Chemistry, Thermodynamics of Chemical Engineering, Chemical Reaction Engineering 1

Textbook:

1. Keith B. Oldham dan Jan C. Myland. Fundamentals of Electrochemical Science, Academic Press, Inc., 1st Edition, London, 1994.
2. Richard G. Comption dan Craig E. Banks. Understanding Voltammetry, 3rd Edition, World Scientific, London, 2018
3. Norio Sato. Electrochemistry at Metal and Semiconductor Electrodes, 1st Edition, Elsevier Science & Technology, Oxford, 1998.
4. Marcel Pourbaix. Atlas of Electrochemical Equilibria in Aqueous Solutions, 2nd Edition, NACE International, Brussels, 1974
5. Allen J. Bard, Martin Stratmann, and all authors. Encyclopedia of Electrochemistry, 1st Edition, John Wiley & Sons, New York 2007

Extraction & Isolation for Natural Products Technology
ENCH800030
3 CREDITS
Learning Objectives:

Able to compare various principles that relate to extraction technology and isolation of natural materials; Determine extraction and / or isolation techniques appropriate for certain natural materials; Developing process skills to solve problems related to the field of extraction technology and natural material isolation

Syllabus:

Natural substances and secondary metabolites, Variety of natural material products, Selection and preparation of materials for extraction, Selection and preparation of materials for isolation, Natural material extraction techniques, Fractionation techniques and isolation of natural materials

Prerequisites:

Textbook:

1. Rydberg, Cox, & Musikas. Solvent Extraction Principles and Practice 2nd Edition. Marcel Dekker, Inc. 2004.
2. Meireles, M. Angela A. Extracting Bioactive Compounds for Food Products: Theory and Applications. CRC Press – Taylor & Francis Group, LLC. 2009.
3. Rostagno, Mauricio A. & Prado, Juliana M. Natural Product Extraction: Principles and Applications. RSC Publishing. 2013.

Special Topic 1
ENCH800031
3 CREDITS

Biochemistry
ENCH800032
3 CREDITS
Learning Objectives:

Able to describe the relationship of structure and chemical compounds in living things, including the functions, synthesis processes and metabolism of these chemical compounds that occur in living things.

Syllabus:

Introduction to cells and tissues; Membranes and organelles; The role of DNA and protein; Energy in cells; Nucleic acid; Structure and replication of DNA and RNA; Transcription and translation; Amino acid; Synthesis and structure of proteins; Enzyme; Metabolism

Prerequisites:

Textbook:

1. Lehninger Principles of Biochemistry & eBook by Albert Lehninger, David L. Nelson and Michael M. Cox (Jun 15, 2008)
2. Biochemistry (3rd Edition) by Christopher K. Mathews, Kensal E. van Holde and Kevin G. Ahern (Dec 10, 1999)
3. Bruckner, Monica Z. Basic Cellular Staining.Serc.carleton.edu.
4. Aryulina, D., Manaf, S., Muslim, C., & Winarni, E.W. 2007. BIOLOGI 3. Jakarta : Esis. Binur
5. Robi. 2011. Teknologi RNA Interference. Retrieved from Campbell, Reece. 2009. Biology. Sansome Street, San Francisco: Pearson Benjamin Cummings.

Elective Courses in Even Semester

Packaging and Storage Technology
ENCE800034
3 CREDITS
Learning Objective :

Students are able to describe characteristics, packaging and storage food technology, the relation between storage and packaging with quality of food, describe factors affecting deviation of food qualities as well as able to choose storage methods and packaging types which is appropriate to food materials.

Syllabus :

Hydratase, material storage technology and food products, deviation of food material qualities, microbial contaminant, purpose and function of food packaging, interaction between food packaging and packaging material types

Prerequisite : -

Textbook :

1. Examining Food Technology by Anne Barnett. Heinemann Secondary,1996
2. Julianti, Sri. The Art of Packaging. Gramedia Pustaka Utama. 2014.
3. Han, Jung H., et al. Innovations in Food Packaging. Elsevier. 2005.

Bioinformatics
ENCE800035
3 CREDITS
Learning Objective :

Are able to explore database and programs to be applied in genetic engineering sectors, proteomic etc

Syllabus :

Database, genomics, genetic molecular, philogeny, protein structure, metabolism and tissues

Textbook :

1. Bioinformatics by Shalini Suri. APH Publishing, 2006
2. Bioinformatics: A Primer by Charles Staben and Staben. Jones & Bartlett Publishers, 2005

Drugs and Cosmetics Technology
ENCE800036
3 CREDITS
Syllabus :

Definition of drugs and cosmetics, types of skins and characteristics, cosmetic types, ethics and regulation of drugs and cosmetics, new drug development technology, process technology in drug and cosmetics industries, packaging technology of drugs and cosmetics technology.

Prerequisite : Organic Chemistry

Textbook :

1. Handbook of Cosmetic Science and Technology by Andre O. Barel, Marc Paye, Howard I. Maibach. INFRMA-HC 2009
2. Biodesign: The Process of Innovating Medical Technologies by Stefanos Zenios, Josh Makower , Paul Yock , Todd J. Brinton, Uday N. Kumar, Lyn Denend, Thomas M. Krummel. Cambridge University Press 2009

Petroleum Processing
ENCE800037
3 CREDITS
Learning Objectives:

Able to explain petroleum characteristics and its refined product and the stages of the process from various petroleum processing technologies.

Syllabus:

Introduction terminology, oil composition, thermal properties of petroleum, chemical processing of petroleum processing, distillation, hydrogenation and dehydrogenation, cracking processes, the processes of reforming, gas processing and petroleum light products, product improvement.

Prerequisites: Fluid and Particle Mechanics, Thermodynamics, Mass Transfer.

Textbook:

1. James G. Speight, The Chemistry and Technology of Petroleum, Marcel Dekker, 1991.
2. James H. Gary and Glenn E. Handwerk, Petroleum Refining, Marcel Dekker, 1974.
3. D. S. J. Jones, Elements of Petroleum Processing, John & Sons Woley

Petrochemical Processing
ENCE800038
3 CREDITS
Learning Objectives:

Able to explain the development of petrochemical products and raw material potential, upstream / downstream petrochemical production lines (olefin center, aromatic center, and the pathways of methane) and the major production processes of several petrochemical industries through methane, olefins and aromatics; able to analyze the impact of industrial processes and petrochemical products to the environment.

Syllabus:

History of the general petrochemical products development and raw material potential, the scope of the petrochemical industry, petrochemical classification process, the type and processing raw materials into petrochemical products, the details of various petrochemical industry: olefins center, aromatics and the center line of methane, industrial and environmental impact of products petrochemicals.

Prerequisites: Organic Chemistry

Textbook:
1. Martyn V. Twigg, "Catalyst Handbook", 2nd Ed., Wolfe Pub. Ltd..
2. Lewis T. Hatch, Sami Matar, "From Hydrocarbon to Petrochemical".
3. Wells, Margaret G., "Handbook of Petrochemicals and Processes", Gower Publishing Company Ltd., 1991.
4. Pandjaitan Maraudin, Petrochemical Industry and The effect of environment, Gadjah Mada University Press, 2002.

Photocatalysis Technology
ENCE800039
3 CREDITS
Learning Objectives:

Able to understand the basic concepts and photocatalysis and apply them in the various simple daily problem, especially related to environment, health, and energy.

Syllabus:

The basic concept photocatalysis processes, thermodynamics and kinetics of photocatlytic process, semiconductor photocatalyst materials, the basic parameters of photocatlytic process, Photocatalyst Nanomaterial Engineering, photocatlytic applications for degradation of organic pollutants and heavy metals, photocatalysis applications for self-cleaning and anti fogging, photocatalysis applications for anti-bacterial and cancer therapy, photocatalysis applications for engineering 'daily life tools', photocatalysis applications in renewable energy sector, solar detoxification engineering with photocatalysis, intensification of photocatalysis process.

Prerequisites: Chemical Reaction Engineering 1

Textbook:
1. M. Schiavello, Heterogeneous Photocatalysis, John Wiley & Sons, 1997.
2. A. Fujishima, K. Hashimoto, and T. Watanabe, TiO_2 Photocatalysis: Fundamentals and Applications, BKC Inc. Japan, 1999.
3. J.B. Galvez, et.al., Solar Detoxification, Natural Sciences, Basic and Engineering Sciences, UNESCO.
4. M. Kaneko, I. Okura, Photacatalysis Science and Technology, Springer USA, 2002.
5. C.A. Grimes, G.K. Mor, TiO_2 Nanotube Arrays: Synthesis, Properties, and Applications, Springer, New York, 2009.
6. Paper-paper dan bahan lain dari berbagai Jurnal Ilmiah dan website.

Exploration and Production of Hydrocarbon
ENCE802110
3 CREDITS
Learning Objectives:

Students are able to explain the economic concept of natural gas and analyze the 4e economy.

Syllabus:

Introduction of hydrocarbon, life cycle of field development, hydrocarbon form and hydrocarbon property and reservoir, hydrocarbon exploration: geology, geophysics, and drilling, field appraisal, reservoir development, drilling development, hydrocarbon production, HSE, hydrocarbon economy and lease, coal and hydrocarbon unconventional (CBM, Shale gas, and Hydrate Gas)

Prerequisites:-

Textbook:
1. Frank Jahn et all, 2008, Hydrocarbon Exploration and Production, Developments in Petroleum Science, second edition
2. Babusiauz et al, 2004, Oil and Gas Exploration and Production. Reserves, Cost and Contracts, IFP-Technip,
3. M. Kelkar, 2008, Natural Gas Production Engineering, PennWell Publications
4. Norman J. Hyne, 2001, Nontechnical Guide to Petroleum Geology, Exploration, Drilling and Production, Pennwell Books, 2 edition.

Waste Management and Prevention
ENCE800041
3 CREDITS
Learning Objectives:

Students are able to explain the concepts of pollution prevention and able to design the waste treatment system.

Syllabus:

Introduction to the concept of pollution prevention, waste water treatment outline and preparation, waste water treatment in physical, biological, and chemical as well as the operating unit, bioremediation, bioseparation and biodegradation, advanced oxidation processes, the handling of waste gas, waste handling B3, solid waste handling , effluent treatment, gas, is unconventional.

Prerequisites: Chemical Reaction Engineering 1.

Textbook:
1. Freeman, H. M., Industrial Pollution Prevention Handbook, McGraw-Hill, New York, 1995.
2. Eckenfelder, W. W., Jr.., Industrial Water Pollution Control. 3rd ed. McGraw-Hill International Editions, New York, 2000.
3. Metcalf & Eddy. (Revised by Tchobanoglous, G. & F. L. Burton). Waste Water Engineering: Treatment, Disposal, Reuse, 3rd ed., McGraw-Hill, Singapore, 1991.
4. Heinson R. J. & R. L. Cable. Source and Control of Air Pollution. Prentice Hall. New Jersey. Of 1999.
5. Legislation on the prevention of pollution and waste management.
6. Journals, the Internet.

Microalgae Cultivation and Development Technology
ENCH800042
3 CREDITS
Learning Objectives:

Able to have insight into the use of microalgae from the cultivation process to its conversion into products of high economic value; able to develop the utilization of microalgae by using a variety of technologies that are currently developing.

Syllabus:

Introduction to microalgae, microalgae cultivation process, microalgae harvesting techniques, the process of extracting microalgae into algal oil and its residues, economic analysis of the development and utilization of microalgae.

Prerequisites:

Textbook:

1. Richmond, Amos, et al. 2013. Handbook of Microalgal Culture: Applied Phycology and Biotechnology, 2nd Ed. John Wiley and Sons
2. E.W. Becker. 1994. Microalgae: Biotechnology and Microbiology. London, Cambridge University Press.

Utilities and Plant Maintenance

ENCE800043
3 CREDITS
Learning Objectives:

Able to explain the strategy of plant and utility maintenance.

Syllabus:

Plant maintenance strategy: maintenance program, maintainability, reliability, planning and scheduling

Prerequisite: Chemical Engineering Thermodynamics

Handbook:
1. Dhillon, B.S., Engineering Maintenance: A Modern Approach, CRC Press, 2002.
2. Higgins, L.R., Mobley, R.K. dan Smith, R., Maintenance Engineering Handbook, McGraw-Hill, 2002.
3. Sanders, R.E., Chemical Process Safety, Elsevier, 2005.
4. Palmer, D., Maintenance Planning and Scheduling Handbook, McGraw-Hill, 1999.

Transportation and Utilization of Natural Gas

ENCH800044
3 CREDITS
Learning Objectives:

Able to analyze several options for the use of natural gas for both energy and feedstocks

Syllabus:

Overview of natural gas: nature and quality, historical milestones, environmental aspects, international issues, and structure of the natural gas industry; transportation and storage of natural gas in the gas phase and liquid phase; natural gas utilization: gas as fuels, gas to synfuels and chemicals, gas to wires/power

Prerequisites: -

Textbook: -

Mixing Technology

ENCH800045
3 CREDITS
Learning Objectives:

Able to understand the basic principles of mixing technology and apply them in the design of mixing systems for various applications in industry.

Syllabus:

Definition of mixing, basic principles and basic concepts of mixing; mixing and mixing mechanism, mixing thermodynamics, mixing fluid flow, friction in mixing, etc.), types of mixing (gas-liquid, liquid-liquid, liquid-solid, suspension, emulsification), mixing techniques (agitation, blending, mixing, particle size reduction, sear etc.), mixing equipment both batch and continuous (mixer type, drainage type, etc.), mixing monitoring and control. Examples of the application of blending in the chemical, pharmaceutical, cosmetic and food industries.

Prerequisites:

Physical Chemistry, Fluid Mechanics and Materials Science

Textbook:

1. Handbook of Industrial Mixing: Science and Practice edited by Edward L. Paul, Victor A. Atiemo-Obeng, Suzanne M. Kresta, John Wiley and Sons Inc. Publication (2003).
2. Food Mixing: Principles and Applications, edited by P. J. Cullen, Ireland, John Wiley and Sons Inc. Publication (2007).
3. Pharmaceutical Blending and Mixing 1st Edition by P. J. Cullen (Editor), Rodolfo J. Romañach (Editor), Nicolas Abatzoglou (Editor), Chris D. Rielly, John Wiley and Sons Inc. Publication (2015)

Problem Solving Skills

ENCH800046
3 CREDITS
Learning Objectives:

Able to develop an understanding of the Problem Based Learning (PBL) learning method in order to be able to direct their own learning (independent learning), communicate effectively and work in groups; able to develop the ability to think critically, creatively, innovatively and have the intellectual ability to solve problems effectively both individually and in groups

Syllabus:

Introduction to PBL, individual problem-solving concepts, problem-solving concepts in groups

Prerequisites:

Textbook:

1. Woods, D. R., 1994, Problem based learning: How to gain the most from PBL, McMaster University, Hamilton, ON L8S 4L8.
2. Journal or articles related to each PBL problem.

Polymer Technology

ENCH800047
3 CREDITS
Learning Objectives:

Able to develop an understanding of the basic principles of polymer synthesis and characterization, so that they can understand, solve polymer problems found in daily life and in industry, and can keep abreast of developments in the latest polymer technology.

Syllabus:

The concept of polymers, Synthesis and kinetics of polymerization, Polymer solutions, Characterization, Plastic manufacturing processes.

Prerequisites: Organic Chemistry

Textbook:

1. Billmeyer, F.W, 2011, Textbook of Polymer Science,3rd edition, John Wiley & Sons Inc.
2. Young, R.J. and Lovell, P.A, 2011, Introduction to Polymers, R.J.Lovell, 3rd edition, CRC Press. Taylor & Francis Group, Boca Raton, FL 33487-2742.
3. Seymour, R.B, 1989, Polymers for Engineering Applications, ASM International.
4. Crawford, R.J, 1998, Plastic Engineering, 3rd edition, Butterworth-Heinemann, Woburn, MA 01901-2041.

5. Woods, D. R., 1994, Problem based learning: How to gain the most from PBL, McMaster University, Hamilton, ON L8S 4L8.
6. Journal or articles related to each PBL problem.

Genetically Modified Organism

ENCH800048
3 CREDITS
Learning Objectives:

Students are able to plan the design of transgenic organisms for purposes in the fields of food, pharmacy and health, energy, or the environment as one of the supporting knowledge in Bioprocess Technology courses

Syllabus:

Gene expression and function, genome, introduction and development of GMO organisms, genome modification techniques, methods of analyzing GMO organisms, GMO organisms in food, GMO organisms in pharmacy and health, GMO organisms in energy, GMO organisms in the field the environment, and the latest research and applications related to GMO organisms.

Prerequisites: Genetic Engineering

Textbook:

1. Harvey Lodish, Arnold Berk, Chris A. Kaiser and Monty Krieger. W. H. Molecular Cell Biology. 6th edition. FreemanS
2. T. A. Brown. 2010. Gene Cloning and DNA Analysis. 6th edition. Willey Blackwell: Hongkong.
3. Jurnal ilmiah terbaru terindeks scopus

Drug Controlled Released Technology

ENCE800049
3 CREDITS
Learning objective :

Able to describe the principle of control drug release or bioactive compound for medical purposes and utilize the principle to apply control drug released technology

Syllabus :

Polymeric biomaterial that is easily degradable, various methods to drug encapsulation and bioactive compounds in nano/microsphere, diffusion and permeation, the strategy of control released, case study

Prerequisite : Organic Chemistry

Textbook :

1. Juergen Siepmann et al. (ed.) Fundamentals and Applications of Controlled Release Drug Delivery, Springer
2. Clive Wilson and Patrick Crowley (ed.) Controlled Release in Oral Drug Delivery, Springer
3. Hong Wen and kinam Park (ed.) Oral Controlled Release Formulation Design and Drug Delivery, Wiley, 2010.
4. WM Saltzman, Drug Delivery: Engineering Principles for Drug Therapy, Oxford University Press, 2001.
5. Nissim Garti, Delivery and controlled release of bioactives in foods and nutraceuticals, CRC Press, 2008.

Special Topic 2

ENCH800050
3 CREDITS

Biomass Thermochemical Conversion Technology

ENCH800051
3 CREDITS
Learning Objectives:

Able to understand the chemical characteristics of biomass and the basic principles of thermo-chemical biomass conversion technology and its application in the design of biomass thermochemical conversion systems to produce fuels and chemicals.

Syllabus:

Chemical characteristics of biomass, biomass classification, thermo-chemical conversion through pyrolysis (fast pyrolysis, slow pyrolysis, co-pyrolysis, hydrodeoxygenation, catalytic pyrolysis, catalytic co-pyrolysis, pyrolysis reactor), thermo-chemical conversion through biomass gasification, thermo-chemical conversion through biomass ligation , physical and chemical analysis of biomass feed and biomass thermo-chemical conversion products, pyrolysis for the manufacture of biofuels and chemicals, biomass gasification for the manufacture of synthetic gases, liquefaction of biomass for the manufacture of biofuels.

Prerequisites:

Organic Chemistry, Heat Transfer, Chemical Reaction Techniques 1

Textbook:

1. Robert C. Brown, Thermochemical processing of biomass: conversion into fuels, chemicals and power, 2nd edition, Wiley Series in Renewable Resources, 2019
2. Mark Crocker, Laurie Peter, Ferdi Schuth, Tim Z. Zhao, Heinz Frei, Thermochemical conversion of biomass to liquid fuels and chemicals, RSC Publishing, 1st edition, 2010
3. James Clark and Fabien Deswarte, Introduction to chemicals from biomass, 2nd edition, John Wiley and Sons, 2015
4. Piet Schenkelaars, Value-added chemicals from biomass, Pira International Ltd, 2012

Basic Computer Programming

ENCH800052
3 CREDITS

Learning Objectives:

Able to formulate and solve cases using logical concepts and programming algorithms and able to construct simple programs consisting of consecutive instructions in Python and MATLAB.

Syllabus:

Introduction: Why should one learn to write programs; Variables, expressions, and statements; Conditional executions; Functions; Iteration; Strings; Files; Lists; Dictionaries; Tuples; Using Python for numerical integration with the Simpson's rule, to solve root finding problem employing the secant method, to solve ordinary differential equation; Introduction to MATLAB/GNU Octave; Numerical methods with MATLAB/GNU Octave; Application of MATLAB/GNU Octave in transport phenomena and chemical reaction engineering.

Prerequisites:

Textbook:

1. Charles R. Severance: Python for Everybody, accessible via https://www.py4e.com

2. John. M. Zelle: Python Programming: An Introduction to Computer Science, 3rd edition, 2016.

3. Yeong Koo Yeo: Chemical Engineering Computation with MATLAB, CRC Press, 2017.

Syllabus of Master Program in Chemical Engineering Department for Gas Management Class

Compulsary Courses

Advanced Chemical Engineering Thermodynamics
ENCH800001
3 CREDITS
Learning Objectives:

Able to understand the basics of thermodynamics, fluid properties, phase equilibrium and reaction and be able to apply it to solve problems of chemical engineering.

Syllabus:

Analysis of the system using the several forms of the first and second laws, the equation network of thermodynamic for thermodynamic properties, condition equation, fluid-phase equilibrium, chemical reaction equilibrium

Prerequisite: Chemical Engineering Thermodynamics

Textbook:
1. Kyle, B.G., Chemical and Process Thermodynamics, 2nd ed., Pretice Hall, 1992.
2. Hand-out Kuliah.
3. Smith J.M. dan van Ness, H.C., Introduction to Chemical Engineering Thermodynamics, 4th ed., McGraw-Hill, 1985.
4. Callen, H.B., Thermodynamics and An Introduction to Thermostatics, 2nd ed., John Wiley and Sons, 1985.

Health and Safety in Natural Gas Industry
ENCH800002
3 CREDITS
Learning Objectives:

Able to identify the condition of health and safety in the geothermal industry and propose ways of overcoming problems of health and safety with observe to safety laws and regulations relating to the work environment.

Syllabus:

The law and regulations relating to safety, national standards and international standards related to safety analysis work, Dual–function chemicals, Hazard Identification and Risk Assessment (HIRA), Hazard Identification (HAZID) and Hazard Operability Study (HAZOPS).

Prerequisites: -

Textbook:

1. Safety Act of 1970 1

2. Regulation of the Minister of Labor, Technical Guidelines for Safety Audit management system and Occupational Health, 1996.

3. International Labor Office, Prevention of Major Industrial Accidents, 1991.

4. Chemical Process Safety Modules

Natural Gas Processing
ENCH800009
3 CREDITS
Learning Objectives :

Able to design natural gas refineries for piped gas, pressurized natural gas, or LNG if given a fluid composition that reaches the surface of the reservoir.

Syllabus:

Introduction and terms in Natural Gas Processing; Physical Properties of Hydrocarbon Fluid; Hydrocarbon Water System; Hydrate; Dew Point Control Unit; AGRU; Absorption Dehydration Unit; Adsorption Dehydration Regeneration Unit; Heavy Hydrocarbon Recovery Unit; LNG Processing

Prerequisite

Chemical Process Simulation

Textbook :
1. Gas Conditioning and Processing Vol. 1
2. Gas Conditioning and Processing Vol. 2
3. Maddox, R.N. dan Morgan, D.J., Pengondisian dan pemrosesan gas, Vol 4: Mengolah gas dan sulfur pemulihan, Campbell Petroleum Series, 1998.
4. Kohl, A. dan Nielsen, R., pemurnian gas, Edisi ke-5, Gulf Publishing Company, 1997.
5. Kidnay, A.J. dan Parrish, W.R., Fundamentals of natural gas processing, Taylor & Francis, 2006

Natural Gas Project Management
ENCH800010
3 CREDITS
Learning Objectives:

Able to apply project management in their fields with appropriate as well as apply it in our main fields

Syllabus:

Concept Project - Production, Project Life Cycle, Project Selection, Project Planning, Project Implementation, Project Completion & Evaluation.

Prerequisite -

Textbook :
1. Suharto, Imam, Manajemen Proyek,1990

Natural Gas Economics
ENCH800011
3 CREDITS
Learning Objective :

Able to explain the concept of natural gas economics and analyze the economics of the natural gas supply chain and natural gas projects.

Syllabus :

Introduction to the structure of the natural gas industry, natural gas market, gas prices and tariffs, natural gas contracts, the economics of the natural gas supply chain from the production, transportation and use of natural gas, gas projects and financial aspects.

Prerequisite :

Engineering Economics

Textbook : -

Engineering System Managemen
ENCH800012
3 CREDITS
Learning Objectives:

Able to describe analysis system, simulation, and related processes until becoming an engineering product which is appropriate with consumer needs

Syllabus:

Design, manufacture, and complex system operation that is the main challenge from a manager nowadays. This system has a strict schedule as well as a financial limitation by pressure in technological development, requires new tools for project planning, organizing, and controlling. This course gives essential knowledge for new management system development as well as a modified complex system. This course also gives a brief understanding of marketing strategy, determining the relation between superior value versus price. These strategies based on marketing as well as how this activity is connected to basic marketing functions such as sales and promotions.

Prerequisites: -

Textbook: -

Sustainable Energy
ENCH800027
3 CREDITS
Learning Objectives:

Able to explain the relationship of energy with a social aspect, economic and environmental and sustainability concepts, and able to analyze the performance of techno-economy and the continuity, especially fossil energy system, new, and renewable.

Syllabus:

Concept of sustainability and sustainable energy, energy hierarchy, energy linkages with economic, environmental and social, fossil energy/fuels and Impacts, global climate change and its mitigation, conversion, transportation/distribution and storage, the analysis method of energy sustainability: LCA, sustainability index, hydrogen and fuel cells and nuclear energy, solar energy (PV and thermal), wind and ocean, hydropower, bioenergy, geothermal energy, energy efficiency and conservation, carbon capture, and storage

Prerequisites:

Chemical Engineering Thermodynamics or Biochemical Engineering

Textbook:

1. Jefferson W. Tester, et al., Sustainable Energy: Choosing Among Options, MIT Press, 2005. Godfrey Boyle, et al., Energy Systems and Sustainability: Power for a Sustainable Future, Oxford University Press, 2003.
2. E. Cassedy S, Prospects for Sustainable Energy: A critical assessment, Cambridge University Press, 2000.
3. DeSimone et al., Eco-Efficiency. The Business Link to Sustainable Development, MIT Press, 1997.
4. D. Elliot, Energy, Society, and Environment, Technology for a sustainable future, Rouledge, 1997
5. Miller, G. T., Environment Science. Sustaining Earth, Wardworld Publish Co. 1993

Special Courses

Pre-Thesis
ENCH800007
2 CREDITS
Learning Objectives :

Able to produce ideas, processes, and scientific research in writing and oral.

Syllabus:

Introduction, techniques to identify problems and arrange hypotheses, think logically, the techniques of scientific writing, technical writing research proposals, designing research techniques, presentation techniques, techniques to collect data, analyze it and present it.

Prerequisite: -

Thesis
ENCH800008
6 CREDITS
Learning Objectives :

Able to design, conduct, and analyze research in Chemical fields; present research result in oral and writing

Syllabus :

Thesis material based on research topic

Prerequisite:

Based on regulation

Textbook :
1. Petunjuk Penulisan Tugas Akhir UI

Scientific Publications
ENCH800055
2 CREDITS
Learning Objective : -

Syllabus : -

Prerequisite : -

Textbook : -

Elective Courses

Elective Courses in Odd Semester

Hydrocarbon Exploration and Processing
ENCH800040
3 CREDITS
Learning Objectives:

Able to explain the economic concept of natural gas as well as analyze the economics of exploration oil and natural gas production

Syllabus:

Introduction of hydrocarbon, the life cycle of field development, hydrocarbon form and hydrocarbon property and reservoir, hydrocarbon exploration: geology, geophysics, and drilling, field appraisal, reservoir development, drilling development, hydrocarbon production, HSE, hydrocarbon economy and lease, coal and hydrocarbon unconventional (CBM, Shale gas, and Hydrate Gas)

Prerequisites:

Textbook:

1. Frank Jahn et all, 2008, Hydrocarbon Exploration and Production, Developments in Petroleum Science, second edition.
2. Babusiauz et al., 2004, Oil and Gas Exploration and Production. Reserves, Cost and Contracts, IFP-Technip.
3. M. Kelkar, 2008, Natural Gas Production Engineering, Pennwell Publications.

4. Norman J. Hyne, 2001, Nontechnical Guide to Petroleum Geology, Exploration, Drilling and Production, Pennwell Books, 2 edition

Elective Courses in Even Semester

Risk Management
ENCH800028
3 CREDITS
Learning Objectives:

Students can explain and apply risk management in a risk assessment.

Syllabus:

Introduction to the risk, the basic principles and guidelines concerning risk, risk manage- ment standards, risk assessment, risk analysis, risk analysis and simulation, simulation of the risk with Montecarlo method, the risk of using software simulation crystal ball.

Prerequisites:

Textbook:

J. F. A. Stoner, Management, 1986

Transportation and Utilization of Natural Gas
ENCH800044
3 CREDITS
Learning Objectives:

Able to analyze several options for the use of natural gas for both energy and feedstocks

Syllabus:

Overview of natural gas: nature and quality, historical milestones, environmental aspects, international issues, and structure of the natural gas industry; transportation and storage of natural gas in the gas phase and liquid phase; natural gas utilization: gas as fuels, gas to synfuels and chemicals, gas to wires/power

Prerequisites: -

Textbook: -

Master Program in Industrial Engineering

Program Specification

1.	**Degree Awarding University**	Universtas Indonesia
2.	**Managing Institution**	Universtas Indonesia
3.	**Faculty**	Engineering
4.	**Study Program**	Master Program of Industrial Engineering
5.	**Vision and Mission**	Vision: To be a leading master study program in Indonesia in developing industrial engineering knowledge to design, improve, and install a complex and industrial systems through analysis and synthesis processes in scientific research principles to increase productivity and sustainable quality. Mission: To conduct an Industrial Engineering graduate program with an international perspective supported by research that can compete internationally to support sustainable development goals in Indonesia.
6.	**Class**	Reguler
7.	**Degree**	Master of Engineering
8.	**Accreditation Status**	A-grade based on BAN-PT Accreditation
9.	**Language**	Bahasa Indonesia
10.	**Study Scheme**	Full Time
11.	**Submission Requirement**	Hold a Bachelor's degree in Engineering, Natural Science, Economics, and Business; passed the UI entrance exam.
12.	**Duration**	2 years

	Semester	Number of semester	Number of weeks/semesters
	Reguler	4	16
	Short Semester	1	8

13. Aims of the program:

1. To implement processes of analyzing and synthesizing based on scientific principles in Industrial Engineering's body of knowledge in designing, improving, and installing integrated systems.
2. To excel in research skills and scientific knowledge in advancing graduate students' careers.
3. To master the ethics of work in scientific communities for promoting improvement in the organizations.

14. Graduates Profile:

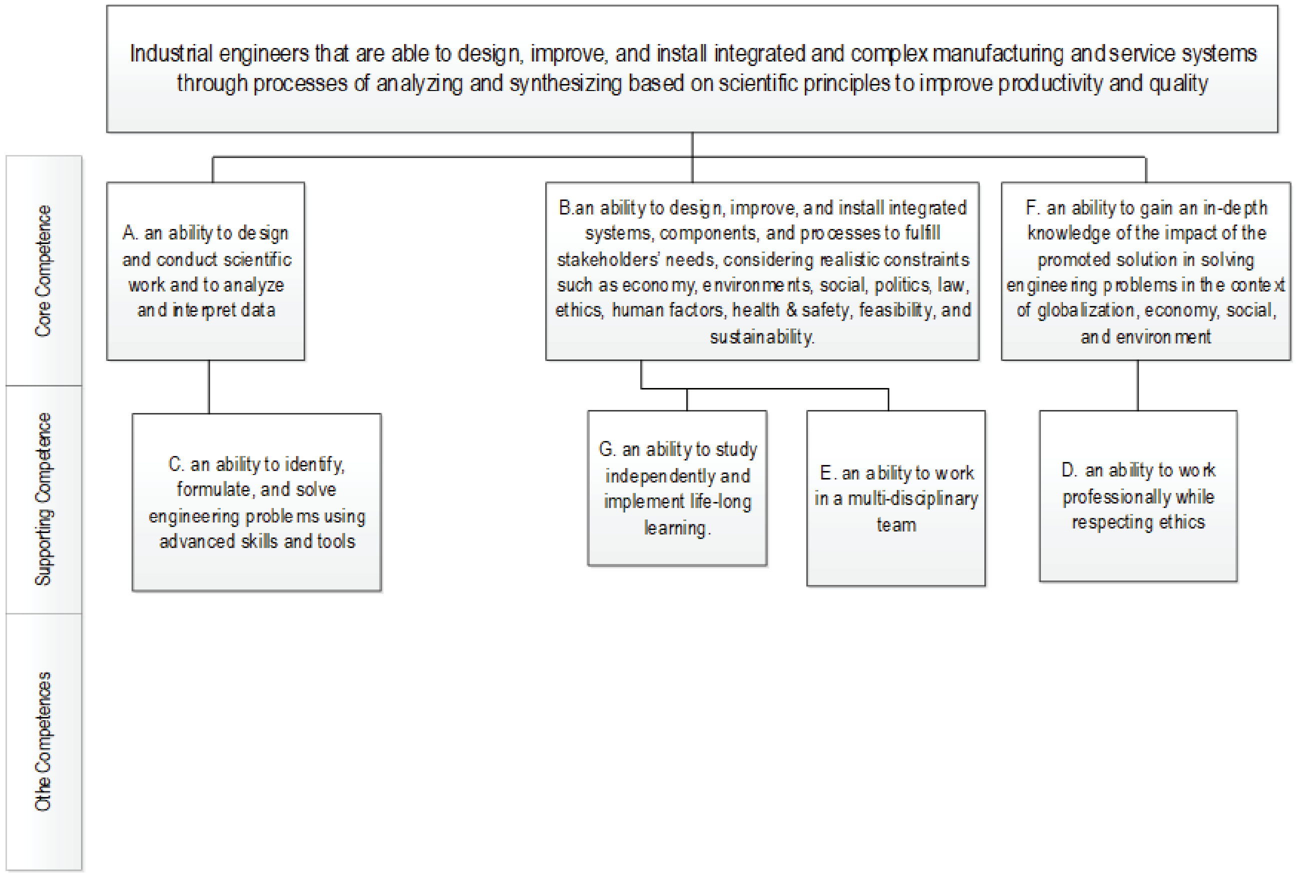
Industrial engineers that are able to design, improve, and install integrated and complex manufacturing and service systems through processes of analyzing and synthesizing based on scientific principles to improve productivity and quality.

15. Expected Learning Outcomes:

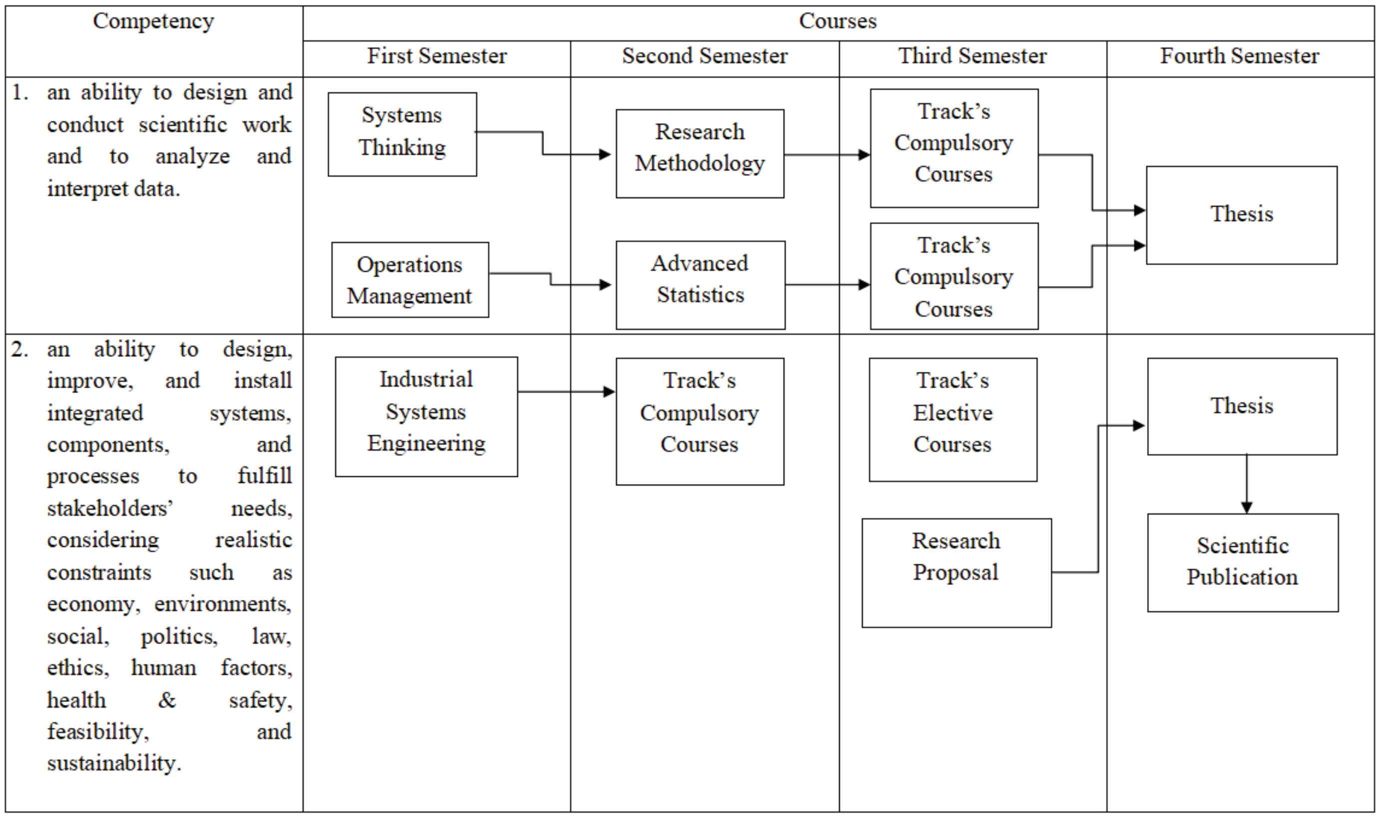
1. an ability to design and conduct scientific work and to analyze and interpret data.
2. an ability to design, improve, and install integrated systems, components, and processes to fulfill stakeholders' needs, considering realistic constraints such as economy, environments, social, politics, law, ethics, human factors, health & safety, feasibility, and sustainability.
3. an ability to identify, formulate, and solve engineering problems using advanced skills and tools.
4. an ability to work professionally while respecting ethics.
5. an ability to work in a multi-disciplinary team.
6. an ability to gain an in-depth knowledge of the impact of the promoted solution in solving engineering problems in the context of globalization, economy, social, and environment.
7. an ability to study independently and implement life-long learning.

16.	Course composition		
No.	**Type of Courses**	**Credit Hours (SKS)**	**Percentage**
I	Compulsory Courses of Study Program	17	38,64%
II	Compulsory Courses of Specialization	9	20,45%
III	Elective Courses	6	13,64%
IV	Matriculation	12	
V	Special Courses	12	27,27%
	Total	44	100 %
	Total Credits		44 Credits

The Network of Expected Learning Outcomes



Flow Diagram of Courses based on Expected Learning Outcomes



3. an ability to identify, formulate, and solve engineering problems using advanced skills and tools.	Advanced Operations Research	Track's Compulsory Courses	Track's Elective Courses	Thesis
4. an ability to work professionally while respecting ethics.		Research Methodology	Research Proposal	Thesis
5. an ability to work in a multi-disciplinary team.		Track's Compulsory Courses	Track's Elective Courses	
6. an ability to gain an in-depth knowledge of the impact of the promoted solution in solving engineering problems in the context of globalization, economy, social, and environment.	Industrial Systems Engineering	Track's Compulsory Courses	Track's Elective Courses	Thesis

7. an ability to study independently and implement life-long learning.			Research Proposal	Thesis Scientific Publication

Curriculum Structure of Industrial Engineering Master Program

Code	Subject	SKS
	1st Semester	
ENIE801001	Systems Thinking	3
ENIE801002	Industrial Systems Engineering	3
ENIE801003	Operation Management	3
ENIE801004	Advanced Operations Research	3
	Linear Programming	
	Basic Statistics	
	Sub Total	**12**
	2nd Semester	
ENIE801005	Research Methodology	2
ENIE801006	Advanced Statistics	3
	Track's Compulsory Courses	3
	Track's Compulsory Courses	3
	Engineering Economics	
	Human Factors in Engineering & Design	
	Sub Total	**11**
	3rd Semester	
ENIE800007	Research Proposal	2
	Track's Compulsory Courses	3
	Track's Elective Courses	3
	Track's Elective Courses	3
	Sub Total	**11**
	4th Semester	
ENIE800008	Scientific Publication	2
ENIE800009	Thesis	8
	Sub Total	**10**
	Total	**44**

Compulsory Specialization Subjects

Code	Subject	SKS
	2nd Semester	
	Innovation And Design Engineering	
ENIE802108	Product and Service Innovation	3
ENIE802109	Work Safety Engineering and Management	3
	Production and Logistics System	
ENIE802216	Manufacturing System	3
ENIE802217	Inventory System	3
	Industrial Management	
ENIE802324	Industrial Project Development	3
ENIE802325	Industrial Strategic Management	3
	Data and Quality Engineering	
ENIE802432	Multivariate Analysis	3
ENIE802433	Quality and Reliability	3
	Systems Design and Management	
ENIE802540	Decisions and Risks in Systems Engineering	3
ENIE802541	Systems Engineering and Analysis	3
	Sub Total	
	3rd Semester	
	Innovation And Design Engineering	
ENIE803110	Macroergonomics	3
	Production and Logistics System	
ENIE803218	Logistics System	3
	Industrial Management	
ENIE803326	Strategic Sourcing Management	3
	Data and Quality Engineering	
ENIE803434	Data Mining	3
	Systems Design and Management	
ENIE803542	Systems Performance Modeling	3
	Track's Elective Courses	3
	Track's Elective Courses	3
	Sub Total	

Elective Courses

Code	Subject	SKS
	Innovation And Design Engineering	
ENIE803111	Knowledge Management	3
ENIE803112	Cognitive Ergonomics	3
ENIE803113	Technopreneurship	3
ENIE803114	Human Performance Engineering	3
ENIE803115	Industrial Technology Manage-ment	3
	Production and Logistics System	
ENIE803219	Total Quality Management	3
ENIE803220	Lean Manufacturing	3
ENIE803221	Industrial Organization	3
ENIE803222	Maritime Logistics	3
ENIE803223	Transportation Systems	3
	Industrial Management	
ENIE803327	Engineering Management in the Value of Materials	3
ENIE803328	Industrial Economics	3
ENIE803329	Supply Chain Management	3

ENIE803330	Maintenance Management	3
ENIE803331	**Enterprise Information Systems**	3
	Data and Quality Engineering	
ENIE803435	Decision Uncertainties and Risk	3
ENIE803436	Consumer Relationship Management	3
ENIE803437	Advanced Optimization	3
ENIE803438	Prognostic and Machinery Health Management	3
ENIE803439	Service Engineering	3
	Systems Design and Management	
ENIE803543	Systems Engineering Management	3
ENIE803544	Supports and Logistics for Systems Engineering	3
ENIE803545	Technology Policy Modeling using System Dynamics	3
ENIE803546	Decision and Policy Models	3
ENIE803547	Renewable and Sustainable Energy Systems	3

Syllabus Master Program Industrial Engineering

System Thinking
ENIE801001
3 Credits
Learning Objective(s) :

Students are expected to implement model-based management concept by understanding systems' problems. The development of systems' mindset will be conducted through the introduction of soft OR in the form SSM approach as a case study

Syllabus:

Introductory lecture, changing yourself by changing the way of thinking, introduction to systems thinking, the Beer Game, Mental Model, language system, Causal Loop diagram, Stock and Flow diagram, General System Blueprint, System Archetypes, Problem Solving with Systems Thinking, introduction of SSM concept, the case study discussion of Albion Group with SSM, development of insight on the scope of modeling.

Pre-requisite(s): -

Text Book(s):
1. Meadows, D. (2008). Thinking in Systems: A Primer. Chelsea Green Publishing
2. Checkland, P., Scholes, J. (2001). Soft Systems Methodology in Action. John & Wiley.
3. Senge, P. M. (1994). The Fifth Discipline Fieldbook: Strategies and Tools for Building a Learning Organization. Crown Business.

Industrial System Engineering
ENIE801002
3 Credits
Learning Objective(s):

Students are expected to promote the design and development of effective and efficient solutions through the framework of industrial engineering systems in accordance with the needs and characteristics of the industry

Syllabus:

Definition of industrial systems engineering, Strategic Management, New Product Development, Supply Chain Management, Industry Level View, Societal Trends, Industry trends, Economy Trends, Technology Trends, Industry 4.0, Case Studies of Industry 4.0, the Shifting of Global Manufacturing competitiveness, Marketing 4.0, Industrial System Design analysis in the case of different industries.

Pre-requisite(s): -

Textbook(s):
1. Chris Harris, Rick Harris, Chuck Streeter - Lean Supplier Development_ Establishing Partnerships and True Costs Throughout the Supply Chain (2010, Productivity Press)
2. Cindy Alvarez - Lean Customer Development. Building Products Your Customers Will Buy (2014, O&_039_Reilly Media)
3. David Simchi-Levi Philip Kaminsky Edith Simchi-Levi - Managing the Supply Chain_ The Definitive Guide for the Business Professional (2003)
4. Paul Trott - Innovation Management and New Product Development (2017, Pearson)
5. Shoshanah Cohen, Joseph Roussel - Strategic Supply Chain Management (2004, McGraw-Hill)

Operations Management
ENIE801003
3 Credits
Learning Objective(s):

The students are expected to master various calculations and analysis for activities in the manufacturing industry and service industry, such as planning activities in project management, understanding the product design, conducting the best process analysis for manufacturing companies or services, taking into account the quality of the work and the quality of services provided to customers, analyzing the strategic supply chain for the company, and applying a variety of quantitative techniques to promote operations excellence.

Syllabus:

Operations Management, Operating Strategy, Introduction to Project Management, Introduction to the Design Process, Process Analysis, Service Operational Classification, Total Quality Management, Supply Chain Strategy, Capacity Management, Lean Logic, Demand Management, Sales and Operations Planning, Material Requirement Planning.

Prerequisite(s): -

Textboks:
1. Jacobs, F. R., Chase, R. B., & Aquilano, N. J. (2004). Operations management for competitive advantage. Boston: Mc-Graw Hill, 64, 70.
2. Reid, R. D., & Sanders, N. R. (2019). Operations management: an integrated approach. John Wiley & Sons

Advanced Operations Research
ENIE801004
3 Credits
Learning Objective(s):

Students are expected to master the theory and basic of integer programming, using advanced techniques in integer program, can apply integer programming knowledge and use the software to solve the problems of integer programming.

Syllabus:

What is Integer Programming, Formulating Integer Programs, Linear Algebra and Convexity, Polyhedral and Dimension, Introduction to Branch and Bound, Relaxation, Duality, Decomposition Methods, Branching Methods, Search Strategies, Introduction to Computational Complexity, Certificates and Complexity Classes, Easy Integer Programs, Integral Polyhedral, Combinatorial Algorithms, Describing Polyhedral, Valid Inequalities, Valid Inequalities From Disjunctions, Strong Valid Inequalities and Lifting, Structured Inequalities, Branch and Cut, Branch and Price, Primal Heuristics, Numerical Analysis.

Pre-requisite(s): -

Text Book(s):
1. Conforti, M., Cornuéjols, G., & Zambelli, G. (2014). Integer programming (Vol. 271). Berlin: Springer.
2. Wolsey, L. A., & Nemhauser, G. L. (2014). Integer and combinatorial optimization. John Wiley & Sons.
3. Taha, H. A. (2017). Operations Research An Introduction. Pearson Education Limited 2017.
4. Hillier, F. S., & Lieberman, G. J. (2005). Introduction to operations research. McGraw-Hill Science, Engineering & Mathematics.

Research Methodology
ENIE801005
2 Credits
Learning Objective(s):

Students are expected to understand the basic concepts used in quantitative and qualitative research methods, including the steps of a scientific research to produce a thesis as a prerequisite for completion of master's degree program.

Topics:

Introduction, Selecting a Problem and Reviewing the Literature, Identifying and Labeling Variables, Constructing Hypotheses and Meta-Analyses, and Constructing Operational Definitions of Variables, Types of Research, Concluding Steps of Research, Additional Approaches.

Pre-requisite(s): -

Text Book(s):
1. Manual Penyusunan Tesis Universitas Indonesia dan Departemen Teknik Industri, 2008.
2. Pedoman Teknis Penulisan Tugas Akhir Mahasiswa Universitas Indonesia. IEEE Citation Reference.
3. Stojmenovic, I. (2010). "How to Write Research Articles in Computing and Engineering Disciplines," IEEE Transactions on Parallel and Distributed Systems, Vol. 21, No. 2.

Advanced Statistics
ENIE801006
3 Credits
Learning Objective(s):

Students are expected to manage the collection, processing, & data analysis by following the assumptions and rules of statistics in conducting the experimental design (Design of Experiment) so that the conclusions can be used as the basis in the decision making process

Syllabus:

Review of Basic Statistical Concepts, Single Factor Experiment (Fixed Effect Model), Single Factor Experiment (Random Effect Model), Randomized Complete Block Design, Latin Square Design, General Factorial Design, 2k Factorial Design, Blocking in Factorial Design, Factorial Experiments with Random Factors, Fractional Factorial Design, Nested Design, Response Surface Model, Statistics and Quality Control.

Pre-requisite(s): Basic Statistics

Text Book(s):
1. Montgomery, D. C. (2017). Design and analysis of experiments. John wiley & sons.
2. Berger, P. D., & Maurer, R. E. (2002). Experimental Design with Applications in Management. Engineering and the Sciences. Cengage Learning.
3. Montgomery, D. C. (2009). Statistical quality control. New York: Wiley.

Research Proposal
ENIE801007
2 Credits
Learning Objective(s):

Students are expected to write a systematic research proposal based on a novel problem formulation through a tourough examination on the body of literature and real-world cases and phenomenon.

Pre-requisite(s): -

Text Book(s):
a. Pedoman Teknis Penulisan Tugas Akhir Mahasiswa Universitas Indonesia. IEEE Citation Reference.
b. Ivan Stojmenovic, "How to Write Research Articles in Computing and Engineering Disciplines," IEEE Transactions on Parallel and Distributed Systems, Vol. 21, No. 2, February 2010.

Product and Service Innovation
ENIE802108
3 Credits
Learning Objective(s):

Students are expected to evaluate the existing concept and case studies of innovation development in organizations.

Topics:

State of the art in 'Innovation', Innovation Development strategy, Innovation Development Stages, Technology Policy for Innovation Development

Pre-requisite(s): -

Text Book(s):
1. Lean Product Playbook, Dan Olsen, 2016
2. Strategic Management of Technological Innovation: Melissa A. Schiling, 3 rd Edition, 2010.
3. Winning at New Products: Robert G. Cooper, 3rd Edition, 2011.

Work Safety Engineering and Management
ENIE802109
3 Credits
Learning Objective(s):

Students are expected to evaluate a design and management of occupational safety as one aspect in human factor-based work system

Topics:

Introduction to occupational safety management and engineering, application of occupational safety management and engineering, work fatigue, risk model and risk management, human error and safety culture.

Pre-requisite(s): Human Factors in Engineering and Design

Text Book(s):
1. Glendon, A. I., & Clarke, S. (2015). Human safety and risk

management: A psychological perspective. CRC Press.
2. Ridley, J., & Channing, J. (Eds.). (2008). Safety at work. Routledge.

Macroergonomics
ENIE603003
3 Credits
Learning Objective(s):

Students are expected to evaluate the design of a working system consisting of variables that interacts with hardware and software in internal physical environments, external environments, and organizational structures.

Topic:

Introduction to the ergonomic macro, methods and tools used in the analysis of work and design systems, introduction of integration of organizations in the context of productivity, safety, health and quality of work life.

Pre-requisite(s): Human Factors in Engineering and Design

Text Book(s):
1. Hendrick, W.H,. Kleiner, Brian, (2002). *Macroergonomics: Theory, Methods, and Applications (Human Factors and Ergonomics)*
2. Stanton, N,. Hedge, A, (2005). *Handbook of Human Factors and Ergonomics Methods*, CRC Press LLC.

Manufacturing System
ENIE802216
3 Credits
Learning Objective(s):

Students are expected to evaluate manufacturing systems based material flow, storage level, capacity, and process duration. The scope of discussion includes analysis of manufacturing operations from the input, process, and output side. In addition, this lecture will also discuss how to build discrete models of existing systems.

Topic:

Types of manufacturing systems, lean manufacturing, capacity planning, schedulling, sales and operation planning, plant layout.

Prerequisite(s): -

Textbooks:
1. Hopp, W. J., & Spearman, M. L. (2011). Factory physics. Waveland Press.
2. Jacobs, F. R., Chase, R. B., & Aquilano, N. (200). Operations management for competitive advantage. Boston: Mc-Graw Hill.

Inventory System
ENIE802217
3 Credits
Learning Objective(s):

Students are expected to demonstrate the analytical skills required to understand the knowledge and principles of inventory management and warehousing. This course emphasizes the importance of the role and functionality of inventory and warehousing operations in logistics and supply chain management.

Topic:

Introduction to Inventory and Warehousing Management, Materials Handling, Inventory Management, Warehousing Operations and Management, Deterministic Models – Economic Lot Scheduling Problems, Discrete-Time-Markov-Chain, Poisson Process, Continuous-Time Markov Chain, Markov Decision Process, Single and Multi-Echelon Inventory Systems, Game Theory & Decentralized Supply Chains, Socially Responsible Supply Chains, Healthcare Operations, Big Data and Supply Management, Sustainability and Social Networks.

Prerequisite(s): -

Textbooks:
a. Axsäter, S. (2015). Inventory control (Vol. 225). Springer.
b. Coyle, J.J., Jr. Langley, C.J., Novack, R.A, & Gibson, B.J. 2013). Managing Supply Chains: A Logistics Approach. (9th ed.). McGraw-Hill.

Logistics System
ENIE803218
3 Credits
Learning Objective(s):

Students are expected to design an effective and efficient logistics system of material flow side, storage level, and lead time. A system capable of delivering goods from the provider to the consumers, the right time, and the quality of excellence. The scope of the discussion includes analysis of the material flow of providers, manufacturers, distributors, retailers, and consumers.

Topic:

Introduction to the concept of logistics systems, urban and inter-island logistics, logistics systems and value-added processes, elements and problems in logistics systems, logistics Systems, the Internet and Industry 4.0, logistics systems modeling.

Prerequisite(s): -

Textbooks:
a. Simchi-Levi, D., Kaminsky, P., Simchi-Levi, E., & Shankar, R. (2008). Designing and managing the supply chain: concepts, strategies and case studies. Tata McGraw-Hill Education.
b. Bowersox, D., Closs, D., & Cooper M. D., (2012). Supply Chain Logistics Management (4th Edition). McGraw-Hill.
c. Goetschalckx, M. (2011). Supply chain engineering (Vol. 161). Springer Science & Business Media.

Industrial Project Development
ENIE802324
3 Credits
Learning Objective(s):

Students are expected to make research and analysis planning on the development of industrial projects, taking into account the location, consideration of the various risks that will arise, and other factors so that mistakes on project development are minimal.

Topic:

Definition of project management, project success, project manager functions, work relationships on organizations, conventional organizations, matrix organizations, time management, performance measurement, compensation, project scheduling, project specifications , Gantt Chart, project reports, budget, earned value measurement system, plan costs, actual cost, trade-off analysis; trade-off contracts, risk identification, risk monitor, risk control, industrial development: facts and direction of policy-making.

Prerequisite(s): -

Textbooks:
a. Kerzner, H. (2017). Project management: a systems approach to planning, scheduling, and controlling. John

Wiley & Sons.

b. United Nations. Commission on Sustainable Development. (2007). Industrial development for the 21st century: Sustainable development perspectives. United Nations Publications.

Industrial Strategic Management
ENIE802325
3 Credits
Learning Objective(s):

Students are expected to evaluate vision, and organizational mission, discuss principles, techniques and models of organizational and environmental analysis and discuss the theory and practice of strategy formulation and implementation of corporate governance and business ethics in developing effective strategic leadership.

Topic:

What is Strategic Management, Mission, Goals and Objectives, Analyzing the External Environment of the Firm, Analyzing the Internal Environment of the Firm, Recognizing a Firm's Intellectual Assets, Business Level Strategy, Corporate Level Strategy, International Strategy, Strategic Control and Corporate Governance.

Prerequisite(s): -

Textbooks:
1. Porter, M. E. (1996). What is strategy?. Harvard business review, 74(6), 61-78
2. Collins, J., & Porter, M. E. (2010). Strategy and competitive Advantage. Montanna. Edu, 102-124
3. David, F. R., & David, F. R. (2013). Strategic management: Concepts and cases: A competitive advantage approach. Pearson.
4. Charles, et.al. 2012
5. Dobbs, et.al. 2014
6. Wu, et.al. 2012
7. Yunna, et.al. 2014
8. Cassidy, et.al. 2013

Strategic Sourcing Management
ENIE803326
3 Credits
Learning Objective(s):

Students are expected to explore strategic sourcing management and promote the understanding of strategic role management in supply chain operations, demand for value creation. Procurement and inventory management plays an important role in the company's ability to operate efficiently and competitively within a contemporary global business environment.

Topic:

Introduction to Strategic Sourcing and Supply Management, The Purchasing Process, The P2P Process, Purchasing Organization, and Commodity Strategy Development, Vendor Relationship Management, Supplier Evaluation and Selection and the Analytic Hierarchy Process, Supplier Performance Management, Quality Management, and Supply Base Integration, Global Sourcing and Outsourcing, Electronic Procurement and Strategic Cost Management, Negotiations, Law, and Contract Management, Ethics and Green Procurement

Prerequisite(s): -

Textbooks:
1. Sollish, F., & Semanik, J. (2011). Strategic global sourcing best practices. John Wiley & Sons.

Multivariate Analysis
ENIE802432
3 Credits
Learning Objective(s):

Students are expected to design research models, analyze data and interpret the research results done using the right multivariate method based on data set characteristics

Topics:

Introduction to Multivariate methods, data characteristics, exploratory factor analysis, multiple regression analysis, double discriminant analysis, logistic regression, conjoint analysis, cluster analysis, multidimensional scaling, correspondence analysis, structural equation modeling, confirmatory factor analysis, structured equation model testing, multiple variant analysis.

Pre-requisite(s): -

Text Book(s):
1. Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2013). Multivariate data analysis: Pearson new international edition. Pearson Higher Ed.

Quality and Reliability
ENIE802433
3 Credits
Learning Objective(s):

Students are expected to design the size of quality and reliability of products or services, evaluating the existing parameters, maintain or improve the value of quality and reliability of products or services and consider the cost and profitability of the application of existing models and methods.

Topics:

Introduction to Quality and Reliability, mathematics for quality and reliability, quality recognition, quality analysis methods, quality management and financing, the introduction of reliability, static reliability evaluation model, dynamic reliability evaluation model, reliability evaluation method, reliability testing, reliability and financing management.

Pre-requisite(s): -

Text Book(s):
1. Dhillon, B. S. (2006). Maintainability, maintenance, and reliability for engineers. CRC press.

Data Mining
ENIE605046
3 Credits
Learning Objective(s):

Students are expected to excute data extract and pattern analysis from large amounts of data.

Syllabus:

Introduction to Data Mining, data preprocessing, exploratory data analysis, dimensioning methods, statistical analysis, data model preparation, classification, clustering, association rules

Pre-requisite(s): -

Text Book(s):
1. Introduction to Data Mining (Second version 2018), P.-N. Tan, M. Steinbach, and V. Kumar, AddisonWesley, 2018.
2. Data Mining: Practical Machine Learning. Tools and Techniques, Second Edition. Ian H. Witten and Eibe Frank

Decision and Risk in Systems Engineering
ENIE802540
3 Credits

Learning objective(s):

Students are expected to explore the process of systems engineering in helping decision-making process with its uncertainties and risks.

Syllabus:

Decision Making Process, Introduction to Risk Process, Risk Management Basic Concepts and Steps, Step 1 : Establishing the Context and Criteria of Assessment, Step 2 : Identify Risk (Risk Identification), Step 3: Analyze Risk, Risk Analysis Tools (Quantitative Risk), Step 4: Evaluating Risk, Step 5: Treating Risk, MCDM, Introduction to AHP, Game Theory 1, Game Theory 2.

Prerequisite(s): -

Text books:
1. Figuera, J., Greco, S., Ehrgott, M. (2005). Multi Criteria Decision Analysis: State of the Art Surveys. Kluwer Academic Publishers.
2. Ragsdale, C. (2004). Spreadsheet Modeling & Decision Analysis. SouthWestern Colege Publisher.

System Engineering and Analysis
ENIE802541
3 Credits
Learning Objective(s):

Students are expected to understands the concepts, methods and tools of analyst-based systems that have a comprehensive, connectivity and contextual feature in the face of systematic and complex problems that can formulate better decisions and policies.

Topic:

System engineering in the world of complex systems, common analytical principles and system analysis, Introduction to Performance Management History and Concepts, various analyses conducted in system engineering, requirements analysis, strategy analysis, operational analysis, business process analysis, operational analysis tools, financial analysis, risk analysis, scenario analysis, Business Case.

Pre-requisite(s): -

Text Book(s):
1. Cadle, J., Paul, D., & Turner, P. (2014). Business analysis techniques. Chartered Institute for IT.
2. Blanchard, B. S., & Fabrycky, W. J. (2010). Systems engineering and analysis. Prentice Hall International Series in Industrial & Systems Engineering.
3. Haskins, C., Forsberg, K., & Krueger, M. (2011). Systems Engineering Handbook: A Guide for System Life Cycle Processes and Activities. International Council on Systems Engineering (INCOSE). INCOSE-TP-2003-002-03.2. 2.

System Performance Modelling
ENIE803542
3 Credits
Learning Objective(s):

Students are expected to conduct specifications, predictions and performance evaluation of systems designed through various approaches to system modeling.

Topics:

The concept and role of modeling and simulation in system engineering, financial modelling, business process modeling, discrete modeling with Promodel, scenario development.

Pre-requisite(s): -

Text Book(s):
1. Haskins, C., Forsberg, K., & Krueger, M. (2011). Systems Engineering Handbook: A Guide for System Life Cycle Processes and Activities. International Council on Systems Engineering (INCOSE). INCOSE-TP-2003-002-03.2. 2.
2. Kossiakoff, A., Sweet, W. N., Seymour, S. J., & Biemer, S. M. (2011). Systems engineering principles and practice. John Wiley & Sons.
3. ISO/IEC 15288 Standard for Systems Engineering. International Organization Standard (ISO).

Special Courses

Thesis
ENIE800009
8 Credits
Learning objective(s):

Students are expected to solve complex industrial engineering problems through thesis study.

Prerequisite(s): -

Text books:
a. Pedoman Teknis Penulisan Tugas Akhir Mahasiswa Universitas Indonesia. IEEE Citation Reference.
b. Ivan Stojmenovic, "How To Write Research Articles in Computing and Engineering Disciplines," IEEE Transactions on Parallel And Distributed Systems, Vol. 21, No. 2, February 2010.

Scientific Publication
ENIE800008
3 Credits
Learning objective(s):

Students are expected to publish his / his scientific articel in national or international journal or proceeding.

Prerequisite(s): -

Text books:
1. Pedoman Teknis Penulisan Tugas Akhir Mahasiswa Universitas Indonesia. IEEE Citation Reference.
2. Ivan Stojmenovic, "How To Write Research Articles in Computing and Engineering Disciplines," IEEE Transactions on Parallel And Distributed Systems, Vol. 21, No. 2, February 2010.

Elective Courses

Knowledge Management
ENIE803112
2 Credits
Learning Objective(s):

Students are able to systematically evaluate the maturity level of a company in managing its knowledge assets and then be able to provide comprehensive improvement advice to allow such knowledge assets to be used to reinforce the company's strategic objectives.

Syllabus:

Knowledge management, Life cycles for knowledge management systems, Knowledge engineering, Knowledge acquisition, Knowledge modelling, Knowledge technology (Decision support systems, Meta-interpreters, Enterprise resource planning systems, Business Intelligence), Knowledge transfer and sharing, Knowledge intensive organizations and innovations

Pre-requisite(s): -

Textbook(s):
1. Amrit Tiwana, The Knowledge Management Toolkit: Practical Techniques for Building A Knowledge Management System, Prentice-Hall, New Jersey, 2000.
2. M.Rao, Knowledge Management Tools and Techniques: Practitioners and Experts Evaluate KM Solutions. Elsevier Inc. Oxford – UK. 2005.
3. Murray Jennex, Case Studies in Knowledge Management, Idea Group Publishing, 2005.
4. Handsout Perkuliahan Manajemen Pengetahuan
5. Ikujiro Nonaka and Hirotaka Takeuchi, The Knowledge Creating Company: How Japanese Companies Create the Dynamics of Innovation, Oxford University Press, New York, 1995.
6. Heidi Collins, Enterprise Knowledge Portals, AMACOM, New York, 2003.
7. Bryan Bergeron, Essentials of Knowledge Management, John Wiley & Sons, Inc. New Jersey 2003.

Cognitive Ergonomics
ENIE803112
3 Credits
Learning Objective(s):

Students are able to provide knowledge and expertise to analyze, design, and apply the work system and products in accordance with human cognitive abilities.

Syllabus:

Mental workload, decision-making, skilled performance, human-computer interaction, human reliability, work stress, eye tracking, EEG, human-system design

Pre-requisite(s): -

Text book(s):
1. Salvendy, G., & Karwowski, W. (2016). Advances in cognitive ergonomics. CRC Press.
2. Stanton, N. A., Hedge, A., Brookhuis, K., Salas, E., & Hendrick, H. W. (Eds.). (2004). Handbook of human factors and ergonomics methods. CRC press.

Technopreneurship
ENIE803113
3 Credits
Learning Objective(s):

Students are able to explain the steps in starting a digital start up and designing the business model canvas

Syllabus:

Introduction to technology entrepreneurship, business model canvas, case study, pitching, venture capital, failure of digital start up

Pre-requisite(s): -

Text book(s):
1. Mankani, D., 2003. Technopreneurship: The Successful entrepreneur in The new economy. Pearson/Prentice Hall.

Human Performance Engineering
ENIE803114
3 Credits
Learning Objective(s):

Students are able to understand the human performance engineering and capable of measuring, evaluating, and analyzing performance and behaviour in various applied fields and in relation to technological and engineering developments.

Syllabus:

An Introduction to Human Performance engineering, methods and tools used in human performance engineering, Human performance engineering in product usability and design.

Pre-requisite(s): -

Text book(s):
1. Bailey, R.W. Human Performance Engineering, Prentice Hall, 1982.
2. Jurnal dan artikel terkait HPE.

Industrial Technology Management
ENIE803115
3 Credits
Learning Objective(s): :

Students are able to propose appropriate management patterns for technological developments and choose technologies that can support business models and corporate strategic plans.

Syllabus:

Technology Acquisition, Technology Forecasting, Technology Strategy and Competitiveness, Technology Adoption, Selection and Implementation in Technology Management.

Pre-requisite(s): -

Textbook(s):
1. Khalil, T.M. and Shankar, R., 2000. Management of technology: The key to competitiveness and wealth creation (pp. 7-11). Boston: McGraw-Hill.
2. Drucker, P.F., 2011. Technology, management, and society. Harvard Business Press.

Total Quality Management
ENIE803219
3 Credits
Learning Objective(s):

Understand the management of total quality management from the perspective of industrial engineering that emphasizes the design, improvement and installation aspects of the organizational system.

Syllabus:

Statistical Process Control, Total Quality Management, TQM Pillars, History of TQM, Six Sigma: Define, Measure, Analyze, Improve, Control.

Pre-requisite(s): -

Text Book(s):
1. Rao, et al, "Total Quality Management: Cross Functional Perspective", 1996.

Lean Manufacturing
ENIE803220
3 Credits
Learning Objective(s):

Students can understand the concept of an effective manufacturing process based on Toyota Production Systems

Syllabus:

History and concept of lean manufacturing, strategies and steps of deploying lean Manufacturing, Toyota Production System

Pre-requisite(s): -

Text Book(s):
1. Wilson, L. (2009). How to Implement Lean Manufacturing, McGrawHill.
2. George L.M. (2004). Lean Six Sigma Pocket Toolbook: A Quick reference Guide to Nearly 100 Tools for Improving Process Quality, Sppeed, and Complexity, McGrawHill

Industrial Organization
ENIE803221
3 Credits
Learning Objective(s):

Student are expected to design the structure of a team-based organization with a division of roles and work descriptions that design is then used in a research project.

Syllabus:

Introduction to organization and industrial psychology, understanding and insight into industrial and organizational psychology, employment selection and placement, training and development of manpower, occupational conditions and psychological psychology, corporate leadership, organizational and working groups, organizational development and culture, work motivation, job satisfaction, stress and occupational safety, consumer psychology.

Pre-requisite(s): -

Text Book(s):
1. Robbins, S. P. (2017). Organizational behavior, 17th Edition. Pearson Education.
2. Griffin, R.W. and Moorhead, G., 2011. Organizational behavior. Nelson Education.

Maritime Logistics
ENIE803222
3 Credits
Learning Objective(s):

Students are able to design, analyze, and improve the performance of the maritime logistics system in general, and container terminals as well as scheduled cruise (liner) in particular.

Syllabus:

Maritime Economy, containerization, scheduled sailing, Berth Allocation problem, Quay Crane allocation problem, Stacking problem, Stowage Planning, Integration phase, Intramodality, Synchomodality, LPG supply chain, Fuel supply chain, Integration phase.

Pre-requisite(s): -

Text Book(s):
1. Notteboom, T. E., Pallis, A. a., De Langen, P. W., & Papachristou, A. (2013). Advances in port studies: the contribution of 40 years Maritime Policy & Management. Maritime Policy & Management, 40(7). https://doi.org/10.1080/03088839.2013.851455
2. Levinson, M. (2006). The Box: How the Shipping Container Made the World Smaller and the World EconomyBigger. Princeton: Princeton University Press.
3. Song, D. W., & Panayides, P. M. (2015). Maritime Logistics: a Guide to Contemporary Shipping and Port Management.
4. Mangan, J., Lalwani, C., Butcher, T., & Javadpour, R. (2012). Global Logistics and Supply Chain Management (2nd ed.). Chihester: John Wiley & Sons, Ltd.
5. International Chamber of Commerce. (2020). Incoterms 2020: ICC Rules for the Domestic and International Trade Terms. Paris.
6. Rodrigue, J.-P., Comtois, C., & Slack, B. (2013). The Geography of Transport Systems (Third Edit). London: Routledge. https://doi.org/10.1080/10630732.2011.603579
7. Kap, H. K., & Gunther, H.-O. (Eds.). (2007). Container Terminals and Cargo Systems: Design, Operations Management, and Logistics Control Issues. Berlin: Springer Berlin Heidelberg.
8. Meisel, F. (2009). Seaside Operations Planning in Container Terminals. https://doi.org/10.1007/978-3-7908-2191-8 9. Lee, S. W., Song, D. W., & Ducruet, C. (2008). A tale of Asia's world ports: The spatial evolution in global hub port cities.Geoforum, 39(1), 372–385. https://doi.org/10.1016/j.geoforum.2007.07.010
9. Mulder, J., & Dekker, R. (2014). Methods for strategic liner shipping network design. European Journal of Operational Research, 235(2), 367–377. https://doi.org/10.1016/j.ejor.2013.09.041
10. Stopford, M. (2009). Maritime Economics (3rd Edition). London: Routledge.
11. Grammenos, C. (Ed.). (2010). The Handbook of Maritime Economics and Business (2nd Editio). London: Lloyd's List.
12. The Danish Shipowners' Association. (2010). The Economic Significance of Maritime Clusters: Lessons Learned from European Empirical Research.
13. Zhou, Q., & Yuen, K. F. (2021). Low-sulfur fuel consumption: Marine policy implications based on game theory. Marine Policy, 124(November 2020), 104304. https://doi.org/10.1016/j.marpol.2020.104304

Transportation Systems
ENIE803223
3 Credits
Learning Objective(s):

Students are expected to understand the basics of transportation system (both goods and people) and role in supporting effective and efficient production system.

Syllabus:

Introduction of basic elements of transportation systems, problems and economic aspects of transportation systems, transportation system planning, transportation models, multimodal transportation, transportation and environment, and technological developments in the field of transportation.

Pre-requisite(s): -

Text Book(s):
a. Rodrigue, J-P. (2017). The geography of transport systems. Fourth Edition. New York: Routledge
b. Black, J. (1981). Urban transport planning: theory and practice. London: The Johns Hopkins University Press
c. Hay, W. W. (1987). An introduction to transportation engineering. Krieger Pub Co.
d. Morlok, E.K., (1978). Introduction to transportation engineering and planning. Mc Graw Hill, Inc.

Engineering Management in The Value of Materials
ENIE803327
3 Credits
Learning Objective(s):

students are able to master knowledge and possess expertise in the form of understanding the meaning of engineering management, material value and engineering management in the creation of value, a paradigm that becomes the foundation of the concept and the ability to choose the right approach, process and/or treatment of materials, and able to apply engineering principles that contribute to the improvement and

Syllabus:

Engineering management, Engineering Design, material value, Engineering Management in material value Creation, material value upgrading, materials value conservation, design for material value upgrading, material value conservation, Design for materials value upgrading, design for material value conservation

Pre-requisite(s): -

Text Book(s):
1. Wodecki, A. (2019). Artificial intelligence in value creation: Improving competitive advantage. Springer.
2. Cinquini, L., Di Minin, A., & Varaldo, R. (Eds.). (2013). New business models and value creation: A service science perspective. Milan: Springer.
3. Manu, A. (2016). Value creation and the internet of things: How the behavior economy will shape the 4th industrial revolution. Routledge.
4. Morse, L. C., Babcock, D. L., & Murthy, M. (2014). Managing engineering and technology. Pearson.

Industrial Economics
ENIE803328
3 Credits
Learning Objective(s):

After attending this lecture participants can learn about the economic provision, i.e. business ventures that apply as sellers (providers of goods and services), variables in the industrial market, covering the market of goods and services, the money market and the labor market; as well as a variety of fiscal policies, monetary and payment balances that can affect and control certain variables, such as income, interest rates and prices, so as to understand the real role of an industrial business the

Syllabus:

Introduction: Modeling in industrial economics, consumer behaviour and demand function, technology concept and production function, company cost function and supply function, balance in competitive market

Pre-requisite(s): -

Text Book(s):
1. Chacholiades, Miltiades. 1978. International Trade And Policy. New York: McGraw-Hill
2. Gould, JP. and CE. Ferguson. 1980. Microeconomic Theory. Homewood: Richard D. Irwin
3. Griffin, Ricky W. and Ronald J. Ebert. 2004. Business. Upper Saddle River: Pearson-Prentice Hall
4. Martin, Stephen. 1988. Industrial Economics: Economic Analysis and Public Policy. Englewood Cliffs: Prentice Hall

Supply Chain Management
ENIE803329
3 Credits
Learning Objective(s):

Students are able to determine effective and efficient supply chain system design solution based on product, market and customer characteristics.

Syllabus:

Inventory Management and Risk pooling, network Planning, supply contracts, information role in supply chain, supply chain integration, distribution strategy, strategic alliances, outsourcing strategy.

Prerequisite:-

Text Book(s):
1. Simchi-Levi, D., Kaminsky, P., Simchi-Levi, E., & Shankar, R. (2008). Designing and managing the supply chain: concepts, strategies and case studies. Tata McGraw-Hill Education.
2. Chopra, S., & Meindl, P. (2007). Supply chain management. Strategy, planning & operation. In Das summa sumum des management (pp. 265-275). Gabler.

Maintenance Management
ENIE803330
3 Credits
Learning Objective(s):

Students are able to design scheduling of maintenance based on Preventive Maintenance concept.

Syllabus:

System theory, project PMDA organization, project resources, staff organization and project team, time Management, Critical Path Method, PERT, project charts, cost control.

Pre-requisite(s): -

Text Book(s):
1. Mann, Jr.,L. (1978). Maintenance Management. Lexington Books
2. Nakajima, Seiichi. (1988). Introduction to Total Productive Maintenance.
3. Levitt, J. (2003). Complete guide to preventive and predictive maintenance. Industrial Press Inc.

Enterprise Information Systems
ENIE803331
3 Credits
Learning Objective(s):

Students are able to make early planning an information system by paying attention to the flow of existing information to achieve a competitive company. The initial information system is created through a database management that will generate important information and analysis that will support the decision making to be taken.

Syllabus:

Introduction to management information systems. MIS/ IT as competitive advantage. IT and Electronic Commerce. Database and database management. System Analysis and Design. MIS and its relationship with RQM and QS. CBIS. Accounting Information System. Decision Support System. Executive Information System. Marketing, Manufacturing Information System. Financial, Human Resource Information System.

Pre-requisite(s): -

Text Book(s):
1. Dym, C., & Little, P. (2005). Engineering design: A material and processing approach.
2. Heller, E. D. (1971). Value management: value engineering and cost reduction. Addison-Wesley Publishing Company.
3. Cross, N., (1994). Engineering Design Methods : Strategies for Product Design, John Wiley & Son, New York

Decisions, Uncertainties and Risk
ENIE803435
3 Credits
Learning Objective(s):

Students are able to analyse risk and uncertainty based on statistical tools in good & correct for decision making

Syllabus:

Concept and decision making process, Theory of uncertainty, risk analysis

Pre-requisite(s): -

Text Book(s):
1. Parmigiani, G. (2009). Decision Theory: Principles and Approaches , John Wiley.

Costumer Relationship Management
ENIE803436
3 Credits
Learning Objective(s):

Students understand the role and function of relationship management with customers in improving the competitiveness of the Company (the organization)

Syllabus:

The concept and implementation steps OF CRM in the organization, CRM process management, measuring the success of CRM, Best Practices implementation OF CRM.

Pre-requisite(s): -

Text Book(s):
1. Peppers, D. (2011). Managing Customer Relationship: A Strategic Framework, John Wiley& Sons.

Advanced Optimization
ENIE803437
3 Credits
Learning Objective(s):

Students can design and implement a variety of heuristic and metaheuristic optimization algorithms to resolve issues in the field of industrial engineering.

Syllabus:

Introduction to optimization, theory of complexity, heuristic fundamentals, Hill Climbing algorithm, Greedy algorithm, Simulated Annealing, Taboo Search, Genetic algorithm, technique dealing constraints, multi-purpose metaheuristic

Pre-requisite(s): -

Text Book(s):
1. How to Solve It: Modern Heuristics, Zbigniew Michalewicz, David B. Fogel. Springer, 2004
2. Essentials of Metaheuristics, Sean Luke, 2009, Essentials of Metaheuristics, Lulu, available at http://cs.gmu.edu/sean/book/metaheuristics/
3. Computational Intelligence, an introduction, Andries P. Engelbrecht, John Wiley & Sons, England: 2007.

Prognostic and Machinery Health Management
ENIE803438
3 Credits
Learning Objective(s):

Students are able to analyze failures in the machining system using predictive analysis approaches and propose appropriate management concept to stop such failures before they occur.

Syllabus:

Thermal Power generation, condition-based maintenance, machine learning methods for Fault detection and Diagnosis, methods for handling unbalanced Data, lesson-based machine learning methods ANN and SVM

Pre-requisite(s): -

Text Book(s):
1. Yan, J., 2014. Machinery prognostics and prognosis oriented maintenance management. John Wiley & Sons.
2. Levitt, J., 2003. Complete guide to preventive and predictive maintenance. Industrial Press Inc..

Service Engineering
ENIE803439
3 Credits
Learning Objective(s):

Students are able to understand the specificity of the service sector in terms of initial design, management, measurement methods of quality of performance workers, and methods of measuring customer satisfaction, starting from service encounter, to the needs of managers in the service sector to combine marketing, technology, workers and information to be competitive.

Syllabus:

Introduction to service engineering, new services development, technology on services, establishment of service companies, operations management services, quality services, capacity planning and Model queuing, forecasting demand on services, inventory management services.

Pre-requisite(s): -

Text Book(s):
1. Fitzsimmons, J. A., & Fitzsimmons, M. J. (1994). Service management for competitive advantage. New York, NY: McGraw-Hill.

Systems Engineering Management
ENIE803543
3 Credits
Learning Objective(s):

Students can understand basic systems engineering management in the industry so as to manage a process design, installation, management and termination of a complex system

Syllabus:

Industrial System Engineering concepts and methodologies. System lifecycle: concept, development, production, utilization and support, as well as the end of the system. Vee-Model. Processes in the system lifecycle: technical process, project process, organizational process and the acquisition process of goods or services. Total System Value and Life Cycle Costing.

Prerequisite(s): -

Textbook(s):
1. Eisner Howard, Essentials of Project and Systems Engineering Management, 3rd Edition, John Wiley & Sons. New Jersey. 2008
2. INCOSE Systems Engineering Handbook: A Guide for System Life Cycle Processes and Activities, 4th Edition. 2015
3. Chang, CM. Service Systems Management and Engineering: Creating Strategic Differentation and Operational Excellence, John Wiley & Sons. New Jersey. 2010

Support and Logistics for System Engineering
ENIE803544
3 Credits
Learning Objective(s):

Students understand the tools and methods of conducting planning and management of resource and logistics support in the process of engineering the system.

Syllabus:

Outsourcing Principles and Methods, Acquisition and Supply, Logistics Planning, Principles of Supply Chain Management System, Scheduling and Sourcing

Pre-requisite(s): -

Text Book(s):
1. Business Analysis, 2nd Edition, James Cadle, Debra Paul, Paul Turner, British Informatics Society Limited (BISL), Swindon, UK, 2010.
2. Business Analysis Techniques: 72 Essential Tools for Success, James Cadle, Debra Paul, Paul Turner, British Informatics Society Limited (BISL), Swindon, UK, 2010.
3. Systems Engineering and Analysis (5th Edition). Prentice Hall International Series in Industrial & Systems Engineering. 2010. Benjamin S. Blanchard dan Wolter J. Fabrycky. Upper Saddle River, New Jersey.
4. Cecilia Haskins, CSEP, Kevin Forsberg, CSEP and Michael Krueger, CSEP. SYSTEMS ENGINEERING HANDBOOK: A GUIDE FOR SYSTEM LIFE CYCLE PROCESSES AND ACTIVITIES, version 3.1, 2007

Technology Policy Modelling Using System Dynamics
ENIE803545
3 Credits
Learning Objective(s):

Students understand concepts, methods and tools of dynamic system modeling to specify, predict and evaluate the impact of a policy so that they can formulate better policy decisions.

Syllabus:

Introduction to technology policies and policies, technological aspects in policy, introduction to Dynamic systems, basic models of dynamic system-based policy analysis, case studies modeling policy,

Pre-requisite(s): -

Text Book(s):
1. Public Policy Analysis : New Developments. Warren E. Walker, Wil A. H. Thissen . Springer. 2014.
2. Thinking in Systems: A Primer. Donella H. Meadows and Diana Wright. Chelsea Green Publishing. 2008
3. Powersim Studio 2003 Reference Guide. Powersim SA. 2003

Decision and Policy Models
ENIE803546
3 Credits
Learning Objective(s):

Students can understand the concept, method and approach of a game-based model theory in the face of complex problems that can formulate appropriate decisions and policies.

Syllabus:

A Strategic Form of play, Nash equilibrium, Continuous and Discontious games, evaluation and learning in the game, games with perfectly NIR-perfect information, Nash collective action, recurring games, mechanism design, social options and voting theory.

Pre-requisite(s): -

Text Book(s):
1. Figuera, J., Greco, S., Ehrgott, M. (2005). Multi Criteria Decision Analysis: State of the Art Surveys. Kluwer Academic Publishers.
2. Ragsdale, C. (2004). Spreadsheet Modeling & Decision Analysis. SouthWestern Colege Publisher.

Renewable and Sustainable Energy Systems
ENIE803547
3 Credits
Learning Objective(s):

tudents can understand the concepts, methods and foundations of the design of renewable and sustainable energy systems.

Syllabus:

Introduction to Sustainable Energy, Carrying Capacity and Exponential Growth, Key Sustainability Considerations, Energy Efficiency and Conservation, Conventional Energy, Renewable Energy

Pre-requisite(s): -

Text Book(s):
1. Usher, B. 2019. Renewable energy: a primer for the twenty-first century. Columbia University Press: New York.
2. Smets, A., Jäger, K., Isabella, O., van Swaaij, R., Zeman, M. 2015. Solar Energy: The physics and engineering of photovoltaic conversion, technologies, and systems. UIT Cambridge, England.
3. De Bruijn & Herder, 2009, System and Actor Perspectives in Sociotechnical Systems, IEEE Transactions on Systems, Man and Cybernetics, Vol. 39.

Transition Policy

1. New curriculum 2020 will be applied effectively from Odd Semester 2020/2021. In principle, after curriculum 2020 is implemented, then only courses from this new curriculum will be opened.
2. The enforcement of the transitional period is one year. During this transition period, if a course in curriculum 2020 is in odd semester while in previous curriculum in even semester (vice versa), then this course can be held (if necessary) in both semesters.
3. For students who have not passed the compulsory courses in curriculum 2016, are required to take the same course or equivalent in curriculum 2020. Equivalence courses can be seen in the table below. All courses in the curriculum 2016 that are not listed in equivalence table have not changed, both in names and credits.
4. When there is a change in the course credits, then the number of graduation credits counted in, is the number of credits when it was taken. The same or equivalent courses when are equated with different credits, if retaken, or just taken will be acknowledged under a new name and credits. (see course equivalence table).
5. When a compulsory subject in the curriculum 2016 is deleted and there is no equivalence in the curriculum 2020, then:

a. For students who have passed these subjects, the credits that are achieved will be counted in the calculation of graduation 44 credits.

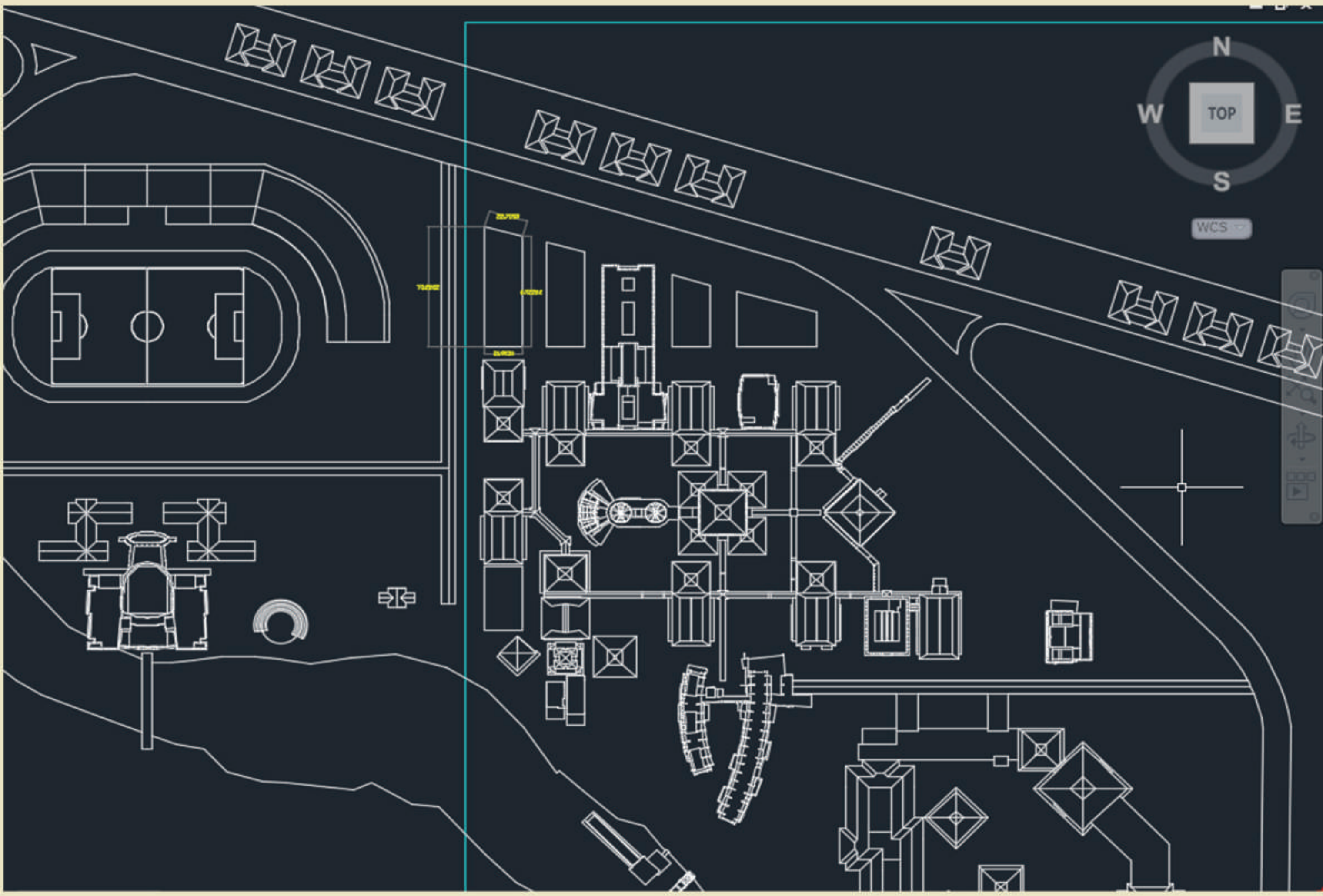
b. For students who did not pass these courses, they can take new compulsory courses or choose elective subjects in the curriculum 2020 to complete 44 credits.

Table of Course Equivalency between Curriculum 2016 and 2020

No	Course Name in 2016 Curriculum	Credits 2016	Course Name in 2020 Curriculum	Credits 2020
1	Research Methodology	3	Research Methodology	2

CHAPTER 7

Doctoral Program



Doctoral Program

FTUI holds Doctoral Program for the seven following study programs:

1. Civil Engineering
2. Mechanical Engineering
3. Electrical Engineering
4. Metallurgy & Material Engineering
5. Chemical Engineering
6. Architecture
7. Industrial Engineering

FTUI Doctoral program was officially opened in 2000 with the opening of the Civil Engineering and Electrical Engineering Doctoral program followed by the emersion of the Opto-electrotechnique and Laser Application study program into the Postgraduate Program of FTUI. The Mechanical Engineering study program was officially opened in 2006 while the Metallurgy & Material Engineering and Chemical Engineering followed in 2007. And In 2009, respectively Department of Architecture opened the Architecture Doctoral Program. In 2001, the Opto-electrotechnique and Laser Application was closed and was emerged into the Electrical Engineering study program. Each Doctoral study program is headed by the Head of Study Program which is held ex-officio by the Head of Department in the Faculty of Engineering UI. The Doctoral study programs have one or more focus subjects to give a more specific knowledge on engineering field to all students of the program.

Currently, the Doctoral Program is held in two ways: Lecture & Research; and Research.

New Students Selection

Selection process for new students for the FTUI Doctoral Program is as follow:

1. Pre-admission stage: future student is encouraged to informally contact their prospective Promotor or the Head of Department to further discuss his/her desired dissertation topic. This is important to make sure the availability of Promotor in accordance to said research topic. Communication may be done through email or face to face. The Head of Department and future Promotor then would discuss the student's proposal internally.
2. Future student should register online via http://penerimaan.ui.ac.id and complete the required documents and prerequisites.
3. Future student will then take the entrance examination (SIMAK UI) which consists of: (i) Academic Potential Examination and (ii) English Proficiency Test.
4. The results of the Entrance Examination will then be sent to FTUI by the UI Entrance Examination Committee. These results will then be discussed in a Department Committee Meeting headed by the Head of Department to determine which students accepted, and the proposed research topic approved, and the availability of future Promotor. An interview have to be arrange with the future student to determine the suitability of research topic, with previous study field, and the student's commitment to participate in the Doctoral program full time. Interview may be done directly or through email or messanger application.
5. The outcome of the Department Committee Meeting will then be submitted to the UI Entrance Examination Committee to be announced.

Academic Counseling

Since the day a student is registered as student for the Doctoral program until the time that he/she passes qualification examination, the student will be under the guidance of an academic advisor who the student expected to be their Promotor or Co-Promotor. Head of Department accepts a proposal of future Promotor/Academic Advisor from a committee in the Department. Once the student pass the qualification examination, the student will earn status as Doctor Candidate and the Academic Advisor's status will revert to Promotor/Co-Promotor.

Promotor and Co-Promotor

Promotor and Co-Promotor for Doctoral Program are lecturers or experts from related field and are assigned by Head of Department based on a Rector's Decree to guide and advise a Doctor candidate in conducting research and dissertation writing. Academic Advisor consist of 1 Promotor and a maximum of 2 (two) Co-Promotors. Promotor is a first chair Advisor who holds an academic degree of Professor or Doctor and a minimum of Senior Lecture academic position; has a relevant expertise in the field which the student's dissertation topic is; and is acknowledge as a full time faculty at the Universitas Indonesia, and for the last five years has produced at the latest: one scientific paper in an accredited national journal or a reputable international journal; or one other form of scientific product which is acknowledge by a group of experts set up by the Academic Senate of Universitas Indonesia.

Co-Promotors are the Promotor's companions who act as second and/or third chair advisor who hold academic degree of Doctor or Senior Lecturer, and has a relevant expertise in the field with the student's dissertation topic. Co-Promotor from outside of the Faculty of Engineering UI must have the approval from the Promotor. Promotor and Co-Promotors are appointed by the Rector based on the proposal submitted by the Dean which are also based on suggestions from the Head of Department after the student has pass the qualification examination. The appointment must be done at the latest 1 (one) semester after the qualification examination. A change of Promotor/Co-Promotor must be proposed by the Dean to the Rector based on a proposal from the Head of Department.

Program Specifications

1.	**Awarding Institution**	Universitas Indonesia
2.	**Teaching Institution**	Universitas Indonesia
3.	**Programme Title**	Doctoral Program in Civil Engineering Doctoral Program in Mechanical Engineering Doctoral Program in Electrical Engineering Doctoral Program in Metallurgy & Material Engineering Doctoral Program in Architecture Doctoral Program in Chemical Engineering Doctoral Program in Industrial Engineering
4.	**Class**	Regular
5.	**Final Award**	Doctor (Dr.)
6 .	**Accreditation / Recognition**	Civil Engineering Doctoral Program: Accreditation A from BAN-PT Mechanical Engineering Doctoral Program: Accreditation A from BAN-PT Electrical Engineering Doctoral Program: Accreditation A from BAN-PT Metallurgy & Material Engineering Doctoral Program: Accreditation A from BAN-PT Chemical Engineering Engineering Doctoral Program: Accreditation A from BAN-PT Architecture Doctoral Program: Accreditation A from BAN-PT Industrial Engineering Doctoral Program: Accreditation A from BAN-PT
7.	**Language(s) of Instruction**	Bahasa Indonesia
8.	**Study Scheme (Full Time / Part Time)**	Full Time
9.	**Entry Requirements**	Master graduate from study programs in line with study program chosen and pass the entrance examination
10.	**Study Duration**	Programmed for 3 years

	Type of Semester	Number of Semester	Number of weeks / semester
	Regular	6	14-17
	Short (optional)	-	-

Streams:

The Civil Engineering Doctoral Program has six streams as follow:
- Structure
- Construction Management
- Transportation
- Water Resource Management
- Project Management
- Geotechnique

The Mechanical Engineering Doctoral Program has four streams as follow:
- Energy Conversion
- Engineering Design and Product Development
- Manufacture Engineering
- Fire Safety Engineering and Management

The Electrical Engineering Doctoral Program has eight streams as follow:
- Telecommunication Engineering
- Electrical Power and Energy Engineering
- Photonic and Electronic Engineering
- Control Engineering
- Multimedia and Information Engineering
- Security of Information Network Engineering
- Telecommunication Management
- Electrical Power and Energy Management

<table>
<tr><td></td><td colspan="3">The Metallurgy & Material Engineering Doctoral Program has two fields of specialization:
• Corrosion and Protection
• Material Engineering and Manufacture Process

The Chemical Engineering Doctoral Program has five streams as follow:
• Industry Catalist
• Gas Management
• Product Design and Chemical Process
• Environmental Protection and Work Safety
• Gas Technology

The Industrial Engineering Doctoral Program has several research focus areas:
1. Manufacturing Systems Engineering
• Industrial Policy and Analysis
• Value Chain and Logistics
• Quality and Reliability
• Product/Process Design and Innovation
2. Service Systems Engineering
• Product - Service - System
• Service Design
• Service Quality & Improvement
• Decisions, Uncertainty & Risk
3. Optimization and Data Analytics
• Operations Research
• Data analytics and Forecasting
• Real-time optimization</td></tr>
<tr><td>11..</td><td colspan="3">Graduate Profiles:

FTUI Doctoral Program Graduates haves the capabilities of demonstrating expansion, novelty breakthrough in research in the engineering or architecture field in accordance to certain stream or sub-stream. The FTUI Doctoral Program prepares student to work in academic and research in accordance to their own stream; dedicate their expertise in research laboratory, industry or government institution; or create a business based on their innovation.

Graduates are able to posess the following skill:
• Be able to show expertise in the engineering or architecture discipline;
• Be able to uphold the academic and research ethics;
• Be able to work collaboratively in research;
• Be able to position themselves as leader in their community;
• Be able to communicate well in their community and build networks;
• Be able to demonstrate individual live skill in connection to human relationship;
• Be able to demonstrate attitude, behavior and way of thinking which support their success in society.</td></tr>
<tr><td>12..</td><td colspan="3">Graduates Competencies:

The aim of Doctoral Program in FTUI is in line with the Doctoral Program of Universitas Indonesia, to produce quality graduates with the following competence:
1. Able to independently update their knowledge on science and technology in engineering or architecture through research based innovation breakthrough.
2. Able to show professionalism in their field of study that can be accountable towards the development of science and technology.
3. Able to write a scientific paper in engineering or architecture and convey the result of their research to the public both orally or written in an international scientific activity.
4. Able to recommend a solution for a complex problem faced by society in the field of engineering or architecture through inter, multi and trans discipline approach.
5. Able to lead a working or research team to solve problem in the field of engineering or architecture that can be of benefit for the good of mankind.
6. Able to develop and maintain a network of cooperation with fellow researcher and research community in the field of engineering and architecture both in national and international level.</td></tr>
<tr><td>13.</td><td colspan="3">Course Composition (Course & Research)</td></tr>
<tr><td>No.</td><td>Classification</td><td>Credit Hours (SKS)</td><td>Percentage</td></tr>
<tr><td>i</td><td>Course Component</td><td>16</td><td>32%</td></tr>
<tr><td>ii</td><td>Research Component</td><td>34</td><td>68%</td></tr>
<tr><td></td><td>Total</td><td>50</td><td>100%</td></tr>
</table>

14.	Classification of Subjects. (Research)		
No.	Classification	Credit Hours (SKS)	Percentage
i	Course Component	0	0 %
ii	Research Component	50	100 %
	Total	50	100%
	Total Credit Hours to Graduate	50 CP	

Curriculum Structure for FTUI Doctoral Program

The curriculum structure for the Doctoral Program in all study programs are the same, they are only differentiated by their codes for the research component. The code "xx" for each study programs are as follow:

ENCV for Civil Engineering, ENME for Mechanical Engineering, ENEE for Electrical Engineering, ENMT for Metallurgy & Material Engineering, ENAR for Architecture, and ENCH for Chemical Engineering, ENIE for Industrial Engineering

The FTUI Doctoral Program is held in two program: Course and Research and Research.

Doctoral Program (Course & Research)

The following is the curriculum structure for Course & Research Doctoral Program in Table 1.

Table 1. The Curriculum Structure – Doctoral Program in Course and Research

Code	Subject	SKS
	1st Semester	
ENGE901001	Advanced Research Method	6
ENXX900001	Special Subject I	3
	Sub Total	**9**
	2nd Semester	
ENGE902002	Qualitative & Quantitative Analysis	4
ENXX900002	Special Subject II	3
ENXX900005	Research Proposal	6
	Sub Total	**13**
	3rd Semester	
ENXX900006	Publication – International Conference	4
	Sub Total	**4**
	4th Semester	
ENXX900008	Research Result Examination	10
	Sub Total	**10**
	5th Semester	
ENXX900009	Publication II – National Journal	8
	Sub Total	**8**
	6th Semester	
ENXX900012	Promotion Examination	6
	Sub Total	**6**
	Total	**50**

The Lecture Component includes four subjects:
a. Advanced Research Method, 6 sks
b. Qualitative and Quantitative Analysis, 4 sks
c. Special Subject I, 3 SKS.
d. Special Subject II, 3 SKS.

The Research Component includes:
1. Research Proposal, 6 SKS
2. Publication – International Conference, 4 SKS
3. Research Result Examination, 10 SKS
4. Publication – International Journal, 8 SKS
5. Promotion Exam, 6 SKS

Doctoral Program (Research)

The following is the curriculum structure for Research Doctoral Program in Table 2.

Table 2. The Curriculum Structure – Doctoral Program in Research

Code	Subject	SKS
	1st Semester	
ENXX900003	Research Group Periodic Seminar	6
	Sub Total	**6**
	2nd Semester	
ENXX900005	Research Proposal	6
	Sub Total	**6**
	3rd Semester	
ENXX900007	Publication I – International Conference	6
	Sub Total	**6**
	4th Semester	
ENXX900008	Research Result Examination	10
	Sub Total	**10**
	5th Semester	
ENXX900009	Publication II – National Journal	8
	Sub Total	**8**
	6th Semester	
ENXX900011	Publication III – International Journal	**8**
ENXX900012	Promotion Examination	6
	Sub Total	**14**
	Total	**50**

Description of Subjects

Advanced Research Method
ENGE901001
6 SKS

Learning Objective(s): Course participants are expected to: (a) master the scientific work process based on science philosophy, which is the scientific justification aspects, innovative aspects and scientific ethics aspects, (b) able to write a research proposal and or draft of scientific writing related to the student's doctoral topic, (c) can map research result from the latest international journal in their field and understand the state-of-the-art from their research topic, and can determine the knowledge gap yet explored in the international level for further research in their Doctoral Program.

Syllabus: (1) Relationship between philosophy and engineering science; (2) Science Philosophy; (3) Epystemology in Engineering Science; (4) Research Method; (5) Problem formulation and hypothesis; (6) Research and state of the art; (7) Research Evaluation; (8) Design Evaluation and research Stages; (9) Introduction to the analysis of the data processing method; (10) Benchmark on research output and conclusion formulation; (11) Various citation method; (12) Finalization of research proposal draft and /or scientific article draft.

Prerequisite(s): None

Textbooks:

1. Haryono Imam R dan C. Verhaak, Filsafat Ilmu Pengetahuan, Gramedia, Jakarta, 1995
2. Willie Tan, "Practical Research Methods", Prentice Hall, 2002.
3. R. Kumar, *Research Methodology, A Step-by-step Guide for Beginner*, 3rd ed., Sage Pub, 2012

Qualitative and Quantitative Analysis

ENGE902002
4 SKS

Learning Objective(s): Discuss the qualitative and quantitative in data analysis and exploring specific data analysis areas. After participating in this subject which discuss the qualitative and quantitative approach in data analysis in exploring specific areas of data analysis. Students are expected to be able to build the following learning outcome: (1) awareness to situations requiring qualitative data analysis in the inductive paradigm; (2) awareness to situations requiring quantitative data analysis in the deductive paradigm; (3) appreciation toward various approaches; (4) possessing skills in giving critical appraisal; (5) possessing skills in performing qualitative and quantitative data analysis.

Syllabus: Introduction; Qualitative Analysis; Quantitative Analysis; Non-Parametric Analysis; Uncertainty Analysis; Critical Appraisal; Design of Experiment; ANOVA revisit; Multivariate Techniques.

Prerequisite(s): None

Textbooks:

1. Miles M & Huberman M, Qualitative Data Analysis, London Sage Publications, (1994)
2. Montgomery, D.C., & Runger, G.C, Applied Statistics and Probability for Engineers 3rd Ed., John Wiley and Sons, Inc., New York, (2003)
3. Kirkup, L, Experimental Method: An Introduction to the Analysis and Presentation, John Wiley and Sons, Australia, Ltd., Queensland, (1994)
4. Montgomery, D.C, Design and Analysis of Experiments 6th Ed., John Wiley and Sons, Inc., New York, (2005)
5. Hair, J.F., B.Black, B.Babin and R.E Anderson, Multivariate Data Analysis 6th Ed., Pearson Education Inc., New Jersey, (2006)

Special Subject 1

ENXX900001
4 SKS

Special Subject 2

ENXX900002
4 SKS

Special Subject 1 in the 1st first semester (4 SKS) and Special Subject 2 in the 2nd semester (4 SKS) are determined together with the student's Academic Advisor to support the student's research and/or to develop the student's knowledge with information and knowledge from unrelated field. Academic Advisor is also allowed to propose a special content for the student to Head of Department.

The following are the requirements for the implementation of Special Subject 1 and 2:

1. For students who do not have in line Master degree educational background from the Faculty of Engineering Universitas Indonesia, they are allowed to take the similar courses of the related field of study available at the Master Program in FTUI during the running semester.
2. Students are also allowed to take courses from other study programs within the Faculty of Engineering Universitas Indonesia or courses from other faculties in UI as stated in the Guidance Book or the Master/Doctoral Program Catalog.
3. Students are allowed to take classes in other Master Program in the Faculty of Engineering Universitas Indonesia or other faculties within the Universitas Indonesia as deemed necessary by their Academic Advisor
4. In the event where neither conditions is viable for the students, the Academic Advisor is allowed to conduct a class of said course.

Research Group Periodic Seminar

ENXX900003
6 SKS

Research Group Periodic Seminar is an early activity of research in the Doctoral Program in Research where students conduct literature study in relation to the materials for their research. This literature study must be done intensively by mapping out the research results from the latest international journals in related field. The final aim was so that students have a state-of-the-art understanding of their research topic, and can determine the knowledge gap previously unexplored in the international level for further research in their Doctoral Program. The result of this literature study is compiled in a literature study report presented in the Research Group Periodic Seminar to be examined by a panel comprises of future Promoter/ Academic Advisor and Examiners from related field of study. Students will passed this Research Group Periodic Seminar if they received a minimum grade of B.

Research Proposal

ENXX900005
6 SKS

Research Proposal is the continuous activity of the literature study, where after gaining a state-of-the-art knowledge of their research topic, students can formulize the scope of their Doctoral research and determine which research method will be use. The result of this activity is a comprehensive research proposal which include: goals, background and data analysis from early study or experiments done. Included in this research proposal is plan of work for each semester and its publication goals. At this level, it is expected for students to begin experiment activity or early study which can show the direction of their research is feasible and recent in his field. The early experiment or study result, the literature study and the whole research plan is then compiled in a Research Proposal Report to be presented and examined in a Research Proposal Examination. Students will passed this Research Proposal if they received a minimum grade of B.

Research Result Examination

ENXX900008
10 SKS

At this stage, students are expected to have a research output with a minimum of 75% from their research plan. Doctorate candidate are expected to have reach a research outcome which is the main part of the originally planned contribution. The outcome of this research is measured through the Research Output Examination. The examination committee is appointed through the Dean's Decree based on the Head of Department's proposal. These examiners consist of experts related in the field of study of the Doctorate candidate with at least one examiner from an institution outside of Universitas Indonesia. Doctor Candidate will passed this Research Output Examination if they received a minimum grade of B. At this stage, a Doctor Candidate are allowed to design a scientific article framework to be published in an indexed International Journal and determine which International Journal they will send the article to.

Publication – International Conference
ENXX900006
4 SKS

Publication I – International Conference
ENXX900007
6 SKS

At this stage, students are expected to have an experiment result or study to focused on in their research topic and clarify their research direction. The result of the experiment must also show innovation or breakthrough, mastery of knowledge on their stream in relation to their research topic, the depth of their research materials, and the mastery of the state of the art development in their field or research interest, originality, and the contribution towards science and/or its implementation. Once presented in front of their promoter and co-promoter, the whole research result at this stage will be deemed worthy for international conference publication.

Publication II – International Journal
ENXX900009
8 SKS

Publication III – National Journal
ENXX900011
8 SKS

The scientific publication is an integral part of research activity and a prerequisite in participating in a Promotion Examination. International Journal meant here is an English language journal which its editorial board consists of member from at least three different countries or more. A mandatory publication must have an "Accepted" status before the Promotion Examination. FTUI itself publish their own international journal, the International Journal of Technology (IJTech), which students can utilize as one of the international journal to publish their Doctoral research.

Promotion Examination
ENXX900012
6 SKS

Before deemed fit to participate in a Promotion Examination. Doctor Candidate are required to conduct additional research as a follow up from the Research Output Examination. The inputs and revisions given during the Research Output Examination must be completed and revised through a series of final research. At this stage, the Doctor Candidate must prove the authencity and originality of their research as new contribution to the scientific world. Thus, at this stage, the Doctor Candidate is required to have an "Accepted" for their international Journal, they are also required to complete their dissertation paper ready to be tested during the Promotion Examination.

Dissertation is an academic scientific paper study output and/or in depth research done independently and contained new contribution to issues that are temporary already known the answer or new questions ask on issues that are seen to have been established in the field of science and technology by the Doctor Candidate under the guidance of his Academic Advisor. A Doctor Candidate that has completed the revision of their dissertation are required to submit a completed version of their dissertation in five hard cover books and original approval form that has been signed by their advisors and submitted to PAF FTUI signifying the end of their study. The format for writing and binding the Dissertation should follow the writing and binding guidelines in the Technical Guidelines of Final Project Writing for Students of Universitas Indonesia that can be downloaded at http://www.ui.ac.id/download.

Promotion Examination is a scheduled academic activity as a medium of evaluation for the Doctor Candidate Dissertation as a requirement to obtain the highest academic title, Doctor. The requirements and provision for Promotion Examination are as follow:

- Promotion Examination can be done if all the scientific publication requirements are completed by the Doctor Candidate: a minimum of one publication in an International Scientific Journal (in "Accepted" status) in relation to their dissertation research. The Publication is required to state Faculty of Engineering Universitas Indonesia as one of the affiliation institution.
- Promoter and Co-Promoter gave a written approval on the dissertation as a sign that the dissertation can move forward to the Promotion Examination.
- The Promotion Examination is carried out by the Committee of Promotion Examination which is appointed with a Rector's Decree based on a proposal from the Head of Department and the Dean of the Faculty of Engineering Universitas Indonesia.
- The Committee of the Promotion Examination comprises of: (a) Promoter and Co-Promoter, (b) The Examiners, (c) a minimum of one examiner from outside of Universitas Indonesia.
- Examiners consist of experts from related field of study. In a special circumstances, an expert that is not from the academic community can be invited as part of the examiners team.
- The Promotion Examination is led by the Head of the Examiners Committee that is also a member of the committee outside of the Promoter/Co-Promoter and outside examiner. If the Head of the Examiners Committee is unavailable, his/her position can be replaced by one of the member of the examiner team.
- The Promotion Examination is held as an open session for a period of maximum three hours divided into two stages: the dissertation presentation given by the Doctor Candidate for 15-30 minutes and a question and answer session for 120-165 minutes.
- The Doctor Candidate will pass the Promotion Examination if they received a minimum grade of B with GPA 3.00.

Facilities for Doctoral Program Students

To make sure that student of FTUI Doctoral Program are able to conduct full time research and produce excellent publications as required, FTUI provides the following facilities:

Doctoral Program Students' Workstation

Compact cubicles in comfortable rooms are available as Doctoral program students' workstation. The locations for these workstations are located on the 2nd and 3rd floor of the Engineering Center Building. Access to these workstations requires a swipe card to guarantee security. A round the clock wi-fi service is also available. To procure a workstation and access card, students are requested to register to the Associate Dean for General Affairs in the Dean's building, 2nd floor, FTUI Depok.

International Journal Article Writing Training

These free of charge trainings for the FTUI Doctoral program students are held several times each year. The information regarding these trainings are communicated through an announcement in SIAK-NG, posters at each Department, Doctoral program mailing list and FTUI website (www.eng.ui.ac.id).

Research Proposal Writing Training

These free of charge trainings for the FTUI Doctoral program students are held several times each year. The information regarding these trainings are communicated through an announcement in SIAK-NG, posters at each Department, Doctoral program mailing list and FTUI website (www.eng.ui.ac.id).

Line Editing Draft for International Journal Article

FTUI provides funds for line editing drafts for International Journal Articles. Requirement for applying for this funds are: the article must include the promoter name as part of the writing team and state FTUI as the main affiliation. To be grant this facility, students only needs to send a draft of their article through email to the FTUI Associate Dean of Academic and Research (risetft@eng.ui.ac.id). The time required for line editing is 2-4 weeks.

Doctoral Program Mailing-List

The Doctoral Program mailing list is used as a communication tool between the Dean's Faculty Heads, the Faculty Center Administration staff and all Doctoral program students in FTUI. Information regarding trainings, seminars, grants or other academic matters is announced through this mailing list. Complaints and suggestions are also accommodated by this mailing list. The mailing list address is: programdoktorft@group.eng.ui.ac.id

Research and Incentive Grants for Master and Doctoral Program

Research funds including consumables and tests for research as part of the thesis and dissertation writing is the responsibility of the student. There are a number of competitive research grants, incentive research grant schemes available from which Master and Doctoral program students may propose to finance his/her research. Complete guidance and research proposal examples are available at the Associate Dean for Research and Community Development secretary at the Dean's Building, 2nd floor or through http://research.eng.ui.ac.id.

International Journal Writing Incentive

This incentives are given to lecturer of State of Private Universities that have published an article in an international journal. Each proposer must be the first writer of the article and include an institution affiliation in Indonesia.

UNIVERSITAS INDONESIA

FACULTY OF ENGINEERING

Secretariate

FTUI Dean's Building 2nd Floor
Depok Campus, Depok 16242
Phone: +6217863504
Fax: +6221 7270050

Public Relation Office

Faculty Administration Center Building
Depok Campus, Depok 16241
Phone: +6221 78888430, Fax: +6221 78888076
Email: humas@eng.ui.ac.id