UNIVERSITAS INDONESIA
Veritas, Probitas, Iustitia

FAKULTAS
TEKNIK

ACADEMIC GUIDEBOOK
2016-2020

PROFILE OF FTUI AND DEPARTMENTS

ACADEMIC SYSTEM AND REGULATION

FACILITIES AND CAMPUS LIFE

UNDERGRADUATE PROGRAM

PROFESSIONAL PROGRAM

MASTER PROGRAM

DOCTORAL PROGRAM

2018 EDITION

CHAPTER 1

PROFILE OF FTUI AND DEPARTMENTS

1. PROFILE OF FTUI AND DEPARTMENTS

1.1. 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 the 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, the youngest study program in the Faculty of Engineering of UI, was opened in 1999 with Ir. M. Dachyar, M.Sc. as its first Head of the Study Program. The term “study program” was later changed into “department”, and it is still used today.

1.2. VISION AND MISSION OF FTUI

FTUI's Vision

The Faculty of Engineering of Universitas Indonesia becomes the excellent nation's pride and will be able to compete in South East Asia.

FTUI's Missions are to

• prepare Undergraduate, Master's, and Doctoral graduates with international insight by using Cutting-Edge Engineering Education & Management which are the benchmark of the higher education system in South East Asia region;

• organize research for the development of the nation's technology and science by focusing on Applied Engineering Research. Applied Engineering Research is a type of research that can not only compete in the international scene, but also benefit the Indonesian people, without disregarding research that has been the back bone of the Faculty of Engineering of Universitas Indonesia;

• encourage the professionals and adapt the Engineering Enterprises system and community engagement to the need of the society and industry. Engineering Enterprises must have an active role in solving the global demand with the support towards sustainable and humane development; and

• build and prepare an engineering institution based on Integrated Information Technology (Integrated IT-Based Institution) with efficiency and professionalism, that are two national benchmarks. Integrated IT-Based Institution must be able to keep up with the trends in FTUI or future technology development.

1.3. UI and FTUI

UI Administration

Rector

Prof. Dr. Ir. Muhammad Anis. M.Met.

Deputy Rector for Academic and Student Affairs

Prof. Dr. Bambang Wibawarta, S.S., M.A.

Deputy Rector for Finance, Logistics, and Facilities

Prof. Sidharta Utama, Ph.D., CFA

Deputy Rector for Research and Innovation

Prof. Dr. rer. nat Rosari Saleh

Deputy Rector for Human Resources, Development, and Cooperation

Prof. Dr. Ir. Dedi Priadi, DEA

FTUI Administration

Dean of the Faculty of Engineering:

Dr. Ir. Hendri D.S. Budiono, M.Eng.

Vice Dean I:

Dr. Ir. Muhamad Asvial, M.Eng.

Vice Dean II:

Prof. Dr.-Ing. Nandy Putra

Associate Dean for Academic Affairs and Head of the Faculty Administration Center:

Dr.Eng. Arief Udhiarto, S.T., M.T., IPM

Associate Dean for Research and Community Engagement:

Dr.Eng. Muhamad Sahlan, S.Si., M.Eng.

Associate Dean for Student Affairs and Alumni:

Dr. Badrul Munir, S.T., M.Eng.Sc.

Associate Dean for Human Resources and General Administration

Jos Istiyanto, S.T., M.T., Ph.D.

Associate Dean for General Affairs and Facilities

Dr. Dwi Marta Nurjaya, S.T., M.T.

Associate Dean for Cooperation and Venture

Dr. Ir. Imansyah Ibnu Hakim, M.Eng.

Head of the Development and Management System Assurance Unit and Academic Quality Assurance Unit

Dr. Ir. Rahmat Nurcahyo, M.Eng.Sc.

Course Coordinator of FTUI Salemba Campus

Prof. Ir. Sutrasno Kartohardjono, M.Sc., Ph.D.

Departments

The following is the list of the Heads of Departments and Vice Heads of Departments:

Civil Engineering:

Ir. R. Jachrizal Sumabrata, M.Sc., Ph.D.

Dr. Cindy Rianti Priadi, S.T., M.Sc.

Mechanical Engineering:

Dr. Ario Sunar Baskoro, S.T., M.T., M.Eng.

Dr. Agus Sunjarianto Pamitran, S.T., M.Eng.

Electrical Engineering:

Dr. Ir. Aries Subiantoro, M.Sc.

Dr. Abdul Halim, M.Eng.

Metallurgical and Materials Engineering:

Prof. Dr. Ir. Akhmad Herman Yuwono, M.Phil.Eng.

Nofrijon Sofyan, Ph.D.

Architecture:

Dr.-Ing. Ir. Dalhar Susanto

Joko Adianto, S.T., M.Ars., Ph.D.

Chemical Engineering:

Dr. Ir. Asep Handaya Saputra, M.Eng.

Dr. Bambang Heru Susanto, S.T., M.T.

Industrial Engineering:

Dr.-Ing. Amalia Suzianti, S.T., M.Sc.

Dr. Komarudin, S.T., M.Eng.

BOARD OF PROFESSORS

Prof. Dr. Ir. Budi Susilo Soepandji
Prof. Dr. Ir. Sutanto Soehodo, M. Eng
Prof. Dr.-Ing. Ir. Bambang Suharno
Prof. Dr. Ir. Bondan T. Sofyan, M.Si

Prof. Dr. Ir. Tommy Ilyas, M.Eng
Prof. Dr. Ir. Irwan Katili, DEA
Prof. Dr. Ir. I Made Kartika, Dipl. Ing.
Prof. Dr. Ir. Raldi Artono Koestoer
Prof. Dr. Ir. Bambang Sugiarto, M.Eng
Prof. Dr. Ir. Yanuar, M.Eng
Prof. Dr. Ir. Tresna P. Soemardi
Prof. Dr. Ir. Budiarso, M.Eng
Prof. Dr. Ir. Yulianto S. Nugroho, M.Sc
Prof. Dr.-Ing. Nandy Putra
Prof. Dr. Ir. Djoko Hartanto, M.Sc
Prof. Dr. Ir. Dadang Gunawan, M.Eng
Prof. Dr. Ir. Bagio Budiardjo, M.Sc
Prof. Dr. Ir. Eko Tjipto Rahardjo, M.Sc
Prof. Dr. Ir. Harry Sudibyo
Prof. Ir. Rinaldy Dalimi, M.Sc., Ph.D
Prof. Dr. Ir. Rudy Setiabudy, DEA
Prof. Dr. Ir. Iwa Garniwa, MK., MT
Prof. Dr. Ir. Muhammad Idrus Alhamid
Prof. Dr. Ir. Riri Fitri Sari, M.Sc.MM
Prof. Dr. Benyamin Kusumoputro, M.Eng
Prof. Dr. Ir. Kalamullah Ramli, M.Eng
Prof. Dr. Ir. Eddy S. Siradj, M.Sc
Prof. Dr. Ir. Johny Wahyuadi Mudaryoto
Prof. Dr. Ir. Anne Zulfia, M.Sc
Prof. Ir. Mahmud Sudibandriyo, M.Sc., Ph.D
Prof. Dr. Heri Hermansyah, S.T., M.Eng.
Prof. Dr. Ir. Sigit P. Hadiwardoyo, DEA
Prof. Dr. Kemas Ridwan Kurniawan, ST., M.Sc
Prof. Dr. Ir. Sunaryo
Prof. Ir. Triatno Yudo Harjoko, M.Sc., Ph.D
Prof. Dr. Ir. Abimanyu Takdir Alamsyah, MS
Prof. Dr. Ir. Widodo Wahyu P, DEA
Prof. Dr. Ir. M. Nasikin, M.Eng
Prof. Dr. Ir. Anondho W., M.Eng
Prof. Dr. Ir. Setijo Bismo, DEA
Prof. Dr. Ir. Slamet, M.T
Prof. Dr. Ir. T. Yuri M. Zagloel, M.Eng.Sc
Prof. Ir. Sutrasno Kartohardjono, M.Sc., Ph.D
Prof. Dr. Ir. Yusuf Latief, MT
Prof. Dr. Ir. Dedi Priadi, DEA
Prof. Dr. Ir. Harinaldi, M.Eng
Prof. Dr. Ir. Djoko M Hartono, SE., M.Eng
Prof. Dr. Ir. Muhammad Anis, M.Met
Prof. Ir. Isti Surjandari Prajitno, MT., MA., Ph.D
Prof. Dr. Ir. Danardono Agus S, DEA
Prof. Dr. Ir. Nji Raden Poespawati,MT
Prof. Dr. Ir. A. Herman Yuwono, M.Phil.Eng
Prof. Yandi A. Yatmo, S.T., M.Arch., Ph.D
Prof. Dr. Ir. Adi Surjosatyo, M.Eng
Prof. Ir. Widjojo Adi Prakoso, M.Sc., Ph.D
Prof. Dr. Ir. Winarto, M.Sc
Prof. Dr. Ing. Ir. Misri Gozan, M.Tech.
Prof. Dr. Ir. Nelson Saksono, MT
Prof. Paramita Atmodiwirjo, S.T., M.Arch., Ph.D.
Prof. Dr. Ir. Gandjar Kiswanto, M.Eng
Prof. Dr.-Ing. Ir. Dwita Sutjiningsih, Dipl.HE
Prof. Dr. Ir. Fitri Yuli Zulkifli, ST., M.Sc

INTERNATIONAL ADJUNCT PROFESSOR

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.

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

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.

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.

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

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

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

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

Prof. Chit Chiow (Andy) Tan, Mechanical Engineering, School of Mechanical, Manufacturing and Medical Engineering, Queensland University of Technology, Australia,

Prof. Kozo Obara, Nanomaterial dan Energi, Dept. of Nanostructure and Advanced Materials, Kagoshima University, Japan,

Prof. Freddy Y.C. Boey, Nanyang Technological University, Singapore, Nanomaterial dan Biomedical Engineering

Prof. Kyoo-Ho Kim, Dr.Eng, Nanomaterial dan Energi, School of Material Science and Engineering, Yeungnam University, Korea,

Prof. Bernard Cambou, Transport and Safety, Ecole Centrale de Lyon,France, INRETS (French National Institute for Transport and Safety Engineering),

Prof. Chia-Fen Chi, Industrial Management, Dept. of Industrial Engineering, National Taiwan University Science and Technology,

Prof. Dr. Katsuhiko Takahashi, Artificial Complex System Engineering, Dept. of Artificial Complex Systems Engineering, Hiroshima Univer- sity, Japan, Artificial Complex System Engineering.

Prof. Martin Betts, Faculty of Built Environment and Engineering, Queensland University of Technology, Australia.

Prof. L. P. Lighart (Emeritus), Delft University of Technology, the Netherlands.

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.

Prof. Dr. Uwe Lahl

Prof. Dr. Tae Jo Ko,

tjko@yu.ac.kr, (B.Sc. Pusan National University; M.Sc. Pusan National University; Ph.D. Pohang Institute)

of Technology), Micromachining, Nontraditional Manufacturing, Machine Tools

Prof. Dr. Keizo Watanabe,

keizo@tmu.ac.jp, (MSc. Tokyo Metropolitan University, 1970; Dr-Eng. Tokyo Metropolitan Uni- versity, 1977), Drag Reduction, Fluid Mechanics.

Prof. Philippe Lours, Superalloys, aerospace material, ÉÉcole nationale supérieure des mines d'Albi-Carmaux, France.

Prof. Christopher Silver

silver2@ufl.edu, (BA St. Lawrence University; MA and PhD University of North Carolina at Chapel Hill MURP Virginia Commonwealth University)

1.4. 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 and Materials Engineering
(8) Architecture
(9) Interior Architecture
(10) Chemical Engineering
(11) Bioprocess Engineering
(12) Industrial Engineering
(13) Biomedical Engineering

Nine Master's Degree Programs:

(1) Civil Engineering
(2) Mechanical Engineering
(3) Electrical Engineering
(4) Metallurgical and Materials Engineering
(5) Architecture
(6) Chemical Engineering
(7) Industrial Engineering
(8) Biomedical Technology
(9) Energy System Engineering

and **seven Doctoral Programs**:

(1) Civil Engineering
(2) Mechanical Engineering
(3) Electrical Engineering
(4) Metallurgical and Materials Engineering
(5) Architecture
(6) Chemical Engineering
(7) Industrial Engineering

and **two Professional Programs:**

(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:

Civil Engineering : A	Industrial Engineering : A
Mechanical Engineering : A	Naval Architecture & Marine Engineering : A
Electrical Engineering : A	Computer Engineering : A
Metallurgical and Materials Engineering : A	Environmental Engineering : A
Architecture : A	Architecure Interior : A
Chemical Engineering : A	Bioprocess Engineering : A

Accreditation for Master's Programs is as follows:

Civil Engineering : A	Architecture : A
Mechanical Engineering : A	Chemical Engineering : A
Electrical Engineering : A	Industrial Engineering : B
Metallurgical and Materials Engineering : A	Biomedical Technology : B

Accreditation for the Doctoral Programs is as follows:

Civil Engineering : A	Architecture : A
Mechanical Engineering : A	Chemical Engineering : A
Electrical Engineering : A	Industrial Engineering : B
Metallurgical and Materials Engineering : A	

In 2008 and 2010, the Departments of Mechanical Engineering, Civil Engineering, Electrical Engineering, Metallurgical and Materials Engineering, Architecture, and Chemical Engineering were accredited by the ASEAN University Network (AUN), and in 2013 the Department of Industrial Engineering were accredited by the ASEAN University Network (AUN)

In 2016 the Department of Civil Engineering was re-accredited by AUN.

In 2017 the Technology Bioprocess and Naval Architecture and Marine Engineering Study Programs were accredited by AUN.

In 2017 the Department of Chemical Engineering was accredited by JABEE (the Japan Accreditation Board for Engineering Education), and in 2018 the Chemical Engineering and Bioprocess Engineering Study Programs were accredited by IABEE (Indonesian Accreditation Board for Engineering Education).

In 2018 the Environmental Engineering Study Program was 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 skills in a particular field of study;
•Being able to implement the science, knowledge, and skills acquired in accordan with their respective field of study; and
•Being able to keep abreast of the development and growth of science and technology.

The aim of the Undergraduate Program of FTUI is to produce graduates with competencies set by the Accreditation Board for Engineering and Technology (ABET) and the Washington Accord as follows:
•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 a 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 understanding of the technological impacts of their projects in both local and global scales;
•Having the motivation and ability to learn continuously;
•Having knowledge of the latest engineering problems;
•Being able and skilled in using the latest engineering methods; and

•Producing graduates from the Architecture Study Program with the competence in accordance to the National Architectural Accrediting Board (NAAB).

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 and 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' cross-cultural adaptability. Students can fulfill their "studying abroad" obligation during regular semesters.

Before finishing their studies, students should fulfill a minimum English proficiency level as the set forth in Dean's Decree No. 740/D/SK/FTUI/IX/2018: a minimum IELTS score of 6.0 with no bands lower than 6.0 or TOEFL IBT score of 75 with no bands lower than 18.

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 Programs

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 Engineers is to fulfill the need for graduates with high competence in engineering, in accordance with the Engineer Law.

The Professional Program for Engineers aims to produce engineers with the following characteristics:
- Having an understanding of an engineer's code of ethics and code of conduct;
- Having the necessary technical skills of an engineer, including consultation service, predesign creation, licensing process, the development of design, and completion of various technical and bidding documents; and
- Having a sound understanding of code of compliances, including those related to providing service to clients, complying with current regulations, 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

PROFILE OF FTUI & DEPARTMENTS

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's Degree 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 the Master's Degree Program:
•Regular Class Program is held full-time from Monday to Friday in FTUI Campus, Depok.
•Special Class Program is held at specific times with the following details:
-Special Class program for Metallurgical and Materials Engineering: Saturday (08.00 a.m.–07.00 p.m.) in FTUI Campus, Depok.
-Special Class program for Industrial Engineering: Friday (05.00 p.m.–09.00 p.m.) and Saturday (08.00 a.m.–05.00 p.m.) in FTUI Campus, Salemba.
-Special Class program for Energy System Engineering, Biomedical Technology, and other Special Class programs: Monday–Friday (05.00 p.m.–09.30 p.m.) 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. 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.

FACULTY OF ENGINEERING

PROFILE OF FTUI & DEPARTMENTS

1.5.1. DEPARTMENT OF CIVIL ENGINEERING

GENERAL INFORMATION

The Civil Engineering Department, previously known as the Civil Engineering Study Program, was estab- lished together with the Faculty of Engineering of Universitas Indonesia (FTUI) onat 17 July 17th, 1964. During In its the 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 Fol- lowing the demand and development of science and technology, the study program it was then expanded to cover with 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 the Postgradu- ate Programs of for Mmaster's Ddegree (S2) and Ddoctoral Degree (S3) were established in 1992 and 2001, respectively. In 2006, the Department established the undergraduate program ofn Environmental Engineering. Previously, Environmental Engineering is one of the majors in Civil Engineering. There are eight specializations for Master's Ddegree Program and Doctoral Program in Civil Engineering, consisting of structural engineer- ing, geotechnical engineering, water resources management, transportation system and& engineering, construction management, environmental engineering, project management, and infrastructure management.

To maintain its ensure the quality, the Department has beenis regularly accredited by the Nnational Aaccreditation Bboard, BAN-PT (Badan Akreditasi Nasional Pendidikan Tinggi or BANPT) since 1998. All of the study programs under the of Civil En- gineering Department, both , undergraduate , Mmaster's degree, and doctoraland graduate, have reached the highest grade of "A". The Environmental Engineering Study Program of was nationally accredited nationally in 2010. The under graduate program of Civil Engineering was accredited internationally in 2001 by tThe 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 in education in the Department, AUN-QA reassessment was conducted in 2015. The Environmental Engineering S1 program assessments was assessed performed by the ASEANsean University Network (AUN) assessment in 2018, and the formal results are being processed by AUN.

Civil Engineering is the oldest engineering discipline and encompasses many specialtiesspecific areas. Civil engi- neering 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, transportation, sanitation, and the 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, as well as other challenges such as deteriorating infrastructures, com- plex environmental issues, outdated transportation systems, and natural disasters. 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 through to national governments,, and in the private sector from individual homeowners through to international companies.

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 ad- verse 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 soils 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: drink- ing water treatment, liquid and solid waste management, drainage, environmental sanitation, water resources, air pollution, pollution preven- tion, and& environmental impact assessment.

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VISION and MISSIONS

VISION

"To become a center of knowledge and technology in Civil Engineering and Environmental Engineer- ing 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 towards 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; and
- To shape and produce students that can demonstrate strong leadership and independent per- sonality, along with the ability to socialize, communicate effectively, and uphold professional ethics.

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Head of the Hydraulics, Hydrology, and River Laboratory:
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Head of the Transportation Laboratory:
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1.5.2. DEPARTMENT OF MECHANICAL ENGINEERING

GENERAL INFORMATION

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. In 2008, the Department of Mechanical Engineering also gained international recognition in the form of accreditation by the ASEAN University Network (AUN). 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; and
- To perform community services.

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 2012 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 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.

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VISION and MISSIONS

Vision
"To become the center of 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; to conduct research and education and to apply them to improve the quality of life and humanity"

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Dr. Agus S. Pamitran, S.T., M.Eng.
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Heads of Laboratory

Head of the Mechanical and Biomechanic Design Laboratory:
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PROFILE OF FTUI & DEPARTMENTS

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Head of the Thermodynamics Laboratory:
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Prof. Dr. Ir. M. Idrus Alhamid
Head of the Ship Design Laboratory:
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FACULTY OF ENGINEERING

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PART-TIME (NON-TENURED) FACULTY

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PROFILE OF FTUI & DEPARTMENTS

1.5.3. DEPARTMENT OF ELECTRICAL ENGINEERING

GENERAL INFORMATION

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 actually 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. Therefore, in 2018 DTE opened the Undergraduate Biomedical Engineering Study Program.

THE OBJECTIVE OF EDUCATION

To produce Bachelors of Engineering who are able to design hardware and/or software as the solution to various problems in the field of electrical engineering in accordance with professional ethics.

VISION AND MISSION

The vision of the Department is to become a center of excellence in education and research in the field of electrical engineering. In order to achieve such vision, the Department has set itself a mission to produce Electrical Engineering graduates who are able to compete beyond the national labor market. The graduates will be capable of responding to the fast-growing development of engineering technology with the support of excellent educational programs, excellent management and organization, qualified teaching staff with international standard of competence, and international reputation in specific research activities.

TARGETS

Bachelors of Electrical Engineering are expected to be
1. able to design hardware;
2. able to design software;
3. able to handle both general and specific issues in electrical engineering;
4. able to apply the basic principles of mathematics, physics, and statistics when solving elec trical engineering problems;
5. able to apply critical thinking, to be creative and innovative, and to possess adequate intelectual curiosity to solve problems at both individual and group levels;
6. able to identify a variety of entrepreneurial efforts that are characterized by innovation and self-reliance based on ethics;
7. able to use both spoken and written Indonesian and English, in academic and non-academic activities;
8. able to provide alternative solutions to problems that arise in their immediate environment,society, nation, and country; and
9. able to utilize information communication technology (ICT).

Bachelors of Computer Engineering are expected to be
1. able to design a system, component, and process based on needs in various areas of life;
2. able to design information networks;
3. able to design a computer-based system;

4. able to generate algorithms and apply them in programming activities;
5. able to apply the basic principles of mathematics, physics, and statistics in solving computer engineering problems;
6. able to use both spoken and written Indonesian and English in academic or non-academic activities;
7. able to show high integrity and to apply critical thinking, to be creative and innovative,and to possess adequate intellectual curiosity to solve problems at both individual and group levels;
8. able to utilize information communication technology (ICT);
9. able to provide alternative solutions to problems that arise in their immediate environment,society, nation, and country; and
10. able to identify a variety of entrepreneurial efforts that are characterized by innovation and self-reliance based on ethics.

Master of Electrical Engineering are expected to be

1. able to model an electrical engineering system into mathematical equations;
2. able to formulate solutions to various problems related to electrical engineering with proper research methods;
3. able to produce innovative and independent scientific works; and
4. able to apply the concepts of professional management in the field of electrical engineering.

ELECTRICAL ENGINEERING STAFF

Heads of the Department:
Dr. Ir. Aries Subiantoro, M.Sc.
Head of the Electrical Engineering Study Program
Dr. Ir. Aries Subiantoro, M.Sc.
Head of the Computer Engineering Study Program
Dr. Muhammad Salman, S.T., MIT
Head of the Biomedic Engineering Study Program
Dr. Basari, S.T., M.Eng.
Vice Head of the Department:
Dr. Abdul Halim, M.Eng.

HEADS OF LABORATORY
Head of the High Voltage and Electrical Measurement Laboratory:
Ir. Amien Rahardjo, M.T.
Head of the Electrical Power Conversion Laboratory:
Ir. I Made Ardita, M.T.
Head of the Electrical Power System Laboratory:
Prof. Dr. Ir. Iwa Garniwa M.K., M.T.
Head of the Electronics Laboratory:
Dr. Agus Santoso Tamsir, M.T.
Head of the Control Laboratory:
Dr. Ir. Feri Yusivar, M.Eng.
Head of the Digital Laboratory:
Dr. Prima Dewi Purnamasari, S.T., M.T., M.Sc.
Head of the Telecommunication Laboratory:
Prof. Dr. Fitri Yuli Zulkifli, M.Sc., IPM
Head of the Optoelectronics Laboratory:
Dr. Ir. Retno Wigajatri Purnamaningsih, M.T.
Head of the Computer Networks Laboratory:
Dr. Muhammad Salman, S.T., MIT

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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@ee.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.
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5. **Prof. Dr. Ir. Rudy Setiabudy, DEA,** rudy@ee.ui.ac.id (Ir., Universitas Indonesia, 1982; DEA, INPG Grenoble, France, 1987; Dr., Montpellier IIUSTL, France, 1991; Prof., UI, 2008) Electrical material technology, electrical measurement.
6. **Prof. Dr. Ir. Dadang Gunawan, M.Eng.,** guna@ee.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. N.R. Poespawati, M.T., IPM,** pupu@ee.ui.ac.id (Ir., Universitas Indonesia, 1985; M.T., Universitas Indonesia, 1997; Dr., Elektro FTUI, 2004; Prof., UI, 2008) Solar cell devices, laser.
8. **Prof. Dr. Ir. Iwa Garniwa, M.K., M.T.,** iwa@ee.ui.ac.id (Ir., Universitas Indonesia, 1987; M.T., Universitas Indonesia, 1998; Dr., Elektro FTUI, 2003; Prof., UI, 2009) High voltage and current, electrical materials.
9. **Prof. Dr.-Ing. Ir. Kalamullah Ramli, M.Eng.,** k.ramli@ee.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.
10. **Prof. Dr. Ir. Riri Fitri Sari, M.Sc., M.M., IPM,** riri@ee.ui.ac.id (S.T., Universitas Indonesia, 1994; M.Sc., Sheffield, 1998; PhD., Leeds Univ., UK, 2004; Prof., UI, 2009) Software engineering, active networks, pervasive computing.
11. **Prof. Dr. Ir. Fitri Yuli Zulkifli, S.T., M.Sc.,** yuli@eng.ui.ac.id (S.T., Universitas Indonesia, 1997; M.Sc., Univ. Karlsruhe, Germany, 2002, Dr., Universitas Indonesia, 2008) Antenna and microwave, communications.

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PROFILE OF FTUI & DEPARTMENTS

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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.

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FULL-TIME FACULTY

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PART-TIME FACULTY

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Faiz Husnayain, S.T., M.T., M.Sc. (S.T., Universitas Indonesia, 2010; M.T., Universitas Indonesia, 2013; M.Sc., NTUST, 2013).

Muhammad Firdaus Syawalludin Lubis, S.T., M.T. (S.T., Universitas Indonesia, 2010; M.T., Universitas Indonesia, 2013).

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Victor Widiputra, S.T., M.T. (S.T., Universitas Indonesia, 2014; M.T., Universitas Indonesia, 2015) Power System.

Diyanatul Husna, S.T., M.T. (S.T., Universitas Indonesia, 2015; M.T., Universitas Indonesia, 2016) Network Security, Big Data.

Alfan Prasekal, S.T., M.Sc. (S.T., Universitas Indonesia, 2014; M.Sc. (DIC), Imperial College London, 2016) Secure Software System / Cyber Security.

1.5.4.DEPARTMENT OF METALLURGICAL AND MATERIALS ENGINEERING

GENERAL INFORMATION

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.

By 2016, the department had produced almost 2,300 Bachelors of Engineering, 163 Masters of Engineering, and 25 Doctors. At the beginning of the first semester of 2016/2017, the department had 479 active undergraduate students from regular and parallel programs, 57 students from undergraduate international program, 71 master program students, and 13 doctoral students. Considering the high demand for producing qualified graduates and following the current trends in the global competition, the Department of Metallurgical and Materials Engineering is committed to continuously improving its academic

activities, which include teaching and learning processes, 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 through three main activities known as tridharma ("three duties"), the department is also committed to carrying out higher level educations, conducting scientific research, and providing 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, granted by National Accreditation Board, the Ministry of National Education (Year 2013 and 2018);
- the establishment of Master's (1995) and Doctoral (2008) programs;
- Grade A Accreditation for Master Program, granted by National Accreditation Board, the Ministry of National Education (Year 2014 to 2019);
- Grade A Accreditation for Doctoral Program, granted by National Accreditation Board, the Ministry of National Education (Year 2012 to 2017);
- the establishment of "Dual-degree" International Program with Monash University (2003);
- grant awards from the Government of the Republic of Indonesia for
  - internal improvement for non-metallic field competence - PHK-A4 (2004),
  - improvement for external and regional competence – PHK-A2 (2004 to 2006), and
  - internationalization of academic and research activities in information technology, energy, and nonmaterial – PHKI (2010 to 2013);
- the establishment of the Center for Materials Processings and Failure Analysis (CMPFA), a venture 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); and
- Materials Testing Laboratory being accredited to ISO 17025 (2011).

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VISION AND MISSIONS OF THE DEPARTMENT OF METALLURGICAL AND MATERIALS ENGINEERING

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."

Missions

To achieve that vision, the Department of Metallurgical and Materials Engineering have the following missions:
- 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 processing technology and material engineering and design, who are capable of undertaking active and dynamic roles in national, regional, and international arenas;
- To perform quality Tridharma (three duties) relevant to national and global challenges;
- To create conducive academic environment to support the vision of the Department of Metallurgical and Materials Engineering.

STAFF OF THE DEPARTMENT OF METALLURGICAL AND MATERIALS ENGINEERING

Head of Department
Prof. Dr. Ir. Akhmad Herman Yuwono, M.Phil.Eng.
Vice Head of Department
Nofrijon Sofyan, Ph.D.
Head of Venture Unit
Dr. Deni Ferdian, S.T., M.Sc.

HEAD OF LABORATORY

Head of Chemical Metallurgy Laboratory
Muhammad Chalid, S.Si., M.Sc., Ph.D.
Head of Physical Metallurgy Laboratory
Wahyuaji Narotama Putra, S.T., M.T.
Head of Mechanical Metallurgy Laboratory
Ir. Rahmat Saptono, M.Sc., Ph.D.
Head of Processing Metallurgy Laboratory
Dr. Ir. Donanta Dhaneswara, M.Sc.
Head of Metallography & Heat Treatment Laboratory
Dr. Ir. Myrna Ariati, M.Si.
Head of Corrosion & Metal Protection Laboratory
Dr. Ir. Yunita Sadeli, M.Sc.

BOARD OF PROFESSORS

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Prof. Kyoo-Ho Kim, School of Materials Science and Engineering, Yeungnam University (Korea), Energy & Nano-materials.
Prof. Kozo Obara, Department of Nano-structured and Advanced Materials, Kagoshima University (Japan), Energy & Nano-materials.
Prof. Freddy Y.C. Boey, School of Materials Science and Engineering, National Technological University (Singapore), Nano-materials & Biomedical Engineering.
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Wahyuaji Narotama Putra (S.T.; M.T.; Ph.D. Candidate, Nanyang Technological University - Singapore), Electrical Material.
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PART-TIME FACULTY

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

STUDY PROGRAM

Department of Metallurgical and 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.

1.5.5. DEPARTMENT OF ARCHITECTURE

GENERAL INFORMATION

Department of Architecture, Universitas Indonesia, (formerly known as Architectural En- gineering Major) was established in 1965 under the Faculty of Engineering UI (FTUI) in Jakarta (established a year earlier under the Presidential Decree No. 76 dated July 17th, 1964). In its early days, education at the FTUI Architectural Engineering Major was performed through a system of per-level or per-year full professional education. The average completion time was seven years to obtain the title of an Engineer (Ir.). In 1978, the Semester Credit System (SKS) went into effect with a minimum number of acquired semester credit units of 160. The average duration of the study was five years, and the academic title was still an Engineer (professional education title). Since 1996, a four-year Bachelor's education program has been implemented with a total of 144 credits, where the graduates obtain a new academic degree of Bachelor of Engineering (S.T.). In the same year, 31 years after its establishment, the Architecture Study Program of UI was given a stronger legal foundation under the Directorate General for Higher Education's Decree No. 215/DIKTI/KEP/1996 dated July 11th, 1996.

In 2000, the Department of Architecture streamlined the 1996 curriculum by publishing the 2000 Curriculum along with the application of problem-based, collaborative, and student-centered learning methods. The 2000 Curriculum stated clearly that the educational direction for undergraduate program in architecture is pre-professional. In the same year, Master of Architecture program was established with two streams, namely Architectural Design and Urban Design. Over the years, the Master's program has grown into six streams. In addition to the two programs 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 point, under the new curriculum (the 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 Settlements
•Technology and sustainability stream: Architecture and Technology

In 2004, Architectural Engineering Major became the Department of Architecture. The academic title granted to its graduates also changed from Bachelor of Engineering (S.T.) to Bachelor of Architecture (S.Ars.) for the undergraduate program and Master of Architecture (M.Ars.) for the master program. From 2000 until 2012, the Department of Architecture had gone through several changes in Curriculum, which eventually produced an integrated curriculum which emphasizes several points:
1.Flexibility in following the development of science and technology
2.Curriculum that responds to the demands of professionals at national, regional, and international levels
3.Adherence to the Competence-based National Education System, with the core contents of the curriculum suited to the profession of architects in collaboration with IAI, and referring to UIA as the international standards

In 2008, the department offered a new study program, namely the Interior Architecture Undergraduate Program, which focuses on the interior aspects of architectural designs. This new study program opens up new opportunity for students to explore and develop the field of interior architecture in Indonesia.

In 2009, a Ph.D. program and a one-year Professional Program of Architect (PPAR) were set. The Ph.D. program is intended to strengthen the position of the Department of Architecture as a leading architectural research-based institution. Ph.D. student's research is focused on two areas: major research areas (research based on architectural issues) and minor research areas (related to specialized areas of study) in which Ph.D. 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 wide and deep exploration of various aspects of knowledge about the studied issues. Meanwhile, for PPAR, the education is carried out in a year to introduce students to real-life professional practices in the field of architecture. Graduates of PPAR are also allowed to transfer their credits in UI to pursue a Master's degree in architecture.

Department of Architecture also offers International Class undergraduate program in architecture, which can be taken as a single degree program (only one semester abroad) and a double degree program (4 semesters in UI and the rest abroad). This program is conducted in collaboration with leading universities in the world such as the Queensland University of Technology (QUT), Curtin University (Australia), Univesity of Florida, and Politecnico di Milano (Italy). In addition, Bachelor students who have excellent academic achievements are eligible for a Fast-Track 5-year program (4 years bachelor + 1 year master), to obtain a Master's Degree in Architecture.

The Department of Architecture UI has a Grade A accreditation from the National Accreditation Board for Higher Education, Indonesian Ministry of Research and Higher Education. The Undergraduate Study Program of the Department of Architecture has also been assessed by the ASEAN University Network (AUN) in 2010. Further information about FTUI's Department of Architecture can be viewed at its official website: http://architecture.ui.ac.id.

VISION and MISION

VISION

To become an excellent architectural education institution with regional and international recognition.

MISSION

To deliver excellent architectural education that leads the development of architectural knowledge and promotes meaningful applications of architectural knowledge for the society.

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Coordinator of Interior Architecture Program
Dr.-Ing. Ir. Dalhar Susanto
Coordinator of Architecture Graduate Program
Ir. Evawani Ellisa, M.Eng., Ph.D.
Head of Fabrication Lab
Mikhael Johanes, S.Ars., M.Ars.
Head of Photography Laboratory
Ir. Toga H. Pandjaitan, Grad. Dipl. AA
Head of Building Physics Laboratory
Ir. Toga H. Pandjaitan, Grad. Dipl. AA
Head of Material Workshop
Widyarko, S.Ars., M.Ars.

BOARD OF PROFESSORS

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2. **Prof. Yandi Andri Yatmo, M.Arch., Ph.D.** (S.T., Architecture, Universitas Indonesia; Dip. Arch., Univ. of Sheffield; M.Arch., Univ. of Sheffield; Ph.D., Univ. of Sheffield) Architectural Design, Urban Architecture.
3. **Prof. Kemas Ridwan Kurniawan, M.Sc., Ph.D.** (S.T., Architecture, Universitas Indonesia; M.Sc. & Ph.D. Bartlett School of Architecture, University of College London, UK) Architectural Design, Architectural Theory and History, Heritage in Architecture.
4. **Prof. Paramita Atmodiwirjo, S.T., M.Arch., Ph.D.** (S.T., 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.

BOARD OF EMERITUS FACULTY

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Prof. Dr. Ir. Emirhadi Suganda, M.Sc.
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Prof. Ir. Gunawan Tjahjono, Ph.D., M.Arch.
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FULL-TIME FACULTY

Ahmad Gamal
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Achmad Hery Fuad
(Ir., Architecture, Universitas Indonesia; M.Eng., Waseda University, Japan) Architectural Design, Urban Design, Urban Housing and Settlements.
Antony Sihombing
(Ir., Architecture, Universitas Indonesia; MPD, University of Melbourne, Australia; Ph.D. University of Melbourne, Australia) Architectural Design, Urban Housing and Settlements, Building Technology.
Azrar Hadi
(Ir., Architecture, Universitas Indonesia; Ph.D., Universiti Teknologi Malaysia) Project Management, Urban Housing and Settlements, Building Technology, Architectural Design.
Dalhar Susanto
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Diandra Pandu Saginatari
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Dita Trisnawan
(S.T., Architecture, Universitas Gajah Mada, Yogyakarta; M.Arch., Suburb and Town Design, University of Miami, USA) Urban Design, Urban Architecture, Industrial Planning, Tourism Design and Real Estate.
Enira Arvanda
(S.T., Architecture, Universitas Indonesia; Master, Instituto Europeo di Disain, Milan, Italy) Interior Architecture, Ergonomy, Furniture Design.
Evawani Ellisa
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Herlily
(Ir., Architecture, Universitas Indonesia; M.Urb.Des., University of Sydney, Australia; Ph.D. Candidate, UC Berkeley, USA) Architectural Design, Urban Design Theory, Studies of Architecture and Urbanism in Developing Country, Urban Studies.
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PART-TIME FACULTY

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1.5.6. DEPARTMENT OF CHEMICAL ENGINEERING

The main mission of the Chemical Engineering Department is to provide the highest quality education, so that graduates have the necessary knowledge, skills, and experience in conducting research on latest topics in the field of chemical engineering and biochemical engineering. Starting from the opening of the Gas Engineering Program in 1981, Chemical Engineering Department UI 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).

Chemical Engineering Department has two study programs: Chemical Engineering (PSTK) and Bioprocess Technology (PSTB). To date the department has 30 permanent academic staff members and about 913 undergraduate and graduate students. In order to enhance the role of the department in the era of biotechnology and life sciences, PSTB was opened in 2008.

Chemical Engineering Department 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 2000 curriculum to the recently updated 2016 curriculum. The current standards of graduate competencies are based on those recommended by ABET and the Bologna Process and on feedbacks 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. Chemical Engineering Department 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 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. At the completion of their studies, students will be awarded a Master of Engineering degree from NTUST or Curtin University.

The 2016 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 special curriculum for those without any educational background in chemical engineering. By adopting this special 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, Chemical Engineering Department has taken part in research collaboration with the theme "sustainable chemical and bioengineering for energy and product development". This research theme is supported by four research groups: chemical and natural product design, sustainable energy, industrial bioprocess technology, and process intensification. These research activities, which are conducted at the Chemical Engineering Department, receive a lot of government funding to support students who

wish to take part in the project.

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VISION, MISSIONS, AND OBJECTIVES OF CHEMICAL ENGINEERING DEPARTMENT UI

Vision
"To become a world-class Chemical Engineering Department as the center of excellence for education and research in chemical engineering."

Mision
•To provide the best quality undergraduate and postgraduate education
•To provide a broad-based education and design experience which enable students to address chemical engineering problems
•To provide students with fundamental aspects to develop in the profession in response to rapidly changing technology and societal needs and expectations
•To develop important soft skills such as problem-solving, communication, and group skills.

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Vice Head of Department:
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Head of Chemical Engineering Study Program:
Dr. Ir. Asep Handaya Saputra, M.Eng.
Head of Bioprocess Engineering Study Program:
Dr. Dianursanti, S.T., M.T.
Coordinator of Special Subjects (Internship, Undergraduate Thesis, Master's Thesis):
Dr. Ir. Yuliusman, M.Eng.
Head of Academic Venture (UPPM):
Dr. Muhammad Ibadurrahman, S.T., M.T., M.Sc.Eng.

HEAD OF LABORATORY
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Head of Chemical Process Intensification Laboratory: Dr. Eva Fathul Karamah, S.T., M.T.
Head of Sustainable Energy Laboratory: Dr. Ir. Prawati P.D.K. Wulan, M.T.
Head of Bioprocess Engineering Laboratory: Dr. Tania Surya Utami, S.T., M.T.
Head of Basic Chemical Process Laboratory: Ir. Rita Arbianti, M.Si.
Head of Chemical Process System Laboratory: Dr. rer. nat. Ir. Yuswan Muharam, M.T.
Head of Basic Process and Operation Laboratory: Dr. Ir. Sukirno, M.Eng.

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Catalysis and Heterogenous catalyst.
Prof. Ir. Sutrasno Kartohardjono, M.Sc., Ph.D.
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Gas absorption and desorption in hollow fiber membrane contractor, utilization of hollow fiber membrane for efficient biomass production.
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1.5.7. DEPARTMENT OF INDUSTRIAL ENGINEERING

GENERAL

Industrial Engineering Education is an answer to a growing need of industrial engineers who have the capabilities of managing production or operations process efficiently and effectively to achieve excellence. Industrial Engineers should be one of the backbones for transforming our national industry to be more competitive and contribute to our nation's welfare. The scope of the term industry is for both service and manufacturing industry.

Industrial Engineering Program was actually formed in the mid 1970s as a part of Mechanical Engineering Department, due to the market needs for a specialized mechanical engineers which defines the current definition of industrial engineers. In 1998, based on Decree by Higher Education Director No 207/DIKTI/Kep/1998 dated June 30 1998, the Industrial Engineering Department was born. With the new status as department, the program had more autonomy and opportunity to enhance the Industrial Engineering Discipline in Indonesia.

After 10 years as an independent Department, Industrial Engineering has been recognized by the national public and industry as one of the forefronts industrial engineering education in Indonesia. This is shown by the high demand and acceptance of our graduates. Today, our graduates have been accepted not only in the manufacturing industry but also service industry such as governments, hospital, financial service, consulting, information technology and many others. In the manufacturing area, we have graduates in charge of production or operations management, human resource development, maintenance, inventory and logistics, and many more.

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VISION and MISSION

Vision

" To be a premier industrial engineering higher education institution with good national and international reputation in providing high quality graduates and researches."

Mission

- Establishing education to provide high quality graduates accepted by national and international industry
- Fostering researches to answer the needs of national industry
- Harnessing the knowledge of industrial engineering for the welfare of the society

STAFF OF THE DEPARTMENT OF INDUSTRIAL ENGINEERING

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

Head of Laboratory
Head of Manufacturing System Laboratory:
Prof. Dr. Ir. T. Yuri M. Zagloel, MEngSc
Head of Human Factors Laboratory:
Ir. Boy Nurtjahyo, MSIE
Head of System Engineering Modeling and Simulation Laboratory:
Dr. Akhmad Hidayatno, ST, MBT
Head of Statistics and Quality Engineering Laboratory:
Prof. Ir. Isti Surjandari P., MT, MA, PhD
Head of Product Development and Innovation Laboratory:
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CHAPTER 2

ACADEMIC SYSTEM AND REGULATION

2. ACADEMIC SYSTEM AND REGULATION

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

2.1. GENERAL

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

Semester Credit 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 of lectures, 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 sessions for 60 (sixty) minutes per week per semester.
- One Semester Credit of seminars or other similar subjects includes: face-to-face study time for 100 (one hundred) minutes per week per semester and independent study sessions for 70 (seventy) minutes per week per semester.
- One Semester Credit of practical training, studio, workshop, field training, research and community services, and/or other similar subjects for 170 (one hundred seventy) minutes per week per semester.
- One semester consists of 16-18 weeks of lectures or other scheduled activities and additional activities. Also included in the schedule are one week of midterm examination and another two weeks of final examination.
- To earn a bachelor's degree, a student must complete all educational activities with a total academic load of 144-145 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 minimum 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 Program curriculum are grouped into University General Subjects (12.5%), Basic Engineering Subjects (15-20%), Basic Skills Subjects (30-35%), and Core Subjects (35-40%). Subjects are categorized as either compulsory or elective. They can be taken across departments or faculties.

Grade Point Average
Grade Point Average or GPA is used to evaluate students' performance, whether for a particular semester in terms of Semester Grade Point Average (SGPA), or, cumulatively for all semesters up to the most recent one in terms of Cumulative Grade Point Average (CGPA). The formula used to calculate SGPA and CGPA is as follows:

$$\text{GPA} = \left(\frac{\sum_{\text{courses}} (\text{Grade Point Value x Semester Credit Unit})}{\sum_{\text{courses}} \text{Semester Credit Unit}} \right)$$

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

Semester Grade Point Average (SGPA)

The Semester Grade Point Average is calculated from all subjects taken in one semester, except for subjects with a letter grade of ‘BS’, ‘I’, or ‘TK’ (BS: Belum Selesai, I: Incomplete, TK: Transfer Kredit). The GPA that takes into account all of the subjects in a certain semester is called the Semester Grade Point Average (SGPA), and it is used to determine the maximum academic load a student may take in the following semester.

Cumulative Grade Point Average (CGPA)

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 assigning tasks, homework, quizzes, or exams throughout the semester. For each subject, there are at least three components of assessment, which may include a midterm exam (UTS), a final exam (UAS), and tasks. A student will be assessed on his/her academic ability if he/she meets the following requirements:

•The courses taken have been registered and verified by an 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

Table 2.1. Grade Value and Point

Grade Value	Marks	Grade Point
A	85 - 100	4.00
A-	80 - < 85	3.70
B+	75 - < 80	3.30
B	70 - < 75	3.00
B-	65 - < 70	2.70
C+	60 - < 65	2.30
C	55 - < 60	2.00
D	40 - < 55	1.00
E	0 - < 40	0.00

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, and the lecturer has made a reasonable effort to inform the student as early as possible that an important part of the session work is incomplete. The ‘I’ mark should be changed to another grade within 1 month; otherwise, it will automatically change to ‘E’ grade. The ‘T’ mark is given for no attendance in exam. The ‘BS’ mark is given for special lecture (such 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 is 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 Form (FRS). Students must take the entire allocated credits and courses during their first and second semesters. The minimum academic load for the Undergraduate Program is 144 (one hundred and forty four) credits including final assignment, and the maximum academic load is 160 (one hundred and sixty) credits including final assignment and can be completed in minimum 7 (seven) semesters and maximum 12 (twelve) semesters.

As for the second semester, the following rules apply:

- Students may take all credits within the load allocated for the second semester according to the structure of the applicable curriculum.
- Students may take more credits than the load allocated for the second semester if their first semester GPA qualifies them according to the Maximum Credit Load Table.

From the third semester onward, the maximum credit load allowed to be taken is determined by SGPA of the previous semester and 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.

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

IPS	Maximum SKS
< 2,00	12
2,00 – 2,49	15
2,50 – 2,99	18
3,00 – 3,49	21
3,50 - 4,00	24

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 maximum 6 (six) semesters.

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

•A semester’s academic load is registered by students 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 less than a 2.50 SGPA, the number of credits taken for the following semester should not exceed 9 credits.

•The maximum number of credits that can be taken in 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 approval of the Vice Dean.

Matriculation for Master Program
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 maximum 2 (two) semesters with a matriculation GPA of 3.00 (three point zero).

Doctoral Program
The academic load in the FTUI's Doctoral Program curriculum is set at 52 credits after finishing the Master Program. A semester's academic load is registered by the students 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. Students' academic load for each semester is proposed by the students 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 minimum 4 (four) semesters and maximum 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/Director of School.

Undergraduate Final Project (Skripsi)
Undergraduate Final Project is a compulsory course for undergraduate students of FTUI taken to complete their study and earn a degree in the field of engineering. The course is the application of science that has been obtained in accordance with the basic scientific disciplines that the student has studied, in the form of 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 (FRS).
•Students have obtained a minimum of 114 credits with a minimum grade of 'C' and have passed all compulsory courses both in the Faculty and the University levels.
•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 Thesis Supervisor and the title of their thesis to be verified by the Vice Head of Department. At the end of the semester, the supervisor will announce the thesis 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 hardcover book, and students must upload their final revision in a pdf file to UI-ana (lib.ui.ac.id/unggah). The undergraduate final project must first be assessed in an undergraduate thesis examination by the Supervisor and examiners assigned by the Head of Department.

Thesis (Master Program)
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. Thesis should be written in Bahasa Indonesia with an English abstract. For Master Program students who are given the opportunity to conduct research and thesis preparation abroad, they

are allowed to write 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 that are in collaboration with universities abroad as stated in the charter

of cooperation.

The requirements for a student to start writing a thesis are:
• The student's thesis has been registered in the Study Plan Form (FRS) in 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 a potential Supervisor 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 seminar. The Head of Study Program will also announce a list of Thesis Supervisors who are assigned to guide the students in writing and finishing the approved topic. Thesis examination committee consists of a committee chair and a minimum of 3 or a maximum of 7 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 maximum two people, Supervisor I and Supervisor II. Supervisor I should have a Ph.D or Master's Degree with a minimum of 5 years of teaching experience and expertise relevant to the student's thesis. Supervisor II should at least have a Master's Degree and expertise relevant to the student's thesis or professional certifications and qualifications equal to level nine (9) of the Indonesian Qualifications Framework (KKNI).

Thesis can be submitted for a thesis examination when it has met the following academic requirements:
• The thesis has been registered in the Study Plan Form (FRS) in said semester.
• The thesis has been declared eligible for examination by the Thesis Advisor.
• After being declared eligible for examination, the thesis must be submitted to the Department to be listed in the examination schedule determined by the Head of Study Program.
• The summary of the undergraduate thesis/thesis/dissertation has been uploaded.

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
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 internship when they are in partner universities (except in UDE, Germany). For example, in Australia, internship is one of the requirements set by the Institution of Engineers Australia (IEAust) to obtain an accredited B.E. (Bachelor of Engineering) Degree. 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 internship in partner universities. However, if they cannot do so, they are allowed to have their internship in Indonesia with a 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 by47

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 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 a 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 a 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 who are registered as a student in these Parallel Classes, credits obtained from the previous diploma program will be transferred in blocks of 36-41 credits. 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 a student exchange program 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 programs 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 the Double Degree 2+2 International Undergraduate Program with FTUI's partner universities. Students participating in this program will spend the last two years of the program studying at partner universities abroad and earn two degrees once they graduate. However, this Double Degree Program offers no scholarship. Thus, participating students should secure their own funding. Students participating in classes outside of the University (through student exchange programs, international dual degree undergraduate programs, sandwich programs, joint degree programs, or other University-acknowledged programs) 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 on SIAK NG has been changed to 'overseas' and are obliged to pay an overseas academic fee to Universitas Indonesia in the amount stated in the applicable Rector's Decree. The period of study abroad, whether through student exchange programs or the Double Degree Program, is counted as part of the whole study period. The results or grades obtained from these programs will not be calculated in determining their GPA and will be given a letter grade of 'TK' in the transcript instead.

Fast Track

FTUI Regular, Parallel or International Undergraduate Program students with brilliant academicachievements can participate in the Fast Track Program. In this program, FTUI undergraduate students

in semesters 7 and 8 are allowed to take several Master 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 within 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 follows:

a. For the Undergraduate Program, 144 (one hundred and forty four) credits including 16-22 credits of elective subjects taken from the main competence subjects in the Master Program.
b. For the Master Program, 40-44 credits including 16-22 credits of the subjects mentioned in point 'a' above and acknowledged through credit transfer.

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

Requirements and Procedures for Fast Track Registration

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

- Have a minimum GPA of 3.50.
- Have a minimum Institutional TOEFL/EPT score of 500 (students may use the score of the EPT test they took as new students in FTUI).
- Have a high motivation for research.

The procedures for the Fast Track Program:

1. The Fast Track Program is open to all FTUI's Undergraduate Study Programs that have the same specializations as the Master Programs (for Undergraduate Study Programs that have specializations).
2. A student who is interested in participating in the Fast Track Program is required to fill out a Registration Form.
3. The Fast Track Registration Form will be evaluated by a team headed by the Head of Department.
4. If the student's application for participating in the Fast Track scheme is approved, he/she is required to counsel with his/her Academic Advisor for the finalization of his/her Undergraduate (S1) and Master (S2) Study Plans. The student's study plan for semesters 7 and 8, especially for the undergraduate elective course selection, must be in line with the compulsory and elective courses in his/her Master Study Program according to his/her specialization.
5. The undergraduate thesis and thesis of the student are expected to be of continuous research to maximize knowledge, experience, and quality of research results.
6. The costs of the Fast Track Program will be borne entirely by the student.

Registration Form for the Fast Track Program for each running academic year should be submitted to each Department Secretariat no later than March each year.

2.2. 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 on SIAK NG

January

Departmental judicium 1st: October

2nd: January

Faculty judicium 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:

- Short semester course period is 8 weeks, including mid-semester and final semester examinations.
- 2 credit courses consist of two 2-hour classes per week, 3 credit courses consist of three 2-hour classes per week, and 4 credit courses consist of four 2-hour classes per week.
- For Regular Undergraduate Program, Faculty Basic Courses (Physics, Mathematics, and Chemistry) are only available for students who wish to retake the courses and have attended the required lab activities.
- A student can take up to maximum 12 credits during a short semester.
- Courses offered are determined by the Department.

50 - If the number of students registered for a certain course in the short semester does not meet the

minimum requirement, the course will be canceled.

- Short semester tuition is not included in the normal tuition (BOP) and is calculated by the number of credits taken during the short semester. The tuition for each credit is determined by FTUI.
- Payment for short semester courses must be made before the payment period ends. 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, midterm and final examinations, and other academic activities. The academic calendar and course schedules can be accessed at http://www.eng.ui.ac.id, and on SIAK NG.
Administrative Registration
Administrative registration includes payments of tuition and admission fee. Students are responsible for paying fees by the payment deadline. Students who fail to complete the registration process by the payment deadline will not be registered at that particular semester, and the relevant semester will be counted towards the students' allowed length of study. A 50% penalty will be imposed on students who fail to make payment on time. Administrative registration is carried out by paying tuition through the host-to-host system via ATM (Automated Teller Machine) or bank teller of banks in cooperation with Universitas Indonesia.
Academic Registration

Students should do online academic registration, consult with their Academic Advisor for approval, and sign the Study Plan Form (FRS) during the academic registration period. The main duties of Academic Advisor are:
•Helping and directing students in their study plan, particularly in selecting courses and solving their academic problems.
•Monitoring and evaluating students' academic performance during their period of study.
Students should login to https://academic.ui.ac.id using the username and password provided by the Office of Direktorat Sistem dan Teknologi Informasi (DSTI) UI. Students can get their username and password at Pusat Pelayanan Mahasiswa Terpadu (PPMT) building. Students can also download course schedules and academic calendars 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 the registration period to ensure that the courses taken are correct. A fine will be levied on students for late administrative and academic registration, as per the University or the Faculty regulations.

Sanctions
1.Students who do not carry out administrative registration will receive an 'inactive' status in the relevant semester, which is counted towards their length of study.
2.Students who do not carry out academic registration are not allowed to take part in the academic activities in the relevant semester, which is counted towards their length of study.
3.Students who are inactive as referred to in point (1) are not charged tuition.
4.Students who do not carry out administrative and academic registration for 2 (two) consecutive semesters will be declared as resigning without notice from the University.

Exception to Administrative Registration
When inactive students, by any reason, intend to maintain their status as an active student, they have to follow the following procedures for administrative registration:
•The students are required to obtain the approval of FTUI by filling out a form available at Pusat Administrasi Fakultas (PAF).
•The students must come to the Directorate of Finance UI to obtain the approval for paying tuition after paying a 50% penalty for the relevant semester.
•The approval will be used by the students for paying the tuition manually.
•The students must give a 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 a sufficient grade (not 'T').

Requirements for Transfer to Partner Universities in Australia for Double Degree Program
The minimum GPA and English proficiency requirements for transferring to partner universities are 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 by the end of the fourth semester for the 2+2 Program.
2.Have passed all the required subjects as listed in the Study Program curriculum with minimum 'C' and a total of passed credits equal to the total number of credits listed in the Study Program curriculum for semesters 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 being administratively and academically registered at FTUI.
5.If their GPA meets the minimum requirement, but their IELTS or TOEFL scores are below the minimum requirement, they are suggested to improve their IELTS or TOEFL scores in Indonesia and maintain administrative registration at FTUI. Another choice is to take English for Academic Purposes (EAP) at the partner universities. Information on the duration and schedule of EAP can be found on the respective partner university's website.

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

Partner University	Minimum GPA	Minimum IELTS / TOEFL
QUT	3.0	IELTS min 6.5 with no band lower than 6 IbT in accordance to partner university's requirement
Curtin		
UQ		
Uni Sydney		
Monash	3.2	

English Language Requirements for Undergraduate International Program Single Degree

Students of the Undergraduate International Program Single Degree are obligated 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:

Type of Test	Overall Minimum Score	Additional Requirements
IELTS	6.0	No bands lower than 6.0
TOEFL iBT	75	No bands lower than 18

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

2.3. 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 (3.01–3.51), 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 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 40–42 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. Honors predicate for a graduate is determined by the student's CGPA as follows: Cum Laude (3.71–4.00), Very Satisfactory (3.41–3.70), and Satisfactory (3.00–3.40). For a Master Program student to graduate Cum Laude, his/her length of study must not exceed 4 (four) semesters 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 52 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 (3.71–4.00), Very Satisfactory (3.41–3.70), and Satisfactory (3.00–3.40). 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 CGPA is within the 3.71–4.00 range but he/she fails to meet the other requirements, he/she will be awarded a 'Very Satisfactory' predicate.

2.4. 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 study:

- Attain at least 24 credits, with a minimum of 'C', by the end of their second semester.
- Attain at least 48 credits, with a minimum of 'C', by the end of their fourth semester.
- Attain at least 72 credits, with a minimum of 'C', by the end of their sixth semester.
- Attain at least 96 credits, with a minimum of 'C', by the end of their eighth semester.
- Attain at least 120 credits, with a minimum of 'C', by the end of their tenth semester.
- Attain all the required credits, with a minimum of 'C', by the end of their twelfth semester.

Or:

- Have an 'inactive' status (empty) for two consecutive semesters, thus automatically being declared as 'resigning' from Universitas Indonesia by a Rector's Decree on Status Determination.
- Proven to be in violation of rules or regulations that causes the students to lose their rights as an FTUI student.
- Deemed unfit to continue their study based on the consideration of 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 Dean with a copy to the Head of Department.

Master Program
The maximum length of study to earn a Master's Degree in FTUI is 6 (six) semesters, starting from registration to graduation. This provision also applies to students who enroll in the FTUI's Master Program with a 'probation' status. Students will lose their rights to continue their study (dropping out) if:
•Students fail to achieve a 3.00 GPA from at least 14-18 passed credits (for Regular Master Program students) or 12-14 passed credits (for Non-regular Master Program students) by the end of the second semester,
•By the end of the study period evaluation, students fail to meet the following graduation require ments: being registered as an active student in Universitas Indonesia during said semester, both administratively and academically; not exceeding the maximum length of study; having completed all administrative obligations, including returning all borrowed library and laboratory collections; and having 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 ≥ 3.00 (three point zero).
•Students do not register academically and administratively for two consecutive semesters.
•Students are proven to be in violation of rules or regulations that causes the students to lose their rights as an FTUI student.
•Students are deemed unfit to continue their study based on the consideration of a team of 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 Dean with a copy to the Head of 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 rights 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 Pro moter 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 Pro moter Team by the end of their eighth semester.
•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 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) disserta tion 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.

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 Dean with a copy to the Head of Department.

Students of the Doctoral Program (Research) will lose their rights 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.

•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.

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 Dean with a copy to the Head of Department.

2.5. 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.
The procedures for academic leave are as follows:
1. To apply for academic leave, a student must write a letter requesting for academic leave to the Dean before the beginning of the administrative registration period of the relevant semester.
2. If the academic leave is approved, 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 in tended 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 registra tion 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.

2.6. FACULTY AND DEPARTMENT JUDICIUMS

Judicium is a meeting held at both the Faculty and the Department levels to decide whether a student has fulfilled all academic requirements and may graduate and earn a degree in engineering based on the Department/Faculty's evaluation.

ACADEMIC SYSTEM & REGULATION

2.7. 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 first 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.

2.8 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:
•Utilizing unauthorized materials/notes to enhance performance during on examination;
•Attempting to observe the work of other students;
•Taking an examination for another person, or permitting someone else to do so;
•Collaborating improperly by joint effort on discussion in anyway expressly prohibited by the lecturer.
When incidents as enumerated above occurs, the following sanctions may be imposed (as per FTUI regulation):
-The student may be assigned E grade 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) (P3T2) may be held.

Academic Sanction for Perpetrators of Academic Cheating in Exams
a.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;
b.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;
c.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;
d.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;
e.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;
f.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;
g.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 Academic Offence in the Completion of Final Project

Plagiarism is an act of stealing ideas or thoughts already available in written and/or someone else's writing and using them as if it is our own ideas, thoughts and/or writing thus causing material or non-material harm/loss to the original owner. Plagiarism can be found in the form of using words, phrases, sentences, paragraphs, or even a chapter of someone else's writings or books, without stating the original source. Included in this is the auto-plagiarism.
Auto-Plagiarism is an act of using an idea or thought repeatedly in writing or copying one's own previous work in parts or whole without stating the original published source as if those ideas or thoughts are an entirely new idea, thought and/or writing.

Plagiarism criteria used to decide a sanction focus on the amount of ideas or phrases stolen and the degree of similarity to the original phrase, sentence, paragraph, section, chapter, and the writing as a whole. A work can be considered as a product of plagiarism if it has been verified to have a similarity level of 35% or more to the original work. To prevent plagiarism, students are obligated to check their final works using the anti-plagiarism software provided by the Faculty or University before submitting their works to their advisor/promoter/co-promoter. If such software is unavailable, students are required to check the existing list of research in connection to the topic of their research and mention such research in their reference of research. Any student caught and proven of committing plagiarism is entitled to an appeal to the Study Program and the Faculty which the Faculty will later passed on to the university through the P3T2 for further verification and process.

For active students, early sanction can be in the form of postponement of the final project examination or postponement of the graduation status for students who have passed the final project examination. For students whose status have been set to graduate but have not received their

diploma, with the approval of the Rector, the Dean may hold the said students' diploma while awaiting the Rector's final decision. Academic sanction on plagiarism for active students is established through the Dean's decree based on the proposal by the Head of the Study Program or recommendation from the Faculty no later than one month since the date of the proposal letter received by the Dean. For graduating students, the sanction will established through the Rector's Decree based on the P3T2 recommendation. The heaviest academic sanction to be given can be in the form of cancellation of the student's final project (for an active student) with the obligation to write a new final project with a new topic, or the revocation of academic titles (for a graduating student).

The act of cheating in the writing of any Final Project, Essay as Exam Substitute, or Assignment, includes the usage of other person's service/ substitute/ consultant/ or any other service to complete assignments in the name of the concerned student and any 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 the student. Sanction given to the perpetrator of said act of cheating in the completion of final project is established under a Dean's decree issued no later than one month since the receipt of the proposal letter from the Head of Study Program by the Dean. The heaviest academic sanction given can be in the form of cancellation of the student final project (for an active student) with the obligation to write a new final project with a new topic, or the revocation of academic titles (for a graduating student). Active students who consciously act as a ghost writer for the final works of other students will be given the equivalent of student academic sanction given to the perpetrators of acts of cheating.

2.9. ACADEMIC REGULATION OF THE UNIVERSITAS INDONESIA

The list of Academic Regulations at Universitas Indonesia can be accessed via http://resipotory.ui.ac.id. Below is a list of Decrees to be used as references for education program at Universitas Indonesia

GENERAL:
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:
Decree of the Rector Universitas Indonesia
Number: 285/SK/R/UI/2003 on the Implementation Guidelines for Cross-Faculty Lectures in Universitas Indonesia

Decree of the Board of Trustees Universitas Indonesia
Number: 006 / MWA-UI/2004 on the Universitas Indonesia's Academic Curriculum

Decree of the Rector of Universitas Indonesia
Number: 491/SK/R/UI/2004 on Universitas Indonesia Education Activities Conclusion Regulations

Decree of the Board of Trustees Universitas Indonesia
Number: 001 / TAP/MWA-UI/2005 on the Establishment of Academic Degrees in the Universitas Indonesia.

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

Regulation of the Board of Trustees Universitas Indonesia
Number: 006 / Peraturan/MWA-UI/2005 on Student Learning Outcomes Evaluation at Universitas Indonesia

Regulation of the Board of Trustees Universitas Indonesia
Number: 007 / Peraturan/MWA-UI/2005 on Academic Education Implementation Norms in Universitas Indonesia

Regulation of the Board of Trustees Universitas Indonesia
Number: 008 / Peraturan/MWA-UI/2005 on Professional Education Curriculum Norms in Universitas Indonesia

Decree of the Rector of Universitas Indonesia
Number: 838/SK/R/UI/2006 on Administration of Universitas Indonesia Student's Learning Outcomes

Decree of the Rector of Universitas Indonesia
Number: 012/SK/R/UI/2007 on Implementation of the of Students Learning Activity in Universitas Indonesia

Decree of the Rector of Universitas Indonesia
Number: 450/SK/R/UI/2008 on the Implementation of E-Learning in the University Indonesia

Decree of the Dean of Faculty of Engineering Universitas Indonesia
Number: 290/D/SK/FTUI/VI/2013 on the English Requirements for Undergraduate International Program Single Degree Faculty of Engineering Universitas Indonesia.

Decree of the Rector of Universitas Indonesia
Number :014 of year 2016 on the Implementation of Undergraduate Program in Universitas Indonesia

Decree of the Rector of Universitas Indonesia
Number :015 of year 2016 on the Implementation of Master Program in Universitas Indonesia

Decree of the Rector of Universitas Indonesia
Number :027 of year 2016 on the Implementation of Doctoral Program in Universitas Indonesia

Decree of the Dean of Faculty of Engineering Universitas Indonesia
Number: 622/D/SK/FTUI/IX/2016 on the Academic Sanction for Academic Offence Perpetrator in Faculty
of Engineering Universitas Indonesia.

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.

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.

735 2016 scientific publication assessment guidelines
703 2016 credit transfer
740 2018 English requirement
60 05 2018 implementation of doctoral program

RESEARCH

Decree of the Board of Trustees Universitas Indonesia
Number 002/SK/MWA-UI/2008 on University's Research Norms

Decree of the Board of Trustees Universitas Indonesia
Number 003/SK/MWA-UI/2008 on Research Policy at Universitas Indonesia

Decree of the Board of Trustees Universitas Indonesia
Number 009/SK/MWA-UI/2008 on the Amendment to 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

3. FACILITIES AND CAMPUS LIFE

NEW FACILITIES AVAILABLE IN FTUI

1.All classrooms in S building now have one special chair dedicated to left-handed students.
2.For the implementation of Student-Centered Learning (SCL), FTUI has renovated S405 classroom into a specially designed discussion room for students to learn and discuss in groups. This renovation was partly funded by USAID through its PEER Science research program by providing chairs, computer screens for each discussion group, wireless LCD projectors, and documentation cameras. The renovation was completed at the beginning of the odd semester of 2015. The classroom is able to accommodate up to 80 students in group discussions such as Problem-Based Learning (PBL) and Collaborative Learning (CL) and up to 100 students in regular classes.
3.Online Electricity Metering and Monitoring System now helps FTUI monitor the electricity usage in each building and its characteristics. www.ee.ui.ac.id/power; www.eng.ui.ac.id/ power
4.Offline Water Metering and Monitoring System prepares FTUI to determine the water usage in each building and helps plan the construction of rain water well within the faculty.
5.Smoking is prohibited throughout most of the faculty areas. However, a new and vastly improved Smoking Shelter is now available in the student cafeteria area and in front of S Building.
6.In April 2012, we started to test all of our cafeteria vendors for E-Coli. Working together with the Faculty of Public Health, we conducted several hygiene tests to our vendors. Between these tests we also conducted seminars, knowledge dissemination, and counseling to all of our food vendors regarding the level of cleanliness and hygiene expected from them. We also improved the sewer, sinks, and the vendor's facilities to achieve the desired effect. By February 2015, all food vendors in our Student's Cafeteria were 100% free of E-Coli, Salmonella, and Borax. Thus, we are proud to say that FTUI's Student Cafeteria is one of the healthiest at the university.

3.1.INTEGRATED STUDENTS SERVICE BUILDING (PPMT)

This building is located on the left of the Rectorate building. It applies one door policy in serving the registration process for all Universitas Indonesia's 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.

3.2.FACULTY ADMINISTRATION CENTER (PAF)

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, testamurs and academic transcripts, registration, absence of leave, enrollments and letters of reference. The working hours are 08.00-18.00 from Monday to Friday, at PAF building.

3.3.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 employees of Universitas Indonesia are entitled for the membership of the central library with the following requirements:
1.Provide the latest semester payment proof or the latest study card (IRS) or certification lettr from any faculty, unit or department within Universitas Indonesia.
2.Provide one 2x3 photo
3.Provide a cover letter from the faculty (for lecturers)

Lending Procedures:
•General text books (max. 3 books) can be borrowed for two weeks by showing the Student Card. Borrowed books need to be stamped.
•Reference books, magazines, newspaper and thesis can only be read on the spot or photocopied.
•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 search for information, especially 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 information packages for certain topics. 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 (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 packages. This training is provided to help improve the information skills 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 email (perpusui@ui.ac.id).

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

UI Central Library Facilities
OPAC (Online Public Access Catalog)
OPAC is a tool to search for information regarding the available collections 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 UI Hotspot. Internet service is also available on the first floor of the central library. Computers with internet access are also available for the members and visitors of the library.

Computer, Scanner, and Data Backup
Students are allowed to use the provided computers to work on their assignments, to scan pictures/photos, and to burn the results 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, a filing cabinet, and internet access.

Locker
250 lockers are available for the members of UI Central Library.

3.4. COMPUTER SCIENCES & NETWORK
Directorate of Information System Development and Service (PPSI) is 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 JUITA:
•Registered as a UI student
•Fill out the registration form with a reference from the Associate Dean for Students Affairs/ the 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 for help from the Computer Technical Unit through the following PPSI hotline service:
Phone : +6221-7863419
Email : support@ui.ac.id
Website : 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 on the 2nd floor of GK Building at FTUI, Depok Campus. The main duty of Puskom is to provide education facilities for students, learning and research facilities for lecturers, and services for education administrators, students, and personnel. Puskom also provides connection services i.e. 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 by faculty members. All computer networks are connected by fiber optic cables for inter-building and copper cable in the buildings with the capacity of 100 Mbps. Besides providing local networks, Puskom also controls 7 computer servers with redundant 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 Kampus UI Salemba. 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.

3.5. STUDENT WELFARE
3.5.1. UNIVERSITAS INDONESIA MOSQUES
•The Ukhuwah Islamiyah (UI) Mosque Depok is located in Kampus UI Depok. It was established on 28 January 1987 during a Friday prayer with Prof. H. Moh. Daud Ali, SH as khatib (preacher). This mosque was named Ukhuwah Islamiyah since it fosters Islamic brotherhood and unity within campus as well as with the area outside campus.
•The Arif Rahman Hakim (ARH) Mosque Salemba is located in Kampus UI Salemba. It was es tablished on 10 November 1967, 27 Rajab 1387 H. Based on UI Rector's Decree dated 16 August 1966, a development committee was established and it consisted of students. The vision of this mosque is to be the center of Islamic education in campus and to produce modern Mos lems (equipped with faith and knowledge) who can implement the teachings of Islam and help solve religious problems.

3.5.2. TEKSAS BRIDGE
The Teksas Bridge is a linkage bridge between two faculties in Kampus UI Depok, the Faculty of Engineering and the Faculty of Humanities. These two faculties are separated by an 80-meter-wide lake. The Teksas Bridge is hoped to serve as:
• a connection bridge and "Landmark",
• a research object for steel application products,
• a promotional tool on "Aesthetics Steel".

The concept of this bridge aims towards two approaches:
•The side of the bridge on the Faculty of Engineering UI reflects a powerful and masculine char acter symbolized by 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 charac ter symbolized by a “Hole Gate” shaped Pylon Bridge as a symbol of “YONI”.

3.5.3. CAMPUS BUS

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

- Blue: UI Dormitory, Gerbatama, UI Train Station, Faculty of Psychology, Faculty of Social and Political Sciences, 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 Sciences, 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 buses for rent. These buses are available for various types of activities, 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 charged a 10% cancellation fee from the paid rent Cancellation on the date of use will be charged a 30% cancellation fee from the paid rent.

3.5.4. STUDENT WELFARE AND FACILITY BUILDING (GKFM) / University Health Cen ter

Address : Kampus UI Depok Phone : +6221-78881019
This building is located in front of the Faculty of Engineering in Kampus UI 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 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:
a.Public Health Service
b.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 aforementioned facilities for students which are funded by the Students Welfare

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and Facility Fund, GKFM in UI Depok Campus also provides facilities for blood chemistry examinations, x-ray, and cardiac examination for university members with affordable prices.

Pharmacy

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

UI Student Counseling and Guidance (BKM)

In providing service for 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 helps 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 them to find a way to solve their 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 daily counseling and guidance services 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 Kampus UI Depok
Phone : +6221-96384797

BKM UI staff of counselors consist of psychologists, 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 lecturers and BKM management at the faculty level
•Coordinating meeting between BKM at the university and faculty level
•Personality development training
•Group therapy

UI Salemba Polyclinic
For students in Kampus UI Salemba, 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

3.5.5. UI STUDENT DORMITORY

Location: Kampus UI 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)
Facilities: TV, cafeteria, 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 Facilities: Badminton court, TV, cafeteria, table tennis court

UI Wismarini student dormitory is provided for students from Kampus UI Salemba (Faculty of Medicine & Faculty of Dentistry).

Facilities
•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 Specifications
•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, out- door 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 resident of the UI Depok dormitory is entitled to live in the dormitory for one year (semesters 1 and 2).
•Residents will be charged for every electronic device which they bring 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.

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3.5.6. 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 Kampus UI Depok campus, is a choice of accommodation for the Southern Jakarta and Depok area. This hotel is very suitable for seminar, training, and 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 quietness 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

3.5.7. UI STUDENT ACTIVITY CENTER (PUSGIWA)

Location : Kampus UI 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' activities such as a 300-400 capacity auditorium.

3.5.8. UI STUDENTS HALL

Location: Kampus UI Salemba Capacity: 300 People
Phone: +6221-31901355/56
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 general public.

3.5.9. 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)

Permit form or letter for using 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, Kampus UI Depok.

Phone : +6221-7866403, 7863453
Fax : +6221-7863453
Several sport facilities are also available in FTUI, such as: basketball court, futsal court, and climbing wall.

3.5.10. BIKE TO CAMPUS

As a proof of 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 its own Bike to Campus program.

These bicycles, whose colors and form were specially designed for UI, are single seat bicycles. By July 2009, there were 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 show their student ID card (KTM) to the officer in charge of each bike shelter.
2.Campus bicycle can only be used on the available bicycle track. It is forbidden to ride them outside the available track or to take them outside campus area.
3.Each bicycle is equipped with a trunk with maximum capacity of 10 kg and is not to be used as a passenger space.
4.Borrowed bicycle is the responsibility of each student until it is returned to the officer incharge 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 the 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 the bicycle is in good order and functions 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 accordingly.
5.Ride the bicycle on the provided track; stay on the left side of the track when passing other bicycles.
6.Take special care for motorcycles at each crossing.
7.Pay special attention to cycling safety.

3.6. STUDENT ORGANIZATION

Students are nation's agents of change towards a fair and prosperous independent society. Their power in fighting and struggling for that goal must always be balanced with moral power as the 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 serving as the parent organization for all student activities in Universitas Indonesia. IKM UI adopts constitutional values adapted to the need of students' lives. Sovereignty of IKM UI lies in the hand of the students and is fully implemented according to Laws and Constitutions of IKM UI. The members of IKM UI are registered students in Universitas

FACILITIES & CAMPUS LIFE

Indonesia, consisting of active and regular members. Active members are IKM UI members that have followed active member admission procedures and have received a 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.Student Forum
2.Student 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 Universitas Indonesia Student Society Association (IKM UI) which possesses a legislative power. Members of the DPM UI consist of independent members from each faculty and the representatives of legislative bodies of each faculty. Independent members are voted through a general election, and there can only be one

representative from each faculty's legislative body. Membership of DPM UI is inaugurated by a student forum decree. The term of office for members of the DPM UI is one year and ends 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 terms of legislative, supervision, and assessment of Students Representative Council's (BEM UI), work accountability report, jurisdiction, facility, and design of the admission mechanism, and the follow up on financial budget plan of each student organizations within Universitas Indonesia for each period. 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's Student Representative Council is a student organization at the university level with the executive power. The term of office for BEM UI is one year, from January to December each year. The Chairman and Vice Chairman of BEM UI are both directly elected in pair by the members of IKM UI during the General Election of Universitas Indonesia. The elected Chairman and Vice Chairman of BEM UI are later officially inaugurated with a Student Forum Decree. The functions and authorities of BEM UI are, among others, to advocate students in issues relating to funds and facilities at the university level; to address the external politic policy of IKM UI; and to serve and coordinate with Autonomous Body of UKM UI, faculty's executive body, and student element of the Board of Trustees. BEM UI Board of Administrators are elected based on open and close recruitment mechanisms.

Student Activity Unit (Unit Kegiatan Mahasiswa - UKM)
Student Activity Unit of Universitas Indonesia (UKM-UI) is a place for students' activities and creations. UKM-UI is for students with one area of specialization, talent, and religious service at the university level. UKM-UI consists of autonomous and semi-autonomous bodies. An autonomous UKM body is a UKM at the university level which is deemed qualified and valid by the decree of the Student Forum. Meanwhile, a semi-autonomous UKM body is under the coordination of the Students Representative Council.

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

b.Sports

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

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

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

3.7. CAREER DEVELOPMENT CENTER (CDC)

Career Development Center is a center with the aim of preparing UI graduates to have more skills and a higher level of competitiveness while at the same time channeling 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

3.8. 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 PIMNAS. PIMNAS is an opportunity to channel creativities and education and community services of the society in a Student Activity Program. Below are some of the Student Activity Programs contested during the National Student Science Week.

Student Creativity Program – Research (PKM-P)
This program is a research program that aims to identify the determinants of the quality of a product, to find a causal relationship between two or more factors, to experiment with a form or equipment, to establish the method of learning, to conduct an inventory of resources, to modify existing products, to identify the chemical compounds in the plants, to test the efficacy of plant

extracts, to formulate marketing techniques, to conduct a health survey of street children, to teach Balinese script to elementary school students, to find out the rate of the economic growth in the craft center of Kasongan, to examine the superstition factors that characterize the behavior of the Javanese community, and to conduct 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, quality assurance systems, and many others) or other micro-or small-scale industries (home industries, small traders, or cooperation) as needed by the potential partners in the program. PKMT requires students to exchange ideas with their partner in the program, because the product created will be a solution to a problem which PKMT's partner prioritizes. Thus, in the proposed program, students 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 place 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. Those commodities will later become some of the basic capital which the students need to start 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, to build business skills, to structure and to improve the environment, to strengthen community institutions, to socialize the rationale of drug use, to get exposure to and to understand aspects of customary law, and to relief efforts on illiterates in the society and other community programs for both formal and non-formal societies.

Student Creativity Program - Writing Scientific Articles (PKM - AI)
This program is a program of writing scientific articles 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 others).

Student Creativity Program – Written Concept (PKM - GT)
This program is a program of writing scientific articles 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 requires a smart and realistic solution. This program is subdivided into seven groups of fields of science, namely:
1.Health, including: Pharmacy, Nutrition, Obstetrics, Medicine, Dentistry, Nursing, Public Health, and Psychology.
2.Agricultural, including: Veterinary Medicine, Forestry, Maritime, Fisheries, Agriculture, Animal Husbandry, and Agricultural Technology.
3.Mathematic and Natural Sciences, including: Astronomy, Biology, Geography, Physics, Chemistry, and Mathematics.
4.Technology and Engineering, including: Information Technology, Engineering, and Agricultural Technology.
5.Social Economy, including: Agribusiness (Agriculture), Economic, Social and Political Sciences.
6.Humanities, including: Religion, Language, Philosophy, Literature, and Art.
7.Education, including: Education Sciences study program under the Faculty of Education.

Submission deadline for PKM-K, PKM-M, and PKM-P proposals is in October each year, while the deadline for PKM-GT and PKM-AI proposals is in March each year. Almost all of these areas can be followed by all students in 12 faculties at UI. PIMNAS is a mean 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

3.9. SCHOLARSHIP

Universitas Indonesia currently manages approximately 71 scholarships from both the government and the private sectors. 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.

There are two types of scholarship in UI:
•UI Scholarship
•Donor/Sponsor Scholarship

General requirement procedures for scholar- ship 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 the GPA corresponding with the requirements given by the donor/sponsor.
•Is not a smoker.
•Is not a receiver of similar scholarships.
•Provide other requirements as stated by the Donor/Sponsor.

LIST OF SCHOLARSHIP DONORS/SPONSORS 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

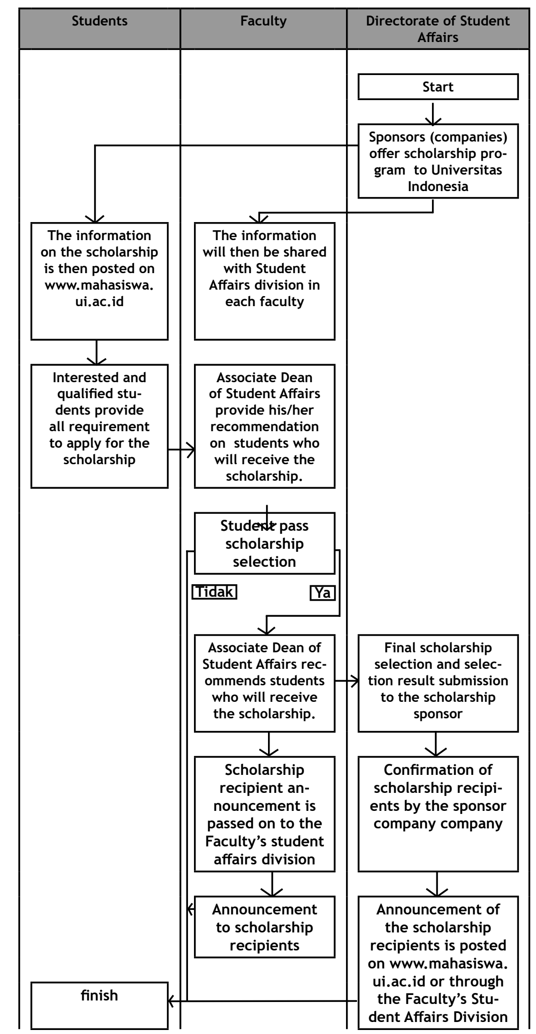
27. Exxon MOBIL (For Students from Aceh)

Thesis
28. Indosat
29. Karya Salemba 4 (KS 4)
30. KORINDO
31. LGE
32. MARUBENI
33. MC.DERMONT
34. Part Time Job

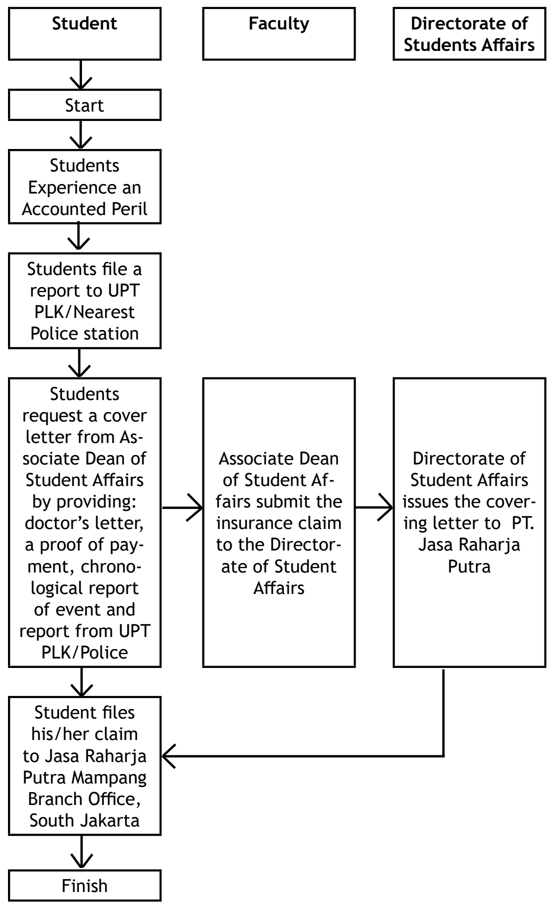
Flowchart of Scholarship Application

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)

Flowchart of Scholarship Application



Insurance Claims Process



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.

3.10. INSURANCE

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

These insured students are allowed to submit an insurance claim in accordance with the following provisions:

- Accidents included within the insurance claim are accidents which occur during the student's journey from home to UI campus to participate in academic and extracurricular activities wheth er it is within or outside 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, students must report the accident no later than 3x24 hours to the of fice 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 the doctor/hospital/clinic that treats the student's injuries.
- Non-medical care or treatment is not compensable.
- Students may send their inquiries regarding any matter that is not listed here directly to the Uni versitas Indonesia Head of Student Welfare Sub Directorate at the Central Administration Build ing, Universitas Indonesia Campus, Depok.

Compensation receivable from the Insurance Claim *)
Death due to an accident:
Rp. 5,000,000, -
Permanent disability due to an accident: Rp. 10,000,000, -
Care/medical treatment due to an accident (maximum payment): Rp. 3,500,000, -

*) Subject about to change without notice

3.11. GENERAL INFORMATION

Post Office, Kampus UI Depok
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
Kampus UI Salemba
Phone : +6221-330343, 3303455
Fax : +6221-330343

Kampus UI 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

3.12. INTERNATIONAL JOURNAL OF TECHNOLOGY

International Journal of Technology (IJTech) is a bi-annual international 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 to serve 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 the work to the international society of practitioners and researchers with interests in technological design and development from a wide variety of sectors.

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

3.13. QUALITY IN RESEARCH (QiR) CONFERENCE

QiR Conference is a bi-annual international conference organized by FTUI since 1998. The 13th QiR was held in Yogyakarta from 25 – 28 June 2013. It was attended by over 400 participants from 16 different countries in the world. This conference provides a chance for all students - undergraduate, master, or doctoral – to present their research findings in front of an international audience. The 16th QiR will be held in July 2019 in Padang, Indonesia. For more detailed information on QiR, please visit: http://qir.eng.ui.ac.id.

3.14. 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. Its goal is to assist the international students and scholars to 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, and International Knowledge Transfer. These opportunities are open for all university members from lecturers to students, be it in their Bachelor, Master or Ph.D. programs. Students can benefit from these programs by 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

4.1. UNDERGRADUATE PROGRAM IN CIVIL ENGINEERING

Program Specification

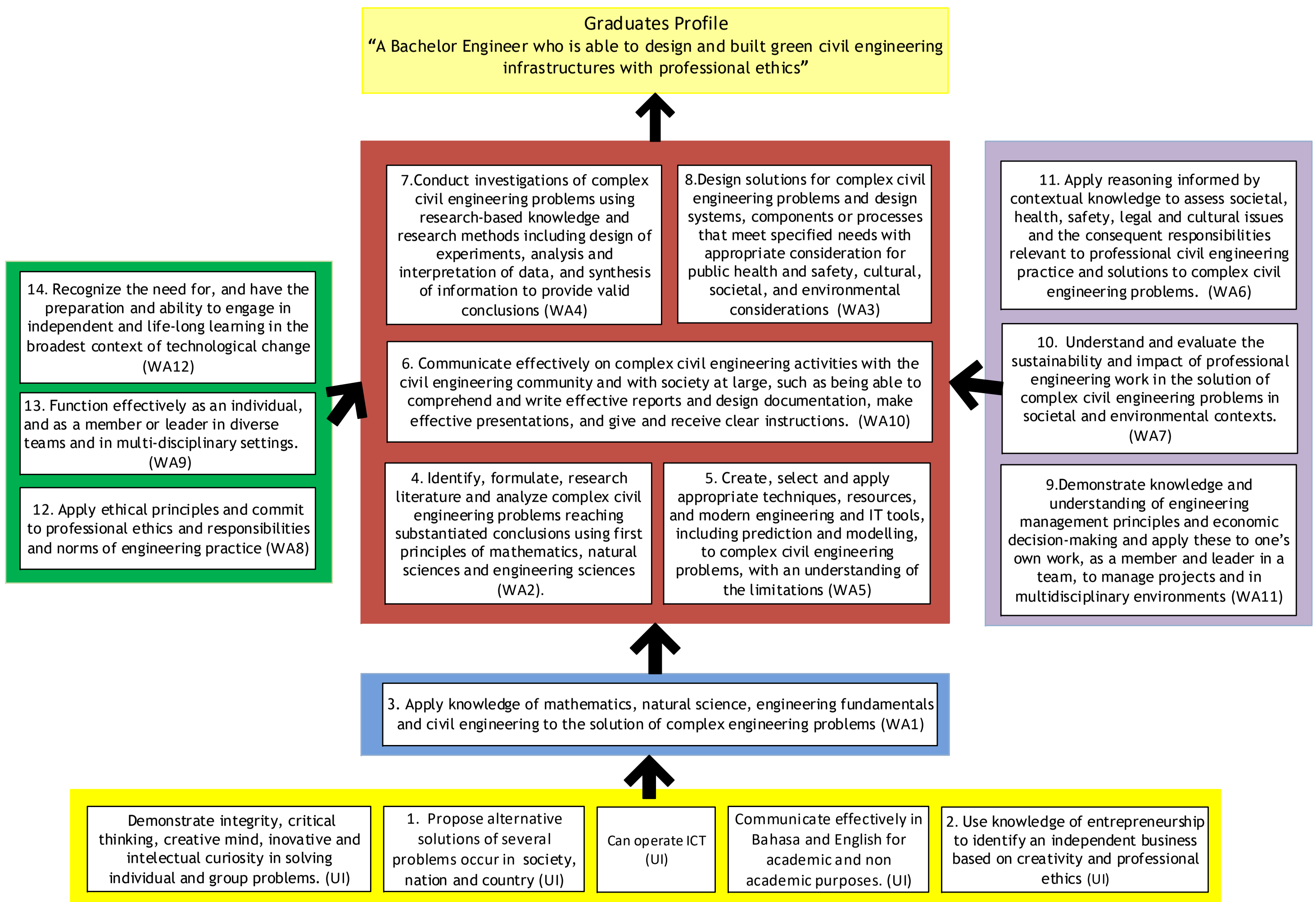
1.	**Awarding Institution**	Universitas Indonesia Double Degree: Universitas Indonesia and partner university	
2.	**Teaching Institution**	Universitas Indonesia Double Degree: Universitas Indonesia and partner university	
3.	**Programme Tittle**	Undergraduate Program in Civil Engineering	
4.	**Class**	Regular, Parallel, and International	
5.	**Final Award**	Sarjana Teknik (S.T) Double Degree: Sarjana Teknik (S.T) and Bachelor of Engineering (B.Eng)	
6.	**Accreditation / Recognition**	BAN-PT: A - Accredited, AUN-QA	
7.	**Language(s) of Instruction**	Bahasa Indonesia and English	
8.	**Study Scheme (Full Time / Part Time)**	Full Time	
9.	**Entry Requirements**	High school /equivalent, or D3 / Polytechnique / 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	17
	Short (optional)	3	8
11.	**Graduate Profiles:** A Bachelor Engineer who is able to design and built green civil engineering infrastructures with professional ethics		

12.	**Expected Learning Outcomes:** 1. Apply knowledge of mathematics, natural science, engineering fundamentals and civil engineering to the solution of complex engineering problems (C3-WA1/engineering knowledge) 2. Identify, formulate, research literature and analyze complex civil engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences. (C4-WA2/problem analysis) 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. (C5-WA3/design or development of solutions) 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. (C4-WA4/investigation) 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. (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 civil 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 civil engineering problems in societal and environmental contexts. (C3-WA7/environment and sustainability)

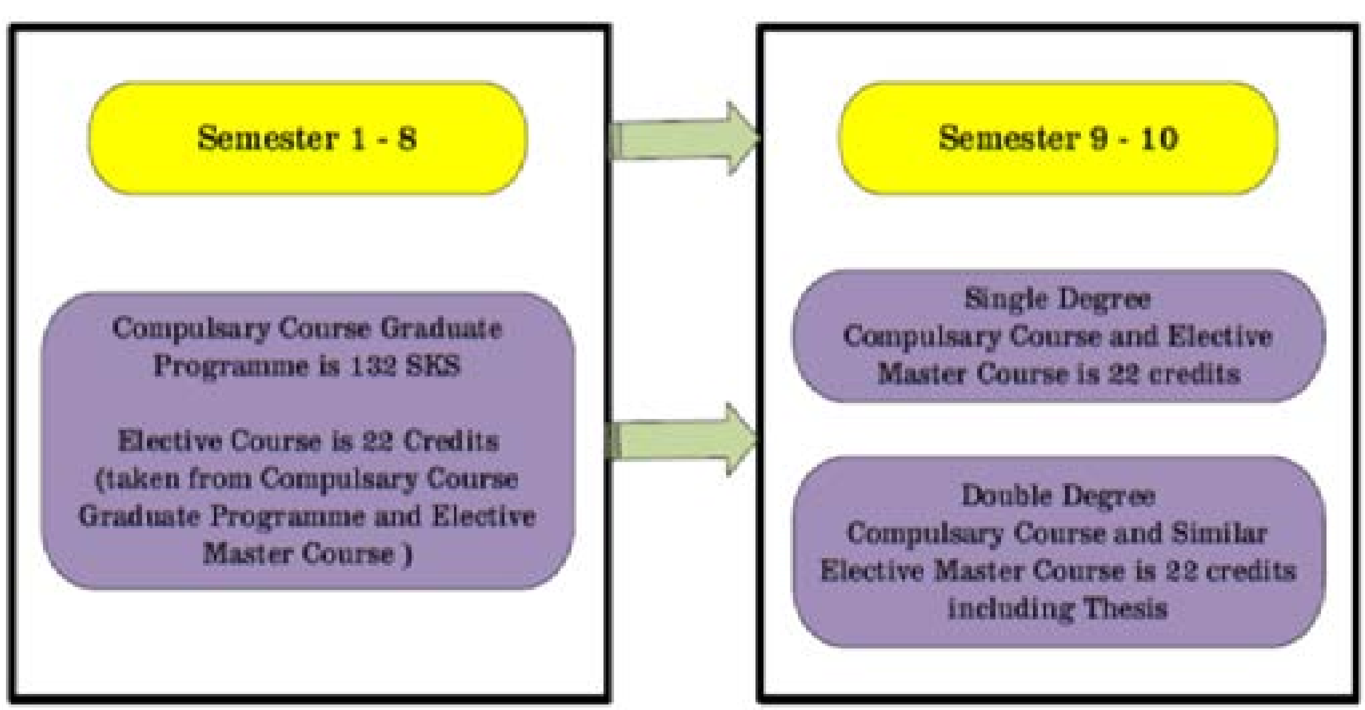
12.	8. Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice. (A4-WA8/ethics) 9. Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings. (P3-WA9/individual and team work) 10. Communicate effectively on complex civil engineering activities with the 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. (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. Propose alternative solutions of several problems occur in society, nation and country. (C3-UI-B) 14. Use knowledge of entrepreneurship to identify an independent business based on creativity and professional ethics. (C3-UI-E)

13	**Classification of Subjects**		
No.	**Classification**	**Credit Hours (SKS)**	**Percentage**
i	**University General Subjects**	**18**	**13 %**
ii	**Basic Engineering Subjects**	**27**	**19 %**
iii	**Core Subjects**	**79**	**55 %**
iv	**Elective Subjects**	**12**	**8 %**
v	**Internship, Seminar, ndergraduate Thesis, Project**	**8**	**6 %**
	Total	**144**	**100 %**
14.	**Total Credit Hours to Graduate**		**144 SKS**

Learning Outcomes Flow Diagram

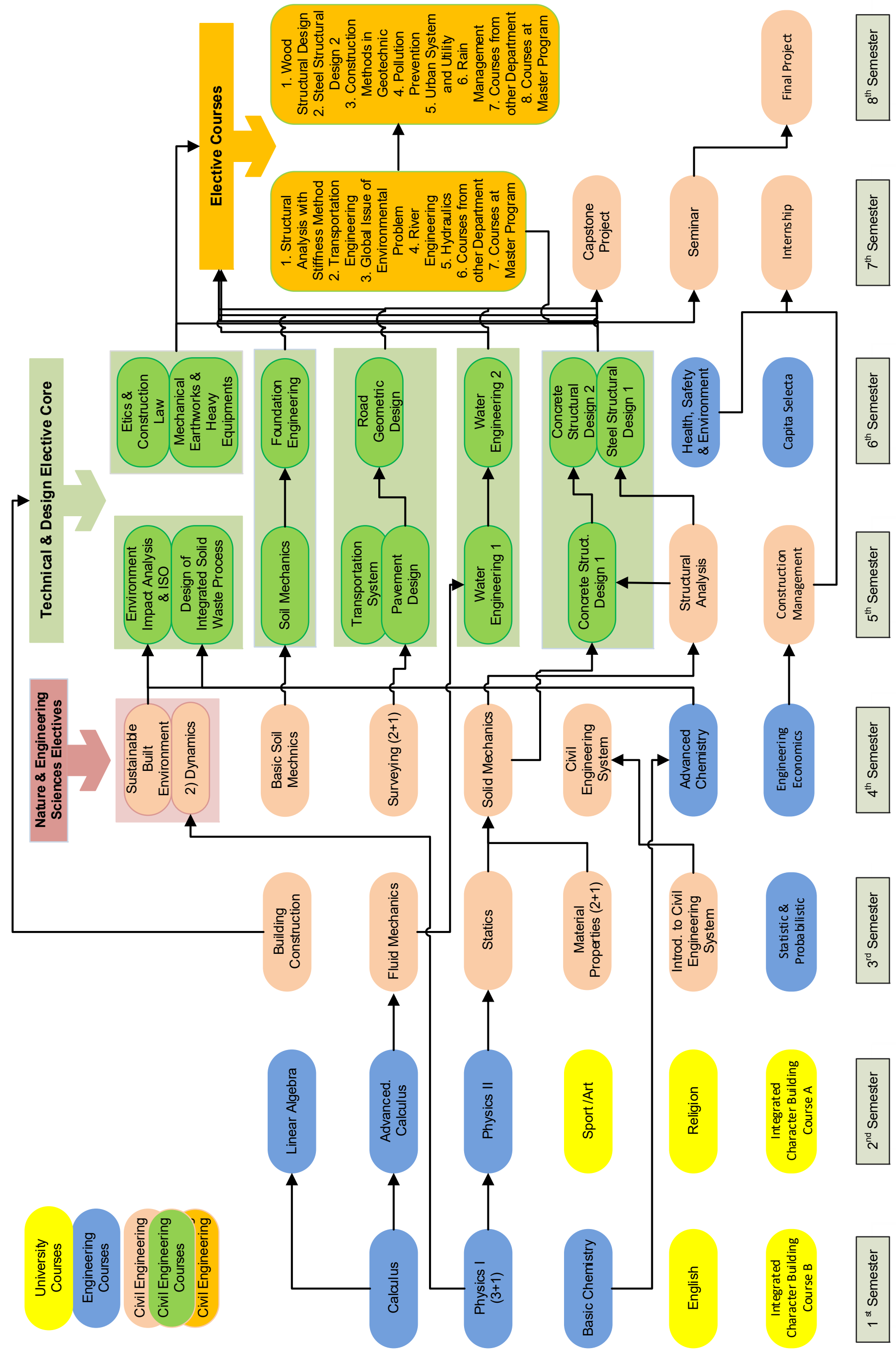


FAST TRACK PROGRAMME FOR DOUBLE DEGREE

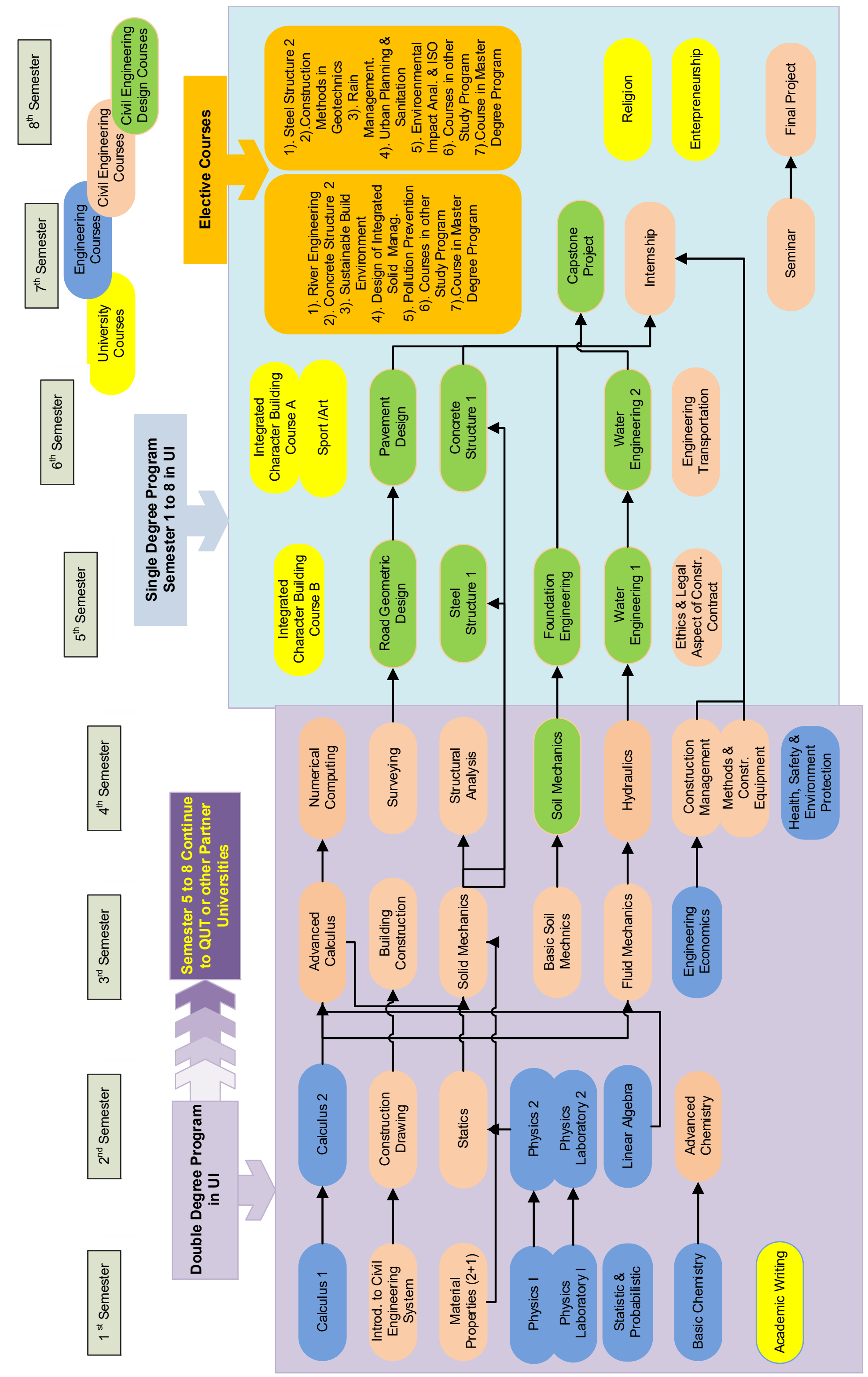


UNDERGRADUATE PROGRAM
CIVIL ENGINEERING

Flow Diagram of Subjects at Regular and Parallel Program



Flow Diagram of Subjects - International Undergraduate Program on Civil Engineering



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

Code	Subject	SKS
	1st Semester	
UIGE610002	Integrated Character Building B	6
UIGE610003	English	3
ENGE600001	Calculus 1	3
ENGE600005	Physics (Mechanics and Thermal)	3
ENGE600006	Physics (Mechanics and Thermal) Lab	1
ENCV601001	Intro to Civil Engineering System	3
	Sub Total	**19**
	2nd Semester	
UIGE610001	Integrated Character Building A	6
UIGE610020 - UIGE610048	Sport/Art	1
UIGE610010 - UIGE610015	Religion	2
ENGE600002	Calculus 2	3
ENGE600004	Linear Algebra	4
ENGE600007	Physics (Electricity, MWO)	3
ENGE600008	Physics (Electricity, MWO) Lab	1
	Sub Total	**20**
	3rd Semester	
ENGE600009	Basic Chemistry	2
ENCV 603 001	Advanced Calculus	3
ENCV 603 002	Material Properties	3
ENCV 603 003	Construction Drawing	2
ENCV 603 004	Surveying	3
ENCV 603 005	Statics	4
ENCV 603 006	Fluid Mechanics	3
	Sub Total	**20**
	4th Semester	
ENGE600010	Statistic and Probability	2
ENCV 604 001	Advanced Chemistry	2
ENCV 604 002	Numerical Computing	2
ENCV 604 003	Building Construction	3
ENCV 604 004	Solid Mechanics	4
ENCV 604 005	Basic Soil Mechanics	3
ENCV 604 006	Hydraulics	3
	Sub Total	**19**
	5th Semester	
ENGE600012	Health Safety and Environemntal Protection	2
ENCV 605 011	Structural Analyses	3
ENCV 605 012	Concrete Structure 1	3
ENCV 605 013	Soil Mechanics	3
ENCV 605 014	Road Geometric Design	3
ENCV 605 015	Transportation Engineering	3
ENCV 605 016	Water Engineering 1	3
	Sub Total	**20**
	6th Semester	
ENGE600011	Engineering Economics	3
ENCV 606 001	Steel Structure 1	3
ENCV 606 002	Foundation Engineering	3
ENCV 606 003	Pavement Design	3
ENCV 606 004	Water Engineering 2	3
ENCV 606 005	Construction Management	2
ENCV 606 006	Construct Method & Equipments	2
	Sub Total	**19**
	7th Semester	
ENCV 607 001	Capstone Project	3
ENCV 600 001	Internship	3
ENCV 600 002	Seminar	1
	Electives	6
	Students choose 12 credits of elective courses program of Civil Engineering or (2) other study program in Universitas Indonesia	
	Sub Total	**13**
	8th Semester	
ENCV 608 001	Etics & Legal of Construction Law	2
ENCV 608 002	Enterpreneurship	2
ENCV 600 003	Final Project	4
	Electives	6
	Students choose 12 credits of elective courses offered by : (1) undergraduate/postgraduate program of Civil Engineering or (2) other study program in Universitas Indonesia	
	Sub Total	**14**
	TOTAL	**144**

Resume

Wajib Universitas	**18**
Wajib Fakultas	**27**
Wajib Program Studi	**87**
Jumlah	**132**
Pilihan	**12**
Total Beban Studi	**144**

ELECTIVES

	7th Semester	
ENCV 607 002	Civil Engineering System	3
ENCV 607 003	Sustainable Built Environemnt	3
ENCV 607 004	Steel Structure 2	3
ENCV 607 005	River Engineering	3
ENCV 605 001	Urban System and Utility	3
	8th Semester	
ENCV 608 003	Concrete Structure 2	3
ENCV 608 004	Construction Methods in Geotechnic	3
ENCV 608 005	Stormwater Management	3
ENCV 606 004	Environmental Impact Analyses and ISO	3

Course Structure International Undergraduate Civil Engineering

Code	Subject	CP
	1st Semester	
UIGE610002	Academic Writing	3
ENGE610001	Calculus 1	3
ENGE610005	Physics (Mechanics and Thermal)	3
ENGE610006	Physics (Mechanics and Thermal) Laboratory	1
ENGE 610009	Basic Chemistry	2
ENGE610010	Statistic and Probability	2
ENCV611001	Intro to Civil Engineering System	3
ENCV611002	Material Properties	3
	Sub Total	**20**
	2nd Semester	
ENGE610002	Calculus 2	3
ENGE610004	Linear Algebra	4
ENGE610007	Physics (Electricity, MWO)	3
ENGE610008	Physics (Electricity, MWO) Laboratory	1
ENCV 612 001	Advanced Chemistry	2
ENCV 612 002	Construction Drawing	2
ENCV 612 003	Statics	4
	Sub Total	**19**
	3rd Semester	
ENGE610011	Engineering Economics	3
ENCV 613 001	Advanced Calculus	3
ENCV 613 002	Building Construction	3
ENCV 613 003	Solid Mechanics	4
ENCV 613 004	Basic Soil Mechanics	3
ENCV 613 005	Fluid Mechanics	3
	Sub Total	**19**
	4th Semester	
ENGE610012	Health Safety Environmental Protection	2
ENCV 614 001	Numerical Method	2
ENCV 614 002	Surveying	3
ENCV 614 003	Structural Analysis	3
ENCV 614 004	Soil Mechanics	3
ENCV 614 005	Transportation Engineering	3
ENCV 614 006	Hydraulics	3
	Sub Total	**19**

	5th Semester	
UIGE610004	Integrated Charater Building Course B	6
ENCV 615 001	Steel Structure 1	3
ENCV 615 002	Foundation Engineering	3
ENCV 615 003	Road Geometric Design	3
ENCV 615 004	Water Engineering 1	3
ENCV 615 005	Ethics and Legal Aspect of Construction Contract	2
	Sub Total	**20**
	6th Semester	
UIGE610001	Integrated Charater Building Course A	6
UIGE610003	Sports / Arts	1
ENCV 616 001	Concrete Structure 1	3
ENCV 616 002	Pavement Design	3
ENCV 616 003	Water Engineering 2	3
ENCV 616 004	Construction Management	2
ENCV 616 005	Construction Methods & Equipments	2
	Sub Total	**20**
	7th Semester	
ENCV 617 001	Capstone Project	3
ENCV 610 001	Internship	3
ENCV 610 002	Seminar	1
	Students choose 12 credits of elective courses offered by : (1) undergraduate/postgraduate program of Civil Engineering or (2) other study program in Universitas Indonesia	6
	Sub Total	**13**
	8th Semester	
UIGE610005-9	Religion	2
ENCV 618 001	Enterpreneurship	2
ENCV 610 003	Final Project	4
	Students choose 12 credits of elective courses offered by : (1) undergraduate/postgraduate program of Civil Engineering or (2) other study program in Universitas Indonesia	
	Sub Total	**14**
	Total	**114**

Resume

Wajib Universitas	18
Wajib Fakultas	27
Wajib Program Studi	87
Jumlah	132
Pilihan	12
Total Beban Studi	144

Electives

Code	Subject	Credit
	7th Semester	
ENCV 617 002	Civil Engineering System	3
ENCV 617 003	Sustainable Built Environment	3
ENCV 617 004	Concrete Structure 2	3
ENCV 617 005	River Engineering	3
ENEV606004	Environmental Impact Analyses and ISO	3
Code	**Subject**	**Credit**
	8th Semester	
ENCV 618 002	Steel Structure 2	3
ENCV 618 003	Construction Methods in Geotechnic	3
ENCV 618 004	Stormwater Management	3
ENEV605001	Urban Planning and Sanitation	3

*) Students may choose Elective courses offered by other Departement/Faculty or offered by Master Program

SYLLABUS OF UNIVERSITY SUBJECTS

INTEGRATED CHARACTER BUILDING A
UIGE600001/UIGE610001
6 sks
Syllabus : Integrated Character Building A facilitates students to understand the basics of character formation and master the basics of cognitive power that is logic. Furthermore, to apply cognitive powers in generating good behaviors which are useful to themselves and society. The establishment of ethical behaviors based on ethics is also facilitated. Students are able to develop the basic strength of character and to know themselves as a human being, both as individuals and as part of a group so that they can develop themselves well enough. In a group, the students need to have skills that are needed to maintain an effective relationship in order to improve the quality of human life. Particularly as a citizen of Indonesia, students need to understand the nature of citizenship and basic philosophy of Pancasila in order to act and behave in accordance with the character of the Indonesian nation.
Core Competencies :
1. Students are able to analyze problems in depth individually, comprehensively, logicaly and critically, and generate solutions using the logical and ethical principles and rules of logic and ethics
2. Students are capable of analyzing the problem individually, thoroughly and deeply about the human being as an individual or as part of group
3. Students are individually able to understand, make critical reasoning and to build an open and critical mind to the problem of nationhood, statehood and citizenship in this dynamic world situation
4. Students are able to create and display a work that depicts the character in accordance with the principles of Pancasila

Learning Method : interactive lecture, Experiential Learning, Collaborative Learning, Problem Based Learning, Project-Based Assignment
Prerequisites : OBM (New Student Orientation)

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))

INTEGRATED CHARACTER BUILDING B
UIGE600002/UIGE610004
6 sks
Syllabus : Integrated Character Building B facilitates students to practice identifying, analyzing, and resolving problems of nature and the environment by making use of integrative and quantitative information. This lecture aims to prepare the future generation who care about nature issues through the balanced development of hard skills and soft skills and have the skills of ICT (Information and Communication Technology).
Core Competencies:
1. Students have an ethic, moral, personality and good character in completing the task at hand;
2. Students role as citizens who take pride and love of the homeland and support the continuity of life;
3. Students are able to work together and have a high sensitivity and awareness to the community and the environment;
4. Students are able to think logically, critically and creatively;
5. Students are able to use mathematics to solve problems quantitatively;
6. Students are able to use information and communication technology (ICT) for development;
7. Students are able to analyze the system of nature integratively and comprehensively;
8. Students are able to act as wise managers of nature to build and maintain the preservation of nature for a better and sustainable life.

Learning Method : Blended e-Learning, Collaborative Learning (CL), Problem Based Learning (PBL) and Group Discussion (GD)
Prerequisites : OBM (New Student Orientation)
Textbook : Digital Form can be downloaded from Scele

ISLAMIC STUDY
UIGE600010/UIGE610005
2 sks
General instructional objectives : The cultivation of students who have concern for social, national 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 practice 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 STUDY
UIGE600011/UIGE610006
2 sks
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 STUDY
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 STUDY
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 STUDY
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 STUDY
UIGE600015
2 sks

ART
UIGE600020-30
1 sks
The option of subjects that can be choosen :
Appreciation of Film (UIGE600020), Batik (UIGE600021), Photography (UIGE600022), Calligraphy (UIGE600023), Javanese Karawitan (UIGE600024), Balinese Dance and Karawitan (UIGE600025), Comic (UIGE600026), Painting (UIGE600027), Music and Vocal (UIGE600028), Theater (UIGE600029), Wayang (UIGE600030)

SPORT
UIGE600040-48
1 sks
The option of subjects that can be choosen :
Basketball (UIGE600040), Volley Ball (UIGE600041), Badminton (UIGE600042), Futsal (UIGE600043), Hockey (UIGE600044), Football (UIGE600045), Softball (UIGE600046), Tennis (UIGE600047), Table Tennis (UIGE600048)

SYLLABUS OF BASIC ENGINEERING SUBJECTS

CALCULUS 1
ENGE600001/ENGE610001
3 sks
Syllabus : This subject gives the opportunity for students to understand the basic concept of calculus and to be able to solve applied calculus problems. Students are also given the opportunity to understand basic concepts the functions of one variable, derivatives and integral functions of one variable, and its application.

CALCULUS 2
ENGE600002/ENGE610002
3 sks
Syllabus : This subject gives the opportunity for students to understand the basic concept of calculus and to be able to solve applied calculus problems. Students are also given the opportunity to understand the basic concept the function of two variables, or variables, total derivative and integral of the function of two or more variables and application. In addition, students can understand the basic concepts of sequence and series.

CALCULUS
ENGE600003/ENGE610003
4 sks
Syllabus : This subject gives the opportunity for students to understand the basic concept of calculus and to be able to solve applied calculus problems. Students are also given the opportunity to understand the basic concept the function of two variables, the total derivative of the function of two or more variables and its application. Students are also expected to understand the basic concept of sequence and series and the basic concept of vector and analytical geometry.

LINEAR ALGEBRA
ENGE600004/ENGE610004
4 sks
Syllabus : This subject gives the opportunity for students to master the basic techniques of Linear Algebra and gain knowledge on how to implement said techniques in solving System of linear equationss, determining the bases and dimension of vector space, as well as calculating eigen values and eigen vectors. This subject also gives students the opportunity to work with other objects, especially vectors and matrices.

PHYSICS (MECHANICS AND THERMAL)
ENGE600005/ENGE610005
3 sks
Syllabus : Physics (Mechanics and Thermal) subject includes the topics of mechanics and thermodynamics. Calculus is use as a mathematic helping tool in the learning process. Students are given the opportunity to learn how to unite their understanding of the basic concept of the analytical capability, their numeracy in learning mechanics and thermodynamics. During the course of this subject, students are not only aim to increase the students' knowledge of the basic physics concepts but also to increase their capability in using information technology and computer and to train their skills, such as: independent and group work and their communication skill.
Students will also be train on how to explain and analyse the nature phenomenon and the result of human engineering exist in their everyday lives by using the basic physics concept and applied them in their daily lives. Students are also taught to develop their synthesis ability and evaluating both quantitative and qualitative natural phenomenon and the result of human engineering in their surrounding environment by using basic physics concept. This subject will give students the opportunity to develop their ability to develop their presentation ability analyse the nature phenomenon and the result of human engineering from the mathematics and natural science point of view integrative and comprehensively.

PHYSICS (MECHANICS AND THERMAL) LABORATORY
ENGE600006/ENGE610006
1 sks
Syllabus : Practical of Mechanics: Measurement, Moment of inertia, Gravity acceleration, Fluid density, Scratch coefficient, Collision, Swing torque, Viscosity of water, Young's modulus, Viscosity of Newtonian fluid, Fluids surface tension, Oscillation, Practical of Heat: Coefficient of linear expansion, Heat conductivity, Thermocouple calibration, Calorimeter, Joule Constant, Laplace Constant, Heat Collector, Determining of air Cp/Cv, Expansion of fluids and water anomaly.
Notes: For Architecture and Interior Architecture Program, practical is not mandatory.

PHYSICS (ELECTRICITY, MWO)
ENGE600007/ENGE610007
3 sks
Syllabus : Physics (Electricity, MWO) subject includes the topics of electricity, magnet, wave, and optics. Calculus is use as a mathematic helping tool in the learning process. Students are given the opportunity to learn how to unite their understanding of the basic concept of the analytical capability, their numeracy in learning mechanics and thermodynamics. During the course of this subject, students are not only aim to increase the students' knowledge of the basic physics concepts but also to increase their capability in using information technology and computer and to train their soft skills, such as: independent and group work and their communication skill. Students will also be train on how to explain and analyze the nature phenomenon and the result of human engineering exist in their everyday lives by using the basic physics concept and applied them in their daily lives. Students are also taught to develop their synthesis ability and evaluating both quantitative and qualitative natural phenomenon and the result of human engineering in their surrounding environment by using basic physics concept.

PHYSICS (ELECTRICITY, MWO) LABORATORY
ENGE600008/ENGE610008
1 sks
Syllabus : Practical of Electricity: Electrolysis, Wheatstone bridge, Kirchhoff law, Earth's magnetic field, Temperature coefficient, Characteristic of series RLC circuit, Ohm law, Transformer. Practical of Optics: Polarimeter, Lens, Photometry, Prisms bias index, Spectrometer, Diffraction grid, Newton's ring.

BASIC CHEMISTRY
ENGE600009/ENGE610009
2 sks
Syllabus : As an engineer, you must have understanding on the chemistry that provides not only the basis for much of what goes on in our world but also that it is a vital, continually developing science. In this study the students will learn many subjects such as matter and measurement; atoms, molecules, and ions; stoichiometry; aqueous reactions; thermochemistry; properties of solutions; chemical kinetics; chemical equilibrium; and electrochemistry.
Learning activities will be conducted through various method, which consists of: problem based learning (PBL), interactive lecture, question-based learning, discussion, demonstration and unguided structured assignments. Assessment will be made continuously through a set of exercises, group discussion, mid semester exam and final exam.

STATISTIC AND PROBABILITY
ENGE600010/ENGE610010
2 sks
Syllabus : Statistics and probability has been known as applied mathematics which is widely used in collecting, organizing, presenting, interpreting and analyzing data to support valid conclusions. Furthermore, these conclusions will be used as recommendation in decision making. The course of Statistics and Probability is intended to give a basic ability for students to handle quantitative data and information. There are two stages that are delivered which is descriptive and inductive/inference stages. Descriptive stage includes collecting, organizing, and presenting the data in a scientific manner. Then, inductive/inference stage includes the process of estimating and drawing conclusion based on available data and relations between variables. Hence, students are expected to apply their knowledge of statistics in conducting experiments in laboratory works/assignments as well as research studies in their final projects.

ENGINEERING ECONOMICS
ENGE600011/ENGE610011
3 sks
Syllabus : This course introduces students to the basic of engineering economy. It covers the time value of money (TVOM) and interest rate; tools for evaluating project alternatives for both non discounted and discounted methods, for instance present worth analysis, annual worth analysis, future worth analysis, rate of return (ROR) analysis and benefit/cost analysis; and choosing the best alternative, break even analysis, and effect of depreciation and after tax analysis and sensitivity analysis, and replacement analysis.
Learning activities will be conducted through various methods, which consist of: interactive lectures, question-based learning, discussion, and structure assignments. Assessment will be made thoroughly through sets of exercises/quizzes, group discussion, midterm and final exam. To expose students on the latest utilization of engineering economy and train them how to use it, a project will be assigned. As an integral part of course, computer utilization such as Microsoft Excel will be demonstrated and discussed on the class.

HEALTH, SAFETY AND ENVIRONMENTAL PROTECTION
ENGE600012/ENGE610012
2 sks
Syllabus : The teaching of Safety, Health and Environmental (SHE) protection to undergraduates studying engineering courses is an important part of the education of future engineers at all levels. It is the generally expressed view amongst practitioners in industry, business and other organisations

that all engineers need to be equipped to appreciate, understand and implement the requirements of SHE management and practice to meet the working needs of industry and of their company (or other organisation). Whilst the level of risk and degree of control is dependant on the industry sector concerned the basic principles do not change. In addition, according to code of ethics of engineers, engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties.
The module covers the regulation framework and standards, risk perception, assessment, and management and detail discussion on physical, chemical and process hazards, and related engineering and management controls. Maintenance of safety conditions, personal protective equipments, audit, incident and emergency planning are discussed in accordance to measures for improving students awareness to their daily activities within the campus premises and local environment.
Learning activities will be conducted through various methods, which consist of: interactive lecture, question-based learning, discussion, demonstration and unguided structured assignments. Assessment will be made continuously through a set of exercises, group discussion, mid semester exam and final exam

COURSE SYLLABUS OF UNDERGRADUATE PROGRAM ON CIVIL ENGINEERING

ENCV 601 001 / ENCV611001
Introduction to Civil Engineering System
3 Credits
Learning Outcomes :

1. Students will be able to elaborate the working scope of Civil Engineering with its sub-expertise for a system related to Civil Engineering work;
2. Be able to work in a team;
3. Be able to deliver the ideas in oral or written form.

Competencies in Curriculum: Prior knowledge untuk WA6 (the engineer and spciety), WA7 (environment and sustainability), WA 9 (individual and team work) dan WA 10 (communication)
Syllabus : Introducing the system and working scope of Civil Engineering: General description of the system and work scope of Civil Engineering, General Description about the sub-expertise of Transportation Engineering, Geotechnical Engineering, Water Resources Management, Environmental Engineering, Structural Engineering and Construction Management; Components and Functions of buildings/infrastructures in Civil Engineering: Physical and non-physical components of buildings/infrastructures in Civil Engineering, Functions of physical and non-physical of buildings/infrastructures in Civil Engineering; Role of Civil Engineering Bachelors: Roles of Civil Engineering Bachelors in areas of expertise of Transportation Engineering, Geotechnical Engineering, Water Resources Management, Environmental Engineering, Structural Engineering and Construction Management, Relationship between scope of work between areas of expertise.
Prerequisites : -
Text Book References :
1. Grava, S., Urban Transportation System, Choices for Communities., Mc Graw-Hill, 2003
2. Project Management Institute, A Guide to Project Management Body of Knowledge, 2013
3. The Little Book of Civilisation

ENCV 604 001 / ENCV612001
Advanced Chemistry
2 Credits

1. **Learning Outcomes :** Students will be able to derive and use the concept of: ordinary differential equation and calculus vector in order to solve its applied problems. (C2)

Competencies in Curriculum : Prior knowledge of WA1 (Engineering knowledge)
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

ENCV 603 002 / ENCV611002
Material Properties
3 Credits
Learning Outcomes :
1. Students will be able to explain comprehensively the definition of practical and elementary

aspects of materials in the Civil Engineering field related to the tension-strain relationship, elasticity, behavior through time, damping property, atom structures, plasticity, yielding criteria, fatigue, ductility, and corrosion process;
2. Be able to design concrete mix design materials according to the desired concrete compressive strength; able to explain the compression test process of a cylinder concrete sample and the tensile test of steel reinforcement in the laboratory and able to explain the meaning of the test results;
3. Be able to work in a team.

Competencies in Curriculum : *prior knowledge* for WA 1 (Engineering knowledge), WA 4 (investigation) and WA9 (team work)
Silabus : Material Particulate, Aggregat, Semen Portland dan Beton Semen Portland, Baja struktural, Semen aspalt dan beton aspalt, kayu, polimer dan plastik, Beton Serat, Dasardasar Dasar dasar material dan solid, micro struktur dan surface properties; Rasponse material terhadap stresses; Leleh dan fracture; Rheology dari fluida dan solid; Fatique
Prasyarat : -
Buku Ajar:
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

ENCV 603 003 / ENCV612002
Construction Drawing
2 Credits
Learning Outcomes :
1. Students will be able to explain engineering drawing symbols in Civil Engineering field and draw it manually or using a software (AutoCAD);
2. Be able to design a one-floor simple healthy house building;
3. Be able to draw the one-floor simple healthy house building according to rules and procedures of engineering drawing such as aperture drawing (plans and appearance) and section view; covering dimension/sizes; foundation drawing, structural beam and column drawing, trestlework drawing, electrical installation and plumbing.

Competencies in Curriculum: *Prior knowledge* for WA5 (*modern tool usage*) and WA10 (communication)
Syllabus : introduction to Civil Engineering knowledge discipline scope and Civil Engineering building construction, introduction to engineering drawing, benefit and purpose of drawing in design process; introduction to drawing tools, drawing paper format, drawing head, standards, lettering, leader, and scale; geometric construction; pictorial projection; orthogonal projection; section view drawing; details of the building drawing, construction drawing of wooden and light steel rooftop; beam construction drawing, column and river stone foundation; electrical installation drawing and plumbing drawing
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,

ENCV 603 004 /ENCV614002
Surveying (2+1)
3 Credits
Learning Outcomes :
1. Students will be able to use various measuring instruments to solve mapping problems and pegs in civil engineering and environmental engineering works, surveying and displaying the results in a form of drawing with integrating various measuring methods and able to read and draw the data from the surveying results done by someone else;
2. Be able to work in team.

Competencies in Curriculum : *prior knowledge* for WA 4 (experiment) and WA9 (individual and team work)
Syllabus : Explanation of surveying concept in civil engineering and environmental engineering works; introduction to distance measuring equipment, angles and other measuring equipment

usually used in mapping and pegging; Operating levelling equipment and Theodolite in order to take field's data and integrating the data into a map or transferring design coordinates into the field coordinates in civil engineering and environmental engineering activities; carrying out field measuring with measuring methods of horizontal, vertical distance, and angle measurement; Error theory; planning of basic concept of mapping and pegging; calculation of area and volume; displaying the field measuring results in a corresponding map for the needs of civil engineering and environmental engineering
Prerequisites : Calculus 1, Calculus 2, and Construction Drawing
Text Book References :
1. Kavanagh, B. and Slattery, D., 2014. Surveying with Construction Applications 8th ed., Prentice-Hall, Inc.
2. Irvine, W., 2005. Surveying for Construction 8th ed., McGraw-Hill Higher Education.
3. Uren, J. and Prince, W., 2010. Surveying for Engineers 5th ed., Palgrave MacMillan.

Schofield, W. and Breach, M., 2007. Engineering Surveying 6th ed., CRC Press.

ENCV 603 005 / ENCV612003
Statics
4 Credits
Learning Outcomes :
1. Students will be able to apply the mechanics physics concept in calculating responds from rigid body as results of working forces (C3);
2. Be able to apply the mechanics physics concept in analyzing simple structure of beam, trusses, and three joints arch (C3).

Competencies in Curriculum : Prior Knowledge untuk WA 1 (Engineering knowledge)
Syllabus : Statics of particle; rigid body; equilibrium of rigid body; structural analysis of trusses with point equilibrium method; influential lines for statically determinate structure caused by moving loads
Prerequisites : Heat and Mechanics 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

ENCV 603 006 / ENCV613005
Fluid Mechanic (2+1)
3 SKS
Learning Outcomes :
1. Students will be able to analyze fluid pressure distribution at a given static situation to be applied for load calculation of structure stability of civil building;
2. Be able to analyzed fluid in motion to be applied for calculation of total flow and the induced dynamic forces;

Competencies in Curriculum : Prior Knowledge untuk WA1 (engineering knowledge).
Syllabus : The most important basic science in civil engineering is mechanics knowledge. This knowledge can be separated into material mechanics and fluid mechanics. The mechanics of fluid discuss about the basic formulation of motion and forces of an object that cannot be perceived as completely integrated fluid, such as wind and water. This knowledge is the basis for all of the water resources engineering subjects, such as Hydraulics, Hydrology, Design of Water Infrastructure, Ground Water Resources, Water Surface Management and Development, etc. Until midterms, the materials that will be discussed is static fluid which covers the definition of pressure, pressure distribution formulation, and the application of the formula to determine the force as an effect from the pressure for various civil engineering buildings. The other half of the semester, the materials that will be discussed is flowing fluid, starting from the Eulerian movement conceptualization and its application in the law of mass, momentum, and energy conservation to calculate the total flow and dynamic force induced by the law. The total flow and force obtained will be the basis of particularly hydraulic building design or civil engineering buildings in general.
Prerequisites : Calculus I, Calculus II, Basic Physics I, Basic Physics II, Basic Physics Laboratory I, Basic Physics Laboratory II
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

ENCV 603 001 / ENCV613001
Advanced Calculus
3 Credits
Learning Outcomes :
1. Students will be able to derive and use the concept of: ordinary differential equation and calculus vector in order to solve its applied problems. (C2)

Competencies in Curriculum: *Prior knowledge* for WA1 (engineering knowledge)
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, John Wiley & Son, 5th ed., 2011

ENCV 604 002 / ENCV614001
Numerical Computing
2 SKS
Learning Objective : Students will be able to solve mathematics equation on linear algebra and differential equation with numerical method using MatLab software.
Competencies in Curriculum : *Prior knowledge* for WA 1 (Engineering knowledge) and WA5 (modern tool usage)
Syllabus : Introduction to MATLAB (programming basics with MATLAB), Searching for root 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

ENCV 604 003 /ENCV613002
Building Construction
3 Credits
Learning Outcomes:
1. Students will be able to apply the knowledge of engineering drawing symbols in Civil Engineering field for describing a two-story building according to the rules and procedures of engineering drawing such as aperture drawing (plans and appearance) and section view; covering dimension/ sizes; foundation drawing, structural beam and column drawing, trestlework drawing, electrical installation and plumbing;
2. Be able to read the construction drawing and explain the parts of water structure (dam), waste treatment building, geotechnical building (foundation, retaining wall), roads, and bridges according to the construction drawing;
3. Be able to calculate the volume of the building, unit price, and cost estimation.

Competencies in Curriculum: *Prior knowledge* untuk WA1 (*engineering knowledge*), WA 10 (*communication*), dan WA 5 (*modern tool usage*)
Syllabus : Introduction of the course syllabus, introduction of standards of every building element and room function, plan and appearance drawing of a building, section-view drawing, foundation plan drawing, column and beam construction drawing, rooftop and trestlework plan drawing, platform drawing, stairs drawing, plafond and floor pattern drawing, window and door frames drawing, lighting installation drawing; plumbing system drawing, fire prevention installation drawing; lightning rod installation drawing, solid waste/trash drawing and septic tank drawing. Calculation of the building's volume and cost estimation. Unit Price. Journals.
Prerequisites : Construction Drawing
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

ENCV 604 004 /ENCV613003
Solid Mechanics (3+1)
4 Credits
Learning Outcomes :
1. Students will be able to analyze tension and shape changes as a result of working forces for various shape of statically determined structure and various shape of sections and type of materials;
2. Be able to calculate the deflection of beam, portal, and trusses structure using the beam, moment area, and energy theory and use the knowledge to analyze a simple statically undetermined structure using the principals of consistent deformation.

Competencies in Curriculum : Prior Knowledge WA1 (engineering knowledge)
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. Stresses on inclined plane and primary stresses.
Deflection of beam, portal, and trusses of statically determined structure caused by external forces using elastic deformation line differential equation method, moment area of an equivalent beam method, energy/unit load method. Simple analysis of statically undetermined structure with the principals of consistent deformation
Prerequisites : Statics
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. McGraw Hill, 2011
3. Egor P. Popov (Author), Engineering Mechanics of Solids (2nd Edition), Prentice Hall, 1998
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

ENCV 604 005 /ENCV613004
Basic Soil Mechanics (2+1)
3 Credits
Learning Outcomes : Students will be 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 civil engineering.

Competencies in Curriculum : Prior knowledge untuk WA1 (engineering knowledge), WA2 (problem analysis), WA 4 (investigation) and WA 9 (individual and team work)
Syllabus : Geological Engineering and Soil Properties; Definitions of geological knowledge, geotechnics with other disciplines/civil; topography and geomorphology map; definition and meaning of units in topography and its tools; how to read and analyze mineralogy, stone types, and stratigraphy, introduction to type of minerals forming igneous rock, geological structure and its types; how to identify and understand the effect of coating, stocky, fault, and unconformity for construction; weathering and movement of soil; introduction of types, processes, and identification of weathering; Explanation of classification process; Geological and Geotechnical maps; analyzing basic topography maps; Criteria of geotechnics geological maps; soil properties: soil in three phases; physical characteristics of soil; soil classification, Atterberg Limit; soil compaction theory and CBR test; one flow dimension in soil, permeability and introduction to groundwater seepage, flow diagram stress theory and the effective stress principal; effective stress reaction because of the change of total stress in a fully saturated soil; soil shear strength theory; laboratory soil shear strength test for clay and sand; consolidation theory and test;
Prerequisites : Material Properties
Text Book References :
1. Burchfiel BC & Foster RJ et .al., "Physical Geology", Charles 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", Fifth edition, 2005, PWS Publishing Company, Boston
6. Budu M., "Soil Mechanics and Foundations", Second Edition, 2007, John Wiley& Sons, New York

ENCV 604 006 / ENCV614006
Hydraulic
3 Credits
Learning Outcomes: Students will be able to apply the mass and momentum conservation law to be applied as the fundamental design of water flow under pressure, and water flow in open drainage system.
Competencies in Curriculum : Prior knowledge untuk WA1 (engineering knowledge) dan WA2 (problem analysis)
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 coefficient.
Prerequisites : Fluid Mechanics
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.

ENCV 605 011 / ENCV614003
Structure Analysis
3 Credits
Learning Outcomes :
1. Students will be able to analyze statically undetermined structural responses of truss, beams, frames and arches affected by external loads and degradation of placement using methods such as slope deflection method and moment distribution (cross-method);
2. Be able to analyze 2D spatial structure using direct stiffness method with computer aid (matrix method);
3. Be able to apply moment distribution principal in analyzing influence line in continuous beam structure.

Competencies in curriculum : Prior knowledge untuk WA2 (problem analysis)

Syllabus : Definition of statically undetermined vs. determined structure, external statically undetermined structure, *Slope deflection* and moment distribution for continuous beam with various condition of placement, fixed portal and portal that have single/double swinging factors, *gable frame*, symmetrical and asymmetrical structure; Influential lines of placement reactions, influential lines of transversal force and flexural moment for continuous beam. Virtual working principals and energies used in structural analysis;
Superposition matrix method in structural analysis; Implementation of superposition matrix method for 2D spatial Structure
Prerequisites : Statics, Material Property and Solid Mechanics
Text Books References :
1. Hibbeler,R.C., Structural Analysis, Prentice Hall, 2016
2. Aslam Kassimali, Structural Analysis, 4th edition, 2011
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

ENCV 605 012 / ENCV616001
Concrete Structure 1
3 Credits
Learning Outcomes :
1. Students will be able to explain design concept of structures, load applied on structures, structural systems;
2. Be able to design structural members from reinforced concrete according to procedures and design standards including beams, T beams, one way and two-way plate, short column and shallow foundation;
3. Be able to describe design results in engineering drawing in accordance to the rules and regulations of engineering drawing.

Competencies in curriculum : Prior knowledge untuk WA2 (problem analysis), WA3 (design/development of solutions) and WA10 (communication)
Syllabus : Introduction to structural system analysis and design; structural systems: purposes, design step; LRFD, reduction factor and allowable stress; loads and loading: Load forms, load types; location of loads, load distribution, load factor and load combination; basic concept of reinforced concrete; Steel and concrete stress-strain properties; Concrete compressive strength characteristic; Concrete compressive strength evolution; Ultimate strength concept, Whitney tensile block simplification, impartial collapse; Reinforcement analysis of single and double reinforcement on a regular beam; analysis of reinforcement for a T-beam section due to internal flexural moment forces; analysis of shear reinforcement for beam and torque reinforcement; analysis of one-way plate reinforcement, two-way plate with method coefficient method, analysis for short column reinforcement; foundation types and local shallow foundation designs with its drawing; able to calculate the deflection of a reinforced concrete structure.
Prerequisites : Construction Drawing, Building Construction, Solid Mechanics and Material Properties
Text Books 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

ENCV 605 013 / ENCV614004
Soil Mechanics (2+1)
3 Credits
Learning Outcomes :
1. Students will be able to apply basic soil parameter knowledge on calculating soil strength and stability for simple buildings/civil engineering construction;
2. Be able to design soil retaining wall and draw it according to the rules and regulations of engineering drawing;
3. Be able to use SLOPE/W software to analyze slope stability.

Competencies in curriculum : Prior knowledge untuk WA 2 (problem analysis), WA3 (design/development of solutions), WA 4 (investigation), WA5 (modern tool usage) dan prior knowledge untuk WA 4 (experiment) dan WA 9 (individual and team work)
Syllabus : Bearing capacity of the soil: Allowable bearing capacity and Ultimate bearing capacity

due to inclination and eccentricity of load; One dimensional elastic settlement and consolidation settlement; Drawing shallow foundation design; Seepage through dam; Stress distribution in the soil: A point load, strip, circle, and square area of footing using Fadum and Newmark theories; Lateral earth pressure: Rankine and Coulomb theories; Structure design of earth retaining wall, gravity wall, cantilever wall, earth retaining cantilever wall, sheet pile; Slope stability: concept of slope stability, undrained analysis, slice method, introduction of Fellenius method, Bishop method, Soil stability method

Prerequisites : Basic Soil Mechanics

Text Books 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", Fifth edition, 2005, PWS Publishing Company, Boston

Budhu M., "Soil Mechanics and Foundations", Second Edition, 2007, John Wiley& Sons, New York

ENCV 605 015 / ENCV614005
Transportation Engineering
3 Credits

Learning Outcomes : Students will be able to design road segment and intersection using traffic variables, decipher the characteristics of modes of transportations and designing steps of urban transportation.

Competencies in Curriculum : Prior knowledge untuk WA1 (engineering knowledge), WA2 (problem analysis) and WA 5 (modern tool usage)

Syllabus : Types, characteristics, and facilities for a single mode and multi-modes of transportations (e.g. transportation modes, parking, and terminal); variables related to the characteristic of traffic and parking flows; measuring and analyzing variables of traffic characteristics; calculating the segment capacity and simple intersection with the rules of *Manual Kapasitas Jalan Indonesia* (MKJI) and Highway Capacity Manual (HCM); Measuring the variables mentioned in the filed with a traffic control equipment for intersection; Introduction to *Four step model (link, nodes, zone)*.

Prerequisites: Calculus 1, and Statistic and Probabilistic

Text Book References :

1. Papacostas, C. and Prevedouros, P., 2000. Transportation Engineering and Planning 3rd ed., Prentice-Hall, Inc.
2. Banks, J., 2002. Introduction to Transportation Engineering 2nd ed., McGraw-Hill.
3. Fricker, J. and Whitford, R., 2004. Fundamentals of Transportation Engineering: A Multimodal System Approach. In Prentice Hall.

ENCV 605 016 /ENCV615004
Water Engineering 1
3 Credits

Learning Outcomes :

1. Students will be able to set the dimension of a channel, culverts, spillway and storage of reservoir/retention pond, in a catchment area with an area not exceeding 50 Km2, based on topographical map with 1:25.000 scale, rain data at the rain station in and/or around the catchment area, domestic water needs survey result and social-economy data in the related district. (C4);
2. Be able to self-organize when working independently or in a group, hence the students can demonstrate the ability to master the course in the form of systematic written documents and an effective and efficient oral presentation (A4).

Competencies in curriculum : Prior knowledge untuk WA 1 (engineering knowledge), WA2 (problem analysis), WA3 (design/development of solutions), WA9 (individual and team work) dan WA10 (communication)

Syllabus : Determining the dimension of a channel, culverts, and reservoir/retention pond spillway based on the calculation of planned flood debit and open channel hydraulics, and determining the dimension of reservoir/retention pond based on water balance calculation. The learning method consists of introductory lecture, individual/group exercises in and out of the class, as well as presentation and writing paper as a group final project. The final project consists of a task to design channel, culvert, spillway and storage of reservoir/retention pond, in a catchment area with an area not exceeding 50 Km2, based on topographical map with 1:25.000 scale, rain data at the rain station in and/or around the catchment area, domestic water needs survey result and social-economy data in the related district/city.

Prerequisites : Hydraulics

Text Books References:

1. Bedient, Philip B. and Huber, Wayne C., 1992. Hydrology and Floodplain Analysis. Second Edition. Addison-Wesley 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 Protection Stream, 2009. Survey Manual. A CITIZEN'S GUIDE to Basic Watershed, Habitat, and Geomorphology Surveys in Stream and River Watersheds — Volume I. http://www.geo.brown.edu/research/Hydrology/FTP_site_5099-05/Maine_water_survey-manual_appendix.pdf
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

ENCV 606 001 / ENCV615001
Steel Structure 1
3 Credits

Learning Outcomes :

1. Students will be able to analyze the strength of a simple steel structure;
2. Be able to proportionate the simple steel structure building such as steel trestlework or pedestrians bridge with steel trusses structures according to the regulations and standards applied and present the designed structure with a design engineering drawing;
3. Be able to work together in a team.

Competencies in curriculum : Prior knowledge untuk WA2 (problem analysis), WA3 (design/development of solutions), WA9 (individual and team work) dan WA10 (communication)

Syllabus : Basic steel structural system; Types of steel structure; Mechanical properties; factors which influences the steel's quality, Stress strain steel curve, Steel material property; Proportion of structural member with LRFD against tensile strength, compressive force, bending strength, and shear force according to the standards; Steel structure element analysis and design: tension rod, compression rod, elastic buckling, inelastic buckling, two-way flexure, shear, lateral-torsion buckling; Design and analysis of steel structural joints; Bolt joints; HTB; Welded joints; Pedestrian bridge/trestle roof design

Prerequisites : Statics, Solid Mechanics, Material Properties

Text Books 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, Specification & Codes Volume 1
4. Manual of Steel Construction, Load Resistance Factor Design, Structural Members, Specification & Codes Volume 2
5. Structural Steel Design, Prentice Hall, 2012

ENCV 606 002 / ENCV615002
Foundation Engineering
3 Credits

Learning Outcomes :

1. Students will be able to explain the soil parameters needed for analysis and design process of deep foundation and deep retaining wall system;
2. Be able to explain the basic of deep foundation from analytical, design and construction aspect;
3. Be able to explain the basic of deep foundation load test;
4. Be able to explain the basic of deep retaining wall system from analytical, design and construction aspect.

Competencies in curriculum : Prior knowledge untuk WA2 (problem analysis), WA3 (design/development of solutions), dan WA10 (communication)

Syllabus : Introduction to types and system of deep foundation, methods to determine the axial bearing capacity of deep foundation; Methods to determine the lateral bearing capacity of deep foundation; Methods to determine vertical and lateral deformation of deep foundation; Pile test method and introduction to types and systems of deep soil retaining structures; Soil retaining system calculation methods, as well as understanding the soil parameters needed; Drawing a deep foundation design
Prerequisites : Soil Mechanics
Text Books References:
1. Bowles, J.E., "Foundation Analysis and Design", International 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. and Woodward J., "Pile Design and Construction Practice, 5th Ed.", Taylor & Francis, Oxon, UK., 2007
6. Reese L.C., Isenhower W.M. and 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 References:
1. ASCE, journals in geotechnics and geomechanics
2. Canadian Geotechnical Journal

ENCV 606 003 / ENCV616002
Pavement Design
3 Credits
Learning Outcomes :
1. Students will be able to create a pavement design by recognizing the type of pavement and pavement damage with the ways of handling it, road pavement structure with mixture of asphalt concrete and cement concrete with tests in laboratory;
2. Be able to use HDM (highway design manual) software as a tool in the designing process.

Competencies in curriculum : Prior knowledge for WA 1 (engineering knowledge), WA2 (problem analysis), WA3 (design/development of solutins) and WA5 (modern tool usage)
Syllabus : Introduction to the history and development of highway design technology; Highway construction Norm, Standards, Rules and Manual; Type of pavement construction, Function of each layer of pavement; Basic soil road stabilization, type of material and test method as well as its use; Road pavement material test and quality test method; Mix Design and Mix test plan, paired with test activity in the laboratories; Introduction to asphalt mixing plant (AMP) – Types of and operating procedures; Design criteria and several analytical and empirical design method; Flexible pavement thickness design using AASHTO methods and component analysis (Bina Marga), staged construction and recoating construction; Rigid pavement design, joints method; Highway maintenance strategy, Type of road damages and how to detect it, as well as on how to repair it.
Prerequisites : Material Properties
Text Books References :
1. Direktorat Jenderal Bina MArga, (2013), *Manual Desain Perkerasan Jalan no 02/M/BM/2013,* Kementerian Pekerjaan Umum.
2. Huang, Y., 2004. Pavement Analysis and Design 2nd ed., Prentice-Hall, Inc.
3. *Petunjuk Desain Drainase Permukaan Jalan* (1990) Direktorat Jendral Bina Marga

AASHTO, 2007. Maintenance Manual for Roadways and Bridges. 4th Ed., American Association of State and Highway Transportation Officials

ENCV 606 004 / ENCV616003
Water Engineering 2
3 Credits
Learning Outcomes :
1. Students will be able to evaluate the implication of changes in spatial hypothetic of Case-DTA, to the planned flood debit value and the dimension of a related water infrastructure, by using hydrology model of WinTR-20 (C5);
2. Be able to self-organize when work independently or in a group, so the students can demonstrate the ability to master the course in the form of systematic written documents and an effective and efficient oral presentation (A4);
3. Be able to operate ArcGIS geospatial model to prepare data for hydrology model WinTR-20 (P3).

Competencies in curriculum : Prior knowledge untuk 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)
Syllabus : Using hydrology model assisted with geospatial model to evaluate the impact of spatial changes on a water catchment area with area not exceeding 50 Km^2, and present the result in a form of a systematically written paper and effective oral presentation. The learning method consists of introductory lecture, individual/group exercises in and out of the class, as well as presentation and writing paper as a group final project. The final project consists of a task to use the ArcGIS geospatial model to prepare hydrological model input data for WinTR-20 that used to simulate the connection between rain and flow of water influenced by the changes of the spatial changes on a water catchment area. The Evaluation is focused on the impact of the changes on water catchment area towards the amount of planned flooding debit value which will impact the dimension of related water structure.
Prerequisites : Water Engineering 1
Text Books References:
1. John E. Gribbin, 2014, Introduction to Hydraulics and Hydrology with Applications for Storm Water 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. http://www.powershow.com/view1/10412d-ZDc1Z/Watershed_Delineation_powerpoint_ppt_presentation#5
9. Maine Stream Team Program of the Maine Department of Environmental Protection Stream, 2009. Survey Manual. A CITIZEN'S GUIDE to Basic Watershed, Habitat, and Geomorphology Surveys in Stream and River Watersheds — Volume I. http://www.geo.brown.edu/research/Hydrology/FTP_site_5099-05/Maine_water_survey-manual_appendix.pdf
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

ENCV 606 005 / ENCV616004
Construction Management
2 Credits
Learning Outcomes :
1. Students will be able to apply process and concept of construction management in analyzing the step of planning, executing and handover stage of a construction project;
2. Be able to apply process and concept of construction management in planning and executing project by considering cost, time and quality aspect of the project;
3. Be able to explain administration of contracts related to a construction project;
4. Be able to use MS Project software as a tool in project planning.

Competencies in curriculum : Prior knowledge untuk WA5 (modern tool usage), dan WA11 (project management & finance)
Syllabus : Construction project knowledge including: Project Planning; Bidding documents preparation; Contract administration; Construction planning; Construction execution methods; Monitoring and Controlling; Material Management; Quality Management; Project Cost Management; Time Management; Safety, Health and Environment; Resource and Stakeholder Management.
Prerequisites :
- Pass these following courses: Construction Drawing; Building Construction; Material Properties
- This course is taken in conjunction with Methods and Equipment Construction Course

Text Books 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

ENCV 606 006 / ENCV616005
Construction Methods and Equipment
2 Credits
Learning Outcomes :
1. Students will be able to calculate the capacity and cost of a heavy construction equipment, able to analyze the character, type and volume of the works;
2. Be able to calculate and plan an execution process of soil displacement using heavy construction equipment by considering the principal of construction management in calculating the cost aspect;
3. Be able to work together in a team.

Competencies in curriculum : Prior knowledge untuk WA3 (design/development of solutions), WA9, (individual and team work) dan WA11 (project management & finance)
Syllabus : Definition of mechanical earth moving, characteristic, type of soil and soil volume, operation of heavy equipment, capacity and production cost of heavy equipment, calculate work volume, determine the equipment needs, designing to combining equipment for optimization times and cost; Calculate production of heavy equipment, the way to work of each heavy equipment, the way to planning project. Several ways to calculate volume of cut and fill, construction method, calculation of the work schedule and related cost.
Prerequisites : Surveying and Basic Soil Mechanics
Text Books References :

1. Imam Sugoto. 1980. *Mempersiapkan Lapisan Dasar Konstruksi Jilid 1*. Jakarta: Departemen Pekerjaan Umum.
2. Imam Sugoto. 1980. *Mempersiapkan Lapisan Dasar Konstruksi Jilid 2*. Jakarta: Departemen Pekerjaan Umum

ENCV 607 001 / ENCV617001
Capstone Project
3 Credits
Learning Outcomes : The students will be able to produce civil engineering building design with detailed engineering design, simulated as a work ready to be executed using basic civil engineering combined with economic analysis and tender documents complete with shop drawing.
Competencies in curriculum : Prior Knowledge untuk WA2 (problem analysis), WA3 (design/development of solutions), WA5 (modern tool usage), WA6 (the engineer and society), WA7 (environment and sustainability), WA8 (ethics), WA9 (individual and team work) and WA10 (communication)
Syllabus : Identification of problems in accordance with the work terms of reference; Planning component negotiations associated with the scope of work and execution time; Formulation of the main and secondary civil engineering structural component as an analysis material; Arranging analysis report consist of design concept, calculating and execution methods, by applying rules, manuals and standards. ; Arranging civil engineering construction component specification according to the rules and technical specification, Calculation of unit price and bill of quantity, details of the overall cost of the job, and detail drawing for main components according to the standard and technical provisions.

Creating a Blue Print as a results of structure calculation in the form of a shop drawings that are ready to be executed by contractors.

Prerequisites : -
Text Books 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 (American Standard 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

ENCV 600 001 / ENCV610001
Internship
3 Credits
Learning Outcomes :
1. Students will be able to observe the application of theoretical civil engineering knowledge in an execution process of a construction project;
2. Be able to observe the application of professional ethics during the execution of a construction project;
3. Be able to apply a part of engineering economics principal and construction management in analyzing the execution of a construction projects;
4. Be able to identify problems that emerge during the execution of the construction project and solution decision process, able to analyze solution options according to the existing theory and able to criticize if there is an incompatibility as well as able to give solution that should be taken according to the existing theory;
5. Be able to read engineering drawing and see the similarities between the engineering drawing and the realization in the construction projects;
6. Be able to write field observation result in a form of an internship report and able to present it in front of the examiner team.

Competencies in curriculum : Prior Knowledge for WA6 (the engineer and society), WA7 (environment and sustainability), WA8 (ethics), WA9, (individual and team work), WA10 (communication) and WA11 (project management & finance)
Syllabus : Implement an internship in a construction project, field observation; interpret a construction drawing, writing an observation report, describing a technical work process, quality control, project management, project specification, engineering drawing and other aspect; problem solving on the fields, presenting an internship reports
Prerequisites :
1. Already pass 6th semesters and pass $\geq$ 75 credits according to the determined conditions applied by the Civil Engineering Department, Faculty of Engineering, Universitas Indonesia and/or the conditions from Faculty of Engineering, Universitas Indonesia
2. Registered and fill out IRS for internship special course, and expresses him/herself to the Internship Coordinator in the Department of Civil Engineering
3. Student choose a project and / or object of selected activities at the internship site and location that has been contracted previously
4. Students must complete and submit the registration form at the Secretariat of Civil Engineering Department

Text Books References : -

ENCV 600 002 / ENCV610002
Seminar
1 Credit
Learning Outcomes :
1. Students will be able to implement the civil engineering knowledge on formulating a problem in the field of civil engineering, conducting a literature studies and formulate a research hypothesis and methodology to solve the problem;
2. Be able to write a study proposal in a scientific writing using a proper Indonesian/English language and following the standard of seminar and undergraduate thesis format and present it to the examiner team;
3. Be able to work independently and complete the work within the time limit.

Competencies in curriculum : Prior knowledge untuk 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), WA10 (communication) dan WA12 (lifelong learning)
Syllabus : Developing problem description, Literature study, constructing research methodology, conducting an initial study, preparing and presenting a well-structured and well-written final report
Prerequisites : Passing 110 credits with GPA >=2.00 and without grade of E
Text Books References: -

ENCV 608 001 / ENCV615005
Ethics and Legal Aspect of Construction Contract
2 Credits
Learning Outcomes :
1. Students will be able to explain ethics and morality in civil engineering profession and able to apply the knowledge in analyzing the impact when ethics is not applied;
2. Be able to explain the legal aspect and contracts in a construction project.

Competencies in curriculum : Prior knowledge for WA6 (the engineer and society) dan WA8 (ethics)
Syllabus : Ethics and morals definition; Ethics theory; Work Ethics; Construction business ethics; Ethics towards environment; Law and regulation in construction works; Legal aspect of the dispute in construction works; Construction contracts
Prerequisites : Construction Management
Text Books References:
1. Mike W. Martin & Roland Schinzinger, Ethics in Engineering, McGraw 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

ENCV 608 002 / ENCV 618 001
Entrepreneurship
2 Credits
Learning Outcomes : The students will be able to explain the comparison among wide types of civil engineering entrepreneurship characterized by innovation and independency which based on ethics as well as able to communicate it both visually and orally.
Competencies in curriculum : Prior knowledge for UI-E (entrepreneurship), WA6 (the engineer and society), WA9, (individual and team work), and WA10 (communication)
Syllabus : Problems and needs from the various stakeholders in the field of civil engineering, General options for entrepreneurship to solve civil engineering problems, Entrepreneurship definition, Businessman Action, Plan and Challenges; Action, Academics and observer challenge and plan, Canvas model Business Concept, General Company Profile, General customer profile, Cost and Turnover, Differences and similarities identification between BMC components, Advantages and disadvantages assessment from each of the BMC components, Various environmental engineering product and services, Definition of product value, Human Needs, Customer segments, Various customer profiles, Knowing the customer profile method, Knowing the customer profile, Differences and similarities identification between VPC components, Advantages and disadvantages assessment from each of the VPC components
Prerequisites : MPKT A, Introduction to Civil Engineering System
Text Books References: -
1. Eawag Sandec, Water and Sanitation in Developing Countries, Compendium of Sanitation Systems and Technologies 2nd Edition 2014
2. WSP, Introductory Guide to Sanitation Marketing, 2011
3. Devine, Jacquelinge; Kullmann, Craig. 2011. Introductory guide to sanitation marketing. Water and sanitation program : toolkit. Washington, DC: World Bank.
4. Osterwarlder, Business Model Generation, 2010
5. Osterwarlder, Value Proposition Design: How to Create Products and Services Customers Want, 2014
6. Mattimore, Idea Stormers: How to Lead and Inspire Creative Breakthroughs, 2012

ENCV 600 003 / ENCV610003
Final Project
4 Credits
Learning Outcomes:
1. Students will be able to apply civil engineering knowledge to solve a complex civil engineering problem through a study that follows the research rules such as: Conducting a literature study, choosing the research methodology, analyze and interpret the data and draw a valid conclusion;
2. Be able to write the result of the research in a scientific writing using the correct Indonesian/English language and following the standard final project format;
3. Be able to present the study result to the examiner team;
4. Be able to work independently and complete the work within the time limit.

Competencies 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) and WA10 (communication), WA12 (lifelong learning)

Syllabus : Problem formulation, Literature study, conducting research, data analysis, result interpretation, preparing a written report of the synthesis and present the study results
Prerequisites : Passing 110 credits with GPA >=2.00 and without grade of E
Text Books References: -

Elective Courses Syllabi

ENCV 607 002
Civil Engineering System
3 Credits
Learning Outcomes:
1. Students will be able to create basic design and proposal for alternative plans or solutions to the problems of civil engineering based on formulation of problems encountered with literature review and field surveys;
2. Students will be able to find the optimal solution for a simple problem in Civil Engineering with a systematic approach through the stages of problem solving techniques (engineering). (C4) /(A3).

Competencies in Curriculum: Prior knowledge for WA2 (problem analysis), WA9 (individual and team work) and WA10 (communication)
Syllabus: The role and function of professional undergraduate Civil Engineering, Process for solving engineering problem, System approach, Systems characteristic in engineering problem, Understanding the characteristics of the problem, Statement of Needs, System hierarchy, Scope and limitation, Systems Analysis, Solutions approach, The role of modeling, Type of modelling, Linear Graph modeling concept, Mathematical modeling concept, Process optimization, Motivation and freedom to choose, Purpose, Objectives and Criteria for optimization, Optimization Methods, Feasibility studies, Planning horizon. Time Value of Money, method of Economic Analysis, Financial Analysis, Element of decision problems, Decision models, Basic Probability, Decision Analysis by Value Utilities.
Prerequisites: 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.

ENCV 617 003
Sustainable Build Environment
3 Credits
Learning Outcomes: Students will be able to apply the basic principles of natural and manmade environmental system and the meaning of sustainable development in engineering activities to be able to design civil engineering buildings with the concept of green building and environmental friendly.
Competencies in Curriculum: Prior knowledge for WA2 (problem analysis) and WA7 (environment and sustainability)
Syllabus: Basic Principles of natural environmental systems and life cycle (cycle of matter and energy, hydrological cycle, food chain); Basic Principles of manmade environment and the impact on the natural environment system and life cycle (social system, ecosystem, build environment; niche concept, carrying capacity and resilience); Construction and infrastructure sector impact on the natural environment; 21 Agenda and Environmental Based Construction (Global agenda / national / local, social-economic, and the environment pillar in construction); The concept of Civil Engineering environment (zero waste, efficiency, waste management hierarchy, waste-pollution and carrying capacity of the environment, sustainable consumption and production); The concept of Green Building (LEED); Criteria for Green Building; Sustainable sites (EIA); Water efficiency; Energy and atmosphere; Materials and natural resources; Innovation and design process; Strategy Conception for Green Building; Examples of Green Building concept in Indonesia and other States; Laws and other regulations in Environmental Affairs, ISO 14001.
Prerequisites: -
Text Book References: -
1. Sarté, S. (2010). *Sustainable Infrastructure* . New Jersey

FACULTY OF ENGINEERING

ENEV605004
Integrated Solid Waste Management Design
3 credits
Learning Outcomes: students are able to plan a solid waste management system in engineering aspects
Competencies in Curriculum : Prior knowledge for WA2 (problem analysis), WA3 (design/development of solutions) and WA7 (environment and sustainability)
Syllabus: Students are expected to explain the properties and problems arising from the solid waste material and developing and selecting alternative management in accordance with local conditions. Understanding of the management of solid waste material, Source, type and composition of the waste material solid, Generation waste material solid, collection, transfer and transport of solid waste materials and disposal, and the processing of solid waste material, aspects of the organization in the management of solid waste material, aspects of financing, aspects of regulation and aspects of community participation management of solid waste and materials. The concept of designing the management of solid waste material. The management system of solid waste material, Regulation of solid waste material management, solid waste material management methods
Prerequisites:
Buku Referensi :
1. Tchobanoglouss, 1993, *Integrated Solid Waste Management*.
2. Tchobanoglous, 1977, Engineering Principles and Management Issues.;
3. Wentz, 1989, *Hazardous Waste Management*
4. Flintoff FF., 1983, *Management of Solid Wastes in Developing Countries*

ENCV 618 002
Steel Structure 2
3 Credits
Learning Outcomes:
1. Students will be able to calculate the connection strength in steel structure and proportioning the connection using plastic and elastic method;
2. Be able to calculate and proportioning girder plate structure, portals and composite structure in a simple multi-stories building using elastic and plastic method.

Competencies in Curriculum: Prior knowledge for WA2 (problem analysis) and WA3 (design/development of solutions)
Syllabus: Calculation of continuous beam by plastic method; Beam-columns; Theory and Analysis of girder plate on building; Advance connection techniques; The design of the portal and gable frame; Structural Analysis; Steel-steel and steel-concrete composite structures in simple multi-stories buildings; Concrete pre-stressed steel composite structure and implementation of Perplex systems in buildings; Cold form section / Light Gage Member.
Prerequisites: Steel Structure 1
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, Specification & Codes Volume 1
4. Manual of Steel Construction, Load Resistance Factor Design, Structural Members, Specification & Codes Volume 2
5. Structural Steel Design, Prentice Hall, 2012

ENCV 617 005
River Engineering
3 Credits
Learning Outcomes: Students will be able to predict and describe (C5) systematically both in oral and in writing, the influence of interactions among various factors of hydrological, hydraulic and river morphology to the behavior of river and if there are problems may propose solutions (A5) with taking into account the technical and environmental aspects.
Competencies in Curriculum: Prior knowledge for WA2 (problem analysis)
Syllabus: Knowledge on how the flow of the river is formed from the river hydrology point of view, River hydraulics and morphology of the river, as well as what problems are caused by changes in river flow due to the nature of the flow and sediment transport, so as too able to predict, analyze and criticize the influence of the local system flow in relation to construction of buildings along the river and river controlling structure.

Prerequisites: Water Engineering 1
Text Book References:
1. Jansen, P.Ph. · Van Bendegom, L. · Van den Berg, J. · De Vries, M. · Zanen, A., 1994, Principles of river engineering: the non-tidal alluvial river, Delftse Uitgevers Maatschappij, Netherland
2. Prins A., 1979. Rivers. Lecture Notes (Unpublished). International Institute for Hydraulics Engineering, Delft, The Netherland
3. Chow, Ven. Te et.al., 1988: Applied Hydrology. McGraw-Hill Book Company
4. Chow, Ven. Te et.al., 1959. Open-Channel Hydraulics. McGraw-Hill Kogakusha.
5. Henderson, F.M., 1966: Open Channel Flow. MacMillan, New York
6. French R.H., 1985: Open-Channel Hydraulics. McGraw-Hill Book Company
7. Bedient P. B. and Huber W.C., 1992: Hydrology and Floodplain Analysis. 2nd ed. Ch.3-5. Addison-Wesley Publishing Company, USA
8. Doelhomid Srimoerni W.S., 1977: Sungai. Diktat Kuliah (tidak dipublikasikan). IMS FTUI, Jakarta
9. R. J. Garde, 2006, River Morphology, New Age International (P) Limited, Publisher

ENEV605001
Urban System and Utility
3 Credits
Learning Outcomes:
1. Students will be able to explain the role of civil engineer in setting up the infrastructure needed in an urban area and be able to apply that knowledge in the process of planning, monitoring and implementation of the regional arrangement;
2. Be able to describe the components of an urban sanitation techniques and applying that knowledge in the planning, monitoring and implementation so as to create environmentally sustainable region.

Competencies in Curriculum: Prior knowledge for WA2 (problem analysis) and WA7 (environment and sustainability)
Syllabus: Definition and function of urban planning, Primary factor in urban planning, Population aspect in urban planning, Social facilities and forms of urban development, Land use, Water management and its relationship with land use. Controlling transmission of infectious and non-infectious diseases in an area, Planning and analyzing impacts of environmental engineering, Clean water supply, Waste water treatment and disposal, Solid waste management, Noise control, Air pollution control.
Prerequisites: -
Text Book References:
1. Hamid Shirvani, Urban Design Process, New York, 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. Environmental Engineering and Sanitation: Joseph A Salvato: John Willey & Son, Inc., Canada
5. Environmental Science and Engineering, J. Glynn Henry and Gary W. Heinke, Prentice Hall International Inc.

ENCV 617 004
Concrete Structure 2
3 Credits
Learning Outcomes:
1. Students will be able to design structural component: columns, portals, with the ultimate strength method due to force from latitude bending moment, normal moment, torque and its combination in accordance to the aspect of service life according to SNI 2847: 2013; able to design a two-way slab without beams, short consoles, as well as understand the application of strut and tie models;
2. Students will be expected to plan a simple pre-stressed concrete structures, according to SNI 2847: 2013.

Competencies in Curriculum:Prior knowledge for WA2 (problem analysis), WA3 (design/development of solutions) and WA10 (communication)
Syllabus: Analysis of shear and torsion; Meaning of bond stress, Termination/cutting of reinforcement steel and length of reinforcement distribution; Serviceability: Analysis of deflection on reinforced concrete structures; Analysis of crack width; Analysis of reinforcement in reinforced concrete slender columns; Biaxial bending; Analysis of P-δ effect; Analysis of shear reinforcement in columns; Plan-

ning of continuous foundation and deep foundations in reinforced concrete; Floor system analysis: two-way slab with and without beam, direct design and the equivalent frame; Understanding the basis for planning and application of reinforced concrete portals; Examination of the relationship between the beams and columns; Corbel and placement; Analysis of Strut and Tie modeling; The basic concept of pre-stressed concrete structures, All kinds of pre-stressed concrete structures, Stage for pre-stress force, Material characteristics, Pre-stressed and anchorage system, Loss of pre-stressed force; Cross-section analysis with elastic method and strength limits for monoliths and composites cross section; Planning of pre-stressed cable cross section due to bending; Analysis of shear stress, Deflection analysis on pre-stressed concrete structures.
Prerequisites: Concrete Structure 1
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. Nawi, E.G. Reinforced Concrete: A Fundamental Approach, 6th. edition, Pearson, 2009
5. Wang C.K. and Salmon C.G., Reinforced Concrete Design, Harper Collins, 1992
6. Lin, T.Y & Burns, N.H., Design of Pre-Stressed Concrete Structures, Third Edition, John Wiley & Sons, 1981

ENCV 618 003
Construction Methods in Geotechnics
3 Credits
Learning Outcomes: Students will be able to design construction method of a geotechnical construction component with considering the economic, environmental, social, ethical, health, safety, constructability, and sustainability factor.
Competencies in Curriculum: Prior knowledge for WA2 (problem analysis), WA3 (design/development of solutions), WA7 (environment and sustainability)
Syllabus: Construction method of deep foundation and retaining wall, and factors that influence the method of selection, Method of testing the integrity of deep foundations; Method of basement construction, Excavation strengthening, dewatering, and factors that influence the selection of method; Construction method of embankment on soft ground, PVD, Preloading, Vacuum preloading, and the factors that influence the selection of method; Geo-synthetic usage in geotechnical construction.
Prerequisites: Basic Soil Mechanics, Soil Mechanics, Foundation Engineering
Text Book References:

1. Chai, J. and Carter, J.P. (2011). Deformation Analysis in Soft Ground Improvement, Springer.
2. Hertlein, B.H. and Davis, A.G. (2006). Nondestructive Testing of Deep Foundations, John Wiley.
3. Koerner, R.M. (2005). Designing with Geosynthetics, 5th Ed., Prentice Hall.
4. Ou, C.-Y. (2006). Deep Excavation: Theory and Practice, Taylor and Francis, London.
5. Tomlinson, M. J. and Woodward, J. (2008). Pile Design and Construction Practice, 5th ed., Taylor and Francis.

ENCV 618 004
Stormwater Management
3 Credits
Learning Outcomes:

1. Students will be able to assess the effectiveness of the management of rain in an existing Region Case (RC) which is a developed region in urban areas, based on the comparison of the evaluation results from the performance of existing drainage systems in existing RC, and performance evaluation of the proposed rain management model by using Low Impact Development (LID) and Water Balance Model (WBM), using a hydrological model WinTR-55 aided with of ArcGIS geospatial model (C5);
2. Be able to organize every individual to work independently and in groups, so as to demonstrate the mastery of the course competencies in the form of a systematic written document and effective and efficient oral presentations (A4).

Competencies in Curriculum: Prior knowledge for WA2 (problem analysis) and WA3 (design/development of solutions)

Syllabus: Utilizing a deterministic hydrology model aided with geospatial model to evaluate the performance of drainage systems that exist in a developed region in urban areas, and making proposals to the management system of rain by using Low Impact Development (LID) models and Water Balance Model (WBM), as well as evaluating the performance of the proposed design by utilizing the same hydrological and geospatial models. The result is presented in a systematic written document and an effective and efficient oral presentations. Learning method consists of introductory lectures, group discussions inside and outside the classroom, written/oral exam, oral presentation and final papers.
Prerequisites: Water Engineering 1
Text Book References:

1. Bedient, Philip B. and Huber, Wayne C., 1992. Hydrology and Floodplain Analysis. Second Edition. Addison-Wesley 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. The Douglas College Institute of Urban Ecology, British Columbia. The Water Balance Model: A Tool for Designing with Nature. Douglas College Rain Conference. www.waterbalance.ca
6. Kim A. Stephens, Patrick Graham and David Reid, 2002. Storm water Planning: A Guidebook for British Columbia. Ministry of Water, Land and Air Protection. British Columbia, Canada.
7. Low Impact Development (LID) Urban Design Tools. http://www.lid-stormwater.net/
8. NRCS and ARS, 2003. WinTR-55: User Guide.
9. NRCS and ARS. WinTR-55: Tutorial.
10. Panduan Pelatihan ArcGIS.

ENEV606004
Environmental Impact Analysis and ISO
3 Credits
Learning Outcomes: Students will be able to apply the method of EIA and environmental audits as inputs for safeguards against human and natural resources.
Competencies in Curriculum: Prior knowledge for WA2 (problem analysis) and WA7 (environment and sustainability)
Syllabus: The meaning of EIA, EIA process and benefits, rules, regulations and management of EIA, Environmental settings, Estimation of environmental impacts, Environmental impact to the physical, chemical, biological, socio-economic, and socio-cultural sector. EIA method, Method and techniques of identification, prediction, evaluation and interpretation of the EIA, Environmental Monitoring Plan, Environmental Management Plan, Environmental Audit and Environmental Management System.
Prerequisites: -
Text Book References:

1. Canter, L.W., Environmental Impact Assessment, New York, McGraw-Hill, 1996.
2. Kuhre W. Lee., *Sistem Manajemen Lingkungan*, Jakarta, Prenhallindo, 1996.
3. "ISO 14000 *Sistem Manajemen Lingkungan*" by Brian Rotherry (1996)
4. Soemarwoto, Otto, *Analisis Mengenai Dampak Lingkungan*, Yogyakarta, Gadjah Mada University Press, 2007

Information:
The whole of the Teaching Plan can be found on the Department of Civil Engineering website http://www.civil.ui.ac.id/en_US/teknik-sipil/

4.2. UNDERGRADUATE PROGRAM IN ENVIRONMENTAL ENGINEERING

Program Specification

1.	**Awarding Institution**	Universitas Indonesia	
2.	**Teaching Institution**	Universitas Indonesia	
3.	**Programme Tittle**	Undergraduate Program in Civil Engineering	
4.	**Class**	Regular and Parallel	
5.	**Final Award**	Sarjana Teknik (S.T)	
6.	**Accreditation / Recognition**	BAN-PT: A - Accredited	
7.	**Language(s) of Instruction**	Bahasa Indonesia and English	
8.	**Study Scheme (Full Time / Part Time)**	Full Time	
9.	**Entry Requirements**	High school /equivalent, or D3 / Polytechnique / 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	17
	Short (optional)	3	8
11.	**Graduate Profiles:** "A Bachelor Engineer who is able to design and built green environmental engineering infrastructures with professional ethics"		

UNDERGRADUATE PROGRAM

ENVIRONMENTAL ENGINEERING

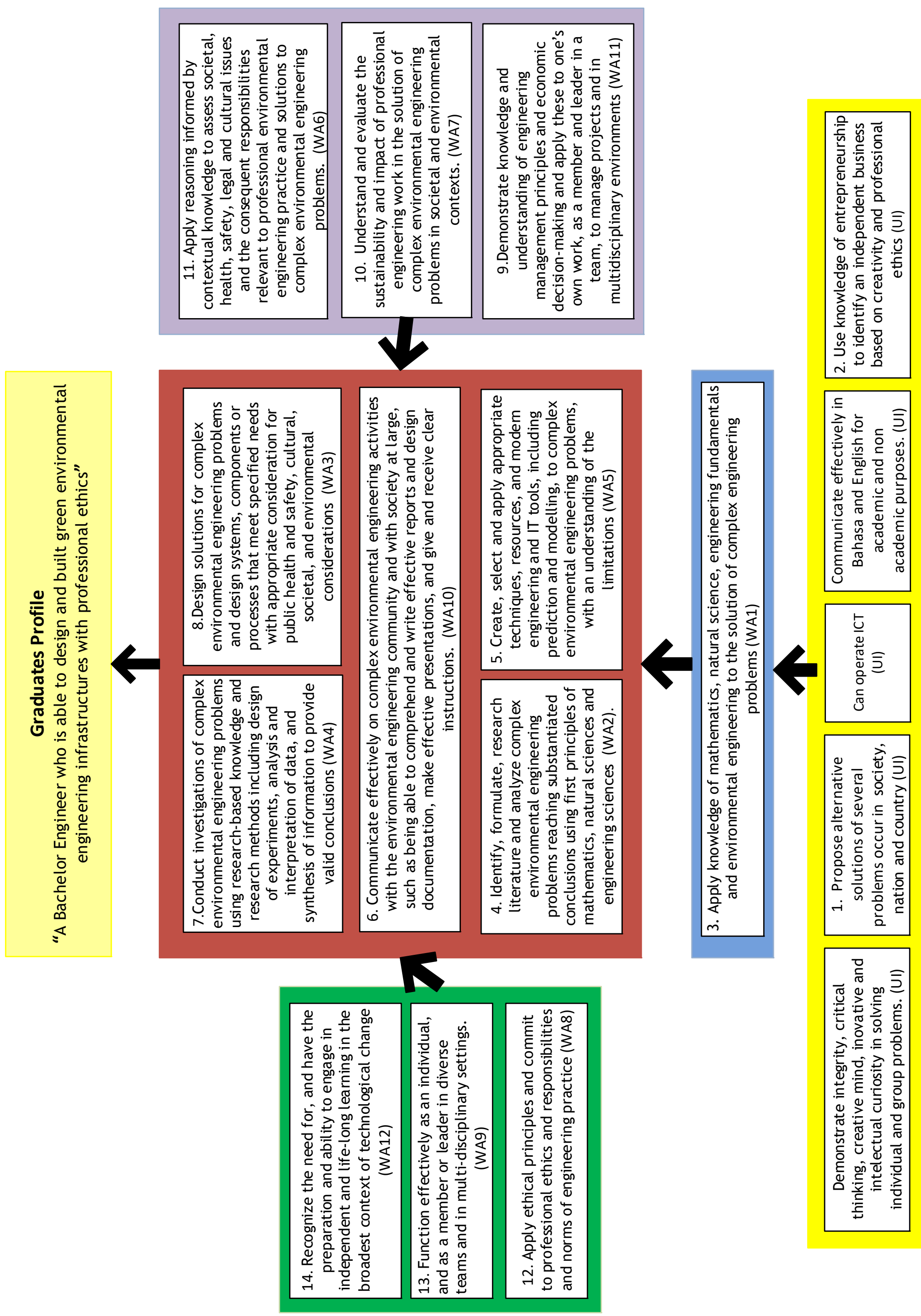
12. Expected Learning Outcomes:

1. Apply knowledge of mathematics, natural science, engineering fundamentals and environmental engineering to the solution of complex engineering problems (C3-WA1/Engineering Knowledge)
2. Identify, formulate, research literature and analyze 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/Investigations)
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 environmental 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 multidisciplinary settings (P3-WA9/Individual and Team Work)
10. Communicate effectively on complex environmental 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 & 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. Propose alternative solutions of several problems occur in society, nation and country (C3, UI-B)
14. Use knowledge of entrepreneurship to identify an independent business based on creativity and professional ethics (C3, UI-E)

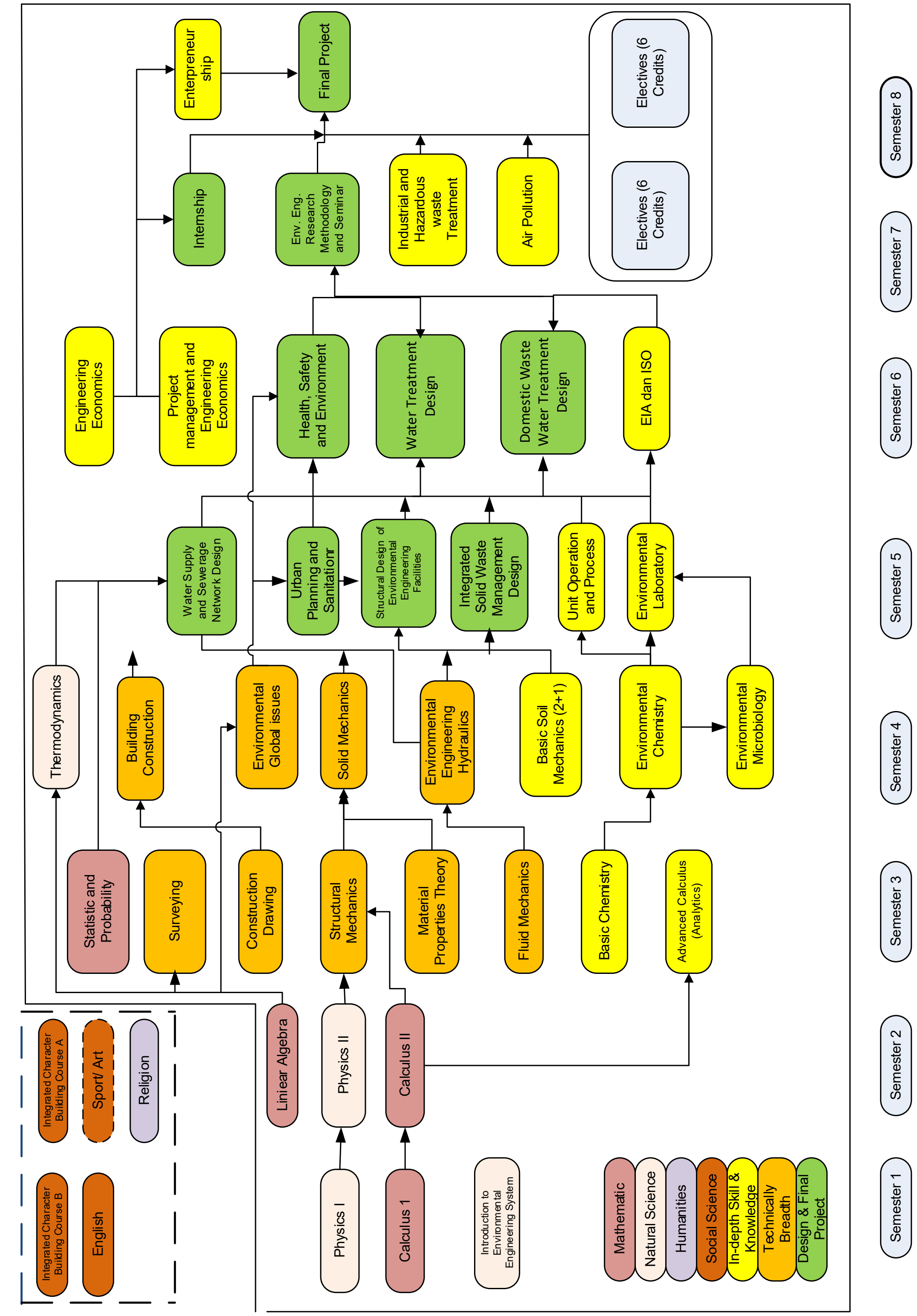
13 Classification of Subjects

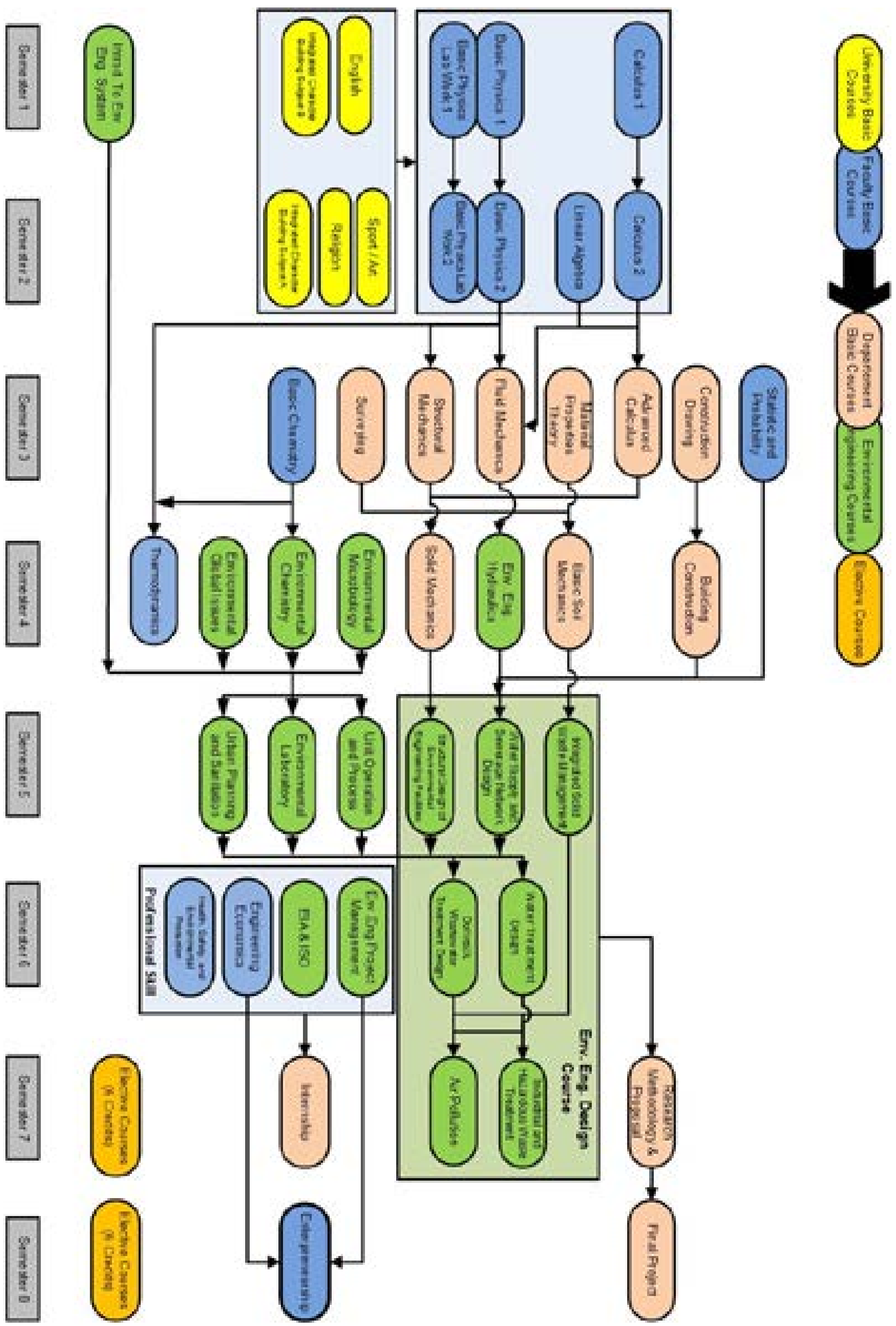
No.	Classification	Credit Hours (SKS)	Percentage
i	**University General Subjects**	18	13 %
ii	**Basic Engineering Subjects**	27	19 %
iii	**Core Subjects**	79	55 %
iv	**Elective Subjects**	12	8 %
v	**Internship, Seminar, Undergraduate Thesis, Project**	8	6 %
	Total	144	100 %
14.	**Total Credit Hours to Graduate**		144 SKS

Learning Outcomes Flow Diagram



Flow Diagram of Subjects





COURSE STRUCTURE UNDERGRADUATE PROGRAM ENVIRONMENTAL ENGINEERING

Code	Subject	Credit
	1st Semester	
UIGE600002	Integrated Character Building Course B	6
UIGE600003	English	3
ENGE600001	Calculus 1	3
ENGE600005	Physics (Mechanics and Thermal)	3
ENGE600006	Physics (Mechanics and Thermal) Laboratory	1
ENEV601001	Intro to Environmental Engineering	3
	Sub Total	19
	2nd Semester	
UIGE600001	Integrated Character Building Course A	6
UIGE600020 - 48	Sport/Art	1
UIGE600010-15	Religion	2
ENGE600002	Calculus 2	3
ENGE600004	Linear Algebra	4
ENGE600007	Physics (Electricity, MWO)	3
ENGE600008	Physics (Electricity, MWO) Laboratory	1
	Sub Total	20
	3rd Semester	
ENGE600009	Basic Chemistry	2
ENGE600010	Statistic and Probability	2
ENCV 603 001	Advanced Calculus	3
ENCV 603 003	Construction Drawing	2
ENCV 603 004	Surveying	3
ENEV 603 001	Material Properties	2
ENEV 603 002	Structural Mechanics	3
ENEV 603 003	Fluid Mechanics	3
	Sub Total	20
	4th Semester	
ENCV 604 003	Building Construction	3
ENCV 604 005	Basic Soil Mechanics	3
ENEV 604 001	Solid Mechanics	3
ENEV 604 002	Environmental Engineering Hydraulics	3
ENEV 604 003	Environmental Chemistry	3
ENEV 604 004	Environmental Global issues	2
ENEV 604 005	Environmental Microbiology	2
ENEV 604 006	Thermodynamics	2
	Sub Total	21

UNDERGRADUATE PROGRAM

	5th Semester	
ENEV 605 001	Urban Planning and Sanitation	3
ENEV 605 002	Structural Design of Environmental Engineering Facilities	3
ENEV 605 003	Water Supply and Sewerage Network Design	3
ENEV 605 004	Integrated Solid Waste Management Design	3
ENEV 605 005	Unit Operation and Process	4
ENEV 605 006	Environmental Laboratory	3
	Sub Total	**19**
	6th Semester	
ENGE600011	Engineering Economics	3
ENGE600012	Health, Safety and Environmental Protection	2
ENEV 606 001	Project Management	3
ENEV 606 002	Water Treatment Design	3
ENEV 606 003	Domestic Waste Water Treatment Design	3
ENEV 606 004	EIA dan ISO	3
	Sub Total	**17**
	7th Semester	
ENEV 607 001	Industrial & Hazardous Waste Treatment	3
ENEV 607 002	Air Pollution	3
ENEV 600 001	Internship	3
ENEV 600 002	Research Methodology & Proposal	2
	Electives Course	6
	Students choose 12 credits of elective courses offered by : (1) undergraduate/postgraduate program of Civil Engineering or (2) other study program in Universitas Indonesia	
	Sub Total	**17**
	8th Semester	
ENEV 608 001	Enterpreneurship	2
ENEV 600 003	Final Project	4
	Elective Course	6
	Students choose 12 credits of elective courses offered by : (1) undergraduate/postgraduate program of Civil Engineering or (2) other study program in Universitas Indonesia	
	Sub Total	**12**
	Total	**144**

Resume

Wajib Universitas	18
Wajib Fakultas	27
Wajib Program Studi	87
Jumlah	132
Pilihan	12
Total Beban Studi	144

Electives

Code	7th Semester	Credit
ENCV 801 501	Environmental Risk Management	3
ENCV 801 502	Technology of Solid Waste Treatment: Operational & Design	3
ENCV 803 501	Urban Water Quality Management	3
ENCV 803 502	Environmental Audit	3
ENCV 803 503	Advanced Environmental Chemistry	3
	8th Semester	
ENCV 802 501	Contaminating & Soil Remediation	3
ENCV 802 502	Advanced Waste Water Engineering	3
ENCV 802 503	Waste to Energy	3
ENCV 802 504	Emission Control	3
ENCV 802 505	Technology of Resources Efficiency - Life Cycle Analysis (LCA)	3
ENCV 802 506	Pollution Prevention	3
ENCV 802 507	Environmental System Dynamics	3

ENVIRONMENTAL ENGINEERING

SYLLABUS OF UNIVERSITY SUBJECTS

INTEGRATED CHARACTER BUILDING A
UIGE600001/UIGE610001
6 sks
Syllabus : Integrated Character Building A facilitates students to understand the basics of character formation and master the basics of cognitive power that is logic. Furthermore, to apply cognitive powers in generating good behaviors which are useful to themselves and society. The establishment of ethical behaviors based on ethics is also facilitated. Students are able to develop the basic strength of character and to know themselves as a human being, both as individuals and as part of a group so that they can develop themselves well enough. In a group, the students need to have skills that are needed to maintain an effective relationship in order to improve the quality of human life. Particularly as a citizen of Indonesia, students need to understand the nature of citizenship and basic philosophy of Pancasila in order to act and behave in accordance with the character of the Indonesian nation.
Core Competencies :
1. Students are able to analyze problems in depth individually, comprehensively, logicaly and critically, and generate solutions using the logical and ethical principles and rules of logic and ethics
2. Students are capable of analyzing the problem individually, thoroughly and deeply about the human being as an individual or as part of group
3. Students are individually able to understand, make critical reasoning and to build an open and critical mind to the problem of nationhood, statehood and citizenship in this dynamic world situation
4. Students are able to create and display a work that depicts the character in accordance with the principles of Pancasila

Learning Method : interactive lecture, Experiential Learning, Collaborative Learning, Problem Based Learning, Project-Based Assignment
Prerequisites : OBM (New Student Orientation)

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))

INTEGRATED CHARACTER BUILDING B
UIGE600002/UIGE610004
6 sks
Syllabus : Integrated Character Building B facilitates students to practice identifying, analyzing, and resolving problems of nature and the environment by making use of integrative and quantitative information. This lecture aims to prepare the future generation who care about nature issues through the balanced development of hard skills and soft skills and have the skills of ICT (Information and Communication Technology).
Core Competencies:
1. Students have an ethic, moral, personality and good character in completing the task at hand;
2. Students role as citizens who take pride and love of the homeland and support the continuity of life;
3. Students are able to work together and have a high sensitivity and awareness to the community and the environment;
4. Students are able to think logically, critically and creatively;
5. Students are able to use mathematics to solve problems quantitatively;
6. Students are able to use information and communication technology (ICT) for development;
7. Students are able to analyze the system of nature integratively and comprehensively;
8. Students are able to act as wise managers of nature to build and maintain the preservation of nature for a better and sustainable life.

Learning Method : Blended e-Learning, Collaborative Learning (CL), Problem Based Learning (PBL) and Group Discussion (GD)
Prerequisites : OBM (New Student Orientation)
Textbook : Digital Form can be downloaded from Scele

ISLAMIC STUDY
UIGE600010/UIGE610005
2 sks
General instructional objectives : The cultivation of students who have concern for social, national 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 practice 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 STUDY
UIGE600011/UIGE610006
2 sks
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 STUDY
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 STUDY
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 STUDY
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 STUDY
UIGE600015
2 sks

ART
UIGE600020-30
1 sks
The option of subjects that can be choosen :
Appreciation of Film (UIGE600020), Batik (UIGE600021), Photography (UIGE600022), Calligraphy (UIGE600023), Javanese Karawitan (UIGE600024), Balinese Dance and Karawitan (UIGE600025), Comic (UIGE600026), Painting (UIGE600027), Music and Vocal (UIGE600028), Theater (UIGE600029), Wayang (UIGE600030)

SPORT
UIGE600040-48
1 sks
The option of subjects that can be choosen :
Basketball (UIGE600040), Volley Ball (UIGE600041), Badminton (UIGE600042), Futsal (UIGE600043), Hockey (UIGE600044), Football (UIGE600045), Softball (UIGE600046), Tennis (UIGE600047), Table Tennis (UIGE600048)

SYLLABUS OF BASIC ENGINEERING SUBJECTS

CALCULUS 1
ENGE600001/ENGE610001
3 sks
Syllabus : This subject gives the opportunity for students to understand the basic concept of calculus and to be able to solve applied calculus problems. Students are also given the opportunity to understand basic concepts the functions of one variable, derivatives and integral functions of one variable, and its application.

CALCULUS 2
ENGE600002/ENGE610002
3 sks
Syllabus : This subject gives the opportunity for students to understand the basic concept of calculus and to be able to solve applied calculus problems. Students are also given the opportunity to understand the basic concept the function of two variables, or variables, total derivative and integral of the function of two or more variables and application. In addition, students can understand the basic concepts of sequence and series.

CALCULUS
ENGE600003/ENGE610003
4 sks
Syllabus : This subject gives the opportunity for students to understand the basic concept of calculus and to be able to solve applied calculus problems. Students are also given the opportunity to understand the basic concept the function of two variables, the total derivative of the function of two or more variables and its application. Students are also expected to understand the basic concept of sequence and series and the basic concept of vector and analytical geometry.

LINEAR ALGEBRA
ENGE600004/ENGE610004
4 sks
Syllabus : This subject gives the opportunity for students to master the basic techniques of Linear Algebra and gain knowledge on how to implement said techniques in solving System of linear equationss, determining the bases and dimension of vector space, as well as calculating eigen values and eigen vectors. This subject also gives students the opportunity to work with other objects, especially vectors and matrices.

PHYSICS (MECHANICS AND THERMAL)
ENGE600005/ENGE610005
3 sks
Syllabus : Physics (Mechanics and Thermal) subject includes the topics of mechanics and thermodynamics. Calculus is use as a mathematic helping tool in the learning process. Students are given the opportunity to learn how to unite their understanding of the basic concept of the analytical capability, their numeracy in learning mechanics and thermodynamics. During the course of this subject, students are not only aim to increase the students' knowledge of the basic physics concepts but also to increase their capability in using information technology and computer and to train their skills, such as: independent and group work and their communication skill.
Students will also be train on how to explain and analyse the nature phenomenon and the result of human engineering exist in their everyday lives by using the basic physics concept and applied them in their daily lives. Students are also taught to develop their synthesis ability and evaluating both quantitative and qualitative natural phenomenon and the result of human engineering in their surrounding environment by using basic physics concept. This subject will give students the opportunity to develop their ability to develop their presentation ability analyse the nature phenomenon and the result of human engineering from the mathematics and natural science point of view integrative and comprehensively.

PHYSICS (MECHANICS AND THERMAL) LABORATORY
ENGE600006/ENGE610006
1 sks
Syllabus : Practical of Mechanics: Measurement, Moment of inertia, Gravity acceleration, Fluid density, Scratch coefficient, Collision, Swing torque, Viscosity of water, Young's modulus, Viscosity of Newtonian fluid, Fluids surface tension, Oscillation, Practical of Heat: Coefficient of linear expansion, Heat conductivity, Thermocouple calibration, Calorimeter, Joule Constant, Laplace Constant, Heat Collector, Determining of air Cp/Cv, Expansion of fluids and water anomaly.
Notes: For Architecture and Interior Architecture Program, practical is not mandatory.

PHYSICS (ELECTRICITY, MWO)
ENGE600007/ENGE610007
3 sks
Syllabus : Physics (Electricity, MWO) subject includes the topics of electricity, magnet, wave, and optics. Calculus is use as a mathematic helping tool in the learning process. Students are given the opportunity to learn how to unite their understanding of the basic concept of the analytical capability, their numeracy in learning mechanics and thermodynamics. During the course of this subject, students are not only aim to increase the students' knowledge of the basic physics concepts but also to increase their capability in using information technology and computer and to train their soft skills, such as: independent and group work and their communication skill. Students will also be train on how to explain and analyze the nature phenomenon and the result of human engineering exist in their everyday lives by using the basic physics concept and applied them in their daily lives. Students are also taught to develop their synthesis ability and evaluating both quantitative and qualitative natural phenomenon and the result of human engineering in their surrounding environment by using basic physics concept.

PHYSICS (ELECTRICITY, MWO) LABORATORY
ENGE600008/ENGE610008
1 sks
Syllabus : Practical of Electricity: Electrolysis, Wheatstone bridge, Kirchhoff law, Earth's magnetic field, Temperature coefficient, Characteristic of series RLC circuit, Ohm law, Transformer. Practical of Optics: Polarimeter, Lens, Photometry, Prisms bias index, Spectrometer, Diffraction grid, Newton's ring.

BASIC CHEMISTRY
ENGE600009/ENGE610009
2 sks
Syllabus : As an engineer, you must have understanding on the chemistry that provides not only the basis for much of what goes on in our world but also that it is a vital, continually developing science. In this study the students will learn many subjects such as matter and measurement; atoms, molecules, and ions; stoichiometry; aqueous reactions; thermochemistry; properties of solutions; chemical kinetics; chemical equilibrium; and electrochemistry.
Learning activities will be conducted through various method, which consists of: problem based learning (PBL), interactive lecture, question-based learning, discussion, demonstration and unguided structured assignments. Assessment will be made continuously through a set of exercises, group discussion, mid semester exam and final exam.

STATISTIC AND PROBABILITY
ENGE600010/ENGE610010
2 sks
Syllabus : Statistics and probability has been known as applied mathematics which is widely used in collecting, organizing, presenting, interpreting and analyzing data to support valid conclusions. Furthermore, these conclusions will be used as recommendation in decision making. The course of Statistics and Probability is intended to give a basic ability for students to handle quantitative data and information. There are two stages that are delivered which is descriptive and inductive/inference stages. Descriptive stage includes collecting, organizing, and presenting the data in a scientific manner. Then, inductive/inference stage includes the process of estimating and drawing conclusion based on available data and relations between variables. Hence, students are expected to apply their knowledge of statistics in conducting experiments in laboratory works/assignments as well as research studies in their final projects.

ENGINEERING ECONOMICS
ENGE600011/ENGE610011
3 sks
Syllabus : This course introduces students to the basic of engineering economy. It covers the time value of money (TVOM) and interest rate; tools for evaluating project alternatives for both non discounted and discounted methods, for instance present worth analysis, annual worth analysis, future worth analysis, rate of return (ROR) analysis and benefit/cost analysis; and choosing the best alternative, break even analysis, and effect of depreciation and after tax analysis and sensitivity analysis, and replacement analysis.
Learning activities will be conducted through various methods, which consist of: interactive lectures, question-based learning, discussion, and structure assignments. Assessment will be made thoroughly through sets of exercises/quizzes, group discussion, midterm and final exam. To expose students on the latest utilization of engineering economy and train them how to use it, a project will be assigned. As an integral part of course, computer utilization such as Microsoft Excel will be demonstrated and discussed on the class.

HEALTH, SAFETY AND ENVIRONMENTAL PROTECTION
ENGE600012/ENGE610012
2 sks
Syllabus : The teaching of Safety, Health and Environmental (SHE) protection to undergraduates studying engineering courses is an important part of the education of future engineers at all levels. It is the generally expressed view amongst practitioners in industry, business and other organisations

that all engineers need to be equipped to appreciate, understand and implement the requirements of SHE management and practice to meet the working needs of industry and of their company (or other organisation). Whilst the level of risk and degree of control is dependant on the industry sector concerned the basic principles do not change. In addition, according to code of ethics of engineers, engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties.
The module covers the regulation framework and standards, risk perception, assessment, and management and detail discussion on physical, chemical and process hazards, and related engineering and management controls. Maintenance of safety conditions, personal protective equipments, audit, incident and emergency planning are discussed in accordance to measures for improving students awareness to their daily activities within the campus premises and local environment.
Learning activities will be conducted through various methods, which consist of: interactive lecture, question-based learning, discussion, demonstration and unguided structured assignments. Assessment will be made continuously through a set of exercises, group discussion, mid semester exam and final exam

Syllabus of Undergraduate Program on Environmental Engineering
ENEV601001
Introduction to Environmental Engineering System
2 credits
Learning Outcomes:
1. Students are expected to explicate (1) the concept of the environment, (2) natural resources and biodiversity, (3) the source of artificial nature, (4) the balance of nature and carrying capacity, (5) water, (6) liquid waste, (7) solid waste, (8) air pollution, (9) the urban planning in environmental engineering, (10) correlation of sanitation and public health, (11) regulations.

Competencies in curriculum : *Prior knowledge* untuk WA2 (*problem analysis*), WA6 (*the engineer and society*), WA9 (*individual* and team work) dan WA10 (communication)
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.
Prerequisites: -
Text Book References:
1. Kevin,T., Jonathan, P., Jeremy C. 2003. *Urban Sanitation: A Guide to Strategic Planning*. GHK International Ltd, London.
2. Gleynn Henry, J & Gary W. Heinke 2007. *Environmental Science & Engineering*, Prentice Hall, Inc, New Jersey 1996
3. Qasim S.R.,Motley E.M., Zhu G., Water Work Engineering : Planning, Design & Operation, Prentice Hall, 2000.
4. Cunningham W.P., Cunningham M. A, Environmental Science : A Global Concern, Mc Graw Hill , NY, 2008
5. Salvato, Joseph A. *Environmental Engineering & Sanitation*, John Wiley & Son Inc. Canada.

ENCV 603 001
Advanced Calculus
3 Credits
Learning Outcomes : Students will be able to derive and use the concept of: ordinary differential equation and calculus vector in order to solve its applied problems. (C2)
Competencies in Curriculum: *Prior knowledge* for WA1 (engineering knowledge)
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, 5^{th} ed., Jones & Barlett Learning, 2014
2. E. Kreyzig, Advanced Mathematical Engineering, John Wiley & Son, 5^{th} ed., 2011

ENCV 603 003
Construction Drawing
2 Credits
Learning Outcomes :
1. Students will be able to explain engineering drawing symbols in Civil Engineering field and draw it manually or using a software (AutoCAD);
2. Be able to design a one-floor simple healthy house building;
3. Be able to draw the one-floor simple healthy house building according to rules and procedures of engineering drawing such as aperture drawing (plans and appearance) and section view; covering dimension/sizes; foundation drawing, structural beam and column drawing, trestlework drawing, electrical installation and plumbing.

Competencies in Curriculum: *Prior knowledge* for WA3 (*design/development of solutions*), WA8 (*ethics*) dan WA10 (*communication*)
Syllabus : introduction to Civil Engineering knowledge discipline scope and Civil Engineering building construction, introduction to engineering drawing, benefit and purpose of drawing in design process; introduction to drawing tools, drawing paper format, drawing head, standards, lettering, leader, and scale; geometric construction; pictorial projection; orthogonal projection; section view drawing; details of the building drawing, construction drawing of wooden and light steel rooftop; beam construction drawing, column and river stone foundation; electrical installation drawing and plumbing drawing
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,

ENCV 603 004
Surveying (2+1)
3 Credits
Learning Outcomes :
1. Students will be able to use various measuring instruments to solve mapping problems and pegs in civil engineering and environmental engineering works, surveying and displaying the results in a form of drawing with integrating various measuring methods and able to read and draw the data from the surveying results done by someone else;
2. Be able to work in team.

Competencies in Curriculum: *Prior knowledge* untuk WA4 (*investigation*) dan WA9 (*individual and team work)*
Syllabus : Explanation of surveying concept in civil engineering and environmental engineering works; introduction to distance measuring equipment, angles and other measuring equipment usually used in mapping and pegging; Operating levelling equipment and Theodolite in order to take field's data and integrating the data into a map or transferring design coordinates into the field coordinates in civil engineering and environmental engineering activities; carrying out field measuring with measuring methods of horizontal, vertical distance, and angle measurement; Error theory; planning of basic concept of mapping and pegging; calculation of area and volume; displaying the field measuring results in a corresponding map for the needs of civil engineering and environmental engineering
Prerequisites : Calculus 1, Calculus 2, and Construction Drawing
Text Book References :
1. Kavanagh, B. and Slattery, D., 2014. Surveying with Construction Applications 8th ed., Prentice-Hall, Inc.
2. Irvine, W., 2005. Surveying for Construction 8th ed., McGraw-Hill Higher Education.
3. Uren, J. and Prince, W., 2010. Surveying for Engineers 5th ed., Palgrave MacMillan.
4. Schofield, W. and Breach, M., 2007. Engineering Surveying 6th ed., CRC Press.

ENEV603001
Material Properties
2 credits
Learning Outcomes:
1. Understand the practical aspects and the fundamental importance of civil engineering materials comperhensively.
2. Understand and able to apply the practical aspects and the fundamental importance at the laboratory level of the material associated with stress and strain correlation, elasticity, behavior depends on the time, property damping, atomic structure, plasticity, yielding criteria, fatigue, ductility, and process corrosion.

Competencies in Curriculum: *Prior knowledge* untuk WA1 (*engineering knowledge*) dan WA4 (*investigation*)
Syllabus: Particulate material, aggregate, Portland Cement and Portland Cement Concrete, Structural Steel, Cement asphalt and asphalt concrete, wood, polymers and plastics, Concrete Fiber, Basic material and solid, micro structure and surface properties; erial response to stresses; Yielding and fracture; Rheology of the fluid and solid; Fatique.
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

ENEV603002
Structural Mechanics
3 Credits
Learning Outcomes :
1. Students will be able to apply the mechanics physics concept in calculating responds from rigid body as results of working forces (C3);
2. Be able to apply the mechanics physics concept in analyzing simple structure of beam, trusses, and three joints arch (C3) and dan WA5 (modern tool usage)

Competencies in Curriculum: Prior knowledge for WA1 (engineering knowledge) and WA5 (modern tool usage)
Syllabus : Statics of particle; rigid body; equilibrium of rigid body; structural analysis of trusses with point equilibrium method
Prerequisites : Heat and Mechanics Physics, Calculus 1 and Calculus 2
Text Book References :
1. Hibbeler, R.C., Engineering Mechanics Statics, Thirteenth Edition, Pearson, 2013
1. Hibbeler, R.C., Structural Analysis, Eighth Edition, Prentice Hall, 2012

ENEV 603003
Fluid Mechanics
3 credits
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.
Competencies in Curriculum: Prior knowledge for WA1 (engineering knowledge)
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.
Prerequisites: Physics (Mechanics and Thermal), Calculus
Text Book References:

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

ENCV 604 003
Building Construction
3 Credits
Learning Outcomes:
1. Students will be able to apply the knowledge of engineering drawing symbols in Civil Engineering field for describing a two-story building according to the rules and procedures of engineering drawing such as aperture drawing (plans and appearance) and section view; covering dimension/ sizes; foundation drawing, structural beam and column drawing, trestlework drawing, electrical installation and plumbing;
2. Be able to read the construction drawing and explain the parts of water structure (dam), waste treatment building, geotechnical building (foundation, retaining wall), roads, and bridges according to the construction drawing;
3. Be able to calculate the volume of the building, unit price, and cost estimation.

Competencies in Curriculum: *Prior knowledge* for WA2 (*problem analysis*) and WA10 (*communication*)

Syllabus : Introduction of the course syllabus, introduction of standards of every building element and room function, plan and appearance drawing of a building, section-view drawing, foundation plan drawing, column and beam construction drawing, rooftop and trestlework plan drawing, platform drawing, stairs drawing, plafond and floor pattern drawing, window and door frames drawing, lighting installation drawing; plumbing system drawing, fire prevention installation drawing; lightning rod installation drawing, solid waste/trash drawing and septic tank drawing. Calculation of the building's volume and cost estimation. Unit Price. Journals.

Prerequisites : Construction Drawing

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

ENCV 604 005 /ENCV613004
Basic Soil Mechanics (2+1)
3 Credits

Learning Outcomes : Students will be 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 civil engineering.

Competencies in Curriculum : Prior knowledge for WA2 (problem analysis), WA3 (design/ development of solutions) WA4 (investigation), WA5 (modern tool usage) and WA 9 (individual and team work)

Syllabus : Bearing capacity of the soil: Allowable bearing capacity and Ultimate bearing capacity due to inclination and eccentricity of load; One dimensional elastic settlement and consolidation settlement; Drawing shallow foundation design; Seepage through dam; Stress distribution in the soil: A point load, strip, circle, and square area of footing using Fadum and Newmark theories; Lateral earth pressure: Rankine and Coulomb theories; Structure design of earth retaining wall, gravity wall, cantilever wall, earth retaining cantilever wall, sheet pile; Slope stability: concept of slope stability, undrained analysis, slice method, introduction of Fellenius method, Bishop method, Soil stability method

Prerequisites : Basic Soil Mechanics
Prerequisites : Material Properties
Text Book References :

1. Muni Budhu, Soil Mechanic& Foundations,
2. R.F. Craig , " Soil Mechanics", Seventh Edition, 2007
3. Bowles, J.E., "Physical and Geotechnical Properties of Soils", McGraw-Hill Kogagusha Ltd., 1998.
4. Braja M. Das, "Principles of Geotechnical Engineering", Fifth edition, 2005, PWS Publishing Company, Boston
5. Budu M., "Soil Mechanics and Foundations", Second Edition, 2007, John Wiley & Sons, New York

ENEV604001
Solid Mechanics
3 SKS
Learning Outcomes :
1. Students will be able to analyze tension and shape changes as a result of working forces for various shape of statically determined structure and various shape of sections and type of materials;

Competencies in Curriculum : Prior knowledge for WA1 (engineering knowledge)

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.

Prerequisites : Statics

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. McGraw Hill, 2011
3. Egor P. Popov (Author), Engineering Mechanics of Solids (2nd Edition), Prentice Hall, 1998
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

ENEV604002
Hydraulics in Environmental Engineering
3 credits
Learning Outcomes:
1. Students have the basic ability 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.

Competencies in Curriculum : Prior knowledge for WA1 (engineering knowledge) and WA3 (design/ development of solutions)

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.

Prerequisites: Fluid Mechanics

Text Book 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
3. *Mechanics of Fluids*, Second Edition. International Edition. Merle C. Potter, David C. Wiggert, Prentice-Hall Inc., 1997

ENEV604003
Environmental Chemistry
3 credits
Learning Outcomes:
1. students are able to analyze various parameters of water and waste water quality, and writing the results in scientific report

Competencies in Curriculum: Prior knowledge for WA3 (design/development of solutions), WA4 (investigation) and WA9 (individual and team work)
Syllabus: The basic principle of environmental chemistry; interactions between environmental factors and various parameters of water quality and waste water; Water resources: the properties and quality of water resources; contamination and water pollution; quality raw water sources and clean water; chemicals and some parameters in water and waste water (turbidity, color, pH, acidity, alkalinity, hardness, dissolved oxygen, BOD, COD, nitrogen, sulfate, Solid, iron, manganese, fluoride, chlorine residual and the chlorine needs), and its source, influence on health and environment; methods of laboratory examination of various parameters of water and waste water quality
Prerequisites: Basic Chemistry
References:

1. Standard Methods, Examination of Water & Wastewater, 20th Edition
2. Sawyer, McCarty, and Perkin. 2003. Chemistry Environmental Engineering Science. McGraw Hill
3. Manahan, S.E. (2005). Environmental Chemistry. Washington: CRC

ENEV604004
Environmental Global Issues
2 credits
Learning Outcomes:
1. Students are able to relate the (C3) concepts and knowledge of environmental science to investigate (C3), criticized (A3) and demonstrating (P2) causes, effects and solutions of the existig contemporary global environmental problems

Competencies in Curriculum: *Prior knowledge* for WA7 (*environment and sustainability*) and WA12 (*lifelong learning*)
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 Buliding Course B
Buku Referensi :

a. Berg, Linda R. 2013. Visualizing Environmental Science 4th Edition. Wiley.
b. Easton, Thomas. 2013. Taking Sides: Clashing Views on Environmental Issues 15th Edition. McGraw-Hill/Dushkin.
c. Hardisty, Paul E. 2010. Environmental and Economic Sustainability 1st Edition. CRC Press.
d. Harris, Frances. 2012. Global Environmental Issues 2nd edition. Wiley Blackwell
e. The Worldwatch Institute & Erik Assdourian. 2013. State of The World 2013: Is Sustainable Still Possible? 1st Edition. Island Press.

ENEV604005
Environmental Microbiology
2 credits
Learning Outcomes:
1. Students are able to explain the system in relation to the microbiological transformation and mineralization of organic wastes and factors that control microbiological processes in wastewater treatment;
2. Students are able to check the quality of water and air microbiological

Competencies in Curriculum: Prior knowledge for WA1 (engineering knowledge), WA3 (design/development of solutions) and WA9 (individual and team work)
Syllabus: The basic concepts of microbiology (Introduction of environmental microbiology, microorganisms found in the environment, diversity of microorganisms and their interaction at natural ekosistem); Nutrition for microorganisms; Bacterial growth; Environmental microorganism (Earth environments, Aeromicrobiology, Aquatic environments, Extreme environments); Remediation of organic pollutants and metals (microorganisms and organic pollutants, microorganisms and metal pollutants); Basic microbiology for waste water treatment and solid waste (processing aerobic, anaerobic processing); Urban microbiology, microbial emerging global issues in the Anthropocene era and risk assessment.
Practicum
1. Microbial Enumeration for water quality (TPC,MTF)
2. Gram staining
3. *Aeromicrobiology – Bioaerosol sampling*

Prerequisites: Introduction to Environmental Engineering System
Buku Referensi :

1. Ian L.P., Charles P.G., Terry J.G. 2015. Environmental Microbiology, 3rd ed. Elsevier. Amsterdam.
2. Willey, J.M., Sherwood, L.M., Woolverton, C.J. 2008. *Microbiology*. 7th. Edition. Mc Graw Hill, Boston.
3. Johnson, T.R., Case, C.L. 2010. *Laboratory Experiments in Microbiology.* Benjamin Cummings. Pearson. San Fransisco
4. Novita, E., Gusniani, I., Handayani, S.D. 2009. Modul Praktikum Mikrobiologi Lingkungan. Laboratorium Teknik Lingkungan-Departemen Teknik Sipil FT-UI. Depok

ENEV604006
Thermodynamics
2 credits
Learning Outcomes: Students are expected to apply the science of thermodynamics in conceptualizing waste management and environmentally efficient and sustainable
Competencies in Curriculum:
Syllabus: The concept of thermodynamics (enthalpy, entropy, free energy, equilibrium, spontaneity), Cycle of energy on earth, energy balance, the concept of conversion and transfer of energy, Equilibrium element on earth, Thermodynamics in sewage treatment in Indonesia, new and renewable energy
Prerequisites: Basic Chemistry, Physics
Buku Referensi :

1. Douce, 2011, Thermodynamics of the Earth and Planets, Cambridge
2. Berg, Linda R. 2013. Visualizing Environmental Science 4th Edition. Wiley.
3. Mihelcic and Zimmerman, 2010, Environmental Engineering, Wiley
4. Brown and Holme, 2011, Chemistry for Engineering Students 2nd edition

ENEV605001
Urban Planning and Sanitation
3 Credits
Learning Outcomes:
1. Students will be able to explain the role of civil engineer in setting up the infrastructure needed in an urban area and be able to apply that knowledge in the process of planning, monitoring and implementation of the regional arrangement;
2. Be able to describe the components of an urban sanitation techniques and applying that

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knowledge in the planning, monitoring and implementation so as to create environmentally sustainable region.

Competencies in Curriculum: WA2 (problem analysis), WA7 (environment and sustainability)

Syllabus: Definition and function of urban planning, Primary factor in urban planning, Population aspect in urban planning, Social facilities and forms of urban development, Land use, Water management and its relationship with land use. Controlling transmission of infectious and non-infectious diseases in an area, Planning and analyzing impacts of environmental engineering, Clean water supply, Waste water treatment and disposal, Solid waste management, Noise control, Air pollution control.

Prerequisites: -

Text Book References:

1. Hamid Shirvani, Urban Design Process, New York, 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. Environmental Engineering and Sanitation: Joseph A Salvato: John Willey & Son, Inc., Canada
5. Environmental Science and Engineering, J. Glynn Henry and Gary W. Heinke, Prentice Hall International Inc.

ENEV605002

Structural Design of Environmental Engineering Facilities

3 credits

Learning Outcomes:

1. Students are able to design environmental engineering structures such as sewage treatment facilities and water tanks of reinforced concrete in accordance with the applicable procedures and standards

Competencies in Curriculum: Prior knowledge for WA3 (design/development of solutions), WA5 (modern tool usage) and WA9 (individual and team work)

Syllabus: objections, step and the process of designing the structure and explain the various methods of planning; shape, type, placement, distribution, factors and combinations of load and able to explain a wide range of structural system reinforced concrete; material and mechanical properties of reinforced concrete cross-section, the concept of elastic and strength limits, simplifying the Whitney tension block and impartial failure; square reinforced concrete beam, with single or double bars and the beam cross-section T to bending and shear, and capable to proportion short and slender columns to bending and axial force, and the shallow foundation; building operating conditions to determine the load recovery techniques, water-resistant requirements, joint detail and placement, shrinkage reinforcement, design parameters, strength for restructuring techniques building design; square tank structure and circular tanks of reinforced concrete for the restructuring techniques building.

Prerequisites: Basic Soil Mechanics, Solid Mechanics

Buku Referensi :

1. Persyaratan beton structural untuk bangunan gedung, SNI 2847 : 2013
2. Beban minimum untuk perancangan bangunan gedung dan struktur lain, SNI 1727 : 2013
3. Mac Gregor, J.G., Reinforced Concrete: Mechanics and design, 6th edition, Pearson, 2012
4. Wahyudi , Syahril A.Rahim, Struktur BetonBertulang, Penerbit Gramedia, 1997
5. Wahyudi & Syahril A.R., *Struktur Beton Bertulang*, Gramedia, 1997.
6. JF. Seidensticker and ES Hoffman, Sanitary

ENEV605003

Network Design in Environmental Engineering

3 credits

Learning Outcomes:

1. Students are able to calculate the regional average rainfall, planned rainfall, organize intensity-duration-frequency rainfall curve, calculate the flood discharge plan at various return period
2. Students are expected be able to divide the service zone, identify water needs of each zone, plan the distribution pipe network of primary and secondary, and determining the location of reservoir distribution
3. Students are able to calculate and design a waste water network; the service zone, calculate peak flow of each zone, plan the distribution pipe network of primary and secondary, and determining the location of waste water treatment plant.

Competencies in Curriculum: *Prior knowledge* for WA3 (*design/development of solutions*), WA5 (*modern tool usage*) and WA9 (*individual and team work*)

Syllabus: (a) the basic concept of the hydrological cycle, catchment area/watershed; (b) the determination of the average rainfall of a region, design rainfall using extreme distribution method; (c) determination of intensity-duration-frequency rainfall curve, and design of flood discharge return period; (d) calculation of flow rate in each segment of the pipe, design velocity, and pipe diameter, calculation of flow distribution in pipe network using Hardy-Cross method and EPANet software.

Prerequisites: Fluid Mechanics, Hydraulics in Environmental Engineering

Text Book References:

1. *Applied Hydrology*, Ven Te Chow, David R. Maidment, Larry W. Mays., 2003 edition, McGraw-Hill. ISBN 0070108102.
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. *Water Works Engineering, Planning, Design & Operation*, Syed R. Qasim, 2000
4. Water and Wastewater Engineering: Design Principles and Practice, Mackenzie L. Davis, 2010. McGraw-Hill Education

ENEV605004

Integrated Solid Waste Management Design

3 credits

Learning Outcomes: students are able to plan a solid waste management system in engineering aspects

Competencies in Curriculum: *Prior knowledge* for WA3 (*design/development of solutions*), WA6 (*the engineer and society*) and WA9 (*individual and team work*)

Syllabus: Students are expected to explain the properties and problems arising from the solid waste material and developing and selecting alternative management in accordance with local conditions. Understanding of the management of solid waste material, Source, type and composition of the waste material solid, Generation waste material solid, collection, transfer and transport of solid waste materials and disposal, and the processing of solid waste material, aspects of the organization in the management of solid waste material, aspects of financing, aspects of regulation and aspects of community participation management of solid waste and materials. The concept of designing the management of solid waste material. The management system of solid waste material, Regulation of solid waste material management, solid waste material management methods

Prerequisites:

Buku Referensi :

1. Tchobanoglouss, 1993, *Integrated Solid Waste Management*.
2. Tchobanoglous, 1977, Engineering Principles and Management Issues.;
3. Wentz, 1989, *Hazardous Waste Management*
4. Flintoff FF., 1983, *Management of Solid Wastes in Developing Countries*

ENEV605005

Unit Operation and Process

4 credits

Learning Outcomes:

1. 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.

Competencies in Curriculum: *Prior knowledge* for WA1 (*engineering knowledge*) and WA2 (*problem analysis*)

Syllabus: unit operations and processes based on the principle (physical processing, chemical, biology), the level of processing; the concept of balanced mass, flow model, and reactor; 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 axis media (filtration);

Students are able to explain the operating unit and the process of separation of ammonia, an operating unit and the adsorption process; unit process of chemical reactions between the ions in

the liquid phase and solid phase (Ion Exchange) in water treatment and wastewater; unit operation and process that separate elements of the solution using pemeable membrane (Membrane Process) in water treatment and wastewater; unit operations and process of oxygen transfer and mixing; biological processes at waste water treatment by the method of suspended growth: Activated Sludge; biological processes at waste water treatment by the method of suspended growth: Stabilization Ponds and aerated Lagoons; biological processes at waste water treatment by the method of suspended growth: Stabilization Ponds and aerated Lagoons; biological processes in wastewater treatment with anaerobic suspended growth method: Anaerobic digestion; biological processes in wastewater treatment with suspended aerobic growth method: Aerobic digestion; sludge treatment process
Prerequisites: Basic Chemistry, Physics (Mechanics and Thermal), Environmental Chemistry
Buku Referensi :
1. Tom D. Reynolds and Paul Richards, Unit Operations and Process in Environmental Engineering Pws Series in Engineering;
2. Rich, Linvil G : " Unit Operation for Sanitary Engineering"Management, McGraw Hill

ENEV605006
Environmental Laboratory
3 credits
Learning Outcomes:
1. Students are able to perform the environmental sampling and water treatment experiment at a laboratory scale by applying the principles of unit operations and processes (C3, P3)

Competencies in Curriculum: *Prior knowledge for* WA2 (*problem analysis*) and WA4 (*investigation*)
Syllabus: Analysis of water resources, Identification of pollution sources ,; Sampling of surface water and solid waste (representativeness of the sampling and analysis of data, surface water sampling, sampling of solid waste); Analysis of surface water quality (analysis of the characteristics and composition of waste on, quality of surface water), composition and characteristics of solid waste, planning experiment of water treatment at at laboratory scale, solid analysissedimentation type 1, coagulation and flocculation processes, sedimentation type 2 , chlorination
Prerequisites: Environmental Chemistry
References:
1. Standard Methods, Examination of Water & Wastewater, 20th Edition
2. Davis, Mackenzie, Water and Wastewater Engineering, New York, McGraw-Hill, 2012
3. Metcalf and Eddy, Wastewater Engineering: Treatment and Resource Recovery, New York, McGraw-Hill Inc, 2013
4. Sawyer, McCarty, and Perkin. 2003. Chemistry Environmental Engineering Science. McGraw Hill
5. Tchobanoglous, G., Thiessen, H., & Vigil, S. (2003). Integrated Solid Waste Management: engineering principles and management issues. Singapore: McGraw-Hill Inc.
6. Buku Pedoman Praktikum Laboratorium Teknik Lingkungan, 2012

ENEV606001
Project Managements
3 credits
Learning Outcomes:
1. At the end of the course, students are expected to select and plan the project management from project initiation to implementation and delivering the works

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
Prerequisites:
Buku Ajar :
1. Blank, L and Tarquin, A., Engineering Economy, McGrawHill, New York, 2002
2. Halpin, D, W and Woodhead, R.W., Costruction Management, 2nd ed., John Wiley & Sons Inc., New York, 1998
3. Buku Referensi :
4. Duffield, C.F and Trigunarsyah, B., Manajemen Proyek – dari Konsepsi sampai Penyelesaian, Engineering Education Australia, Melbourne, 1999
5. Europen Construction Institute, Total Project Management of Construction Safety, Health and Enviornment, Thoman Telford, London, 1995
6. Slough, R.H., Sears, G.A. and Sears, S.K., Construction Project Management, 4th ed., John Wiley & Sons Inc., New York, 2000
7. Project Management Institute, A Guide to the Project Management Body of Knowledge (PMBOK®Guide). PMI, USA 2000

UNDERGRADUATE PROGRAM

ENEV606002
Water Treatment Design
3 credits
Learning Outcomes: students are able to plan water treatment systems and to design dimensions of the unit in the processing unit of the treatment plant
Competencies in Curriculum: *Prior knowledge* for WA1 (*engineering knowledge*), WA2 (*problem analysis*) and WA3 (*design/development of solutions*)
Syllabus: Water supply systems and their components, water needs, raw water sources, water and raw water quality, water catchments and water transmission and equipment, water treatment, physical treatment, chemicals treatment, reservoir, equipments of another installation, layout, hydraulic profile
Prerequisites: Unit Operation and Process, Fluid Mechanics, Water Supply and Sewerage Network Design
Buku Referensi :
1. Water Works Enginering, *Planning, Design & Operation* , Syed R. Qasim, 2000
2. *Water Treatment Principles and design, J. M. Montgomery, 1985*
3. Water and Wastewater Technology, Mark J. Hammer, 1996
4. Cheremisinof. *Handbook of Water and Waste Water Technology*, 1995
5. Water Supply and Sewerage, Terence J. Mc.Ghee, 1991

ENVIRONMENTAL ENGINEERING

ENEV606003
Domestic Wastewater Treatment Design
3 credits
Learning Outcomes:
1. The student is able to design the details of domestic waste water treatment facility in a city.

Competencies in Curriculum: *Prior knowledge* for WA1 (*engineering knowledge*), WA3 (*design/development of solutions*), WA6 (*the engineer and societ)* and WA9 (*individual and team work*)
Syllabus: Domestic Wastewater Treatment Design course begins with a study that determining the water needs in its coreelation with the discharge and the characteristics of domestic wastewater generated. Domestic wastewater treatment plant designed including all processing units of physical, chemical processing (if necessary) and biological treatment which is the core domestic wastewater. Pre-processing, primary processing and secondary processing and effluent processing units are required to guarantee the quality of treated water before discharged to the receiving water bodies in accordance to applicable Environmental Quality Standards.
Prerequisites: Unit Operation and Process, Perancangan Jaringan TL, Fluid Mechanics
Buku Referensi :
1. Water and Wastewater Technology, Mark J. Hammer, 1996
2. Cheremisinof. *Handbook of Water and Waste Water Technology*, 1995
3. Water Supply and Sewerage, Terence J. Mc.Ghee, 1991
4. Metcalf and Eddy, *Waste Water Engineering Treatment and Disposal, Reuse*, Singapour, McGraw-Hill Inc, 2004.
5. Qasim, Syeed, R, Wastewater Treatment Plants, Planning, Design and Operations, New York, CBS Collin Publishing, 2000

ENEV606004
Environmental Impact Analysis and ISO
3 Credits
Learning Outcomes: Students will be able to apply the method of EIA and environmental audits as inputs for safeguards against human and natural resources.
Competencies in Curriculum: *Prior knowledge* for WA4 (*investigation*), WA6 (*the engineer and*

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society), WA7 (*environment and sustainability*) and WA10 (*communication*)
Syllabus: The meaning of EIA, EIA process and benefits, rules, regulations and management of EIA, Environmental settings, Estimation of environmental impacts, Environmental impact to the physical, chemical, biological, socio-economic, and socio-cultural sector. EIA method, Method and techniques of identification, prediction, evaluation and interpretation of the EIA, Environmental Monitoring Plan, Environmental Management Plan, Environmental Audit and Environmental Management System.
Prerequisites: -
Text Book 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

ENEV607001
Industrial and Hazardous Waste Treatment
3 credits
Learning Outcomes: Students are expected to implement processes and technology of industrial waste treatment within the framework of environmental pollution control and environmental work
Competencies in Curriculum: *Prior knowledge* for WA1 (*engineering knowledge*), WA2 (*problem analysis*), WA3 (*design/development of solutions*) and WA9 (*individual and team work*)
Syllabus: Sustainable Development Goals in the perspective of environmental development, especially in waste management, regulation and legislation in environmental management industry; concept of environmental carrying capacity and environmental components in the industrial waste management; Sources, types and characteristics of the waste industry based on raw materials, processes and products used; The impact of pollution (liquid, solid and gas waste), vibration and noise on humans and the environment; Pollution prevention and waste minimization industry; Process and waste treatment technology of liquid, solid and gas waste; Case of industrial waste management and treatment.
Prerequisites: Unit Operation and Process
Text Book References:

1. La Grega (1994), 'Hazardous Waste Management' ERM, England
2. Nemerow (1992),'Industrial and Hazardous Waste Pollution Control', McGraw-Hill, Singapore
3. W.W. Eckenfelder (2004),'Industrial Water Polluiton Control', McGraw-Hill, Singapore
4. Peraturan Pemerintah 101 Tahun 2014 tentang Pengelolaan Limbah B3

ENEV607002
Air Pollution
3 credits
Learning Outcomes: students are able to identify the problem of air pollution in the solid waste management and waste water treatment setting, determining the source, type, and characteristics of air pollutants and providing advice on control. This course is conducted in Bahasa Indonesia with face to face method, discussions and group assignments.
Competencies in Curriculum: *Prior knowledge* for WA2 (*problem analysis*), WA4 (*investigation*) and WA7 (*environment and sustainability*)
Syllabus: Sources and types of air pollution, impacts of air pollution, meteorological factors, Detail discussion of the types of air pollution such as sulfur dioxide, nitrogen oxides, particulates, contaminants microbiological, and environmental tobacco smoke, Technology available for air pollution control such as cyclone, bag house filter, and scrubber.
Prerequisites: -
References:

1. Nevers, N.D., Air Pollution Engineering, McGraw-Hill, USA, 2000.
2. Spengler, J.d. *et al.*, Indoor Air Quality Handbook, McGraw-Hill, USA, 2001.
3. Ross, R.D., Air Pollution and Industry, Van Nostrand Reinhold Company, New York, 1972.
4. Metcalf and Eddy, Wastewater Engineering: Treatment and Resource Recovery, New York, McGraw-Hill Inc, 2013
5. Tchobanoglous, G., Thiessen, H., & Vigil, S. (2003). Integrated Solid Waste Management: engineering principles and management issues. Singapore: McGraw-Hill Inc.

ENEV607003
Internship
3 Credits
Learning Outcomes :

1. Students are expected to describe a project / work in the field of civil engineering and the environment at the internship location, identify the problem, conduct analysis and thought to overcome it as stated in the form of a written report and be responsible for it before the examiner team

Competencies in Curriculum: *Prior knowledge* for WA8 (*ethics*), WA9 (*individual and team work*), WA10 (*communication*) and WA11 (*project management and finance*)
Syllabus : Implement an internship in a construction project, field observation; interpret a construction drawing, writing an observation report, describing a technical work process, quality control, project management, project specification, engineering drawing and other aspect; problem solving on the fields, presenting an internship reports
Prerequisites :

1. Already pass 6th semesters and pass ≥ 75 credits according to the determined conditions applied by the Civil Engineering Department, Faculty of Engineering, Universitas Indonesia and/or the conditions from Faculty of Engineering, Universitas Indonesia
2. Registered and fill out IRS for internship special course, and expresses him/herself to the Internship Coordinator in the Department of Civil Engineering
3. Student choose a project and / or object of selected activities at the internship site and location that has been contracted previously
4. Students must complete and submit the registration form at the Secretariat of Civil Engineering Department

Text Books References : -

ENEV607004
Research Methods and Seminar in Environmental Engineering
2 credits
Learning Outcomes:

1. Students are expected be able to apply knowledge and demonstrate understanding of research methods in civil and environmental engineering; conduct literature review and design experimental methods to solve basic problems in civil and environmental engineering context, as well as be able to communicate verbally and in writing.

Competencies in Curriculum: *Prior knowledge* for WA4 (*investigation*), WA5 (*modern tool usage*), WA6 (*the engineer and society*), WA7 (*environment and sustainability*), WA8 (*ethics*), WA9 (*individual and team work*) and WA11 (*project management and finance*)
Syllabus: Identification of major issue and problems in environmental engineering, formulating research problem, determining specific aims/objectives of the research, collecting related data, study or previous research, conducting literature review and meta-analysis, designing research methods, writing research proposal (introduction, literature review, methods), presentation of research proposal
Prerequisites: Have completed courses of 110 credits with a GPA ≥ 2.00 and without E value
Textbook References:

1. *Research Methods for Engineers*. David V. Thiel, 2014. Cambridge University Press
2. *Research Methodology: A Step-by-Step Guide for Beginners*. 3rd Edition, Ranjit Kumar, 2010. SAGE Publications Ltd

ENEV608001
Enterpreneurship
2 credits
Learning Outcomes: Students are able to explain the comparison of various entrepreneurial activity of civil / environment engineering characterized by innovation and self-reliance based on ethics

and able to communicate visually and verbally
Competencies in Curriculum: *Prior knowledge* for UI-E(*entrepreneurship*) and UI-B(*social sciences, nationality & humanities*)
Syllabus: Problems and needs of the various stakeholders in the fields of water, waste and sanitation in Indonesia, existing solution for the problems of Environmental Engineering, general opportunity entrepreneurship to solve the problems of Environmental Engineering, Definition of entrepreneurship, Action, plans and challenges for enterpreneur, Action, plans and challenges academics and observers, Business models canvas (BMC) concept, profile the company in general, customer profile in general, fees and turnover, identification of differences and similarities between the components of the BMC, Assessment of the advantages and disadvantages of each component of BMC, variety of products and services environmental engineering, definition of product value, human needs, customer segments, various customer profiles, customer profiles excavation methods, excavation customer profiles, identification of differences and similarities between the components of BMC, Assessment advantages and disadvantages of each component of BMC.
Prerequisites: Integrated Character Building Course A, Introduction to Environmental Engineering System, Urban Planning and Sanitation
Text Book References:

1. Eawag Sandec, Water and Sanitation in Developing Countries, Compendium of Sanitation Systems and Technologies 2nd Edition, 2014
2. WSP, Introductory Guide to Sanitation Marketing, 2011
3. Devine, Jacqueline; Kullmann, Craig. 2011. Introductory guide to sanitation marketing. Water and sanitation program: toolkit. Washington, DC: World Bank.
4. Osterwarlder, Business Model Generation, 2010
5. Osterwarlder, Value Proposition Design: How to Create Products and Services Customers Want, 2014
6. Mattimore, Idea Stormers: How to Lead and Inspire Creative Breakthroughs, 2012

ENEV600003
Final Project
4 Credits
Learning Outcomes:

1. Students will be able to apply civil engineering knowledge to solve a complex civil engineering problem through a study that follows the research rules such as: Conducting a literature study, choosing the research methodology, analyze and interpret the data and draw a valid conclusion;
2. Be able to write the result of the research in a scientific writing using the correct Indonesian/English language and following the standard final project format;
3. Be able to present the study result to the examiner team;
4. Be able to work independently and complete the work within the time limit.

Competencies in Curriculum: *Prior knowledge* for WA1 (*engineering knowledge*), WA2 (*problem analysis*), WA3 (*design/development of solutions*), WA4 (*investigation*), WA5 (*modern tool usage*), WA10 (*communication*) and WA12 (*lifelong learning*)
Syllabus : Problem formulation, Literature study, conducting research, data analysis, result interpretation, preparing a written report of the synthesis and present the study results
Prerequisites : Passing 110 credits with GPA >=2.00 and without grade of E
Text Books References: related to the subject

Information:
Complete Teaching Plan can be found at http://www.civil.ui.ac.id/id_ID/engineering-environmental/

4.3. UNDERGRADUATE PROGRAM IN MECHANICAL ENGINEERING

Program Specification

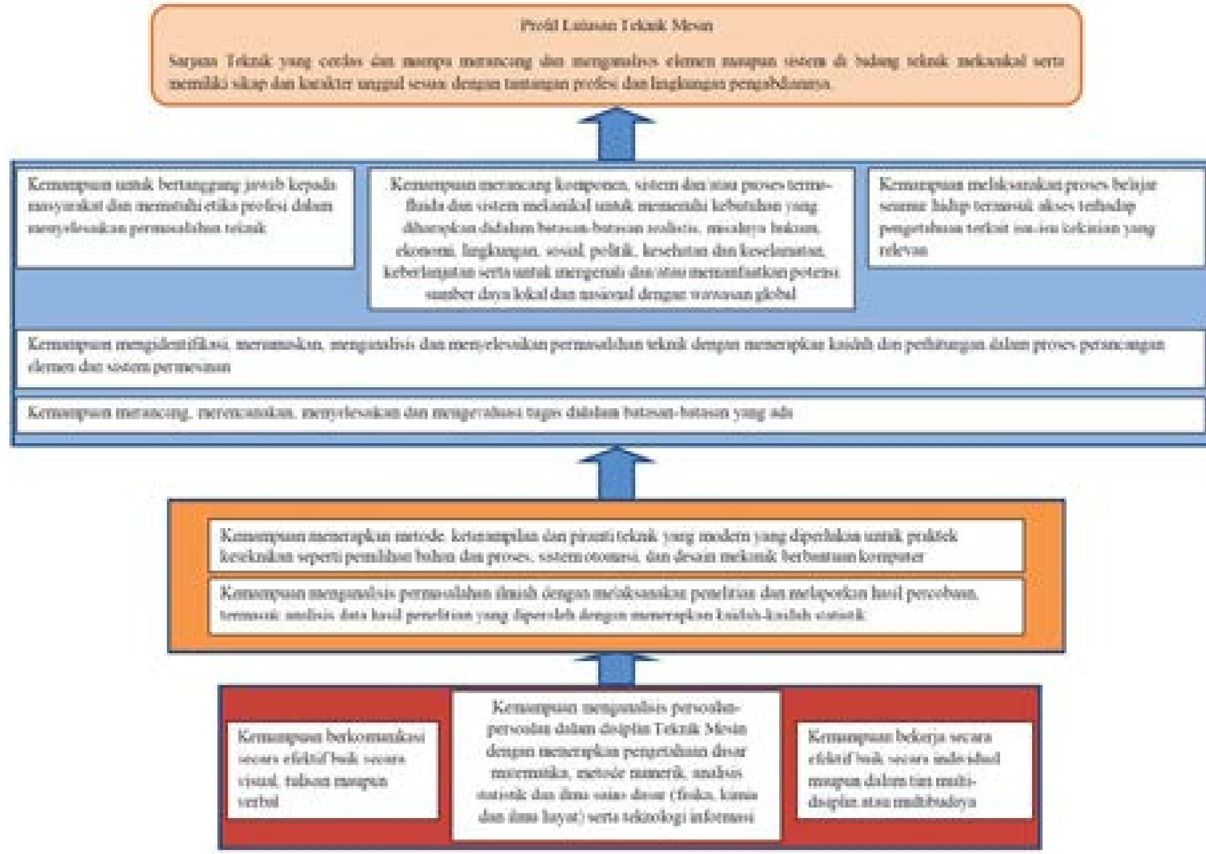
1.	**Awarding Institution**	Universitas Indonesia Double Degree: Universitas Indonesia and Partner University	
2.	**Teaching Institution**	Universitas Indonesia Double Degree: Universitas Indonesia and Partner University	
3.	**Programme Tittle**	Undergraduate Program in Mechanical Engineering	
4.	**Class**	Regular, Parallel and International	
5.	**Final Award**	Sarjana Teknik (S.T) Double Degree: Sarjana Teknik (S.T) and Bachelor of Engineering (B.Eng)	
6.	**Accreditation / Recognition**	BAN-PT: A Accredited - AUN-QA	
7.	**Language(s) of Instruction**	Bahasa Indonesia and English	
8.	**Study Scheme (Full Time / Part Time)**	Full Time	
9.	**Entry Requirements**	High school /equivalent, or D3 / Polytechnique / 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	17
	Short (optional)	3	8
11.	**Graduate Profiles:** Competent engineering graduates who have abilities to design and analyze the element and system in the field of mechanical engineering and have the excellent attitude and character that can adapt the professional challenge in their work field		
12.	List of Graduates Competency: 1. Ability to analyze the problems in mechanical engineering field by applying the basic knowledge of mathematics, numerical method, statistical analysis and basic science (physics, chemistry and life science), as well as information technology 2. Ability to design component, system and/or thermofluid process and mechanical system to fulfill the realistical needs, for example law, economics, environment, social, politics, health and safety, sustainability and to understand and/or to use potential local and national resources in global perspective 3. Ability to analyze the scientific problems by conducting research and to publish the results, including the data analysis of the results using the statistical principles 4. Ability to identify, to formulate, to analyze and to solve the engineering problems by applying the principles and calculation in mechanical elements and system design process 5. Ability to use the method, skill and modern engineering tools that used for engineering practice such as material selection and manufacturing process, automation system and computer aided mechanical design 6. Ability to communicate effectively by visual, writing and also verbal 7. Ability to design, to plan, to conduct and to evaluate the task for the given boundary condition 8. Ability to work effectively in individual and multidiscipline or multicultural team 9. Ability to be responsible to the society and to obey the professional ethics in solving engineering problems 10. Ability to conduct life long learning including to access the knowledge on the relevant current issues		

12	**As a Universitas Indonesia student, every graduate of Mechanical Engineering Undergraduate Program should have the following compenteces as follow:** 1. Able to use information and communication technology; 2. Able to think critically, creatively, and innovatively and have intellectual curiosity to solve the individual and group problems; 3. Able to use verbal and writing communication in good bahasa Indonesia and English for academic or non-academic acitivity; 4. Has an integrity and able to respect others; 5. Able to identify entrepreneurship efforts which show innovation and autonomy based on ethics		
13	**Classification of Subjects**		
No.	**Classification**	**Credit Hours (SKS)**	**Percentage**
i	University General Subjects	18	12,5 %
ii	Basic Engineering Subjects	30	20,8 %
iii	Core Subjects	68	47,2 %
iv	Elective Subjects	16	11,1 %
v	Internship, Seminar, Undergraduate Thesis, Project	12	8,4 %
	Total	144	100 %
14.	Total Credit Hours to Graduate		144 SKS

Career Prospects

Graduates of Mechanical Engineering has devoted itself in various fields, including mechanical element and system engineer (mechanical system, thermal and fluid, material and production process), government, process plan supervisor, construction, operation and maintenance, leader and instructor of community development, technical project inspector, Sales & Service Engineer, Entrepreneur and Adjuster

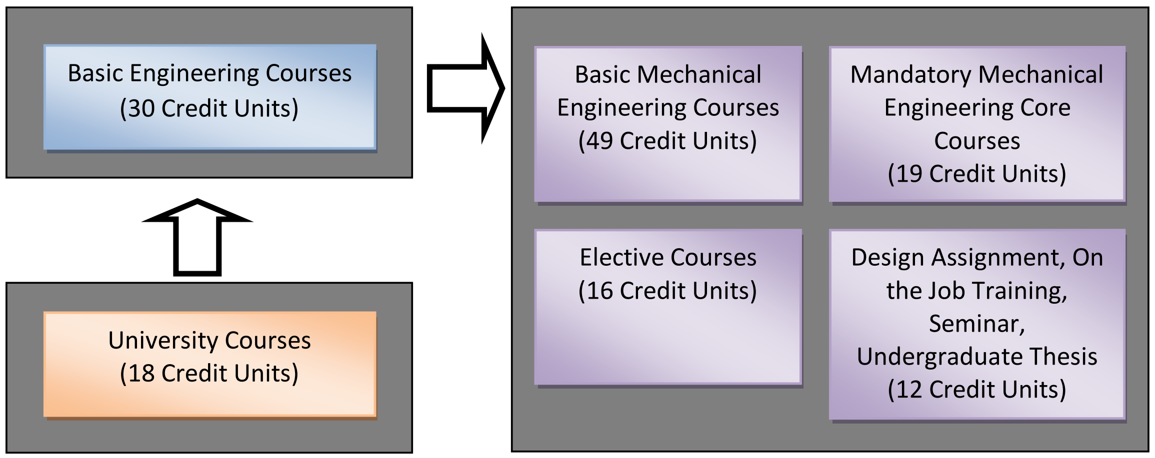
Learning Outcomes Flow Diagram



MECHANICAL ENGINEERING

MECHANICAL ENGINEERING

Curriculum Structure



Composition :

University Courses (18 Credit Units)	
MPKT A	6
MPKT B	6
English	3
MPK Religion	2
MPK Sport/Art	1

Basic Engineering (30 Credit Units)	
Calculus 1	3
Calculus 2	3
Linear Algebra	4
Basic Physics 1 (Mechanics and Heat)	3
Laboratory Experiment for Basic Physics 1	1
Basic Physics 2 (Electrical, Magnet, Wave, and Optic)	3
Laboratory Experiment for Basic Physics 2	1
Engineering Drawing #	2
Chemistry	2
Health, Safety and Enviroment	2
Statistics and Probability	2
Life Science for Engineer	2
Industrial Seminar	2

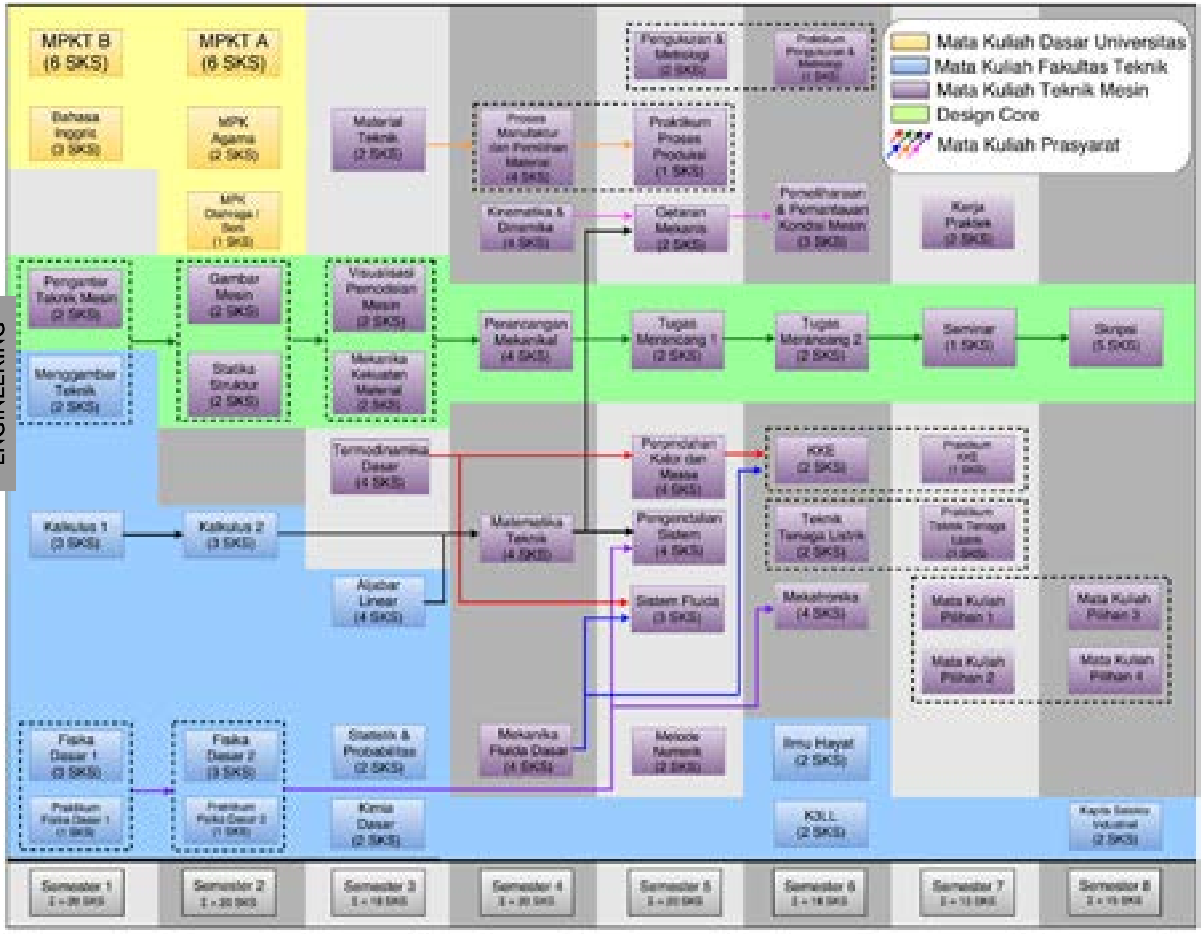
Basic Mechanical Engineering Courses (49 Credit Units)	
Introduction to Mechanical Engineering	2
Mechanical Drawing	2
Mechanical Modelling and Visualization	2
Engineering Statics	2
Strength of Materials	2
Enginnering Material	2
Mechanical Design	4
Basic Thermodynamics	4
Engineering Mathematics	4
Kinematics and Dynamics	4
Basic Fluid Mechanics	4
Material Selection and Manufacturing Process	4
Laboratory Experiment for Manufacturing Process	1
Heat and Mass Transfer	4
Electrical Power Engineering	2
Laboratory Experiment for Electrical Power Engineering	1
Measurement and Metrology	2
Laboratory Experiment for Measurement and Metrology	1
Numerical Method	2

Mandatory Mechanical Engineering Core Courses (19 Credit Units)	
Fluid System	3
Mechatronics	4
Maintenance and Condition Monitoring	3
Energy Conversion and Conservation	2
Laboratory Experiment for Energy Conversion and Conservation	1
Mechanical Vibration	2
Control System	4

Elective Courses (16 Credit Units)	
Elective Courses Semester 7:	
Elective Course #1	4
Elective Course #2	4
Elective Courses Semester 8:	
Elective Course #3	4
Elective Course #4	4

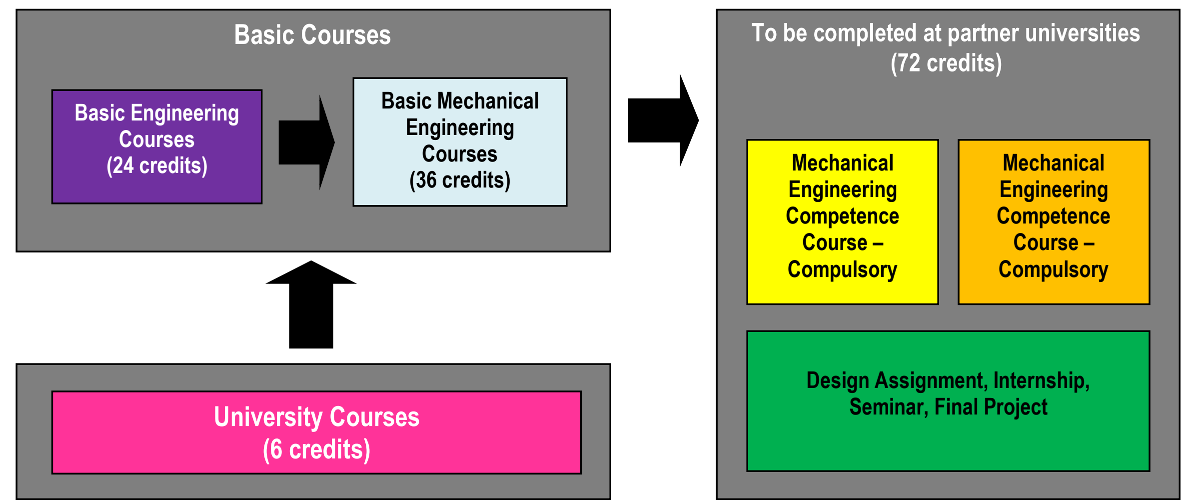
Design Assignment, Internship, Seminar and Undergraduate Thesis (12 Credit Units)	
Design Assignment 1	2
Design Assignment 2	2
Internship	2
Seminar	1
Final Project	5

The groups of the courses can be seen according to the characteristic and the education purposes that are expected as shown in figure below



Mechanical Engineering Undergraduate International Program Curriculum

The international program of mechanical engineering study is divided into two phase which are the first will be done at University of Indonesia and the other phase will be completed at partner universities in Australia. There will be option to continue the second phase at UI. A student at the Department of Mechanical Engineering - Univesity of Indonesia must complete and pass 72 - 76 credits over 4 semester before continuing to partner universities. The courses are classified into University courses (6 credits) and basic courses that consist of Basic Engineering courses (24 credits) and Basic Mechanical Engineering courses (36 credits).



COURSE STRUCTURE UNDERGRADUATE PROGRAM MECHANICAL ENGINEERING

KODE	SUBJECT	Credit
	1st Semester	
UIGE600002	Integrated Character Building B	6
ENME601001	Introduction to Mechanical Engineering	2
UIGE600003	English	3
ENGE 6 0 0001	Calculus 1	3
ENGE 6 0 0005	Physics (Mechanics and Thermal)	3
ENGE 6 0 0006	Physics (Mechanics and Thermal) Lab	1
ENME601002	Engineering Drawing	2
	Sub Total	**20**
	2nd Semester	
UIGE600001	Integrated Character Building A	6
UIGE600010-15	Relligion	2
ENGE 6 0 0002	Calculus 2	3
ENGE 6 0 0007	Physics (Electricity, MWO)	3
ENGE 6 0 0008	Physics (Electricity, MWO) Lab	1
UIGE600020 - 48	Sport / Art	1
ENME602003	Machine Drawing	2
ENME602004	Statics	2
	Sub Total	**20**
	3rd Semester	
ENME603005	Engineering Material	2
ENME603006	Mechanical Modelling and Visualization	2
ENME603007	Strength of Materials	2
ENGE 6 0 0009	Basic Chemistry	2
ENME603008	Basic Thermodynamics	4
ENGE 6 0 0010	Statistic and Probability	2
ENGE 6 0 0004	Linear Algebra	4
	Sub Total	**18**
	4th Semester	
ENME600009	Kinematics and Dynamics	4
ENME604010	Material Selection & Manuf. Process	4
ENME604011	Basic Fluid Mechanics	4
ENME604012	Mechanical Design	4
ENME600013	Engineering Mathematics	4
	Sub Total	**20**
	5th Semester	
ENME605014	Mechanical Vibration	2
ENME605015	Measurement and Metrology	2
ENME600016	Numerical Method	2
ENME605017	Heat and Mass Transfer	4
ENME605018	Fluid Systema	3
ENME605019	Control System	4
ENME600001	Design Assignment 1	2
ENME600007	Lab of Production Process	1
	Subtotal	**20**
	6th Semester	
ENGE 6 0 0012	HSE Protection	2
ENME606020	Maintenance & Machine Monitoring	3
ENME606021	Energy Conversion & Conservation	2
ENME606024	Life Science for Engineer	2
ENME606022	Mechatronics	4
ENME600002	Design Assignment 2	2
ENME606023	Electrical Power Engineering	2
ENME600008	Lab for Measurement and Metrology	1
	Subtotal	**18**
	7th Semester	
ENME600019	Laboratory Experiment for ECC	1
ENME600010	Lab for Electrical Power Engineering	1
ENME600003	On the Job Training	2
ENME600004	Seminar	1
	Electives	4
	Electives	4
	Subtotal	**13**
	8th Semester	
ENME600005	Final Project	5
ENME600006	Industrial Seminar	2
	Electives	4
	Electives	4
	Subtotal	**15**
	TOTAL	**144**

Resume

Wajib Universitas	18
Wajib Fakultas	30
Wajib Program Studi	80
Jumlah	128
Pilihan	16
Total Beban Studi	144

ELECTIVES

CODE	MATA AJARAN PILIHAN / ELECTIVES SEMESTER 7	Credit
	SUBJECT	
ENME801113	Ventilation & AC System	4
ENME803105	Internal Combustion Engine	4
ENME803106	Flow Measurement & Visualization	4
ENME803107	CFD Application	4
ENME803104	Thermal Power Generation	4
ENME803115	Clean Room	4
ENME803124	Energy Audit	4
ENME803134	Enclosure Fire Dynamics & Modelling	4
ENME803143	Mechanical Failure	4
ENME803145	Composite Product Development	4
ENME803147	Toy Production Design and Development	4
ENME803153	Machine Vision System	4
ENME803154	Quality & Production Manag. 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

KODE	MATA AJARAN PILIHAN / ELECTIVES SEMESTER 8	Credit
	SUBJECT	
ENME804110	Combustion Engineering	4
ENME804109	Heat and Mass Transfer Engineering	4
ENME804111	Aerodynamics Engineering	4
ENME804118	Mechanical system for Building	4
ENME802103	Energy System Optimization	4
ENME804138	Evaluation of Fire Protection System	4
ENME804148	Design For Manufacture and Assembly	4
ENME804149	Noise and Vibration	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 Stability and Control	4
ENME804190	Advanced Welding Engineering	4
ENME803108	Refrigeration Engineering	4

COURSE STRUCTURE INTERNATIONAL UNDERGRADUATE MECHANICAL ENGINEERING

KODE	SUBJECT	SKS
	1st Semester	
ENME611001	Introduction to Mechanical Engineering	2
UIGE610002	Academic Writing	3
ENGE 6 1 0001	Calculus 1	3
ENGE610005	Physics - Mechanics and Heat	3
ENGE610006	Physics - Mechanics and Heat Laboratory	1
ENME611002	Engineering Drawing	2
ENGE 6 1 0010	Statistic and Probability	2
ENGE 6 1 0004	Linear Algebra	4
	Subtotal	**20**
	2nd Semester	
UIGE610005-9	Religion	2
ENGE 6 1 0002	Calculus 2	3
ENGE610007	Physics - Electricity, MWO	3
ENGE610008	Physics - Electricity, MWO Laboratory	1
UIGE600020-48	Sport/ Art	1
ENME612003	Machine Drawing	2
ENME612004	Engineering Statics	2
ENME612005	Engineering Material	2
ENGE 6 1 0009	Basic Chemistry	2
	Subtotal	**18**
	3rd Semester	
ENME610013	Engineering Mathematics	4
ENME613006	Machanical Modelling and Visualization	2
ENME613007	Strength of Materials	2
ENME610016	Life Science for Engineer	2
ENME613008	Basic Thermodynamics	4
ENME613010	Material Selection and Manuf. Process	4
ENME613015	Measurement and Metrology	2
	Subtotal	**20**
	4th Semester	
ENME610009	Kinematics and Dynamics	4
ENME610007	Laboratory Experiment of Production Process	1
ENME614011	Basic Fluid Mechanics	4
ENME614012	Mechanical Design	4
ENGE 6 1 0012	Health, Safety and Environmental Protection	2
ENME616024	Numerical Method	2
ENME610008	Laboratory Experiment for Measurement and Metrology	1
	Subtotal	**18**
	5th Semester	

UIGE610004	Integrated Character Building Course B	6
ENME615014	Mechanical Vibration	2
ENME615017	Heat and Mass Transfer	4
ENME615018	Fluid System	3
ENME615019	Control System	4
ENME610001	Design Assignment 1	2
	Subtotal	**21**
	6th Semester	
UIGE610001	Integrated Character Building Course A	6
ENME616020	Maintenance and Machine Monitoring	3
ENME616021	Energy Conversion and Conservation	2
ENME616022	Mechatronics	4
ENME610002	Design Assignment 2	2
ENME616023	Electrical Power Engineering	2
	Subtotal	**19**
	7th Semester	
ENME610019	Laboratory Experiment for ECC	1
ENME610010	Laboratory Experiment for Electrical Power Engineering	1
ENME610003	On the Job Training	2
ENME610004	Seminar	1
	Elective # 1	4
	Elective # 2	4
	Subtotal	**13**
	8th Semester	
ENME610005	Final Project	5
ENME610006	Industrial Seminar	2
	Elective # 3	4
	Elective # 4	4
	Subtotal	**15**

Resume

Wajib Universitas	**18**
Wajib Fakultas	**30**
Wajib Program Studi	**80**
Jumlah	**128**
Pilihan	**16**
Total Beban Studi	**144**

MECHANICAL ENGINEERING

ELECTIVE COURSES

KODE	ELECTIVES FOR 7th SEMESTER	SKS
	SUBJECT	
ENME803105	Internal Combustion Engine	4
ENME803106	Applied Flow Measurement and Visualization	4
ENME803107	CFD Application	4
ENME803104	Thermal Power Generation	4
ENME803115	Clean Room	4
ENME803124	Energy Audit	4
ENME803134	Enclosure Fire Dynamics and Modelling	4
ENME803143	Mechanical Failure	4
ENME803145	Composite Product Development	4
ENME803147	Toy Production Design	4
ENME803153	Machine Vision System	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

KODE	ELECTIVES FOR 8th SEMESTER	SKS
	SUBJECT	
ENME804110	Combustion Engineering	4
ENME804109	Heat and Mass Transfer Engineering	4
ENME804111	Aerodynamics Engineering	4
ENME801113	Ventilation and Air Conditioning System	4
ENME804118	Mechanical system for Building	4
ENME802103	Energy System Optimization	4
ENME804138	Evaluation and Maintenance of Fire Protection System	4
ENME804148	Design For Manufacture and Assembly	4
ENME804149	Noise and Vibration	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 Stability and Control	4
ENME804190	Advanced Welding Engineering	4
ENME803108	Refrigeration Engineering	4

MECHANICAL ENGINEERING

Curriculum Design for Queensland University of Technology (QUT) 2+2

For Mechanical Engineering, the advanced standing is as follows (based on 2009 mechanical course structure at UI):

UI Units	QUT Units
MCS110802l + ENG100808l + ENG100807l + MCS210803l	ENB100, ENB200, ENB150
ENG100801l + ENG100804l + ENG200801l + MCS210810l	MAB126, MAB127, MAB233
ENG100805l+ MCS120801l	ENB130, ENB110
ENG200802l + EES21089l + EES210914l	ENB120
MCS220801l	ENB211
MCS120801l + MCS220802l + MCS320801l	ENB231, ENB331
MCS220804l	ENB221
MCS210802l	ENB222
MCS210803l + MCS220803l	ENB212, ENB215

Provisional Program at QUT

February Entry

Semester 1, Year 1		Semester 2, Year 1	
Code	Course Title	Code	Course Title
ENB311	Stress Analysis	ENB205	Electrical and Computer Engineering
ENB312	Dynamics of Machinery	ENB321	Fluids Dynamics
ENB316	Design of Machine Elements		Minor/Second Major 4
	Minor/Second Major 1		Minor/Second Major 2

Semester 1, Year 2		Semester 2, Year 2	
Code	Course Title	Code	Course Title
ENB421	Thermodynamics 2	ENB317	Design and Maintenance of Machinery
BEB801	Project 1	ENB313	Automatic Control
SEB400	Foundations of Research	BEB802	Project 2
	Minor/Second Major 3		Advance Selective

July Entry (preferred)

		Semester 2, Year 1	
		Code	Course Title
		ENB205	Electrical and Computer Engineering
		ENB321	Fluids Dynamics
			Minor/Second Major 4
			Minor/Second Major 2

Semester 1, Year 2		Semester 2, Year 2	
Code	Course Title	Code	Course Title
ENB311	Stress Analysis	ENB317	Design and Maintenance of Machinery
ENB312	Dynamics of Machinery	ENB313	Automatic Control
ENB316	Design of Machine Elements	BEB801	Project 1
	Minor/Second Major 1		Advance Selective

Semester 1, Year 3			
Code	Course Title		
ENB421	Thermodynamics 2		
BEB802	Project 2		
SEB400	Foundations of Research		
	Minor/Second Major 3		

New QUT Units Name:
BEB801 Project 1
Synopsis: This unit is usually taken in the final year of study. Students complete an individual project involving the application of skills and knowledge attained during the earlier years of their degree program. For some students, this unit will be taken one of two 'project' units related to the same student project; in such cases this unit may be a pre-requisite or co-requisite to the second unit (or a follow-on from the first unit). The final 'deliverable' for this unit may vary for each discipline and details will be provided in lectures/tutorials and on the Blackboard website.

BEB802 Project 2
Synopsis: This unit is usually taken in the final year of study, and is only taken by students completing a two unit project. Students complete an individual project involving the application of skills and knowledge attained during the earlier years of their degree program. This unit will be taken as the second of two 'project' units related to the same student project.

SEB400 Foundations of Research
Synopsis: This unit facilitates the acquisition of knowledge and skills essential to engaging with, and conducting research. This unit introduces you to the research process, project planning and management, and methodologies used in science, information technology, engineering, mathematics, urban development and property economics. The learning acquired in this unit will be applied to your project which is further developed in the Research units.

Curriculum Design for University of Queensland (UQ) 2+2

Course list for the Mechanical Engineering Single Major

Show information for:

Information valid for students commencing 2016

Mechanical Engineering
Students must complete for the BE(Hons) (Mechanical Engineering) a Single Major (Plan code: MECHAX2342) or Extended Major (Plan code: MECHAY2342), #64 comprising one of the following:
1. a. a major - #50, comprising all compulsory courses listed in Part A of the Me-

chanical Engineering lists; and

b. balance from electives, being courses from the BE(Hons) list or other courses approved by the executive dean, with

(i) a minimum of #6 from courses on the BE(Hons) list, other than courses on the Mechanical Engineering Part B0 list, and

(ii) a maximum of #4 from courses from part B0 of the Mechanical Engineering list, and

(iii) a maximum of #4 from level one courses not on the BE(Hons) list;

OR

2. a. an extended major - #60, comprising

(i) #50 being all courses in part A compulsory;plus

(ii) #10 from part B Electives under Extended Major; and

b. balance from electives, being courses from the BE(Hons) list or other courses approved by the Executive Dean.

Part A – Compulsory

Year 1, Semester 1		
Course Code	**Units**	**Course Title**
ENGG1100	2	Engineering Design
Year 1, Semester 1 or 2		
Course Code	**Units**	**Course Title**
ENGG1300	2	Introduction to Electrical Systems
ENGG1400	2	Engineering Mechanics: Statics & Dynamics
ENGG1500	2	Engineering Thermodynamics
MATH1051	2	Calculus & Linear Algebra I [1]
Year 1, Semester 2		
Course Code	**Units**	**Course Title**
ENGG1200	2	Engineering Modelling & Problem Solving
MATH1052	2	Multivariate Calculus & Ordinary Differential Equations
Year 2 Semester 1		
Course Code	**Units**	**Course Title**
MATH2000 MATH2001	2 2	Calculus & Linear Algebra II or Advanced Calculus and Linear Algebra
MECH2300	2	Structures & Materials
MECH2305	2	Introduction to Engineering Design and Manufacturing
MECH2410	2	Fundamentals of Fluid Mechanics

Year 2 Semester 2		
Course Code	**Units**	**Course Title**
MECH2100	2	Machine Element Design
MECH2210	2	Intermediate Mechanical & Space Dynamics
MECH2700	2	Engineering Analysis I
Year 3 Semester 1		
Course Code	**Units**	**Course Title**
MATH2010	1	Analysis of Ordinary Differential Equations
MECH3300	2	Finite Element Method & Fracture Mechanics
MECH3400	2	Thermodynamics & Heat Transfer
MECH3600	2	Engineering Management & Communication
STAT2201	1	Analysis of Engineering & Scientific Data
Year 3 Semester 2		
Course Code	**Units**	**Course Title**
MECH3100	2	Mechanical Systems Design
MECH3200	2	Advanced Dynamics & Vibrations
MECH3410	2	Fluid Mechanics
Year 3 or 4 #2 from -		
Course Code	Units	Course Title
MECH3250	2	Engineering Acoustics
MECH3750	2	Engineering Analysis II
ENGY4000	2	Energy Systems
METR3100	2	Sensors & Actuators
Year 4		
Course Code	**Units**	**Course Title**
METR4201	2	Introduction to Control Systems
and at least #4 from -		
Course Code	Units	Course Title
ENGG4011	6	Professional Engineering Project
MECH4500	4	Engineering Thesis [2]
MECH4501	4	Engineering Thesis [2]
MECH4552	4	Major Design Project [2]
Part B Electives Part B0 - Preparatory Mathematics & Science Electives		
CHEM1090	2	Introductory Chemistry [3]
MATH1050	2	Mathematical Foundations [1] [4]
PHYS1171	2	Physical Basis of Biological Systems [5]

Extended Major

Students enrolled in the extended major are required to obtain the major plus an additional #10 from introductory or advanced electives from Part B1 or B2, including a minimum of #8 from Part B2. Students participating in the CEED program and undertaking #6 ENGG4011 are only required to obtain an additional #8 towards the extended major, including a minimum of #6 from Part B2.

B1 - Introductory Electives		
Course Code	Units	Course Title
CHEM1100	2	Chemistry 1
CSSE1001	2	Introduction to Software Engineering
ENGG1600	2	Introduction to Research Practices - The Big Issues
PHYS1002	2	Electromagnetism and Modern Physics
B2 - Advanced Electives		

Course Code	Units	Course Title
AERO4300	2	Aerospace Composites
CHEE4302	2	Electrochemistry & Corrosion
ELEC2003	2	Electromechanics & Electronics
ENGG4103	2	Engineering Asset Management
ENGG4900	2	Professional Practice and the Business Environment
ENGY4000	2	Energy Systems
FIRE3700	2	Introduction to Fire Safety Engineering
MECH3250	2	Engineering Acoustics
MECH3305	2	Science & Engineering of Metals
MECH3750	2	Engineering Analysis II
MECH4301	2	Materials Selection
MECH4304	2	Net Shape Manufacturing
MECH4450	2	Aerospace Propulsion
MECH4470	2	Hypersonics & Rarefied Gas Dynamics
MECH4480	2	Computational Fluid Dynamics
MECH4552	4	Major Design Project [2]
MECH4800	2	Space Engineering
MECH4950	2	Special Topics C
MECH4951	1	Special Topics D
METR3100	2	Sensors & Actuators
METR4202	2	Advanced Control & Robotics
TIMS3309	2	Fundamentals of Technology and Innovation Management

End notes
- [1] Students without at least a Sound Achievement in Senior Maths C are required to take MATH1050 as an elective before MATH1051
- [2] This course is offered over more than one semester. Enrol in the same course code in each semester.
- [3] CHEM1090 is not available for students with a Sound Achievement or higher in Senior Chemistry or equivalent.
- [4] MATH1050 is not available for students with a High Achievement or higher in Senior Maths C. MATH1050 is not available to students who have passed MATH1051 and/or MATH1052.
- [5] PHYS1171 is not available for students with a Sound Achievement or higher in Senior Physics or equivalent.

SYLLABUS OF UNIVERSITY SUBJECTS

INTEGRATED CHARACTER BUILDING A
UIGE600001/UIGE610001
6 sks
Syllabus : Integrated Character Building A facilitates students to understand the basics of character formation and master the basics of cognitive power that is logic. Furthermore, to apply cognitive powers in generating good behaviors which are useful to themselves and society. The establishment of ethical behaviors based on ethics is also facilitated. Students are able to develop the basic strength of character and to know themselves as a human being, both as individuals and as part of a group so that they can develop themselves well enough. In a group, the students need to have skills that are needed to maintain an effective relationship in order to improve the quality of human life. Particularly as a citizen of Indonesia, students need to understand the nature of citizenship and basic philosophy of Pancasila in order to act and behave in accordance with the character of the Indonesian nation.
Core Competencies :
1. Students are able to analyze problems in depth individually, comprehensively, logicaly and critically, and generate solutions using the logical and ethical principles and rules of logic and ethics
2. Students are capable of analyzing the problem individually, thoroughly and deeply about the human being as an individual or as part of group
3. Students are individually able to understand, make critical reasoning and to build an open and critical mind to the problem of nationhood, statehood and citizenship in this dynamic world situation
4. Students are able to create and display a work that depicts the character in accordance with the principles of Pancasila

Learning Method : interactive lecture, Experiential Learning, Collaborative Learning, Problem Based Learning, Project-Based Assignment
Prerequisites : OBM (New Student Orientation)

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))

INTEGRATED CHARACTER BUILDING B
UIGE600002/UIGE610004
6 sks
Syllabus : Integrated Character Building B facilitates students to practice identifying, analyzing, and resolving problems of nature and the environment by making use of integrative and quantitative information. This lecture aims to prepare the future generation who care about nature issues through the balanced development of hard skills and soft skills and have the skills of ICT (Information and Communication Technology).
Core Competencies:
1. Students have an ethic, moral, personality and good character in completing the task at hand;
2. Students role as citizens who take pride and love of the homeland and support the continuity of life;
3. Students are able to work together and have a high sensitivity and awareness to the community and the environment;
4. Students are able to think logically, critically and creatively;
5. Students are able to use mathematics to solve problems quantitatively;
6. Students are able to use information and communication technology (ICT) for development;
7. Students are able to analyze the system of nature integratively and comprehensively;
8. Students are able to act as wise managers of nature to build and maintain the preservation of nature for a better and sustainable life.

Learning Method : Blended e-Learning, Collaborative Learning (CL), Problem Based Learning (PBL) and Group Discussion (GD)
Prerequisites : OBM (New Student Orientation)
Textbook : Digital Form can be downloaded from Scele

ISLAMIC STUDY
UIGE600010/UIGE610005
2 sks
General instructional objectives : The cultivation of students who have concern for social, national 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 practice 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)

UNDERGRADUATE PROGRAM

CATHOLIC STUDY
UIGE600011/UIGE610006
2 sks
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 STUDY
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 STUDY
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 STUDY
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

MECHANICAL ENGINEERING

FACULTY OF ENGINEERING

(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
2 sks

ART
UIGE600020-30
1 sks
The option of subjects that can be choosen :
Appreciation of Film (UIGE600020), Batik (UIGE600021), Photography (UIGE600022), Calligraphy (UIGE600023), Javanese Karawitan (UIGE600024), Balinese Dance and Karawitan (UIGE600025), Comic (UIGE600026), Painting (UIGE600027), Music and Vocal (UIGE600028), Theater (UIGE600029), Wayang (UIGE600030)

SPORT
UIGE600040-48
1 sks
The option of subjects that can be choosen :
Basketball (UIGE600040), Volley Ball (UIGE600041), Badminton (UIGE600042), Futsal (UIGE600043), Hockey (UIGE600044), Football (UIGE600045), Softball (UIGE600046), Tennis (UIGE600047), Table Tennis (UIGE600048)

SYLLABUS OF BASIC ENGINEERING SUBJECTS

CALCULUS 1
ENGE600001/ENGE610001
3 sks
Syllabus : This subject gives the opportunity for students to understand the basic concept of calculus and to be able to solve applied calculus problems. Students are also given the opportunity to understand basic concepts the functions of one variable, derivatives and integral functions of one variable, and its application.

CALCULUS 2
ENGE600002/ENGE610002
3 sks
Syllabus : This subject gives the opportunity for students to understand the basic concept of calculus and to be able to solve applied calculus problems. Students are also given the opportunity to understand the basic concept the function of two variables, or variables, total derivative and integral of the function of two or more variables and application. In addition, students can understand the basic concepts of sequence and series.

CALCULUS
ENGE600003/ENGE610003
4 sks
Syllabus : This subject gives the opportunity for students to understand the basic concept of calculus and to be able to solve applied calculus problems. Students are also given the opportunity to understand the basic concept the function of two variables, the total derivative of the function of two or more variables and its application. Students are also expected to understand the basic concept of sequence and series and the basic concept of vector and analytical geometry.

LINEAR ALGEBRA
ENGE600004/ENGE610004
4 sks
Syllabus : This subject gives the opportunity for students to master the basic techniques of Linear Algebra and gain knowledge on how to implement said techniques in solving System of linear equationss, determining the bases and dimension of vector space, as well as calculating eigen values and eigen vectors. This subject also gives students the opportunity to work with other objects, especially vectors and matrices.

PHYSICS (MECHANICS AND THERMAL)
ENGE600005/ENGE610005
3 sks
Syllabus : Physics (Mechanics and Thermal) subject includes the topics of mechanics and thermodynamics. Calculus is use as a mathematic helping tool in the learning process. Students are given the opportunity to learn how to unite their understanding of the basic concept of the analytical capability, their numeracy in learning mechanics and thermodynamics. During the course of this subject, students are not only aim to increase the students' knowledge of the basic physics concepts but also to increase their capability in using information technology and computer and to train their skills, such as: independent and group work and their communication skill.
Students will also be train on how to explain and analyse the nature phenomenon and the result of human engineering exist in their everyday lives by using the basic physics concept and applied them in their daily lives. Students are also taught to develop their synthesis ability and evaluating both quantitative and qualitative natural phenomenon and the result of human engineering in their surrounding environment by using basic physics concept. This subject will give students the opportunity to develop their ability to develop their presentation ability analyse the nature phenomenon and the result of human engineering from the mathematics and natural science point of view integrative and comprehensively.

PHYSICS (MECHANICS AND THERMAL) LABORATORY
ENGE600006/ENGE610006
1 sks
Syllabus : Practical of Mechanics: Measurement, Moment of inertia, Gravity acceleration, Fluid density, Scratch coefficient, Collision, Swing torque, Viscosity of water, Young's modulus, Viscosity of Newtonian fluid, Fluids surface tension, Oscillation, Practical of Heat: Coefficient of linear expansion, Heat conductivity, Thermocouple calibration, Calorimeter, Joule Constant, Laplace Constant, Heat Collector, Determining of air Cp/Cv, Expansion of fluids and water anomaly.
Notes: For Architecture and Interior Architecture Program, practical is not mandatory.

PHYSICS (ELECTRICITY, MWO)
ENGE600007/ENGE610007
3 sks
Syllabus : Physics (Electricity, MWO) subject includes the topics of electricity, magnet, wave, and optics. Calculus is use as a mathematic helping tool in the learning process. Students are given the opportunity to learn how to unite their understanding of the basic concept of the analytical capability, their numeracy in learning mechanics and thermodynamics. During the course of this subject, students are not only aim to increase the students' knowledge of the basic physics concepts but also to increase their capability in using information technology and computer and to train their soft skills, such as: independent and group work and their communication skill. Students will also be train on how to explain and analyze the nature phenomenon and the result of human engineering exist in their everyday lives by using the basic physics concept and applied them in their daily lives. Students are also taught to develop their synthesis ability and evaluating both quantitative and qualitative natural phenomenon and the result of human engineering in their surrounding environment by using basic physics concept.

PHYSICS (ELECTRICITY, MWO) LABORATORY
ENGE600008/ENGE610008
1 sks
Syllabus : Practical of Electricity: Electrolysis, Wheatstone bridge, Kirchhoff law, Earth's magnetic field, Temperature coefficient, Characteristic of series RLC circuit, Ohm law, Transformer. Practical of Optics: Polarimeter, Lens, Photometry, Prisms bias index, Spectrometer, Diffraction grid, Newton's ring.

BASIC CHEMISTRY
ENGE600009/ENGE610009
2 sks
Syllabus : As an engineer, you must have understanding on the chemistry that provides not only the basis for much of what goes on in our world but also that it is a vital, continually developing science. In this study the students will learn many subjects such as matter and measurement; atoms, molecules, and ions; stoichiometry; aqueous reactions; thermochemistry; properties of solutions; chemical kinetics; chemical equilibrium; and electrochemistry.
Learning activities will be conducted through various method, which consists of: problem based learning (PBL), interactive lecture, question-based learning, discussion, demonstration and unguided structured assignments. Assessment will be made continuously through a set of exercises, group discussion, mid semester exam and final exam.

STATISTIC AND PROBABILITY
ENGE600010/ENGE610010
2 sks
Syllabus : Statistics and probability has been known as applied mathematics which is widely used in collecting, organizing, presenting, interpreting and analyzing data to support valid conclusions. Furthermore, these conclusions will be used as recommendation in decision making. The course of Statistics and Probability is intended to give a basic ability for students to handle quantitative data and information. There are two stages that are delivered which is descriptive and inductive/inference stages. Descriptive stage includes collecting, organizing, and presenting the data in a scientific manner. Then, inductive/inference stage includes the process of estimating and drawing conclusion based on available data and relations between variables. Hence, students are expected to apply their knowledge of statistics in conducting experiments in laboratory works/assignments as well as research studies in their final projects.

ENGINEERING ECONOMICS
ENGE600011/ENGE610011
3 sks
Syllabus : This course introduces students to the basic of engineering economy. It covers the time value of money (TVOM) and interest rate; tools for evaluating project alternatives for both non discounted and discounted methods, for instance present worth analysis, annual worth analysis, future worth analysis, rate of return (ROR) analysis and benefit/cost analysis; and choosing the best alternative, break even analysis, and effect of depreciation and after tax analysis and sensitivity analysis, and replacement analysis.
Learning activities will be conducted through various methods, which consist of: interactive lectures, question-based learning, discussion, and structure assignments. Assessment will be made thoroughly through sets of exercises/quizzes, group discussion, midterm and final exam. To expose students on the latest utilization of engineering economy and train them how to use it, a project will be assigned. As an integral part of course, computer utilization such as Microsoft Excel will be demonstrated and discussed on the class.

HEALTH, SAFETY AND ENVIRONMENTAL PROTECTION
ENGE600012/ENGE610012
2 sks
Syllabus : The teaching of Safety, Health and Environmental (SHE) protection to undergraduates studying engineering courses is an important part of the education of future engineers at all levels. It is the generally expressed view amongst practitioners in industry, business and other organisations that all engineers need to be equipped to appreciate, understand and implement the requirements of SHE management and practice to meet the working needs of industry and of their company (or other organisation). Whilst the level of risk and degree of control is dependant on the industry sector concerned the basic principles do not change. In addition, according to code of ethics of engineers, engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties.
The module covers the regulation framework and standards, risk perception, assessment, and management and detail discussion on physical, chemical and process hazards, and related engineering and management controls. Maintenance of safety conditions, personal protective equipments, audit, incident and emergency planning are discussed in accordance to measures for improving students awareness to their daily activities within the campus premises and local environment.
Learning activities will be conducted through various methods, which consist of: interactive lecture, question-based learning, discussion, demonstration and unguided structured assignments. Assessment will be made continuously through a set of exercises, group discussion, mid semester exam and final exam

COURSE DESCRIPTION

ENME601001 – INTRODUCTION TO MECHANICAL ENGINEERING (2 SKS)
Learning Objective(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. Memberikan gambaran tentang keilmuan teknik mesin dengan menjabarkan ruang lingkup, bidang, serta hubungan dengan keilmuan lain. Melalui mata ajaran ini, diharapkan mahasiswa memahami aplikasi dan keilmuan teknik mesin di berbagai sektor
Syllabus:
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): -
Text Book(s):

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 K. Antonsson. Springer handbook of mechanical engineering. Vol. 10. Springer Science & Business Media, 2009.

ENME601002 – ENGINEERING DRAWING (2 SKS)
Learning Objective(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.
Syllabus:
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): -
Text Book(s):
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.

ENME602003 – MECHANICAL DRAWING (2 SKS)
Learning Objective(s):
Students have the basic ability to visualize the information content of one component effectively, capable to create a model for 2D and 3D visualization with utilize the software and interprete the subject into a drawing that can be used as working guidance and can be understand clearly by the user.
Syllabus:
The purpose and the advantage of the drawing in the design and manufacturing process, surface working quality and tolerance, standard and marking classification of working quality, standard and marking classification of working tolerance, Welding construction, standard and marking of weld groove, line diagram, 2D and 3D representation method, introduction to modeling software interface, modeling, manipulation and 2D & 3D visualization.
Pre-requisite(s): Engineering Drawing, Introduction to Mechanical Engineering
Text Book(s):
1. A.W. Boundy, Engineering Drawing, McGraw-Hill Book Company
2. Colin Simmons & Dennis Maguire, Manual of Engineering 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..

ENME602004 – ENGINEERING STATICS (2 SKS)
Learning Objective(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.
Syllabus:
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
Text Book(s):
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

ENME603005 – ENGINEERING MATERIAL (2 SKS)
Learning Objective(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. **Syllabus:**
Introduction to the importance of the engineering material science in mechanical engineering, 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): -
Text Book(s):
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

ENME603006 – MECHANICAL VISUALIZATION AND MODELING (2 SKS)
Learning Objective(s):
This course will give the understanding of any respond of solid material when it is given the specific thermal and mechanical load.
Syllabus:
Introduction of physical mechanism related to the design of material properties, such as,rigidity, strength, toughness and endurance; understanding of basic mechanical properties of material, testing procedure for determining the properties, every properties that influence the material responses; material capability in engineering design; and fundamental principle to choose the material in mechanical design.
Pre-requisite(s): Mechanical Drawing, Engineering Statics
Text Book(s):
1. Lardner, T. J., R. R. Archer, S. H. Crandall, and N. C. Dahl. An Introduction to the Mechanics of Solids. 2nd ed. New York: McGraw-Hill Primis Custom Publishing, 1999. ISBN: 9780072380415.
2. Dowling, N. E. Mechanical Behavior of Materials. 2nd ed. Upper Saddle River, NJ: Prentice-Hall, 1998. ISBN: 9780139057205.
3. Ashby, M. F., and D. R. H. Jones. Engineering Materials 1: An Introduction to their Properties and Applications. 2nd ed. Oxford, UK: Butterworth-Heinemann, 1996. ISBN: 9780750627665.
4. Bowman, Keith. Mechanical Behavior of Materials. Hoboken, NJ: John Wiley & Sons, 2003. ISBN: 9780471241980.

ENME603007 – STRENGTH OF MATERIALS (2 SKS)
Learning Objective(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.
Syllabus:

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
Text Book(s):

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.

ENME603008 – BASIC THERMODYNAMICS (4 SKS)
Learning Objective(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.
Syllabus :
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): -
Text Book(s):

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

ENME600009 – KINEMATICS AND DYNAMICS (4 SKS)
Learning Objective(s):
The students have the ability to understand the key concept of kinematics and dynamics of mechanical system and capable to analyse the movement, velocity, acceleration force and equilibrium.
Syllabus:
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 Giroscope.
Pre-requisite(s): Engineering Statics
Text Book(s):

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.

ENME604010 – MATERIAL SELECTION AND MANUFACTURING PROCESS (4 SKS)
Learning Objective(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.
Syllabus:
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): Material Teknik
Text Book(s):

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

ENME600007 – LABORATORY EXPERIMENT FOR MANUFACTURING PROCESS (1 SKS)
Learning Objective(s):
This course is laboratory practice for Material Selection and Manufacturing Process course. After this course, student can have practical ability of manufacturing process of product by considering the technology and material.
Syllabus:
Laboratory practice usingn manual machine tool for workbench such as turning machine, drilling, milling, sawing, etc., welding process; rapid prototyping
Pre-requisite(s): Material Selection and Manufacturing Process
Text Book(s):

1. Buku Panduan Praktikum Proses Produksi, Departemen Teknik Mesin FTUI.

ENME604011 – BASIC FLUID MECHANICS (4 SKS)
Learning Objective(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.
Syllabus:

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): -
Text Book(s):
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, K.L., Engineering Fluid Mechanics, Eurasia Publishing House Ltd., 2010

ENME604012 – MECHANICAL DESIGN (4 SKS)
Learning Objective(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.
Syllabus:
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 Visuzalization and Modelling,Strength of Material
Text Book(s):
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

ENME600013 – ENGINEERING MATHEMATICS (4 SKS)
Learning Objective(s):
Complete student's anylitical ability. Students understand and able to use the advances mathematical concepts in order to solve the engineering problems.
Syllabus:
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
Text Book(s):
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

ENME605014 – MECHANICAL VIBRATION (2 SKS)
Learning Objective(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.
Syllabus:
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
Text Book(s):
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.

ENME605015 – MEASUREMENT AND METROLOGY (2 SKS)
Learning Objective(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
Syllabus:
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): -
Text Book(s):
1. Busch, Ted, Fundamentals of Dimensional Metrology, 4th Ed, Delmar Publishers
2. Fargo F.T., Curtis, M.A., Handbook of Dimensional Measurement, 5th Ed, Industrial Press. 2013.
3. Slocum, A., Precision Machine Design, SME Press, 1992.
4. Raldi Artono Koestoer, Pengukuran Teknik, Departemen Teknik Mesin FTUI.

ENME600008 – LABORATORY EXPERIMENT FOR MEASUREMENT AND METROLOGY (1 SKS)
Learning Objective(s):
This course is laboratory practice for Measurement and Metrology course. By this course, student can study the technical application of metrology, sensors and tranducer and how to use it in measurement system.
Syllabus:
Laboratory practice to use metrology tool; practice to use some sensors such as temperature and pressure.
Pre-requisite(s): Measurement and Metrology

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Text Book(s):
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.

ENME600016 – NUMERICAL METHODS (2 SKS)
Learning Objective(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.
Syllabus:
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): -
Text Book(s):
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

ENME605017 – HEAT AND MASS TRANSFER (4 SKS)
Learning Objective(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.
Syllabus:
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
Text Book(s):
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.

ENME605018 – FLUID SYSTEM (3 SKS)
Learning Objective(s):
Fluid system 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.
Syllabus:
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
Text Book(s):
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, McGraw-Hill, 2013

ENME605019 – CONTROL SYSTEM (4 SKS)
Learning Objective(s):
System control is one of the sciences discussed about the method to control the value of parameters within a system. Parameters within the system in this course are base on physic that could be position, velocity, rotation, pressure, acceleration flow rate, temperature and other variables. This course aims for students to understand the basics, analysis, and engineering design and control system compensation techniques, and be able to choose a control system (controller) is right for a mechanical system.
Syllabus:
Introduction to system control, laplace transform, reverse laplace transform, solution for linier ordinary differential equation, mathematical modeling I-IV, control action, PID controller, electronic controller, pneumatic and hydraulic control, transient response analysis I and II, root place analysis, design of system control with root place analysis method, frequency response analysis, stability analysis, MATLAB laboratory activity, design of control system with response frequency method, discrete time system and Z-Transform, PID control and introduction to robust control, space condition analysis I-II, design of control system within space condition, liapunove stability analysis and optimum square control.
Pre-requisite(s): Engineering Mathematics, Basic Physics 1, Basic Physics 2
Text Book(s):

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 K., Analysis of Linear System, Addison–Wesley P. C., Inc.

ENME600001 – DESIGN ASSIGNMENT 1 (2 SKS)
Learning Objective(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.
Syllabus:
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
Text Book(s):
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.

ENME606020 – MAINTENANCE AND CONDITION MONITORING (3 SKS)
Learning Objective(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.
Syllabus:
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
Text Book(s):
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 K. Pathak, Maintenance Engineering and Management, PHI, 2004
4. Bruel & Kjaer. Handbook of Vibration & Condition Monitoring

ENME606021 - ENERGY CONVERSION AND CONSERVASION (3 SKS)
Learning Objective(s):
This course discusses about the energy resources, type and classification of energy, energy

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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 conservasion of energy system, and also capable to perform a basic calculation of energy conversion engine performance and critical consideration of energy conversion.
Syllabus:
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
Text Book(s):
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.

ENME600009 – LABORATORY EXPERIMENT FOR ENERGY CONVERSION AND CONSERVASION (1 SKS)
Learning Objective(s):
This course is laboratory practice for Energy Conversion and Conservation course. By this course, student can understand practical applicaton of energy conversion and conservation
Syllabus:
Laboratory practice of compressor, Pelton turbine, axial turbine, heat pump, Refrigeration Training Unit, Diesel engine, Otto engine, sentrifugal pump
Pre-requisite(s): Konversi dan Konservasi Energi
Text Book(s):
1. Panduan Praktikum Prestasi Mesin Konversi energi, Departemen Teknik Mesin versi 2003. Depok 2003.

ENME606022 – MECHATRONICS (4 SKS)
Learning Objective(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.
Syllabus:
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
Text Book(s):
1. Smaili A. dan Mrad F., Applied Mechatronics, Oxford University Press, 2007

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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

ENME606023 – ELECTRICAL POWER ENGINEERING (2 SKS)
Learning Objective(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.
Syllabus:
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): -
Text Book(s):
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

ENME600010 – LABORATORY EXPERIMENT FOR ELECTRICAL POWER ENGINEERING (1 SKS)
Learning Objective(s):
The laboratory is intended to introduce electric power basic concept to electrical engineering students : motor and generator includes DC or AC transformator
Syllabus:
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
Text Book(s):
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

ENME606024 – LIFE SCIENCE FOR ENGINEERS (2 SKS)
Learning Objective(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.
Syllabus:
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): -
Text Book(s):
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

ENME600002 – DESIGN ASSIGNMENT 2 (2 SKS)
Learning Objective(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.
Syllabus:
Product Generation, Evaluation and Performance; Project Management; Product Evaluation or Mechanical System for Cost, Manufacutring, Assembling etc; Technopreneurship consideration.
Pre-requisite(s): Design Assingment 1
Text Book(s):
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.

ENME600006 – INDUSTRIAL SEMINAR (2 SKS)
Learning Objective(s):
Able to understand industrial development and its problems.
Syllabus:
Special topics in industries which are not covered in other courses.
Pre-requisite(s): Passed 76 SKS and GPA > 2.00
Text Book(s): -

ENME600003 – INTERNSHIP (2 SKS)
Learning Objective(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.
Syllabus:
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

ENME600004 - SEMINAR (1 SKS)
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

Syllabus:

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 SKS and GPA > 2.00 without Grade E

Text Book(s): -

ENME600005 – FINAL PROJECT (5 SKS)

Learning Objective(s):

Students are able to conduct design and analysis the object of system that related to the mechanical engineering field

Syllabus:

Synthesizing various lectures taken by students to design or to solve engineering problems. Preparing a written report of the synthesis.

Pre-requisite(s): Passed 128 SKS and GPA > 2.00 without Grade E

ELECTIVES

ENME803105 – INTERNAL COMBUSTION ENGINE (4 SKS)

Learning Objective(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.

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): -

Text Book(s):

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.

ENME803106 – APPLIED FLOW MEASUREMENT AND VISUALIZATION (4 SKS)

Learning Objective(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.

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 Assitested Method.

UNDERGRADUATE PROGRAM

Pre-requisite(s): Fluid Mechanics, Fluid System

Text Book(s):

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

ENME803107 – CFD APPLICATIONS (4 SKS)

Learning Objective(s):

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): -

Text Book(s):

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.

ENME803108 – REFRIGERATION ENGINEERING (4 SKS)

Learning Objective(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

Text Book(s):

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.

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MECHANICAL ENGINEERING

ENME803104 – THERMAL POWER GENERATION (4 SKS)
Learning Objective(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.
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): -
Text Book(s):

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.

ENME801113 – VENTILATION AND AIR CONDITIONING SYSTEM (4 SKS)
Learning Objective(s) :
This course provide the understanding and basic competence in design the air conditioning system regarding a better air condition. The student will provided with knowledge about the environmentally friendly regrigerant.
Syllabus :
Basic of Air Conditioning: Air Cooled dan Water Cooled Chiller, Packaged Unit, Direct Expansion and Split Unit; Basic VAC Calculation : Design Condition, Load Estimating, Cooling Load; Sistem Ventilasi : Air Changes, Outdoor Air Requirement, Indoor Air Quality. Clean Space and Air Filter System in industry and hospotal; distribution system: Equal Friction Method and Static Regain, Duct and Piping Sizing; Air Conditioning System Components : Chiller, Cooling Tower, Fan, S and AHU; Control System in Building.
Pre-requisite(s): Refrigeration System
Text Book(s) :

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.

ENME803115 – CLEAN ROOM (4 SKS)
Learning Objective(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.
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): -
Text Book(s):

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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.

ENME803124 – ENERGY AUDIT (4 SKS)
Learning Objective(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.
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): -
Text Book(s):

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.

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ENME803134 – ENCLOSURE FIRE DYNAMICS AND MODELLING (4 SKS)
Learning Objective(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.
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): -
Text Book(s):

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.

ENME803143 - MECHANICAL FAILURE (4 SKS)
Learning Objective(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.
Syllabus:
Theory and Buckling Mode (Torsional-lateral, Plastic, Dynamic), Theory and Corrosion mode

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(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 Material, Basic Mechanical Design, Mechanical Design
Text Book(s):

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

ENME803145 - COMPOSITE PRODUCT DEVELOPMENT (4 SKS)
Learning Objective(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.
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, Design Assignment.
Text Book(s):

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

ENME803147 - TOY PRODUCTION DESIGN (4 SKS)
Learning Objective(s):
Understanding the basics and design development of educational products in the industry props, product education, and game props.
Syllabus:
Brainstorming and express the ideas and opinions, Innovation and Development Themes, Basics of Toy Product Design, Basic Design Engineering and Mechanical, Basic Theory Make Sketch, Process Modeling Sketch Image, Design Aesthetics, Theory of Manufacturing and Selection of Materials for Viewer tool Games, Basic Theory Creation prototype, Portfolio Design, Presentation and Pitching Idea.
Pre-requisite(s): -
Text Book(s):

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.

ENME803153 - SISTEM MACHINE VISION (4 SKS)
Learning Objective(s):
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): -
Text Book(s):

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.

ENME803154 - QUALITY AND PRODUCTION MANAGEMENT SYSTEM (4 SKS)
Learning Objective(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.
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): -
Text Book(s):

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

ENME803161 – MICROFABRICATION AND PRECISION MANUFACTURING (4 SKS)
Learning Objective(s):
In this course provides expertise of micro manufacturing process widely used in the making 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): Basic mechanical design, Mechatronics, Design assignment, Metrology and Measurement, Engineering Materials, Manufacturing Process and Materials Selection

Text Book(s):

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

ENME803167 – MODERN VEHICLE TECHNOLOGY (4 SKS)

Learning Objective(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.

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): -

Text Book(s):

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.

ENME803195 – OIL AND GAS DRILLING EQUIPMENT (4 SKS)

Learning Objective(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.

Syllabus:

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): -

Text Book(s):

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

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6. Amanat U.C., "Gas Well Testing handbook", Elsevier, 2004

ENME803174 – RISK MANAGEMENT (4 SKS)
Learning Objective(s):
Students can explain and apply risk management in a risk assessment.
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 system, Operational Risk and its Basel II requirements.
Pre-requisite(s): -
Text Book(s):
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

ENME804110 – COMBUSTION ENGINEERING (4 SKS)
Learning Objective(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.
Syllabus:
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 Chemistry, Basic Thermodynamics, Basic Fluid Mechanic, Heat and Mass Trasnfer.
Text Book(s):
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.

ENME804109 – HEAT AND MASS TRANSFER ENGINEERING (4 SKS)
Learning Objective(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.
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, Fluid Mechanics
Text Book(s):
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.

ENME804111 – AERODYNAMICS ENGINEERING (4 SKS)
Learning Objective(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.
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): Fluid Mechanics, Basic Thermodynamics
Text Book(s):
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.

ENME804118 – BUILDING MECHANICAL AND ELECTRICAL SYSTEM (4 SKS)
Learning Objective(s):
The course's objective is to deliver knowledge, skills and understanding of the mechanical and electrical systems in a modern building that has been increasing in its requirements in terms of sophistication, efficiency, and low energy use.
Syllabus:
General Building Mechanical System, Plumbing System: SNI, Calculation, Waste Water Management, Building Energy System; Building Automation System; Lift and Escalator: Types, Round Trip Time, Handling Capacity, Waiting Time, Installation and Control System; Escalator Types, Application and Installation, Building Automation System,
Pre-requisite(s): -

Text Book(s):

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

ENME802103 - ENERGY SYSTEM OPTIMIZATION (4 SKS)

Learning Objective(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.

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): Matematika Teknik, Termodinamika Dasar, Mekanika Fluida.

Text Book(s):

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.

ENME804138 – EVALUATION AND MAINTENANCE OF FIRE PROTECTION SYSTEM (4 SKS)

Learning Objective(s):

Students understand the basic and important parameters in the process of fire and fire hazards. Students have the competency on the regulations and standards on the testing of material of the fire and the design of fire protection systems. Students have the expertise in specialized skills in fire modeling, designing and analyzing the protection system against fire. Students know the role of safety management on the fire hazard in ensuring the industry and high rise building operations.

Syllabus:

Introduction of Fire Process; Fire Dynamics; dangerous Elements Release in Fire; Fire Modeling Theory; Fire Modeling with Computer Program; Material Testing Method for Fire Hazard; Fire Detection Systems; Standard Rules on Fire Hazard; Fire Protection System Design Fire, Fire Fighting Systems: Hydrant and Sprinkler System; Analysis of Fire Risk in Buildings.

Pre-requisite(s): -

Text Book(s):

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

ENME804148 - DESIGN FOR MANUFACTURE AND ASSEMBLY (4 SKS)

Learning Objective(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.

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): -

Text Book(s):

Boothroyd, Product Design for Manufacture and Assembly 3rd Ed, CRC Press, 2010

ENME804149 – NOISE AND VIBRATION (4 SKS)

Learning Objective(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

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) : Numerical Computation, Mechanical Vibration, Maintenance and Machine Cond. Minitoring

Text Book(s) :

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

ENME804155 - CAD/CAM (4 SKS)

Learning Objective(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.

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): -

Text Book(s):

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

ENME804156 – MANUFACTURING PERFORMANCE ASSESMENT (4 SKS)
Learning Objective(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.
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): -
Text Book(s):
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”

ENME802152 – AUTOMATION AND ROBOTICS (4 SKS)
Learning Objective(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.
Syllabus:
Automation System; Classification Type Manufacturing Automation machinery; Actuator; Sensor System; PLC Control System in the Manufacturing Automation machinery; Robot- cs: 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): -
Text Book(s):
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.

ENME804168 – RAILWAY VEHICLE ENGINEERING (4 SKS)
Learning Objective(s):
Provide 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): -
Text Book(s):
1. Simon Iwnicki, handbook of railway vehicle dynamics, CRC Press, Taylor & Francis Group, 2006.

ENME804197 – MATERIAL HANDLING EQUIPMENT (4 SKS)
Learning Objective(s):
Provide 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): Mechanical Design, Design Assigment
Text Book(s):
1. ASME. Handbook of Materials Handling.
2. Mc.Guiness. Mechanical and Electrical Equiment for Building.

ENME804198 – AIRCRAFT STABILITY AND CONTROL (4 SKS)
Learning Objective(s):
Provide the students with the knowledge and ability in analyzing the aircraft (A/C) stability and control.
Syllabus:
Systems of Aircraft Axes and Notation, Aircraft Static Equilibrium and Trim, The Equations of Aircraft Motion, Aircraft Longitudinal Dynamics, Aircraft Lateral–Directional Dynamics, Aircraft Maneuverability, Aircraft Stability, Aircraft Flying and Handling Qualities, Aircraft Stability Augmentation, Aircraft Aerodynamic Modelling, Aircraft Aerodynamic Stability and Control Derivatives
Pre-requisite(s): -
Text Book(s) :
1. Cook, Michael V., Flight Dynamics Principles, Elsevier Aerospace Engineering Series, 2007.
2. Russell, J.B., Performance and Stability of Aircraft, Butterworth Heinemann, 2003.
3. Von Mises, Richard, Theory of Flight, Dover Books on Aeronautical Engineering, 1959

ENME804190 - ADVANCED WELDING ENGINEERING (4 SKS)
Learning Objective(s):

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): -
Text Book(s):

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.

4.4. UNDERGRADUATE PROGRAM IN NAVAL ARCHITECTURE AND MARINE ENGINEERING

Program Specification

1.	**Awarding Institution**	Universitas Indonesia	
2.	**Teaching Institution**	Universitas Indonesia	
3.	**Programme Tittle**	Undergraduate Program in Naval Architecture and Marine Engineering	
4.	**Class**	Regular	
5.	**Final Award**	Sarjana Teknik (S.T)	
6.	**Accreditation / Recognition**	BAN-PT: A - Accredited AUN-QA	
7.	**Language(s) of Instruction**	Bahasa Indonesia	
8.	**Study Scheme (Full Time / Part Time)**	Full Time	
9.	**Entry Requirements**	High school /equivalent, or D3 / Polytechnique / 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	17
	Short (optional)	3	8
11.	**Graduate Profiles:** A Bachelor in Engineering with abilities to design ship structure and system, and excellence in leadership and professional characters.		
12.	**List of Graduates Competency:** 1. Ability to aply basic knowledge of mathematics, numerical methods, statistical analysis, basic sciences (physics and chemistry), as well as information technology required to achieve competence in the discipline of Maritime Engineering (Main competency) 2. Ability to design by applying methods, skills and modern engineering software required for practical engineering problems such as materials selection and process, as well as ship designing using a computer (Main competency) 3. Ability to carry out analysis for problem solving in the field of Maritime Engineering by applying calculation and principles in ship designing process and ship system (Main competency) 4. Ability to evaluate scientific problem by carrying out research and report the results, including statistical data analysis obtained for decision making in the field of Marine Engineering (Main competency) 5. Ability to identify impacts as a result of solution in the field of Marine Engineering with respect to sustainable development (Supporting competency) 6. Ability to think critically, creatively, and innovatively as well as to maintain intellectual curiosity for problem solving in individual and group level (UI) 7. Ability to communicate effectively in visual, written, and verbal (Supporting competency) 8. Ability to apply professional ethics related to law, economy, environment, social, politic, health, and safety with responsibility and integrity (Supporting competency) 9. Ability to carry out life-long learning including access to knowledge of relevant recent issues (Supporting competency) 10. Ability to apply financial principles and management as well as entrepreneurship in the field of Marine Engineering		
	As a Universitas Indonesia student, every graduate of Mechanical Engineering Undergraduate Program should have the following compenteces as follow: 1. Able to use information and communication technology; 2. Able to think critically, creatively, and innovatively and have intellectual curiosity to solve the individual and group problems; 3. Able to use verbal and writing communication in good bahasa Indonesia and English for academic or non-academic acitivity; 4. Has an integrity and able to respect others; 5. Able to identify entrepreneurship efforts which show innovation and autonomy based on ethics		

13	Classification of Subjects		
No.	Classification	Credit Hours (SKS)	Percentage
i	University General Subjects	18	12.5 %
ii	Basic Engineering Subjects	26	18.05 %
iii	Core Subjects	70	48.6 %
iv	Elective Subjects	12	8.33 %
v	Ship Design Assignment 1, Ship Design Assignment 2, Ship Design Assignment 3, On The Job Training, Seminar, Undergraduate Thesis	18	12.5 %
	Total	144	100 %
14.	Total Credit Hours to Graduate		144 SKS

Career Prospects

Naval architecture and marine engineering graduates have devoted themselves to various fields such as: maritime industry, government classification, research institutes, industrial engineering, automotive industry, shipbuilding industry, oil and gas industry, heavy machinery industry, educational institutions and other industries both domestically and internationally.

DESCRIPTION

Naval architecture and Marine Engineering study program was developed with a purpose, namely: producing graduates who have the attitude of leadership and excellence in scholarship and professionalism that have ability to analyze and synthesize characteristics of shipbuilding technology that includes design and planning process and ship machinery systems, as well as managing the installation and production systems ship, and were able to analyze and solve any scientific problem, work together in teams, and able to develop themselves and their knowledge.

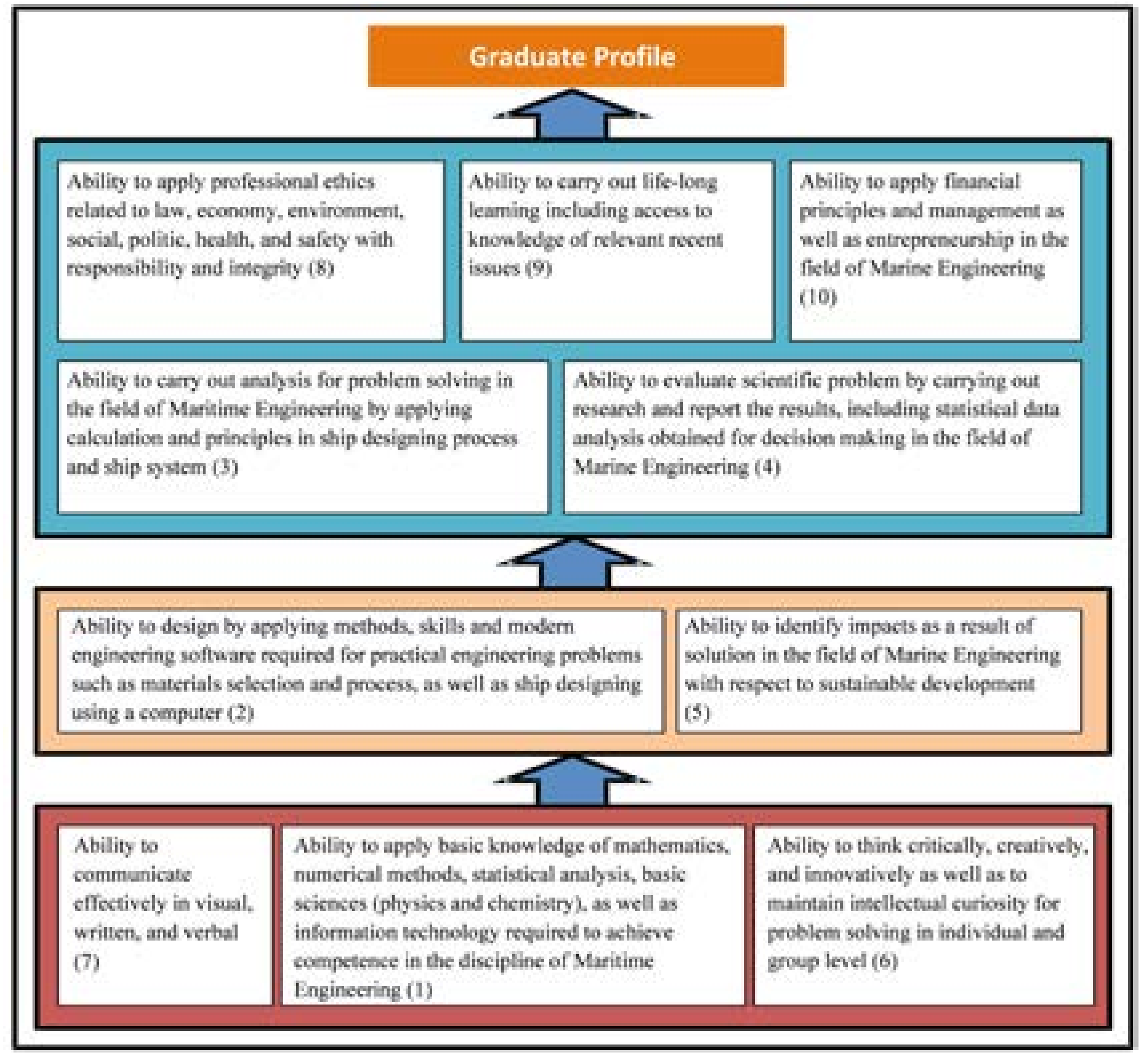
The basic curriculum 2012 in Bachelor of Naval architecture and Marine Engineering which can be seen in the figure shows the grouping and the relationship between subject groups.

Before reaching a Bachelor's degree from a total of 144 SKS, a student in Marine Engineering must complete the university courses (18 SKS), basic courses (75 SKS) which consists of basic engineering (26 SKS) and basic of marine engineering (49 SKS), and marine technical skills courses (33 SKS) consisting of core courses (21 SKS), elective courses (12 SKS), and the remaining 18 SKS in the form of assigment, intership and final project.

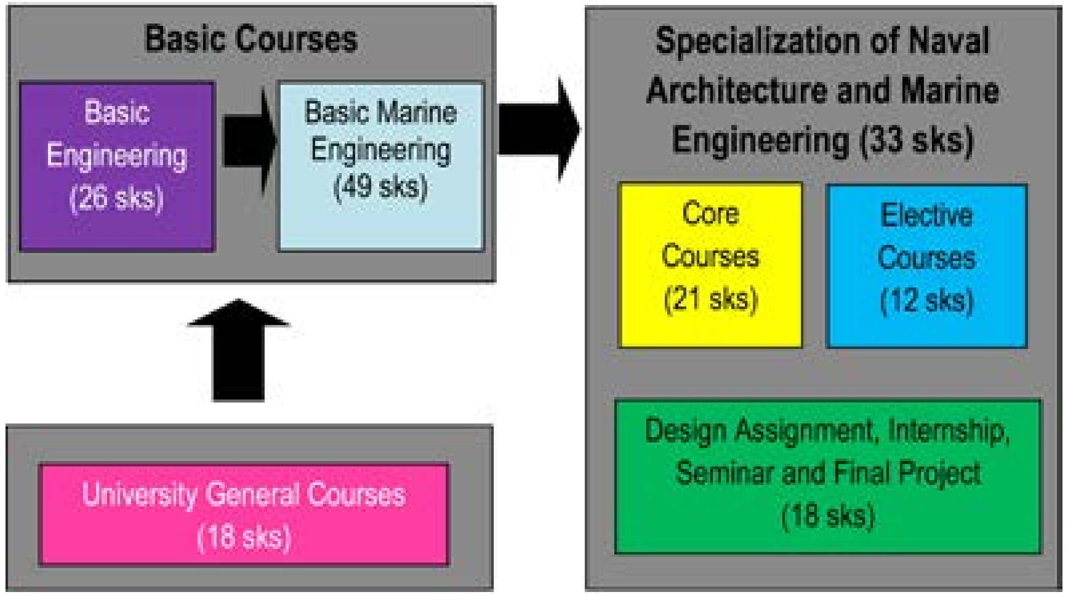
The curriculum was designed and developed to make the learning process is able to produce graduates who are competent in the field of Naval architecture and marine engineering with characteristics in accordance with the purpose of education, that is :

1. Having a strong base of engineering knowledge through the sciences of mathematics, physics, and chemistry
2. The ability to design and conduct research to analyze and interpret the data.
3. The ability to identify, formulate and solve problems in the field of shipbuilding techniques based on a review of the latest issue
4. The ability to design a system, component or process to meet desired needs by considering and implementing aspects of the economy,
5. Knowledge of leadership, ability to communicate well, work together in teams, and develop themselves and their knowledge

Learning Outcomes Flow Diagram



Curriculum Structure



Flow Diagram of Subjects

COURSE STRUCTURE UNDERGRADUATE PROGRAM IN NAVAL ARCHITECTURE AND MARINE ENGINEERING REGULLAR

KODE	SUBJECT	Credit
	1st Semester	
UIGE600002	Integrated Character Building B	6
UIGE600003	English	3
ENGE 6 0 0001	Calculus 1	3
ENGE 6 0 0005	Physics (Mechanics and Thermal)	3
ENGE 6 0 0006	Physics (Mechanics and Thermal) Lab	1
ENMR601001	Intro to Marine Engineering	2
ENME601002	Engineering Drawing	2
	Subtotal	**20**
	2nd Semester	
UIGE600001	Integrated Character Building A	6
UIGE600010-15	Relligion	2
UIGE600020 - 48	Sport / Art	1
ENGE 6 0 0002	Calculus 2	3
ENGE 6 0 0007	Physics (Electricity, MWO)	3
ENGE 6 0 0008	Physics (Electricity, MWO) Lab	1
ENMR602002	Ships Visualization & Modelling	3
	Subtotal	19
	3rd Semester	
ENME600013	Engineering Mathematics	4
ENGE 6 0 0009	Basic Chemistry	2
ENME603008	Basic Thermodynamics	4
ENGE 6 0 0004	Linear Algebra	4
ENMR603003	Ship Materials	2
ENMR603004	Ship Building Theory	2
ENMR603005	Ship Structure 1	2
	Subtotal	**20**
	4th Semester	
ENMR604006	Thermofluids	4
ENMR604007	Ship Machinery	2
ENMR604008	Ship Structure 2	4
ENME600016	Numerical Method	2
ENMR604009	Ship Resistance and Propulsion	4
ENMR604010	Ship Hydrodynamics	2
ENMR600001	Ship Design Assignment 1	2
	Subtotal	**20**
	5th Semester	
ENMR605011	Fluid & Piping System of Ship	2
ENME600009	Kinematics and Dynamics	4
ENMR605012	Engineering Economics	2
ENMR605013	Ship Manufacturing Process	2
ENMR605014	Welding Engineering	2
ENMR605015	Ship Electrical System	2
ENMR605016	Engine Room Layout Design	2
ENMR600002	Ship Design Assignment 2	4
	Subtotal	**20**
	6th Semester	
ENGE 6 0 0010	Statistic and Probability	2
ENGE 6 0 0012	HSE Protection	2
ENMR606017	Ship Vibration	2
ENMR606018	Ship Machinery & Equipment	2
ENMR606019	Ship Electronic System	2
ENMR606020	Ship Power System	2
ENMR606021	Ship Maintenance & Repair	2
ENMR600003	Ship Design Assignment 3	3
	Subtotal	**17**
	7th Semester	
ENME600006	Capita Selecta Industrial	2
ENMR600004	On the Job Training	2
ENMR607022	AC & Refrigeration System of Ship	4
ENMR607023	Survey and Inspection of Ship	2
ENMR600005	Seminar	1
	Electives	4
	Subtotal	**15**
	8th Semester	
ENMR600006	Final Project	5
	Electives	4
	Electives	4
	Subtotal	**13**
	Total	**144**

Resume

Wajib Universitas	**18**
Wajib Fakultas	**28**
Wajib Program Studi	**86**
Jumlah	**132**
Pilihan	**12**
Total Beban Studi	**144**

ELECTIVES

KODE	MATA AJARAN PILIHAN SEMESTER 7	SKS
	SUBJECT	
ENME803183	Marine and Offshore Structure	4
ENME803184	Sea Transportation Port Manag.	4
ENME803185	Maritime Law and regulation	4

KODE	MATA AJARAN PILIHAN SEMESTER 8	SKS
	SUBJECT	
ENME804186	Special Ship Project	4
ENME804187	Ship Production Management	4
ENME802103	Energy Optimization System	4
ENME804188	Maritime Energy Management	4
ENME804189	Maritime Safety	4
ENME804190	Advanced Welding Engineering	4

SYLLABUS OF UNIVERSITY SUBJECTS

INTEGRATED CHARACTER BUILDING A
UIGE600001/UIGE610001
6 sks
Syllabus : Integrated Character Building A facilitates students to understand the basics of character formation and master the basics of cognitive power that is logic. Furthermore, to apply cognitive powers in generating good behaviors which are useful to themselves and society. The establishment of ethical behaviors based on ethics is also facilitated. Students are able to develop the basic strength of character and to know themselves as a human being, both as individuals and as part of a group so that they can develop themselves well enough. In a group, the students need to have skills that are needed to maintain an effective relationship in order to improve the quality of human life. Particularly as a citizen of Indonesia, students need to understand the nature of citizenship and basic philosophy of Pancasila in order to act and behave in accordance with the character of the Indonesian nation.
Core Competencies :
1. Students are able to analyze problems in depth individually, comprehensively, logicaly and critically, and generate solutions using the logical and ethical principles and rules of logic and ethics
2. Students are capable of analyzing the problem individually, thoroughly and deeply about the human being as an individual or as part of group
3. Students are individually able to understand, make critical reasoning and to build an open and critical mind to the problem of nationhood, statehood and citizenship in this dynamic world situation
4. Students are able to create and display a work that depicts the character in accordance with the principles of Pancasila

Learning Method : interactive lecture, Experiential Learning, Collaborative Learning, Problem Based Learning, Project-Based Assignment
Prerequisites : OBM (New Student Orientation)

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))

INTEGRATED CHARACTER BUILDING B
UIGE600002/UIGE610004
6 sks
Syllabus : Integrated Character Building B facilitates students to practice identifying, analyzing, and resolving problems of nature and the environment by making use of integrative and quantitative information. This lecture aims to prepare the future generation who care about nature issues through the balanced development of hard skills and soft skills and have the skills of ICT (Information and Communication Technology).
Core Competencies:
1. Students have an ethic, moral, personality and good character in completing the task at hand;
2. Students role as citizens who take pride and love of the homeland and support the continuity of life;
3. Students are able to work together and have a high sensitivity and awareness to the community and the environment;
4. Students are able to think logically, critically and creatively;
5. Students are able to use mathematics to solve problems quantitatively;
6. Students are able to use information and communication technology (ICT) for development;
7. Students are able to analyze the system of nature integratively and comprehensively;
8. Students are able to act as wise managers of nature to build and maintain the preservation of nature for a better and sustainable life.

Learning Method : Blended e-Learning, Collaborative Learning (CL), Problem Based Learning (PBL) and Group Discussion (GD)
Prerequisites : OBM (New Student Orientation)
Textbook : Digital Form can be downloaded from Scele

ISLAMIC STUDY
UIGE600010/UIGE610005
2 sks
General instructional objectives : The cultivation of students who have concern for social, national 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 practice 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)

UNDERGRADUATE PROGRAM

CATHOLIC STUDY
UIGE600011/UIGE610006
2 sks
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 STUDY
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 STUDY
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 STUDY
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

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(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
2 sks

ART
UIGE600020-30
1 sks
The option of subjects that can be choosen :
Appreciation of Film (UIGE600020), Batik (UIGE600021), Photography (UIGE600022), Calligraphy (UIGE600023), Javanese Karawitan (UIGE600024), Balinese Dance and Karawitan (UIGE600025), Comic (UIGE600026), Painting (UIGE600027), Music and Vocal (UIGE600028), Theater (UIGE600029), Wayang (UIGE600030)

SPORT
UIGE600040-48
1 sks
The option of subjects that can be choosen :
Basketball (UIGE600040), Volley Ball (UIGE600041), Badminton (UIGE600042), Futsal (UIGE600043), Hockey (UIGE600044), Football (UIGE600045), Softball (UIGE600046), Tennis (UIGE600047), Table Tennis (UIGE600048)

SYLLABUS OF BASIC ENGINEERING SUBJECTS

CALCULUS 1
ENGE600001/ENGE610001
3 sks
Syllabus : This subject gives the opportunity for students to understand the basic concept of calculus and to be able to solve applied calculus problems. Students are also given the opportunity to understand basic concepts the functions of one variable, derivatives and integral functions of one variable, and its application.

CALCULUS 2
ENGE600002/ENGE610002
3 sks
Syllabus : This subject gives the opportunity for students to understand the basic concept of calculus and to be able to solve applied calculus problems. Students are also given the opportunity to understand the basic concept the function of two variables, or variables, total derivative and integral of the function of two or more variables and application. In addition, students can understand the basic concepts of sequence and series.

CALCULUS
ENGE600003/ENGE610003
4 sks
Syllabus : This subject gives the opportunity for students to understand the basic concept of calculus and to be able to solve applied calculus problems. Students are also given the opportunity to understand the basic concept the function of two variables, the total derivative of the function of two or more variables and its application. Students are also expected to understand the basic concept of sequence and series and the basic concept of vector and analytical geometry.

LINEAR ALGEBRA
ENGE600004/ENGE610004
4 sks
Syllabus : This subject gives the opportunity for students to master the basic techniques of Linear Algebra and gain knowledge on how to implement said techniques in solving System of linear equationss, determining the bases and dimension of vector space, as well as calculating eigen values and eigen vectors. This subject also gives students the opportunity to work with other objects, especially vectors and matrices.

PHYSICS (MECHANICS AND THERMAL)
ENGE600005/ENGE610005
3 sks
Syllabus : Physics (Mechanics and Thermal) subject includes the topics of mechanics and thermodynamics. Calculus is use as a mathematic helping tool in the learning process. Students are given the opportunity to learn how to unite their understanding of the basic concept of the analytical capability, their numeracy in learning mechanics and thermodynamics. During the course of this subject, students are not only aim to increase the students' knowledge of the basic physics concepts but also to increase their capability in using information technology and computer and to train their skills, such as: independent and group work and their communication skill.
Students will also be train on how to explain and analyse the nature phenomenon and the result of human engineering exist in their everyday lives by using the basic physics concept and applied them in their daily lives. Students are also taught to develop their synthesis ability and evaluating both quantitative and qualitative natural phenomenon and the result of human engineering in their surrounding environment by using basic physics concept. This subject will give students the opportunity to develop their ability to develop their presentation ability analyse the nature phenomenon and the result of human engineering from the mathematics and natural science point of view integrative and comprehensively.

PHYSICS (MECHANICS AND THERMAL) LABORATORY
ENGE600006/ENGE610006
1 sks
Syllabus : Practical of Mechanics: Measurement, Moment of inertia, Gravity acceleration, Fluid density, Scratch coefficient, Collision, Swing torque, Viscosity of water, Young's modulus, Viscosity of Newtonian fluid, Fluids surface tension, Oscillation, Practical of Heat: Coefficient of linear expansion, Heat conductivity, Thermocouple calibration, Calorimeter, Joule Constant, Laplace Constant, Heat Collector, Determining of air Cp/Cv, Expansion of fluids and water anomaly.
Notes: For Architecture and Interior Architecture Program, practical is not mandatory.

PHYSICS (ELECTRICITY, MWO)
ENGE600007/ENGE610007
3 sks
Syllabus : Physics (Electricity, MWO) subject includes the topics of electricity, magnet, wave, and optics. Calculus is use as a mathematic helping tool in the learning process. Students are given the opportunity to learn how to unite their understanding of the basic concept of the analytical capability, their numeracy in learning mechanics and thermodynamics. During the course of this subject, students are not only aim to increase the students' knowledge of the basic physics concepts but also to increase their capability in using information technology and computer and to train their soft skills, such as: independent and group work and their communication skill. Students will also be train on how to explain and analyze the nature phenomenon and the result of human engineering exist in their everyday lives by using the basic physics concept and applied them in their daily lives. Students are also taught to develop their synthesis ability and evaluating both quantitative and qualitative natural phenomenon and the result of human engineering in their surrounding environment by using basic physics concept.

PHYSICS (ELECTRICITY, MWO) LABORATORY
ENGE600008/ENGE610008
1 sks
Syllabus : Practical of Electricity: Electrolysis, Wheatstone bridge, Kirchhoff law, Earth's magnetic field, Temperature coefficient, Characteristic of series RLC circuit, Ohm law, Transformer. Practical of Optics: Polarimeter, Lens, Photometry, Prisms bias index, Spectrometer, Diffraction grid, Newton's ring.

BASIC CHEMISTRY
ENGE600009/ENGE610009
2 sks
Syllabus : As an engineer, you must have understanding on the chemistry that provides not only the basis for much of what goes on in our world but also that it is a vital, continually developing science. In this study the students will learn many subjects such as matter and measurement; atoms, molecules, and ions; stoichiometry; aqueous reactions; thermochemistry; properties of solutions; chemical kinetics; chemical equilibrium; and electrochemistry.
Learning activities will be conducted through various method, which consists of: problem based learning (PBL), interactive lecture, question-based learning, discussion, demonstration and unguided structured assignments. Assessment will be made continuously through a set of exercises, group discussion, mid semester exam and final exam.

STATISTIC AND PROBABILITY
ENGE600010/ENGE610010
2 sks
Syllabus : Statistics and probability has been known as applied mathematics which is widely used in collecting, organizing, presenting, interpreting and analyzing data to support valid conclusions. Furthermore, these conclusions will be used as recommendation in decision making. The course of Statistics and Probability is intended to give a basic ability for students to handle quantitative data and information. There are two stages that are delivered which is descriptive and inductive/ inference stages. Descriptive stage includes collecting, organizing, and presenting the data in a scientific manner. Then, inductive/inference stage includes the process of estimating and drawing conclusion based on available data and relations between variables. Hence, students are expected to apply their knowledge of statistics in conducting experiments in laboratory works/assignments as well as research studies in their final projects.

ENGINEERING ECONOMICS
ENGE600011/ENGE610011
3 sks
Syllabus : This course introduces students to the basic of engineering economy. It covers the time value of money (TVOM) and interest rate; tools for evaluating project alternatives for both non discounted and discounted methods, for instance present worth analysis, annual worth analysis, future worth analysis, rate of return (ROR) analysis and benefit/cost analysis; and choosing the best alternative, break even analysis, and effect of depreciation and after tax analysis and sensitivity analysis, and replacement analysis.
Learning activities will be conducted through various methods, which consist of: interactive lectures, question-based learning, discussion, and structure assignments. Assessment will be made thoroughly through sets of exercises/quizzes, group discussion, midterm and final exam. To expose students on the latest utilization of engineering economy and train them how to use it, a project will be assigned. As an integral part of course, computer utilization such as Microsoft Excel will be demonstrated and discussed on the class.

HEALTH, SAFETY AND ENVIRONMENTAL PROTECTION
ENGE600012/ENGE610012
2 sks
Syllabus : The teaching of Safety, Health and Environmental (SHE) protection to undergraduates studying engineering courses is an important part of the education of future engineers at all levels. It is the generally expressed view amongst practitioners in industry, business and other organisations

that all engineers need to be equipped to appreciate, understand and implement the requirements of SHE management and practice to meet the working needs of industry and of their company (or other organisation). Whilst the level of risk and degree of control is dependant on the industry sector concerned the basic principles do not change. In addition, according to code of ethics of engineers, engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties.
The module covers the regulation framework and standards, risk perception, assessment, and management and detail discussion on physical, chemical and process hazards, and related engineering and management controls. Maintenance of safety conditions, personal protective equipments, audit, incident and emergency planning are discussed in accordance to measures for improving students awareness to their daily activities within the campus premises and local environment.
Learning activities will be conducted through various methods, which consist of: interactive lecture, question-based learning, discussion, demonstration and unguided structured assignments. Assessment will be made continuously through a set of exercises, group discussion, mid semester exam and final exam

COURSE DESCRIPTION

ENMR601001 - INTRODUCTION TO MARINE ENGINEERING (2 sks)
Course Objective :
Provides basic competence of ship building and structure and the approach to ship designing.
Syllabus :
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; Stability: resistance and Propulsion; Tonnage; Ship building method. Historical of ship machinery, main engines, auxiliary engines, the engine room layout.
Pre-requisite: -
References :
1. GM Kok, A.C. Nierich., *Bangunan Kapal* , MARTECH
2. D A Taylor, *Introduction to Marine Engineering*.1996

ENME601002 – ENGINEERING DRAWING (2 SKS)
Course Objective:
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.
Syllabus:
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: -
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.

ENMR602002 - SHIPS VISUALIZATION AND MODELING (3 sks)
Course Objective :

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.

Syllabus :

Drawing Lines Plan; Optimizing the main dimensions and coefficients on ship designs with restrictions on ship type; Method of Nederlandsche Scheepsbouw Proefstatioen (NSP); Data Form Method; 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 : -

References :

1. Tupper E.C., *Basic Ship Theory*, Butterworth Heinemann, 2001
2. David Watson, *Practical 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 Naval Architecture*, Butterworth Heinemann, 1996
5. T.C. Gillmer, Modern Ship Design, US Naval Institute, 1975.
6. Manual *Autocad* dan *Maxsurf 12.02*

ENMR603003 – SHIP MATERIALS (3 sks)

Course Objective:

Students are expected to understand available material options depending on the operation requirement of the ships, encompassing both qualitative and quantitative understanding. Qualitative 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.

Syllabus:

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: -

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

ENMR603004 – SHIP BUILDING THEORY (2 sks)

Course Objective :

Provides an understanding about hydrostatic and dynamic stability calculation

Syllabus :

Lines Plan calculation and methodology; Bouyancy system; Metasentra, Static Stability: Calculation of hydrostatic curves and cross curves; docking, Ship crashes out, inclining test, ship launching, 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 Conditions Due to shaky ship; Impact loading.

Pre-requisite : Ship Visualization and Modelling

References :

1. Bryan Barrass & Dr Derrett, *ship stability for master and mates*.2006
2. A.B Brain, *Ship hydrostatics and stability*, Butterworth, Heinemann, 2003.
3. Volker Bertram, *Practical ship hydrodynamics*, Butterworth, Heinemann, 2000.
4. Dr C B Barrass, *Ship stability notes & example,3rd edition* Butterworth, Heinemann, 2001
5. E.C. Tupper & K.J. Rawson, *Basic ship Theory*, Butterworth, Heinemann, 2001.

6. M.A. Talahatu, Hidrodinamika kapal I & II, FTUI. 1998.

ENME600013 – ENGINEERING MATHEMATICS (4 SKS)

Course Objective:

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.

Syllabus:

Introduction to differential equation, 1st order differential equation, 2nd order differential equation, higher order differential equation, vector analysis, vector differential, grad operation, divergence and curl, 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: 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

ENME603008 – BASIC THERMODYNAMICS (4 SKS)

Course Objective:

This course introduces the basic concept of thermodynamics and its application in real life and gives the understanding about the design of thermodynamics system.

Syllabus :

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, phsycometric chart, cooling tower, real gas, real gas equation, enthalpy and entrophy.

Pre-requisite: 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 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

ENMR603005 – SHIP STRUCTURE 1 (2 sks)

Course Objective :

Provides an understanding for calculating transversal and longitudinal constructions, profile and plate selection

Syllabus :

Stress and strain torsion (torque) and calculation of moment inertia; axial force, shear force and bending moment; Calculation 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 Section, Bending and Buckling on the panels; concept of fatigue.

Pre-requisite : -

References :

1. Dr. Yong Bai, *Marine Structural 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

ENME600016 – NUMERICAL METHOD (2 SKS)
Course Objective:
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.
Syllabus:
Introduction to numerical method and programming, simple mathematical modeling, programming 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 differential equation
Pre-requisite: 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

ENMR605013 – SHIP MANUFACTURING PROCESS (2 sks)
Course Objective:
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.
Syllabus:
Ship manufacturing process (ship planning & Mouldloft, Sand Blasting & Primer Coating, Keel Laying, Fabrication, Assembly, Erection, Outfitting, Painting, Leakage Test, Launching, Sea Trial, Delivery), Forming and shaping process (Rolling, Forging, Extrusion, Sheet Metal Forming), Manufacturing of ship's plate (surface roughness, surface treatment, surface coating, surface cleaning), Machining process (machining fundamentals, turning, milling, broaching, sawing, & filing)
Pre-requisite: -
References:
1. Kalpakjian S., Manufacture Engineering and Technology, Pearson Springer, 2009

ENMR605014 – WELDING ENGINEERING (2 sks)
Course Objective:
This course aims to study basic knowledges in welding, joining, cutting. Students are expected to achieve the basic competences of welding engineering.
Syllabus:
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: -
References:
1. Harsono W., T. Okumura, Teknologi Pengelasan Logam, PT Pradnya Paramita Jakarta Cetakan ke-10, 2008.
2. American Welding Society, AWS D1.1/D1.1M:2004, Structural Welding Code – Steel, 19thedition, 2004.

ENMR605012 – ENGINEERING ECONOMICS (2 sks)
Course Objective :
Provides an understanding of utilizing concepts in advanced mathematics to solve problems in naval engineering
Syllabus :
Graphs, Trigonometry and Geometry, Solution of Triangles, Mensuration of Areas, Volume-Mass, Centre of Gravity, Moment, Economic Mathematics
Pre-requisite : -
References :
1. Kevin Corner, *Mathematic for Marine Engineers*. Thomas Reed Publications.2013

ENMR606020 – SHIP POWER SYSTEM (2 sks)
Course Objective:
Students can understand the principles of power system of the ship, including the current and the future trends.
Syllabus:
The need for ship power system, current and future trends (fossil fuel, carbon emission, international 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- conventional 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: 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

ENMR604010 – SHIP HYDRODYNAMICS (2 sks)
Course Objective :
Students are expected to understand basic knowledge on ship hydrodynamics, waves, and viscous flow
Syllabus :
Basic of fluid, hydrostatic pressure, basic of hydrodynamics, theory of linear wave, Bernoulli equation 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 : 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

ENMR604008 – SHIP STRUCTURE 2 (4 sks)
Course Objective :
Provides knowledge and understanding of the types of construction on the ship structure and competence to design ship structures
Syllabus :
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 Construction: Doors and Windows; Fire Protection; Cabin Construction: Construction of loading and unloading Equipments; Painting and Corrosion Prevention.
Pre-requisite : 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

ENMR604006 - TERMOFLUIDS (4 sks)
Course Objective :
Students can understand various heat transfer mechanism between two systems if there exists a temperature difference, can calculate its heat transfer coefficient, and can solve various heat transfer problems with dimensionless parameters.
Syllabus :
Principles of Fluid Dynamics: Pressure distribution of fluid flow, integral flow analysis, differensial flow analysis. Viscous flow, drag and lift force for floating and moving objects. Laminar and turbulent flow; Boundary Layer; Losses in Fluid Flow. Heat Transfer; one-dimensional steady state; Steady dimensional conduction state; Convection principles; empirical formulas and practices for forced convection and heat transfer.; natural convection System, heat exchangers.
Pre-requisite : Basic Thermodynamics
References :
1. Munson, B.R., Fundamentals of Fluid Mecha-nics 4th Ed, John Wiley & Sons, Inc. 2000
2. Smits, A.J., A, Physical Introduction to Fluid Mechanics, John Wiley & Sons, Inc. 2000
3. Kumar, K.L., Engineering Fluid Mechanics, Eurasia Publishing House Ltd., 2000
4. Frank P Incropere, David P De Witt, Fundamental heat and mass transfer, 5th Ed., John Wiley & Sons, 1996, New York
5. Holman JP, Heat Transfer, 9th, Mc Graw Hill, 2003.

ENMR604007 – SHIP MACHINERY (2 sks)
Course Objective :
Understanding of types and concept of the main system, supporting system, lubrication system, and refrigeration system of a ship machinery
Syllabus :
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 : Basic Thermodynamics
References :
1. D A Taylor, *Introduction to Marine Engineering*.1996

ENMR600001 - SHIP DESIGN ASSIGNMENT 1 (2 sks)
Course Objective :
Understanding of ship design procedures and monitoring.
Syllabus :
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 positioning for passenger ships.
Pre-requisite : 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.

ENMR605011 – FLUID AND PIPING SYSTEM OF SHIP (2 sks)
Course Objective :

Understanding types of fluid system, piping system, and practical aspects on the Ship Construction
Syllabus :
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 system (auxiliary motor), fuel system, lubrication system, cooling system, compressed air systems, domestic systems, tanker loading and unloading systems.
Pre-requisite : Thermofluids
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 Butterworth-Heinemann, 1999
5. Giles, R.V, Fluid Mechanics and Hydraulics, 2nd Edition Schaum's Outline Series, Mc- Graw-Hill, 1994

ENMR604009 – SHIP RESISTANCE AND PROPULSION (4 sks)
Course Objective :
Provides an understanding for the calculation of ships resistance and propulsion, both theoretically and by using a model
Syllabus :
Ship force; Ship Resistance Comparative Law; Frictional resistance: wave resistance; pressure resistance: Air resistance; Effect of Ship Shape; Resistance predictions with Model Test; Wake Friction: 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 : -
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. *Harvald*, Resistance and *Propulsion* of *Ships, 1983*
4. C. Gallin, Ships and Their Propulsion System, Lohmann & Stolterfoht

ENMR605016 – ENGINE ROOM LAYOUT DESIGN (2 sks)
Course Objective :
Students can design the layout and ergonomic aspect of engine room
Syllabus :
Engine Room Lay Out: ergonomic consideration in the placement of equipments, placement of the main engine, placement of auxilliary engine system, placement of ship supporting system
Pre-requisite :
References :
1. Anthony F. Molland, *The Maritime Engineering Reference Book*, Elsevier.2008
2. Nigel Calder, *Marine Diesel Engines*, McGraw-Hill, 2006

ENMR600002 - SHIP DESIGN ASSIGNMENT 2 (4 sks)
Course Objective :
Understanding the calculation and monitoring of supporting system for ships designing
Syllabus :
Ship displacement methode; determine main dimension and coefficient; determine lines plan, hydrostatic calculation, main section plan, profile and bulkhead plan, design of air condirtioning system, ship maintenance design, communication devices election, navigate devices election, safety plan
Pre-requisite : Ship Design Assignment 1
References :

 UNDERGRADUATE PROGRAM

1. B. Baxter, *Teach Yourself Naval Architecture*, The English Universities Press. Signifi cant Ships, RINA
2. M.A Talahatu, Teori Merancang Kapal. FTUI 1998.

ENMR606019 – ELECTRONIC SYSTEM OF SHIPS (2 sks)
Course Objective :
Understanding of the principles, operations, and applications of electronic systems of ships
Syllabus :
Basic of electronics: Passive Components: Semiconductors: Electronic Components; Digital Systems; 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 operation: 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 : 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

ENMR605015 – ELECTRICAL SYSTEM OF SHIPS (2 sks)
Course Objective :
Understanding the principles of engineering and automation and control applications of the ship
Syllabus :
Introduction to automation systems engineering; proportional plus integral plus derivative control; Application of mathematical modeling to determine the performance of control system. Response system signals I and Order II: Analysis of transient response of the system order I and order II: Introduction to process control in shipbuilding applications; computer simulations and laboratory-scale models; Introduction of hydraulic and pneumatic control systems. Instruments for UMS classification
Pre-requisite : Physics (Elec. Magnet, Wave & Optic)
References :
1. E. Hughes, Electrical Technology, IBS
2. John Bird, Electrical & Electronic Principle and Technology. Jhon Bird.2003
3. John C Payne, The Marine Electronical & Electronics Bible, John Pyne.1993

ENME600009 – KINEMATICS AND DYNAMICS (4 SKS)
Course Objective:
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.
Syllabus:
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: Physics of Mechanics & Heat
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.

ENMR606017 – SHIP VIBRATION (2 sks)
Course Objective :
Understanding of engine vibration system and vibration source detection
Syllabus :
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 : Kinematics and Dynamics
References :
1. L.C. Burrill, *Ship vibration: simple methods of estimating critical 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.

ENMR606021 – SHIP MAINTENANCE AND REPAIR (2 sks)
Course Objective :
Students are able to understand the maintenance and control of ship's engine system.
Syllabus :
Introduction to reliability system, reliability Fundamental Review of the concept, simple system Network Modelling, Network Modelling System, Introduction to Markov and Monte Carlo Simulation, Discrete Markov Chains and Markov Continuous Process. Public Review: Economic and Reliability, Maintenance Strategy. Functions of Manual Maintenance; Parts List and Stock; Preparation of Schedule Maintenance: Maintenance Document Preparation; Engine Room Maintenance, Maintenance of Inventory: The Role of Engine Builders Tips andTools: Spare-Parts.
Pre-requisite : 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

ENMR606018 – SHIP MACHINERY AND EQUIPMENT (2 sks)
Course Objective :
Understanding of theory, system, and working principle of ship equipment
Syllabus :
Anchoring and mooring equipment supplies; loading and unloading equipment; Water-tight windows and doors; Ventilation Equipment: Safety Equipment: Equipment Navigation and Communications; Firefighting Equipment: Equipment Ship Steering; Oil Separator Equipment: Pumps and System Installation.
Pre-requisite : -
References :
1. H. McGeorge, Marine Auxiliary Machinery, Butterworth Heinemann, 2001.
2. D.A. Taylor, Introduction to Marine Engineering, Butterworth Heinemann, 1996

ENMR600003 – SHIP DESIGN ASSIGNMENT 3 (3 sks)
Course Objective :
Understanding of calculation and monitoring of ship engine design
Syllabus :
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 system; 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 System); 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 : Ship Design Assignment 2

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.

ENME600006 – INDUSTRIAL SEMINAR (2 SKS)
Course Objective:
Able to understand industrial development and its problems.
Syllabus: Special topics in industries which are not covered in other courses
Pre-requisite: Passed 76 SKS and GPA > 2.00
References: -

ENMR607022 – AIR CONDITIONING AND REFRIGERATION SYSTEM (4 sks)
Course Objective :
Students are able to analyze the design of air conditioning and refrigeration system on the ship
Syllabus :
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 : Ship Power System
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

ENMR607023 – SURVEY AND INSPECTION OF SHIP AND MARINE STRUCTURE (2 sks)
Course Objective :
Understanding of types of class survey, statutory approval and ship operation
Syllabus :
Statutory survey; Class survey; Hull survey; Loadline survey, Inclining experiment; Damage survey; Machinery Installations survey; Electrical & Genset survey; Seatrial procedure.
Pre-requisite : Ship Maintenance & Repair
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

ENME600003 – INTERNSHIP (2 SKS)
Learning Objective(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.
Syllabus:
1. Management and Engineering according to the field of interest. Presentation of internship results and report.
2. **Pre-requisite(s):** Passed 95 SKS and GPA > 2.00

ENME600004 – SEMINAR (1 SKS)
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
Syllabus:
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 SKS and GPA > 2.00 without Grade E
Text Book(s): -

ENME600005 – FINAL PROJECT (5 SKS)
Learning Objective(s):
Students are able to conduct design and analysis the object of system that related to the mechanical engineering field
Syllabus:
Synthesizing various lectures taken by students to design or to solve engineering problems. Preparing a written report of the synthesis.
Pre-requisite(s): Passed 128 SKS and GPA > 2.00 without Grade E

ELECTIVES

ENME803183 - MARINE AND OFFSHORE STRUCTURE (4 sks)
Course Objective :
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.
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

ENME803184 - SEA TRANSPORT AND PORT MANAGEMENT (4 sks)
Course Objective :
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

ENME803185 - MARITIME LAW AND REGULATION (4 sks)
Course Objective :
Provide 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

ENME804186 - SPECIAL SHIP PROJECT (4 sks)

Course Objective :

Provide 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.

ENME804187 - SHIP PRODUCTION MANAGEMENT (4 sks)

Course Objective :

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

ENME802103 - ENERGY OPTIMIZATION SYSTEM (4 sks)

Course Objective :

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 optimization 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 : -

References :

1. Stoecker, W.F. “ Design of Thermal System”, Mc.Graw Hill Book Co, 1989.
2. Boehm,R.F.”Design of Analysis of Thermal System”John Wiley&Sons,1987.
3. Yogesh Jaluria, “Design and Optimization of Thermal Systems “ Mc.Graw Hill Book Co, 1998.

ENME804188 - MARITIME ENERGY MANAGEMENT (4 sks)

Course Objective :

This course aims to provide an understanding of analysis for energy optimization resulted from minimum fuel consumption as well as analysis for performance optimization from minimum initial energy

Syllabus :

Principle and regulation of maritime energy, design and operation of efficient ship, energy management for off shore structure, port energy management, renewable energy, and human resources factors in energy management.

Pre-requisite : -

References :

1. Hongyi Lai, “Asian Energy Security: The Maritime Dimension”, Palgrave MacMillan, 2009
2. Steve Doty, Wayne C. Turner, “Energy Management Handbook 8th Ed.”, Fairmont Press, 2012
3. Petrecca, Giovann, “Energy Conversion and Management: Principles and Applications,” Springer, 2014

ENME804189 - MARITIME SAFETY (4 sks)

Course Objective:

Provides knowledge and understanding of maritime safety through regulations, management and development of maritime transportation technology.

Syllabus :

SOLAS: general provision, construction, safety equipment, communication radio, safety navigation, freight, management for ship safety, MARPOL Annex I-V, maritime safety, threats from maritime trading, threats from shipping, evolution of maritime safety, implementation of ISPS code, safety planning.

Pre-requisite: -

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

ENME804190 - ADVANCED WELDING ENGINEERING (4 SKS)

Learning Objective(s):

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): -
Text Book(s):

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.

4.5. 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.	**Programme Tittle**	Undergraduate Program in Electrical Engineering	
4.	**Class**	Regular, Parallel, International	
5.	**Final Award**	Sarjana Teknik (S.T) Double Degree: Sarjana Teknik (S.T) and Bachelor of Engineering (B.Eng)	
6.	**Accreditation / Recognition**	BAN-PT: A accredited AUN-QA	
7.	**Language(s) of Instruction**	Bahasa Indonesia and English	
8.	**Study Scheme (Full Time / Part Time)**	Full Time	
9.	**Entry Requirements**	High school /equivalent, or D3 / Polytechnique / 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	17
	Short (optional)	3	8
11.	**Graduate Profiles:** Bachelor of engineering who is able to design both hardware and/or software as solution in electrical engineering problem based on technological advancement in accordance with professional ethics.		
12.	**Expected Learning Outcomes:** General outcomes: 1. Able to design hardware. 2. Able to design software. 3. Able to handle general issues and specific in electrical engineering. 4. Able to apply the basic principles of mathematics, physics, and statistics in solving electrical engineering. 5. Capable of critical thinking, creative, and innovative and have the intellectual curiosity to solve problems at the level of the individual and the group. 6. Able to identify varieties of entrepreneurial efforts that are characterized by innovation and self-reliance based on ethics. 7. Able to use the language both spoken and written in the Bahasa Indonesia and English for academic or non-academic activities. 8. Able to provide alternative solutions to problems that arise in the environment, society, nation, and country. 9. Able to utilize information communication technology (ICT). Electronics Engineering Majoring Outcomes: 1. Able to design advanced electronics circuit. 2. Able to analyse photonic devices. 3. Able to design MEMS. 4. Able to design VLSI circuit. 5. Able to analyse state of the art in the field of electronics and photonics. 6. Able to utilize technological advancement to solve problems related to his/her expertise (stream).		

12.	Telecommunication Engineering Majoring Outcomes: 1. Able to design wire and wireless communication equipment system. 2. Able to design communication network system 3. Able to analyse the performance of communication systems on different media. 4. Able to identify the process of information signal processing. 5. Able to examine the development of telecommunications engineering 6. Able to study the latest technology to solve the problem of appropriate areas of expertise (Majoring) Control Engineering Majoring Outcomes: 1. Able to identify dynamic control system in mathematical equation. 2. Able to design discrete controller. 3. Able to design knowledge-based controller. 4. Able to reverse engineer simple controller. 5. Able to study the latest technology to solve the problem of appropriate areas of expertise (Majoring) Electrical Power Engineering Majoring: 1. Able to characterize electric power engineering and energy. 2. Able to review the latest technology to solve the problem of electric power and energy fields. 3. Able to analyze the phenomenon of high field to resolve the problems of the field of electric power. 4. Able to itemize the problems of electric power and energy. 5. Able to design simple application in the fields of electric power and energy. 6. Able to study the latest technology to solve the problem of appropriate areas of expertise (Majoring). Biomedical Engineering Majoring Outcomes: 1. Able to apply the basic principles of biology in field of biomedicine engineering. 2. Able to apply the techniques, skills and modern tools that are necessary in the practice of biomedicine engineering. 3. Able to analyse medical data/information related to the condition of human physiology. 4. Able to make simple medical device design at the level of individuals and groups. 5. Able to process medical signal to improve the performance of a medical device. 6. Able to study the latest technology to solve the problem of appropriate areas of expertise (Majoring).

13	Classification of Subjects		
No.	**Classification**	**Credit Hours (SKS)**	**Percentage**
i	University General Subjects	18	12,5 %
ii	Basic Engineering Subjects	18	12,5 %
iii	Core Subjects	71	49,31 %
iv	Majoring Subject	21	14,58 %
iv	Elective Subjects	8	5,56 %
v	Special Subject (Internship, Seminar, Undergraduate Thesis)	8	5,56 %
	Total	144	100 %
14.	**Total Credit Hours to Graduate**		144 SKS

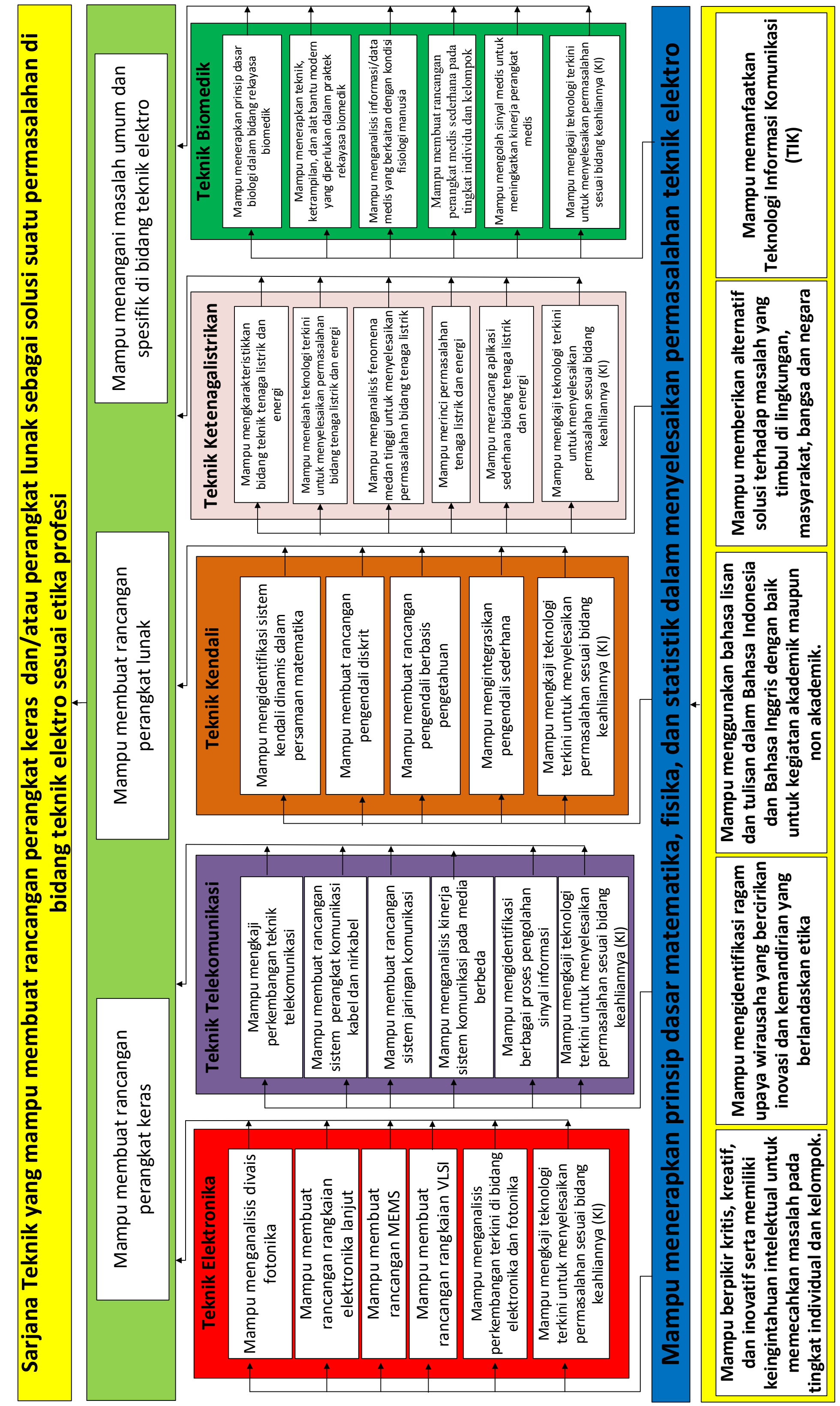
Career Prospects

The graduates of this program have been employed in various inductrial companies within one month (in average) after the graduation. Some of them are involved in power engineering, IT, electronic, oil & gas, telecommunication and other related inductries. Some of graduates were even employed before the graduation.

Some occupation or job titles that are suitable for this program are electrical engineer, process engineer, control engineer, instrumentation engineer, program manager, project manager, technical manager and professional lecturers.

ELECTRICAL ENGINEERING

LEARNING OUTCOMES



ELECTRICAL ENGINEERING

FLOW DIAGRAM OF SUBJECTS

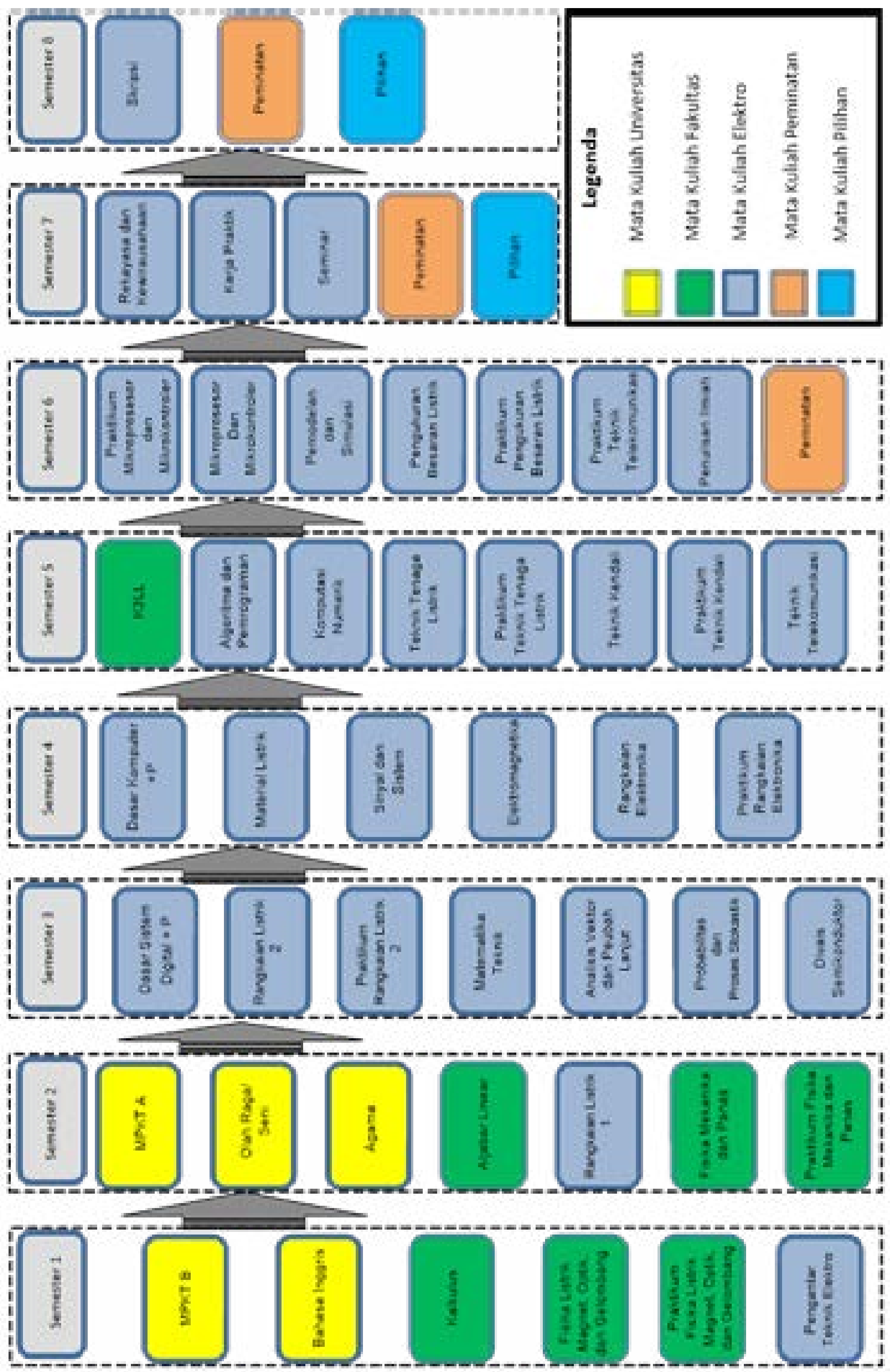
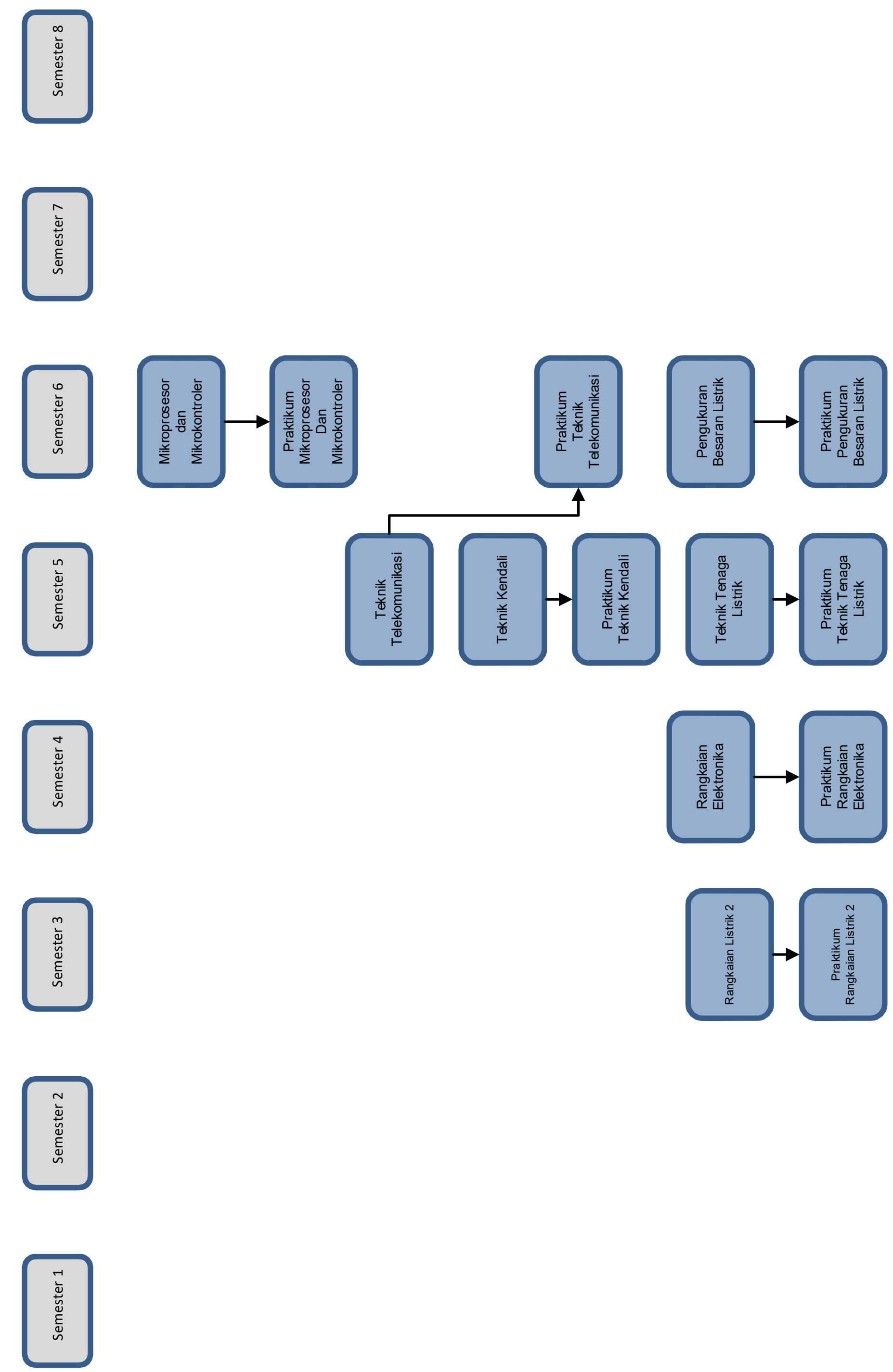
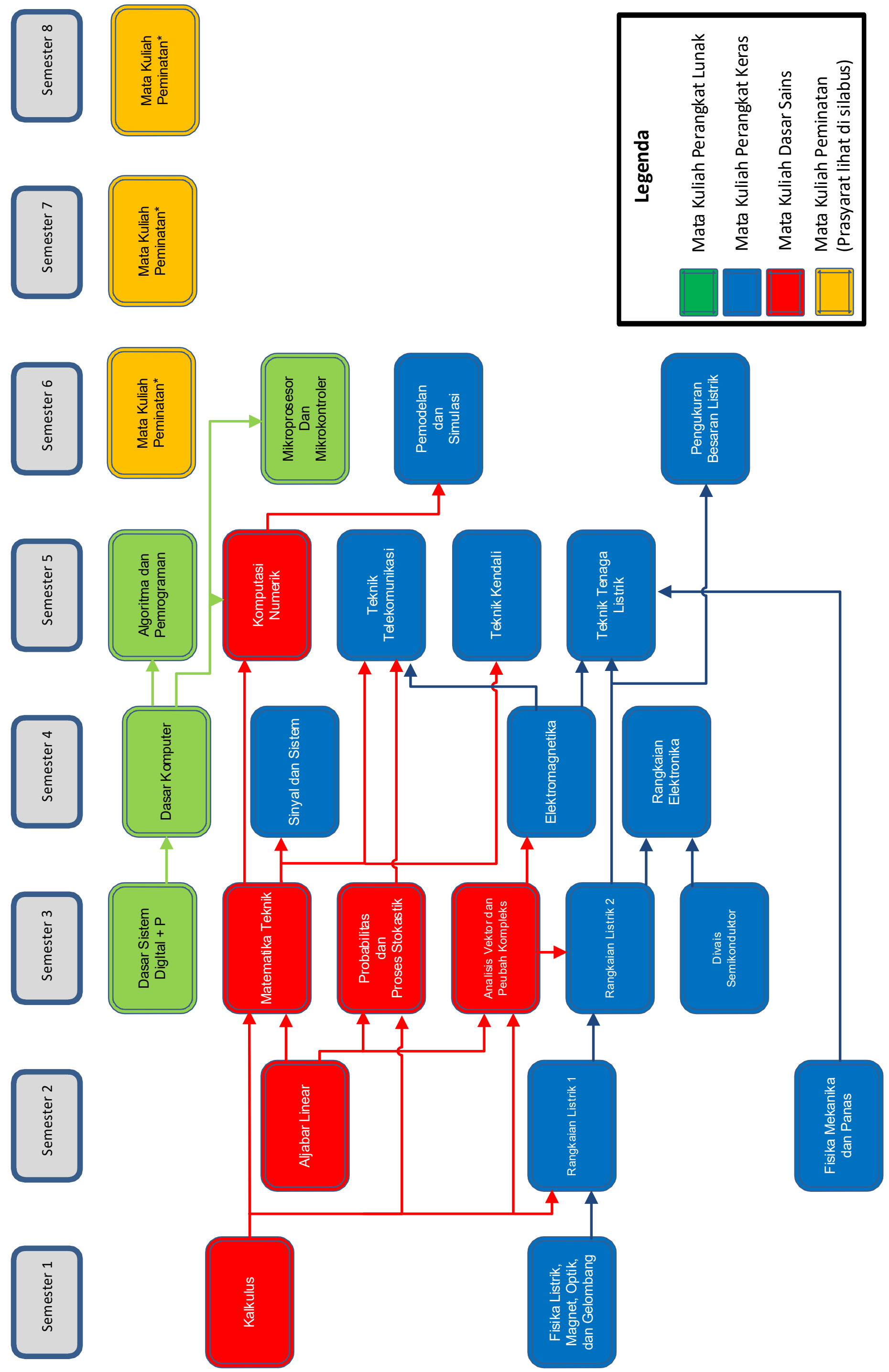


Diagram Alir Mata Kuliah Prasyarat Untuk Mata Kuliah Praktikum



ELECTRICAL ENGINEERING

Diagram Alir Mata Kuliah Prasyarat Untuk Mata Kuliah Non Praktikum



ELECTRICAL ENGINEERING

COURSE STRUCTURE UNDERGRADUATE PROGRAM ELECTRICAL ENGINEERING

CODE	SUBJECT	CREDIT
	1st Semester	
UIGE600002	Integrated Character Building B	6
UIGE600003	English	3
ENGE600003	Calculus	4
ENGE600007	Physics (Electricity, MWO)	3
ENGE600008	Physics (Electricity, MWO) Lab	1
ENEE601001	Intro to Electrical Engineering	2
	Subtotal	19
	2nd Semester	
UIGE600001	Integrated Character Building A	6
UIGE600010-15	Religion	2
UIGE600020 - 48	Sport / Art	1
ENGE600004	Linear Algebra	4
ENGE600005	Physics (Mechanics and Thermal)	3
ENGE600006	Physics (Mechanics and Thermal) Lab	1
ENEE602002	Electric Circuit 1	3
	Subtotal	20
	3rd Semester	
ENEE603003	Electric Circuit 2	3
ENEE603004	Electric Circuit Laboratory	1
ENEE603005	Vector Analysis and Complex Variable	2
ENEE603006	Probability and Stochastic Process	3
ENEE603007	Engineering Mathematics	4
ENEE603008	Semiconductor Devices	2
ENEE603009	Fund. of Digital System & Lab	3
	Subtotal	18
	4th Semester	
ENEE604010	Basic Computer and Laboratory	3
ENEE604011	Electronic Circuits	3
ENEE604012	Electronic Circuits Laboratory	1
ENEE604013	Electromagnetics	4
ENEE604014	Signal and Systems	3
ENEE604015	Electric Materials	2
	Subtotal	16
	5th Semester	
ENGE600012	Health, Safety & Environment Protection	2
ENEE605016	Numerical Computation	2
ENEE605017	Telecommunication Engineering	3
ENEE605018	Electric Power Engineering	3
ENEE605019	Electric Power Engineering Lab	1

ENEE605020	ControlEngineering	3
ENEE605021	ControlEngineering Laboratory	1
ENEE605022	Algorithm and Programming	4
	Subtotal	**19**
	6th Semester	
ENEE607032	Academic Writing	2
ENEE606024	Modelling and Simulations	2
ENEE606025	Telecommunication Engineering Lab	1
ENEE606026	Microprocessor and Microcontroller	4
ENEE606027	Microprocessor & Microcontroller Lab	1
ENEE606028	Electric Measurements	2
ENEE606029	Electric Measurements Laboratory	1
	Majoring Courses	9
	Subtotal	**22**
	7th Semester	
ENEE607030	Seminar	2
ENEE607031	Engineering Enterpreneurship	2
ENEE606023	Internship	2
	Majoring Courses	6
	Elective	4
	Subtotal	**16**
	8th Semester	
ENEE608033	Bachelor Thesis	4
	Majoring Courses	6
	Elective	4
	Subtotal	**16**
	TOTAL	**144**

CURRICULUM STRUCTURE TELECOMMUNICATION ENGINEERING MAJOR

CODE	COURSE	CREDIT
ENEE606301	Coding Technique and Applications	3
ENEE606302	Communication Networks	3
ENEE606303	Broadband Multimedia Communications	3
ENEE607304	Antennas and Propagation	3
ENEE607305	Optical Communications	3
ENEE608307	Mobile and Wireless Communications	3
ENEE608308	Communication System Devices	3

CURRICULUM STRUCTURE ELECTRICAL POWER ENGINEERING MAJOR

CODE	COURSE	CREDIT
ENEE606101	Electric Energy Conversion	2
ENEE606102	Power Electronics and Laboratory	3
ENEE606103	Management and Engineering Economy	3
ENEE607104	Electric Power System and Laboratory	3
ENEE607105	High Current & Voltage Eng + Lab	3
ENEE607106	Building Electric Installation	2
ENEE608108	Electric Power Transmission & Distribution	3
ENEE608109	Electric Power System Protection	2

CURRICULUM STRUCTURE ELECTRONICS ENGINEERING MAJOR

CODE	COURSE	CREDIT
ENEE606201	Advanced Electronic Circuits	3
ENEE606202	Photonic Devices	3
ENEE606203	Semiconductor Device Fabr + Lab	3
ENEE606204	Introduction of Nanoelectronics	3
ENEE606205	VLSI	3
ENEE606207	Solar Cell	3
ENEE606208	MEMS	3

CURRICULUM STRUCTURE CONTROL ENGINEERING MAJOR

CODE	COURSE	CREDIT
ENEE606401	Digital Control System	3
ENEE606402	Process Control System	3
ENEE606403	Electric Drive Control System	3
ENEE607404	Robotics	3
ENEE607405	Adaptive and Predictive Control System	3
ENEE608407	Mechatronics	3
ENEE608408	Knowledge Based System	3

CURRICULUM STRUCTURE BIOMEDICAL ENGINEERING MAJOR

CODE	COURSE	CREDIT
ENEE606501	Biology and Anatomy	3
ENEE606502	Medical Communication System	3
ENEE606503	Intro to Biomedical Technologies	3
ENEE607504	Medical Imaging Technology	3
ENEE607505	Medical System Modelling	3
ENEE608507	Biomedical Instrumentations and Laboratory	3
ENEE608508	Medical Informatics	3

ELECTIVES		
CODE	SUBJECT	CREDIT
ENEE607306	Special Course of Telecommunications 1	2
ENEE608309	Special Course of Telecommunications 2	2
ENEE607107	Special Course of Electrical Power 1	2
ENEE608110	Special Course of Electrical Power 2	2
ENEE606206	Special Course of Electronics 1	2
ENEE606209	Special Course of Electronics 2	2
ENEE607406	Special Course of Control 1	2
ENEE608409	Special Course of Control 2	2
ENEE607506	Special Course of Biomedics 1	2
ENEE608509	Special Course of Biomedics 2	2

FAST-TRACK CURRICULUM (S1 AND S2)

FAST TRACK CURRICULUM TELECOMMUNICATION ENGINEERING MAJOR

CODE	MATA AJARAN	COURSE	CREDIT
	Semester 7	**7th Semester**	
ENEE607030	Seminar	Seminar	2
ENEE607031	Rekayasa dan Kewirausahaan	Engineering Enterpreneurship	2
ENEE607032	Penulisan Ilmiah	Academic Writing	2
ENEE603007	Matematika Terapan	Applied Mathematics	3
ENEE606303	Komunikasi Multimedia Pita Lebar	Broadband Multimedia Communications	3
ENET801002	Sistem Radar dan Disain	Radar Systems and Design	3
ENET801003	Pengolahan Sinyal dan Aplikasi	Digital Signal Processing & Apps	3
ENEE607304	Antena dan Propagasi	Antennas and Propagation	3
ENEE607305	Komunikasi Optik	Optical Communications	3
		Subtotal	**24**
	Semester 8	**8th Semester**	
ENEE608033	Skripsi	Bachelor Thesis	4
ENEE802002	Metodologi Penelitian	Research Method	3
ENET802004	Teknik Sistem Medis Nirkabel	Wireless Medical System Eng.	3
ENET802005	Disain RF Lanjut	RF Engineering Design	3
ENET802006	Disain Antena Modern	Modern Antenna Design	3
ENMT803007	Komunikasi Multimedia Nirkabel	Multimedia Wireless Communications	3
ENEE608308	Divais Sistem Komunikasi	Communication System Devices	3
		Subtotal	**22**
	Semester 9	**9th Semester**	
ENET803007	Tek. Komunikasi Gelombang Cahaya	Lightwave Communication Technology	3
ENET803008	Topik Khusus Telekomunikasi	Special Topic in Telecommunication	2
ENEE803003	Manajemen & Keekonomian Proyek Teknik	Engineering Economy & Project Man-agement	3
		Subtotal	**8**
	Semester 10	**10th Semester**	
ENEE804005	Publikasi Ilmiah	Publication Scientific	2
ENEE804004	Tesis	Thesis	8
		Subtotal	**10**

FAST TRACK CURRICULUM ELECTRONICS ENGINEERING STREAM

CODE	MATA AJARAN	COURSE	CREDIT
	Semester 7	**7th Semester**	
ENEE607030	Seminar	Seminar	2
ENEE607031	Rekayasa dan Kewirausahaan	Engineering Enterpreneurship	2

ENEE607032	Penulisan Ilmiah	Academic Writing	2
ENEE801001	Matematika Terapan	Applied Mathematics	3
ENEF801001	Disain Rangkaian Terpadu	Integrated Circuit Design	3
ENEF801002	Nanoelektronika	Nanoelectronics	3
ENEF801003	Divais Fotonik Lanjut	Advanced Photonic Devices	3
ENEE606204	Pengantar Nanoelektronik	Introduction of Nanoelectronics	3
ENEE606205	Very Large Scale Integration (VLSI)	VLSI	3
		Subtotal	**24**
	Semester 8	**8th Semester**	
ENEE608033	Skripsi	Bachelor Thesis	4
ENEF802004	Disain MEMS (Micro Electronics & Mechanical)	MEMS Design	3
ENEF802005	Divais Solid State	Solid State Device	3
ENEF802006	Divais Hetero-struktur	Hetero-structure Devices	3
ENEE802002	Metodologi Penelitian	Research Method	3
ENEE606207	Sel Surya	Solar Cell	3
ENEE606208	MEMS	MEMS	3
		Subtotal	**22**
	Semester 9	**9th Semester**	
ENEE803003	Manaj. & Keekonomian Proyek Teknik	Engineering Economy & Project Manag.	3
ENEF803007	Sistem Optik Koheren	Optical Coherent System	2
ENEF803008	Sistem Pengukuran dengan Metode Optik	Optical Method for Measurement	3
		Subtotal	**8**
	Semester 10	**10th Semester**	
ENEE804005	Publikasi Ilmiah	Publication Scientific	2
ENEE804004	Tesis	Thesis	8
		Subtotal	**10**

FAST TRACK CURRICULUM ELECTRICAL POWER ENGINEERING STREAM

CODE	MATA AJARAN	COURSE	CREDIT
	Semester 7	**7th Semester**	
ENEE607030	Seminar	Seminar	2
ENEE607031	Rekayasa dan Kewirausahaan	Engineering Enterpreneurship	2
ENEE607032	Penulisan Ilmiah	Academic Writing	2
ENEE801001	Matematika Terapan	Applied Mathematics	3
ENEP801001	Operasi & Kendali Pembangkitan TL	Power Generation Ops & Control	3
ENEP801002	Mutu dan Kualitas Daya Sistem TL	Electrical Power System Quality	3
ENEP801003	Energi dan Lingkungan	Energy and Environment	3
ENEE607104	Sistem Tenaga Listrik danPrakti-kum	Electrical Power System and Laboratory	3
ENEE607105	Teknik Tegangan & ArusTinggi +P	High Current & Voltage Engineering Lab	3
		Subtotal	**24**
	Semester 8	**8th Semester**	
ENEE608033	Skripsi	Bachelor Thesis	4
ENEE802002	Metodologi Penelitian	Research Method	3
ENEP802004	Sistem Dinamik dan Pemodelan	Dynamic System and Modeling	3
ENME802004	Manajemen & Ekonomi Energi	Economics Energy and Management	3
ENEP802006	Elektronika Daya Industri	Industrial Power Electronics	3
ENEE608108	Distribusi & Transmisi Tenaga Listrik	Electric Power Trans. & Distribution	3
ENEE608109	Proteksi Sistem Tenaga Listrik	Electric Power System Protection	3
		Subtotal	**22**
	Semester 9	**9th Semester**	
ENEE803003	Manajemen & Keekonomian Proyek Teknik	Engineering Economy & Project Man-agement	3
ENEP803007	Topsus Ketenagalistrikan & Energi	Topics in Power System and Energy	2
ENEP803008	Perencanaan Sistem Tenaga Listrik	Power System Planning	3
		Subtotal	**8**
	Semester 8	**8th Semester**	
ENEE804005	Publikasi Ilmiah	Publication Scientific	2
ENEE804004	Tesis	Thesis	8
		Subtotal	**10**

FAST TRACK CURRICULUM CONTROL ENGINEERING STREAM

CODE	MATA AJARAN	COURSE	CREDIT
	Semester 7	**7th Semester**	
ENEE607030	Seminar	Seminar	2
ENEE607031	Rekayasa dan Kewirausahaan	Engineering Entrepreneurship	2
ENEE607032	Penulisan Ilmiah	Academic Writing	2
ENEE801001	Matematika Terapan	Applied Mathematics	3
ENEC801001	Kendali Analog dan Dijital	Analog and Digital Control	3
ENEC801002	Topik Khusus Riset Terkini	Special Topic on Advance Research	3
ENEC801003	Pemodelan dan Rekayasa Sistem	Modeling and System Engineering	3
ENEE607404	Robotika	Robotics	3
ENEE607405	Sistem Kendali Prediktif & Adaptif	Adaptive & Predictive Control System	3
		Subtotal	**24**
	Semester 8	**8th Semester**	
ENEE608033	Skripsi	Bachelor Thesis	4
ENEE802002	Metodologi Penelitian	Research Method	3
ENEC802004	Sistem Kendali Multivariabel	Multivariable Control Systems	3
ENEC802005	Robotika Cerdas	Intelligent Robotics	3
ENEC802006	Kendali Adaptif dan Optimal	Adaptive and Optimal Control	3
ENEE608407	Mekatronika	Mechatronics	3

ENEE608408	Sistem Berbasis Pengetahuan	Knowledge Based System	3
		Subtotal	**22**
	Semester 9	**9th Semester**	
ENEC803007	Kendali dan Sistem Cerdas	Intelligent System and Control	3
ENEC803008	Kendali Lanjut Sistem Penggerak Elektrik	Advanced Control on Electric Drive System	2
ENEE803003	Manaj. & Keekonomian Proyek Teknik	Engineering Economy & Project Manag.	3
		Subtotal	**8**
	Semester 10	**10th Semester**	
ENEE804005	Publikasi Ilmiah	Publication Scientific	2
ENEE804004	Tesis	Thesis	8
		Subtotal	**10**

CURRICULUM OF INTERNATIONAL PROGRAM ELECTRICAL ENGINEERING

CODE	Course	CREDIT
	1st Semester	
ENEE611001	Fundamental of Digital Systems and Laboratory	3
ENEE611002	Academic Writing	2
ENGE610003	Calculus	4
ENGE610007	Physics (Electric, Magnet,Wave & Optic)	3
ENGE610008	Physics (Electric, Magnet,Wave & Optic)Laboratory	1
ENEE611003	Introduction to Electrical Engineering	**2**
ENEE611004	Electrical Materials	2
	Subtotal	**17**
	2nd Semester	
ENEE612005	Basic Computer and Laboratory	3
ENEE612006	Semiconductor Devices	2
ENGE610004	Linear Algebra	4
ENGE610005	Physics (Mechanics and Thermal)	3
ENGE610006	Physics (Mechanics and Thermal) Laboratory	1
ENEE612007	Engineering Mathematics	**4**
ENEE612008	Electric Circuit 1	3
	Subtotal	**20**
	3rd Semester	
ENEE613009	Electric Circuit 2	3
ENEE613010	Algorithm & Programming	4
ENEE613011	Vector and Complex Variable Analysis	2
ENEE613012	Electric Circuit Laboratory	1
ENEE613013	Electrical Power Engineering	3
ENEE613014	Electrical Power Engineering Laboratory	**1**
ENEE613015	Telecommunication Engineering	3

ENEE613016	Telecommunication Engineering Laboratory	1
ENEE613017	Probability and Stochastic Process	3
	Subtotal	**21**
	4th Semester	
ENEE614018	Control Engineering	3
ENEE614019	Control Engineering Laboratory	1
ENEE614020	Electronics Circuits	**3**
ENEE614021	Electronics Circuits Laboratory	1
ENEE614022	Electromagnetics	4
ENEE614023	Electrical Measurements	2
ENEE614024	Electrical Measurements Laboratory	1
ENEE614025	Numerical Computation	2
ENEE614026	Signal & Systems	3
	Subtotal	**20**
	5th Semester	
ENEE615027	Microprocessor & Microcontroller	4
ENEE615028	Microprocessor and Microcontroller Laboratory	**1**
UIGE610004	Integrated Characteristic Building Subject B	**6**
ENEE615029	Digital Control Systems	3
ENEE615030	Communication Networks	3
ENEE615031	Power Electronics and Laboratory	3
	Subtotal	**20**
	6th Semester	
ENEE616032	Internship	2
ENEE616033	Modelling and Simulation	2
UIGE610005-9	Religion	2
UIGE610001	Integrated Characteristic Building Subject A	6
ENEE616034	Introduction of Nanoelectronics	3
ENEE616035	Communication System Devices	3
	Subtotal	**18**
	7th Semester	
UIGE610003	Sports/Arts	1
ENGE 6 1 0012	Health, Safety & Environment Protection	2
ENEE617036	Seminar	**2**
ENEE617037	Engineering Enterpreneurship	2
ENEE617038	Electric Power System and Laboratory	3
ENEE617039	Process Control Systems	3
ENEE617040	Photonic Devices	3
	Electives	2
	Subtotal	**18**
	8th Semester	
ENEE618041	Bachelor Thesis	4
	Electives	6
	Subtotal	**10**

	Total	144

ELECTIVES

CODE	Electives	CREDIT
ENEE617101	Object Oriented Programming and Laboratory	3
ENEE618102	Software Engineering	3

Resume

University General Subjects	15
Basic Engineering Subjects	18
Core Subjects	103
Sum	136
Elective	8
Total Credit Hours to Graduate	144

UNDERGRADUATE PROGRAM

THE SYLLABUS
UNIVERSITY COURSES

UIGE600001 (6 Credits)
MPKT A
Learning Outcomes:
Capable of critical thinking, creative, innovative; have the intellectual curiosity to solve problems at the individual and group level.
Able to provide problem-solving alternative against various problems arising in the environment, society, nation, and country.
Topics:
The power and primacy of the character, the basics of philosophy, logic, foundations of ethics, whether it’s human, individual and group, society and culture
Prerequisites: none
Textbook:
1. Evita e. Singgih, Miranda D.Z., Ade Solihat, Jossy p. Moeis, “ Buku Ajar I Kekuatan dan Keutamaan Karakter, Filsafat, Logika dan Etika “, University of Indonesia
2. Evita e. Singgih, Miranda D.Z., Ade Solihat, Jossy p. Moeis, “ Buku Ajar II Manusia sebagai Individu, Kelompok dan Masyarakat “, University of Indonesia

UIGE600002 (6 Credits)
MPKT B
Learning Outcomes:
Capable of critical thinking, creative, innovative; have the intellectual curiosity to solve problems at the individual and group level.
Able to provide problem-solving alternative against various problems arising in the environment, society, nation, and country.
Topics:
The power and primacy of the character, the basics of philosophy, logic, foundations of ethics, whether it’s human, individual and group, society and culture
Prerequisites: none
Textbook:-

UIGE600003 (3 Credits)
ENGLISH
Learning Outcomes:
Able to use spoken and written English well for both academic and non-academics activities.
Topics:
Study skills: active learner, vocabulary building, word formation and using the dictionary, listening strategies, extensive reading
Grammar: Basic grammar of sentences, clause. Reading: reading skills: skimming, scanning, main ideas, supporting ideas; Note taking reading popular science article, reading an academic text
Listening: short conversation, lecture and note-taking, news broadcast, short story
Speaking: discussion, giving presentation
Writing: summary of short articles, self-describing graphs and tables, academic paragraphs, essays
Prerequisites: none
Textbook:

UIGE600020 - UIGE600048
SPORTS/ARTS
See the academic guidebook of Faculty of Engineering

UIGE600010 - UIGE600015
RELIGION
See the academic guidebook of Faculty of Engineering

FACULTY COURSES

ENGE600003

ELECTRICAL ENGINEERING

CALCULUS (4 CREDITS)
Learning Outcomes:
Able to apply advanced mathematical concepts for electrical engineering; Able to apply mathematical concepts of functions and limits, derivative (single/multivariable) and its applications, integrals (single/multifold) and its applications, Taylor series, and Maclaurin series
Topics:
Functions and limits, Derivative (single/multivariable) and applications, integrals (single/multifold) and its applications, Taylor and Maclaurin series
Prerequisites: none
Textbook: none

ENGE600004
LINEAR ALGEBRA (4 CREDITS)
Learning Outcomes:
Able to apply the concept of Linear equations systems, Determinants, vector spaces, the space Results In Time, value and Eigen Vectors, as well as a Linear transformation
Topics:
The concept of Linear equations System, Determinants, vector spaces, the space Results in Time, value and Eigen Vectors, Linear transformation
Prerequisites: none
Textbook: none

ENGE600005
PHYSICS (MECHANICS AND THERMAL) (3 CREDITS)
Learning Outcomes:
Able to apply the concepts of basic physics, mechanics and thermodynamics in understanding nature and engineering phenomena including its applications.
Topics:
Mechanics of motion, gravity, the potential energy of the particle dynamical, works and energy, momentum, rotational motion, collision, kinematics and dynamic, angular momentum Physics Heat-Sound, temperature, heat, laws of thermodynamics I and II, kinetic gas theory I and II, Modern Physics-Quantum
Prerequisites: none
Textbook:
Haliday, Resnick, Walker, and *Principles of Physics 9th Edition,* Wiley, 2011.

ENGE600006
PHYSICS (MECHANICS AND THERMAL) LABORATORY (1 CREDIT)
See the academic guidebook of Faculty of Engineering

ENGE600007
PHYSICS (ELECTRICITY, MWO) (3 CREDITS)
Learning Outcomes:
Able to apply the concepts of basic physics, electricity, magnetism, optics, and waves in understanding nature and engineering phenomena including its applications.
Topics:
A static electric charge, Coulomb, electric field, Gauss law, electric potential, Capacitor and dielectric. Dynamic power, current, and prisoners, Ohm's law, electrical, electrochemical potential difference, the electric circuit. Field magnetism, magnetic motive force and flow, the effects of Hall, law ampere, the intensity of the magnetic field B, Biot-Savart's law, the law of Faraday, inductance, electromagnetics, oscillations, Maxwell's equations.
Prerequisites: none
Textbook:
Haliday, Resnick, Walker, and *Principles of Physics 9th Edition,* Wiley, 2011.

ENGE600008
PHYSICS (ELECTRICITY, MWO) LAB
See the academic guidebook of Faculty of Engineering

ELECTRICAL ENGINEERING

ENGE600012
HEALTH SAFETY ENVIRONMENT PROTECTION
See the academic guidebook of Faculty of Engineering

ELECTRICAL ENGINEERING COURSES

ENEE611003
ENEE601001
INTRODUCTION TO ELECTRICAL ENGINEERING (2 CREDITS)
Learning Outcomes:
Able to explain the basic concepts of electrical engineering and its application in everyday life.
Topics:
Basic concepts and its applications of: Electronics Engineering, telecommunications engineering, Control Engineering, electric engineering and energy, and biomedical engineering.
Prerequisites: none
Textbook:
Diktat Pengantar Teknik Elektro UI

ENEE612008
ENEE602002
ELECTRIC CIRCUITS 1 (3 CREDITS)
Learning Outcomes:
Able to calculate the electric charge, current, and voltage in a series basis; Able to explain voltage source, current source (free/bound), resistors, and capacitors; Being able to compute the independent circuit using the superposition theorem, the transformation of the source, and Thevenin-Norton; Able to calculate the electric circuit analysis using the variables node (current series), mesh, super-node (circuit voltage), super-mesh; Being able to analyze the response time a series order and order-1-2;
Topics:
Concept: current, voltage, power, and energy; Voltage source, current source (free/bound), resistors, and capacitors; Resistive circuit of series and parallel; Analysis of node, super-node, mesh, super-mesh; Superposition theorem, the transformation of the source, and Thevenin-Norton; Response time-order series 1 and 2
Equipment:
Prerequisite: Calculus, Physics (electricity, mwo).
Textbook:
1. David e. Johnson, Johnny r. Johnson, John l. Hilburry, Peter d. Scott, "Electric Circuit Analysis", 3rd Edition, Prentice Hall International, Inc., 1997. (Chapter 1-9)
2. James w. Nilsson, Susan a. Riedel, "Electric Circuits", 6th Edition, Prentice Hall International, Inc., 2000. (Chapter 1-10)

ENEE613009
ENEE603003
ELECTRIC CIRCUITS 2 (3 CREDITS)
Learning Outcomes:
Being able to make a simple electric circuit design; Able to analyze a 3-phase circuit; Able to analyze electric circuit of frequency response order-1 and order-2; Able to analyze basic circuits shared ideal transformer and inductance; Able to make design of passive and active filter circuits by utilizing basic circuits; Able to analyze a 4 poles circuit.
Topics:
3 phase circuits; Laplace transform; frequency response; shared inductance circuits; 1 order filter circuits passive and active; 4 poles circuits.
Prerequisite: Electric Circuits 1, Vector Analysis and Complex Variables.
Textbook:
1. James W. Nilsson, Susan a. Riedel, "Electric Circuits", 6th Edition, Prentice Hall International, Inc., 2000 (Chapter 11-18).

ELECTRICAL ENGINEERING

2. David E. Johnson, Johnny r. Johnson, John l. Hilburry, Peter d. Scott, "Electric Circuit Analysis", 3rd Edition, Prentice Hall International, Inc., 1997 (Chapter 10-17).

ENEE613012
ENEE603004
ELECTRIC CIRCUIT LABORATORY (1 CREDITS)
Learning Outcomes:
Able to calculate the electric charge, current, and voltage in a series basis; Able to explain voltage source, current source (free/bound), resistors, and capacitors; Being able to compute the independent circuit using the superposition theorem, the transformation of the source, and Thevenin-Norton; Able to analyze circuit ammeter, voltmeter, ohmmeter, and wheat-stone bridge; Able to calculate the electric circuit analysis using the variables node, super-node, mesh, super-mesh;
Topics:
Basic electricity; linearity analysis-mesh and knot; analysis of superposition; Thevenin and Norton; poles series circuits; alternating current circuits; three phases circuits;
Prerequisite: Electric Circuits 1
Textbook: Modul Praktikum Rangkaian Listrik – Laboratorium Tegangan Tinggi dan Pengukuran Listrik.

ENEE613011
ENEE603005
VECTOR ANALYSIS COMPLEX VARIABLE (2 CREDITS)
Learning Outcomes:
Able to apply advanced mathematical concepts to the field of electrical engineering that includes the complex variable, Cauchy-Riemann equation, Integral Cauchy; Able to apply basic vector differential, integral vector (line, surface and volume), Green's theorem, the Divergence theorem, Gauss and Stokes '; Able to apply the concept of Vector calculus, Complex numbers and functions
Topics:
Complex variables, complex numbers and functions, polar form, powers and roots, de Moiv're theorem, dot and cross products, limit. The derivatives, the analytic function. The Cauchy-Riemann equations, Laplace equation, exponential, trigonometric and hyperbolic functions, logarithm and general power. Complex integration, line integrals in complex plane, the Cauchy integral theorem and formula, derivatives of analytic functions. Laurent series, singularities, zeros and infinity, residue integration method and residue, integration of real integrals. With a conformal mapping, Complex analysis and potential theory. Vector differential calculus, vector in 2-space and 3-space. The inner (dot) Product and vector (cross) product, vector and scalar functions and fields. Derivatives, the gradient of scalar fields. Directional derivatives. The divergence and the curl of the vector field. Line integral, the path independence of line integrals. Double integrals, Green's theorem in the plane, the Surfaces for surface integrals, Triple integrals. Divergence theorem of Gauss, Stokes's theorem.
Prerequisite: Calculus, Linear Algebra
Textbook:
1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley Publishers.
2. Glyn James, "Advanced Modern Engineering Mathematics", 2nd Edition, Prentice Hall Publishers, 1999.

ENEE613017
ENEE603006
PROBABILITY AND STOCHASTIC PROCESSES (3 CREDITS)
Learning Outcomes:
Able to apply the concepts of probability and stochastic processes in the field of electrical engineering.
Topics:
The distribution function of a random variable, probability, discrete probability distributions, and continuous, normal, Poison, gamma, Chi-squared, Beta logarithm Weibull, the transformation of the probability distribution, the sampling distribution of one and two sample Estimation, hypothesis tests one and two sample, linear regression and stochastic models, its correlation, Autoregressive Moving Average Model, Autoregressive Moving Average models, Markov chains.
Prerequisite: Calculus, Linear Algebra
Textbook:
1. R. D. Yates and d. j. Goodman, "Probability and Stochastic Processes: A Friendly Introduction for Electrical and Computer Engineers", 2nd Edition, Wiley, 2004.
2. J. A. Gubner, "Probability and Random Processes for Electrical and Computer Engineers", Cambridge, 2006.
3. Ronald E. Walpole, Raymond h. Myers, Sharon l. Myers, Keying Ye, and "Probability & Statistics for Engineering & Scientists, 7th Edition, Pearson Education International, USA, 2002

ENEE603009
ENEE611001
Fund. of Digital System & Laboratory (3 CREDITS)
Learning Outcomes: In this course, students will learn all design phases and implementations of a digital system. At the end of the course, students will be able to analyze simple digital circuits, and able to design digital systems using combinational and simple sequential building blocks. This lecture also involves several practical work in the laboratory to design, implement and verify digital logic systems using digital circuit simulation software.
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, Module 5 - 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 Mano, r. 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. Basics of Digital System Lab. Practice Modules

ENEE612007
ENEE603007
ENGINEERING MATHEMATICS (4 CREDITS)
Learning Outcomes:
Able to apply differential equations and several transformation functions for solving problems in the field of electrical engineering.
Topics:
Ordinary Differential Equations (and Constant Coefficient is not constant), Partial Differential Equations, Difference Equations, Laplace transform, Fourier series, Fourier transform, Z Transformation
Prerequisites : Calculus, Linear Algebra
Textbook:
1. Erwin Kreyszig, "Advanced Engineering Mathematics," 9th Edition, Wiley Publishers, 2006.
2. Glyn James, "Advanced Modern Engineering Mathematics," Second Edition, Prentice Hall Publishers, 1999.

ENEE612006
ENEE603008
SEMICONDUCTOR DEVICES (2 CREDITS)
Learning Outcomes:
Students are able to explain basic concept of semiconductor material for electronics application, basic operation of metal-semiconductor junction, p-n junction, bipolar transition, Metal-Oxide-Semiconductor Field-Effect Transistor, current state of electronic devices
Topics:
Semiconductor Fundamentals: Semicondutor: A general Introduction, Carrier Modeling, Carrier properties, distributions, concentrations and carrier action, Drift, Diffusion, Recombination-Generation, pn junction Diodes: Preliminaries, Quantitative Electrostatic Relationship, pn Junction Diode: I-V characteristics, Ideal Diode Equation, Derrivations from the Ideal pn Junction Diode: Small-Signal Admittance, Reserve Bias Junction Capacitance, Forward-Bias Diffusion Admittance, pn Junction Diode: Transient Response, Optoelectronic Diodes, Bipolar Junction Transistor Fundamentals, BJT Static Characteristic, BJT Dynamic Response Modeling, Junction Capacitance, Transient Response,

Metal-Semiconductor Contacts and Schottky Diodes, Ideal MS Contact, Schottky Diode, MOS Fundamentals, Ideal Structure, Electrostatics MOFSET-The Essentials, Qualitative Theory of Operation, Quantitative ID-VD Relationship, ac response Metal-Semiconductor Workfunction Difference, Oxide Charges.
Prerequisites : No
Textbook:
Primary Text : *Semiconductor Devices Fundamentals:* R. F. Pierret (Addison Wesley, 1996)
Reference Text: 1. *Solid State Electronic Devices 4th Edition:* B. G. Stretman, S. Banerjee (Prentice Hall, 2000)
2. *Devices Electronics for Integrated Circuits 3rd Edition:* R. Muller, T. Kamins (Willey & Sons, 2003)

ENEE612005
ENEE604010
BASIC COMPUTER AND LABORATORY (3 CREDITS)
Learning Outcomes:
Able to explain types and function of computer hardware; Able to make the draft algorithms to solve the problem of computation and manipulation of data; Able to make the draft algorithms: Pseudocode, Flowcharts, Looping, selection/Branching; Able to implement the algorithm into a high level programming language and low level; Able to implement the Matlab Script; Able to implement the structure and control in the language of C; Able to implement modular programming in C language.
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: Basic System digital and Practical.
Textbook:
1. Alan Evans, Kendall Martin, Mary Anne Poatsy, "Technology in Action (TiA)," 12th Edition, Prentice-Hall, 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.

ENEE614020
ENEE604011
ELECTRONIC CIRCUITS (3 CREDITS)
Learning Outcomes:
Able to apply the basic concepts of electronics; Able to analyze basic electronics circuits; Able to compose electronic circuits by using electronic devices

Topics:
Series diode transistor circuits, the circuit configuration of power supply transistors, transistor applications; Frequency Response, a series of *amplifiers*
Prerequisite: Semiconductor device, Power Series 1, Series 2 Electric
Textbook:
Boylestad R, Nashhelsky L (2006), Electronic Devices and Circuit Theory, 9th Edition, Prentice Hall, New Jersey, USA.

ENEE614021
ENEE604012
ELECTRONIC CIRCUITS LABORATORY (1 CREDIT)
Learning Outcomes:
Able to apply the basic concepts of electronics; Being able to practice the workings of a diode, transistor, circuit configuration, frequency response, *amplifiers;* Able to use electronic measuring instrument
Topics:
Series diode transistor circuits, the circuit configuration of power supply transistors, transistor applications; response frequency, the circuit *amplifier*.

UNDERGRADUATE PROGRAM

Prerequisites : Electronic Circuit.
Textbook:
Electronic Circuit Teaching Modules – Electronic Laboratory.

ENEE614022
ENEE604013
ELECTROMAGNETICS (4 CREDITS)
Learning Outcomes:
Able to apply physical concept for electrical engineering; Able to apply Maxwell's equations on solving the problem of time variation in the form of an integral and differential, energy storage, and quasi static field and analysis of wave in time domain.
Topics:
Electrostatic, Magneto-static, Electromagnetic dynamic, Plane Waves, Maxwell's Laws, Electromagnetic Interference, transmission line
Prerequisite: Complex Variables and Vector analysis
Textbook:
1. Stuart M. Wentworth, "Fundamentals of Electromagnetics with Engineering Applications", John Wiley, 2005.
2. Fawwaz T Ulaby, "Fundamentals of Applied Electromagnetics", Prentice Hall Publications, 2001.

ENEE614026
ENEE604014
SIGNAL AND SYSTEMS (3 CREDITS)
Learning Outcomes:
Able to apply physical concept for electrical engineering; Able to apply the concept of linear systems for signal processing and digital filter design

Topics:
Other types of signals and linear systems, the characteristics of the system time fixed (LTI), review of the Fourier transform, the discrete time Fourier transform, digital Fourier transform, Laplace, sampling and reconstruction of discrete time signals, the transformation of analog filter design, Z.

Prerequisite: Engineering Mathematics
Textbook:
1. Simon Haykin & Barry Van Veen, "Signals and systems", 2nd Edition John Wiley & Sons publishers, 2003.
2. Alan V. Oppenheim, Alan S. Willsky, S. Hamid Nawab, "Signals and Systems", Prentice Hall; 2nd Edition, 1996.

ENEE611004
ENEE604015
ELECTRICAL MATERIAL (2 CREDITS)
Learning Outcomes:
Able to explain the classification of electric materials; Being able to analyze the problems of electrical material;
Topics:
Description of the electrical material, bonds of the molecule, the arrangement of atoms in the solid, dielectric polarization, electric material classification
Prerequisites:-
Textbook:
Rudy Setiabudy, "Material Teknik Listrik", UI Press, 2007
R. E. Hummel, "Electronic Properties of Materials", Third Edition, Springer, 2000

ENEE614025
ENEE605016
NUMERICAL COMPUTATION (3 CREDITS)
Learning Outcomes:
Able to apply numerical methods in the form design computing algorithms and data manipulation;

Topics:
The design of algorithms for numerical Methods: a search for roots, numerical methods for the resolution of systems of linear equations, numerical methods a search of curve fitting, numerical methods for differential and integral, numerical methods for ordinary differential equations; The Concept Of Interpolation
Prerequisite: Engineering Mathematics, Basic Computer

Textbook:
Steven Chapra, Canale Raymond. "Numerical Methods for Engineers 7th Edition", McGraw Hill. 2014.

ENEE613015
ENEE605017
TELECOMMUNICATION ENGINEERING (3 CREDITS)
Learning Outcomes:
Able to apply the basic concept of telecommunications engineering; Able to apply the concept of global communication systems; Capable of analyzing analog and digital modulation; Able to explain telephony system; Able to calculate the PCM and TDM, Digital Line Coding; Able to analyze telecommunications network: a basic Phone, the technique of grafting, signaling techniques, the concept of Queuing, a communications network radio, *microwave*, and fiber optics
Topics:
Global communication systems; analog and digital modulation; telephony system; PCM and TDM; Digital Line Coding; telecommunications network: a basic phone, connection, signaling, and the concept of the queue; communications network radio, *microwave*, and fiber optics

Prerequisites : Probability and stochastic processes, mathematical techniques, and 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.

ELECTRICAL ENGINEERING

ENEE605018
ELECTRIC POWER ENGINEERING (3 CREDITS)
Learning Outcomes:
Able to explain the concept of electric that includes generation, transmission and distribution; Being able to compute the parameters of electric machines.

Topics:
The basic Mechanical and electromagnetic, circuit of Three phase transformer, the basics of Machine Flow back and forth, Synchronous Machine, Parallel Operation of Synchronous Generators, Induction Motors, direct current Motors, transmission line, equation and Representation system, introduction of a power Flow Study, disturbance of symmetric and Asymmetric

Prerequisite: Electrical Circuits.
Textbook:
S. J. Chapman, "Electric Machinery and Power System Fundamentals," McGraw-Hill Science/Engineering/Math, 2001.

ENEE605019
ELECTRICAL POWER ENGINEERING LABORATORY (1 CREDITS)
Learning Outcomes:
Capable of testing characteristics of electric machines; Being able to classify the electrical machines
Topics:
Direct Current Machines, Transformers, Synchronous Machines, Induction Machines

Prerequisite: Electrical Circuits.
Textbook:
Electric Power Engineering Teaching Modules-Power Energy Conversion Laboratory

ENEE614018
ENEE605020
CONTROL ENGINEERING (3 CREDITS)
Learning Outcomes:
Able to apply the basic concept of control; Able to apply the concept of block diagrams, Time Response, system stability and steady-state error, root locus, frequency response; Capable of designing controllers with the bode diagram, and is able to analyze the state-space, capable of governing designing state-space,.
Topics:
Block diagrams; Time Response; The stability of the system; Steady-state error; Root locus; Frequency response; Design controllers with root locus; Design of controller with bode diagram; The state-space model analysis; Governing state-space design; Design Observer
Prerequisite: Engineering Mathematics
Textbook:
1. Nise, n. "Control Systems Engineering", 4th Edition, Wiley, 2005.
2. Katsuhiko Ogata, "Modern Control Engineering" 4th Edition, Prentice Hall, 2002.

ENEE614019
ENEE605021
CONTROL ENGINEERING LABORATORY (1 CREDITS)
Learning Outcomes:
Able to use the device data acquisition; Able to apply the response time, system stability and steady error, root locus design, frequency response, controllers with root locus, Bode's diagram with controller design, the introduction of PLC, state-space.
Topics:
Response time, system stability and steady error, root locus design, frequency response, controllers with root locus, Bode's diagram with controller design, the introduction of PLC, state-space
Prerequisite: Engineering Control
Textbook:
Laboratory Workbook – Control Systems Laboratory.

ELECTRICAL ENGINEERING

ENEE613010
ENEE605022
ALGORITHM AND PROGRAMMING (4 CREDITS)
Learning Outcomes:
Able to make the draft algorithms to solve the problem of computation and manipulation of data; Able to apply the concepts: Modular; Iteration and Recursion; Sorting; Searching; Array; Pointers; Linked List
Topics:
Modular; Iteration and Recursion; Sorting; Searching; Array; Pointers; Linked List; Static and dynamic data structures in C language
Prerequisites : Basic of computer
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
3. Deitel & Deitel, "How to Program"

ENEE616033
ENEE606024
MODELLING AND SIMULATION (3 CREDITS)
Learning Outcomes:
Able to establish mathematical model system, capable of performing the analysis of mathematical models of the system, able to build simulations based on mathematical models,
Capable of analyzing simulation system.
Topics:
Basic modelling and simulation, methods of modeling of physical systems, analysis of the model of non-linear dynamical systems, dynamical models of simulation with Matlab/Simulink,
Data modeling, system identification, data exploration methods, methods of optimization of the

least squares model, validation, data modeling with Matlab/Simulink.
Prerequisite: Numerical Computation
Textbook:
1. Harold Klee, Randal Allen, "Simulation of Dynamic Systems with MATLAB and Simulink", CRC Press, 2011
2. William j. Palm III, "System Dynamics", 2nd Edition ", McGraw-Hill, 2005.
3. John a. Sokolowski, Catherine m. Banks, "Modeling And Simulation Fundamentals", John Wiley & Sons, 2010

ENEE613016
ENEE606025
TELECOMMUNICATIONS ENGINEERING LABORATORY (1 CREDIT)
Learning Outcomes:
Able to put into practice the basic concept of telecommunications engineering; Being able to practice the communication system globally; analog and digital modulation; telephony system; PCM and TDM; Digital Line Coding; telecommunication network: telecommunications network: a basic Phone, the technique of grafting, signaling techniques, the concept of Queuing, a communications network radio, *microwave*, and fiber optic; Able to use the measure of telecommunications.
Topics:
Global communication systems; analog and digital modulation; Telephony system; PCM and TDM; Digital Line Coding; FIR Filters; the parameters of the antenna and wireless communication and channel simulation using software radio mobile; optical communication systems.
Prerequisite: Telecommunications Engineering
Textbook:
Laboratory Workbook – Telecommunication Engineering Laboratory.

ENEE615027
ENEE606026
MICROPROCESSOR AND MICROCONTROLLER (4 CREDITS)
Learning Outcomes:
Able to implement the algorithm into a high level programming language and low level; Able to implement Microprocessors and programming addressing mode in Assembly language for Microprocessors.
Topics:
Microprocessor's Addressing Modes; Programming Assembly language for Microprocessors

Prerequisite: Basic Computer

Textbook:
1. The Intel 8086/8088 Microprocessors, 80186/80188, 80286, 80386, 80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium IV Architecture, Programming, and Interfacing, Seventh Edition, Brey, Barry, b., PHI Inc., USA, 2006.
2. The 8051 Microcontroller and Embedded Systems, Second Edition, Muhammad Ali Mazidi, Prentice Hall, 2006

ENEE615028
ENEE606027
MICROPROCESSOR AND MICROCONTROLLER LABORATORY (1 CREDITS)
Learning Outcomes:
Able to implement the algorithm into a high level programming language and low level; Capable of practicing Microprocessors and programming addressing mode in Assembly language for Microprocessor.
Topics:
Microprocessor's Addressing Modes; Programming Assembly language for Microprocessors.
Prerequisite: Microprocessor and Microcontroller
Textbook:
1. Practical module Microprocessor and Microcontroller Digital Laboratory, Department of electrical engineering.

2. Barry B. Brey, "The Microprocessors Intel 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium IV Architecture, Programming, and Interfacing," 7th Edition, PHI Inc., USA, 2006.
3. Muhammad Ali Mazidi, "The 8051 Microcontroller and Embedded Systems," Second Edition, Prentice Hall, 2006.

ENEE614023
ENEE606028
ELECTRIC MEASUREMENTS (2 CREDITS)
Learning Outcomes:
Able to explain the philosophy of electric quantity measurement; Able to calculate the threshold quantity of electricity that is safe; able to analyze a series of measurements
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, a Digital gauge
Prerequisite: Electronics Circuits.
Textbook:
1. Rudy Setiabudy, " Pengukuran Besaran Listrik," LP-FEUI, 2007.
2. Klaas b. Klaassen, "Electronic Measurement and Instrumentation," Cambridge University Press, 1996.

ENEE614024
ENEE606029
ELECTRIC MEASUREMENTS LABORATORY (1 CREDITS)
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
Prerequisites:
Measurement of Electrical Quantities
Textbook:
Electric Quantity Measurement lab course modules-high-voltage Laboratory and measurement of electricity.

ENEE617037
ENEE607031
ENGINEERING ENTREPRENEURSHIP (2 CREDITS)
Learning Outcomes:
Able to implement the concepts and skills of entrepreneurship in the field of electrical engineering; Able to perform analysis and make the business plan expertise in innovation/product which corresponds to the development of information technology; Able to implement the concepts and skills of entrepreneurship in the field of electrical engineering
Topics:
Charging for Expertise, Think, Plan, Act Like an Entrepreneur, Making a Business Successful, Taking the Initiative, Enabling an E-Business, Providing Outsourced Services & Building a Contracting Business, guest lectures
Prerequisites : None
Textbook:
1. New Venture Creation – Entrepreneurship for the 21st Century, 6th Edition, J.A. Timmons and S. Spinelli, Irvin McGraw-Hill, 2004.
2. The material of the lectures given by practitioners of the entrepreneurial

ENEE611002
ENEE607032

ACADEMIC WRITING (3 CREDITS)
Learning Outcomes:
Able to write scientific papers with good structure
Being able to write down the steps with a detailed and structured research; capable of processing data with research tools statistics
Topics:
Systematics of academic writing; experimental variables and set up; statistical analysis tools, the use of the language of Indonesia is good in scientific works; English usage in scientific papers, word processing software; styling; referencing tools
Prerequisites: none
Textbook: Academic Writing, A Practical Guide for Students, Stephen Bailey, Taylor and Francis, London, 2003

MAJORING
TELECOMMUNICATIONS ENGINEERING

ENEE606301
CODING TECHNIQUE AND APPLICATIONS (3 CREDITS)
Learning Outcomes:
Capable of outlining the types of encoding; Being able to analyze the techniques used in data compression coding and reliable communications.
Topics:
Information measures, source and channel models, various source coding schemes including Huffman coding, run-length coding, linear predictive coding, transform coding, and various channel coding schemes including cyclic codes, BCH codes and convolutional codes. Trellis Coded Modulation. Application for Speech Coding, Image and Video Coding.
Prerequisite: Probability and stochastic processes
Textbook:
1. Andre Evidence, “Coding Theory: Algorithms, Architectures and Applications, Wiley-Interscience, 2007.
2. Thomas M. Cover & Joy A. Thomas, Elements of Information Theory “, Wiley-Interscience, 2006.
3. Jorge Castineira Moreira & Patric Guy keeps on, “Essentials of Error Control Coding”, John Wiley & Son Pub., 2006.

ENEE615030
ENEE606302
COMMUNICATION NETWORKS (3 CREDITS)
Learning Outcomes:
Able to explain mathematical concepts with regard to the concept of communication networks; Able to explain the concept of circuit switching and packet switching as well as concepts related to communication traffic; Able to explain the concept of queuing and queue theories for communication network; Able to explain concepts and mechanisms of QoS on the network communication
Topics:
Mathematics for the network, the concept of a communication network (layering); Circuit Switched and Packet Switched, the concept of communication traffic (Erlang B, Erlang C, Engset, Bernoulli, etc.); Various theories of the queue (M/M/1, M/M/c, M/G/1, M/G/c, etc.); Markov chain concept for communication networks, QoS assurance mechanism concept and the communication network.
Prerequisite: Telecommunications Engineering.
Textbook:
1. James R. Boucher, “Traffic System Design Handbook,” IEEE Press, 1993
2. Piet Van Mieghem, “Performance Analysis of Communication Networks and Systems,” Cambridge University Press, 2006, USA
3. Jean Walrand, “An Introduction to Queueing Networks,” Prentice-Hall Int’l, USA, 1988

ENEE606303
BROADBAND MULTIMEDIA COMMUNICATIONS (3 CREDITS)
Learning Outcomes:
Being able to analyze the concept of broadband multimedia.

UNDERGRADUATE PROGRAM

Topics:
The concept of multimedia technologies, TCP/IP, network protocols, ATM, Frame Relay, MPLS, broadband wireless access technologies, metro Ethernet, NGN and IMS, QoS, Resource management, QoS, the mechanisms work and how to guarantee it, a multimedia network model, the component performance throughput capacity.
Prerequisite: Telecommunications Engineering.
Textbook:
1. Lu Guojun, “Communication and Computing for Distributed Multimedia Systems,” John Wiley and Sons
2. Luis Correia, “Mobile Broadband Multimedia Networks,” Elsevier, UK, 2006

ENEE607304
ANTENNAS AND PROPAGATION (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; Being able to analyze the types of wave propagation and select the correct antenna for wireless communication system.
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: Electromagnetics
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. IEEE journal transaction Antenna and Propagation

ENEE607305
OPTICAL COMMUNICATIONS (3 CREDITS)
Learning Outcomes:
Able to explain wired transmission media/fiber optic as well as their principles; Able to explain the components of the optical communication system; Able to analyze optical communication systems
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
Prerequisite: Electromagnetics and Telecommunications Engineering.
Textbook:
1. Raat p. Agrawal, “Fiber-Optic Communication Systems”, 3rd Edition, Wiley Interscience, 2002.
2. G. Keiser, “Optical Fiber Communications”, 3rd Edition, McGraw Hill, 2000.

ENEE608308
MOBILE AND WIRELESS COMMUNICATIONS (3 CREDITS)
Learning Outcomes:
Able to explain the different types of wireless communication, concept of cellular, wireless communication components; Able to explain concepts, techniques and components of wireless mobile communication; Able to analyze performance of wireless mobile communications system.
Topics:
Overview of wireless communications, cellular concept/fundamentals, large scale fading/path loss,

ELECTRICAL ENGINEERING

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 ad hoc networks, body area networks and mobile health, future wireless system.

Prerequisite: Telecommunications Engineering
Textbook:
1. T. S. Rappaport, "Wireless Communications: Principles and Practice", Upper Saddle River, New Jersey: Prentice Hall, 2nd ed., 2002.
2. A. Goldsmith, "Wireless Communications," Cambridge University Press, 2005.
3. W. Stallings, "Wireless Communications and Networks", Prentice Hall, 2nd ed., 2005.

ENEE616035
ENEE608307
COMMUNICATION SYSTEM DEVICES (3 CREDITS)
Learning Outcomes:
Being able to analyze subsystem of communication systems such as: varieties of transmission line; impedance matching; S-parameter; resonator; other microwave passive devices; microwave active components (diode and transistors). Designing a simple radio communication subsystems devices based on passive and active components.
Topics:
Microwave transmission lines (Waveguide, Coaxial, Stripline, Microstrip, CPW); Microwave Network Analysis (S-parameter, Signal flow graph); Impedance Matching; Passive devices (Power divider, combiner, directional coupler, hybrid, junction); Resonator; Microwave diode and transistor; Simple Amplifier and Oscillator.
Prerequisites: Electromagnetics; Electronics Circuit; Telecommunication Engineering
Textbook:
1. David M. Pozar, "Microwave Engineering," 4th ed.John-Wiley and Sons, 2012
2. G. Gonzales, " Microwave Transistor Amplifier: Analysis and Design," 2nd ed., Prentice-Hall, 1998

ENEE607306
SPECIAL COURSE OF TELECOMMUNICATIONS 1 (3 CREDITS)
Learning Outcomes:
Able to follow the development of the telecommunications industry and apply it; Able to follow the development of the latest telecommunications technology aspects;
Topics:
Current issues about aspects of telecommunication technology
Prerequisites: none
Textbook: no

ENEE608309
SPECIAL COURSE OF TELECOMMUNICATIONS 2 (3 CREDITS)
Learning Outcomes:
Able to follow the development of the telecommunications industry and apply it; Able to follow the latest developments in business and telecommunications regulation.
Topics:
Current issues of business and regulation of telecommunications.
Prerequisites: none
Textbook: no

MAJORING
ELECTRICAL POWER ENGINEERING

ENEE606102
POWER ELECTRONICS AND LABORATORY (3 CREDITS)
Learning Outcomes:
Able to design simple application field of electric power; Able to explain the philosophy of power electronics equipment; Capable of calculating parameters on power electronics circuits; Able to design simple circuits using power electronics equipment
Topics:
Introduction to power electronics, electronic components, power converter AC-AC converter, AC-DC, DC-DC converter, DC-AC converter, power electronics applications
Prerequisite: Electric Power Engineering, Electronic Circuit
Electricity.
Textbook:
1. Muhammad H. Rashid, "Power Electronics Circuits, Devices and Applications," Prentice Hall, Fourth Edition, 2013.
2. Power Electronics lab course Modules-Electrical energy conversion Laboratory

ENEE606103
MANAGEMENT AND ENGINEERING ECONOMY (3 CREDITS)
Learning Outcomes:
Being able to classify the energy field; Able to explain the basics of business and management; Able to calculate the economics in electric field; Able to analyses the comparison of alternative technologies; Able to analyze alternative replacement; Being able to analyze the latest technology in the field of energy conversion; Able to calculate the economics source of energy; Being able to analyze the potential source of energy.
Topics:
The basic concept of management, organization type, organization resources, economic concepts, and the correlation value is money and time, comparative studies, analysis of replacement, the basics of energy management, energy costs, and calculation of potential energy
Prerequisite: none
Textbook:
1. William g. Sullivan, Elin M Wicks, James t. Luxhoj, "Engineering Economy," 3rd Edition, Pearson Education International, 2006.
2. Andrew c. Paine, John Chelsom, Lawrence v. R.P. Reavill, "Management for Engineers," John Wiley and Sons, 1996.

ENEE617038
ENEE607104
ELECTRICAL POWER SYSTEM AND LABORATORY (3 CREDITS)
Learning Outcomes:
Being able to analyze the magnetic and electric field high on power system; Able to explain the philosophy of power system; Able to calculate the parameters of power network; Capable of analyzing system of electric power network; Being able to find a solution to the problem of the quality of electric power; Being able to analyze the source of disturbance in the generation, transmission, and distribution of electricity; Capable of minimizing the effects of disturbance on electric power systems.
Topics:
The phenomenon of electric field and magnetic field on the electric power system, the effects of magnetic field and electric field on electric power systems, mitigation of effects of magnetic field and electric field.
Sources of disturbance on electric power systems, the effects of disturbance on mitigation of the effects of power system disturbances in electric power systems
Prerequisite: Engineering Mathematics, Electrical Power Engineering
Textbook: B. M. Weedy, B. J. Cory, "Electric Power Systems," 4th Edition, John Wiley and Sons, 2001.

ENEE606101
ELECTRICAL ENERGY CONVERSION (3 CREDITS)
Learning Outcomes:
Being able to classify the energy field; Being able to decipher the various types of energy as electric generators; Able to calculate the range of potential energy as electricity generation; Being able to analyze the process of converting electric energy;
Able to apply the principles of electrical energy conversion; Being able to analyze the latest technology in the field of energy conversion.
Topics:
Basic conversion of energy, sources of energy, new energy Conversion Technology, and renewable

power plants, Thermal power plants, non-thermal power plant.
Prerequisite: Electric Power Engineering.
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," Penerbit Elsevier, 2007

ENEE607106
BUILDING ELECTRIC INSTALLATION (2 CREDITS)
Learning Outcomes:
Able to make the planning of the electrical installation of the building; Able to calculate the magnitudes of the electrical installation parameters on the building; Able to itemize those parts of the electrical installation of the building
Topics:
Basic electrical installation, the components of the electrical installation, the requirements of the electrical installation, electrical installation technology, security lighting, security and safety, as well as the procedures for electrical installation of buildings
Prerequisite: Electric Power Engineering
Textbook:
1. William K Y Tao R, Richard Janis, "Mechanical and Electrical System in Building," Prentice Hall, 1997.
2. Brian Scaddan, "Electrical Installation Work". Elsevier Publishing, 2005.

ENEE607105
HIGH CURRENT & VOLTAGE ENGINEERING + LABORATORY (3 CREDITS)
Learning Outcomes:
Being able to analyze the magnetic and electric field high on power system; Able to explain the phenomenon of electric field and magnetic field is high; Capable of testing electric power equipment; Able to analyze about the occurrence of interference due to the phenomenon of the high terrain.
Topics:
The concept of a high-voltage, high-voltage test, high voltage generation, impulse generators, direct current testing and flow back and forth, testing electrical equipment
Prerequisite: Electromagnetics, 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.

ENEE608109
ELECTRICAL POWER SYSTEM PROTECTION (3 CREDITS)
Learning Outcomes:
Able to explain the philosophy of electric power system protection; Able to calculate the electrical protection system; Able to evaluate the protection system of electric power; Able to design protection system of electric power.
Topics:
Electrical protection philosophy, types of relay protection, the principle of relay protection, setup relay protection, the coordination principle of protection.
Prerequisite: Electric Power Engineering
Textbook:
1. the G.E.C. Alsthom, "Protective Relays Application Guide," U.K., 2015

ENEE608108
ELECTRICAL POWER TRANSMISSION & DISTRIBUTION (3 CREDITS)
Learning Outcomes:
Able to explain the philosophy of the distribution and transmission of electric power systems; Able to calculate the parameters of the transmission and distribution; Being able to analyze the transmission and distribution of electric power systems.
Topics:
The introduction of transmission and distribution of electrical power, the circuit of three phase motors, Inductance, Capacitance and Resistance on the transmission network, transmission network performance characteristics, the distribution Transformer, electric power distribution network.
Prerequisite: Electric Power Engineering
Textbook:
1. Luces m. Faulkenberry, Walter Coffer, "Electric Power Distribution and Transmission," Prentice Hall, 1996.
2. Iwa Garniwa, "design of electric power Distribution Equipment," Publisher - high-voltage Laboratory and measurement of electricity, Electrical Engineering Department, FTUI, 2008.
2. Iwa Garniwa, "design of Power transmission equipment," Publisher - high-voltage Laboratory and measurement of electricity, Electrical Engineering Department, FTUI, 2008.

ENEE607107
SPECIAL COURSE OF ELECTRICAL POWER 1 (2 CREDITS)
Learning Outcomes:
Able to design a simple application in the field of energy and power system.
Topics: customized to class' needs about power system technological development, and can be given by several guest lecturers
Prerequisite: Electrical Power Engineering
Textbook: None

ENEE608110
SPECIAL COURSE OF ELECTRICAL POWER 2 (2 CREDITS)
Learning Outcomes:
Able to design a simple application in the field of energy and power system.
Topics: customized to class' needs about power system technological development, and can be given by several guest lecturers
Prerequisite: Electrical Power Engineering
Textbook: None

MAJORING
ELECTRONICS ENGINEERING

ENEE617040
ENEE606202
PHOTONIC DEVICES (3 CREDITS)
Learning Outcomes:
Able to explain the working principle of passive and active photonic
Able to apply the principles of physics and mathematics to calculate the variable change device photonic
Being able to determine the independent device photonic
Able to explain passive: photonic device and optical, lattice (grating), polarization; and active photonic device: laser, LED, and photodetector
Being able to compute using Photonic device variables theory of light: the law of Snell, Fresnel equation, Fermat's law, polarization
Able to determine variables NA, attenuation, dispersion, mode sense, dispersive power, Registrar, power, free spectral range, coherence, vector and matrix Jones
Topics:
The theory of light: the law of Snell, the law of Fresnel, Maxwell's equation, Fermat's law, polarization, diffraction, NA, attenuation, dispersion, mode sense, dispersive power, Registrar, power, free spectral range, the coherency matrix, vector, Jones,
Photonic passive devices: optical, as well as lattice (grating), polarization; Active photonic device: laser diode, an LED and a photodetector.
Prerequisite: a Semiconductor Device
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 Optoelektronika

ENEE607205
VERY LARGE SCALE INTEGRATION (VLSI) (3 CREDITS)
Learning Outcomes:
Able to design VLSI circuit
Topics:
Review of CMOS semiconductor device fabrication, the rules of design, Scale of Lambda, Asynchrony, designing logic gates, Inverter, NAND, NOR, Full custom design, Semi-custom design, validation, Packaging/IO, design for manufacturing, testing and design of fault modeling, Coding for synthesis, characteristics and Estimate the performance series, the high level design Optimization, Programmable logic arrays, subsystem Design, Properties of CMOS Logic: Area, Power, Delay, time Optimization Engine, sequential, and the structure of the regular VLSI.
Prerequisite: Electronics Circuit, semiconductor device Fabrication
Textbook:
N. Kamran Eshraghian, & Weiste "Principles of CMOS VLSI Design: A perspective", Second Edition, Addison Wesley, 2002.

ENEE606201
ADVANCED ELECTRONICS CIRCUITS (3 CREDITS)
Learning Outcomes:
Able to analyze: integrated circuits, digital circuits with bipolar digital circuits, MOSFET, power amplifier, high-order active filter, oscillator circuit, Schmidt Trigger, voltage regulators; Able to design: integrated circuits, digital circuits with bipolar digital circuits, MOSFET, power amplifier, high-order active filter, oscillator circuit, Schmidt Trigger, voltage regulators.
Topics:
Integrated circuits, digital circuits with bipolar digital circuits, MOSFET, power amplifier, high-order active filter, oscillator circuit, Schmidt Trigger, voltage regulator
Prerequisite: Electronics Circuits
Textbook:
Boylestad R, Nashhelsky L, "Electronic Devices and Circuit Theory, 9th Edition," Prentice Hall, New Jersey, USA, 2006.

ENEE616034
ENEE607204
INTRODUCTION OF NANOELECTRONICS (3 CREDITS)
Learning Outcomes:
Able to analyze recent developments in the field of electronics and photonic; Being able to analyze the workings of the Nano-electronic and Nano-photonic device.
Topics:
Nano technology and its application in the field of electronics, from the micro to the Nano, the miniaturization of electronics device, scaling the dimensions of transistor, the workings of the single electron transistors, molecular electronics work, fabrication, and characterization of Nano-devices, Nano-technology and its application in the field of photonic, the workings of the single-photon detector, the workings of the OLED
Prerequisite: A Semiconductor Device, Semiconductor Device Fabrication
Textbook:
1. Massimiliano Di Ventra, et al. Introduction to NST ch. 11 Kluwer ACAD. Publishers, 2004.
2. Vladimir v. Mitin, Viatcheslav a. Kochelap, Michael a. Stroscio, "Introduction to Nanoelectron ics", Cambridge University Press, 2008

ENEE606203
SEMICONDUCTOR DEVICE FABRICATION + LABORATORY (3 CREDITS)
Learning Outcomes:

ELECTRICAL ENGINEERING

Able to explain the process of fabricating semiconductor devices; Capable of making a semiconductor fabrication process design on microelectronics devices; Able to use the device fabrication process design.
Topics:
The history of the semiconductor industry, semiconductor, wafer preparation and Crystal growth, contamination control, lithography, oxidation, diffusion, ion implantation, etching, deposition, application usage Supreme ver. 4.
Prerequisite: Device Electronics.
Textbook:
1. Peter Van Zant, "Microchip Fabrication," 8th Edition, International Edition, McGraw-Hill, 2004.
2. Practical semiconductor device Fabrication Module-Electronics Laboratory

ENEE608207
SOLAR CELLS (3 CREDITS)
Learning Outcomes:
Able to identify work areas devices to solar cells; Being able to compute the parameter limit efficiency, loss-power loss in a solar cell device; Being able to analyze the way of working and the solar cell performance, design and fabrication of silicon solar cells.
Topics:
The workings of the solar cell, the Parameter limit efficiency, loss-power loss in a device the solar cell, solar cell device work area, the design of silicon solar cells, and fabrication of silicon solar cells
Prerequisite: Electronics Circuit, Semiconductor Device Fabrication
Textbook:
Marten a. Green, "Solar Cells Operating Principles, Technology and System Applications", UNSW, 1998.

ENEE608309
MICRO ELECTRONIC MECHANICAL SYSTEM (3 CREDITS)
Learning Outcomes:
Able to design MEMS circuits;
Topics:
Background the development of MEMS, electronics and materials processing, MEMS and microelectronics technology, preparation of standard silicon micromachining, bulk, and the surface of silicon micromachining, MEMS, micro stereo lithography micro-sensor, the SAW, the SAW on a solid object, the measurement parameter micro-sensor IDT, IDT micro-sensor Fabrication Micro-sensor, IDT, smart sensors and MEMS.
Prerequisite: Electronics Circuit, Semiconductor Device Fabrication
Textbook:
Julian w. Gardner, Vijay k. Varadan, and Osama o. Awadelkarim, "Microsensors, MEMS and Smart Devices," Wiley; 1 edition (December 15, 2001), ISBN-10:047186109X, ISBN-13:978-0471861096.

ENEE60730 6
SPECIAL COURSE OF ELECTRONICS 1 (2 CREDITS)
Learning Outcomes:
Being able to analyze the development of technology devices and photonic systems; Able to analyze basic photonic system for certain functions
Topics:
Current topics of development of technology devices and systems photonic
Prerequisite: Electronics Circuits
Textbook: none

ENEE607309
SPECIAL COURSE OF ELECTRONICS 2 (2 CREDITS)
Learning Outcomes:
Able to analyze recent developments in the field of electronics;
Topics:
The topics of the current technological development of electronic systems and devices

ELECTRICAL ENGINEERING

Prerequisite: Electronics Circuits
Textbook:-

MAJORING
CONTROL ENGINEERING

ENEE607405
ADAPTIVE & PREDICTIVE CONTROL SYSTEM (3 CREDITS)
Learning Outcomes:
Able to identify the model and application of predictive and Adaptive; Capable of analyzing discrete control system, the stability of non-linear system using Lyapunov method; Capable of designing discrete adaptive and predictive control; Able to evaluate the performance of predictive and adaptive control systems.
Topics:
The basic concept of predictive and adaptive control, recursive parameter estimation, method of pole placement method, minimum variance, dynamic matrix control, model algorithmic control, generalized predictive control, predictive control room situation.
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

ENEE615029
ENEE606401
DIGITAL CONTROL SYSTEM (3 CREDITS)
Learning Outcomes:
Capable of analyzing discrete control system; Able to explain the characteristics of discrete systems; Capable of analyzing the stability of discrete systems; Able to design a simple discrete controller; Able to make discrete controller design method: root locus, and pole placement; Able to make the design of state observer of discrete Full order observer, and Reduced order observer
Topics:
The basic concept of a digital control system, a review of z-transforms, discrete time transfer functions, methods of realization of discrete control system, Transient and steady state response, analysis of stability of discrete systems, discrete root locus method, design the root locus method control discrete, discrete state space models, canonical forms, discrete state space model analysis (Eigen values, controllability, observability), pole-placement method of discrete, observer design of discrete.
Prerequisite: Control Engineering
Textbook:
Ogata, k. “Discrete Time Control Systems”, Prentice Hall, 2002.

ENEE617039
ENEE606402
PROCESS CONTROL SYSTEM (3 CREDITS)
Learning Outcomes:
Able to identify the model of dynamical systems of industrial processes; Able to explain measurement techniques of dynamical systems of industrial processes; Able to explain the characteristics of industrial processes; Able to describe systems of industrial processes; Able to identify industrial process modeling method
Topics:
Process and characteristics of the problem, the process of measurement methods, sensors and transmitters, signal conditioning and installation, industrial process modeling, PID controllers, tuning PID control, cascade control, feedforward control, smith predictor, a variation on another controller.
Prerequisite: Control Engineering
Textbook:
1. Curtis d. Johnson, “Process Control and Instrumentations”, 8th Edition, Prentice Hall Inc. 2005.
2. Carlos a. Smith and Armando Corripio, b. “Principles and Practice of Automatic Process Control”, 3rd Edition, John Wiley & Sons, Inc. 2005.

ENEE607404
ROBOTICS (3 CREDITS)
Learning Outcomes:
Able to identify the needs of the components of Robotics; Being able to analyze the kinematics of the robot; Able to evaluate the drive systems Robotics; Integrated control system capable of designing on simple robotics systems; Able to design kinematics robotics.
Topics:
Robotics Automation system components (sensors, actuators, controllers), the principle of work of system of robotics, kinematics of robots, robotics control systems (position control) robot kinematics-based interconnection system components, robotics, engineering the design of robots, robot programming, simulation with OpenGL, the introduction of a high level of robots.
Prerequisite: Engineering control, algorithms and programming.
Textbook:
1. Robotics: design, control, and artificial intelligence, Andi Publisher by Endra Pitowarno, 2006.
2. Introduction to Robotics: mechanics and control, 3rd Edition, John Craig, Pearson, 2009.

ENEE606403
ELECTRIC DRIVE CONTROL SYSTEM (3 CREDITS)
Learning Outcomes:
Being able to analyze the component controller and electric drive system components; Able to evaluate the performance of the electric drive system with simulation; Able to evaluate simple motor drive systems.
Topics:
Electric drive systems, modeling of electric motors (DC, PMSM, IM), power transfer circuit (PWM 3 phase inverter), the servo motor DC brushless speed controller, and position, the concept of reference frame, vector control, simulation of electric drive system.
Prerequisite: Engineering Control.
Textbook:
1. Peter vase, “Electrical Machines and Drives: A Space-Vector Theory Approach”, Oxford University Press, UK, 1993.
2. Peter vase, “Sensor-less Vector and Direct Torque Control”, Oxford University Press, 1998.

ENEE608407
MECHATRONICS (3 CREDITS)
Learning Outcomes:
Being able to analyze the components of the controller; Capable of analyzing the limitations of Mechatronics system components; integrated control system capable of designing in Mechatronics system is simple; capable of designing system of Mechatronics Robotics with applications to accommodate the limitations of the components.
Topics:
Introduction to Mechatronics systems, characteristics and limitations of Mechatronics system Method of improvement reliability of Mechatronics system components, Mechatronics system design, electromechanical system modeling, design and development of application software, control compliant, tele-robotic, bilateral control.
Prerequisite: Robotics
Textbook:
Robert Bishop, “Mechatronics and Introduction”, 2006.

ENEE608408
KNOWLEDGE BASED SYSTEMS (3 CREDITS)
Learning Outcomes:
Able to identify the model of knowledge-based dynamical systems; Being able to analyze the performance of artificial neural network; Able to implement algorithms in programming language for knowledge-based systems.
Topics:
the working system of neurons, cells, artificial 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 as

the system identifier of the pattern, the system control based neural network: an analysis of the use of methods of control, as a system of BPNN identification of neural network-based systems: representation of data and the use of BPNN as identification system, program development system identification 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, Algorithms and programming
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.

ENEE607406
SPECIAL TOPIC OF CONTROL ENGINEERING 1 (2 CREDITS)
Learning Outcomes:
Able to follow the development of the control technology and its implementation; Able to follow the development of current aspects of control technology.
Topics:
Current issues about control technological aspects
Prerequisites: none
Textbook: none

ENEE608409
SPECIAL TOPIC OF CONTROL ENGINEERING 2 (2 CREDITS)
Learning Outcomes:
Able to follow the development of the control technology and its implementation; Able to follow the latest development of the control technology business.
Topics:
Current issues about control business technology.
Prerequisites: none
Textbook: none

MAJORING
BIOMEDICAL ENGINEERING

ENEE606502
MEDICAL COMMUNICATION SYSTEM (3 CREDITS)
Learning Outcomes:
-Able to explain some of the technology of communication system for medical applications
-Able to explain the system of e-healthcare and telemedicine
-Able to explain the process of designing the system wired/wireless medical communication
Able to make the design through simulation design of medical devices
Topics:
Introduction to medical communication system, e-healthcare and telemedicine. Several special course will be delivered include body-centric wireless communications, electromagnetic properties and modeling of the human body, portable wearable devices, medical implant communication systems, e-healthcare infrastructure, wireless body area network, mobile-based telemedicine system, and wireless power technology in medical devices.
Communication systems on and off, in the body and how to model the via simulation
Prerequisites: none
Textbook:
1. E-Healthcare Systems and Wireless Communications: Current and Future Challenges, Mohamed k. Watfa, Publisher: IGI Global.
2. Antennas and Propagation for Wireless Communications Centric Body, P. Hall, Publisher: Artech House, 2006.

ENEE607504

UNDERGRADUATE PROGRAM

MEDICAL IMAGING TECHNOLOGY (3 CREDITS)
Learning Objective:
After getting the courses the student is expected to:
1. Able to understand some basic concepts in medical imaging technology
2. Able to explain and analyze the basic method of medical image processing in reconstructing, improving the quality of the image, making the image segmentation, image analysis, visualization of image data, and manage medical imagery in order to support the process of imaging/medical imaging in the field of health
Able to apply the methods in environmental biology and basic science to medical applications system
Able to integrate circuit and electronic device to device/instrument of biomedicine
Able to make simulations of imaging methods in medical devices
Being able to make a report of the results of the simulation of a small project
Being able to analyze the signals in the medical system to process the signal with the signal processing technique of medical
Topics:
Introduction to Medical Imaging Technologies (x-ray and Ultrasound, MRI, CT, 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, adaptive, and fixed, pixel-based methods), Image Segmentation and Analysis (Fundamentals of Medical Image Segmentation, Image acquisition and preprocessing artefacts, 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 Compression Standards, Storage and Communication, Image archive and retrieval, three-dimensional compression).
Medical image processing, artifact acquisition, thresholding, Edge-based techniques, Region-based segmentation, Classification,
The methods of image formation process and its analysis
Image formation, medical imaging tools
Formation of the image of medical signals and image analysis, visualization
Prerequisites: None.
Textbook:
1. Handbook of Medical Imaging: Processing and Analysis Management, Isaac Bankman, Academic Press 2000, CA, USA.
2. Handbook of Medical Imaging, vol. 2: Medical Image Processing and Analysis, M. Sonka & J.M. Fitzpatrick, SPIE Press, 2009, Washington, USA.

ENEE606501
BIOLOGY AND ANATOMY (3 CREDITS)
Learning Objective:
Give the basic knowledge of the mechanisms of biology and anatomy of engineering.
Instructional Objectives:
a. Able to explain the basic concepts of cell biology, molecular, biochemical and genetic engineering
b. Have the knowledge about the essential components and the various functions of the system of molecular cell.
c. Have the knowledge of the techniques and approaches that are commonly used in molecular biology of the cell.
d. Apply the knowledge of biology to biomedical engineering and health sciences.
Able to explain the phenomenon in the medical field with the approach to biology and anatomy of human organs
Able to make reports papers
Able to explain the phenomenon in the medical world with the approach to biology and anatomy of human organs

Topics: constituent molecules of the cell, structure and function of proteins within the cell, metabolism, changes in the cells; Molecular design of biochemical constituents of life, and the genetic revolution, DNA, linkages with biodiversity, biochemical protein synthesis of nucleic acids into a sequence of amino acids-RNA polymerase 2, until the Ribosome for protein synthesis, eukaryotic and

prokaryotic differences; Catalytic reactions in cells: nucleoside monophosphate kinases, proteases; Mechanical chemical in cells: how protein motors to convert chemical energy into mechanical work. Understanding human anatomy, Cytology and Histology, Osteology, Arthrologi, Miologi, digestive system, respiratory system, circulatory system.
Constituent molecules of the cells and organs of human body Anatomy

Prerequisites: None
Textbook:
1. Alberts, 2003, Molecular Biology of the cell.
2. Lodish, Molecular cell biology, 2004.
3. G.W. Jenkins, C.P. Kemnitz, G.J. Tortora, Anatomy and Physiology: From Science to Life, John Wiley & Sons: 2nd Ed. 2010.

ENEE607505
MEDICAL SYSTEM MODELLING (3 CREDITS)
Learning Outcomes:
Learning Objective:
Understand the components of the medical system, understand the mathematical model of the medical system, understand the modeling method of the medical system, Able to perform simple modelling medical systems and able to simulate.
Able to apply the algorithm for a device/instrument of biomedicine
Able to report the results of the coding program

Topic: Introduction to signal and system of medical models, mathematical modeling and signal system in General, analytic modeling of medical system, analysis of analytical models, methods of identification of the medical system, the method of parameter estimation model, the simulation model of the medical system.
Analytic modeling of medical system
Analysis of analytical models, methods of identification of the medical system, the method of parameter estimation model, the simulation model of the medical system.
Prerequisites: None.
Textbook:
1. David T. Westwick, Robert E. Kearney, "Identification of Nonlinear Physiological Systems," John Wiley & Sons, 2003.
2. Willem van Meurs, "Modeling and Simulation in Biomedical Engineering: Applications in Cardiorespiratory Physiology," 1st ed., McGraw-Hill Education, 2011

ENEE608508
MEDICAL INFORMATICS (3 CREDITS)
Learning Objective:
After getting the courses the student is expected to:
1. Able to understand the basic concepts of information technology to be applied in the field of health
2. Able to apply the basic methods of Informatics with the use of basic knowledge of programming to acquire, organize, combine, and analyze health data sources
3. Able to apply the algorithm for a device/instrument of biomedical engineering
4. Able to apply the basic principles in biology in the concept of medical technology
5. Able to explain the basic biomedical engineering

Able to apply concepts of basic science into principles in biomedicine

Topic: 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.
Introduction to medical informatics and its method
Algorithms and methods of medical informatics

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.

ENEE606503
INTRODUCTION TO BIOMEDICAL TECHNOLOGIES (3 CREDITS)
Learning Objective:
After completion of the following courses, students are able to:
1. Understand biomedical technology systems
2. Explain the concept of system engineering applications to the problems of human biology
3. Illustrate the concept of detection, measurement, and monitoring of human physiological signal
4. Explain the concept of the diagnosis interpretations through the techniques of signal processing bioelectric data
5. Explain the concept device-device for therapy and rehabilitation
6. Make computer data analysis based on data from patients in the framework of decision making in clinical
7. Explain the concept of device for artificial organs
8. Reviewing the concept of medical imaging techniques

Able to apply the basic principles in biology in the concept of medical technology
Able to explain the basic biomedical engineering
Able to apply concepts of basic science into principles in biomedical engineering
Topics: Physiologic Systems, Bioelectric Phenomena, Introduction to Biomechanics & Biomaterials, Introduction to Biomedical Sensors, Biomedical Signal Analysis, Introduction to Medical Imaging, Medical Instruments and Devices.
Prerequisites: None.
Textbook:
1. The Biomedical Engineering Handbook, D.R. & Bronzino J.D. Peterson, 4th ed., CRC Press, 2000.
2. Standard Handbook of Biomedical Engineering and Design, M. Kutz, McGraw-Hill, 2003.
3. Handbook of Biomedical Engineering, J. Kline, Academic Press, 1988.

ENEE608507
BIOMEDICAL INSTRUMENTATIONS + LAB (3 CREDITS)
Learning Outcome:
After following this course, students are able to:
1. Understand the biomedical measurement system
2. Understand and apply various kinds of cardiovascular system measurement
3. Understand and apply various kinds of respiration system measurement
4. Understand and apply various kinds of nervous system
5. Understand patient safety factors that must be considered in the measurement

Able to apply the basic principles in biology in the concept of medical technology
Able to explain the basic engineering science biomedicine

Able to apply concepts of basic science into the principles of biomedical engineering
Able to operate medical equipment
Able to integrate circuit and electronic device to device/instrument of biomedicine
Able to make the design through simulation design of medical devices
Topic: Introduction to biomedical instrumentation; Basic transducer principle (active and passive transducer, the transducer for biomedical application; the source of bioelectric potensials; electrodes; the cardiovascular system; cardiovascular measurement; measurement in respiratory system; non invasive diagnostic instrumentation; measurement in nervous system; sensory and behavioural measurements; electrical safety of medical equipment; role of laser in healthcare.

Prerequisites: None.
Textbook:
1. Biomedical Instrumentation and Measurement, Leslie Cromwell, Fred J. Weibel and Erich A.

Pleiffer, Prentice Hall, New Jersey.
2. Handbook of Biomedical Instrumentation, RS Khanpur, Tata McGraw-Hill Education, 2003.

ENEE608509
SPECIAL COURSE OF BIOMEDICAL 1 (2 CREDITS)
Learning Outcome:
This course provides an understanding of physical principles on the biological mechanisms and process (movement, design, structure, materials and transport).
At the end of the study, students are expected to:
- Apply biomechanical principles to resolve problems in human movement and musculoskeletal such as ergonomic, rehabilitation and training.
- Use of the effective and safe biomechanics instrumentation and equipment for the acquisition/assessing human movement.
- Understand the trend of future problems of biomechanics.

Able to explain the phenomenon in the medical with the approach of biology and anatomy human organs
Topics:
Newton's laws, fluid mechanics: Bernoulli, Drag forces, Reynold number, Mechanics of static systems and moving system, Kinetics and force on the body as well as the influence on the movement and stability, Basic mathematic in motion/movement, analysis and instrumentation on the motion of the body, the basic concept of human body bones muscle mechanics, Ergometry, The basic concept of energy.
Prerequisites: None.
Textbook:
1. N. Ozkaya, and M. Nordin, "Fundamentals of Biomechanics: Equilibrium, Motion and Deformation", 2nd ed., Springer, 1998.
2. E. Okuno, and L. Fratin, "Biomechanics of the Human Body", Springer, 2013.

ELECTRICAL ENGINEERING

SPECIAL COURSE OF BIOMEDICAL 2 (2 CREDITS)

ENEE618102
SOFTWARE ENGINEERING (3 CREDITS)
Learning Outcomes: In this course, students will learn how to design software with correct steps and able to document them. After following this course, students will able to design software using the stage of the software life cycle with the desired risk level, capable of making design software with the correct stages; capable of documenting the stages of design software
Topics: Hardware and software processes; Requirements analysis and elicitation; System specifications; System architectural design and evaluation; Concurrent hardware and software design; System integration, Software testing and validation; Maintainability, manufacturability, sustainability
Prerequisite: Algorithm and Programming
Textbook:
1. Ian Sommerville, Software Engineering, 10th ed., Pearson, April 3, 2015
2. Robert c. Martin, Agile Software Development, Principles, Patterns, and Practices, Pearson, 2002

ENEE617101
OBJECT ORIENTED PROGRAMMING + LABORATORY (3 CREDITS)
Learning Outcomes: In this lecture, students will study how to create program with object-oriented concepts. After following this course, students are able to implement a software design into object-oriented programming language; able to establish the concept of object-oriented programming (class, constructor, scope of variables); able to outline the Basic objects (arrays, array list, object collection, iterator); able to describe the concept of design class (coupling, cohesion, refactoring, inheritance, polymorph, substitution); able to implement a GUI-based programming, exception handling and multithreading.
Topics: Java Language Elements; Java Language Operation; Defining and Using Class; System, Strings, String Buffer, Math & Wrapper Classes; Array; Classes & Inheritance; Design Graphical User Interface & Event Driven; Exceptions; Collections; Threads and Javadoc
Prerequisite: Algorithm and Programming

Textbook:
1. David j. Barnes, "Objects First with Java: A Practical Introduction Using BlueJ", 5th ed., Pearson, 2011
2. Bart Baesens URet.al., "Beginning Java Programming: The Object-Oriented Approach", Wrox, 2015

SPECIAL COURSES

ENEE616032
ENEE606023
INTERNSHIP (2 CREDITS)
Learning Outcome:
Able to apply technical knowledge that has been acquired during the study; Able to demonstrate work professionalism, work in teams, discipline, responsibility, initiative & interest, leadership, and attitude/behaviour; Able to present the results of the internship in the internship's defense.
Topic: None.
Prerequisite:
Have passed the 90 CREDITS. Internship place are industrial or lab associated with electrical engineering on the condition there is a supervisor in the internship place. The selection of the internship place is started with the administrative process through the Department of electrical engineering.
Textbook: None.

ENEE617036
ENEE607030
SEMINAR (2 CREDITS)
Learning Outcome:
Able to propose system, component, and process of the research; Able to write research proposal; Able to present the research proposals.
Syllabus: Introduction; Literature studies; Research design.
Prerequisite: Passed the 90 CREDITS.
Textbook:
1. Technical guidelines on the writing of Thesis students of the University of 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.

ELECTRICAL ENGINEERING

ENEE618041
ENEE608033
BACHELOR THESIS (4 CREDITS)
Learning Outcome:
Able to make the design of the system, component, and process; Able to carry out the research plan; Able to analyze the research results; Able to convey the results of the study in the bachelor thesis defense.
Topic: Design and implementation of experimental research; Data analysis; Conclusions.
Prerequisite: Passed Seminar
Textbook:
1. Technical guidelines on the writing of bachelor thesis of the 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.

4.6. UNDERGRADUATE PROGRAM IN COMPUTER ENGINEERING

Program Specification

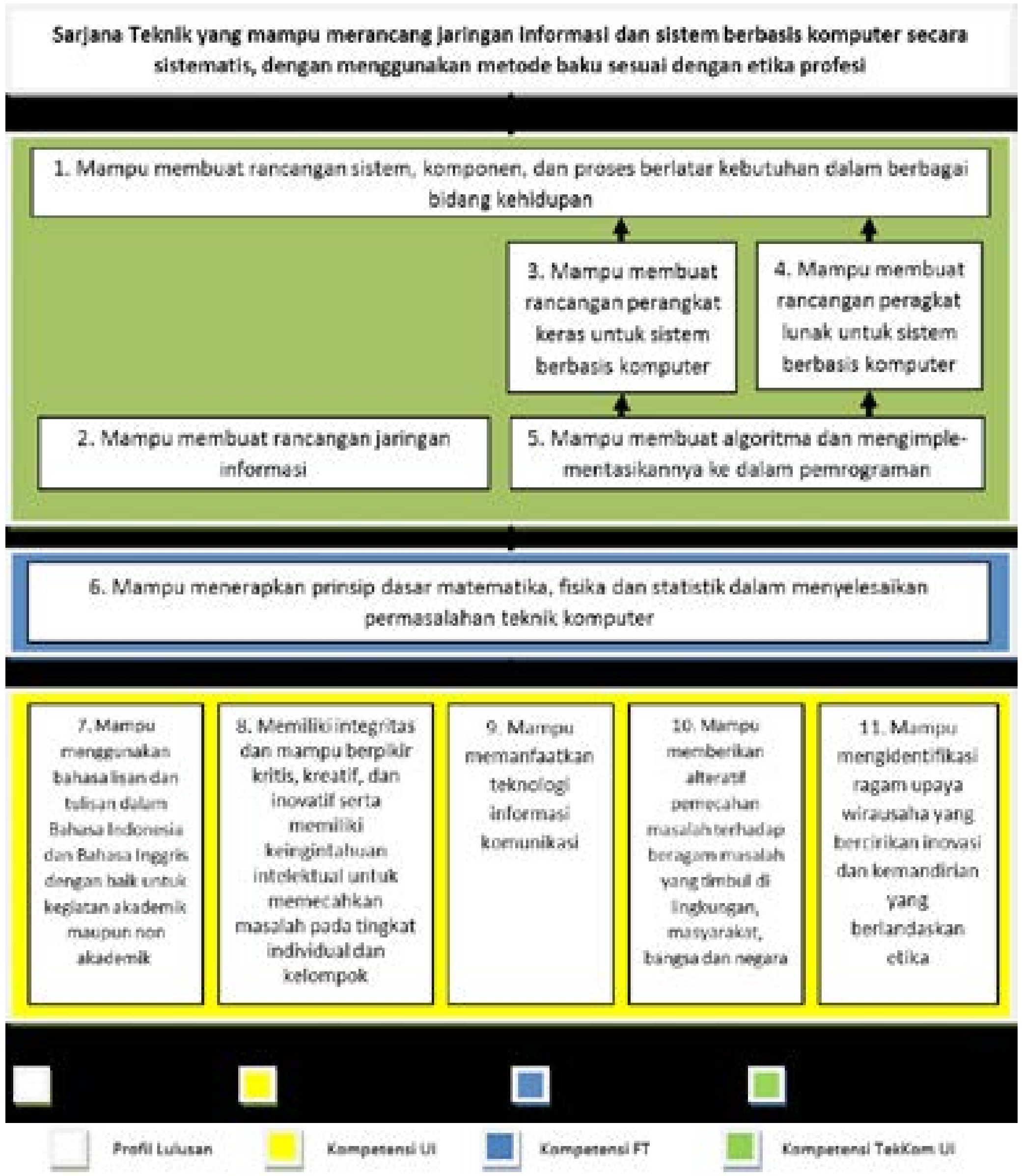
1.	**Awarding Institution**	Universitas Indonesia	
2.	**Teaching Institution**	Universitas Indonesia	
3.	**Programme Tittle**	Undergraduate Program in Computer Engineering	
4.	**Class**	Regular	
5.	**Final Award**	Sarjana Teknik (S.T)	
6.	**Accreditation / Recognition**	BAN-PT: A - accredited	
7.	**Language(s) 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	17
	Short (optional)	3	8
11.	**Graduate Profiles:** Bachelor of Engineering who is able to design information network and computer based system systematically using standard method in accordance with professional ethics.		
12.	Expected Learning Outcomes: 1. Able to design system, component, and process based on demand for various field in life. 2. Able to design information network plan. 3. Able to design hardware for computer based system. 4. Able to design software for computer based system. 5. Able to design algorithm and implement them in programming. 6. Able to implement the basic principles of mathematics, physics, and statistic in solving computer-engineering problems. 7. Able to use spoken and written language of Bahasa Indonesia and English in academic and nonacademic activities. 8. Have integrity and able to think critically, creatively, and innovatively and have the intellectual knowledge to solve problems in individual and group level. 9. Able to utilize communication information technology. 10. Able to provide alternatives of solutions for various problems within the society, country, and nation. 11. Able to identify the various entrepreneurship efforts characterized with innovation and independence based on ethics.		

13	**Classification of Subjects**		
No.	**Classification**	**Credit Hours (SKS)**	**Percentage**
i	University General Subjects	18	12.50%
ii	Basic Engineering Subjects	16	11,11%
iii	Basic Electrical Engineering Subject	17	11,80%
iv	Core subject	76	52,78%
v	Elective Subject	9	6,25%
vi	Special Subject (Internship, Seminar, Undergraduate Thesis)	8	5.56%
	Total	**144**	**100 %**
14.	**Total Credit Hours to Graduate**		**144 SKS**

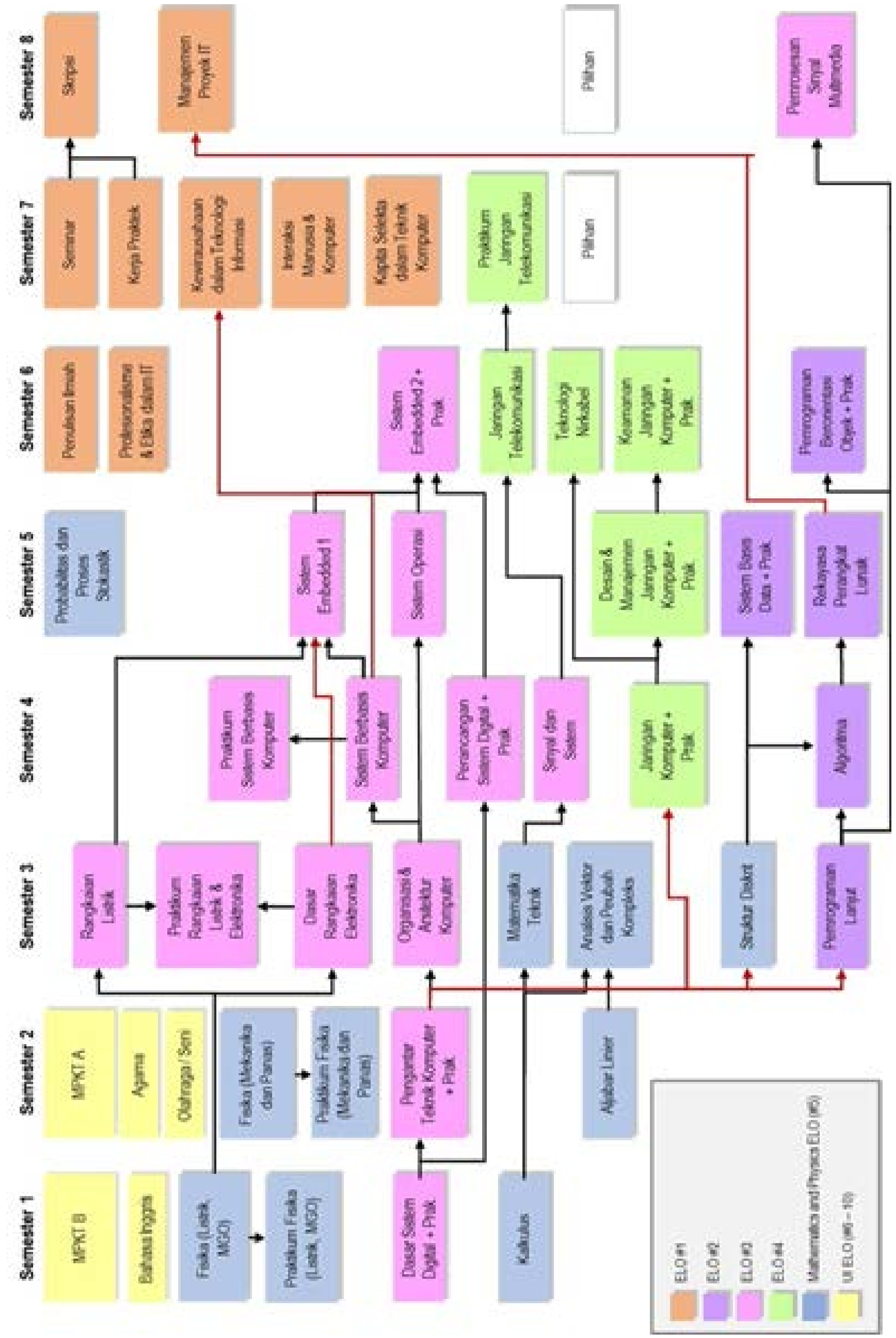
Career Prospects

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.

Learning Outcomes



UNDERGRADUATE PROGRAM



COMPUTER ENGINEERING

FACULTY OF ENGINEERING

CURRICULUM STRUCTURE COMPUTER ENGINEERING

KODE	SUBJECT	CREDITS
	1st Semester	
UIGE600002	Integrated Character Building B	6
ENGE600007	Physics (Electricity, MWO)	3
ENGE600008	Physics (Electricity, MWO) Lab	1
ENGE600003	Calculus	4
ENCE601001	Fundamental of Digital System and Lab.	3
UIGE600003	English	3
	Sub Total	**20**
	2nd Semester	
UIGE600001	Integrated Character Building A	**6**
UIGE600010-15	Religion	2
UIGE600020 - 48	Sport / Art	1
ENGE600004	Linear Algebra	4
ENGE600005	Physics (Mechanics and Thermal)	3
ENGE600006	Physics (Mechanics and Thermal) Lab	1
ENCE602002	Introduction to Computer Engineering +Lab.	3
	Sub Total	**20**
	3rd Semester	
ENCE603003	Engineering Mathematics	4
ENCE603004	Basics of Electronic Circuits	2
ENCE603005	Electric Circuits	2
ENCE603006	Electric and Electronic Circuits Lab.	1
ENCE604012	Advanced Programming	3
ENCE603008	Computer Organization and Architecture	3
ENCE603009	Discrete Structures	3
ENCE603010	Vector Analysis and Complex Variables	2
	Sub Total	**20**
	4th Semester	
ENCE604011	Signal and Systems	3
ENCE603007	Algorithm	3
ENCE604013	Digital System Design and Laboratory	3
ENCE604014	Computer Based Systems	4
ENCE604015	Computer Based Systems Laboratory	1
ENCE604016	Computer Networks and Laboratory	4
	Sub Total	**18**
	5th Semester	
ENCE605017	Probability and Stochastic Process	3
ENCE605018	Software Engineering	3
ENCE605019	Embedded System 1	2
ENCE605020	Operating Systems	3
ENCE605021	Design & Management Computer Networks +Lab	4
ENCE605022	Database Systems and Laboratory	3
	Sub Total	**18**
	6th Semester	
ENCE607031	Academic Writing	2
ENCE606024	Telecommunication Networks	3
ENCE606025	Computer Networks Security and Laboratory	3
ENCE606026	Embedded Systems 2 and Laboratory	3
ENCE606027	Professionalism and Ethics in IT	2
ENCE606028	Object Oriented Programming + Lab	3
ENCE606029	Wireless Technology	2
	Sub Total	**18**
	7th Semester	
ENCE606023	Internship	2
ENCE607030	Seminar	2
ENCE607032	Entrepreneurship in Information Technology	2
ENCE607033	Capita Selecta in Computer Engineering	2
ENCE607034	Telecommunication Networks Lab	1
ENCE607035	Human Computer Interaction	2
	Elective	6
	Sub Total	**17**
	8th Semester	
ENCE608036	Bachelor Thesis	4
ENCE608037	Project Management in IT	3
ENCE608038	Multimedia Signal Processing	3
	Elective	3
	Sub Total	**13**
	Total	**144**

ELECTIVES COMPUTER ENGINEERING

KODE	SUBJECT	CRED-ITS
	Odd Semester	
ENCE607101	Regulation & Public Policy on ICT Sector	3
ENCE607102	Data Analysis Engineering	3
	Even Semester	
ENCE608103	VLSI Design	2
ENCE608104	Big Data Technology	3

UNDERGRADUATE PROGRAM
COMPUTER ENGINEERING

FACULTY OF ENGINEERING

Resume

University General Subjects	18
Basic Engineering Subjects	16
Basic Electrical Engineering Subjects	101
Total	135
Elective Subjects	9
Total Credit Hours to Graduate	144

UNDERGRADUATE PROGRAM

COMPUTER ENGINEERING

Syllabus of courses in Computer Engineering according to the structure of the curriculum:

UIGE600002
MPKT B
6 CREDITS
See The Engineering Syllabus

ENGE600007
Physics (Electricity, MWO)
3 CREDITS
See The Engineering Syllabus

ENGE600008
PHYSICS (ELECTRICITY, MWO) LABORATORY
1 CREDITS
See The Engineering Syllabus

ENGE600003
CALCULUS
4 CREDITS
See The Engineering Syllabus

ENCE601001
FUNDAMENTAL OF DIGITAL SYSTEM + LABORATORY
3 CREDITS
Learning Outcomes: In this course, students will learn all design phases and implementations of a digital system. At the end of the course, students will be able to analyze simple digital circuits, and able to design digital systems using combinational and simple sequential building blocks. This lecture also involves several practical work in the laboratory to design, implement and verify digital logic systems using digital circuit simulation software.
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, Module 5 - 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 Mano, r. 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. Basics of Digital System Lab. Practice Modules

UIGE600003
ENGLISH
3 CREDITS
See The Engineering Syllabus

UIGE600001
MPKT A
6 CREDITS
See The Engineering Syllabus

UIGE600010 - UIGE600015
RELIGION

2 CREDITS
See The Engineering Syllabus

UIGE600020 – UIGE600048
SPORTS/ARTS
1 CREDITS
See The Engineering Syllabus

ENGE600002
LINEAR ALGEBRA
4 CREDITS
See The Engineering Syllabus

ENGE600005
PHYSICS (MECHANICS AND THERMAL)
3 CREDITS
See The Engineering Syllabus

ENGE600006
PHYSICS (MECHANICS AND THERMAL) LABORATORY
1 CREDITS
See The Engineering Syllabus

ENCE602002
INTRODUCTION TO COMPUTER ENGINEERING + LABORATORY
3 CREDITS
Learning Outcomes : This course is the introduction to the computer engineering world. This lecture discusses topics that are the basics required in computer engineering. At the end of the course students will be able to explain the components of a computer system both hardware and software, able to design simple algorithms in pseudocode and able to implement them into programs by using a particular programming language.
Syllabus : The introduction of Computers, introduction to computer hardware, introduction to Computer Software, algorithm, Pseudocode, introduction to C language, control structures in C language, structured Program in C language.
Practical work: Module 1 – Introduction, Module 2- computer hardware, Module 3- computer software, Module 4- Flowchart, Module 5 – Pseudocode, Module 6- Introduction to Programming in C language, Module 7- Branching in C Language, Module 8- Looping in C language, Module 9-Project in C Language.
Prerequisite: Basic Digital System
Textbook:
1. Alan Evans, Kendall Martins, Mary Anne Poatsy, Technology in Action, Complete, 11th Edition, Pearson, 2015
2. Deitel & Deitel, “C How to Program,” 5th Edition, Pearson Education, 2007.

ENCE603003
ENGINEERING MATHEMATICS
4 CREDITS
See Electrical Engineering Syllabus

ENCE603004
BASICS OF ELECTRONICS CIRCUITS
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, Optics and waves
Textbook:
1. Robert Boylestad Louis Nashelsky, & “Electronic Devices And Circuit Theory”, Ninth Edition, Prentice Hall, Upper Saddle River, New Jersey, Columbus, Ohio, 2006.

ENCE603005
ELECTRIC CIRCUIT
2 CREDITS
Learning Outcomes : In this course, students will learn the basic electric circuits. At the end of this course, students will be able to analyze simple electronic and electric circuits using appropriate techniques, analyze the resistive circuits, their AC and DC properties as the basics of electric engineering.
Topics: Introduction, resistive circuits, the dependent sources and op. amps, analysis methods, energy – storage elements, first – order circuits, second – order circuits, phasors, sources and sinusoidal AC steady state analysis, air conditioning – steady – state power.
Prerequisites : Physics electricity, magnetism, Optics and waves
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 . D. Nilsson, S. A. Riedel, “Electric Circuits”, 10th Edition, Prentice Hall International, Inc., 2014.

ENCE603006
ELECTRIC AND ELECTRONIC CIRCUITS LABORATORY
1 CREDITS
Learning Outcomes: In this course students will learn the practical skills in handling components and basic electronic and electric circuit. At the end of this lab practice, students will be able to analyze the operation of electric and electronics circuit using simple techniques.
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;
Prerequisite: Physics electricity, magnetism, Optics and waves, Electrical Circuits, basic Electronics Circuits
Textbook:
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

ENCE603007
ALGORITHM
3 CREDITS
Learning Outcomes: In this course students learn how to evaluate the algorithm. After following this course, the student will be able to explain the basis of the analysis of algorithms; able to explain classic algorithms; able to evaluate algorithm by its complexity
Topics: The basic of algorithms analysis; The algorithm strategy; Classical algorithms for common taCREDITS; Analysis and design of algorithms for specific application; Parallel algorithms and multi-threading; Algorithm complexity
Prerequisite: Advanced Programming
Textbook:
1. Gilles Brassard, Paul Bratley, “Algorithms: Theory and Practice”, Prentice Hall Professional Technical Reference, 1988

2. Thomas H. Cormen, "Introduction to Algorithms", 3rd Edition, MIT Press, 2009
3. Robert Sedgewick & Kevin Wayne, "Algorithms", 4th ed., Addison-Wesley Professional, 2011

ENCE600008
COMPUTER ORGANIZATION & ARCHITECTURE
3 CREDITS
Learning Outcomes: In this course, the architecture and the organization of computer system is discussed. After following this course, the student will be able to distinguish the meanings of computer organization and architecture computer, capable of analyzing the computer architecture, particularly the design of instruction-set, the correlation between clock-speed and CPU performance and the influence of the structure of the bus for computing speed, was able to decipher the role of cache memory to improve memory access time, including its organization and updates mechanism. Student will also be able to develop small programs using the basic instruction set of hypothetical processor. Students will also be able to elaborate on the influence of the programming techniques for computational speed. Students will also be able to analyze advanced processor design in improving performance computing like pipelining, parallel processors and multicore processors.
Topics: The basic Instruction set architecture; Organization Of The Processor; Memory; Peripheral subsystems; Multi-many core architectures; Pipelining
Prerequisite: Intro to Computer Engineering + Lab
Textbook:
1. W . Stallings, "Computer Organization and Architecture", 9 th Edition, Pearson International , 2012
2. Petterson and Hennesy, "Computer Organization and Design" 5th edition, Morgan Kaufman, 2013

ENCE603009
DISCRETE STRUCTURES
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: none
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

ENCE603010
COMPLEX VARIABLES AND VECTOR ANALYSIS
2 CREDITS
See Electrical Engineering Syllabus

ENCE604011
SIGNAL AND SYSTEMS
3 CREDITS
See Electrical Engineering Syllabus

ENCE604012
ADVANCED PROGRAMMING

3 CREDITS
Learning Outcomes : In this course will be on learn regarding programming using high-level languages. After following this course the student is expected to able to implement modular programming in the form of a function (by value and by reference); being able to implement recursion algorithm into the C language; capable of using arrays in C program; able to make programs with data structures; able to make programs with dynamic data structures.
Topics: Programming constructs and paradigms: pointer, Array, linked list; Problem-solving strategies: searching, sorting; Data structures; Recursion
Prerequisite: Introduction to computer engineering and Practical
Textbook:
1. Deitel & Deitel, "C How to Program", 7 th Edition, Pearson International Edition 20 12.

ENCE604013
DIGITAL SYSTEM DESIGN + LABORATORY
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: Modular Design of Combinational Circuits; Modular Design of Sequential Circuits; Control and Data-path design; design with programmable logic; system design constraints; fault models & testing
Prerequisite: Fundamental of Digital System + Lab
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

ENCE604014
COMPUTER BASED SYSTEMS
4 CREDITS
Learning Outcomes: In this course, it will be discussed about microprocessor and microcontroller technology. After following this course, the student is expected to be able to do the process interface to the I/O equipments; able to make simple programs in Assembly language for embedded systems; capable of designing embedded systems with a simple microcontroller
Topics: Introduction to computer systems, addressing modes, data transfer, programming microprocessor with Assembly language, memory interface, introduction of computer-based systems, programming Input/Output, interrupt handling, timer
Prerequisite: Computer Organization & Architecture, Basic Electronic Circuit
Textbook:
1. Brey, Barry B, The Intel 8086/8088 Microprocessors: 80186/80188, 80286, 80386, 80486, Pentium Pro, Pentium, Processor, Pentium II, Pentium III, Pentium 4, and Core2 with 64-bit Extensions, 8th ed., PHI Inc., USA, 2011.
2. The 8051 Microcontroller and Embedded Systems, Second Edition, Muhammad Ali Mazidi, Prentice Hall, 2006
3. Joseph Yiu, "The Definitive Guide to the ARM Cortex-M0", Academic Press, 2011

ENCE604015
COMPUTER BASED SYSTEMS LABORATORY
1 CREDITS
Learning Outcomes: In this subject, students will conduct hands-on programming the microprocessor and microcontroller-based embedded systems, as well as interfacing microcontroller. After following this lab course students are expected to be able to conduct interfacing to the i/o tools, able to make simple programs in Assembly language for embedded systems and capable of designing embedded systems with a simple microcontroller 8051 and ARM
Topics: Module 1-Introduction to Practical Microprocessors & microcontroller, module 2-Programming the microprocessor with Assembly language, module 3 – Program Control Instruction Modules,

module 4-Procedure and Macro, module 5-Project Microprocessor, Module-6 Microcontroller Programming with Assembly language, Module 7 – Subroutines, Module 8- Input/Output, Module 9-Introduction to Microcontroller Programming with C language, Module 10 -Microcontroller Project
Prerequisite: Computer Based Systems
Textbook:
1. Lab Module System of Computer-Based Digital Laboratory, Department of Electrical Engineering
2. Brey, Barry B, The Intel 8086/8088 Microprocessors: 80186/80188, 80286, 80386, 80486, Pentium Pro, Pentium, Processor, Pentium II, Pentium III, Pentium 4, and Core2 with 64-bit Extensions, 8th ed., PHI Inc., USA, 2011.
3. The 8051 Microcontroller and Embedded Systems, Second Edition, Muhammad Ali Mazidi, Prentice Hall, 2006
4. Joseph Yiu, "The Definitive Guide to the ARM Cortex-M0", Academic Press, 2011

ENCE604016
COMPUTER NETWORKS AND LABORATORY
4 CREDITS
Learning Outcomes: In this course, students study the topics about computer networks comprehensively from layer 1 to layer 7. After following this course, the student will be able to implement the various Protocol TCP/IP and Ethernet network technology as well as the right addressing in a simple network, able to implement simple network-based VLAN and applying various routing protocols such as static routing, RIP, Single Area OSPF and make use of Access Control lists, DHCP and NAT to support networking capabilities, and is able to implement basic access control features in computer networks and are able to utilize the concept of dynamic addressing and implementing network address translation in simple computer network
Topics: architecture and network topology, Protocol and communications networks; OSI and TCP/IP Layer; technology access network on the LAN and WAN; Ethernet technology; network layer; IP Address & Subnetting; transport network and application protocol; Basic switched networks; VLAN & InterVAN; The concept of routing static & dynamic; Routing Protocol RIP; Single Area OSPF; Access Control List Standard & Extended; DHCP Server & Client, Relay, Static & Dynamic NAT
Prerequisite: Intro to Computer Engineering + Laboratory
Textbook:
1. A. Tanenbaum, "Computer Networks", Prentice Hall, 5th Eds, 2010
2. CISCO Networking Academy Program: Network Fundamentals, CCNA Exploration 4 ver, http://cisco.netacad.net

ENCE605017
PROBABILITY AND STOCHASTIC PROCESSES
3 CREDITS
See Electrical Engineering Syllabus

ENCE605018
SOFTWARE ENGINEERING
3 CREDITS
Learning Outcomes: In this course, students will learn how to design software with correct steps and able to document them. After following this course, students will able to design software using the stage of the software life cycle with the desired risk level, capable of making design software with the correct stages; capable of documenting the stages of design software
Topics: Hardware and software processes; Requirements analysis and elicitation; System specifications; System architectural design and evaluation; Concurrent hardware and software design; System integration, Software testing and validation; Maintainability, manufacturability, sustainability
Prerequisite: Advanced Programming
Textbook:
1. Ian Sommerville, Software Engineering, 10th ed., Pearson, April 3, 2015
2. Robert c. Martin, Agile Software Development, Principles, Patterns, and Practices, Pearson, 2002

ENCE605019
EMBEDDED SYSTEMS 1
2 CREDITS
Learning Outcomes: In this course, students learn to make embedded systems design (hardware and software) for specific applications. After following this course, students will be able to design embedded systems with sensors and actuators in synchronous and asynchronous system.
Topics: Characteristics of embedded systems; Asynchronous and synchronous serial communication; Data acquisition, control, sensors, actuators
Prerequisite: Computer-Based Systems, Electric Circuits, Basics of Electronics Circuits
Textbook:
1. Lee & Seshia , " Introduction to Embedded Systems-A Cyber-Physical Systems Approach " , 2nd edition, UC-Berkeley , 2015

ENCE605020
OPERATING SYSTEM
3 CREDITS
Learning Outcomes: In this subject, it will be discussed the basic principles of early generation and up-to-date operating system. After following this course, the student will be able to explain the system resource management of computer systems, able to explain the memory management techniques; able to explain the techniques of data storage management; able to explain the techniques of management of computer resources; able to explain the architecture of distributed systems
Topics: Operating Systems Structures; Process; Thread; CPU Scheduling; Concurency; Memory-system management, storage management; distributed system architectures
Prerequisite: Computer Organization & Architecture
Textbook:
1. Andrew s. Tanenbaum, "Modern Operating Systems", 4th ed., Pearson, Mar. 20, 2014
2. Abraham Silberschatz, "Operating System Concepts ", 9th ed., Dec. 21, 2012

ENCE60 5021
DESIGN & MANAGEMENT COMPUTER NETWORKS + LABORATORY
4 CREDITS
Learning Outcomes: On this subject it will be studied how to design a network with a larger scale taking into account aspects of scalability and reliability. After following this course the student will be able to implement the various techniques of redundancy and LAN Link Aggregation to increase scalability and reliability of the network, being able to use the Routing Protocol EIGRP and OSPF in the scale of a larger network, as well as capable of designing a network WAN and Internet as well as applying the principles of network management and procedures
Topics: Network Scalability; LAN redundancy; Link Aggregation; Wireless LAN; Multi-area OSPF Multi-access and; EIGRP. Hierarchical Network Design; WAN technologies; Point to Point connection and Frame Relay; Broadband Solutions; Internet VPN; Network Monitoring; Troubleshooting the networks; Network performance evaluation. Project: The design of computer network in an organization of a company.
Prerequisite: Computer Network + P
Textbook:
1. CISCO Networking Academy Program: Network Fundamentals, CCNA Exploration 4 ver, http://cisco.netacad.net
2. James d. McCabe, "network analysis, architecture and design", 3 nd Edition, Morgan Kaufmann, 2007.

ENCE60 5022
DATABASE SYSTEMS AND LABORATORY
3 CREDITS
Learning Outcomes: In this course, students will learn the concepts of database systems and applications. After following this course, the student is able to design a structured database in the software design and implement it into a SQL database system
Topics: Database systems; Event-driven and concurrent programming; Using application program-

ming interfaces
Prerequisite: Discrete Structures
Textbook:
1. Ramez Elmasri, Shamkant 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.

ENCE607031
ACADEMIC WRITING
2 CREDITS
Learning Outcomes: In this course students will learn how to create a proposal and scientific papers for publication. After following this course the student will be able to write scientific papers with a good structure, able to use the Bahasa Indonesia and English in scientific writing, and being able to use the software to write scientific papers with a good format.
Topics: Systematics of scientific writing; experimental variables and sets up; statistical analysis tools; The use of the Bahasa Indonesia in scientific works; The use of English languages in scientific 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 Scientific Paper, 6th ed. Greenwood Press, London, 2006

ENEE606024
TELECOMMUNICATION NETWORKS
3 CREDITS
Learning Outcomes: This courses discusses the telecommunications network system. After following this course, the students will able to explain the principles and basic methods of Telecommunication Engineering as well as the use of telecommunication devices in the network system, capable of outlining the techniques of modulation and multiplexing; able to explain the functions of telecommunications devices in the network system
Topics: Introduction to Telecommunication Networks; Modulation (Amplitude and frequency); Digital Modulation; Multiplexing Techniques; Coding; Telephony Systems; Technology of Telecommunications Devices
Prerequisite: Signals and systems
Textbook:
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.

ENCE606025
COMPUTER NETWORKS SECURITY + LABORATORY
3 CREDITS
Learning Outcomes: In this subject, student will study security techniques in computer networks. After following this course, students are able to analyze and implement security aspects on the network computer, capable of analyzing the security and integrity of your data and perform protection, able to apply the techniques of cryptography and authentication in network security and web.
Topics: Security and integrity of Data; Vulnerabilities; Resource Protection; Private & Public Key Cryptography; Authentication; Network and Web Security.
Prerequisite: Design and management of computer networks + Lab
Textbook:
1. W. Stallings, "Network Security Essentials: Applications and Standards, 5/E, Prentice Hall, 1995.
2. R.R. Panko, Corporate Computer and Network Security, Prentice-Hall, 2004
3. M.E. Whitman and Henry Julian Mattord, Principles of Information Security, Thomson Course, 2003

ENCE606026
EMBEDDED SYSTEMS 2 + LABORATORY
3 CREDITS
Learning Outcomes: In this course, students learn to optimize resources in embedded systems that include the CPU, memory and other resources. After following this course, the student will be able to make advanced embedded systems design with attention to efficient power, and for mobile and networking purposes
Topics: Periodic interrupts, waveform generation, time measurement; Implementation strategies for complex embedded systems; Techniques for low-power operation; Mobile and networked embedded systems.
Prerequisite: Embedded Systems 1, Operating Systems, Digital System Design + Lab
Textbook:
1. Sam Siewer & John Pratt, real-time Embedded Components and Systems with Linux and RTOS, 2nd ed., Mercury Learning, 2015

ENCE606027
PROFESSIONALISM AND ETHICS IN INFORMATION TECHNOLOGY
2 CREDITS
Learning Outcomes: In this course, students will learn the concept of professionalism and ethics in the field of information technology. After following this course, the student is able to describe the current issues in the code of conduct IT; able to elaborate on professional ethics, the role of professional organizations against its members; able to explain the current job classification in the field of IT and professional certification IT field; capable of outlining the importance of the code of ethics of the profession and its impact on the wider community; able to explain the social responsibility in the field of IT; able to apply the concepts of professionalism and ethics in certain cases
Topics: Ethics; Job, profession and professional; Profession in information technology; Organization and code of Ethics of IT experts; cyber ethics; intellectual copyright; Internet crime
Prerequisite: none
Book Reference:
1. ACM Code of Ethics and Professional Conduct, https://www.acm.org/about-acm/acm-code-of-ethics-and-professional-conduct
2. Tavani, Herman t., "Ethics & Technology: Ethical Issues in an Age of Information and Communication Technology", John Wiley & Sons, 2004

COMPUTER ENGINEERING

ENCE606028
OBJECT ORIENTED PROGRAMMING + LABORATORY
3 CREDITS
Learning Outcomes: In this lecture, students will study how to create program with object-oriented concepts. After following this course, students are able to implement a software design into object-oriented programming language; able to establish the concept of object-oriented programming (class, constructor, scope of variables); able to outline the Basic objects (arrays, array list, object collection, iterator); able to describe the concept of design class (coupling, cohesion, refactoring, inheritance, polymorph, substitution); able to implement a GUI-based programming, exception handling and multithreading.
Topics: Java Language Elements; Java Language Operation; Defining and Using Class; System, Strings, String Buffer, Math & Wrapper Classes; Array; Classes & Inheritance; Design Graphical User Interface & Event Driven; Exceptions; Collections; Threads and Javadoc
Prerequisite: Advanced Programming
Textbook:
1. David j. Barnes, "Objects First with Java: A Practical Introduction Using BlueJ", 5th ed., Pearson, 2011
2. Bart Baesens URet.al., "Beginning Java Programming: The Object-Oriented Approach", Wrox, 2015

ENCE606029

WIRELESS TECHNOLOGY
3 CREDITS
Learning Outcomes: In this course, students learn the basics of wireless technologies including how it works, techniques, and standardizing on wireless network and mobile. After following this course, the participant is able to explain the basics of wireless technology, techniques in wireless network technology, the standard IEEE 802.11, 802.15 and capable of analyzing projections of future wireless technologies.
Topics: The technology 802.11 (Wireless LAN); Technology 802.15 (Bluetooth, Zigbee, WPAN)
Prerequisite: Computer Networks + Laboratory
Textbook:
1. Eldad Perahia, "Next Generation Wireless LANs: 802 .11n and 802.11 air conditioning", 2nd Edition, Cambridge University Press; 2nd edition, June 24, 2013
2. Al Petrick, "IEEE 802.11 Handbook: A designer's Companion," 2nd Edition, IEEE Standards Information Network, 2005

ENCE607030
SEMINAR
2 CREDITS
Learning Outcomes: In this subject, students learn how to make bachelor thesis proposal to design system, component, and process in the field of embedded systems or computer networks within the research framework
Topics: Introduction and research background; literature studies; research design
Prerequisite: already passed 120 CREDITS
Textbook:
-

ENEE606023
INTERNSHIP
2 CREDITS
Learning Outcomes : In this subject, students will learn how to work in a company. After following this subject, the student will be able to participate significantly in the team to complete the work related to the field of ICT. In this course, the student is required to be able to be active for working with the team. Students will also be able to deliver the results of his/her work in the internship report seminar.
Topics: Practical work in the company
Prerequisite: already passed 90 CREDITS
Textbook:
-

ENCE607032
ENTREPRENEURSHIP IN INFORMATION TECHNOLOGY
2 CREDITS
Learning Outcomes: In this course students learn the basic concepts of project management and marketing specialized in the field of information technology. After following this course the students are able to implement the concepts and skills of entrepreneurship in innovation of information technology in the form of a business plan expertise in innovation/product which corresponds to the development of information technology.
Topics: Charging for Expertise, Think, Plan, Act Like an Entrepreneur, Making a Business Successful, Taking the Initiative, Enabling an E-Business, Providing Outsourced Services & Building a Contracting Business, guest lectures
Prerequisite: Computer-Based Systems
Textbook:
1. Bill Aulet, Disciplined Entrepreneurship: 24 Steps to a Successful Startup, Wiley, Aug 12.2013

ENCE607033
CAPITA SELECTA IN COMPUTER ENGINEERING
2 CREDITS

UNDERGRADUATE PROGRAM

Learning Outcomes: In this course, students will learn about the current topics in computer engineering industry. After following this course the students are able to analyze the development of the industry in the field of computer engineering and the problems faced in General.
Topics: The concept of the latest computer technology; Latest computer technology applications; Tradeoff in the new technology of computer science; The latest issues in computer engineering
Prerequisite: none
Textbook: to be determined later

ENCE607034
TELECOMMUNICATION NETWORKS LAB
1 CREDITS
Learning Outcomes : This course aims to provide experience to students in doing experiments that analyze and demonstrate the concepts of Telecommunication Engineering. After completing this course, students are able to explain the techniques of modulation and multiplexing; able to describe the workings of all components of telecommunications devices in the network system
Topics: Introduction to telecommunication networks, Amplitude Modulation, frequency modulation, Telephony Systems, PCM and TDM, Digital Modulation, Line Coding, Digital Filters FIR
Prerequisite: Telecommunications Network
Textbook:
1. Telecommunications Engineering Teaching Modules – Laboratory of Telecommunications.
2. S. Haykin, "Communication Systems", 5th Edition, John Wiley & Sons, Inc., 2008.
3. R.L. Freeman, "Telecommunication Systems Engineering", 4th Edition, John Wiley & Sons, Inc., 2004.

ENCE607035
HUMAN COMPUTER INTERACTION
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: none
Textbook:
1. A.J. Dix, J.E. Finlay, G.D. Abowd and Beale, r. "Human-Computer Interaction", Third Edition, Prentice Hall, USA, 2003.
2. B. Shneiderman and Plaisant, C. "Designing The User Interface: Strategies for Effective Human Interaction", Fifth Edition, Pearson Addison-Weasley, 2010.

ENCE608036
BACHELOR THESIS
4 CREDITS
Learning Outcomes: In this special course, students will learn to examine and engage in a research team. After following this course, students will be able to design systems, components, and processes in the field of embedded systems or computer networks within the framework of research. Students will be able to carry out the planned research, be able to analyze the results of the study, able to convey the results of the research in thesis defense.
Topics: Design and implementation of experimental research; Data analysis; Conclusion
Prerequisite: Seminar
Textbook:
-

ENCE608037
PROJECT MANAGEMENT IN INFORMATION TECHNOLOGY
3 CREDITS
Learning Outcomes: In this subject, students will discuss the managerial principle in IT proj-

ects. After following this course, students are expected to be able to apply project management, including team management, scheduling, project management, information management, and design of the project plan
Topics: Project management principles; Risk, safety, dependability and fault tolerance; IT Project Collaboration strategies; Relevant tools, standards and/or engineering constraints
Prerequisite: Software Engineering
Textbook:
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.

ENCE608036
MULTIMEDIA SIGNAL PROCESSING
3 SKS
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 algorithms to analyze the information in it.
Topic: Introduction to Multimedia network, Coding and compression of Multimedia Signals (images, sounds, video), improvement the quality of an image, image processing, image Segmentation, representation and description, object recognition
Prerequisite: Advanced Programming
Textbook:
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.

ELECTIVES OFFERED IN COMPUTER ENGINEERING STUDY PROGRAM:

ENCE607101
VLSI DESIGN
2 SKS
Learning Outcomes: At the end of this course, student will be able to describe the stages of the CMOS design process, implement the Scale of Lambda design, evaluate the characteristics and performance of the power transistor circuit and CMOS digital , as well as the explain the optimization of high level design techniques.
Topics: Mixed-signal circuits; Design parameters issues; Circuit modelling & Simulation methods
Prerequisite: Fundamental of Digital System + P
Textbook:
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 Publishers, 2006.

ENCE60 71 0 2
DATA ANALYSIS ENGINEERING
3 CREDITS
Learning Outcomes: In this course the student is directed to implement the data analysis algorithm into the program. At the end of this course the student will be able to use mathematical and statistical techniques commonly used in basic pattern recognition. Students will be able to use some of the techniques common learning algorithm either supervised or unsupervised in conducting pattern recognition, classification and clustering.
Topics: An introduction to pattern recognition, artificial neural networks, the back-propagation algorithm, unsupervised learning, Principal Component Analysis
Prerequisite: Complex Variables and Vector Analysis, probability & process Stochastic Programming, Advanced

Textbook:
1. Christopher M. Bishop, “ Pattern Recognition and Machine Learning

ENCE608103
BIG DATA TECHNOLOGY
3 CREDITS
Learning Outcomes: In this course students will learn the technology that can be used in utilizing big data to solve different fields (for example: internet, telecommunications, retail). At the end of this course, students will be able to manage (collection, preparation, processing, validation, interpretation) and analyze large amounts of structured and random data.
Topics: Introduction to Data Engineering, Hadoop Architecture, The Hadoop Distributed File system, Setting Up Hadoop clusters, administering Hadoop, Map Reduce Framework, developing a Database Application, Hive Map Reduce, Spark Processing, Big Data Analytic Project
Prerequisite: Data Base System
Textbook:
1. Jure Leskovec, Anand Rajaraman, Jeff Ullman, Mining of Massive Datasets, Cambridge University Press, 2014
2. Tom White, “Hadoop: The Definition Guide”, Third Edition, the O’Relly, 2012

ENCE60 81 0 4
REGULATION & PUBLIC POLICY on ICT SECTOR
3 CREDITS
Learning Outcomes: In this course students will be exposed on the basics of drafting process and the development of regulatory and public policies, especially in the era of vast development in information and communication technology (ICT). At the end of this course, the student will be able to explain the basics of public policy, law and regulation in telecommunication industry, and Internet governance. This course will also provide examples of applicable regulation and policy in the field of telecommunications and the Internet, to anticipate the pace of change and the community dynamics implied by the development of ICT.
Topics: Public administration, public policy significance, range of research methods and policy research, comparative studies, introduction to law and policy regulation in telecommunications, economic analysis of telecommunications regulation, key issues of telecommunication regulation, understanding internet governance, the internet governance stakeholder, the internet governance process
Prerequisite: -
Textbook:
1. Ian Walden, “Telecommunications Law and Regulation”, Oxford University Press, 2012
2. Jovan Kurbalija, “about Internet governance: an introduction”, JIHAD, 2011
3. Riant Nugroho, “Public Policy: the dynamics of policy, Policy Analysis, policy management”, Elex Media Komputindo, 2012

4.6. UNDERGRADUATE PROGRAM IN BIOMEDICAL ENGINEERING

Program Specification

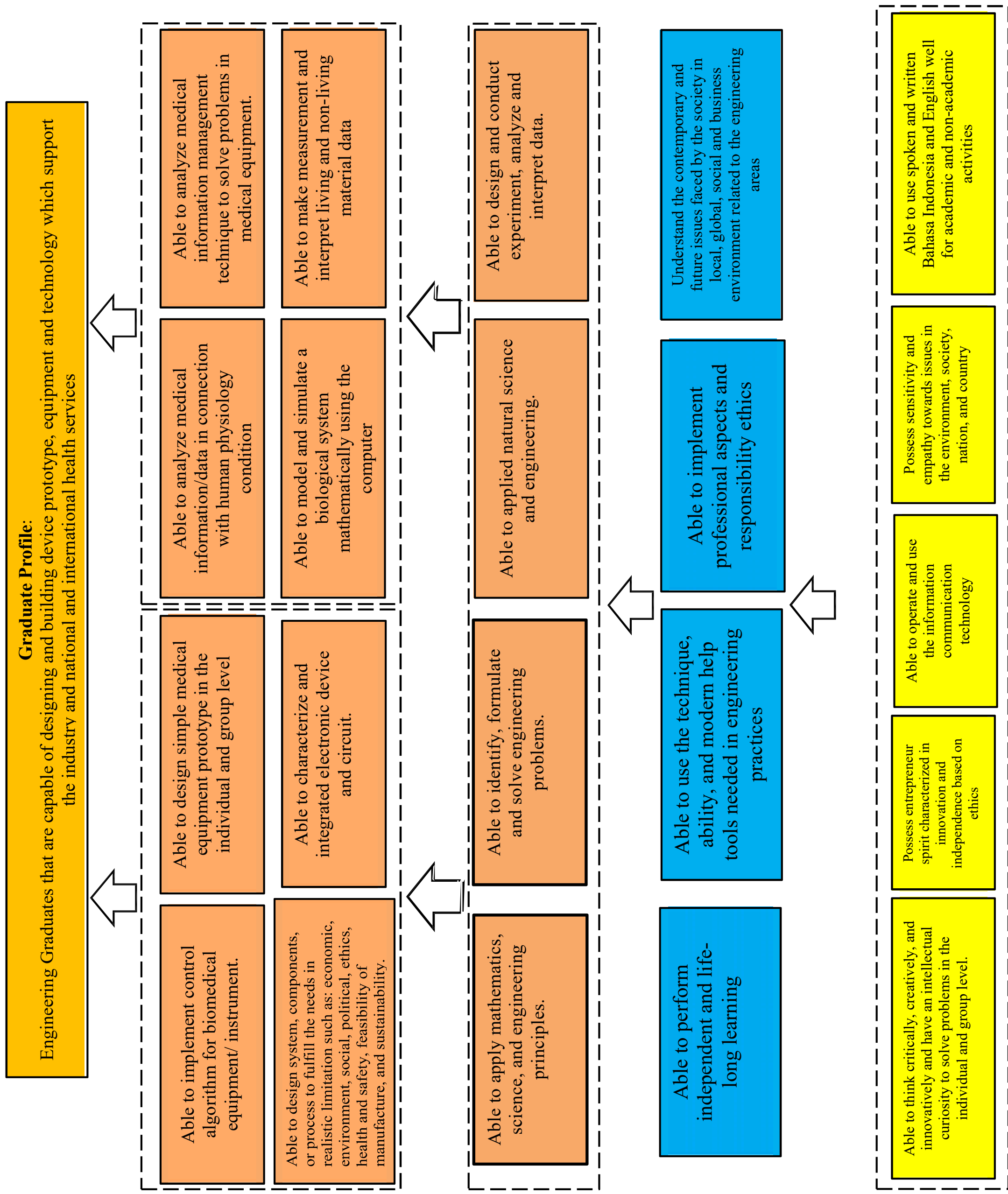
1.	**Awarding Institution**	Universitas Indonesia	
2.	**Teaching Institution**	Universitas Indonesia	
3.	**Programme Tittle**	Undergraduate Program in Biomedical Engineering	
4.	**Class**	Regular	
5.	**Final Award**	Sarjana Teknik (S.T)	
6.	**Accreditation / Recognition**	Early accreditation by BAN PT 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 and build device prototype, equipment and technology which support the industry and national and international health services.		
12.	Expected Learning Outcomes : Biomedical Engineering Graduates are expected to have the following competence: 1. Able to apply mathematics, science, and engineering principles. 2. Able to model and simulate a biological system mathematically using the computer. 3. Able to implement the basic principles in mathematics, biology, physics, and engineering. 4. Able to design and conduct experiment, analyze and interpret data. 5. Able to make measurement and interpret living and non-living material data. 6. Able to design system, components, or process to fulfill the needs in realistic limitation such as: economic, environment, social, political, ethics, health and safety, feasibility of manufacture, and sustainability. 7. Able to identify, formulate and solve engineering problems. 8. Able to perform independent and life-long learning. 9. Able to use the technique, ability, and modern help tools needed in engineering practices. 10. Able to implement professional aspects and responsibility ethics. 11. Understand the contemporary and future issues faced by the society in local, global, social and business environment related to the engineering areas. 12. Able to think critically, creatively, and innovatively and have an intellectual curiosity to solve problems in the individual and group level. 13. Possess entrepreneur spirit characterized in innovation and independence based on ethics. 14. Able to use spoken and written Bahasa Indonesia and English well for academic and non-academic activities. 15. Possess sensitivity and empathy towards issues in the environment, society, nation, and country. 16. Able to operate and use the information communication technology. 17. Able to analyze medical information/data in connection with human physiology condition. 18. Able to design simple medical equipment prototype in the individual and group level. 19. Able to analyze medical information management technique to solve problems in medical equipment. 20. Able to characterize and integrated electronic device and circuit. 21. Able to implement control algorithm design for biomedical devices/instruments.		

13	Classification of Subjects		
No.	Classification	Credit Hours (SKS)	Percentage
i	**University General Subjects**	18	12.50%
ii	**Basic Engineering Subjects**	19	13,19%
iii	**Expertise Subjects**	90	62,5%
iv	**Elective Subjects**	9	6,25%
v	**Special Subjects (KP, Seminar, and Undergraduate Thesis)**	8	5,56%
	Total	144	100 %
14.	**Total Credit Hours to Graduate**		144 SKS

Carrier 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



UNDERGRADUATE PROGRAM

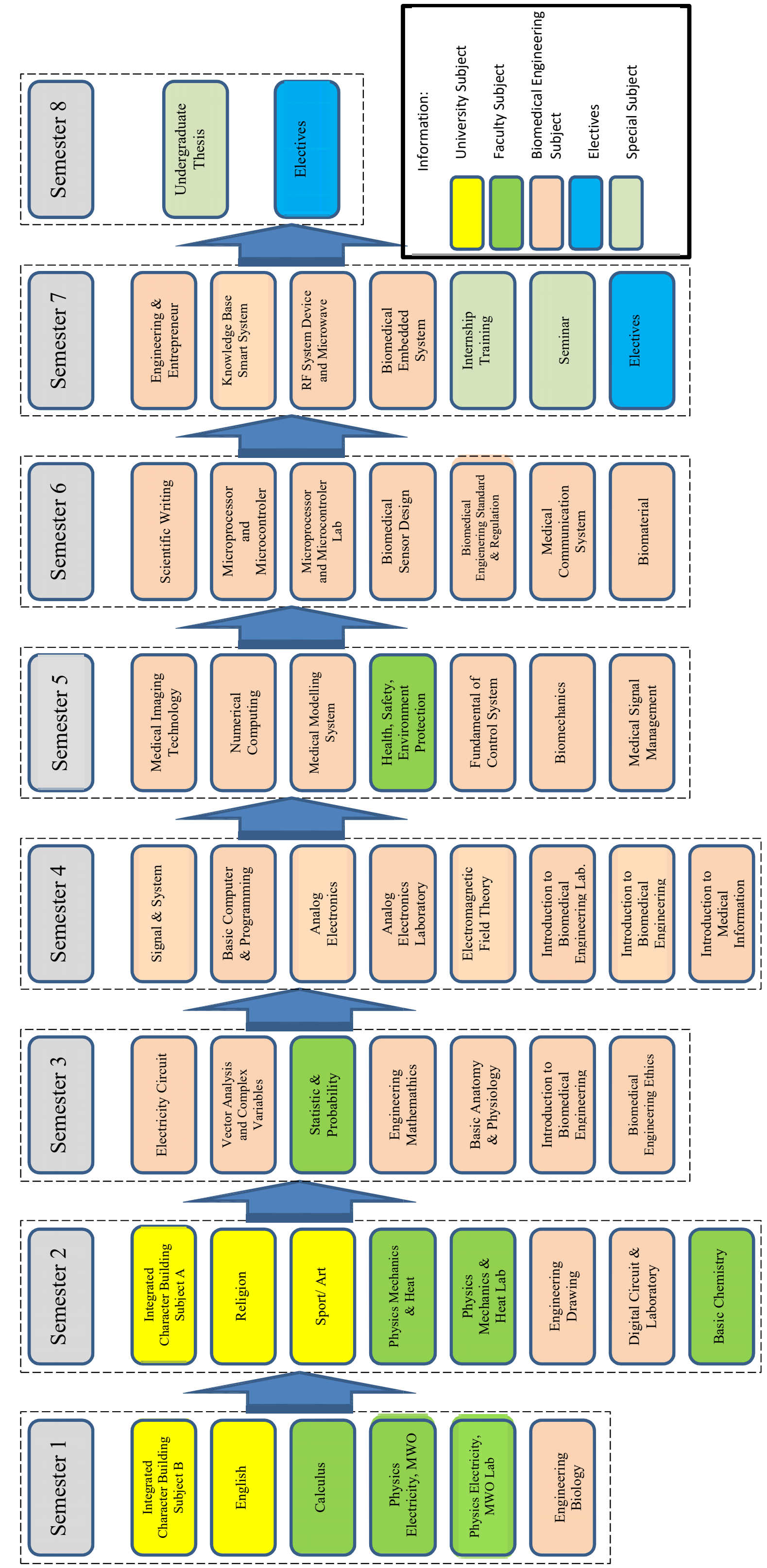
LEARNING OUTPUT

Undergraduate Level		
KKNI Level 6	**General Competency**	**Output**
Able to applied 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 apply mathematics, science, and engineering principles. • Able to implement the basic principles in mathematics, biology, physics, and engineering. • Able to model and simulate a biological system mathematically using the computer. • Able to design simple medical equipment prototype in the individual and group level. • Able to characterize and integrated electronic device and circuit. • Able to implement control algorithm design for biomedical devices/instruments.	• Undergraduate Thesis • Paper • Publication, including a summary article of undergraduate thesis with journal format on UI repository. • Internship training report.
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 identify, formulate and solve engineering problems. • Able to implement the basic principles in mathematics, biology, physics, and engineering. • Able to use the technique, ability, and modern help tools needed in engineering practices. • Able to design system, components, or process to fulfill the needs in realistic limitation such as economic, environment, social, political, ethics, health and safety, feasibility of manufacture, and sustainability.	• Undergraduate Thesis • Paper • Publication, including a summary article of undergraduate thesis with journal format on UI repository. • Internship training report.
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 analyze medical information management technique to solve problems in medical equipment. • Able to analyze medical information/ data in connection with human physiology condition. • Able to design and conduct experiment, analyze and interpret data. • Able to make measurement and interpret living and non-living material data. • Able to analyze medical information management technique to solve problems in medical equipment.	• **Undergraduate Thesis** • **Paper** • **Publication, including a summary article of undergraduate thesis with journal format on UI repository.**

Be responsible for their own work and can be given responsibility in achieving organization's output	• Able to think critically, creatively, and innovatively and have an intellectual curiosity to solve problems in the individual and group level. • Understand the contemporary and future issues faced by the society in local, global, social and business environment related to the engineering areas. • Possess entrepreneur spirit characterized in innovation and independence based on ethics.	• Undergraduate Thesis • Paper • MPKT concept map. • Publication, including a summary article of undergraduate thesis with journal format on UI repository.

UNDERGRADUATE PROGRAM

FLOW DIAGRAM OF SUBJECTS



BIOMEDICAL ENGINEERING

FACULTY OF ENGINEERING

COURSE STRUCTURE
UNDERGRADUATE PROGRAM IN BIOMEDICAL ENGINEERING

Semester 1			
No	Code	Subject	Credit
1	UIGE600002	Integrated Character Building B	6
2	UIGE600003	English	3
3	ENGE600003	Calculus	4
4	ENGE600007	Physics (Electricity, MWO)	3
5	ENGE600008	Physics (Electricity, MWO) Laboratory	1
6	ENBE601001	Biology Engineering	2
		Sub-Total	19

Semester 2			
No	Code	Subject	Credit
1	UIGE600001	Integrated Character Building A	6
2	UIGE600010-15	Religion	2
3	UIGE600020-48	Sport/Art	1
4	ENGE600005	Physics (Mechanics and Thermal)	3
5	ENGE600006	Physics (Mechanics and Thermal) Laboratory	1
6	ENBE602002	Engineering Drawing	2
7	ENBE602003	Digital Circuits & Laboratory	3
8	ENGE600009	Basic Chemistry	2
		Sub-Total	20

Semester 3			
No	Code	Subject	Credit
1	ENBE603004	Electrical Circuit	3
2	ENEE603005	Vector Analysis and Complex Variables	2
3	ENGE600010	Statistic and Probability	3
4	ENEE603007	Engineering Mathematics	4
5	ENBE603005	Basic Anatomy and Physiology	3
6	ENBE603006	Introduction to Biomedical Technology	3
7	ENBE603007	Ethics of Biomedical Technology	2
		Sub-Total	20

BIOMEDICAL ENGINEERING

Semester 4			
No	Code	Subject	Credit
1	ENEE604014	Signal and System	3
2	ENBE604008	Basic Computer and Programming	3
3	ENBE604009	Analog Electronics	3
4	ENBE604010	Analog Electronics Laboratory	1
5	ENBE604011	Electromagnetic Field Theory	3
6	ENBE604012	Introduction to Biomedical Technology Laboratory	1
7	ENBE604013	Introduction to Biomedical Instrumentation	3
8	ENBE604014	Introduction to Medical Informatics	3
		Sub-Total	20

Semester 5			
No	Code	Subject	Credit
1	ENBE605015	Medical Imaging Technology	3
2	ENEE605016	Numerical Computing	2
3	ENBE605016	Modelling of Medical System	3
4	ENGE600012	Health, Safety and Environmental Protection	2
5	ENBE605017	Basic Control System	3
6	ENBE605018	Biomechanics	3
7	ENBE605019	Medical Signal Processing	3
		Sub-Total	19

Semester 6			
No	Code	Subject	Credit
1	ENBE606020	Scientific Writing	2
2	ENEE606026	Microprocessor and Microcontroller	4
3	ENEE606027	Microprocessor and Microcontroller Laboratory	1
4	ENBE606021	Design of Biomedical Sensors	3
5	ENBE606022	Biomedical Engineering Standards & Regulation	2
6	ENBE606023	Medical Communication System	3
7	ENBE606024	Biomaterials	3
		Sub-Total	18

BIOMEDICAL ENGINEERING

Semester 7			
No	Code	Subject	Credit
1	ENEE607031	Engineering and Entrepreneur	2
2	ENBE607025	Knowledge Base Inteligent Systems	3
3	ENBE607026	RF and Microwave System Device	3
4	ENBE607027	Embedded Biomedical System	3
5	ENBE607028	Internship (Special Subjects)	2
6	ENBE607029	Seminar (Special Subjects)	2
7		Electives	3
		Sub-Total	18

Semester 8			
No	Code	Subject	Credit
1	ENBE608033	Bachelor Thesis (Special Subjects)	
2		Electives	
		Sub-Total	10
		TOTAL	144

Elective Subjects for Biomedical Engineering Study Program are as follow:

No	Code	Subject	Credit
1	ENBE607030	Biomedical Special Topic 1	3
2	ENBE608031	Biomedical Special Topic 2	3
3	ENBE608032	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.

THE SYLLABUS

UNIVERSITY COURSES

INTEGRATED CHARACTER BUILDING A
UIGE600001
6 credits
General Purpose: Facilitates students to understand the basics of character formation and master the basics of cognitive power that is logic. Furthermore, to apply cognitive powers in generating good behaviors which are useful to themselves and society. The establishment of ethical behaviors based on ethics is also facilitated. Students are able to develop the basic strength of character and to know themselves as a human being, both as individuals and as part of a group so that they can develop themselves well enough. In a group, the students need to have skills that are needed to maintain an effective relationship in order to improve the quality of human life. Particularly as a citizen of Indonesia, students need to understand the nature of citizenship and basic philosophy of Pancasila in order to act and behave in accordance with the character of the Indonesian nation.
Learning Outcome:
1. Students are able to analyze problems in depth individually, comprehensively, logically and critically, and generate solutions using the logical and ethical principles and rules of logic and ethics
2. Students are capable of analyzing the problem individually, thoroughly and deeply about the human being as an individual or as part of group
3. Students are individually able to understand, make critical reasoning and to build an open and critical mind to the problem of nationhood, statehood and citizenship in this dynamic world situation
4. Students are able to create and display a work that depicts the character in accordance with the principles of Pancasila

Topics : Interactive lecture, Experiential Learning, Collaborative Learning (CL), Problem Based Learning (PBL), Project-Based Assignment and *Computer Mediated Learning* (CML)
Prerequisites : OBM (New Student Orientation)
Textbook : According to the topic

Integrated Character Building B
UIGE600002
6 credits
General Purpose: Facilitates students to practice identifying, analyzing, and resolving problems of nature and the environment by making use of integrative and quantitative information. This lecture aims to prepare the future generation who care about nature issues through the balanced development of hard skills and soft skills and have the skills of ICT (Information and Communication Technology).
Learning Outcome:
Students have an ethic, moral, personality and good character in completing the task at hand;
Students role as citizens who take pride and love of the homeland and support the continuity of life;
Students are able to work together and have a high sensitivity and awareness to the community and the environment;
Students are able to think logically, critically and creatively;
Students are able to use mathematics to solve problems quantitatively;
Students are able to use information and communication technology (ICT) for development;
Students are able to analyze the system of nature integrative and comprehensively;
Students are able to act as wise managers of nature to build and maintain the preservation of nature for a better and sustainable life.
Topics : Interactive lecture, Experiential Learning, Collaborative Learning (CL), Problem Based Learning (PBL), Project-Based Assignment and *Computer Mediated Learning* (CML)
Prerequisites : OBM (New Student Orientation)
Textbook : According to the topic

ENGLISH
UIGE600003
3 credits

Learning Outcomes: After finishing this course, student is expected to have the ability to use English in supporting the learning process in the University and increase their language ability independently.
Syllabus: Learning ability (to be a person that is active in learning, building diction, word format, and use the dictionary, listening strategy and extensive reading). Grammar (Basic Grammar Revision, Adjective Clause Type, Adverb Clause, Verb Clause), Reading (reading skills: skimming, scanning, main idea, supporting idea, reading popular science article, reading academic text), Listening (listening to short conversation, listening to lectures, listening to the news and listening to short stories), Conversation (participation in discussion and meetings, giving presentation), Writing (writing summary of short story, articulating graphic and table, write an academic paragraph, writing basic academic essay).
Prerequisites : None
Textbook : Poerwoto, C. et.al. Reading Comprehension for Engineering Students

RELIGION
UIGE600010-15
2 credits

SPORT/ART
UIGE600020-48
1 credit

BASIC ENGINEERING COURSES

CALCULUS
ENGE600003
4 credits
Learning Outcomes : Able to apply advanced mathematical concepts for electrical engineering; Able to apply mathematical concepts of functions and limits, derivative (single/multivariable) and its applications, integrals (single/multifold) and its applications, Taylor series, and Maclaurin series.
Syllabus: Functions and limits, Derivative (single/multivariable) and applications, integrals (single/multifold) and its applications, Taylor and Maclaurin series
Prerequisites: None
Textbook:
D.E. Vanberg and E.J. Purcell, Calculus with Analytic Geometry, 7th ed., Appleton-Century-Crofts, 1996.
D.E. Vanberg, E.J. Purcell, A.J. Tromba, Calculus, 9th Ed. Prentice-Hall, 2007.
G.B. Thomas & R.L. Finney, Calculus & Analytic Geometry 9th Ed., 1996, Addison- Wesley.

PHYSICS (ELECTRICITY, MWO)
ENGE600007
3 credits
Learning Outcomes: this subject includes the topics of electricity, magnet, wave, and optics. Calculus is use as a mathematic helping tool in the learning process. Students are given the opportunity to learn how to unite their understanding of the basic concept of the analytical capability, their numeracy in learning mechanics and thermodynamics. During the course of this subject, students are not only aim to increase the students' knowledge of the basic physics concepts but also to increase their capability in using information technology and computer and to train their soft skills, such as: independent and group work and their communication skill. Students will also be train on how to explain and analyze the nature phenomenon and the result of human engineering exist in their everyday lives by using the basic physics concept and applied them in their daily lives. Students are also taught to develop their synthesis ability and evaluating both quantitative and qualitative natural phenomenon and the result of human engineering in their surrounding environment by using basic physics concept.
Syllabus: electricity charge and Coulomb law, static electric field and Gauss law, electric potential, capacitor, DC current and basic circuit analysis, magnetic field, induction and electromagnet, Faraday law and inductance, magnetic material characteristic, transient, AC current, wave, sound, polarization, interference, diffraction, optical geometric, light and measurement of light intensity, electricity laboratory: electrolysis, Wheatstone bridge, Kirchhoff law, earth magnetic field, temperature coefficient, RLC series grid characteristic, Ohm Law, Transformer. Optic Laboratory: polarmeter, lenses, prism index bias, spectrometer, diffraction grid, Newton's ring.
Prerequisites: None
Textbook:
Halliday, D, R. Resnick, Fisika II,edisi terjema-han P. Silaban, Penerbit Erlangga, 1986.
Ganijanti AS, Gelombang dan Optik, ed III, Jurusan Fisika FMIPA UI, 1981.
Tipler P.A, Fisika II, ed III terjemahan Bambang Sugiyono, Penerbit Erlangga, 2001.
D.C.Giancoli, General Physics, Prentice Hall Inc, 1984.

PHYSICS (ELECTRICITY, MWO) LAB
ENGE600008
1 credit
Syllabus :
Practical of Electricity: Electrolysis, Wheatstone bridge, Kirchhoff law, Earth's magnetic field, Temperature coefficient, Characteristic of series RLC circuit, Ohm law, Transformer. Practical of Optics: Polarimeter, Lens, Photometry, Prisms bias index, Spectrometer, Diffraction grid, Newton's ring.

PHYSICS (MECHANICS AND THERMAL)
ENGE600005
3 credits
Learning Outcomes: This subject includes the topics of mechanics and thermodynamics. Calculus is use as a mathematic helping tool in the learning process. Students are given the opportunity to learn how to unite their understanding of the basic concept of the analytical capability, their numeracy in learning mechanics and thermodynamics. During the course of this subject, students are not only aim to increase the students' knowledge of the basic physics concepts but also to increase their capability in using information technology and computer and to train their skills, such as: independent and group work and their communication skill.
Students will also be train on how to explain and analyze the nature phenomenon and the result of human engineering exist in their everyday lives by using the basic physics concept and applied them in their daily lives. Students are also taught to develop their synthesis ability and evaluating both quantitative and qualitative natural phenomenon and the result of human engineering in their surrounding environment by using basic physics concept. This subject will give students the opportunity to develop their ability to develop their presentation ability analyze the nature phenomenon and the result of human engineering from the mathematics and natural science point of view integrative and comprehensively.
Syllabus: scale, object kinematic, object mechanic, linier momentum conservation law and energy, harmonic movement, gravitation, dynamic and hard object kinematic, introduction to basic concept (pressure, thermodynamic system, system environment, temperature), expansion, energy equilibrium (thermal equation), energy transfer, ideal gas, thermodynamic first law, enthalpy and entropy, application of thermodynamic first law for open and shut system, thermodynamic second law, kinetic theory for ideal gas. Mechanical Practice, measurement, inertia moment, gravitation speed, liquid density, friction coefficient, collision, movement torque, liquid viscosity, modulus young, newton liquid viscosity, liquid surface pressure, oscillatory. Heat Practice: disruptive coefficient, heat conductivity, thermocouple calibration, calorimeter, joule constant, Laplace constant, heat collector, determine air Cp/Cv value, liquid disruptive and water anomaly.
Prerequisites: None
Textbook:
Halliday. D, R Resnick, Fisika I, edisi terjemahan P Silaban, Penerbit Erlangga 1986.
Ganijanti AS, Mekanika, Penerbit Salemba Teknik, 2000.
Tipler PA, Fisika I, ed III, terjemahan Lea Prasetio, Penerbit Erlangga, 1998.
Giancoli D.C, General Physics, Prentice Hall Inc, 1984
Sears-Salinger, Thermodynamics, Kinetic theory and statistical thermodynamics, Wesley, 1975.
Giancoli, D.C, Physics: principles with applications, Prentice Hall Inc. 2000.

PHYSICS (MECHANICS AND THERMAL) LABORATORY
ENGE600006

1 credit
Syllabus :
Practical of Mechanics: Measurement, Moment of inertia, Gravity acceleration, Fluid density, Scratch coefficient, Collision, Swing torque, Viscosity of water, Young's modulus, Viscosity of Newtonian fluid, Fluids surface tension, Oscillation, Practical of Heat: Coefficient of linear expansion, Heat conductivity, Thermocouple calibration, Calorimeter, Joule Constant, Laplace Constant, Heat Collector, Determining of air Cp/Cv, Expansion of fluids and water anomaly.
Notes: For Architecture and Interior Architecture Program, practical is not mandatory.

BASIC CHEMISTRY
ENGE600009
2 credits
Learning Outcomes: As an engineer, you must have understanding on the chemistry that provides not only the basis for much of what goes on in our world but also that it is a vital, continually developing science. In this study the students will learn many subjects such as matter and measurement; atoms, molecules, and ions; stoichiometry; aqueous reactions; thermochemistry; properties of solutions; chemical kinetics; chemical equilibrium; and electrochemistry.
Learning activities will be conducted through various method, which consists of: problem based learning (PBL), interactive lecture, question-based learning, discussion, demonstration and unguided structured assignments. Assessment will be made continuously through a set of exercises, group discussion, mid semester exam and final exam.
Syllabus: Introduction to chemistry science and engineering application, material and measurement, atom, molecule and ion, chemistry equation and Mol concept, chemical reaction solution, atomic structure and periodic property, thermochemical, chemical kinetic, chemistry equilibrium, electrochemical, metal material and substance.
Prerequisites: None
Textbook:
John McMurry, Robert C. Fay, Chemistry (3rd Ed.), Prentice Hall, 2001.
Raymond Chang, Williams College, Chemistry (7th Ed.), McGraw-Hill, 2003.

HEALTH, SAFETY AND ENVIRONMENTAL PROTECTION
ENGE60001
2 credits
Syllabus: The teaching of Safety, Health and Environmental (SHE) protection to undergraduates studying engineering courses is an important part of the education of future engineers at all levels. It is the generally expressed view amongst practitioners in industry, business and other organizations that all engineers need to be equipped to appreciate understand and implement the requirements of SHE management and practice to meet the working needs of industry and of their company (or other organization). Whilst the level of risk and degree of control is dependent on the industry sector concerned, the basic principles do not change. In addition, according to code of ethics of engineers, engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties.
The module covers the regulation framework and standards, risk perception, assessment, and management and detail discussion on physical, chemical and process hazards, and related engineering and management controls. Maintenance of safety conditions, personal protective equipment, audit, incident and emergency planning are discussed in accordance to measures for improving students awareness to their daily activities within the campus premises and local environment.
Learning activities will be conducted through various methods, which consist of: interactive lecture, question-based learning, discussion, demonstration and unguided structured assignments. Assessment will be made continuously through a set of exercises, group discussion, mid semester exam and final exam

STATISTIC AND PROBABILITY
ENGE600010
3 credits
Learning Outcomes: Statistics and probability has been known as applied mathematics, which is widely used in collecting, organizing, presenting, interpreting and analyzing data to support valid conclusions. Furthermore, these conclusions will be used as recommendation in decision-making. The course of Statistics and Probability is intended to give a basic ability for students to handle quantitative data and information. There are two stages that are delivered which is descriptive and inductive/inference stages. Descriptive stage includes collecting, organizing, and presenting the data in a scientific manner. Then, inductive/inference stage includes the process of estimating and drawing conclusion based on available data and relations between variables. Hence, students are expected to apply their knowledge of statistics in conducting experiments in laboratory works/assignments as well as research studies in their final projects.
Syllabus: Probability concept, random variables and probability distribution, mathematic expectancy, probability distribution function, probability transformation, stochastic process, random walk, spectrum, mean square estimation, entropy, Markov process, central limit theorem.
Prerequisites: None
Textbook:
Guojun Lu, "Communication and Computing for Distributed Multimedia Systems," John Wiley and Sons
Luis Correia, "Mobile Broadband Multimedia Networks," Elsevier, UK, 2006

BIOMEDICAL ENGINEERING COURSES

ENBE601001
BIOLOGY ENGINEERING
2 credits
Learning Outcomes: Give basic knowledge on Mechanism Biology from engineering perspectives.
Instruction:
Able to explain the basic concept on cell, molecular biology, biochemistry and genetic engineering.
Possess comprehensive knowledge on important components, and various functions of molecular cell system.
Have the knowledge on techniques and approaches often used in biology molecular cell.
Applied biological knowledge for Biomedical Engineering and Health Science.
Syllabus: Molecules of cell, structure and function of protein, metabolism in cell, changes in cell: constituent of life molecule design, biochemistry and genetic revolution, DNA, biochemistry linkages with biodiversity, protein synthesis from nucleate acid to amino-.2 acid sequence, RNA polymerase to ribosome for protein synthesis, the difference between prokaryotic and eukaryotic; catalyst reaction to cell: protease, nucleoside monophosphate kinases; mechanical chemistry on cell: how protein motors convert chemical energy into mechanical work.
Prerequisites: None
Textbook:
Alberts, 2003, Molecular Biology of the cell.
Lodish, 2004, Molecular cell biology.

ENBE602002
ENGINEERING DRAWING
2 credits
Learning Outcomes: Students are able to change geometry component by drawing according to the drawing standard of International Standard Organization (ISO). Students understand the drawing theory and procedures based on ISO standard. Students have the ability to read, interpret and moving 2D/3D geometry images from components or construction. Students are able to draw orthogonal projection based on ISO standard.
Syllabus: Function and benefit of engineering drawing; SAP; measurement and evaluation; Introduction to drawing tools; understanding basic geometry, paper format, drawing rules, line, plane, line configuration, basic shape geometry; geometric visualization, isometric and unsymmetrical projection, function and type of lines, geometric configuration shape, orthogonal projection, projection standard, viewing concept, width of view principle, advance orthogonal projection, the concept of circumpolar regions, the concept of special areas, cutting concept, wide display and refraction.
Prerequisites: None
Textbook:
ISO 1101, Technical Drawings, International Organization for Standardization.
A.W. Boundy, Engineering Drawing, McGraw-Hill Book Company.

Colin Simmons & Dennis Maguire, Manual of Engineering Drawing, Edward Arnold.
Warren J. Luzadder, Fundamentals of Engineering Drawing, Prentice- Hall, Inc.
Giesecke-Mithcell-Spencer-Hill-Dygdon-Novak, Technical Drawing, Prentice Hall Inc.

ENBE602003
DIGITAL CIRCUITS AND LABORATORY
3 credits
Learning Outcomes: This course is aim for students to understand the many level of planning and implementation of digital system by using simple logic gate, logic function component, and simple memory unit. This course includes several laboratory classes in design, implementation and verification of digital logic sequence. Tools such as Xilinx and other digital sequence simulation will be use.
Syllabus: Introduction to AND, OR, and NOT logic gates: combination logic sequence, Multiplieser-dan Decoder, Full Adder, Biner Memory Unit: SR latch, D and JK flip-flops, sequential sequence: Ripple Counter, Register and Counter: Universal Shift Register, Ring Counter and BCD counter, design and simulation.
Prerequisites: None
Textbook:
M. Morris Mano, “Digital Design,” 4th Edition (International Edition), Prentice-Hall, 2007.
Robert Dueck, ”Digital Design with CPLD Applications and VHDL,” Delmar Cengage Learning; Second Edition, 2004, ISBN-10: 1401840302, ISBN-13: 978-1401840303.
M.M. Mano and C.R. Kime,” Logic and Computer Design Fundamentals,” Third Edition (International Edition), Prentice-Hall, 2004.

ENBE603004
ELECTRICAL CIRCUIT
3 credits
Learning Outcomes: After finishing this course, students are expected to be able to use star and delta circuit, calculate current phase, conductor, three-phase electric power system, electric circuit complex frequency, and use Laplace and Fourier transformation and its invers on electric circuit.
Syllabus: Balanced three-phase sequence, complex frequency, magnetic clutched circuit; Laplace transformation, Laplace transformation circuit, frequency selection, active filter sequence, two polar sequence, Fourier series review, circuit with Fourier transformation, resistive circuit, dependent sources and opamp, analysis method, energy saving element, orde 1 circuit, orde 2 circuit, sources and fasor sinusoidal, analysis the state of AC tunak, tunak AC power condition.
Prerequisites: None
Textbook:
James W. Nilsson, Susan A. Riedel, “Electric Circuits”, 6th Edition, Prentice Hall International, Inc., 2000 (Chapter 11-18)
David E. Johnson, Johnny R. Johnson, John L. Hilburry, Peter D. Scott, “Electric Circuit Analysis”, 3rd Edition, Prentice Hall International, Inc., 1997 (Chapter 10-17)

ENBE603005
BASIC ANATOMY AND PHISIOLOGY
3 credits
Learning Outcomes: After finishing this course, students are expected to have the ability to analyze the human body structure and the physiological function of the human body.
Syllabus: The understanding of the human anatomy, Cytology and Histology, Osteology, Arthrology, Myology, Digestive System, Respiratory System, Blood Circulatory System, Muscle System, Bone System, Hormone System, Urine System, Nerve System, Reproduction System, Body Immunity System, Skin System.
Prerequisites: None
Textbook:
Marieb EN and Hoen K. Human. Anatomy & Physiology. 10th ed.Elsevier Inc. 2015
Tortora GJ et al. Principles of Anatomy & Physiology : 1st Asia-Pacific Ed. John Wiley & Sons Australia Ltd.2015
Martini FH, Nath JL, Bartholomew E. Fundamentals of Anatomy & Physiology, 10th Edition. 2015
Sherwood L. Human Physiology, From Cells to System. 7th ed. Brook/Cole. 2016

BIOMEDICAL ENGINEERING

ENBE603006
INTRODUCTION TO BIOMEDICAL TECHNOLOGY
3 credits
Learning Outcomes:
After finishing this course, students are expected to have the following abilities:
Have an understanding of the biomedical technology system.
Have the ability to explain the concept of engineering system application to solve human biology problems.
Able to illustrate the concept of detection, measurement, and monitoring of the human physiological signal.
Able to convey the diagnosis interpretation concept through bioelectric data signal processing technique.
Able to explain the concept of devices for therapy and rehabilitation.
Able to make analysis based on computer data of a patient data in connection with making clinical decision.
Able to explain the concept of device for artificial organ.
Able to analyze the concept of medical imaging technique.
Syllabus: Physiologic Systems, Bioelectric Phenomena, Introduction to Biomechanics & Biomaterials, Introduction to Biomedical Sensors, Biomedical Signal Analysis, Introduction to Medical Imaging, Medical Instruments and Devices.
Prerequisites: None
Textbook:
The Biomedical Engineering Handbook, J.D. Bronzino & D.R. Peterson, 4th Ed., CRC Press, 2015
Standard Handbook of Biomedical Engineering and Design, M. Kutz, McGraw-Hill, 2003.
Handbook of Biomedical Engineering, J. Kline, Academic Press, 1988.

ENBE603007
ETHICS OF BIOMEDICAL TECHNOLOGY
2 credit
Learning Outcomes:
Able to explain the ethic and ethical code in medical field both in the international level and in Indonesia.
Able to analyze the ethics problem in medical field.
Syllabus: The procedures and ethics that must be followed while planning to conduct experiment on subject of animal and human; the ethical dilemma in biomedical engineering research and the importance of considering all sides of the problems; the health technology impact for the society; several equality concept for gender, culture, and ethic.
Prerequisites: None
Textbook:
Ethics, Research Methods and Standards in Biomedical Engineering, Monique Frize, Publisher: Morgan & Claypool, 2011.
Ethics and Community in the Health Care Professions, Michael Parker, Publisher: Routledge, 1999.

ENBE604008
BASIC COMPUTER AND PROGRAMMING
3 credits
Learning Outcomes: Students are able to explain the hardware and software of computer system, able to design simple algorithm like pseudo code and implemented said algorithm to programming language.
Syllabus: Introduction to computer system, Introduction to computer hardware, Introduction to computer software, algorithm, pseudo code, Introduction to programming language C, programming process on programming language C, structured program for programming language C.
Prerequisites: None
Textbook:
A. Evans, K. Martin, and M. A. Poatsy, “Technology in Action (TiA),” 2nd Edition, Prentice-Hall, 2006

BIOMEDICAL ENGINEERING

FACULTY OF ENGINEERING

UNDERGRADUATE PROGRAM

G. B. Shelly and M. E. Vermaat, "Discovering Computers 2011: Living in a Digital World," Course Technology, Cengage Learning, 2011.
Deitel & Deitel, "C How to Program," 5th Edition, Pearson Education, 2007.

ENBE604009
ELECTRONIC ANALOG
3 credits
Learning Outcomes: After finishing this course, students are expected to be able to explain, characterize diode, FET, JFET, MOSFET, VMOS, CMOS, and MESFET; able to analyze BJT application sequence: small-signal model and large-signal for electronic circuit and able to analyze FET application circuit.
Syllabus: Diode basic principles, transistor circuit, FET, JFET, MOSFET, VMOS, CMOS, MESFET, BJT common source circuit, common base, common emitter, and common collector, BJT applications, small signal and large signal BJT model; current and voltage amplifier; MOSFET depletion and enhancement type, FET application.
Prerequisites: Electrical Circuit
Text Books:
Boylestad R, Nashhelsky L, "Electronic Devices and Circuit Theory" 9th Edition Prentice Hall, New Jersey, USA, 2006

ENBE604010
ELECTRONIC ANALOG LABORATORY
1 credit
Learning Outcomes: After finishing this course, students are expected to able to design one stage, two stages, and multi stages of amplifier sequence and multi vibrator, oscillator, and op amp circuit.
Syllabus: the defining experiment of device characteristic, diode circuit, amplifier one stage, compound transistor stages, multi vibrator circuit, oscillator circuit, op amp circuit.
Prerequisites: Electrical Circuit
Textbook:
Electrical Circuit Laboratory Module

ENBE604011
ELECTROMAGNETIC FIELD THEORY
3 credits
Learning Outcomes: After finishing this course, students area expected to able to apply the Maxwell Law 1, 2, 3, and 4.
Syllabus: Static Electricity, Magnetic Field, Maxwell Equation, Electromagnetic Wave, Wave Propagation, Wave Characteristic on Different medium, Wave Transmission, Matching Impedance, Radiation.
Prerequisites: Calculus, Engineering Mathematics
Textbook:
Stuart M. Wentworth, "Fundamentals of Electromagnetics with Engineering Applications," John Wiley, 2005.
Fawwaz T. Ulaby, "Fundamental of Applied Electromagnetics," Prentice Hall, Publications, 2001.

ENBE604012
INTRODUCTION TO BIOMEDICAL TECHNOLOGY LABORATORY
1 credit
Learning Outcomes: After finishing the course, students are expected to
Syllabus: Basic Anatomy and Physiology Module, Basic Module on Medical Instrumentation, System Module for Body Monitoring.
Prerequisites: Introduction to Biomedical Technology
Textbook:
Biomedical Engineering Laboratory Module

ENBE604013
INTRODUCTION TO BIOMEDICAL INSTRUMENTATION
3 credits
Learning Outcomes: After finishing this course, students are expected to have the following abilities:
Understand biomedical measurement system.
Understand and applied various types of cardiovascular system measurements.
Understand and applied various types of respiration system measurements.
Understand and applied various types of nerve system.
Understand safety patient factors that needed to be paid attention to in measurement.
Syllabus: Introduction to biomedical instrumentation; basic transducer principle (active and passive transducer, transducer for biomedical application; source of bioelectric potentials; electrodes; the cardiovascular system; cardiovascular measurement; measurement in respiratory system; noninvasive diagnostic instrumentation; measurement in nervous system; sensory and behavioral measurements; electrical safety of medical equipment; role of laser in healthcare.
Prerequisites: None
Textbook:
Biomedical Instrumentation and Measurement, Leslie Cromwell, Fred J. Weibel and Erich A. Pleiffer, Prentice Hall, New Jersey.
Handbook of Biomedical Instrumentation, RS Khanpur, Tata McGraw-Hill Education, 2003.

ENBE604014
INTRODUCTION TO MEDICAL INFORMATICS
3 credit
Learning Outcomes:
After this course, students are expected to:
Able to understand the basic concept of information technology for application in the medical field.
Able to implement information basic method by combining basic knowledge of programming to acquire, organize, combine, and analyze health data sources.
Syllabus: 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:
Biomedical Informatics: Computer Applications in Health Care and Biomedicine (Health Informatics) 4th ed. 2014 Edition.
Method in Medical Informatics: Fundamentals of Healthcare Programming in Perl, Python, and Ruby, Jules Berman, CRC Press 2010.

ENBE605015
MEDICAL IMAGING TECHNOLOGY
3 credits
Learning Outcomes:
After this course, students are expected to:
Able to understand several basic concept in medical imaging technology.
Able to explain and analyze basic method of medical imaging process in reconstruction, improve image quality, creating image segmentation, image analysis, image visualization, and manage medical image data in relation with supporting the medical imaging process in health field.
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

BIOMEDICAL ENGINEERING

FACULTY OF ENGINEERING

(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:
Handbook of Medical Imaging: Processing and Analysis Management, Isaac Bankman, Academic Press 2000, CA, USA.
Handbook of Medical Imaging, Vol. 2: Medical Image Processing and Analysis, M. Sonka & J.M. Fitzpatrick, SPIE Press, 2009, Washington, USA.

ENBE605016
MODELING OF MEDICAL SYSTEM
3 credits
Learning Outcomes:
Students should understand the medical system components, understand the medical mathematic system model, understand the medical system modelling method, able to conduct simple medical system modelling and able to simulate.
Syllabus: Introduction to modelling system and medical signal, general system and signal mathematic model, analytic modelling medical system, analytic modelling analysis, medical system identification method, modelling parameter estimation method, and medical system modelling simulation.
Prerequisites: None
Textbook:
David T. Westwick, Robert E. Kearney, "Identification of Nonlinear Physiological Systems," John Wiley & Sons 2003.
Willem van Meurs, "Modeling and Simulation in Biomedical Engineering: Applications in Cardiorespiratory Physiology," 1st ed., McGraw-Hill Education, 2011

ENBE605017
BASIC CONTROL SYSTEM
3 credits
Learning Outcomes: This course is aimed to give students the ability to draw static or dynamic response from order system one, two, and higher, determine pole and zero from system, and dominant pole on a higher order system, explain Routh-Hurwitz, Nyquist diagram, TKA, and create Bode diagram.
Syllabus: continuous characteristic system order 1, 3 and approach for higher system order, stability analysis method of continuous linear system.
Textbook:
N. Nise, "Control Systems Engineering", 4^{th} Edition, Wiley, 2005
Katsuhiko Ogata, "Modern Control Engineering"4^{th} Edition, Prentice Hall, 2002

ENBE605018
BIOMECHANIC
3 credits
Learning Outcomes: This course gives the understanding of physical principal, which based the biological process and mechanism (movement, design, structure, material and transport). At the end of the course, students are expected to:
Apply the biomechanics principle to solve problems in human movement and musculoskeletal such as ergonomic, rehabilitation, and training.
Use effectively and safely biomechanics instrument and tools to acquire or appraise human movement.
Understanding the trend and issue in the future in regards to biomechanics.
Syllabus: Newton Law, Fluid Mechanics, Bernoulli, Drag Forces, Reynold Number, Static System Mechanic and Moving System, the Body's Kinetic and Force and the influence on Movement and Stability, Basic Mathematics on Movement, Analysis and Instrumentation on body motion, the Basic concept of the human body bone and muscle mechanics, ergometry, the Basic concept of energy.
Prerequisites: None
Textbook:

N. Ozkaya, and M. Nordin, "Fundamental of Biomechanics: Equilibrium, Motion and Deformation", 2nd Ed., Springer, 1998.
E. Okuno, and L. Fratin, "Biomechanics of the Human Body", Springer, 2013.

ENBE605019
MEDICAL SIGNAL PROCESSING
3 credits
Learning Outcomes: This course is meant to introduce the students to basic signal processing management and use software for signal processing or image. After finishing this course, students are expected to able to explain the basic of digital signal processing and able to use the software for basic simulation for signal processing or image and familiar with the function within the signal or image processing toolbox (ex: Metlab).
Syllabus: Introduction to signal, visual and digital image, image transformation, color representation, image enhancement (domain spatial), image enhancement (frequency domain), convolution and correlation, image segmentation, object feature characteristic, image compression, pattern recognition, image restoration, image morphology, wavelet transformation.
Prerequisites: Basic Computer and Programming
Textbook:
R.C. Gonzalez and R.E. Woods, "Digital Image Processing", 2nd Edition, Prentice-Hall, 2002
J.W. Leis, "Digital Signal Processing Using Matlab for Students and Researchers," John Wiley & Sons, 2011.
R.C. Gonzalez, R.E. Woods, and S.L. Eddins, "Digital Image Processing using MATLAB", 2nd Edition, Gatesmark Publishing, 2009.
E.S. Gopi, "Digital Signal Processing for Medical Imaging Using Matlab," Springer, 2013.

ENBE606020
SCIENTIFIC WRITING
3 credits
Learning Outcomes: Students are able to write scientific paper with good structure that includes the usage of formal Bahasa Indonesia and English in scientific writing and the use of software to write a well-formatted scientific paper.
Syllabus: scientific writing systematic, experimental variables and set up; statistical analysis tools, the use of excellent Bahasa Indonesia in scientific writing; the use English in scientific writing, word processing software; styling; referencing tools.
Prerequisites: None
Textbook:
How to Write & Publish a Scientific Paper, Robert A. Day, Publisher: Oryx Press 5th Ed., 1998.
Technical Guidance for Universitas Indonesia Students' Final Project
IEEE - Publish a Paper with IEEE (www.ieee.org)

ENBE606021
DESIGN OF BIOMEDICAL SENSORS
3 credits
Learning Outcomes:
Able to understand the development of microelectronics technology up until MEM.
Able to understand fabrication process of MEMS and Micro sensor.
Able to explain micro sensor performance and smart device.
Able to design biosensor for medical application.
Syllabus: various sensors for biology and medical, electronic materials and their process, biosensor material, standard microelectronic technology, micro sensor, SAW device, IDT micro sensor measurement parameter, IDT micro sensor fabrication, IDT micro sensor, smart sensor and MEMS.
Prerequisites: Analog Electronic, Electricity Current
Textbook:
Julian W. Gardner, Vijay K. Varadan, and Osama O. Awadelkarim, "Microsensors, MEMS and Smart Devices," John Wiley; 1^{st} Ed., 2001.
Biological and Medical Sensor Technologies, Krzysztof Iniewski, Publisher: CRC Press, 2012.

ENBE606022
BIOMEDICAL ENGINEERING STANDARD AND REGULATION
2 credits
Learning Outcomes:
Able to analyze standard and regulation for biomedical engineering.
Able to analyze patient's safety and security.
Syllabus: Medical devices design and manufacturing control, ISO 13485, How to Manufacture Good Health Device (CPAKB) in Indonesia, International Standard for Medical Devices: IEC 60601; EC Medical device directed (MDD), Medical devices design and control in the hospital. 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:
National Institutes of Health (NIH), Ethical Guidelines & Regulations.
International Organization for Standardization (ISO). IEC 60601 Series.
Ethics, Research Methods and Standards in Biomedical Engineering, Monique Frize, Publisher: Morgan & Claypool, 2011.

ENBE606023
MEDICAL COMMUNICATION SYSTEM
3 SKS
Learning Outcomes:
Able to explain the concept of several communication system technology for medical application.
Able to explain e-healthcare and telemedicine system.
Able to explain the design process for wired and wireless medical communication system.
Syllabus: Introduction to medical communication system, e-healthcare and telemedicine. Several special topics will be delivered include body-centric wireless communications, electromagnetic properties and modeling of the human body, portable wearable devices, medical implant communication systems, e-healthcare infrastructure, wireless body area network, mobile-based telemedicine system, and wireless power technology in medical devices.
Prerequisites: None
Textbook:
E-Healthcare Systems and Wireless Communications: Current and Future Challenges, Mohamed K. Watfa, Publisher: IGI Global, 2012.
Antennas and Propagation for Body Centric Wireless Communications, P.S. Hall, Publisher: Artech House, 2006.

ENBE606024
BIOMATERIALS
3 credits
Learning Outcomes:
This course focuses on the basic biomaterial, characterization, biocompatibility, biodegradable, toxicity and the potential in commercial application. During class period, students are expected to have an understanding of the biomaterial concept and the characteristic it possess. At the end of the course, students are expected to:
Understand the basic concept of biomaterial and its characteristics.
Use modern analysis technique for biomaterial characterization.
Use engineering computation for biomaterial.
Understand the issue in surface area and toxicity.
Understand the material process and cost analysis.
Syllabus: Introduction and Overview/Importance of biomaterials, Classes of Materials Used in Medicine, Metallic Biomaterials, Polymeric Materials and composite, Ceramic biomaterials, Biodegradable materials, Soft and Hard tissue replacement, Tissue Engineering, Surface Properties and characterization of Biomaterials, Surface & Protein Interactions, Dental Implants, Biosensors, Bio devices, Targeted drug delivery, Biomaterials corrosion and degradation.
Prerequisites: None
Textbook:

BIOMEDICAL ENGINEERING

J.Y. Wong and J.D. Bronzino, "Biomaterials", CRC Press, 2007.
D. Sihm, "Introduction to Biomaterials", World Scientific, 2006.

ENBE607025
KNOWLEDGE BASED SMART SYSTEM
3 credits
Learning Outcomes: The course will discuss how to solve problems by using non-conventional method based on real mathematics value. The discussed method includes tolerant algorithm towards "imprecision", "uncertainty", and "limited knowledge" on system. The aim is to obtain an effective working system by using trained expert knowledge in the system.
Syllabus: Introduction to artificial intelligence system, concept and definition of fuzzy logic, fuzzy sets, fuzzy relations, fuzzy number operation, linguistic description, fuzzy inference, and fuzzy algorithm. Fuzzy control system, the Basic Concept of Artificial Neural Network (ANN), ANN training, back-propagation algorithm, other ANN algorithm, ANN application on fuzzy system, genetic algorithm, application.
Prerequisites: Engineering Mathematics, Basic Computer and Programming.
Textbook:
Lefteri H., Tsoukalas and Robert E. Uhrig, "Fuzzy and Neural Approaches in Engineering", John Wiley & Sons, Inc., Singapore, 1997
John Yen and Reza Langari, "Fuzzy Logic, Intelligence, Control and Information", Prentice Hall, Inc. New Jersey, 1999

ENBE607026
RF SYSTEM DEVICE AND MICROWAVE
3 credits
Learning Outcomes:
Able to understand the principle of RF working sequence and microwave.
Able to design RF equipment and microwave.
Able to understand problem in designing RF sequence and microwave.
Able to suggest original idea to develop microwave technology in the future for Indonesia.
Able to implement microwave circuit instrument in interdisciplinary field.
Syllabus: Introduction to microwave engineering, Transmission line theory, Transmission Line and Waveguide, Network analysis, Impedance matching and tuning, Microwave Resonators, Microwave power dividers and couplers, Microwave Filters, Noise in Microwave Circuits & Active RF Components , Microwave Amplifier , Microwave Oscillators and Mixers.
Prerequisites: None
Textbook:
Microwave Engineering, David M. Pozar, Publisher: John Wiley & Sons, 4th Ed. 2012.
RF & Microwave Design Essentials, Matthew M. Radmanesh, Publisher: AuthorHouse, 2007.

ENBE607027
BIOMEDICAL EMBEDDED SYSTEM
3 credits
Learning Outcomes: This course teaches students to implement medical application from embedded system. By the end of the course, students should be able to explain the development concept of embedded system and its implementation by using programming language such as Assembly Language, C Programming Language and other Programming Language.
Syllabus: Specification and Model for Embedded System, Sensor and Actuator, Programming Language for Embedded System, Operation System for Embedded System, Evaluation and Validation for Embedded System.
Prerequisites: Microprocessor and Microcontroller
Textbook:
J. Liu, "Real-Time Systems", Prentice Hall, 2000.
P. A. Laplante, "Real-Time Systems Design and Analysis - An Engineer's Handbook", 2^{nd} Edition, IEEE Press, 1997.

ENEE603005
VECTOR ANALYSIS AND COMPLEX VARIABLES
3 credits

Learning Outcomes: After completing this course, students are expected to have the ability to use complex function on electric circuit, implement Cauchy Riemann method on Laplace and Poisson equation, use Cauchy integral method on Cartesius coordinate and polar.
Syllabus: Number and complex function, polar form, De Moivre theory, dot multiplication and cross limit complex function, derivative, del, gradient, divergence, curl in complex function, analytical and harmonic function, Cauchy-Riemann equation, Laplace and Poisson, complex integral, Cauchy integral and residue integration, real integrals using complex function, vector on two dimension and three dimension space, vector operation, dot and cross.
Prerequisites: Calculus.
Textbook:
Erwin Kreyszig, "Advanced Engineering Mathematics", 9th Edition, Wiley Publisher 2006
Glyn James, "Advanced Modern Engineering Mathematics", 2nd Edition, Prentice Hall, Publisher 1999

ENEE603007
ENGINEERING MATHEMATICS
3 credits
Learning Outcomes: After finishing this course, students are expected to implement the Green theory, Gauss and Stoke divergence for line and surface integral to determine series convergence to convert function towards Taylor series, MacLaurin and Fourier, and use function linearization, use Laplace, Fourier, and Z transformation.
Syllabus: The use and operation of vector, Derivative, del, gradient, divergence and curl from vector, line, surface integral, Gauss divergence, Stoke and Green theory, the use in electromagnetic field, definition of order, series, type of series, series test, ratio test, integral test, comparison test, root test, Raabe test, Gauss test, Taylor and MacLaurin series, Fourier series in complex form, Laplace, Fourier, and Z transformation.
Prerequisites: Calculus
Textbook:
Erwin Kreyszig, "Advanced Engineering Mathematics"9th Edition, Wiley Publisher 2006
Glyn James, "Advanced Modern Engineering Mathematics", 2nd Edition, Prentice Hall, Publisher 1999

BIOMEDICAL ENGINEERING

ENEE604014
SIGNAL AND SYSTEM
3 credits
Learning Outcomes: This course is focus to introduce students on tools and technique on digital and analog signal analysis. After completing this course, students are expected to be able to process and transform signal to Fourier, Laplace, and Hilbert function, able to design a simple filter, capture signal to discrete (Z transform), able to design IRR and FIR filter on a continuous system.
Syllabus: Fourier transformation and its characteristics, Discrete Time Fourier Transformations and its characteristics, continuous time system, Laplace transformation and its characteristics. System function, windows, filter design. Hilbert transformation. Discreet time signals, sampling, reconstruction theory, Z-transformation and its characteristics. System function, discreet simulation of continuous system, windows, IIR and FIR filter design.
Prerequisites: Engineering Mathematics
Textbook:
Simon Haykin and Barry Van Veen, "Signals and System", 2nd Edition John Wiley & Sons, Publisher, 2003
Alan V. Oppenheim, Ronald W. Schafer, and John R. Buck, "Discrete-Time Signal Processing", Prentice Hall; 2nd Edition, 1998

ENEE605016
NUMERIC COMPUTATION
3 credits
Learning Outcomes: Able to solve problem using computational method.
Syllabus: Biner Computing System, computer memory, algorithm and system efficiency, the dynamics and Monte Carlo, Stochastic and random, error and error reduction.
Prerequisites: Engineering Mathematics
Textbook:
Wen Shen, "An Introduction to Numerical Computation," World Scientific Publishing, 2016.
T.A. Driscoll and R.J. Braun, "Fundamental of Numerical Computation," SIAM, 2018.

ENEE606026
MICROPRECESSOR AND MICROCONTROLLER
4 credits
Learning Outcomes: This course teaches students on microprocessor and microcontroller technology. After this course, students are expected to be able to create Intel Microprocessor 16 bits and 32 bits and 8051 Microcontroller (8 bits) program using low level programming and be able to design embedded system based on microcontroller 8051.
Syllabus: Microprocessor: Introduction to Microprocessor, Microprocessor Hardware Specification, Microprocessor Internal Architecture, Addressing Modes, Assembly Language Programming, Data Movement Instruction, Arithmetic and Logic Instruction, Program Control Instruction, Microprocessor Programming, Memory and I/O Interfacing. Microcontroller: Introduction to Microcontroller, 8051 Microcontroller Architect, 8051 Microcontroller Programming, 8051 Addressing Modes, I/O Port Programming and Interfacing, Arithmetic and Logic Instruction, Introduction to Embedded System Design by using Microcontroller 8051.
Prerequisites: Digital Sequence and Laboratory, Basic Computer and Programming.
Textbook:
The Intel Microprocessors 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium IV Architecture, Programming, and Interfacing, 7th Edition, Brey, Barry, B., PHI Inc, USA, 2006
The 8051 Microcontroller and Embedded Systems, 2nd Edition, Muhammad Ali Mazidi, Prentice Hall, 2006

ENEE606027
MICROPRECESSOR AND MICROCONTROLLER LABORATORY
1 credit
Learning Outcomes: This course teaches students on microprocessor and microcontroller technology. After this course, students are expected to be able to create Intel Microprocessor 16 bits and 32 bits and 8051 Microcontroller (8 bits) program using low level programming and be able to design embedded system based on microcontroller 8051.
Syllabus: Assembly programming for 8086/8088 Intel Microprocessor, Assembly Programming and Micro Controller Interface on LED, Switch, LCD, Keypad, Assembly Programming and Stepper Motor Interface. Mid-Term Examination Project: Assembly Program Development for Micro Processor 8086/8088. Final Examination Project: Embedded System Development for Micro Processor 8051.
Prerequisites: Digital Sequence and Laboratory, Basic Computer and Programming
Textbook:
Digital Laboratory, "Microprocessor and Microcontroller Laboratory Modules"
The Intel Microprocessors 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium IV Architecture, Programming and Interfacing, 7th Edition, Brey, Barry, B., PHI Inc, USA, 2006
The 8051 Microcontroller and Embedded Systems, 2nd Edition, Muhammad Ali Mazidi, Prentice Hall, 2006

BIOMEDICAL ENGINEERING

ENEE607031
ENGINEERING AND ENTREPRENEURSHIP
2 credits
Learning Outcomes: In this course, students studied the basic concept of management and marketing project specifically on information technology field. Upon completion from this course, students are expected to be able to create outline concept of IT product marketing, IT organization based on business concept, explain the concept of accounting and financial management in an IT company, and able to conduct an analysis on IT project. Students are also expected to be able to explain the entrepreneurship concept, marketing, and risk analysis in an IT project.
Syllabus: Introduction to marketing, Business organization, Accounting management, Business Finance, Business Analysis for new project proposal, Introduction to Entrepreneurship concept, Marketing risk analysis.
Prerequisites: None
Textbook: None (Lecture presented by professionals in the field of Information Technology.

FACULTY OF ENGINEERING

ELECTIVES COURSES

ENBE607028
INTERNSHIP
2 credits
Learning Outcomes: In this course, students will be expected to participate in an internship in industries, institutions, or laboratories related to biomedical engineering. Upon completion of this course, students are expected to be able to combine and implement engineering knowledge that they've learnt before with new knowledge given by their supervisors. Students are also expected to be able to show professional conduct such as team work, discipline, responsibility, initiative, and interest, leadership, and improvement prospect.
Syllabus: Not Available
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: Not Available

ENBE607029
SEMINAR
2 credits
Learning Outcomes: In this course, students are directed to implement their learnt knowledge into a full research supervised by a lecturer. After finishing this course, students are expected to be able to design and analyze a guided research, and able to write the findings of said research into a scientific writing in the form of seminar book. Students are also expected to showed their research in front of lecturers.
Syllabus: Not Available
Prerequisites: Earns more than 90 credits.
Textbook:
Technical Guidance for Universitas Indonesia Students' Final Project
IEEE Citation Reference
IEEE Transactions on Parallel and Distributed Systems, Vol. 21, No. 2, February 2010, "How To Write Research Articles in Computing and Engineering Disciplines"

ENBE608033
UNDERGRADUATE THESIS
4 credits
Learning Outcomes: In this course, students are directed to implement their learnt knowledge into a research supervised by a lecturer. Upon completion of this course, students are expected to create a research concept by implementing existing theory. Under the guidance of a lecturer, students are expected to integrate and implement their concept and write their research results into scientific writing in the form of undergraduate thesis book. Students are also expected to present and defend their concept and findings in front of a panel of examiners on thesis examination day.
Syllabus: Not Available
Prerequisites: Earns more than 120 credits
Textbook:
Technical Guidance for Universitas Indonesia Students' Final Project
IEEE Citation Reference
IEEE Transactions on Parallel and Distributed Systems, Vol. 21, No. 2, Feb. 2010, "How To Write Research Articles in Computing and Engineering Disciplines"

ELECTIVE COURSES FOR BIOMEDCIAL ENGINEERING

ENBE60703
BIOMEDIC SPECIAL TOPIC

UNDERGRADUATE PROGRAM

3 credits
Learning Outcomes: Able to follow the latest development of biomedical engineering, including technology, business, and regulation aspects.
Syllabus: The latest issues on technology, application, business, and regulation aspects in the health field.
Prerequisites: None
Textbook: None

ENBE608031
BIOMEDIC SPECIAL TOPIC 2
3 credits
Learning Outcomes: Able to follow the latest development of biomedical engineering including the technology, business, and regulation aspects.
Syllabus: The latest issues on technology, application, business, and regulation aspects in the health field.
Prerequisites: None
Textbook: None

ENBE608032
MEDICAL THERAPY TECHNOLOGY
3 credits
Learning Outcomes: Able to analyze cancer and tumor issues and their treatment solution with radiotherapy and thermal therapy methods.
Syllabus: Radiotherapy: Radioisotope physics principle, several cancer and tumor, radiotherapy method for benign and malignant cancer. Thermal Therapy: RF Ablation and Microwave Coagulation, Hyperthermia Method, Ultrasound Thermal Therapy.
Prerequisites: None
Textbook:
Peter Hoskin, "Radiotherapy in Practice - Radioisotope Therapy," Oxford University Press, 2007.
E.G. Moros, Physics of Thermal Therapy - Fundamentals and Clinical Applications, CRC Press, 2012.

BIOMEDICAL ENGINEERING

FACULTY OF ENGINEERING

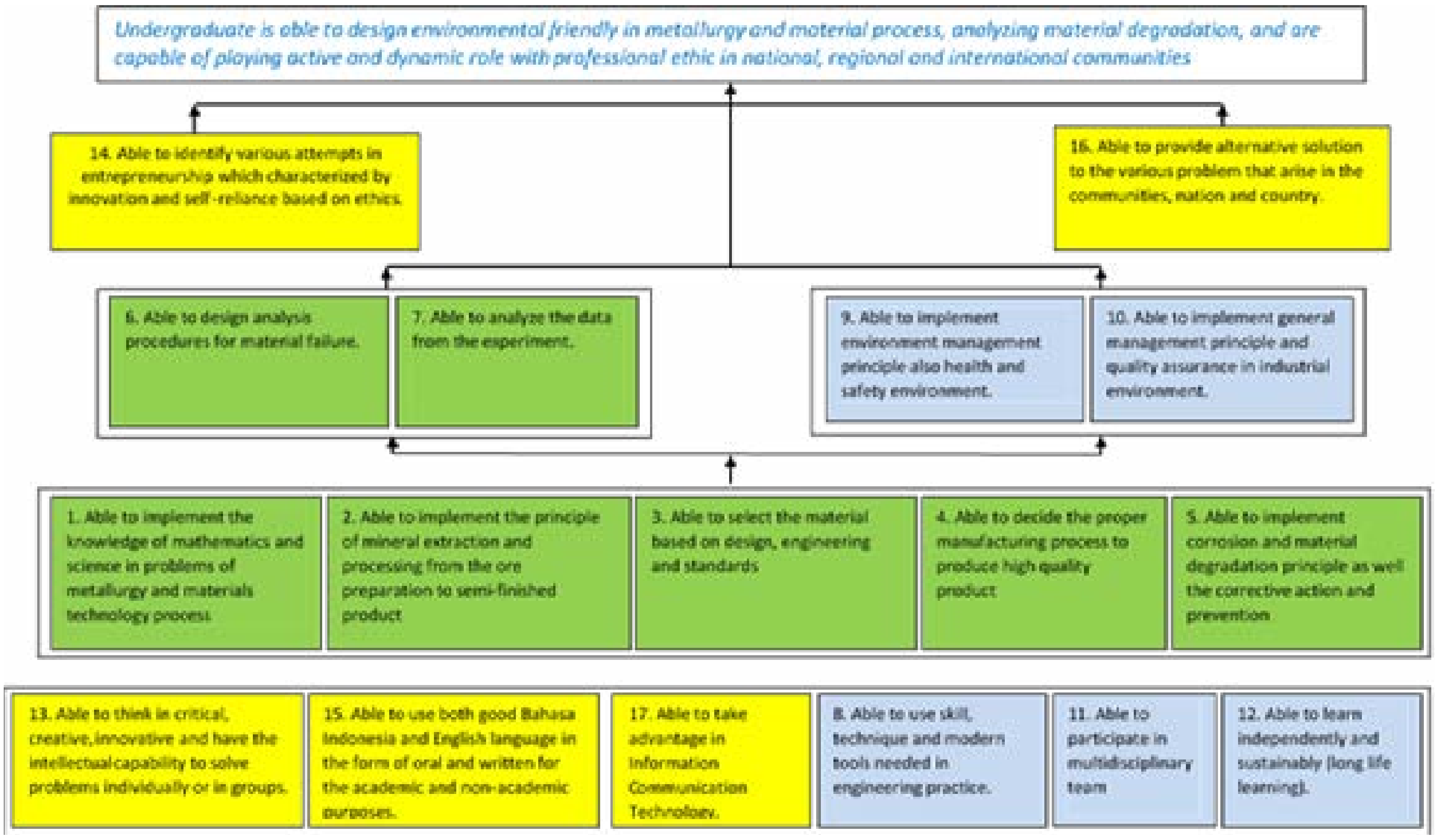
4.7. UNDERGRADUATE PROGRAM IN METALLURGY & MATERIALS ENGINEERING

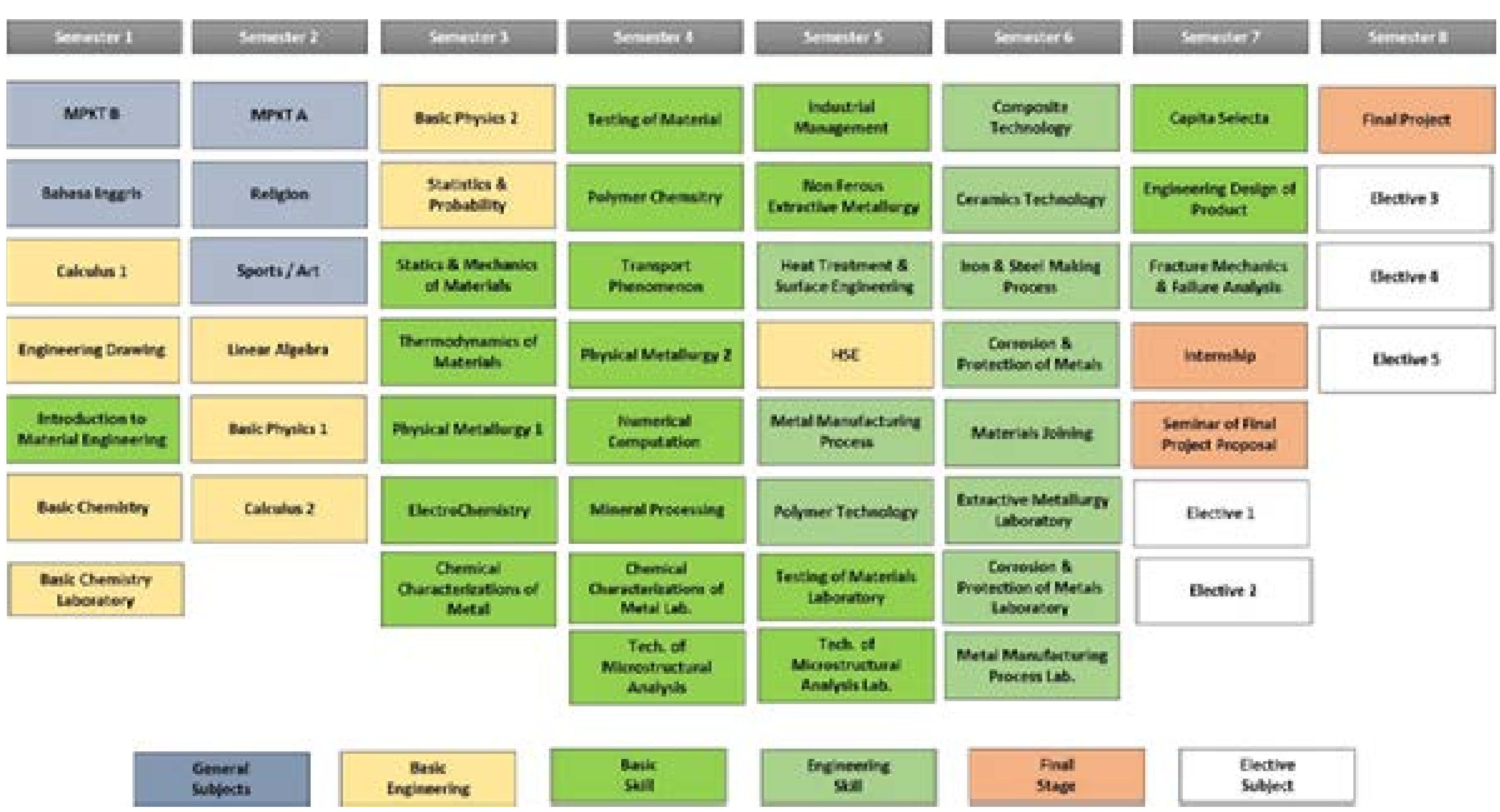
Program Specification

1	**Awarding Institution**		Universitas Indonesia Double degree : Universitas Indonesia & partner universities
2	**Teaching Institution**		Universitas Indonesia Double degree : Universitas Indonesia & partner universities
3	**Programme Title**		Undergraduate Program in Metallurgy and Materials Engineering
4	**Class**		Regular, Parallel, International
5	**Final Award**		Sarjana Teknik (S.T) Double Degree : Sarjana Teknik (S.T) and Bachelor of Engineering (B.Eng)
6	**Accreditation / Recognition**		BAN-PT : “A” Grade AUN-QA : Accredited
7	**Language(s) of Instruction**		Bahasa Indonesia and English
8	**Study Scheme (Full Time / Part Time)**		Full Time
9	**Entry Requirements**		High school graduate/equivalent, or Vocational/ Polytechnics graduate
10	**Study Duration**		Programmed for 4 Years
	Type of Semester	Number of semester	Number of weeks /semester
	Regular	8	17
	Short (optional)	3	8
11	**Graduate Profiles:** Undergraduate is able to design environmental friendly in metallurgy and material process, analyzing material degradation, and are capable of playing active and dynamic role with professional ethic in national, regional and international communities		
12	**Expected Learning Outcomes :** 1. Able to implement the knowledge of mathematic and science in problems of metallurgy and materials technology process 2. Able to implement the principle of mineral extraction and processing from the ore preparation to semi-finished product 3. Able to select the material based on design, engineering and standards 4. Able to decide the proper manufacturing process to produce high quality product 5. Able to implement corrosion and material degradation principle as well the corrective action and prevention 6. Able to design analysis procedures for material failure. 7. Able to analyze the data from the experiment. 8. Able to use skill, technique and modern tools needed in engineering practice. 9. Able to implement environment management principle also health and safety environment. 10. Able to implement general management principle and quality assurance in industrial environment. 11. Able to participate in multidisciplinary team 12. Able to learn independently and sustainably (long life learning). 13. Able to think in critical, creative, innovative and have the intellectual capability to solve problems individually or in groups.		

12	14. Able to identify various attempts in entrepreneurship which characterized by innovation and self-reliance based on ethics. 15. Able to use both good bahasa Indonesia and English language in the form of oral and written for the academic and non academic purposes. 16. Able to provide alternative solution to the various problem that arise in the communities, nation and country. 17. Able to take advantage in Information Communication Technology.		
13	**Classification of Subjects**		
No	Classification	Credit Hours (SKS)	Percentage
i	Basic University Courses	20	14 %
ii	Basic Engineering Courses	22	15 %
iii	Compulsory Courses	85	59 %
iv	Elective Courses	10	7 %
v	Internship, Seminar, Thesis, Projects	7	5 %
	Total	144	100 %
14	**Total Credit to Graduate**		**144 SKS**

Employment Prospects
Bachelor of Metallurgy and Materials Engineering graduates can work in various sectors, both private and government, like industry, automotive, manufacturing, heavy equipment, mining, material consultant, oil and gas, research and development institutions, academia, and others both within and abroad.





UNDERGRADUATE PROGRAM
METALLURGY & MATERIALS ENGINEERING

COURSE STRUCTURE UNDERGRADUATE PROGRAM METALLURGICAL AND MATERIALS ENGINEERING

CODE	SUBJECT	Credit
	1st Semester	
UIGE600002	Integrated Character Building B	6
UIGE600003	English	3
ENGE 6 0 0001	Calculus 1	3
ENGE 6 0 0009	Basic Chemistry	2
ENMT 6 0 1 001	Engineering Drawing	2
ENMT 6 0 1 002	Introduction to Engineering Materials	2
ENMT 6 0 1 003	Basic Chemistry Lab.	1
	Sub Total	**19**
	2nd Semester	
UIGE600002	Integrated Character Building A	6
UIGE600010-15	Religion	2
UIGE600020 - 48	Sport / Art	1
ENGE 6 0 0004	Linear Algebra	4
ENGE 6 0 0002	Calculus 2	3
ENGE 6 0 0005	Physics - Mechanics and Heat	3
ENGE 6 0 0006	Physics - Mechanics and Heat Laboratory	1
	Sub Total	**20**
	3rd Semester	
ENGE 6 0 0007	Physics - Electricity, MWO	3
ENGE 6 0 0008	Physics - Electricity, MWO Laboratory	1
ENGE 6 0 0010	Statistic and Probability	2
ENMT 6 0 3 004	Electrochemistry	3
ENMT 6 0 3 005	Chemical Characterization of Materials	2
ENMT 6 0 3 006	Physical Metallurgy 1	4
ENMT 6 0 3 007	Static & Mechanic of Materials	3
ENMT 6 0 3 008	Thermodynamics of Materials	3
	Sub Total	**21**
	4th Semester	
ENMT 6 0 4 009	Technique of Microstructural Analysis	2
ENMT 6 0 4 010	Polymer Chemistry	4
ENMT 6 0 4 011	Numerical Computation	2
ENMT 6 0 4 012	Physical Metallurgy 2	3
ENMT 6 0 4 013	Mineral Processing	4
ENMT 6 0 4 014	Testing of Materials	2
ENMT 6 0 4 015	Transport Phenomena	3
ENMT 6 0 4 016	Chemical Characterization of Materials Laboratory	1
	Sub Total	**21**

UNDERGRADUATE PROGRAM

	5th Semester	
ENGE 6 0 0012	HSE Protection	2
ENMT 6 0 5 017	Industrial Management	2
ENMT 6 0 5 018	Non Ferrous Extractive Metallurgy	3
ENMT 6 0 5 019	Heat Treatment & Surface Eng.	3
ENMT 6 0 5 020	Metal Manufacturing Process	4
ENMT 6 0 5 021	Polymer Technology	3
ENMT 6 0 5 022	Technique of Microstructural Analysis Lab	1
ENMT 6 0 5 023	Testing of Materials Lab.	1
	Sub Total	**19**
	6th Semester	
ENMT 6 0 6 024	Corrosion & Protection of Metals	3
ENMT 6 0 6 025	Materials Joining	3
ENMT 6 0 6 026	Iron & Steel Making Process	2
ENMT 6 0 6 027	Ceramic Technology	3
ENMT 6 0 6 028	Composite Technology	3
ENMT 6 0 6 029	Corrosion & Protect of Metals Laboratory	1
ENMT 6 0 6 030	Extractive Metallurgy Lab.	1
ENMT 6 0 6 031	Metal Manufacturing Process Lab	2
	Sub Total	**18**
	7th Semester	
ENMT 6 0 7 032	Engineering Design of Products	3
ENMT 6 0 7 033	Capita Selecta	2
ENMT 6 0 7 034	Fracture Mech & Failure Analysis	4
ENMT 6 0 7 035	Internship	2
ENMT 6 0 7 036	Seminar	1
	Elective 1	2
	Elective 2	2
	Sub Total	**16**
	8th Semester	
ENMT 6 0 7 037	Final Project/Thesis	4
	Elective 3	2
	Elective 4	2
	Elective 5	2
	Sub Total	**10**
	TOTAL	**144**

Resume

University Subjects	18
Faculty Subjects	24
Compulsory Subjects	92
Total	134
Elective Subjects	10
Total Credits	144

METALLURGY & MATERIALS ENGINEERING

ELECTIVES

	ELECTIVES ODD SEMESTER	
CODE	SUBJECT	Credit
ENMT 6 0 7 038	Polymer Additives	2
ENMT 6 0 7 039	Special Steels & Superalloys	2
ENMT 6 0 7 040	Biomaterial	2
ENMT 6 0 7 041	Metallurgical Plant Design	2
ENMT 6 0 7 042	High Temperature Corrosion	2
ENMT 6 0 7 043	Electronic Materials	2
ENMT 6 0 7 044	Research Methodology	2
ENMT 6 0 7 045	Plastic Processing	2
ENMT 6 0 7 046	Refractory Materials	2
ENMT 6 0 7 047	Quality Management Systems	2
	ELECTIVES EVEN SEMESTER	
ENMT 6 0 8 948	Analysis of Deformation	2
ENMT 6 0 8 949	Industrial Ecology	2
ENMT 6 0 8 950	Concrete Corrosion	2
ENMT 6 0 8 951	Energy Materials	2
ENMT 6 0 8 952	Advanced Extractive Metallurgy	2
ENMT 6 0 8 953	Industrial Mechanic Equipment	2
ENMT 6 0 8 954	Advanced Surface Engineering	2
ENMT 6 0 8 955	Material Standardization	2
ENMT 6 0 8 956	Polymer Recycling Technology	2
ENMT 6 0 8 957	Rubber Technology	2
ENMT 6 0 8 958	Nanotechnology	2

COURSE STRUCTURE INTERNATIONAL UNDERGRADUATE METALLURGICAL & MATERIALS ENGINEERING

KODE	SUBJECT	SKS
	1st Semester	
ENGE 6 1 0001	Calculus 1	3
UIGE610002	Academic Writing	3
ENGE 6 1 0005	Physics (Mechanics and Thermal)	3
ENGE 6 1 0006	Physics (Mechanics and Thermal) Laboratory	1
ENGE 6 1 0009	Basic Chemistry	2
ENMT 6 1 1 001	Engineering Drawing	2
ENMT 6 1 1 002	Introduction to Engineering Materials	2
ENMT 6 1 1 003	Thermodynamics of Materials	3
ENMT 6 1 1 004	Basic Chemistry Laboratory	1
	Sub Total	20
	2nd Semester	
ENGE 6 1 0004	Linear Algebra	4
ENGE 6 1 0002	Calculus 2	3
ENGE 6 1 0007	Physics (Electric, Magnet,Wave & Optic)	3
ENGE 6 1 0008	Physics (Electric, Magnet,Wave & Optic)Laboratory	1
ENGE 6 1 0010	Statistics & Probability	2
ENMT 6 1 2 005	Polymer Chemistry	4
ENMT 6 1 2 006	Transport Phenomena	3
	Sub Total	20
	3rd Semester	
ENGE 6 1 0012	Health, Safety & Environment	2
ENMT 6 1 3 007	Chemical Characterization of Materials	2
ENMT 6 1 3 008	Electrochemistry	3
ENMT 6 1 3 009	Heat Treatment & Surface Engineering	3
ENMT 6 1 3 010	Physical Metallurgy 1	4
ENMT 6 1 3 011	Polymer Technology	3
ENMT 6 1 3 012	Static & Mechanic of Materials	3
	Sub Total	20
	4th Semester	
ENMT 6 1 4 013	Corrosion & Protection of Metals	3
ENMT 6 1 4 014	Iron & Steel Making Process	2
ENMT 6 1 4 015	Mineral Processing	4
ENMT 6 1 4 016	Numerical Computation	2
ENMT 6 1 4 017	Physical Metallurgy 2	3
ENMT 6 1 4 018	Technique of Microstructural Analysis	2
ENMT 6 1 4 019	Testing of Materials	2
ENMT 6 1 4 020	Chemical Characterization of Materials Laboratory	1
ENMT 6 1 4 021	**Corrosion & Protection of Metals Laboratory**	1
	Sub Total	20
	5th Semester	
UIGE610004	Integrated Character Building Subject B	6
ENMT 6 1 5 022	Industrial Management	2
ENMT 6 1 5 023	Metal Manufacturing Process	4
ENMT 6 1 5 024	Non Ferrous Extractive Metallurgy	3
ENMT 6 1 5 025	Technique of Microstructural Analysis Laboratory	1
ENMT 6 1 5 026	Testing of Materials Laboratory	1
	Sub Total	17
	6th Semester	
UIGE610001	Integrated Character Building Subject A	6
UIGE610005 - 9	Religious Studies	2
UIGE610003	Sport & Art	1
ENMT 6 1 6 027	Ceramic Technology	3
ENMT 6 1 6 028	Composite Technology	3
ENMT 6 1 6 029	Materials Joining	3

ENMT 6 1 6 030	Extractive Metallurgy Laboratory	1
ENMT 6 1 6 031	Metal Manufacturing Process Laboratory	2
	Sub Total	**21**
	7th Semester	
ENMT 6 1 7 032	Capita Selecta	2
ENMT 6 1 7 033	Engineering Design of Products	3
ENMT 6 1 7 034	Fracture Mechanics & Failure Analysis	4
ENMT 6 1 0 035	Internship	2
ENMT 6 1 0 036	Seminar of Final Project Proposal	1
	Elective 1	2
	Elective 2	2
	Sub Total	**16**
	8th Semester	
ENMT 6 1 0 037	Final Project/Thesis	4
	Elective 3	2
	Elective 4	2
	Elective 5	2
	Sub Total	**10**
	TOTAL	**144**

Electives

	ELECTIVES ODD SEMESTER	
CODE	**SUBJECT**	**Credit**
ENMT 6 0 7 938	Polymer Additives	2
ENMT 6 0 7 939	Special Steels & Super Alloys	2
ENMT 6 0 7 940	Biomaterial	2
ENMT 6 0 7 941	Metallurgical Plant Design	2
ENMT 6 0 7 942	High Temperature Corrosion	2
ENMT 6 0 7 943	Electronic Materials	2
ENMT 6 0 7 944	Research Methodology	2
ENMT 6 0 7 945	Plastic Processing	2
ENMT 6 0 7 946	Refractory Materials	2
ENMT 6 0 7 947	Quality Management Systems	2
	ELECTIVES EVEN SEMESTER	
ENMT 6 0 8 948	Analysis of Deformation	2
ENMT 6 0 8 949	Industrial Ecology	2
ENMT 6 0 8 950	Concrete Corrosion	2
ENMT 6 0 8 951	Energy Materials	2
ENMT 6 0 8 952	Advanced Extractive Metallurgy	2
ENMT 6 0 8 953	Industrial Mechanic Equipment	2
ENMT 6 0 8 954	Advanced Surface Engineering	2
ENMT 6 0 8 955	Material Standardization	2
ENMT 6 0 8 956	Polymer Recycling Technology	2
ENMT 6 0 8 957	Rubber Technology	2
ENMT 6 0 8 958	Nano Technology	2

SYLLABUS OF UNIVERSITY SUBJECTS

INTEGRATED CHARACTER BUILDING A
UIGE600001/UIGE610001
6 sks
Syllabus : Integrated Character Building A facilitates students to understand the basics of character formation and master the basics of cognitive power that is logic. Furthermore, to apply cognitive powers in generating good behaviors which are useful to themselves and society. The establishment of ethical behaviors based on ethics is also facilitated. Students are able to develop the basic strength of character and to know themselves as a human being, both as individuals and as part of a group so that they can develop themselves well enough. In a group, the students need to have skills that are needed to maintain an effective relationship in order to improve the quality of human life. Particularly as a citizen of Indonesia, students need to understand the nature of citizenship and basic philosophy of Pancasila in order to act and behave in accordance with the character of the Indonesian nation.
Core Competencies :
1. Students are able to analyze problems in depth individually, comprehensively, logicaly and criticaly, and generate solutions using the logical and ethical principles and rules of logic and ethics
2. Students are capable of analyzing the problem individually, thoroughly and deeply about the human being as an individual or as part of group
3. Students are individually able to understand, make critical reasoning and to build an open and critical mind to the problem of nationhood, statehood and citizenship in this dynamic world situation
4. Students are able to create and display a work that depicts the character in accordance with the principles of Pancasila

Learning Method : interactive lecture, Experiential Learning, Collaborative Learning, Problem Based Learning, Project-Based Assignment
Prerequisites : OBM (New Student Orientation)

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))

INTEGRATED CHARACTER BUILDING B
UIGE600002/UIGE610004
6 sks
Syllabus : Integrated Character Building B facilitates students to practice identifying, analyzing, and resolving problems of nature and the environment by making use of integrative and quantitative information. This lecture aims to prepare the future generation who care about nature issues through the balanced development of hard skills and soft skills and have the skills of ICT (Information and Communication Technology).
Core Competencies:
1. Students have an ethic, moral, personality and good character in completing the task at hand;
2. Students role as citizens who take pride and love of the homeland and support the continuity of life;
3. Students are able to work together and have a high sensitivity and awareness to the community and the environment;
4. Students are able to think logically, critically and creatively;
5. Students are able to use mathematics to solve problems quantitatively;
6. Students are able to use information and communication technology (ICT) for development;
7. Students are able to analyze the system of nature integratively and comprehensively;
8. Students are able to act as wise managers of nature to build and maintain the preservation of nature for a better and sustainable life.

Learning Method : Blended e-Learning, Collaborative Learning (CL), Problem Based Learning (PBL) and Group Discussion (GD)
Prerequisites : OBM (New Student Orientation)
Textbook : Digital Form can be downloaded from Scele

ISLAMIC STUDY
UIGE600010/UIGE610005
2 sks
General instructional objectives : The cultivation of students who have concern for social, national 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 practice 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)

UNDERGRADUATE PROGRAM

CATHOLIC STUDY
UIGE600011/UIGE610006
2 sks
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 STUDY
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 STUDY
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 STUDY
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

METALLURGY & MATERIALS ENGINEERING

(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
2 sks

ART
UIGE600020-30
1 sks
The option of subjects that can be choosen :
Appreciation of Film (UIGE600020), Batik (UIGE600021), Photography (UIGE600022), Calligraphy (UIGE600023), Javanese Karawitan (UIGE600024), Balinese Dance and Karawitan (UIGE600025), Comic (UIGE600026), Painting (UIGE600027), Music and Vocal (UIGE600028), Theater (UIGE600029), Wayang (UIGE600030)

SPORT
UIGE600040-48
1 sks
The option of subjects that can be choosen :
Basketball (UIGE600040), Volley Ball (UIGE600041), Badminton (UIGE600042), Futsal (UIGE600043), Hockey (UIGE600044), Football (UIGE600045), Softball (UIGE600046), Tennis (UIGE600047), Table Tennis (UIGE600048)

SYLLABUS OF BASIC ENGINEERING SUBJECTS

CALCULUS 1
ENGE600001/ENGE610001
3 sks
Syllabus : This subject gives the opportunity for students to understand the basic concept of calculus and to be able to solve applied calculus problems. Students are also given the opportunity to understand basic concepts the functions of one variable, derivatives and integral functions of one variable, and its application.

CALCULUS 2
ENGE600002/ENGE610002
3 sks
Syllabus : This subject gives the opportunity for students to understand the basic concept of calculus and to be able to solve applied calculus problems. Students are also given the opportunity to understand the basic concept the function of two variables, or variables, total derivative and integral of the function of two or more variables and application. In addition, students can understand the basic concepts of sequence and series.

CALCULUS
ENGE600003/ENGE610003
4 sks
Syllabus : This subject gives the opportunity for students to understand the basic concept of calculus and to be able to solve applied calculus problems. Students are also given the opportunity to understand the basic concept the function of two variables, the total derivative of the function of two or more variables and its application. Students are also expected to understand the basic concept of sequence and series and the basic concept of vector and analytical geometry.

LINEAR ALGEBRA

ENGE600004/ENGE610004
4 sks
Syllabus : This subject gives the opportunity for students to master the basic techniques of Linear Algebra and gain knowledge on how to implement said techniques in solving System of linear equationss, determining the bases and dimension of vector space, as well as calculating eigen values and eigen vectors. This subject also gives students the opportunity to work with other objects, especially vectors and matrices.

PHYSICS (MECHANICS AND THERMAL)
ENGE600005/ENGE610005
3 sks
Syllabus : Physics (Mechanics and Thermal) subject includes the topics of mechanics and thermodynamics. Calculus is use as a mathematic helping tool in the learning process. Students are given the opportunity to learn how to unite their understanding of the basic concept of the analytical capability, their numeracy in learning mechanics and thermodynamics. During the course of this subject, students are not only aim to increase the students' knowledge of the basic physics concepts but also to increase their capability in using information technology and computer and to train their skills, such as: independent and group work and their communication skill.
Students will also be train on how to explain and analyse the nature phenomenon and the result of human engineering exist in their everyday lives by using the basic physics concept and applied them in their daily lives. Students are also taught to develop their synthesis ability and evaluating both quantitative and qualitative natural phenomenon and the result of human engineering in their surrounding environment by using basic physics concept. This subject will give students the opportunity to develop their ability to develop their presentation ability analyse the nature phenomenon and the result of human engineering from the mathematics and natural science point of view integrative and comprehensively.

PHYSICS (MECHANICS AND THERMAL) LABORATORY
ENGE600006/ENGE610006
1 sks
Syllabus : Practical of Mechanics: Measurement, Moment of inertia, Gravity acceleration, Fluid density, Scratch coefficient, Collision, Swing torque, Viscosity of water, Young's modulus, Viscosity of Newtonian fluid, Fluids surface tension, Oscillation, Practical of Heat: Coefficient of linear expansion, Heat conductivity, Thermocouple calibration, Calorimeter, Joule Constant, Laplace Constant, Heat Collector, Determining of air Cp/Cv, Expansion of fluids and water anomaly.
Notes: For Architecture and Interior Architecture Program, practical is not mandatory.

METALLURGY & MATERIALS ENGINEERING

PHYSICS (ELECTRICITY, MWO)
ENGE600007/ENGE610007
3 sks
Syllabus : Physics (Electricity, MWO) subject includes the topics of electricity, magnet, wave, and optics. Calculus is use as a mathematic helping tool in the learning process. Students are given the opportunity to learn how to unite their understanding of the basic concept of the analytical capability, their numeracy in learning mechanics and thermodynamics. During the course of this subject, students are not only aim to increase the students' knowledge of the basic physics concepts but also to increase their capability in using information technology and computer and to train their soft skills, such as: independent and group work and their communication skill. Students will also be train on how to explain and analyze the nature phenomenon and the result of human engineering exist in their everyday lives by using the basic physics concept and applied them in their daily lives. Students are also taught to develop their synthesis ability and evaluating both quantitative and qualitative natural phenomenon and the result of human engineering in their surrounding environment by using basic physics concept.

PHYSICS (ELECTRICITY, MWO) LABORATORY
ENGE600008/ENGE610008
1 sks
Syllabus : Practical of Electricity: Electrolysis, Wheatstone bridge, Kirchhoff law, Earth's magnetic field, Temperature coefficient, Characteristic of series RLC circuit, Ohm law, Transformer. Practical of Optics: Polarimeter, Lens, Photometry, Prisms bias index, Spectrometer, Diffraction grid, Newton's ring.

BASIC CHEMISTRY
ENGE600009/ENGE610009
2 sks
Syllabus : As an engineer, you must have understanding on the chemistry that provides not only the basis for much of what goes on in our world but also that it is a vital, continually developing science. In this study the students will learn many subjects such as matter and measurement; atoms, molecules, and ions; stoichiometry; aqueous reactions; thermochemistry; properties of solutions; chemical kinetics; chemical equilibrium; and electrochemistry.
Learning activities will be conducted through various method, which consists of: problem based learning (PBL), interactive lecture, question-based learning, discussion, demonstration and unguided structured assignments. Assessment will be made continuously through a set of exercises, group discussion, mid semester exam and final exam.

STATISTIC AND PROBABILITY
ENGE600010/ENGE610010
2 sks
Syllabus : Statistics and probability has been known as applied mathematics which is widely used in collecting, organizing, presenting, interpreting and analyzing data to support valid conclusions. Furthermore, these conclusions will be used as recommendation in decision making. The course of Statistics and Probability is intended to give a basic ability for students to handle quantitative data and information. There are two stages that are delivered which is descriptive and inductive/inference stages. Descriptive stage includes collecting, organizing, and presenting the data in a scientific manner. Then, inductive/inference stage includes the process of estimating and drawing conclusion based on available data and relations between variables. Hence, students are expected to apply their knowledge of statistics in conducting experiments in laboratory works/assignments as well as research studies in their final projects.

ENGINEERING ECONOMICS
ENGE600011/ENGE610011
3 sks
Syllabus : This course introduces students to the basic of engineering economy. It covers the time value of money (TVOM) and interest rate; tools for evaluating project alternatives for both non discounted and discounted methods, for instance present worth analysis, annual worth analysis, future worth analysis, rate of return (ROR) analysis and benefit/cost analysis; and choosing the best alternative, break even analysis, and effect of depreciation and after tax analysis and sensitivity analysis, and replacement analysis.
Learning activities will be conducted through various methods, which consist of: interactive lectures, question-based learning, discussion, and structure assignments. Assessment will be made thoroughly through sets of exercises/quizzes, group discussion, midterm and final exam. To expose students on the latest utilization of engineering economy and train them how to use it, a project will be assigned. As an integral part of course, computer utilization such as Microsoft Excel will be demonstrated and discussed on the class.

HEALTH, SAFETY AND ENVIRONMENTAL PROTECTION
ENGE600012/ENGE610012
2 sks
Syllabus : The teaching of Safety, Health and Environmental (SHE) protection to undergraduates studying engineering courses is an important part of the education of future engineers at all levels. It is the generally expressed view amongst practitioners in industry, business and other organisations that all engineers need to be equipped to appreciate, understand and implement the requirements of SHE management and practice to meet the working needs of industry and of their company (or other organisation). Whilst the level of risk and degree of control is dependant on the industry sector concerned the basic principles do not change. In addition, according to code of ethics of engineers, engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties.
The module covers the regulation framework and standards, risk perception, assessment, and management and detail discussion on physical, chemical and process hazards, and related engineering and management controls. Maintenance of safety conditions, personal protective equipments, audit, incident and emergency planning are discussed in accordance to measures for improving students awareness to their daily activities within the campus premises and local environment.
Learning activities will be conducted through various methods, which consist of: interactive lecture, question-based learning, discussion, demonstration and unguided structured assignments. Assessment will be made continuously through a set of exercises, group discussion, mid semester exam and final exam

Curriculum of 2016 – Subjects Syllabus
Bachelor Degree – Dept. of Metallurgy & Materials Engineering

ENMT 601001 - ENGINEERING DRAWING – (2 Credit Points)
Illustration: Function and benefit of Engineering Drawing; SAP; Measurement and Evaluation; Introduction to drawing equipment; Basic definition of geometric, paper format, draw regulation, line, fild, line confiuration, basic geometric form; Visualization geometric: Skew projection and isometric, function and line types, confiuration 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.
Prerequisite: -

ENMT 601002 - INTRODUCTION TO ENGINEERING MATERIALS – (2 Credit Points)
(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: -

ENMT 601003 - BASIC CHEMISTRY LABORATORY – (1 Credit Point)
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
Prerequisite: -

ENMT 603004 - ELECTRO-CHEMISTRY – (3 Credit Points)
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: -

ENMT 603005 - CHEMICAL CHARACTERIZATION OF MATERIAL – (2 Credit Points)
Review of structure and physiochemical characteristics of materials, concept of material analysis (qualitative and quantitative), principal of analysis instrument from spectroscopy method (UV/VIS, FTIR, XRF, Spark Emission) and thermal method (TGA, DSC/DTA, MFI and Vicat), material characterization strategy.
Prerequisite: -

ENMT 603006 - PHYSICAL METALLURGY 1 – (4 Credit Points)
(1) Definition of crystal; (2) Crystal lattice(3) Unit cell; (4) Bravais lattice; (5) Miller index for planes and direction; (6) Stereographic projection; (7) Crystal symmetry; (8) Formation of crystal; (9) Identification of crystal; (10) Crystal defects: point defects, line defects (dislocations), edge dislocations, screw dislocations, burgers vector, movement of dislocations, energy of dislocation, dislocations in FCC, BCC and HCP structures, planar defects; (11) Fatigue and Fracture of Materials; (12) Creep of Materials; (13) Strengthening Mechanism: strain (work) hardening, grain boundary strengthening, solid solution strengthening, precipitation (two-phase) strengthening, steel alloys strengthening, composite strengthening, study case in materials strengthening.
Prerequisite: -

ENMT 603007 - STATIC & MECHANIC OF MATERIALS – (3 Credit Points)
General principle of mechanics, Vector and forces, Equilibrium points, Resultant of forces, Structure analysis, Center of gravity and centroid, Moment inertia, Internal forces, Friction. The concept of stress strain, Relation of stress and strain in axial loading, Twisting, Buckling, Transversals loading, Stress analysis, Design of shaft and beam, Beam deflection, Structural joints, Column and thick cylinder, Energy method.
Prerequisite: -

ENMT 603008 - THERMODYNAMICS OF MATERIALS – (3 Credit Points)
Definition of thermodynamics, first, second, and third law of thermodynamics, statistical interpretation of entropy, auxiliary functions, heat capacity, enthalpy and entropy, phase equilibrium in a component, gas and solution behavior, free energy, binary system composition, reaction of pure condensation phase and gas phase, equilibrium reaction of a system in a solution component
Prerequisite: -

ENMT 604009 - TECH. OF MICROSTRUCTURAL ANALYSIS – (2 Credit Points)
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.
Prerequisite: Physical Metallurgy 1

ENMT 604010 - POLYMER CHEMISTRY – (4 Credit Points)
Fundamentals of organic chemistry (bonding atom and molecule, polar molecules, free radicals, the nomenclature of organic compounds, isomer, conjugation and resonance). Reaction types of organic compounds, addition reactions, nucleophilic and electrophilic substitution, elimination, rearrangement, and radical reaction mechanism. Basic Properties of Polymer Chemistry
Prerequisite: -

ENMT 604011 - NUMERICAL COMPUTATION – (2 Credit Points)
Introduction to models, types of models, basics of Matlab, array in Matlab, if and switch selection, loop in Matlab, function and m-file in Matlab, linear equation, Taylor expansion method, Euler, differential equation, basic of solid works, solid modeling, basics of simulink, first and second order simulink
Prerequisite: -

ENMT 604012 - PHYSICAL METALLURGY 2 – (3 Credit Points)
(1) Concept of Equilibrium: single component system, binary component system, the phase rule, binary phase diagrams; (2) Fe-Fe3C Phase Diagram; (3) Ternary Equilibrium: ternary system representation, ternary system containing 2 phase, ternary system containing 3 phase; (4) Diffusion in Materials: atomic mechanism of diffusion, interstitial diffusion, substitutional diffusion; (5) Crystal Interfaces and Microstructure: interfacial free energy, grain boundary, interphase interfaces in solids, interface migration; (6) Solidification: nucleation in pure metals, growth of a pure solid, solidification of alloy, solidification of ingots and castings, solidification of fusion welds, rapid solidification; (7) Diffusional Transformation in Solids: homogeneous and heterogeneous nucleation in solids, precipitate growth, transformation kinetics, eutectoid transformation, ordering transformation; (8) Diffusionless Transformation in Solids: theories of martensite nucleation, martensite growth, tempering of ferrous martensite, martensite transformation in nonferrous metals, case study in diffusionless transformation
Prerequisite: Thermodynamics of Materials

ENMT 604013 - MINERAL PROCESSING – (4 Credit Points)
Understanding mineralogy, classification 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 process, grinding process, the classification 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: Physical Metallurgy 1

ENMT 604014 - TESTING OF MATERIALS – (2 Credit Points)
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)
Prerequisite: Physical Metallurgy 1

ENMT 604015 - TRANSPORT PHENOMENON – (3 Credit Points)
Mass transfer, Fluid flow concept, Laminar flow, momentum conservation, Turbulent flow, Enthalpy & heat transfer, Solid & liquid diffusion mass transport
Prerequisite: Thermodynamics of Materials

ENMT 604016 - CHEMICAL CHARACTERIZATION OF MATERIAL LABORATORY – (1 Credit Point)
Quantitative analysis of organic and anorganic matter using titrimetry method
Prerequisite: Chemical Characterization of Material

ENMT 605017 - INDUSTRIAL MANAGEMENT – (2 Credit Points)
Introduction to industrial management, organization and management functions, theories and techniques of decision-making, management of production / operations, the strategic decisions of products and processes, location and layout, management and control of stocks (inventory), R & D, project management, QC and productivity, management production practices, marketing and industrial management, HR management, IT and manufacturing industry, manufacturing industry in Indonesia
Prerequisite: -

ENMT 605018 - NON-FERROUS EXTRACTIVE METALLURGY – (3 Credit Points)
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: Electro-chemistry, Mineral Processing

ENMT 605019 - HEAT TREATMENT & SURFACE ENGINEERING – (3 Credit Points)
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, various heat-treating furnace and its atmosphere, deviation in heat treatment process, special heat treatment, case study of heat treatment and surface engineering
Prerequisite: Physical Metallurgy 1

ENMT 605020 - METAL MANUFACTURING PROCESS – (4 Credit Points)
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 non-ferrous (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
Prerequisite: Physical Metallurgy 1

ENMT 605021 - POLYMER TECHNOLOGY – (3 Credit Points)
Relationship of structure and behaviour of polymer molecule, polimer material characteristics (thermal, chemical, mechanic, optic and electrical), fabrication process stages (formulation, continuous & discontinuous manufacturing, product finalization) on thermoplastic, thermosetting and rubber product, polimer raw material formulation, case study of polymer product in packaging, automotive, electronic and construction application
Prerequisite: Polymer Chemistry

ENMT 605022 - TECH. OF MICROSTRUCTURAL ANALYSIS LABORATORY – (1 Credit Point)
Metallographic sample preparation (techniques of cutting, grinding, polishing and etching), microstructural analysis techniques of metal (ferrous and non-ferrous) with an optical microscope
Prerequisite: Tech. of Microstructural Analysis

ENMT 605023 - TESTING OF MATERIALS LABORATORY – (1 Credit Points)
Tensile test, Compressive test, Micro and Macro Hardness test, Impact Test, Wear Test
Prerequisite: Testing of Materials

ENMT 606024 - CORROSION & PROTECTION OF METALS – (3 Credit Points)
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: Electro-Chemistry

ENMT 606025 - MATERIALS JOINING – (3 Credit Points)
Principles of various material joining and its classification, adhesive bonding, mechanical joining, methods of welding: fusion welding (electric arc), electrical resistance welding, pressure welding (solid state welding), other welding process (EBW, laser welding, thermit welding, underwater welding), soldering and brazing, design of joint and welding symbol, welding metallurgy: carbon steel, low alloy steel, stainless steel, concrete steel, non ferrous, WPS and welding standards and code, weld defect and its prevention, control of joint and its testing
Prerequisite: Physical Metallurgy 1, Testing of Materials

ENMT 606026 - IRON & STEEL MAKING PROCESS – (2 Credit Points)
Classification and the development of steel (iron ores, reductor, etc.) and their preparatory process, thermodynamics and kinetics of iron and steel making process, blast furnace reduction of iron ores, direct reduction (hylsa, midrex, rotary kiln SL-RN, rotary hearth), smelting reduction, desulfurization, deoxidation, dephosphorisation, degassing, steel making in EAF (Electric Arc Furnace) and BOF (Basic Oxygen Furnace), secondary metallurgy process, continuous casting, hot and cold rolling, special steel making
Prerequisite: Mineral Processing

ENMT 606027 - CERAMIC TECHNOLOGY – (3 Credit Points)
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 nature dielektris. 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: Physical Metallurgy 2

ENMT 606028 - COMPOSITE TECHNOLOGY – (3 Credit Points)
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 Technology

ENMT 606029 - CORROSION & PROTECTION OF METALS LABORATORY – (1 Credit Point)
Corrosion cells, corrosion potential measurement of selected metals, polarization of stainless steel, cathodic protection, surface treatment.
Prerequisite: -

ENMT 606030 - EXTRACTIVE METALLURGY LABORATORY – (1 Credit Point)
Metals extraction test and electrometallurgy (e.g. Electroplating, froth flotation)
Prerequisite: Non Ferrous Extractive Metallurgy

ENMT 606031 - METAL MANUFACTURING PROCESS LABORATORY – (2 Credit Points)
(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. (4) Solid silinder forging, (5) Sheet metal rolling, (6) Sheet metal forming which includes non-simulative testing (tensile testing for n and r value), and simulative testing (streching and deep-drawing, LDH and LDR)
Prerequisite: Metal Manufacturing Process

METALLURGY & MATERIALS ENGINEERING

ENMT 607032 - ENGINEERING DESIGN OF PRODUCT – (3 Credit Points)
Introduction to Engineering Design, total design activity, group dynamics and design management, problem identification and design specification, creativity and the conception of design, modeling, optimallisation, materials and process selection, design communication and presentation.
Prerequisite: Polymer Technology, Composite Technology, Ceramic Technology, Iron & Steel Making Process

ENMT 607033 - CAPITA SELECTA – (2 Credit Points)
Specific topics that have not been included in Subjects and supplied by external resource persons which is experienced in industry
Prerequisite: Metal Manufacturing Process, Corrosion & Protection of Metals

ENMT 607034 - FRACTURE MECHANICS & FAILURE ANALYSIS - (4 Credit Points)
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 behavior, residual stress, corrosion and environment, case study.
Prerequisite: Physical Metallurgy 1, Testing of Materials, Tech. of Microstructural Analysis, Corroson & Protection of Metals

ENMT 600035 - INTERNSHIP – (2 Credit Points)
Specify the job objectives in the proposal; Implement an internship at a site that has been approved and in accordance with its specifiity; Study and describe the process of technical work, quality control, project management, project specifications, engineering drawings and other aspects; Identify the problem related to the technical work, quality control, project management, project

specifiations, engineering drawings and other aspects; Conduct problems that occur at each stage of the project; Determine ways or solutions to overcome the problems associated with the project learned; Prepare a final report includes project description, existing problems and problem solving
Prerequisite: Student has obtained minimum of 100 credits

ENMT 600036 - SEMINAR OF FINAL PROJECT PROPOSAL – (1 Credit Points)
Final assignment writing guide including initial research, abstract writing guide, research methodology, type of references, discussion, also conclusion. To make scientific paper from existing final report which then be presented according to certain journal term or final assignment proposal presentation.
Prerequisite: Student has obtained minimum of 105 credits

ENMT 600037 - FINAL PROJECT – (4 Credit Points)
Implementation/application of various lectures taken by students on integration in a research to solve a problem in metallurgy and material engineering field. The research result is presented in a form of scientific report and presented in front of the judging lecturers.
Prerequisite: Student has obtained minimum of 125 credits

ELECTIVES

ENMT 607938 - POLYMER ADDITIVES – (2 Credit Points)
Strategic role of polymer compounding industries, additives type and functions, modification of polymer product according to market, mixing theory in polymer base material, polymer compounding fabrication process for thermoplastic and rubber, success evaluation for polymer compounding, dispersion test / observation and additives distribution in plastic pellet product
Prerequisite: Polymer Technology

ENMT 607939 - SPECIAL STEELS & SUPERALLOYS – (2 Credit Points)
Classification, alloying elements and microstructures of special steels and super alloys which include: stainless steels (ferritic, austenitic, duplex, martensitic, and precipitation hardened), heat resistant steels, wear resistant steels, tool steels, Ni and Co based steels.
Prerequisite: Iron & Steel Making Process

ENMT 607940 - BIOMATERIALS – (2 Credit Points)
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: Statics & Mechanics of Materials, Corrosion & Protection of Metals

ENMT 907941 - METALLURGICAL PLANT DESIGN – (2 Credit Points)
Risk-based approach to plan design, process economic and selection, business case, site selection, project development, managing technology risk, costum designed equipment, sustainability in plant design, design for safety, plant layout and logistics, project implementation
Prerequisite: Non Ferrous Extractive Metallurgy, Iron & Steel Making Process

ENMT 607942 - HIGH TEMPERATURE CORROSION – (2 Credit Points)
Metal oxidation reaction thermodynamics, Ellingham diagram, oxide structure, type-n and type-p oxidation, Pilling-Bedworth ratio, oxide growth mechanism and rate, high temperature corrosion in specific environment (hot corrosion, boiler, carburization, thermal cycle), protection method (material selection, high temperature resistant alloy, coating / surface engineering)
Prerequisite: Corrosion & Protection of Metals

ENMT 607943 - ELECTRONIC MATERIALS – (2 Credit points)
Elementary concepts of electron theory (wave – particle duality, free electrons, nearly free electrons, band structure, insulators – conductors – semiconductors). Modern theory of solids (band theory of solids, density of states, Boltzmann and Fermi-Dirac statistics, electron effective mass and Fermi energy). Electrical conduction in materials (classical electron theory, quantum mechanical considerations, magnetism, superconductivity, dielectrics and insulator, thermoelectric phenomena). Semiconductors (intrinsic and extrinsic semiconductors, degenerate semiconductors, recombination ad minority carrier junction, Schottky junctions and Ohmic contacts, semiconductor devices)
Prerequisite: Transport Phenomenon

ENMT 607944 - RESEARCH METHODOLOGY – (2 Credit Points)
Scientific understanding, research method, problem specifiation, hypothesis, literature study, data collection and processing, elaboration of research proposal and scientific work presentation
Prerequisite: -

ENMT 607945 - PLASTIC PROCESSING – (2 Credit Points)
Introduction of polymer and its product, polymer characteristics related to process, polymer rheology, polymer equipment (injection molding, blow molding, calendaring, thermoforming), polymer composites (reinforcing process, laminating process)
Prerequisite: Polymer Technology

ENMT 607946 – REFRACTORY MATERIALS – (2 Credit Points)
Introduction to refraktory materials. Types of refractory materials (acid, basic, neutral refractory). Shape of refractory materials. Industrial application.
Prerequisite: Ceramic Technology

ENMT 607947 - QUALITY MANAGEMENT SYSTEMS – (2 Credit Points)
General introduction, ISO 9004 system approach and its connection with environment and safety, quality management system requirement, internal audit, correction and preventive procedure
Prerequisite: Statistic & Probability

ENMT 608948 - ANALYSIS OF DEFORMATION – (2 Credit Points)
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: Statics & Mechanics of Materials, Metal Manufacturing Process, Engineering Design of Products

ENMT 608949 - INDUSTRIAL ECOLOGY – (2 Credit Points)
Views on Industrial Ecology, Life-Cycle Assessment: Method Basics, Environmental Evaluation and Advanced Methods, Aggregate Materials Flows, Environmental Policy Strategies
Prerequisite: Non Ferrous Extractive Metallurgy, Iron & Steel Making Process

ENMT 608950 - CONCRETE CORROSION – (2 Credit Points)
Cement material characteristics (types, water ratio, porosity, permeability), transport process of cement (water content and diffusion), cement degradation (sea water attack, acid attack), corrosion mechanism in cement, electrochemistry aspects, carbonated corrosion, chloride corrosion, stray current corrosion, hydrogen corrosion, corrosion protection (inhibitor, surface engineering, cathodic protection, inspection, monitoring, repair)
Prerequisite: Corrosion & Protection of Metals

ENMT 608951 - ENERGY MATERIAL – (2 Credit Points)
Introduction to energy material, photovoltaic material, dye-sensitized solar cell, lithium ion battery, copper nanoparticles, carbon nanotubes, applications and manufacturing process
Prerequisite: Polymer Technology, Composite Technology, Ceramic Technology

ENMT 608952 - ADVANCED EXTRACTIVE METALLURGY – (2 Credit Points)
Waste characterization for raw material, innovation in hydrometallurgy and pyrometallurgy for energy efficient process, metal recycle process, by-product process and utilization, mineral processing from tailing, metal recovery from red mud and water sludge, updated technology for metal recycle process.
Prerequisite: Non Ferrous Extractive Metallurgy

ENMT 608953 - INDUSTRIAL MECHANIC EQUIPMENTS – (2 Credit Points)
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,

UNDERGRADUATE PROGRAM
METALLURGY & MATERIALS ENGINEERING

Process Pipes, Utility Pipes, Onshore and Offshore
Prerequisite: Metal Manufacturing Process, Corrosion & Protection of Metals

ENMT 608954 - ADVANCED SURFACE ENGINEERING – (2 Credit Points)
Fundamental of surface engineering, conventional surface engineering, advanced surface engineering practices, surface coatings and surface modifications, advanced topics on characterizations for thin film
Prerequisite: Heat Treatment & Surface Engineering

ENMT 608955 – MATERIAL STANDARDIZATION – (2 Credit points)
Introduction to material standard. Types of material standard. Industrial standard of materials.
Prerequisite: -

ENMT 608956 - PLASTIC RECYCLING TECHNOLOGY – (2 Credit Points)
National and international regulation on polymer recycling, polymer material cycle, classification of polymer industry in Indonesia, ecology and polymer product, basic principal for recycling, selection of polymer recycle methods, physical and chemical engineering of polymer recycle product, case study of polymer recycle (PET, PP, PE, PS, Styrofoam, PVC, polyacrylate, thermoplastic, ABS, rubber, thermoset)
Prerequisite: Polymer Technology

ENMT 608957 - RUBBER TECHNOLOGY – (2 Credit points)
Introduction, types and characteristics of rubber raw material and products, additives for rubber product, manufacturing process and equipment for rubber product, testing methods and applications of rubber products
Prerequisite: Polymer Technology

ENMT 608958 - NANO TECHNOLOGY – (2 Credit Points)
Scope and definition of nanotechnology, physical and chemical of solid surface, nanostructures (zero, one and two dimensional), special nanomaterials, fabrication processes (lithography, nanolithography, soft lithography, assembly), nanomaterial characterizations (physical, chemical and structural) and applications (MEMS, DNA chips, photonics, crystal)
Prerequisite: Polymer Technology, Composite Technology, Ceramic Technology

Curriculum of 2016 – Subjects Syllabus
International Program - Bachelor Degree
Dept. of Metallurgy & Materials Engineering

ENMT 611001 - ENGINEERING DRAWING – (2 Credit Points)
Illustration: Function and benefit of Engineering Drawing; SAP; Measurement and Evaluation; Introduction to drawing equipment; Basic definition of geometric, paper format, draw regulation, line, fild, line confiuration, basic geometric form; Visualization geometric: Skew projection and isometric, function and line types, confiuration 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.
Prerequisite: -

ENMT 611002 - INTRODUCTION TO ENGINEERING MATERIALS – (2 Credit Points)
(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: -

ENMT 611003 - THERMODYNAMICS OF MATERIALS – (3 Credit Points)
Definition of thermodynamics, first, second, and third law of thermodynamics, statistical interpretation of entropy, auxiliary functions, heat capacity, enthalpy and entropy, phase equilibrium in a component, gas and solution behavior, free energy, binary system composition, reaction of pure condensation phase and gas phase, equilibrium reaction of a system in a solution component
Prerequisite: -

ENMT 611004 - BASIC CHEMISTRY LABORATORY – (1 Credit Point)
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
Prerequisite: -

ENMT 612005 - POLYMER CHEMISTRY – (4 Credit Points)
Fundamentals of organic chemistry (bonding atom and molecule, polar molecules, free radicals, the nomenclature of organic compounds, isomer, conjugation and resonance). Reaction types of organic compounds, addition reactions, nucleophilic and electrophilic substitution, elimination, rearrangement, and radical reaction mechanism. Basic Properties of Polymer Chemistry
Prerequisite: -

ENMT 612006 - TRANSPORT PHENOMENON – (3 Credit Points)
Mass transfer, Fluid flow concept, Laminar flow, momentum conservation, Turbulent flow, Enthalpy & heat transfer, Solid & liquid diffusion mass transport
Prerequisite: Thermodynamics of Materials

ENMT 613007 - CHEMICAL CHARACTERIZATION OF MATERIAL LABORATORY – (1 Credit Point)
Quantitative analysis of organic and anorganic matter using titrimetry method
Prerequisite: Chemical Characterization of Material

ENMT 613008 - ELECTRO-CHEMISTRY – (3 Credit Points)
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: -

ENMT 613009 - HEAT TREATMENT & SURFACE ENGINEERING – (3 Credit Points)
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, various heat-treating furnace and its atmosphere, deviation in heat treatment process, special heat treatment, case study of heat treatment and surface engineering
Prerequisite: Physical Metallurgy 1

ENMT 613010 - PHYSICAL METALLURGY 1 – (4 Credit Points)
(1) Definition of crystal; (2) Crystal lattice(3) Unit cell; (4) Bravais lattice; (5) Miller index for planes and direction; (6) Stereographic projection; (7) Crystal symmetry; (8) Formation of crystal; (9) Identification of crystal; (10) Crystal defects: point defects, line defects (dislocations), edge dislocations, screw dislocations, burgers vector, movement of dislocations, energy of dislocation, dislocations in FCC, BCC and HCP structures, planar defects; (11) Fatigue and Fracture of Materials; (12) Creep of Materials; (13) Strengthening Mechanism: strain (work) hardening, grain boundary strengthening, solid solution strengthening, precipitation (two-phase) strengthening, steel alloys strengthening, composite strengthening, study case in materials strengthening.
Prerequisite: -

ENMT 613011 - POLYMER TECHNOLOGY – (3 Credit Points)
Relationship of structure and behaviour of polymer molecule, polimer material characteristics (thermal, chemical, mechanic, optic and electrical), fabrication process stages (formulation, continuous & discontinuous manufacturing, product finalization) on thermoplastic, thermosetting and rubber product, polimer raw material formulation, case study of polymer product in packaging, automotive, electronic and construction application
Prerequisite: Polymer Chemistry

ENMT 613012 - STATIC & MECHANIC OF MATERIALS – (3 Credit Points)
General principle of mechanics, Vector and forces, Equilibrium points, Resultant of forces, Structure analysis, Center of gravity and centroid, Moment inertia, Internal forces, Friction. The concept of stress strain, Relation of stress and strain in axial loading, Twisting, Buckling, Transversals loading, Stress analysis, Design of shaft and beam, Beam deflection, Structural joints, Column and thick cylinder, Energy method.
Prerequisite: -

ENMT 614013 - CORROSION & PROTECTION OF METALS – (3 Credit Points)
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: Electro-Chemistry

ENMT 614014 - IRON & STEEL MAKING PROCESS – (2 Credit Points)
Classification and the development of steel (iron ores, reductor, etc.) and their preparatory process, thermodynamics and kinetics of iron and steel making process, blast furnace reduction of iron ores, direct reduction (hylsa, midrex, rotary kiln SL-RN, rotary hearth), smelting reduction, desulfurization, deoxidation, dephosphorisation, degassing, steel making in EAF (Electric Arc Furnace) and BOF (Basic Oxygen Furnace), secondary metallurgy process, continuous casting, hot and cold rolling, special steel making
Prerequisite: Mineral Processing

ENMT 614015 - MINERAL PROCESSING – (4 Credit Points)
Understanding mineralogy, classification 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 process, grinding process, the classification 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: Physical Metallurgy 1

ENMT 614016 - NUMERICAL COMPUTATION – (2 Credit Points)
Introduction to models, types of models, basics of Matlab, array in Matlab, if and switch selection, loop in Matlab, function and m-file in Matlab, linear equation, Taylor expansion method, Euler, differential equation, basic of solid works, solid modeling, basics of simulink, first and second order simulink
Prerequisite: -

ENMT 614017 - PHYSICAL METALLURGY 2 – (3 Credit Points)
(1) Concept of Equilibrium: single component system, binary component system, the phase rule, binary phase diagrams; (2) Fe-Fe3C Phase Diagram; (3) Ternary Equilibrium: ternary system representation, ternary system containing 2 phase, ternary system containing 3 phase; (4) Diffusion in Materials: atomic mechanism of diffusion, interstitial diffusion, substitutional diffusion; (5) Crystal Interfaces and Microstructure: interfacial free energy, grain boundary, interphase interfaces in solids, interface migration; (6) Solidification: nucleation in pure metals, growth of a pure solid, solidification of alloy, solidification of ingots and castings, solidification of fusion welds, rapid solidification; (7) Diffusional Transformation in Solids: homogeneous and heterogeneous nucleation in solids, precipitate growth, transformation kinetics, eutectoid transformation, ordering transformation; (8) Diffusionless Transformation in Solids: theories of martensite nucleation, martensite growth, tempering of ferrous martensite, martensite transformation in nonferrous metals, case study in diffusionless transformation
Prerequisite: Thermodynamics of Materials

ENMT 614018 - TECH. OF MICROSTRUCTURAL ANALYSIS – (2 Credit Points)
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.
Prerequisite: Physical Metallurgy 1

ENMT 614019 - TESTING OF MATERIALS – (2 Credit Points)
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)
Prerequisite: Physical Metallurgy 1

ENMT 614020 - CHEMICAL CHARACTERIZATION OF MATERIAL LABORATORY – (1 Credit Point)
Quantitative analysis of organic and anorganic matter using titrimetry method
Prerequisite: Chemical Characterization of Material

ENMT 614021 - CORROSION & PROTECTION OF METALS LABORATORY – (1 Credit Point)
Corrosion cells, corrosion potential measurement of selected metals, polarization of stainless steel, cathodic protection, surface treatment.
Prerequisite: -

ENMT 615022 - INDUSTRIAL MANAGEMENT – (2 Credit Points)
Introduction to industrial management, organization and management functions, theories and techniques of decision-making, management of production / operations, the strategic decisions of products and processes, location and layout, management and control of stocks (inventory), R & D, project management, QC and productivity, management production practices, marketing and industrial management, HR management, IT and manufacturing industry, manufacturing industry in Indonesia
Prerequisite: -

ENMT 615023- METAL MANUFACTURING PROCESS – (4 Credit Points)
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 non-ferrous (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
Prerequisite: Physical Metallurgy 1

ENMT 615024 - NON-FERROUS EXTRACTIVE METALLURGY – (3 Credit Points)
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: Electro-chemistry, Mineral Processing

ENMT 615025 - TECH. OF MICROSTRUCTURAL ANALYSIS LABORATORY – (1 Credit Point)
Metallographic sample preparation (techniques of cutting, grinding, polishing and etching), microstructural analysis techniques of metal (ferrous and non-ferrous) with an optical microscope
Prerequisite: Tech. of Microstructural Analysis

ENMT 615026 - TESTING OF MATERIALS LABORATORY – (1 Credit Points)
Tensile test, Compressive test, Micro and Macro Hardness test, Impact Test, Wear Test
Prerequisite: Testing of Materials

ENMT 616027 - CERAMIC TECHNOLOGY – (3 Credit Points)
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 nature dielektris. 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: Physical Metallurgy 2

ENMT 616028 - COMPOSITE TECHNOLOGY – (3 Credit Points)
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 Technology

ENMT 616029 - MATERIALS JOINING – (3 Credit Points)
Principles of various material joining and its classification, adhesive bonding, mechanical joining, methods of welding: fusion welding (electric arc), electrical resistance welding, pressure welding (solid state welding), other welding process (EBW, laser welding, thermit welding, underwater welding), soldering and brazing, design of joint and welding symbol, welding metallurgy: carbon steel, low alloy steel, stainless steel, concrete steel, non ferrous, WPS and welding standards and code, weld defect and its prevention, control of joint and its testing
Prerequisite: Physical Metallurgy 1, Testing of Materials

ENMT 616030 - EXTRACTIVE METALLURGY LABORATORY – (1 Credit Point)
Metals extraction test and electrometallurgy (e.g. Electroplating, froth flotation)
Prerequisite: Non Ferrous Extractive Metallurgy

ENMT 616031 - METAL MANUFACTURING PROCESS LABORATORY – (2 Credit Points)
(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. (4) Solid silinder forging, (5) Sheet metal rolling, (6) Sheet metal forming which includes non-simulative testing (tensile testing for n and r value), and simulative testing (streething and deep-drawing, LDH and LDR)
Prerequisite: Metal Manufacturing Process Metal

ENMT 616032 - CAPITA SELECTA – (2 Credit Points)
Specific topics that have not been included in Subjects and supplied by external resource persons which is experienced in industry
Prerequisite: Metal Manufacturing Process, Corrosion & Protection of Metals

ENMT 616033 - ENGINEERING DESIGN OF PRODUCT – (3 Credit Points)
Introduction to Engineering Design, total design activity, group dynamics and design management, problem identification and design specification, creativity and the conception of design, modeling, optimallisation, materials and process selection, design communication and presentation.
Prerequisite: Polymer Technology, Composite Technology, Ceramic Technology, Iron & Steel Making Process

ENMT 616034 - FRACTURE MECHANICS & FAILURE ANALYSIS – (4 Credit Points)
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 behavior, residual stress, corrosion and environment, case study.
Prerequisite: Physical Metallurgy 1, Testing of Materials, Tech. of Microstructural Analysis, Corroson & Protection of Metals

ENMT 616035 - INTERNSHIP – (2 Credit Points)
Specify the job objectives in the proposal; Implement an internship at a site that has been approved and in accordance with its specifiity; Study and describe the process of technical work, quality control, project management, project specifications, engineering drawings and other aspects; Identify the problem related to the technical work, quality control, project management, project specifiations, engineering drawings and other aspects; Conduct problems that occur at each stage of the project; Determine ways or solutions to overcome the problems associated with the project learned; Prepare a final report includes project description, existing problems and problem solving
Prerequisite: Student has obtained minimum of 100 credits

ENMT 616036 - SEMINAR OF FINAL PROJECT PROPOSAL – (1 Credit Points)
Final assignment writing guide including initial research, abstract writing guide, research methodology, type of references, discussion, also conclusion. To make scientific paper from existing final report which then be presented according to certain journal term or final assignment proposal presentation.
Prerequisite: Student has obtained minimum of 105 credits

ENMT 616037 - FINAL PROJECT – (4 Credit Points)
Implementation/application of various lectures taken by students on integration in a research to solve a problem in metallurgy and material engineering field. The research result is presented in a form of scientific report and presented in front of the judging lecturers.
Prerequisite: Student has obtained minimum of 125 credits

4.8. UNDERGRADUATE PROGRAM IN ARCHITECTURE

Program Specification

1	**Awarding Institution**		Universitas Indonesia, for Double Degree Program : Universtas Indonesia and partner university
2	**Teaching Institution**		Universitas Indonesia Double Degree: Universitas Indonesia and Partner Universities
3	**Program**		Undergraduate Program in Architecture
4	**Class**		Regular, Parallel, International
5	**Degree Offered**		Sarjana Arsitektur (S.Ars) for Double Degree: Sarjana Arsitektur (S.Ars) and Bachelor of Architecture (B.Arch)
6	**Accreditation / Recognition**		A Accredited from BAN-PT AUN-QA
7	**Language of Instruction**		Bahasa Indonesia and English
8	**Study Scheme (Full time/Part time)**		Full time
9	**Entry requirement**		SMA Graduate/equal or D3/Polytechnic graduate
10	**Duration of Study**		4 years / program
	Semester	Total of semester	Weeks / Semester
	Regular	8	16-17
	Short (optional)	3	8
11	**Graduates Profile:** 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. Graduates are expected to have the ability as: • **An Initiator**- able to provide solutions to spatial problems critically and creatively with respect to local context and needs • **A 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. • **A Communicator** – able to communicate ideas through words, writings, drawings, modeling and other media. • **A Collaborator** - able to work together with various stakeholders to propose creative solutions for real problems		

12	**Learning Outcome**
	1. Able to create architectural design by integrating basic architectural knowledge, applying design and communication skills, 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 influence the quality of architectural design. 3. Able to analyze context in which 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 and integrate them as the basis to define contextual and functional requirements for different types of built environment. 5. Able to construct the knowledge of architectural design methods. 6. Able to construct the knowledge of structural systems, building materials and construction, and building utility. 7. Able to integrate the knowledge of natural and environmental systems into a sustainable architectural design. 8. Aware of various roles of architects in the society. 9. Able to gather information, formulate problems, perform analysis and synthesis that are related to architecture. 10. Able to apply mathematics, science, and basic engineering into the solution of complex 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 endeavors with respect to ethics.

13	**Course Composition**		
No	Type of Course	Credits	Percentage
i	University General Subjects	18	12,5%
ii	Basic Engineering Subjects	11	7,6%
iii	Architecture Core Subjects	87	60,4%
iv	Electives	28	19,5%
v	Total	144	100%
14	**Total credits for graduation**		**144 Credit Semester Units**

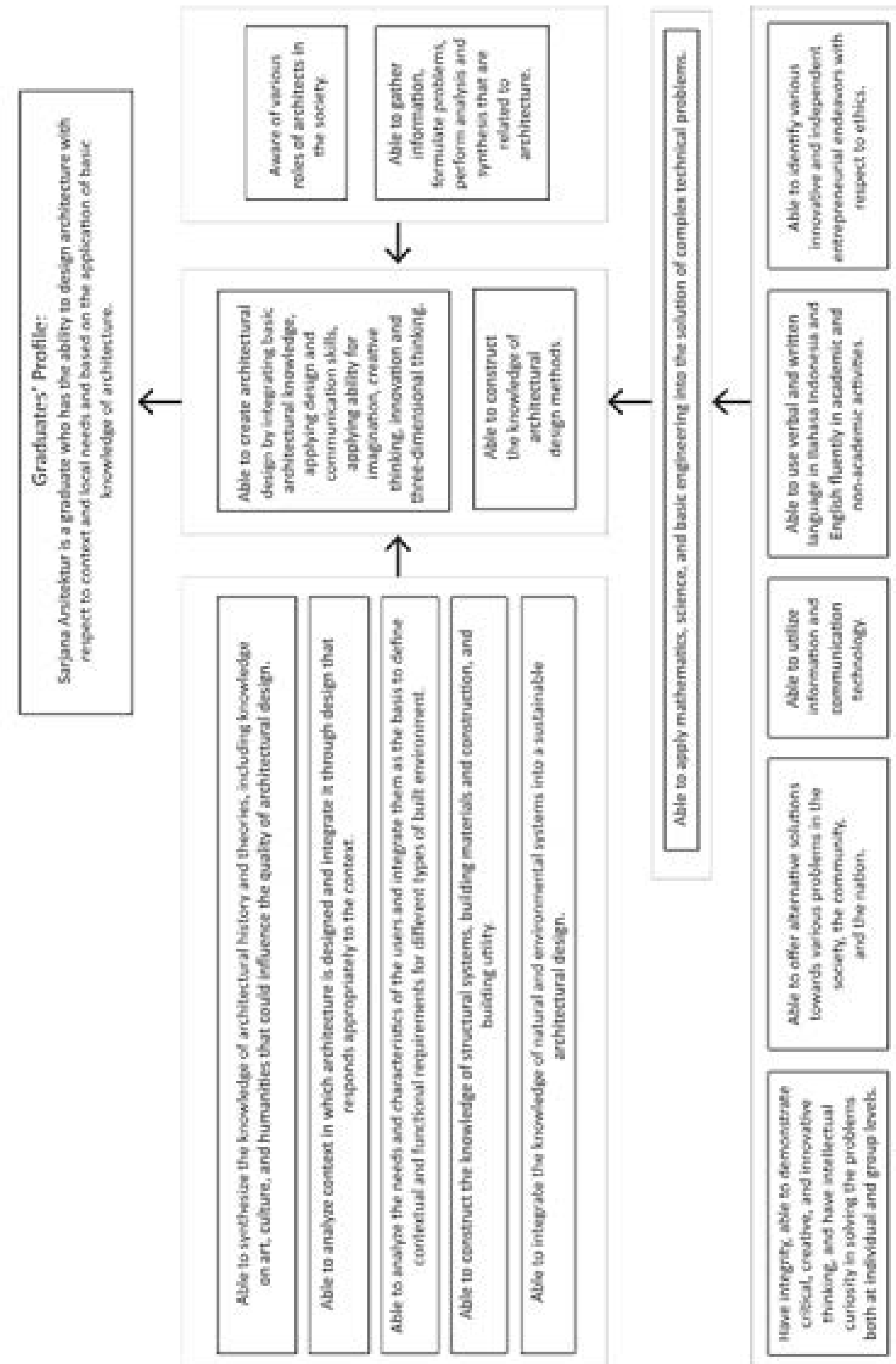
Job Opprtunity

Graduates of Strata-1 Architecture Program UI hold a Sarjana Arsitektur with pre-professional qualifications. The graduate will be able/can may 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 assessment 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

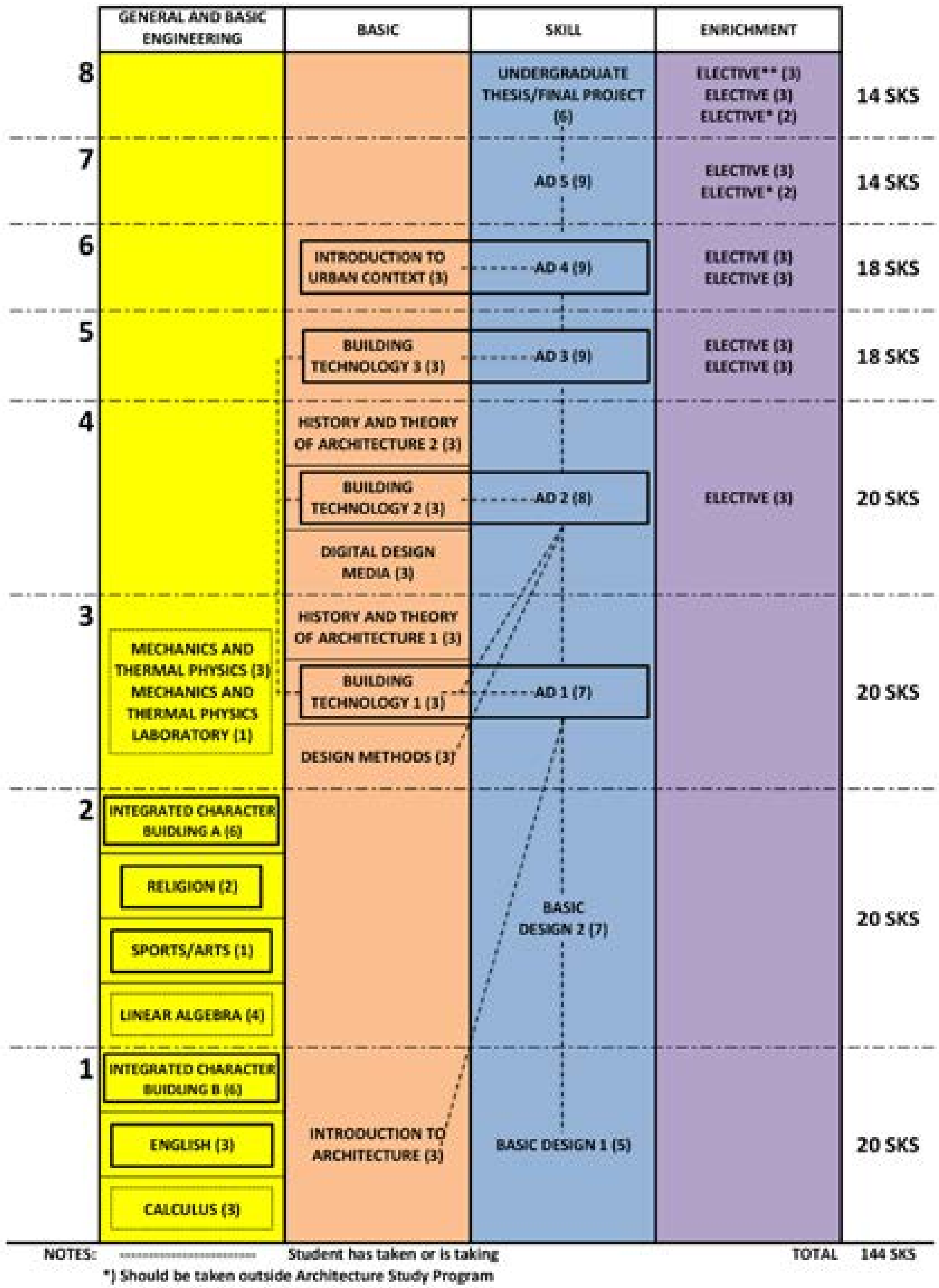
ARCHITECTURE

Network Competencies



ARCHITECTURE

Curriculum Structure of Undergraduate Program in Architecture



CURRICULUM STRUCTURE ARCHITECTURE

KODE	SUBJECT	CREDIT
CODE	1st Semester	
UIGE600002	Integrated Character Building B	6
UIGE600003	English	3
ENGE600003	Calculus	3
ENAR601009	Introduction to Architecture	3
ENAR601001	Basic Design 1	5
	Sub Total	**20**
	2nd Semester	
UIGE600001	Integrated Character Building A	6
UIGE600010 - 15	Religion	2
ENGE600004	Linear Algebra	4
UIGE600020 - 48	Sport / Art	1
ENAR602002	Basic Design 2	7
	Sub Total	**20**
	3rd Semester	
ENGE600005	Physics (Mechanics and Thermal)	3
ENGE600006	Physics (Mechanics and Thermal) Lab	1
ENAR603003	Architectural Design 1	7
ENAR603010	History & Theory of Architecture 1	3
ENAR603011	Design Methods	3
ENAR603012	Building Technology 1	3
	Sub Total	**20**
	4th Semester	
ENAR604004	Architectural Design 2	8
ENAR604013	History & Theory of Architecture 2	3
ENAR604014	Building Technology 2	3
ENAR604015	Digital Design Media	3
	Elective	3
	Sub Total	**20**
	5th Semester	
ENAR605005	Architectural Design 3	9
ENAR605016	Building Technology 3	3
	Elective	3
	Elective	3
	Sub Total	**18**
ENAR606006	Architectural Design 4	9
ENAR606017	Introduction to Urban Context	3
	Elective	3
	Elective	3
	Sub Total	**18**
	7th Semester	
ENAR607007	Architectural Design 5	9
	Elective	3
	Elective*)	2
	Sub Total	**14**

	8th Semester	
ENAR600008	Undergraduate Final Project	6
	Elective	3
	Elective**)	3
	Elective*)	2
	Sub Total	**14**
	Total	**144**

*) Mahasiswa wajib mengambil minimal 2 mata ajar di luar Program Studi S1 Arsitektur sebagai mata ajar pilihan.
**) Kajian Perancangan wajib diambil sebagai mata ajar pilihan bagi mahasiswa yang memilih Tugas Akhir

Resume

Wajib Universitas	18
Wajib Fakultas	11
Wajib Program Studi	87
Jumlah	116
Pilihan	28
Total Beban Studi	144

ELECTIVES

Code	Elective Course	Credit
ENAR600018	Acoustics	3
ENAR600019	Coastal Architecture	3
ENAR600020	Ethnic Achitecture	3
ENAR600021	Architecture, City and Power	3
ENAR600022	Heritage Architecture	3
ENAR600023	Urban Ecology	3
ENAR600024	Digital Fabrication	3
ENAR600025	High-Rise Building Facades	3
ENAR600026	Photography	3
ENAR600027	Geometry and Architecture	3
ENAR600028	Everyday and Architecture	3
ENAR600029	2D Design Dgital Communication	3
ENAR600030	3D Digital Design Communication	3
ENAR600031	Life Cycle Environment	3
ENAR600032	Project Management	3
ENAR600033	Principles of Urban Housing	3
ENAR600034	Interior Design	3
ENAR600035	Site Planning and Design	3
ENAR600036	City Planning	3
ENAR600037	Architectural Psychology	3
ENAR600038	Real Estate	3
ENAR600039	Project Feasibility Study	3
ENAR600040	Lighting Design	3
ENAR600041	Environ Design Theories and Methods	3
ENAR600042	Urban Housing Theory	3
ENAR600043	Building Utility	3
ENAR600044	Tectonic Workshop	3
ENAR600045	Independent Study	3
ENAR600046	Design Study **)	3
ENAR600047	Capita Selecta	3
ENAR600048	Internship	3
ENAR600049	Special Topic on Architectural Design	3
ENAR600050	Special Topic on Urban Design	3
ENAR600051	Special Topic on Urban Housing&Settlement	3
ENAR600052	Spec Topic Arch. History, Theory & Critics	3
ENAR600053	Special Topic on Building Technology	3

ARCHITECTURE

CURRICULUM STRUCTURE OF UNDERGRADUATE PROGRAM IN ARCHITECTURE INTERNATIONAL CLASS

KODE	SUBJECT	CREDIT
CODE	1st Semester	
ENGE610005	Physics (Mechanics and Thermal)	3
ENGE610006	Physics (Mechanics and Thermal) Laboratory	1
UIGE610002	Academic Writing	3
ENGE610003	Calculus	3
ENAR611009	Introduction to Architecture	3
	Sub Total	**18**
	2nd Semester	
ENGE610004	Linear Algebra	4
ENAR612002	Basic Design 2	7
ENAR612015	Digital Design Media	3
	Elective	3
	Sub Total	17
	3rd Semester	
ENAR613003	Architectural Design 1	7
ENAR613010	History and Theory of Architecture 1	3
ENAR613011	Design Methods	3
ENAR613012	Building Technology 1	3
	Elective	3
	Sub Total	19
	4th Semester	
ENAR614004	Architectural Design 2	8
ENAR614013	History and Theory of Architecture 2	3

ARCHITECTURE

ENAR614014	Building Technology 2	3
	Elective	3
	Elective	3
	Sub Total	**20**
	5th Semester	
ENAR615005	Architectural Design 3	9
ENAR615016	Building Technology 3	3
UIGE610004	Integrated Character Building (Social-Humanities)	6
	Sub Total	**18**
	6th Semester	
ENAR616006	Architectural Design 4	9
ENAR616017	Introduction to Urban Context	3
UIGE610001	Integrated Character Building (Science, Technology, Health)	6
UIGE6100xx	Religion	2
	Sub Total	**20**
	7th Semester	
ENAR617007	Architectural Design 5	9
	Elective	3
	Elective	3
	Elective *)	2
	Sub Total	**17**
	8th Semester	
ENAR610008	Undergraduate Thesis/Final Project	6
UIGE610003	Sports/Arts	1
	Elective	3
	Elective **)	3
	Elective *)	2
	Sub Total	**15**
	Total	**144**

Resume

Wajib Universitas	**18**
Wajib Fakultas	**11**
Wajib Program Studi	**87**
Jumlah	**116**
Pilihan	**28**
Total Beban Studi	**144**

ELECTIVE COURSES

Kode	Elective Course Subject	Credit
ENAR610018	Acoustics	3
ENAR610020	Ethnic Achitecture	3
ENAR610022	Heritage Architecture	3
ENAR610054	Introducing Sustainability	3
ENAR610031	Life Cycle Environment	3
ENAR610040	Lighting Design	3
ENAR610026	Photography	3
ENAR610038	Real Estate	3
ENAR610035	Site Planning and Design	3
ENAR610029	2D Design Dgital Communication	3
ENAR610030	3D Digital Design Communication	3
ENAR610045	Independent Study	3
ENAR610046	Design Study **)	3
ENAR610047	Capita Selecta	3
ENAR610048	Internship	3
ENAR610049	Special Topic on Architectural Design	3
ENAR610050	Special Topic on Urban Design	3
ENAR610051	Special Topic on Urban Housing and Settlement	3
ENAR610052	Special Topic on Architectural History, Theory and Criticism	3
ENAR610053	Special Topic on Building Technology	3

*) Students are required to take minimum 2 subjects from outside Architecture Study Program as electives
**) Design Study is required as elective for students who choose to take 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
ARCH3008	Urban Contexts	25
ARCH3006	Environmental and Technological Systems in Architecture 1	25

	Sub Total	**100**
	Year 4-Semester 7 (July)	
ARCH3024	Architectural Design and Technical Integration Studio	25
ARCH3025	Architectural Design and Technical Integration 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)

February Entry		July Entry	
Code	**Course Title**	**Code**	**Course Title**
	Semester 5 (February)		**Semester 5 (July)**
DAB511	Architectural Design 5	DAB611	Architectural Design 6
DAH530	Integrated Technologies 2	DAH635	Architectural Technology 2
DAH525	Architecture and The City	DAB403	Visualisation 3
DAB325	**Architecture in The 20th Century**		**Minor Unit/Elective**
	Semester 6 (July)		**Semester 6 (February)**
DAB611	Architectural Design 6	DAB511	Architectural Design 5
DAH635	Architectural Technology 2	DAH530	Integrated Technologies 2
DAB403	Visualisation 3	DAH525	Architecture and The City
	Minor Unit/Elective	DAB325	Architecture in The 20th Century
	Semester 7 (February)		**Semester 7 (July)**
DAH710	**Architectural Design 7**	**DAH811**	**Architectural Design 8 (triple)**
DEH701	Research Methods		Minor Unit/Elective
	Minor Unit/Elective		
	Minor Unit/Elective		
	Semester 8 (July)		**Semester 8 (February)**
DAH811	**Architectural Design 8 (triple)**	**DAH710**	**Architectural Design 7**
	Minor Unit/Elective	**DEH701**	**Research Methods**
			Minor Unit/Elective
			Minor Unit/Elective
Total Credits (Year 3 & Year 4) taken at QUT = 192			

SYLLABUS OF UNIVERSITY SUBJECTS

INTEGRATED CHARACTER BUILDING A
UIGE600001/UIGE610001
6 sks
Syllabus : Integrated Character Building A facilitates students to understand the basics of character formation and master the basics of cognitive power that is logic. Furthermore, to apply cognitive powers in generating good behaviors which are useful to themselves and society. The establishment of ethical behaviors based on ethics is also facilitated. Students are able to develop the basic strength of character and to know themselves as a human being, both as individuals and as part of a group so that they can develop themselves well enough. In a group, the students need to have skills that are needed to maintain an effective relationship in order to improve the quality of human life. Particularly as a citizen of Indonesia, students need to understand the nature of citizenship and basic philosophy of Pancasila in order to act and behave in accordance with the character of the Indonesian nation.
Core Competencies :
1. Students are able to analyze problems in depth individually, comprehensively, logicaly and criticaly, and generate solutions using the logical and ethical principles and rules of logic and ethics
2. Students are capable of analyzing the problem individually, thoroughly and deeply about the human being as an individual or as part of group
3. Students are individually able to understand, make critical reasoning and to build an open and critical mind to the problem of nationhood, statehood and citizenship in this dynamic world situation
4. Students are able to create and display a work that depicts the character in accordance with the principles of Pancasila

Learning Method : interactive lecture, Experiential Learning, Collaborative Learning, Problem Based Learning, Project-Based Assignment
Prerequisites : OBM (New Student Orientation)

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))

INTEGRATED CHARACTER BUILDING B
UIGE600002/UIGE610004
6 sks
Syllabus : Integrated Character Building B facilitates students to practice identifying, analyzing, and resolving problems of nature and the environment by making use of integrative and quantitative information. This lecture aims to prepare the future generation who care about nature issues through the balanced development of hard skills and soft skills and have the skills of ICT (Information and Communication Technology).
Core Competencies:
1. Students have an ethic, moral, personality and good character in completing the task at hand;
2. Students role as citizens who take pride and love of the homeland and support the continuity of life;
3. Students are able to work together and have a high sensitivity and awareness to the community and the environment;
4. Students are able to think logically, critically and creatively;
5. Students are able to use mathematics to solve problems quantitatively;
6. Students are able to use information and communication technology (ICT) for development;
7. Students are able to analyze the system of nature integratively and comprehensively;
8. Students are able to act as wise managers of nature to build and maintain the preservation of nature for a better and sustainable life.

Learning Method : Blended e-Learning, Collaborative Learning (CL), Problem Based Learning (PBL) and Group Discussion (GD)
Prerequisites : OBM (New Student Orientation)
Textbook : Digital Form can be downloaded from Scele

ISLAMIC STUDY
UIGE600010/UIGE610005
2 sks
General instructional objectives : The cultivation of students who have concern for social, national 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 practice 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)

UNDERGRADUATE PROGRAM

CATHOLIC STUDY
UIGE600011/UIGE610006
2 sks
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 STUDY
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 STUDY
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 STUDY
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

ARCHITECTURE

FACULTY OF ENGINEERING

(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
2 sks

ART
UIGE600020-30
1 sks
The option of subjects that can be choosen :
Appreciation of Film (UIGE600020), Batik (UIGE600021), Photography (UIGE600022), Calligraphy (UIGE600023), Javanese Karawitan (UIGE600024), Balinese Dance and Karawitan (UIGE600025), Comic (UIGE600026), Painting (UIGE600027), Music and Vocal (UIGE600028), Theater (UIGE600029), Wayang (UIGE600030)

SPORT
UIGE600040-48
1 sks
The option of subjects that can be choosen :
Basketball (UIGE600040), Volley Ball (UIGE600041), Badminton (UIGE600042), Futsal (UIGE600043), Hockey (UIGE600044), Football (UIGE600045), Softball (UIGE600046), Tennis (UIGE600047), Table Tennis (UIGE600048)

SYLLABUS OF BASIC ENGINEERING SUBJECTS

CALCULUS 1
ENGE600001/ENGE610001
3 sks
Syllabus : This subject gives the opportunity for students to understand the basic concept of calculus and to be able to solve applied calculus problems. Students are also given the opportunity to understand basic concepts the functions of one variable, derivatives and integral functions of one variable, and its application.

CALCULUS 2
ENGE600002/ENGE610002
3 sks
Syllabus : This subject gives the opportunity for students to understand the basic concept of calculus and to be able to solve applied calculus problems. Students are also given the opportunity to understand the basic concept the function of two variables, or variables, total derivative and integral of the function of two or more variables and application. In addition, students can understand the basic concepts of sequence and series.

CALCULUS
ENGE600003/ENGE610003
4 sks
Syllabus : This subject gives the opportunity for students to understand the basic concept of calculus and to be able to solve applied calculus problems. Students are also given the opportunity to understand the basic concept the function of two variables, the total derivative of the function of two or more variables and its application. Students are also expected to understand the basic concept of sequence and series and the basic concept of vector and analytical geometry.

UNDERGRADUATE PROGRAM

LINEAR ALGEBRA
ENGE600004/ENGE610004
4 sks
Syllabus : This subject gives the opportunity for students to master the basic techniques of Linear Algebra and gain knowledge on how to implement said techniques in solving System of linear equationss, determining the bases and dimension of vector space, as well as calculating eigen values and eigen vectors. This subject also gives students the opportunity to work with other objects, especially vectors and matrices.

PHYSICS (MECHANICS AND THERMAL)
ENGE600005/ENGE610005
3 sks
Syllabus : Physics (Mechanics and Thermal) subject includes the topics of mechanics and thermodynamics. Calculus is use as a mathematic helping tool in the learning process. Students are given the opportunity to learn how to unite their understanding of the basic concept of the analytical capability, their numeracy in learning mechanics and thermodynamics. During the course of this subject, students are not only aim to increase the students' knowledge of the basic physics concepts but also to increase their capability in using information technology and computer and to train their skills, such as: independent and group work and their communication skill.
Students will also be train on how to explain and analyse the nature phenomenon and the result of human engineering exist in their everyday lives by using the basic physics concept and applied them in their daily lives. Students are also taught to develop their synthesis ability and evaluating both quantitative and qualitative natural phenomenon and the result of human engineering in their surrounding environment by using basic physics concept. This subject will give students the opportunity to develop their ability to develop their presentation ability analyse the nature phenomenon and the result of human engineering from the mathematics and natural science point of view integrative and comprehensively.

PHYSICS (MECHANICS AND THERMAL) LABORATORY
ENGE600006/ENGE610006
1 sks
Syllabus : Practical of Mechanics: Measurement, Moment of inertia, Gravity acceleration, Fluid density, Scratch coefficient, Collision, Swing torque, Viscosity of water, Young's modulus, Viscosity of Newtonian fluid, Fluids surface tension, Oscillation, Practical of Heat: Coefficient of linear expansion, Heat conductivity, Thermocouple calibration, Calorimeter, Joule Constant, Laplace Constant, Heat Collector, Determining of air Cp/Cv, Expansion of fluids and water anomaly.
Notes: For Architecture and Interior Architecture Program, practical is not mandatory.

PHYSICS (ELECTRICITY, MWO)
ENGE600007/ENGE610007
3 sks
Syllabus : Physics (Electricity, MWO) subject includes the topics of electricity, magnet, wave, and optics. Calculus is use as a mathematic helping tool in the learning process. Students are given the opportunity to learn how to unite their understanding of the basic concept of the analytical capability, their numeracy in learning mechanics and thermodynamics. During the course of this subject, students are not only aim to increase the students' knowledge of the basic physics concepts but also to increase their capability in using information technology and computer and to train their soft skills, such as: independent and group work and their communication skill. Students will also be train on how to explain and analyze the nature phenomenon and the result of human engineering exist in their everyday lives by using the basic physics concept and applied them in their daily lives. Students are also taught to develop their synthesis ability and evaluating both quantitative and qualitative natural phenomenon and the result of human engineering in their surrounding environment by using basic physics concept.

PHYSICS (ELECTRICITY, MWO) LABORATORY
ENGE600008/ENGE610008
1 sks
Syllabus : Practical of Electricity: Electrolysis, Wheatstone bridge, Kirchhoff law, Earth's magnetic field, Temperature coefficient, Characteristic of series RLC circuit, Ohm law, Transformer. Practical of Optics: Polarimeter, Lens, Photometry, Prisms bias index, Spectrometer, Diffraction grid, Newton's ring.

BASIC CHEMISTRY
ENGE600009/ENGE610009
2 sks
Syllabus : As an engineer, you must have understanding on the chemistry that provides not only the basis for much of what goes on in our world but also that it is a vital, continually developing science. In this study the students will learn many subjects such as matter and measurement; atoms, molecules, and ions; stoichiometry; aqueous reactions; thermochemistry; properties of solutions; chemical kinetics; chemical equilibrium; and electrochemistry.
Learning activities will be conducted through various method, which consists of: problem based learning (PBL), interactive lecture, question-based learning, discussion, demonstration and unguided structured assignments. Assessment will be made continuously through a set of exercises, group discussion, mid semester exam and final exam.

STATISTIC AND PROBABILITY
ENGE600010/ENGE610010
2 sks
Syllabus : Statistics and probability has been known as applied mathematics which is widely used in collecting, organizing, presenting, interpreting and analyzing data to support valid conclusions. Furthermore, these conclusions will be used as recommendation in decision making. The course of Statistics and Probability is intended to give a basic ability for students to handle quantitative data and information. There are two stages that are delivered which is descriptive and inductive/inference stages. Descriptive stage includes collecting, organizing, and presenting the data in a scientific manner. Then, inductive/inference stage includes the process of estimating and drawing conclusion based on available data and relations between variables. Hence, students are expected to apply their knowledge of statistics in conducting experiments in laboratory works/assignments as well as research studies in their final projects.

ENGINEERING ECONOMICS
ENGE600011/ENGE610011
3 sks
Syllabus : This course introduces students to the basic of engineering economy. It covers the time value of money (TVOM) and interest rate; tools for evaluating project alternatives for both non discounted and discounted methods, for instance present worth analysis, annual worth analysis, future worth analysis, rate of return (ROR) analysis and benefit/cost analysis; and choosing the best alternative, break even analysis, and effect of depreciation and after tax analysis and sensitivity analysis, and replacement analysis.
Learning activities will be conducted through various methods, which consist of: interactive lectures, question-based learning, discussion, and structure assignments. Assessment will be made thoroughly through sets of exercises/quizzes, group discussion, midterm and final exam. To expose students on the latest utilization of engineering economy and train them how to use it, a project will be assigned. As an integral part of course, computer utilization such as Microsoft Excel will be demonstrated and discussed on the class.

HEALTH, SAFETY AND ENVIRONMENTAL PROTECTION
ENGE600012/ENGE610012
2 sks
Syllabus : The teaching of Safety, Health and Environmental (SHE) protection to undergraduates studying engineering courses is an important part of the education of future engineers at all levels. It is the generally expressed view amongst practitioners in industry, business and other organisations that all engineers need to be equipped to appreciate, understand and implement the requirements of SHE management and practice to meet the working needs of industry and of their company (or other organisation). Whilst the level of risk and degree of control is dependant on the industry sector concerned the basic principles do not change. In addition, according to code of ethics of engineers, engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties.
The module covers the regulation framework and standards, risk perception, assessment, and management and detail discussion on physical, chemical and process hazards, and related engineering and management controls. Maintenance of safety conditions, personal protective equipments, audit, incident and emergency planning are discussed in accordance to measures for improving students awareness to their daily activities within the campus premises and local environment.
Learning activities will be conducted through various methods, which consist of: interactive lecture, question-based learning, discussion, demonstration and unguided structured assignments. Assessment will be made continuously through a set of exercises, group discussion, mid semester exam and final exam

COURSE DESCRIPTION: COMPULSORY COURSES

ENAR601009
ENAR611009
INTRODUCTION TO ARCHITECTURE
3 CREDIT UNITS

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; understanding 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

ENAR601001
ENAR611001
BASIC DESIGN 1
5 CREDIT UNITS

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.

ENAR602002
ENAR612002
BASIC DESIGN 2
7 CREDIT UNITS

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; communicating object and space for various purpose and audiences; communicate human activity space.

Prerequisites: Student has taken Basic Design 1 (or Visual Art in 2012 Curriculum)

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

ENAR603010
ENAR613010
HISTORY AND THEORY OF ARCHITECTURE 1
3 CREDIT UNITS

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: -

Reference:

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

ENAR603011
ENAR613011
DESIGN METHODS
3 CREDIT UNITS

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

Reference:

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

UNDERGRADUATE PROGRAM
ARCHITECTURE
365
FACULTY OF ENGINEERING

4. Jean-Pierre Protzen & David J. Harris, *The Universe of Design: Horst Rittel's Theories of Design and Planning*, Routledge, 2010

ENAR604013
ENAR613013
HISTORY AND THEORY OF ARCHITECTURE 2
3 CREDIT UNITS

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 various 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: -

Reference:

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

ENAR604015
ENAR614015
DIGITAL DESIGN MEDIA
3 CREDIT UNITS

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.

UNDERGRADUATE PROGRAM

Prerequisites: Student has taken Basic Design 2 (or Architectural Communication Technique or Interior Architectural Communication Technique in 2012 Curriculum)

Reference:

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

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.

ENAR603003
ENAR613003
ARCHITECTURAL DESIGN 1
7 CREDIT UNITS

Learning Objectives:
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,

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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 (or Architectural Communication Technique or Interior Architectural Communication Technique in 2012 Curriculum)
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

ENAR603012
ENAR613012
BUILDING TECHNOLOGY 1
3 CREDIT UNITS

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 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.

ENAR604004
ENAR614004
ARCHITECTURAL DESIGN 2
8 CREDIT UNITS

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:
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 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

ENAR604014
ENAR614014
BUILDING TECHNOLOGY 2
3 CREDIT UNITS

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 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 technology 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.

ENAR605005
ENAR615005
ARCHITECTURAL DESIGN 3
9 CREDIT UNITS

Learning Objectives:
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*, Architectural 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

ENAR605016
ENAR615016
BUILDING TECHNOLOGY 3
3 CREDIT UNITS

Learning Objectives:
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.

ENAR606006

ENAR616006
ARCHITECTURAL DESIGN 4
9 CREDIT UNITS

Learning Objectives:
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

ENAR606017
ENAR616017
INTRODUCTION TO URBAN CONTEXT
3 CREDIT UNITS

Learning Objectives:
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

ENAR607007
ENAR617007
ARCHITECTURAL DESIGN 5
9 CREDIT UNITS

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. Other reference relevance for Architectural Design.

ENAR600008
ENAR610008
UNDERGRADUATE THESIS
6 CREDIT UNITS

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 credit units 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

ENAR600008
ENAR610008
FINAL PROJECT
6 CREDIT UNITS

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 credit units 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

ENAR600018
ENAR610018
ACOUSTICS
3 CREDIT UNITS

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

ENAR600019
COASTAL ARCHITECTURE
3 CREDIT UNITS

Learning Objectives:
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: -

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

1. Malcolm Newson, *Land, Water and Development: River Basin Systems and their Sustainable Development*, Routledge,1992
2. Koen Olthuis and David Keuning, *Float!. Building on Water to Combat Urban Congestion and Climate Change*, Frame Publishers, 2010
3. Djoko Pramono, *Budaya Bahari*, Gramedia Pustaka Utama, 2005
4. Alan P. Trujillo and Harold V. Thurman, *Essentials of Oceanography, Ninth Edition*, Pearson Education *Ltd, 2008*
5. Heather Vies and Tom Spencer, *Coastal Problems: Geomorphology, Ecology and Society at the Coast*, Edward Arnold, 1995
6. Ary Wahyono, AR Patji, SS Laksono, R. Indrawasih, Sudiyono dan Surmiati Ali, *Hak Ulayat Laut di Kawasan Indonesia Timur*, Media Presindo Yogjakarta, 2000

ENAR600020
ENAR610020
ETHNIC ARCHTECTURE
3 CREDIT UNITS

Learning Objectives:
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, building process.

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

ENAR600021
ARCHITECTURE, CITY AND POWER
3 CREDIT UNITS

Learning Objectives:
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

ENAR600022
HERITAGE BUILDING
3 CREDIT UNITS

Learning Objectives:
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

ENAR600023
URBAN ECOLOGY
3 CREDIT UNITS

Learning Objectives:
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

ENAR600024
DIGITAL FABRICATION
3 CREDIT UNITS

Learning Objectives:
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

ENAR600025
HIGH RISE BUILDING FAÇADE
3 CREDIT UNITS

Learning Objectives:
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

ENAR600026
PHOTOGRAPHY
3 CREDIT UNITS

Learning Objectives:
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 through two-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

ENAR600027
GEOMETRY AND ARCHITECTURE
3 CREDIT UNITS

Learning Objectives:
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

ENAR600028
EVERYDAY AND ARCHITECTURE
3 CREDIT UNITS

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. Arnstein, *Ladder of Citizen Participation*, 1969

ENAR600029
ENAR610029
2D DIGITAL DESIGN COMMUNICATION
3 CREDIT UNITS

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 (or Architectural Communication Techniques or Interior Architectural Communication Techniques in 2012 Curriculum)

References:
1. L Farrelly, *Basic Architecture: Representation Techniques*, 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

ENAR600030
ENAR610030
3D DIGITAL DESIGN COMMUNICATION
3 CREDIT UNITS

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 (or Architectural Communication Techniques or Interior Architectural Communication Techniques in 2012 Curriculum)

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

ENAR600031
LIFE CYCLE ENVIRONMENT
3 CREDIT UNITS

Learning Objectives:
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)

ENAR600032
PROJECT MANAGEMENT
3 CREDIT UNITS

Learning Objectives:
Student should be able to develop knowledge about project management and process in design and built environment, particularly administration of technical aspects and building economy from early

FACULTY OF ENGINEERING

stage of the project, design, construction, to the the end of the project; should be able to analyze the content of project management documents, building regulation and standard; should be able to create proposal, TOR, auction document, design administration, construction administration, or Project Manual of construction service in small scale project, including working with real client.

Syllabus:
As a product, project management is record of series of project activities as a holistic process, including as a working guide, coordination tools, and as a control for a project. As a process, project management is series of activities that produce responsibilities toward the quantity of records of the whole stages of project management, in one multidiscipline function. This subject introduces the skills required to manage project along its stages through chronological model.

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

ENAR600033
URBAN DESIGN PRINCIPLES
3 CRESIT UNITS

Learning Objectives:
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

ENAR600034
INTERIOR DESIGN
3 CREDIT UNITS

Learning Objectives:
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

ENAR600035
ENAR610035
SITE PLANNING AND DESIGN
3 CREDIT UNITS

Learning Objectives:
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
4. William A. Mann, *Landscape Architecture, An Illustrated History in Timeless, Site Plans and Biography*, 1993
5. Geoffrey & Susan Jellicoe, *The Landscape of Man, Shaping the Environment From Prehistory to the Present Day*, Thames and Hudson Ltd,1995
6. Charles W. Moore et al, *The Poetics of Gardens*, MIT Press, 1993
7. Francis DK Ching, *Architecture: Form, Space and Order*, Erlangga, 1996

ENAR600036
CITY PLANNING
3 CREDIT UNITS

Learning Objectives:

UNDERGRADUATE PROGRAM

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 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 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.
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.

ENAR600037
ARCHITECTURAL PSYCHOLOGY
3 CREDIT UNITS

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 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

ENAR600038
ENAR610038
REAL ESTATE
3 CREDIT UNITS

Learning Objectives:
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

ENAR600039
PROJECT FEASIBILITY STUDY
3 CREDIT UNITS

Learning Objectives:

FACULTY OF ENGINEERING

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: -

ENAR600040
ENAR610040
LIGHTING DESIGN
3 CREDIT UNITS

Learning Objectives:
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

ENAR600041
ENVIRONMENTAL DESIGN THEORIES AND METHODS

Learning Objectives:
Students should be able to understand basic theories and methods of environmental design, able to explain their own ideas and works, and apply one of various methods of designing built environment through writing and drawing (sketches).

Syllabus:
Theory and method of thinking: axiomatic and reductive; Theory and method of identifying built environment related problems, environmental observation and buildings that shape the environment, theory and methods of understanding problems of built environment; environmental analysis; theory and method of environmental design problem solving.

Prerequisites: -

References:
1. Gunawan Tjahjono, Metode Perancangan: Suatu pengantar untuk arsitek dan perancang, 1998
2. Christopher Alexander, Notes on the Synthesis of Form, Harvard University Press, 1994
3. Christopher Alexander, Timeless Way of Buildings, Oxford University Press, 1979

UNDERGRADUATE PROGRAM

ENAR600042
URBAN HOUSING THEORY
3 CREDIT UNITS

Learning Objectives:
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

ENAR600043
BUILDING UTILITY
3 CREDIT UNITS

Learning Objectives:
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

ENAR600044
TECTONIC WORKSHOP
3 CREDIT UNITS

Learning Objectives:
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.

Prerequisite: -

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

ENAR600045
ENAR610045
INDEPENDENT STUDY
3 CREDIT UNITS

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.

ENAR600046
ENAR610046
DESIGN STUDY
3 CREDIT UNITS

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 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

ENAR600047
ENAR610047
CAPITA SELECTA
3 CREDIT UNITS

Learning Objective:
Students should be able to expand their knowledge on various topics that support acquisition of architectural knowledge and design skills.

Sylabus:
Selected topics that are relevant to architectural knowledge, design skills and their recent development.

Prerequisite: -

References: Relevant references to the topic offered.

ENAR600048
ENAR610048
INTERNSHIP
3 CREDIT UNITS

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 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.

Prerequisite: -

References: -

ENAR600049
ENAR610049
SPECIAL TOPIC ON ARCHITECTURAL DESIGN
3 CREDIT UNITS

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.

ENAR600050
ENAR610050
SPECIAL TOPIC IN URBAN DESIGN
3 SKS

Learning Objectives:
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.

Prerequisite: -

References: Relevant references to the topic offered.

ENAR600051
ENAR610051
SPECIAL TOPIC ON URBAN HOUSING AND SETTLEMENT
3 SKS

Learning objectives:
Students should be able to demonstrate knowledge on current development of urban housing and settlement.

Silabus:
Studies on the development of urban housing and settlement theories; studies on current issues that are relevant to urban housing and settlement.

Prerequisite: -

References: Relevant references to the topic offered.

ENAR600052
ENAR610052
SPECIAL TOPIC ON ARCHITECTURAL HISTORY, THEORY AND CRITICISM
3 SKS

Learning Objectives:
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.

Prerequisite: -

References: Relevant references to the topic offered.

ENAR600053
ENAR610053
SPECIAL TOPIC ON BUILDING TECHNOLOGY
3 SKS

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.

4.9. UNDERGRADUATE PROGRAM IN INTERIOR ARCHITECTURE

Program Specification

1	**Awarding Institution**		Universitas Indonesia
2	**Teaching Institution**		Universitas Indonesia
3	**Program**		Undergraduate Program in Interior Architecture
4	**Class**		Regular
5	**Degree Offered**		Sarjana Arsitektur (S.Ars)
6	**Accreditation / Recognition**		A Accredited from BAN-PT AUN-QA
7	**Language of Instruction**		Bahasa Indonesia and English
8	**Study Scheme (Full time/Part time)**		Full time
9	Entry Requirements		SMA Graduate/equal or D3/Polytechnique graduate
10	**Duration of Study**		4-year Program
	Semester	Total semester	Weeks / Semester
	Regular	8	17
	Short (optional)	3	8
11	Graduates' Profile: Sarjana Arsitektur Interior is a graduate who has the ability to design interior architecture 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: • An Initiator- able to provide solutions to spatial problems critically and creatively with respect to local contexts and needs • A Designer - have the skill in assembling interior architectural elements and materials, have an • understanding of buildability aspects, and have a sensitivity in creating meaningful interior architectural design. • A Communicator – able to communicate ideas verbally and through writings, drawings, models and other media. • A Collaborator - able to work together with various stakeholders in the socitety to propose creative solutions for real problems		
12	**Graduates' Competencies:** 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, formultae, 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.		
13	**Course Composition**		
No	Type of Course	Credits	Percentage
i	University General Subjects	18	12,5%
ii	Basic Engineering Subjects	11	7,6%
iii	Architecture Core Subjects	90	62,5%
iv	Electives	25	17,4%
	Total	144	100%
14	**Total Credits for Graduation**		**144 SKS**

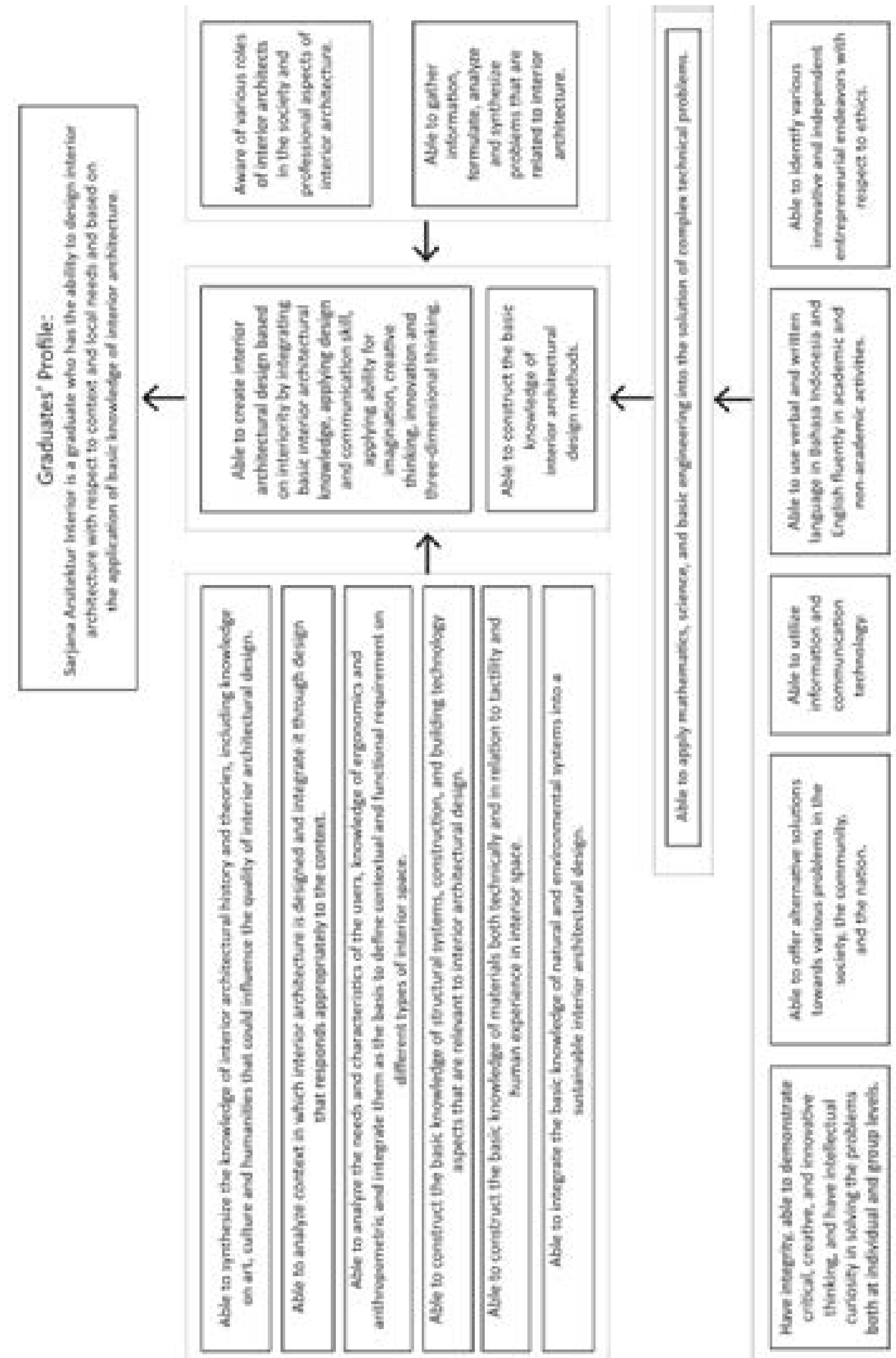
Job Opportunity

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.

INTERIOR ARCHITECTURE

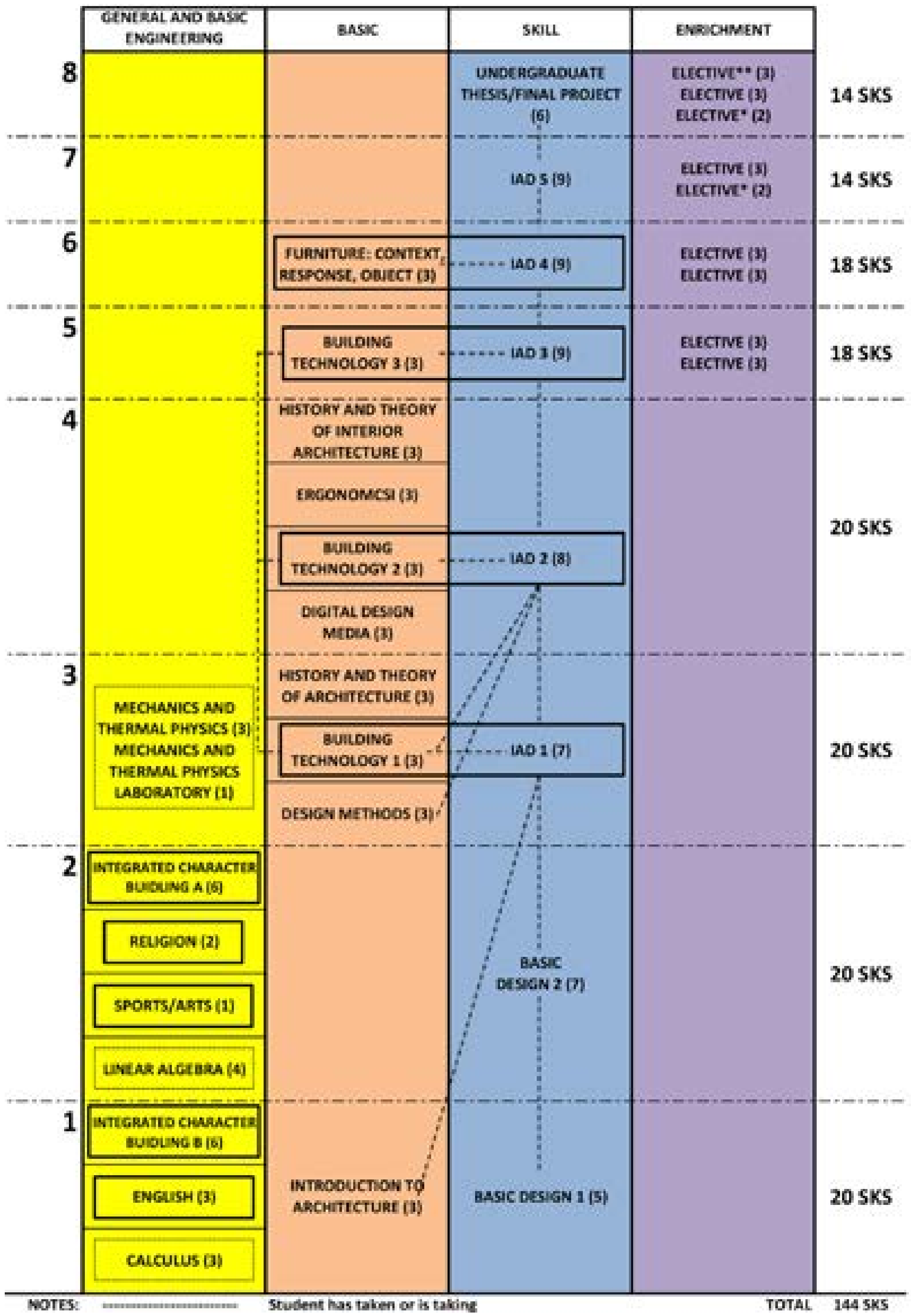
UNDERGRADUATE PROGRAM

Network of Competencies



INTERIOR ARCHITECTURE

Curriculum Structure of Undergraduate Program in Interior Architecture



CURRICULUM STRUCTURE UNDERGRADUATE INTERIOR ARCHITECTURE

KODE	SUBJECT	CREDIT
CODE	1st Semester	
UIGE600002	Integrated Character Building B	6
UIGE600003	English	3
ENGE600003	Calculus	3
ENAR601009	Introduction to Architecture	3
ENAI601001	Basic Design 1	5
	Sub Total	20
	2nd Semester	
UIGE600001	Integrated Character Building A	6
ENGE6000xx	Religion	2
ENGE600004	Linear Algebra	4
ENGE6000xx	Sport / Art	1
ENAI602002	Basic Design 2	7
	Sub Total	20
	3rd Semester	
ENGE600005	Physics (Mechanics and Thermal)	3
ENGE600006	Physics (Mechanics and Thermal) Lab	1
ENAI603003	Interior Architectural Design 1	7
ENAR603010	History & Theory of Architecture 1	3
ENAR603011	Design Methods	3
ENAI603012	Building Technology 1	3
	Sub Total	20
	4th Semester	
ENAI604004	Interior Architectural Design 2	8
ENAR604013	History & Theory of Interior Arch	3
ENAI604014	Building Technology 2	3
ENAR604015	Digital Design Media	3
ENAI604016	Ergonomics	3
	Sub Total	20
	5th Semester	
ENAI605005	Interior Architectural Design 3	9
ENAI605017	Building Technology 3	3
	Elective	3
	Elective	3
	Sub Total	18
ENAI606006	Interior Architectural Design 4	9
ENAI606018	Furniture: Context, Response, Object	3
	Elective	3
	Elective	3
	Sub Total	18
	7th Semester	
ENAI607007	Interior Architectural Design 5	9

	Elective	3
	Elective*)	2
	Sub Total	**14**
	8th Semester	
ENAI600008	Undergraduate Final Project	6
	Elective	3
	Elective**)	3
	Elective*)	2
	Sub Total	**14**
	Total	**144**

ELECTIVES

Kode	Elective Course	Credit
ENAI600019	Acoustics	3
ENAI600020	Anatomy of Space	3
ENAI600021	Art Appreciation	3
ENAI600022	Furniture Design	3
ENAR600026	Photography	3
ENAI600023	Life Style & Interior Architecture	3
ENAR600029	2D Design Dgital Communication	3
ENAR600030	3D Digital Design Communication	3
ENAI600024	Matriality in Interior Architecture	3
ENAI600025	Spatial Object	3
ENAR600037	Architectural Psychology	3
ENAI600026	Exhibition Space and Narrative	3
ENAI600027	Art and Architecture	3
ENAI600028	Lighting Design for Interior Arch	3
ENAI600029	Independent Study	3
ENAI600030	Design Study**)	3
ENAI600031	Capita Selecta	3
ENAI600032	Internship	3
ENAI600033	Special Topic on Interior Architecture	3

*) Students are required to take minimum 2 subjects from outside Interior Architecture Study Program as electives

**) Design Study is required as elective for students who choose to take Final Project

SYLLABUS OF UNIVERSITY SUBJECTS

INTEGRATED CHARACTER BUILDING A
UIGE600001/UIGE610001
6 sks
Syllabus : Integrated Character Building A facilitates students to understand the basics of character formation and master the basics of cognitive power that is logic. Furthermore, to apply cognitive powers in generating good behaviors which are useful to themselves and society. The establishment of ethical behaviors based on ethics is also facilitated. Students are able to develop the basic strength of character and to know themselves as a human being, both as individuals and as part of a group so that they can develop themselves well enough. In a group, the students need to have skills that are needed to maintain an effective relationship in order to improve the quality of human life. Particularly as a citizen of Indonesia, students need to understand the nature of citizenship and basic philosophy of Pancasila in order to act and behave in accordance with the character of the Indonesian nation.
Core Competencies :
1. Students are able to analyze problems in depth individually, comprehensively, logicaly and criticaly, and generate solutions using the logical and ethical principles and rules of logic and ethics
2. Students are capable of analyzing the problem individually, thoroughly and deeply about the human being as an individual or as part of group
3. Students are individually able to understand, make critical reasoning and to build an open and critical mind to the problem of nationhood, statehood and citizenship in this dynamic world situation
4. Students are able to create and display a work that depicts the character in accordance with the principles of Pancasila

Learning Method : interactive lecture, Experiential Learning, Collaborative Learning, Problem Based Learning, Project-Based Assignment
Prerequisites : OBM (New Student Orientation)

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))

INTEGRATED CHARACTER BUILDING B
UIGE600002/UIGE610004
6 sks
Syllabus : Integrated Character Building B facilitates students to practice identifying, analyzing, and resolving problems of nature and the environment by making use of integrative and quantitative information. This lecture aims to prepare the future generation who care about nature issues through the balanced development of hard skills and soft skills and have the skills of ICT (Information and Communication Technology).
Core Competencies:
1. Students have an ethic, moral, personality and good character in completing the task at hand;
2. Students role as citizens who take pride and love of the homeland and support the continuity of life;
3. Students are able to work together and have a high sensitivity and awareness to the community and the environment;
4. Students are able to think logically, critically and creatively;
5. Students are able to use mathematics to solve problems quantitatively;
6. Students are able to use information and communication technology (ICT) for development;
7. Students are able to analyze the system of nature integratively and comprehensively;
8. Students are able to act as wise managers of nature to build and maintain the preservation of nature for a better and sustainable life.

Learning Method : Blended e-Learning, Collaborative Learning (CL), Problem Based Learning (PBL) and Group Discussion (GD)
Prerequisites : OBM (New Student Orientation)
Textbook : Digital Form can be downloaded from Scele

ISLAMIC STUDY
UIGE600010/UIGE610005
2 sks
General instructional objectives : The cultivation of students who have concern for social, national 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 practice 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 STUDY
UIGE600011/UIGE610006
2 sks
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 STUDY
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 STUDY
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 STUDY
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 STUDY
UIGE600015
2 sks

ART
UIGE600020-30
1 sks
The option of subjects that can be choosen :
Appreciation of Film (UIGE600020), Batik (UIGE600021), Photography (UIGE600022), Calligraphy (UIGE600023), Javanese Karawitan (UIGE600024), Balinese Dance and Karawitan (UIGE600025), Comic (UIGE600026), Painting (UIGE600027), Music and Vocal (UIGE600028), Theater (UIGE600029), Wayang (UIGE600030)

SPORT
UIGE600040-48
1 sks
The option of subjects that can be choosen :
Basketball (UIGE600040), Volley Ball (UIGE600041), Badminton (UIGE600042), Futsal (UIGE600043), Hockey (UIGE600044), Football (UIGE600045), Softball (UIGE600046), Tennis (UIGE600047), Table Tennis (UIGE600048)

SYLLABUS OF BASIC ENGINEERING SUBJECTS

CALCULUS 1
ENGE600001/ENGE610001
3 sks
Syllabus : This subject gives the opportunity for students to understand the basic concept of calculus and to be able to solve applied calculus problems. Students are also given the opportunity to understand basic concepts the functions of one variable, derivatives and integral functions of one variable, and its application.

CALCULUS 2
ENGE600002/ENGE610002
3 sks
Syllabus : This subject gives the opportunity for students to understand the basic concept of calculus and to be able to solve applied calculus problems. Students are also given the opportunity to understand the basic concept the function of two variables, or variables, total derivative and integral of the function of two or more variables and application. In addition, students can understand the basic concepts of sequence and series.

CALCULUS
ENGE600003/ENGE610003
4 sks
Syllabus : This subject gives the opportunity for students to understand the basic concept of calculus and to be able to solve applied calculus problems. Students are also given the opportunity to understand the basic concept the function of two variables, the total derivative of the function of two or more variables and its application. Students are also expected to understand the basic concept of sequence and series and the basic concept of vector and analytical geometry.

LINEAR ALGEBRA
ENGE600004/ENGE610004
4 sks
Syllabus : This subject gives the opportunity for students to master the basic techniques of Linear Algebra and gain knowledge on how to implement said techniques in solving System of linear equationss, determining the bases and dimension of vector space, as well as calculating eigen values and eigen vectors. This subject also gives students the opportunity to work with other objects, especially vectors and matrices.

PHYSICS (MECHANICS AND THERMAL)
ENGE600005/ENGE610005
3 sks
Syllabus : Physics (Mechanics and Thermal) subject includes the topics of mechanics and thermodynamics. Calculus is use as a mathematic helping tool in the learning process. Students are given the opportunity to learn how to unite their understanding of the basic concept of the analytical capability, their numeracy in learning mechanics and thermodynamics. During the course of this subject, students are not only aim to increase the students' knowledge of the basic physics concepts but also to increase their capability in using information technology and computer and to train their skills, such as: independent and group work and their communication skill.
Students will also be train on how to explain and analyse the nature phenomenon and the result of human engineering exist in their everyday lives by using the basic physics concept and applied them in their daily lives. Students are also taught to develop their synthesis ability and evaluating both quantitative and qualitative natural phenomenon and the result of human engineering in their surrounding environment by using basic physics concept. This subject will give students the opportunity to develop their ability to develop their presentation ability analyse the nature phenomenon and the result of human engineering from the mathematics and natural science point of view integrative and comprehensively.

PHYSICS (MECHANICS AND THERMAL) LABORATORY
ENGE600006/ENGE610006
1 sks
Syllabus : Practical of Mechanics: Measurement, Moment of inertia, Gravity acceleration, Fluid density, Scratch coefficient, Collision, Swing torque, Viscosity of water, Young's modulus, Viscosity of Newtonian fluid, Fluids surface tension, Oscillation, Practical of Heat: Coefficient of linear expansion, Heat conductivity, Thermocouple calibration, Calorimeter, Joule Constant, Laplace Constant, Heat Collector, Determining of air Cp/Cv, Expansion of fluids and water anomaly.
Notes: For Architecture and Interior Architecture Program, practical is not mandatory.

PHYSICS (ELECTRICITY, MWO)
ENGE600007/ENGE610007
3 sks
Syllabus : Physics (Electricity, MWO) subject includes the topics of electricity, magnet, wave, and optics. Calculus is use as a mathematic helping tool in the learning process. Students are given the opportunity to learn how to unite their understanding of the basic concept of the analytical capability, their numeracy in learning mechanics and thermodynamics. During the course of this subject, students are not only aim to increase the students' knowledge of the basic physics concepts but also to increase their capability in using information technology and computer and to train their soft skills, such as: independent and group work and their communication skill. Students will also be train on how to explain and analyze the nature phenomenon and the result of human engineering exist in their everyday lives by using the basic physics concept and applied them in their daily lives. Students are also taught to develop their synthesis ability and evaluating both quantitative and qualitative natural phenomenon and the result of human engineering in their surrounding environment by using basic physics concept.

PHYSICS (ELECTRICITY, MWO) LABORATORY
ENGE600008/ENGE610008
1 sks
Syllabus : Practical of Electricity: Electrolysis, Wheatstone bridge, Kirchhoff law, Earth's magnetic field, Temperature coefficient, Characteristic of series RLC circuit, Ohm law, Transformer. Practical of Optics: Polarimeter, Lens, Photometry, Prisms bias index, Spectrometer, Diffraction grid, Newton's ring.

BASIC CHEMISTRY
ENGE600009/ENGE610009
2 sks
Syllabus : As an engineer, you must have understanding on the chemistry that provides not only the basis for much of what goes on in our world but also that it is a vital, continually developing science. In this study the students will learn many subjects such as matter and measurement; atoms, molecules, and ions; stoichiometry; aqueous reactions; thermochemistry; properties of solutions; chemical kinetics; chemical equilibrium; and electrochemistry.
Learning activities will be conducted through various method, which consists of: problem based learning (PBL), interactive lecture, question-based learning, discussion, demonstration and unguided structured assignments. Assessment will be made continuously through a set of exercises, group discussion, mid semester exam and final exam.

STATISTIC AND PROBABILITY
ENGE600010/ENGE610010
2 sks
Syllabus : Statistics and probability has been known as applied mathematics which is widely used in collecting, organizing, presenting, interpreting and analyzing data to support valid conclusions. Furthermore, these conclusions will be used as recommendation in decision making. The course of Statistics and Probability is intended to give a basic ability for students to handle quantitative data and information. There are two stages that are delivered which is descriptive and inductive/ inference stages. Descriptive stage includes collecting, organizing, and presenting the data in a scientific manner. Then, inductive/inference stage includes the process of estimating and drawing conclusion based on available data and relations between variables. Hence, students are expected to apply their knowledge of statistics in conducting experiments in laboratory works/assignments as well as research studies in their final projects.

ENGINEERING ECONOMICS
ENGE600011/ENGE610011
3 sks
Syllabus : This course introduces students to the basic of engineering economy. It covers the time value of money (TVOM) and interest rate; tools for evaluating project alternatives for both non discounted and discounted methods, for instance present worth analysis, annual worth analysis, future worth analysis, rate of return (ROR) analysis and benefit/cost analysis; and choosing the best alternative, break even analysis, and effect of depreciation and after tax analysis and sensitivity analysis, and replacement analysis.
Learning activities will be conducted through various methods, which consist of: interactive lectures, question-based learning, discussion, and structure assignments. Assessment will be made thoroughly through sets of exercises/quizzes, group discussion, midterm and final exam. To expose students on the latest utilization of engineering economy and train them how to use it, a project will be assigned. As an integral part of course, computer utilization such as Microsoft Excel will be demonstrated and discussed on the class.

HEALTH, SAFETY AND ENVIRONMENTAL PROTECTION
ENGE600012/ENGE610012
2 sks
Syllabus : The teaching of Safety, Health and Environmental (SHE) protection to undergraduates studying engineering courses is an important part of the education of future engineers at all levels. It is the generally expressed view amongst practitioners in industry, business and other organisations that all engineers need to be equipped to appreciate, understand and implement the requirements of SHE management and practice to meet the working needs of industry and of their company (or other organisation). Whilst the level of risk and degree of control is dependant on the industry sector concerned the basic principles do not change. In addition, according to code of ethics of engineers, engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties.
The module covers the regulation framework and standards, risk perception, assessment, and management and detail discussion on physical, chemical and process hazards, and related engineering and management controls. Maintenance of safety conditions, personal protective equipments, audit, incident and emergency planning are discussed in accordance to measures for improving students awareness to their daily activities within the campus premises and local environment.
Learning activities will be conducted through various methods, which consist of: interactive lecture, question-based learning, discussion, demonstration and unguided structured assignments. Assessment will be made continuously through a set of exercises, group discussion, mid semester exam and final exam

COURSE DESCRIPTION: COMPULSORY COURSES

ENAR601009
ENAR611009
INTRODUCTION TO ARCHITECTURE
3 CREDIT UNITS

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; understanding 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

ENAI601001
BASIC DESIGN 1
5 CREDIT UNITS

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.

ENAI602002
BASIC DESIGN 2
7 CREDIT UNITS

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; communicating object and space for various purpose and audiences; communicate human activity space.

Prerequisites: Student has taken Basic Design 1 (or Visual Arts in 2012 Curriculum)

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

ENAR603010
HISTORY AND THEORY OF ARCHITECTURE 1
3 CREDIT UNITS

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: -

Reference:
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

ENAR603011
DESIGN METHODS
3 CREDIT UNITS

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

Reference:

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

ENAI604013
HISTORY AND THEORY OF INTERIOR ARCHITECTURE
3 CREDIT UNITS

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: -

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 Baudrillard, *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.

ENAI604016
ERGONOMICS
3 CREDIT UNITS

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

ENAR604015
DIGITAL DESIGN MEDIA
3 CREDIT UNITS

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 (or Architectural Communication Technique or Interior Architectural Communication Technique in 2012 Curriculum)

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

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 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, Interior Architectural Design 1 and Building Technology 1.

ENAI603003
INTERIOR ARCHITECTURAL DESIGN 1
7 CREDIT UNITS

Learning Objectives:
Student should be able to design a space for a single person, through understanding the relationship 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 (or Architectural Communication Technique or Interior Architectural Communication Technique in 2012 Curriculum)
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

INTERIOR ARCHITECTURE

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

ENAI603012
BUILDING TECHNOLOGY 1
3 CREDIT UNITS

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 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, Interior Architectural Design 2 and Building Technology 2.

ENAI604004

INTERIOR ARCHITECTURE

INTERIOR ARCHITECTURAL DESIGN 2
8 CREDIT UNITS

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. 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

INTERIOR ARCHITECTURE

ENAI604014
BUILDING TECHNOLOGY 2
3 CREDIT UNITS

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.

ENAI605005
INTERIOR ARCHITECTURAL DESIGN 3
9 SKS

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:

INTERIOR ARCHITECTURE

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*

ENAI605017
TEKNOLOGI BANGUNAN 3
3 SKS

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. A. 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

UNDERGRADUATE PROGRAM

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.

ENAI606006
INTERIOR ARCHITECTURAL DESIGN 4
9 CREDIT UNITS

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 course

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

INTERIOR ARCHITECTURE

FACULTY OF ENGINEERING

14. Graeme Brooker, *Key Interiors since 1900*, Laurence King, 2013

ENAI606018
FURNITURE: CONTEXT, RESPONSE, OBJECT
3 CREDIT UNITS

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

ENAI607007
INTERIOR ARCHITECTURAL DESIGN 5
9 CREDIT UNITS

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,* atau *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

ENAI600008
UNDERGRADUATE THESIS
6 CREDIT UNITS

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 credit units 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. 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

ENAI600008
FINAL PROJECT
6 CREDIT UNITS

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.

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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 credit units and have taken Interior 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

ENAI600019
ACOUSTICS
3 CREDIT UNITS

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

ENAI600020
ANATOMY OF SPACE
3 CREDIT UNITS

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, austism, 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

ENAI600021
ART APPRECIATION
3 CREDIT UNITS

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 artswork. 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

ENAI600022
FURNITURE DESIGN
3 CREDIT UNITS

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.

UNDERGRADUATE PROGRAM
INTERIOR ARCHITECTURE
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FACULTY OF ENGINEERING

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

ENAR600026
PHOTOGRAPHY
3 CREDIT UNITS

Learning Objectives:
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 through two-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

ENAI600023
LIFESTYLE AND INTERIOR ARCHITECTURE
3 CREDIT UNITS

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

ENAR600029
2D DIGITAL DESIGN COMMUNICATION
3 CREDIT UNITS

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 (or Architectural Communication Techniques or Interior Architectural Communication Techniques in 2012 Curriculum)

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

ENAR600029
3D DIGITAL DESIGN COMMUNICATION
3 CREDIT UNITS

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 (or Architectural Communication Techniques or Interior Architectural Communication Techniques in 2012 Curriculum)

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
4. Brightman, M. 2013. *The Sketchup Workflow for Architecture*. Wiley.

ENAI600024
MATERIALITY IN INTERIOR ARCHITECTURE
3 CREDIT UNITS

Learning Objectives:
Students should be able to understand material as an essential part of thinking dan 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

ENAI600025
SPATIAL OBJECTS
3 CREDIT UNITS

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

ENAR600037
ARCHITECTURAL PSYCHOLOGY
3 CREDIT UNITS

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

ENAI600026
EXHIBITION SPACE AND NARRATIVE
3 CREDIT UNITS

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

ENAI600027
ART AND ARCHITECTURE
3 CREDIT UNITS

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, dll, 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

ENAI600028
LIGHTING DESIGN FOR INTERIOR ARCHITECTURE
3 CREDIT UNITS

Learning Objectives:
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

ENAI600029
INDEPENDENT STUDY
3 CREDIT UNITS

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.

ENAI600030
DESIGN STUDY
3 CREDIT UNITS

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

ENAI600031
CAPITA SELECTA
3 CREDIT UNITS

Learning Objective:
Students should be able to expand their knowledge on various topics that support acquisition of interior architectural knowledge and design skills.

Sylabus:
Selected topics that are relevant to interior architectural knowledge, design skills and their recent development.

Prerequisite: -

References: Relevant references to the topic offered.

ENAI600032
INTERNSHIP
3 CREDIT UNITS

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: -

ENAI600033
SPECIAL TOPIC ON INTERIOR ARCHITECTURE
3 CREDIT UNITS

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.

4.10. UNDERGRADUATE PROGRAM IN CHEMICAL ENGINEERING

Program Specification

1	**Awarding Institution**		Universitas Indonesia and partner universities
2	**Teaching Institution**		Universitas Indonesia Universitas Indonesia and partner universities
3	**Programme Title**		Undergraduate Program in Chemical Engineering
4	**Type of Class**		Regular, Paralel, Internasional
5	**Degree Given**		Sarjana Teknik (S.T) Double degree: Sarjana Teknik (S.T) and Bachelor of Engineering (B.Eng)
6	**Accreditation status**		BAN-PT: A Accreditation AUN-QA
7	**Medium Language**		Indonesian and English
8	**Study Scheme(Full time/Part time)**		Full time
9	**Entry requirement**		High school /equivalent, or D3 / Polytechnique / equivalent, AND pass the entrance exam.
10	**Duration of Study**		Designed for 4 years
	Type of Semester	Number of semester	Number of weeks /semester
	Regular	8	16
	Short (optional)	3	8
11	**Graduate Profiles:** *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 ethics aspects; able to think critically, communicate effectively, and work together in multidisciplinary teams.*		
12	**Expected Learning Outcomes:** 1. Able to communicate effectively and work in multidisciplinary team. 2. Capable of critical, creative, and innovative thinking, and also have the intellectual ability to solve problems independently and and interdependently 3. Good at both spoken and written Bahasa Indonesia and English for academic and non-academic activity 4. Capable of utilizing communication information technology 5. Able to apply knowledge of mathematics and science in solving engineering problems 6. Able to apply concept of mass and energy balances in solving chemical engineering problems 7. Able to apply thermodynamic concepts in solving chemical engineering problems 8. Able to apply concepts of transport phenomena in solving chemical engineering problems 9. Able to apply the concepts of chemical reaction engineering 10. Able to use modern chemical engineering tools 11. Able to conducts experiments and analyze the data obtained		

13	12. Able to design components, systems, processes, and products related to chemical engineering profession with careful consideration of the engineering, economic, social, health and safety, energy, environment, sustainability, and ethics aspects 13. Able to provide solutions to various problems occurred wherever they live and work 14. Able to identify the kind of entrepreneurial approach needed based on innovation, self-reliance and ethics 15. Continuously develop oneself to contribute in solving local and global problems.

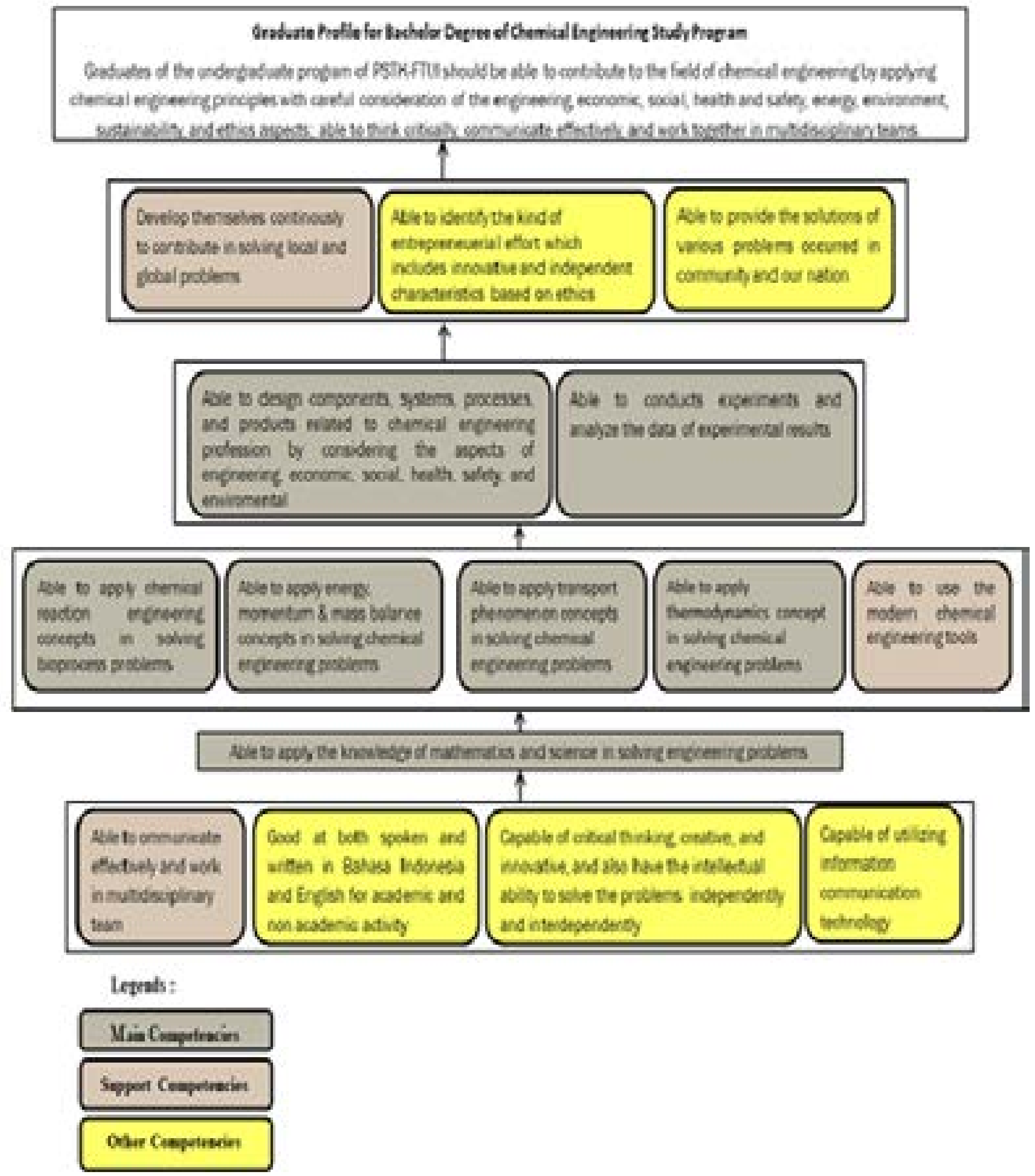
14	**Course Composition**		
No	Type of Course	Credits	Percentage
i	General Course of University	18	12,4
ii	General Course of Engineering Faculty	25	17,2
iii	Skill Course	82	57
iv	Optional Course	12	8
v	Internship , Seminar, Final Project, Project	7	5
	Type of Course	144	100 %
15	**Total Credit Hours to Graduate**		**144 SKS**

Employment Prospects

A graduate of the chemical engineering and bioprocess technology study programs can be described as a “Universal Engineer” as they learn the basics of engineering such as thermodynamics, reaction kinetics and reactor design, separation processes, as well as transport phenomena (momentum, energy and mass). Graduates of 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.

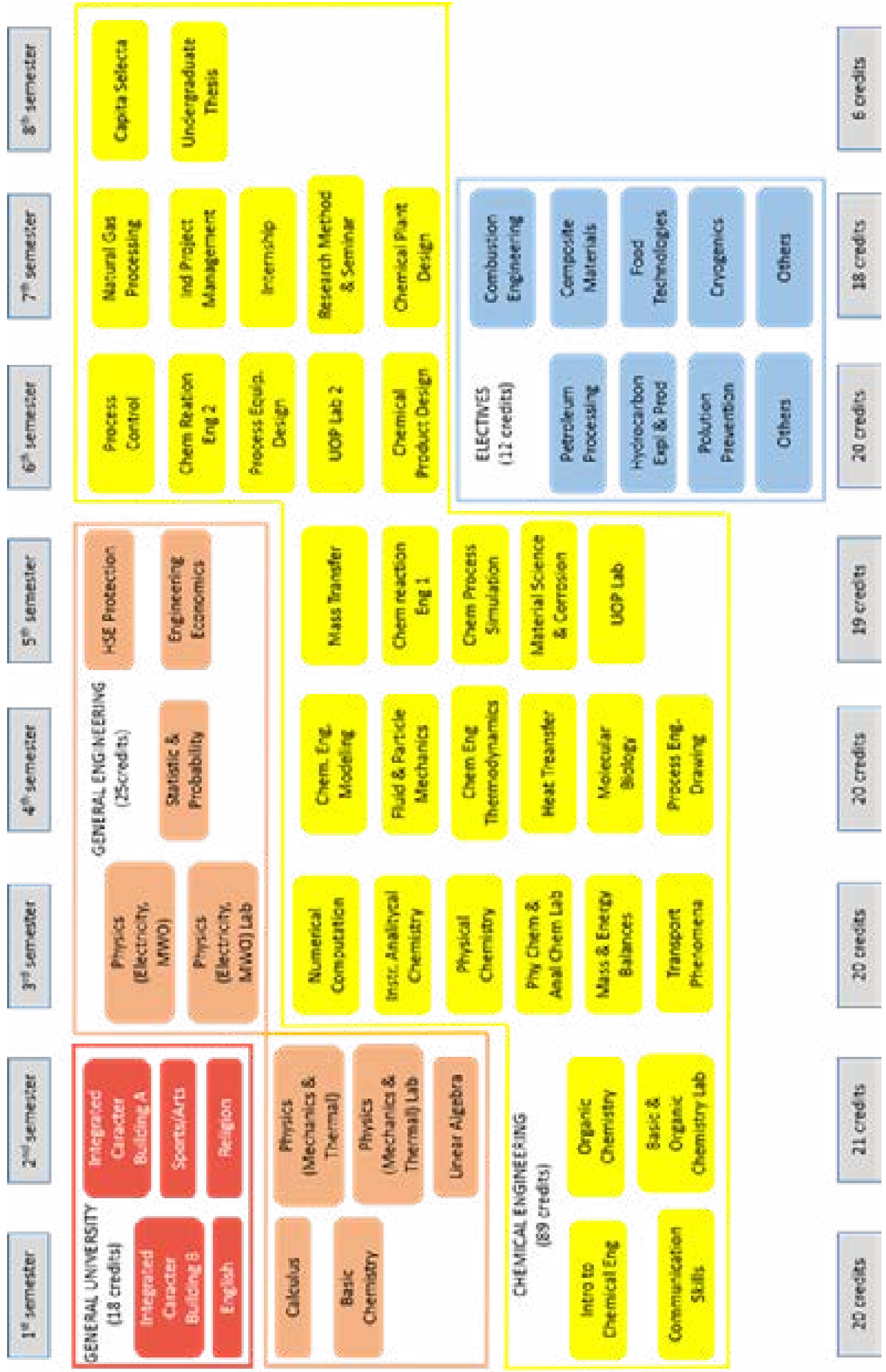
CHEMICAL ENGINEERING

NETWORK COMPETENCE



CHEMICAL ENGINEERING

FLOW DIAGRAM OF SUBJECT



CURRICULUM STRUCTURE UNDERGRADUATE CHEMICAL ENGINEERING

KODE	SUBJECT	CREDIT
CODE	1st Semester	
UIGE600002	Integrated Character Building B	6
UIGE600003	English	3
ENGE600003	Calculus	4
ENGE600009	Basic Chemistry	2
ENCH601001	Intro to Chemical Engineering	3
ENCH601002	Communication skills	2
	Total Credit Term 1	20
2nd Semester	2nd Semester	
UIGE600001	Integrated Character Building A	6
UIGE600010-15	Religion	2
ENGE600004	Linear Algebra	4
UIGE600020-48	Sport / Art	1
ENGE600005	Physics (Mechanics and Thermal)	3
ENGE600006	Physics (Mechanics and Thermal) Lab	1
ENCH602003	Organic Chemistry	3
ENCH602004	**Organic and Basic Chemistry Lab**	**1**
	Total Credit Term 2	21
3rd Semester	3rd Semester	
ENGE600007	Physics (Electricity, MWO)	3
ENGE600008	Physics (Electricity, MWO) Lab	1
ENCH603005	Numerical Computation	3
ENCH603006	Instrumental Analytical Chemistry	3
ENCH603007	Physical Chemistry	3
ENCH603008	Phys. Chem. and Anal. Chem. Lab	1
ENCH603009	Mass and Energy Balance	3
ENCH603010	Transport Phenomena	3
	Total Credit Term 3	20
4th Semester	4th Semester	
ENCH604011	**Chemical Engineering Modeling**	**3**
ENCH604012	**Fluid and Particle Mechanics**	**3**
ENGE600010	**Statistic and Probability**	**2**
ENCH604013	**Chemical Eng. Thermodynamics**	**4**
ENCH604014	**Heat Transfer**	**3**
ENCH604015	**Process Engineering Drawing**	**2**
ENCH604016	**Molecular Biology**	**3**
	Total Credit Term 4	**20**
5th Semester	5th Semester	
ENCH605017	Material Science and Corrosion	3
ENGE600012	HSE Protection	2
ENGE600011	Engineering Economics	3
ENCH605019	Mass Transfer	4
ENCH605020	Unit Operation Process Lab I	1
ENCH605021	Chemical Reaction Engineering 1	3

ENCH605022	Chemical Process Simulation	3
	Total Credit Term 5	**19**
6th Semester	**6th Semester**	
ENCH606023	Process Control	3
ENCH606024	Unit Operation Process Lab II	1
ENCH606025	Chemical Reaction Engineering 2	3
ENCH606026	Process Equipment Design	3
ENCH606027	Chemical Product Design	4
	Elective 1	3
	Elective 2	3
	Total Credit Term 6	**20**
7th Semester	**7th Semester**	
ENCH607028	Natural Gas Processing	3
ENCH607029	Industrial Project Management	2
ENCH600030	Plant Design	4
ENCH600031	Internship	2
ENCH600032	Research Methodology & Seminar	2
	Elective 3	3
	Elective 4	2
	Total Credit Term 7	**18**
8th Semester	**8th Semester**	
ENCH600033	**Undergraduate Thesis**	**4**
ENCH600034	**Capita Selecta**	**2**
	Total Credit Term 8	**6**

ELECTIVES

Kode	Elective Course for Odd Semester	Credit
ENCH801101	Food Technology	3
ENCH801102	Herbal Engineering	3
ENCH801103	Composite Material	3
ENCH801104	Hydrocarbon Thermodynamic	3
ENCH801105	Lubricants Engineering	3
ENCH801106	Combustion Engineering	3
ENCH801107	Heterogenous Catalyst	3
ENCH803101	Oleochemistry Industry	3
ENCH803102	Protein Engineering	3
ENCH803103	Applied Thermodynamics	3
ENCH803104	Dynamics System	3
ENCH803105	Cryogenics	3
ENCH803106	Plasma and Ozone Engineering	3
ENCH803107	Special Topics 1	3
ENCH803201	Renewable Energy	3
Kode	**Elective Course for Even Semester**	**Credit**
ENCE802101	Packaging and Storage Technology	3
ENCE802102	Bioinformatics	3
ENCE802103	Drugs and Cosmetics Technology	3
ENCE802104	Biomaterial	3
ENCE802105	Petroleum Processing	3
ENCE802106	Petrochemical Processing	3
ENCE802107	Photocatalysis Technology	3
ENCE812108	Polymer Engineering	3
ENCE802109	Pollution Prevention	3
ENCE802110	Exploration and Production of Hydrocarbon	3
ENCE802111	Utilities and Plant Maintenance	3
ENCE802112	Natural Gas Transportation and Utilization	3
ENCE812113	Drug Controlled Released Technology	3
ENCE802114	Analysis and Synthesis of Chemical Processes	3
ENCE802115	Geothermal Technology	3
ENCE802116	Problem-Solving Skills	3
ENCE802117	Special Topic 2	3

Resume	General Course of University	18
	General Course of Engineering Faculty	25
	Skill Course	90
	Total	133
	Optional Course	12
	Total Courses Load	145

COURSE STRUCTURE INTERNATIONAL UNDERGRADUATE CHEMICAL ENGINEERING

KODE	SUBJECT	CREDIT
CODE	**1st Semester**	
Compulsory		
UIGE610002	Academic Writing	3
ENGE 610005	Physics (Mechanics and Thermal)	3
ENGE 610006	Physics(Mechanics and Thermal) Laboratory	1
ENGE 610003	Calculus	4
ENGE 610009	Basic Chemistry	2
ENGE 610010	Statistics and Probability	2
ENCH611001	Introduction to Chemical Engineering	3
	Total	**18**
Elective		
	Total	**0**
	Total Credit Term 1	**18**
	2nd Semester	
Compulsory		
ENGE 610004	Linear Algebra	4
ENGE610007	Physics (Electric, Magnet,Wave & Optic)	3
ENGE610008	Physics (Electric, Magnet,Wave & Optic)Laboratory	1

ENCH612002	Organic Chemistry	3
ENCH612003	Mass and Energy Balances	3
ENCH612004	Basic Chem. and Org. Chem. Lab.	1
ENCH612005	Physical Chemistry	3
	Total	**18**
Elective		
	Total	**0**
	Total Credit Term 2	**18**
	3rd Semester	
Compulsory		
ENCH613006	Material Science and Corrosion	3
ENCH613007	Numerical Computation	3
ENCH613008	Instrumental Analytical Chemistry	3
ENCH613009	Fluid and Particle Mechanics	3
ENCH613010	Phys. Chem. and Anal. Chem. Lab.	1
ENCH613011	Chemical Engineering Thermodynamics	4
ENCH613012	Transport Phenomena	3
	Total	**20**
Elective		
	Total	**0**
	Total Credit Term 3	**20**
	4th Semester	
Compulsory		
ENCH614013	Chemical Engineering Modeling	3
ENCH614014	Mass Transfer	4
ENCH614015	Heat Transfer	3
ENCH614016	Process Engineering Drawing	2
ENCH614017	Chemical Process Simulation	3
ENCH614018	Molecular Biology	3
ENGE 6 1 0012	Health, Safety and Environmental Protection	2
	Total	**20**
Elective		
	Total	**0**
	Total Credit Term 4	**20**
	5th Semester	
Compulsory		
UIGE610004	Integrated Character Building B	6
ENGE610011	Engineering Economics	3
ENCH615019	Chemical Reaction Engineering 1	3
ENCH615020	Process Control	3
ENCH615021	Unit Operation Laboratory 1	1
ENCH615022	Industrial Project Management	2
	Total	**18**
Elective		
	Total	**0**
	Total Credit Term 5	**18**
	6th Semester	
Compulsory		

CHEMICAL ENGINEERING

UNDERGRADUATE PROGRAM

UIGE610001	Integrated Character Building A	6
UIGE610003	Sport/ Art	1
UIGE610005-9	Religion Studies	2
ENCH616023	Unit Operation Laboratory 2	1
ENCH616024	Chemical Reaction Engineering 2	3
ENCH616025	Process Equipment Design	3
ENCH616026	Chemical Product Design	4
	Total	**20**
Elective		
	Total	**0**
	Total Credit Term 6	**20**
	7th Semester	
Compulsory		
ENCH617027	Plant Design	4
ENCH610028	On the Job Training	2
ENCH610029	Research Methodology and Seminar	2
ENCH610030	Capita Selecta	2
	Total	**10**
Elective		
	Elective 1	3
	Elective 2	3
	Elective 3	3
	Total	**9**
	Total Credit Term 7	**19**
	8th Semester	
Compulsory		
ENCH618031	Natural Gas Processing	3
ENCH610032	Final Project	4
	Total	**7**
Elective		
	Elective 4	3
	Elective 5	3
	Total	**6**
	Total Credit Term 8	**13**

ELECTIVE COURSES

Code	Elective Course for Odd Semester	Credit
ENCH617101	Applied Termodynamics	3
ENCH617102	Thermodynamic Prop. Hydrocarbons	3
ENCH610103	Special Topics 1	3

Code	Elective Course for Even Semester	Credit
ENCH618104	Polymer Engineering	3
ENCH618105	Controlled Release of Drugs	3
ENCH618106	Special Topics 2	3

CHEMICAL ENGINEERING

Resume	General Course of University	18
	General Course of Engineering Faculty	25
	Skill Course	88
	Total	131
	Elective Course	15
	Total Courses Load	144

Couse Structure Interantioanl Undergraduate Chemical Engineering at Partner University

Tabel. Corse Structure at Monash University

Year 3	5th Semester (Monash) July		Year 3	6th Semester (Monash) Feb	
Code	Course Title	CREDIT	Code	Course Title	CREDIT
CHE3162	Process control	6	CHE3162	Chemistry and chemical thermodynamics	6
CHE3164	Reaction engineering	6	CHE3164	Sustainable processing I	6
CHE3166	Process design	6	CHE3166	Separation processes	6
	Choose one stream	6		Transport phenomena and numerical methods	6
	Subtotal	24		Subtotal	24

Year 4	7th Semester (Monash) July		Year 4	8th Semester (Monash) Feb	
Code	Course Title	CREDIT	Code	Course Title	CREDIT
CHE4162	Particle technology	6	CHE4161	Engineers in society	6
CHE4170	Design project	12	CHE4180	Chemical engineering project	12
	Choose one stream	6		Choose one stream	6
	Subtotal	24		Subtotal	24

Year 3			Year 4		
Code	Course Title	CREDIT	Code	Course Title	CREDIT
Biotechnology Stream					
CHE3171	Bioprocess technology	6	BCH2011 CHE4171	Structure and function of cellular biomolecules Biochemical engineering	6 6
Nanotechnology and Materials Stream					
CHE3172	Nanotechnology and materials I	6	CHE4172 MTE2541	Nanotechnology and materials 2 Nanostructure of materials	6 6
Sustainable Processing Stream					

CHE3175	Process engineering	6	CHE4173 ENE3608	Sustainable processing II Environmental impact and management systems	6 6

Tabel. Corse Structure at Curtin University

Year 3	5th Semester		Year 3	6th Semester	
CODE	COURSE TITLE	CREDIT	KODE	SUBJECT	CREDIT
CHE 223	Thermodynamics	25	ChE 322	Process Plant Engineering	25
CHE 324	Fluid & ParticleProcesses	25	ChE 312	Proc Syn & Design 1	12.5
CHE 325	ReactionEngineering	25	ChE 479	Advanced Special Topics	12.5
CHE 328	ProcessInstrumentation & Control	25	CHE	Mass TransferOperations	25
			ChE 421	Risk Management	25
	Subtotal	100		Subtotal	100

Year 4	7th Semester		Year 4	8th Semester	
CODE	COURSE TITLE	CREDIT	KODE	SUBJECT	CREDIT
ChE 423	Process Economics & Management	25	ChE 481	Process Laboratory Projects	25
ChE 422	Advanced Separation Processes	25	ChE 414	Proc Syn & Design II	12.5
ChE 499	Design Project (Lectures/Feasibility Studies)	50	ChE 411	Advanced Process Control	12.5
			ChE 491 ChE 493	Research Project Research Project Optional Unit Optional Unit	12.5 12.5 12.5 12.5
	Subtotal	100		Subtotal	100

Tabel. Elective Course at Curtin University.

CODE	COURSE TITLE	CREDIT
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 ari pollution control	12.5

5th Semester

Year 3	5th Semester		Year 3	6th Semester	
CODE	COURSE TITLE	CREDIT	KODE	SUBJECT	CREDIT
CHEE3004	Unit operations	2	CHEE4002	Environmental risk assessment	2
CHEE3005	Reaction engineering	2	CHEE4009	Transport phenomena	2
CHEE3006	Process and control system synthesis	2	CHEE1001	Principles of biological engineering	2
CHEE3007	Process modelling and dynamics	2		Part B2 Advanced Elective	2
	Subtotal	8			8

Year 4	7th Semester		Year 4	8th Semester	
CODE	COURSE TITLE	CREDIT	KODE	SUBJECT	CREDIT
CHEE4001	Process engineering design project	4		Part B2 Advanced Elective	2
	Part B2 Advanced Elective	2		Part B2 Advanced Elective	2

Year 4	7th Semester		Year 4	8th Semester	
	Part B2 Advanced Elective	2		Part B3 Advanced Elective	2
	Subtotal	8			6

Tabel. Elective Courses at University of Queensland.

CODE	COURSE TITLE	CREDIT
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	Chemicalproduct design	2
CHEE3008	Special Topics C	12.5
CHEE3301	Polymer engineering	12.5
CHEE3305	Biomaterials: Materials in Medicine	12.5
CHEM2002	Biophysical chemistry	
CIVL3150	Modelling of environmental systems	
MINE2201	Physical & chemical processing of minerals	

SYLLABUS OF UNIVERSITY SUBJECTS

INTEGRATED CHARACTER BUILDING A
UIGE600001/UIGE610001
6 sks
Syllabus : Integrated Character Building A facilitates students to understand the basics of character formation and master the basics of cognitive power that is logic. Furthermore, to apply cognitive powers in generating good behaviors which are useful to themselves and society. The establishment of ethical behaviors based on ethics is also facilitated. Students are able to develop the basic strength of character and to know themselves as a human being, both as individuals and as part of a group so that they can develop themselves well enough. In a group, the students need to have skills that are needed to maintain an effective relationship in order to improve the quality of human life. Particularly as a citizen of Indonesia, students need to understand the nature of citizenship and basic philosophy of Pancasila in order to act and behave in accordance with the character of the Indonesian nation.
Core Competencies :
1. Students are able to analyze problems in depth individually, comprehensively, logicaly and criticaly, and generate solutions using the logical and ethical principles and rules of logic and ethics
2. Students are capable of analyzing the problem individually, thoroughly and deeply about the human being as an individual or as part of group
3. Students are individually able to understand, make critical reasoning and to build an open and critical mind to the problem of nationhood, statehood and citizenship in this dynamic world situation
4. Students are able to create and display a work that depicts the character in accordance with the principles of Pancasila

Learning Method : interactive lecture, Experiential Learning, Collaborative Learning, Problem Based Learning, Project-Based Assignment
Prerequisites : OBM (New Student Orientation)

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))

INTEGRATED CHARACTER BUILDING B
UIGE600002/UIGE610004
6 sks
Syllabus : Integrated Character Building B facilitates students to practice identifying, analyzing, and resolving problems of nature and the environment by making use of integrative and quantitative information. This lecture aims to prepare the future generation who care about nature issues through the balanced development of hard skills and soft skills and have the skills of ICT (Information and Communication Technology).
Core Competencies:
1. Students have an ethic, moral, personality and good character in completing the task at hand;
2. Students role as citizens who take pride and love of the homeland and support the continuity of life;
3. Students are able to work together and have a high sensitivity and awareness to the community and the environment;
4. Students are able to think logically, critically and creatively;
5. Students are able to use mathematics to solve problems quantitatively;
6. Students are able to use information and communication technology (ICT) for development;
7. Students are able to analyze the system of nature integratively and comprehensively;
8. Students are able to act as wise managers of nature to build and maintain the preservation of nature for a better and sustainable life.

Learning Method : Blended e-Learning, Collaborative Learning (CL), Problem Based Learning (PBL) and Group Discussion (GD**)**
Prerequisites : OBM (New Student Orientation)
Textbook : Digital Form can be downloaded from Scele

ISLAMIC STUDY
UIGE600010/UIGE610005
2 sks
General instructional objectives : The cultivation of students who have concern for social, national 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 practice 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 STUDY
UIGE600011/UIGE610006
2 sks
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 STUDY
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 STUDY
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 STUDY
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

UNDERGRADUATE PROGRAM

(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
2 sks

ART
UIGE600020-30
1 sks
The option of subjects that can be choosen :
Appreciation of Film (UIGE600020), Batik (UIGE600021), Photography (UIGE600022), Calligraphy (UIGE600023), Javanese Karawitan (UIGE600024), Balinese Dance and Karawitan (UIGE600025), Comic (UIGE600026), Painting (UIGE600027), Music and Vocal (UIGE600028), Theater (UIGE600029), Wayang (UIGE600030)

SPORT
UIGE600040-48
1 sks
The option of subjects that can be choosen :
Basketball (UIGE600040), Volley Ball (UIGE600041), Badminton (UIGE600042), Futsal (UIGE600043), Hockey (UIGE600044), Football (UIGE600045), Softball (UIGE600046), Tennis (UIGE600047), Table Tennis (UIGE600048)

SYLLABUS OF BASIC ENGINEERING SUBJECTS

CALCULUS 1
ENGE600001/ENGE610001
3 sks
Syllabus : This subject gives the opportunity for students to understand the basic concept of calculus and to be able to solve applied calculus problems. Students are also given the opportunity to understand basic concepts the functions of one variable, derivatives and integral functions of one variable, and its application.

CALCULUS 2
ENGE600002/ENGE610002
3 sks
Syllabus : This subject gives the opportunity for students to understand the basic concept of calculus and to be able to solve applied calculus problems. Students are also given the opportunity to understand the basic concept the function of two variables, or variables, total derivative and integral of the function of two or more variables and application. In addition, students can understand the basic concepts of sequence and series.

CALCULUS
ENGE600003/ENGE610003
4 sks
Syllabus : This subject gives the opportunity for students to understand the basic concept of calculus and to be able to solve applied calculus problems. Students are also given the opportunity to understand the basic concept the function of two variables, the total derivative of the function of two or more variables and its application. Students are also expected to understand the basic concept of sequence and series and the basic concept of vector and analytical geometry.

LINEAR ALGEBRA
ENGE600004/ENGE610004
4 sks
Syllabus : This subject gives the opportunity for students to master the basic techniques of Linear Algebra and gain knowledge on how to implement said techniques in solving System of linear equationss, determining the bases and dimension of vector space, as well as calculating eigen values and eigen vectors. This subject also gives students the opportunity to work with other objects, especially vectors and matrices.

PHYSICS (MECHANICS AND THERMAL)
ENGE600005/ENGE610005
3 sks
Syllabus : Physics (Mechanics and Thermal) subject includes the topics of mechanics and thermodynamics. Calculus is use as a mathematic helping tool in the learning process. Students are given the opportunity to learn how to unite their understanding of the basic concept of the analytical capability, their numeracy in learning mechanics and thermodynamics. During the course of this subject, students are not only aim to increase the students' knowledge of the basic physics concepts but also to increase their capability in using information technology and computer and to train their skills, such as: independent and group work and their communication skill.
Students will also be train on how to explain and analyse the nature phenomenon and the result of human engineering exist in their everyday lives by using the basic physics concept and applied them in their daily lives. Students are also taught to develop their synthesis ability and evaluating both quantitative and qualitative natural phenomenon and the result of human engineering in their surrounding environment by using basic physics concept. This subject will give students the opportunity to develop their ability to develop their presentation ability analyse the nature phenomenon and the result of human engineering from the mathematics and natural science point of view integrative and comprehensively.

PHYSICS (MECHANICS AND THERMAL) LABORATORY
ENGE600006/ENGE610006
1 sks
Syllabus : Practical of Mechanics: Measurement, Moment of inertia, Gravity acceleration, Fluid density, Scratch coefficient, Collision, Swing torque, Viscosity of water, Young's modulus, Viscosity of Newtonian fluid, Fluids surface tension, Oscillation, Practical of Heat: Coefficient of linear expansion, Heat conductivity, Thermocouple calibration, Calorimeter, Joule Constant, Laplace Constant, Heat Collector, Determining of air Cp/Cv, Expansion of fluids and water anomaly.
Notes: For Architecture and Interior Architecture Program, practical is not mandatory.

PHYSICS (ELECTRICITY, MWO)
ENGE600007/ENGE610007
3 sks
Syllabus : Physics (Electricity, MWO) subject includes the topics of electricity, magnet, wave, and optics. Calculus is use as a mathematic helping tool in the learning process. Students are given the opportunity to learn how to unite their understanding of the basic concept of the analytical capability, their numeracy in learning mechanics and thermodynamics. During the course of this subject, students are not only aim to increase the students' knowledge of the basic physics concepts but also to increase their capability in using information technology and computer and to train their soft skills, such as: independent and group work and their communication skill. Students will also be train on how to explain and analyze the nature phenomenon and the result of human engineering exist in their everyday lives by using the basic physics concept and applied them in their daily lives. Students are also taught to develop their synthesis ability and evaluating both quantitative and qualitative natural phenomenon and the result of human engineering in their surrounding environment by using basic physics concept.

CHEMICAL ENGINEERING

PHYSICS (ELECTRICITY, MWO) LABORATORY
ENGE600008/ENGE610008
1 sks
Syllabus : Practical of Electricity: Electrolysis, Wheatstone bridge, Kirchhoff law, Earth's magnetic field, Temperature coefficient, Characteristic of series RLC circuit, Ohm law, Transformer. Practical of Optics: Polarimeter, Lens, Photometry, Prisms bias index, Spectrometer, Diffraction grid, Newton's ring.

BASIC CHEMISTRY
ENGE600009/ENGE610009
2 sks
Syllabus : As an engineer, you must have understanding on the chemistry that provides not only the basis for much of what goes on in our world but also that it is a vital, continually developing science. In this study the students will learn many subjects such as matter and measurement; atoms, molecules, and ions; stoichiometry; aqueous reactions; thermochemistry; properties of solutions; chemical kinetics; chemical equilibrium; and electrochemistry.
Learning activities will be conducted through various method, which consists of: problem based learning (PBL), interactive lecture, question-based learning, discussion, demonstration and unguided structured assignments. Assessment will be made continuously through a set of exercises, group discussion, mid semester exam and final exam.

STATISTIC AND PROBABILITY
ENGE600010/ENGE610010
2 sks
Syllabus : Statistics and probability has been known as applied mathematics which is widely used in collecting, organizing, presenting, interpreting and analyzing data to support valid conclusions. Furthermore, these conclusions will be used as recommendation in decision making. The course of Statistics and Probability is intended to give a basic ability for students to handle quantitative data and information. There are two stages that are delivered which is descriptive and inductive/inference stages. Descriptive stage includes collecting, organizing, and presenting the data in a scientific manner. Then, inductive/inference stage includes the process of estimating and drawing conclusion based on available data and relations between variables. Hence, students are expected to apply their knowledge of statistics in conducting experiments in laboratory works/assignments as well as research studies in their final projects.

ENGINEERING ECONOMICS
ENGE600011/ENGE610011
3 sks
Syllabus : This course introduces students to the basic of engineering economy. It covers the time value of money (TVOM) and interest rate; tools for evaluating project alternatives for both non discounted and discounted methods, for instance present worth analysis, annual worth analysis, future worth analysis, rate of return (ROR) analysis and benefit/cost analysis; and choosing the best alternative, break even analysis, and effect of depreciation and after tax analysis and sensitivity analysis, and replacement analysis.
Learning activities will be conducted through various methods, which consist of: interactive lectures, question-based learning, discussion, and structure assignments. Assessment will be made thoroughly through sets of exercises/quizzes, group discussion, midterm and final exam. To expose students on the latest utilization of engineering economy and train them how to use it, a project will be assigned. As an integral part of course, computer utilization such as Microsoft Excel will be demonstrated and discussed on the class.

HEALTH, SAFETY AND ENVIRONMENTAL PROTECTION
ENGE600012/ENGE610012
2 sks
Syllabus : The teaching of Safety, Health and Environmental (SHE) protection to undergraduates studying engineering courses is an important part of the education of future engineers at all levels. It is the generally expressed view amongst practitioners in industry, business and other organisations that all engineers need to be equipped to appreciate, understand and implement the requirements of SHE management and practice to meet the working needs of industry and of their company (or other organisation). Whilst the level of risk and degree of control is dependant on the industry sector concerned the basic principles do not change. In addition, according to code of ethics of engineers, engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties.
The module covers the regulation framework and standards, risk perception, assessment, and management and detail discussion on physical, chemical and process hazards, and related engineering and management controls. Maintenance of safety conditions, personal protective equipments, audit, incident and emergency planning are discussed in accordance to measures for improving students awareness to their daily activities within the campus premises and local environment.
Learning activities will be conducted through various methods, which consist of: interactive lecture, question-based learning, discussion, demonstration and unguided structured assignments. Assessment will be made continuously through a set of exercises, group discussion, mid semester exam and final exam

SYLLABUS OF CHEMICAL ENGINEERING

TERM 1
UIGE600002
INTEGRATED CHARACTERISTIC BUILDING SUJECT B
6 CREDITS

Learning Objectives
Syllabus
Prerequisites
Textbook

UIGE600003
ENGLISH
3 CREDITS

Learning Objectives
Students able to use English for suporting study in Universitas Indonesia as well as continuing language learning indepedently.
Syllabus

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

Prerequisites : -

Textbook : Poerwoto, C. et.al. - Reading Comprehension for Engineering Students

ENGE 6 0 0003
CALCULUS
4 CREDITS

Learning Objectives
After attending this subject, students are expected to capable of:
1. Understanding calculus basic concepts and competent to solve applied calculus problems.
2. Understanding the basic concepts of two or more variables function with its application.
3. Understanding the basic concepts of sequences and series as well as basic concepts of vectors and analytic geometry.

Syllabus :

Real number system, non-equivalency, Cartesians Coordination System, mathematic induction, Function and Limit, Continuous Function. Differential including chain's rule, implicit differential, and advanced differential function. Transcendent and differential Function. Applied Differential. Integral, basic integral function, Integration technique. Integral application on Cartesians and polar coordinate, indefinite. Sequences and infinite series. Spare rows and rows of positive change sign, Taylor and McLaurin series. Function of many variables and its derivatives. Maximum and Minimum. Lagrange Methods. Integral folding and its application.
Prerequisites : -
Textbook :
1. D.E.Vanberg and E.J, Purcell, Calculus with Analytic Geometry, 7th ed., Aplleton-Century-Crofts, 1996.
2. D.E.Vanberg, E.J Purcell, A.J Tromba, Calculus, 9th. Prentice-Hall, 2007.
3. G.B Thomas & R.L Finney, Calculus & Analytic Geometry 9th ed., 1996, Addison-Wesley

ENGE 6 0 0009
BASIC CHEMISTRY
2 CREDITS

Learning Objectives
1. Students able to resolve the problems of qualitative chemistry and indicate the reasons clearly as well as integrate various ideas in problem solving.
2. Students able to explain and model chemical and physical processes in the molecul level to explain the macroscopics properties.
3. Students able to classify materials based on conditions and bond properties by using periodic table as refference.
4. Students able to apply important theories such as kinetics of molecules or thermochemistry in chemical proble solving

Syllabus :

1. Materials and Measurements
2. Atoms, molecules, ions, and the Periodic Table
3. Stoichiometry: Calculations by using formulas of chemical equations
4. Chemical Reactions in Solution and stoichiometric solution
5. Thermochemistry; Chemical equilibrium
6. Acid and base
7. Electrochemistry

8. Chemical Kinetics
9. Application of Chemicals

Prerequisites : -
Textbook :
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

ENCE601001
INTRODUCTION TO CHEMICAL ENGINEERING
3 CREDITS

Learning Objectives: Students are able to:
1. Distinguish chemical engineering from the other techniques
2. Explain the development of chemical engineering
4. Understand the fundamentals of chemical engineering of existing processes and systems as well
5. Do simple calculation from mass and energy balance, and know the criteria for process equipment.

Syllabus: Introduction to Chemical engineering (definition and history), Overview of the chemical engineering profession, employment, and the contribution of chemical engineering, chemical engineering code of ethics, processes and equipment of chemical industry, Chemical Engineering flow in particular industry.
Prerequisites: -
Textbook:
1. R.N. Shreve and G.T. Austin, Shreve's Chemical Process Industries, McGraw Hill, 1984
2. R.M. Felder and R.W. Rousseau, Elementary Principles of Chemical Processes, 3rd Edition, Wiley 2005
3. R. Schizininger and M. W. Martin. Introduction to Engineering Ethics. Mc. Graw-Hill, 2000.

ENBE601002
Communication Skill
2 Credits

Learning Objectives
Students are able to show their ability in identify of important component oral communication and effective writing as well as students are able to search references, read and criticize a writing. Students also able to write short accurate resume from reference. Students are able to apply skills in creating scientific research as well as presents it with clear and effective oral presentation that related to audience situation.

Syllabus : Introduction effective communication and audience analysis , Oral presentation, visual aids for oral presentation and assessment criteria, effective reading, making summary, preparing teaching notes, and assessment criteria, how to make memo writing and assessment criteria, writing processes - PKM GT guidelines including assessment criteria, Writing processes - referencing, Writing Process - how to make scientific poster and assessment criteria
Prerequisites : -
Textbook :
Donald R. Woods, Communicating effectively, McMaster University Bookstore, 1996.

TERM 2

UIGE600001
Integrated Characteristic Building Suject A
6 Credits

UIGE600010-15
RELIGIOUS STUDIES
2 CREDITS

General instructional objectives: Students have a concern for social issues, national and state based on religious moral values applied in the development of knowledge through intellectual skills.
Learning Objectives: After attending this subject, when students given a problem, students can:
1. Analyzed based on values their religion.
2. Analyzed by applying the steps to active learn.
3. Discuss and express their opinions by using Bahasa Indonesia in right and good manner, both in discussion and paper.
Syllabus: Adapted to the respective religion.
Prerequisite: -
Textbook: Adapted to the problem subject.

ENGE 6 0 0004
LINIEAR ALGEBRA
4 CREDITS

Learning Objectives: Students are able to explain/understand/apply linear algebra and associate this subject with other subjects.
Syllabus: Introduction of elementary linear algebra, Matrix, Determinant, Vectors in R2 and R3. Euclideas vector space, General vector space, Review of vector space, Product space, Value and diagonalization eigen vector, Linier Transformation, Application on the system of differential equation, Application on the quadratic surface, Decomposition of LU, Least Squares.
Prerequisite: -
Textbook:
1. H. Anton, Elementary Linear Algebra, 9th ed, John Wiley& Sons, 2005.
2. G.Strang, Introduction to Linear Algebra, Wellesley-Cambridge Press, 2007.

UIGE600020 – 48
Sports/Arts
1 Credit
Learning Objectives
Syllabus
Prerequisites
Textbook

ENGE 6 0 0005
PHYSICS MECHANICS AND HEAT
3 CREDITS

Learning Objectives
Students are able to understand the concepts and basic laws of mechanics physics and applied in a systematic and scientific problem solving which influenced by the force for both moving and not moving objects.

Syllabus
1. Scale, kinematics of point objects, mechanics of point objects, law of conservation of linear momentum and energy, harmonic motion, gravity, dynamics and kinematics of rigid objects.
2. Introduction and basic concept (pressure, thermodynamic system, state of the system, temperature), expansion, equilibrium energy (thermal state equation), heat transfer, ideal gas.
3. First law of thermodynamics, enthalpy and entropy, The first law of thermodynamics application for open and closed system, Second law of thermodynamics, kinetic theory of ideal gas.

Prerequisites : -
Textbook :
1. Halliday.D, R Resnick, Fisika I, edisi terjema-han P Silaban, Penerbit Erlangga 1986.
2. Ganijanti AS, Mekanika,Penerbit Salemba Teknik, 2000.
3. Tipler PA, Fisika I, ed III, terjemahan Lea Prasetio, Penerbit Erlangga, 1998.
4. Giancoli D.C, General Physics, Prentice Hall Inc, 1984.
5. Sears-Salinger, Thermodinamics, Kinetic theory and statistical thermodynamics, Wesley, 1975.
6. Giancoli, D.C, Physics: principles with aplica-tions, Prentice Hall Inc, 2000

ENGE 6 0 0006
PHYSICS MECHANICS AND HEAT LAB
1 CREDIT

Syllabus
Practical of Mechanics: Measurement, Moment of inertia, Gravity acceleration, Fluid density, Scratch coefficient, Collision, Swing torque, Viscosity of water, Young's modulus, Viscosity of Newtonian fluid, Fluids surface tension, Oscillation, Practical of Heat: Coefficient of linear expansion, Heat conductivity, Thermocouple calibration, Calorimeter, Joule Constant, Laplace Constant, Heat Collector, Determining of air Cp/Cv, Expansion of fluids and water anomaly.
Notes: For Architecture and Interior Architecture Program, practical is not mandatory.

ENCE 602003
ORGANIC CHEMISTRY
3 CREDITS

Learning Objectives: Students are able to:
Explain the link structure and stereochemistry, IUPAC name, physical properties, chemical reactivity, and reaction mechanisms
Determine the mechanisms of some organic chemical reactions and be able to estimate how to synthesize a simple organic chemical compounds.
Syllabus: Naming of organic compounds, the role of structure and stereochemistry of the physical / chemical an organic compound, the cracking reactions or free radicals alkane, polymerization of alkenes, aromatic electrophilic substitution on benzene, substitution and elimination reactions of alkyl halidas, acylation and esterification reactions, dehydration-polymerization on carboxylic compound
Prerequisites: -
Textbook:
4. Fessenden, alih bahasa : A. Hadiyana Pujatmaka, Kimia Organik, edisi Kedua Erlangga 1986
5. Morrison, RT and Boyd, RN, Organic Chemistry, 6th ed., Prentice Hall 1998.
6. Organic Chemistry lecture notes

ENCE602004
BASIC CHEMISTRY AND ORGANIC CHEMISTRY LAB.
2 CREDIT

Learning Objectives: Students are able to prepare a preliminary report on the theory behind the lab module, conducting experiments in the laboratory, process and analyze data from

UNDERGRADUATE PROGRAM

CHEMICAL ENGINEERING

experiments, and create a final report containing the explanation of phenomena that occur during experiments.
Syllabus: General techniques and chemical lab safety aspect, physical and chemical properties, separation and purification of substances, the reaction of metals with acids, water crystals, suspension formed reaction, identification of hydrocarbons, alcohols and phenols identification, identification of carbonyl compounds, carbohydrates, lipid analysis, extraction and identification of fatty acids from corn oil.
Prerequisites: -

Textbook:
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.
1. Vogel, Practical Organic Chemistry
4. TGP majors, Organic Chemistry Lab Instructions diktat (Basic Chemistry and Organic Chemistry Guide, Department of Chemical Engineering , FTUI)
5. Fieser, Organic Chemistry
6. Moran, L. dan Masciangioli, T.Safety and Security of Chemical Lab, the National Academies Press, 2010
7. Brown, T.L., H. E. LeMay and B.E. Bursten, Chemistry, ed. 8, Prentice Hall, 2000.
8. Vogel, Anorganic Qualitative Analyze, PT. Kalman Media Pustaka, 1985.

TERM 3

ENGE 6 0 0007
PHYSICS ELECTRICITY, MAGNETS, WAVE, AND OPTICS
3 CREDITS

Learning Objectives: Students are able to understand:
1. The concept and basic law of physics – electricity and magnetism and apply it systematically and scientifically in solving everyday magnetism and electricity physics problem.
2. The concept and basic law of wave and optical physics and apply systematic and scientific problem solving in a natural wave phenomenon or wave that arises from technical, physical properties of light and geometric optics.

Syllabus: Electric charge and Coulomb law, Electric field, Static and Gauss law, Electric potential, Capacitor, Direct electric current and basic circuit analysis, Magnetic field, Induction and electromagnetic, Faraday law and inductance, Material magnetism properties, A series of transient, Alternating current, Waves, Sounds, Polarization, Interference, Diffraction, Optical geometry, Lighting and photometry.
Prerequisite: -
Textbook:
1. Halliday, D, R. Resnick, Fisika II,edisi terjema-han P. Silaban, Penerbit Erlangga, 1986.
2. Ganijanti AS, Gelombang dan Optik, ed III, Jurusan Fisika FMIPA UI, 1981.
3. Tipler P.A, Fisika II, ed III terjemahan Bam-bang Sugiyono, Penerbit Erlangga, 2001.
4. D.C.Giancoli, General Physics, Prentice Hall Inc, 1984.

ENGE 6 0 0008
PHYSICS ELECTRICITY, MAGNETS, WAVE, AND OPTICS LAB
1 CREDIT
Syllabus:
Practical of Electricity: Electrolysis, Wheatstone bridge, Kirchhoff law, Earth's magnetic field, Temperature coefficient, Characteristic of series RLC circuit, Ohm law, Transformer. Practical of Optics: Polarimeter, Lens, Photometry, Prisms bias index, Spectrometer, Diffraction grid, Newton's ring.
ENBE603005

NUMERICAL COMPUTATION
3 CREDITS

Learning Objectives
Students are able to solve chemical process through computational methods
Syllabus :
Chemical process modeling, simple differential equation : initial problem value, simple differential equation : limitation problem value ; differential partial equations.
Prerequisites : -
Textbook : -

ENBE603006
INSTRUMENTAL ANALYTICAL CHEMISTRY
3 CREDITS

Learning Objectives: Students are able to explain and compare the various basic principles methods of analytical chemistry and apply it for qualitative and quantitative analysis of pure and mixture compounds
Syllabus: Skill workshop, Electrochemistry process, Potentiometry, Atomic Spectroscopy (AAS), Molecular spectroscopy (IR), Chromatography gas.
Prerequisite: -
Textbook:
1. Day R.A. dan A. L. Underwood, Analisis Kimia kuantitatif (terjemahan), Erlangga, 1986, atau buku aslinya dalam bahasa Inggris.
2. D. A. Skoog, et.al., Fundamentals of Analytical Chemistry, 5th. Ed., Saunders College Publishing, 1988. Atau edisi terbaru
3. G. D. Christian and J. E O'Reilly, Instrumental Analysis, 2nd. Ed., Allyn Bacon Inc., 1986.
4. Donald R. Woods, Problem based learning: How to gain the most from PBL, 2994, Mc-Master University, Hamilton, ON L8S 4L8.

ENBE603007
PHYSICAL CHEMISTRY
3 CREDITS

Learning Objectives: Students are able to understand the basic concepts of physical chemistry including the topics of thermodynamics, equilibrium reactions, and molecular spectroscopy, and apply these concepts to solve simple problems of chemical physics
Syllabus: Introduction, gas and liquids, Chemical Equilibrium, surface phenomena
Prerequisites: -
Textbook:
1. Levine, IN, Physical Chemistry, 6th ed., McGraw-Hill, 2008.
2. Atkins & de Paula, Atkin's Physical Chemistry, 9th ed., Oxford University Press, 2009
3. Samuel H. Maron, Jerome B. Lando, Fundamental of Physical Chemistry, Macmillan Publishing Co. Inc., Collier Macmillan Publishers, London1974

ENBE603008
PHYSICAL CHEMISTRY AND ANALYTICAL CHEMISTRY LAB
1 CREDIT

Learning Objectives:
Students are able to conduct pre-eliminary report which is supported laboratory module theories, practicing experiments in laboratory, and arrange final report that contains the results of processing and analysis data experiments as well as explain the phemomena
Syllabus: Isothermal adsorption, effect of concentration and temperature on reaction rate, colligative properties of solution, chemical equilibrium determination, determination of mo-

lecular properties based on gas density, potentiometric methods, spectrophotometry visible light, conductometric methods, Chromatoghraphy Gas
Prerequisite: Basic Chemistry, Physical Chemistry and Analytical Chemistry Instrumental
Textbook:
1. Physical Chemistry Lab Instructions FTUI TGP-1989.
2. Guidance of Physical Chemistry and Analytical Chemistry Lab, Chemical Engineering, Universitas Indonesia.
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

ENBE603009
MASS AND ENERGY BALANCE
3 CREDITS

Learning Objectives: Students are able to solve the problem of mass balances, energy balances, and the combination of it.
Syllabus: Introduction, mass balance, solves mass balance for single unit without reactions, chemical reaction equation and stoichiometry, mass balance with reaction, mass balance involving units/equipments, recycle, bypass, purge, Energy : terminilogy, consepts and units, Introduction to energy balances in process without reaction, entalphy changes, application of energy balances without chemical reactions, energy balances : how to calculate chemical reactions, energy balances involving effects of chemical reaction, psychometric chart and the utilization
Prerequisites: Basic Chemistry, Introduction to Chemical Engineering
Textbook:
1. Himmelblau D.M. Basic Principles and Calculation in Chemical Engineering, 6th ed, Prentice Hall 1996
2. G. Reklaitis V. Introduction to Material and Energy Balances, John Wiley 1983
3. Felder, R.M. & R.W. Rousseau. Elemnetary Principle of Chemical Process. John Wiey & Sons inc. 2005.
4. Dictates of Mass and Energy Balance 2001

ENCE603010
TRANSPORT PHENOMENA
3 CREDITS

Learning Objectives: Students can identify and describe as well as analyze momentum, mass, and heat transfer phenomenon, through the application of macroscopic and microscopic balance.
Syllabus: Introduction, 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.
Prerequisites: Fluids mechanics particle, heat transfer, mass transfer
Textbook:
1. R. B. Bird, W. E. Stewart and E. N. Lightfoot, Transport Phenomena, 2nd Ed., John Wiley, 2002.
2. J.R. Welty et al., Fundamentals of Momentum, Heat and Mass Transfer, 3rd Ed., Wiley, 1984.
3. Brodkey, R. S and RC Herskey, Transport Phenomena, McGraw-Hill, 1998

4. Harry C. Hershey, Robert S. Brodkey, Transport Phenomena: A Unified Approach Vol. 1, McGraw-Hill, New York, 1987, 847 pp.,

TERM 4

ENCE604011
CHEMICAL ENGINEERING MODELING
3 CREDITS

Learning Objectives: Students are able to create a physicochemical model of a process system and solve it using numerical methods with the assistance of a programming language
Syllabus: Modeling chemical process systems, equation systems of linear algebra and non-linear algebra; ordinary differential equations: initial value problem and boundary value problem; partial differential equations.
Prerequisites: Numerical computation
Textbook:
1. Rice, RG. And Duong D. D, Applied Mathematics and Modeling for Chemical Engineers, John Willey & Sons, New York, 1995.
2. Davis, M. E., Numerical Methods and Modeling for Chemical Engineers, John Willey & Sons, New York, 1984
3. Constantinides, A. and Mostouvi, N, Numerical Methods for Chemical Engineers with MATLAB Applications, Prentice Hall, 1999.
4. Tosun, I., Modeling in Transport Phenomena: A Conceptual Approach, Elsevier, 2002.

ENBE604012
FLUIDS AND MECHANICS PARTICLE
3 CREDITS

Learning Objectives: Students are able to apply the phenomenon of fluid flow and particle (continuity equation, Bernoulli, etc) to solve problem in process unit through calculation of energy and force, etc, especially in the fluid flow system of piping, rate measurer and fluid transportation tool, and in the system of fluid-solid flow (fluidization, filtration, sedimentation, particle motion in gas.
Syllabus: transfer process, Shell momentum balances, momentum balances with Navier-stokes equations, shell energy balances, sehell mass balances, momentum and energy movement in turbulent, transfer between phase, macroscopics balances of isothermal system, macroscopics balances of non isothermal, macroscopics balances in multicomponent system
Prerequisite: Calculus
Textbook:
1. R. B. Bird, W. E. Stewart, and E. N. Lightfoot, Transport Phenomena, John Wiley and Sons, New York, 2nd edition, 2002,

1. Harry C. Hershey, Robert S. Brodkey, Transport Phenomena: A Unified Approach Vol. 1, McGraw-Hill, New York, 1987, 847 pp.,

ENGE 6 0 0010
STATISTICS AND PROBABILITY
2 CREDITS

Learning Objectives
Syllabus
Prerequisites
Textbook

UNDERGRADUATE PROGRAM

ENCE604013
CHEMICAL ENGINEERING THERMODYNAMICS
4 CREDITS

Learning Objectives: Students are 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: PVT properties of pure compounds, process track, steam table ; steady and non steady energy balances ; cyclic processes : rankine cycle for energy power and refrigerant cycle ; ideal system phase equilibrium and approachment to activity coefficient ; phase equilibrium in high pressure : approachment in fugacity coefficient by cubic equational state ; equilibrium reactions.
Prerequisites: mass and energy balances
Textbook:

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

ENBE604014
HEAT TRANSFER
3 CREDITS

Learning Objectives: Students are able to develop knowledge in heat transfer as well as long-term learning skills to follow avance knowledge and technology that related to heat transfer
Syllabus: Introduction, skills workshop process, steady-state conduction, unsteady-state conduction, natural and forced convection, radiation and Evaporation
Prerequisite: Transport Phenomena
Textbook:
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.

ENCE604015
PROCESS ENGINEERING DRAWING
2 CREDITS

Learning Objectives: Students are able to draw it manually process flow diagrams, P & IDs and plant layout, familiar with the use of software for drawing, understand and able to read the meaning of the picture
Syllabus: The importance of engineering drawings, standard rules of the drawing, block diagrams, and symbols of industrial equipment, process flow diagrams, piping and instrumentation symbols, piping and Instrumentation diagram, plot plan, plant layout, isometric piping and equipment.
Prerequisites: -
Textbook:
1. W. Boundy, Engineering Drawing, McGraw-Hill Book Company
2. Colin Simmons and 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.

ENCE604016
MOLECULAR BIOLOGY
3 CREDITS

Learning Objectives: Students are able to explain structure and chemical compounds in living things including the function, the synthesis and metabolism of chemical compounds that occur in cells. Chemical compounds include nucleic acids, proteins, carbohydrates, and lipids and metabolism involves basic reactions of metabolism, glycolysis, as well as lipid and steroid metabolism.
Syllabus: Molecular biology, nucleic acids, structure and replication of DNA and RNA, transcription and translation, amino acids, synthesis and structure of proteins, enzymes, and metabolism.
Prerequisite: -
Textbook:
1. Arumingtyas, Estri Laras dan Fatchiyah. (2011). Biologi Molekular Prinsip Dasar Analisis. Jakarta : Erlangga
2. Bruckner, Monica Z. Basic Cellular Staining.Serc.carleton.edu.
3. Aryulina, D., Manaf, S., Muslim, C., & Winarni, E.W. 2007. BIOLOGI 3. Jakarta : Esis. Binur
4. Robi. 2011. Teknologi RNA Innterference. Retrieved from Campbell, Reece. 2009. Biology. Sansome Street, San Francisco: Pearson Benjamin Cummings
5. Fatchiyah,Arumingtyas Estri Laras, Widyarti Sri, Rahayu Sri.2011. Biologi Molekular Prinsip Dasar Analisis. Erlangga. Jakarta.

TERM 5

ENCE605017
MATERIAL SCIENCE AND CORROSION
3 CREDITS

Learning Objectives
1. Students able to understand the role of materials selection in designing equipment
2. Students able to understand the characteristics of materials
3. Students able to understand corrosion : Process, prevention, testing and protection, as well as calculating and designing simple corrosion protection

Syllabus
1. History of Material Science in human civilization, material science applications in Chemical Engineering
2. Atomic, Molecular, Chemical Bonding and its correlation with the properties of materials
3. Crystal structure
4. Phase Diagram and its relation to the manufacture of metal
5. Mechanical properties of materials and ters equipments
6. Metal and the alloy
7. Corrosion and Chemical Industry
8. The basic concept of corrosion, electrochemical, polarization, passivity

9. The types of corrosion mechanism and its prevention
10. Cathodic protection and inhibitors
11. Corrosion monitoring

Prerequisites : -
Textbook
1. Ilmu Bahan dan Teknologi Bahan (Lawrence H.Van Vlack diterjemahkan oleh Ir. Sriati Djaprie, M.E.,M.Met). Bagian Pendahuluan

ENGE 6 0 0012
HEALTH, SAFETY AND ENVIRONMENT
2 CREDIT

Learning Objectives: Students are able to:
1. Identify various types of hazards, characterization, proposes a method which is suitable for risk reduction and mitigation and safety management system design.
2. Increase awareness of health and safety industry, and understand the regulatory framework and standard of safety and environmental programs.

Syllabus: Introduction to Regulation and Standards; Risk Perception, Assessment and Management; Machinery Hazards; Noise Hazards; Process Safety Hazard; Fire and Explosion Hazard; Electrical Hazard; Toxicology in The Workplace; Environmental Protection; Environmental Protection Control Processes; Hazard Communication to Employees; Personal Protective Equipment (PPE): Types of PPE and Selection of PPE; Safety Audits, Incident and Emergency Planning.
Prerequisite: -
Textbook:
1. Charles A. Wentz, Safety, Health and Environ-mental Protection, MGH, 1998.
2. Asfahl, C.R., Rieske, D.W., Industrial Safety and Health Management, 6th Ed., Pearson Education, Inc. 2010.
3. United Kingdom – Health and Safety Executive, http://www.hse.gov.uk/
4. Undang-undang dan Peraturan Nasional terkait dengan Sistem Manajemen K3 dan Lingkungan.
5. Related Journal, standards and Publications.

ENGE 605018
ENGINEERING ECONOMICS
3 CREDITS

Learning Objectives
Students are able to explain fundamentals of decision-making and feasibilty study by using ecpnomic approach
Syllabus :
1. The principels of engineering economics
2. Equivalence
3. Compound Interest Factor
4. Alternative Evaluation by equivalance value method
5. Alternative Evaluation by IRR Method
6. Comparing Alternatives
7. Benefit-cost ratio Method to cost (B/C ratio)
8. Depreciation
9. Income tax
10. Evaluation after Tax

Prerequisites : Statistics and Probability
Textbook :
1. Blank, L and Tarquin, A., Engineering Economy, McGraw Hill, New York, 2002
2. Sulivab, G. W., Bontadelli, J. A. and Wicks, E. M., Engineering Economy, 11th ed., Prentice Hall, New Jersey, 2000
3. Stermole, Frank J., Economic Evaluation and Investment Decision Methods, Investment Evaluations Corporation, Golden
4. Newman, Donald G., Engineering Economic Analysis, Engineering Press, Inc., san Jose, 1988
5. Bakuan Kompetensi INTAKINDO-2007

ENCE605019
MASS TRANSFER
4 CREDITS

Learning Objectives: Students are able to analyze the phenomenon of mass transfer and apply it to solve the problem of unit mass transfer process.
Syllabus: Batch and continuous distillation; a mixture of binary or multiple components, humidification and drying, gas absorption, solvent extraction.
Prerequisites: Chemical engineering thermodynamics, transport phenomena
Textbook:
1.Ketta, John J., Unit Operations Handbook, Vol 2: Mass Transfer, Marcel Dekker 1993
2.Treyball, R. E, Mass Transfer Operations, McGraw-Hill, 1984
3.Coulson, J. M. And J. Richardson R. Chemical Engineering Vol. 2, Pergamon Press. In 1989.

ENCE605020
UNIT OPERATION LABORATORY
11 CREDITS

Learning Objectives: Students be able to:
1. Verify the technique of chemical engineering concept in fluid mechanic (CHS 220804), heat transfer (CHS 220807) that applied on tools or process unit.
1. Operate the equipment and measuring the flow rate (orifice meter, venturimeter, rotameter), temperature (thermocouple), process and analyze the data, discussed and took the conclusion, convey the result in the writing report in standard format.

Syllabus: The modules operating unit including: fluid circuit, centrifugal pump, incompressible flow, filtration, fluidization, conduction, convection, double pipe heat exchange, mixing and compounding.
Prerequisites: Fluid Mechanics and Heat Transfer
Textbook: Practical Manual Processes and Operations Teknik1, UI Department of Chemical Engineering

ENCE605021
CHEMICAL REACTION ENGINEERING 1
3 CREDITS

Learning Objectives: Students are able to comprehend the concept of chemical kinetics and catalysis, design the experiment of kinetics data interpretation, formulate the kinetics models as well as analyze the performance of reaction
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.
Prerequisites: Physical Chemistry
Textbook:
1. Davis, Mark E. and Davis, Robert J. (2003) Fundamentals of chemical reaction engineering. McGraw-Hill Higher Education, New York, NY.
2. Fogler, H. S., Elements of Chemical Reaction Engineering, Prentice-Hall, 3rd Ed., 1999
3. Fogler, H. S., and LeBlanc, Strategies for Creative Problem Solving, Prentice-Hall, 1995.
4. Levenspiel, O., Chemical Reaction Engineering, 2nd Ed., John Wiley & Sons. Of 1972.
5. K. J. Leidler, Chemical Kinetics, 3rd ed., Harper Publish, 1987
6. Widodo, W. P., Slamet, Lecture diktat of Chemical Kinetics and Reactor Design, TGP-UI, 2002.

ENCE605022
SIMULATION OF CHEMICAL PROCESS
3 CREDITS

Learning Objectives: Students are able to use the latest chemical engineering software to make the steady state and dynamic simulations, and able to manipulate the process variable and the topology of the unit processes in the chemical industry.
Syllabus: steady state and dynamic models, stream, heat exchanger equipment, piping and rotating equipment, separation equipment, columns and towers, reactors, refrigeration system, the selection of PID controllers for temperature, pressure, level and flow, cascade control, model testing and tuning PID controllers.
Prerequisites: -
Textbook:
2. Fogler, HS, Elements of Chemical Reaction Engineering, Prentice-Hall
3. Douglas, J. M., 1998, Conceptual Design of Chemical Processes, McGraw-Hill, 1988
4. Peter, M.S, and K.D. Timmerhaus, 1991, Plant Design and Economic for Chemical Engineering 4th Edition, McGraw-Hill.
5. HYSYS Steady State Model and Tutorial
6. SuperPro Designer User Guide and Tutorial, intelligent, Inc.

TERM 6

ENCE606023
PROCESS CONTROL
3 CREDITS

Learning Objectives: Students are able to design a single loop control system and connected the dynamic process with the performance
Syllabus: Introduction to process control, objectives and benefits of control, the principle of mathematical modeling, process modeling and control analysis, the system dynamic behavior of a typical process, the identification of empirical models, loop-back baited, PID controllers, PID controller tuning, stability analysis,
Prerequisites: Numerical computation
Textbook:
1. T. Marlin, Process Control: Designing Processes and Control Systems for Dynamic Performance, 2nd Edition, McGraw-Hill, New York, 2000.
2. D. E Seborg, T. F. Edgar, D. A. Mellichamp, Process Dynamics and Control, John Wiley & Sons, 1989, ISBN 0-471-86389-0
2. Ogata, Katsuhiko, Teknik Kontrol Automatik (Sistem Pengaturan), Jilid 1, Penerbit Erlangga, 1985, Bandung
3. Bequette, R. W., Process Dynamics: Modeling, Analysis, and Simulation, Prentice Hall,1998

UNDERGRADUATE PROGRAM

4. Luyben, William L., Process Modeling, Simulation and Control for Chemical Engineers, Second Edition, McGraw-Hill International Edition, 1990
5. Stephanopoulos, George, Chemical Process Control: An Introduction to Theory and Practice, Prentice-Hall International, 1984

ENCE606024
UNIT OPERATION LAB 2
1 CREDIT

Learning Objectives: Students be able to:
1. Verify the technique of chemical engineering concept in transport phenomena theory (CHS 210802), Heat Transfer (CHS 220807), Process Control (CHS 310806) that applied on tools or process unit.
2. Operate the equipment and measuring the flow rate (orifice meter, venturimeter, rotameter), air humidity (humidity meter), temperature (thermocouple), process and analyze the data, discussed and took the conclusion, convey the result in the writing report in standard format.

Syllabus: The modules operating unit of mass transfer and the process controlling including: measuring the diffusivity coefficient of liquid gas, drainage, wetted wall column, gas absorption, climb film evaporation, flow rate control, pipe reactor.
Prerequisites: Mass Transfer and Process Controll
Textbook:
1. Practical Manual Processes and Technique Operations 2, UI Department of TGP
2. Literature for the course prerequisites

ENCE606025
CHEMICAL REACTION ENGINEERING 2
3 CREDITS

Learning Objectives: Students are able to design and analyze various types of chemical reactors
Syllabus: The basic concept of chemical reactor design, isothermal ideal reactor designs: batch, CSTR, and PFR / PBR, ideal-isothermal reactor designs: spherical reactor, membrane reactor, micro-reactor, reactor design for multiple reactions, non-isothermal reactor designs: CSTR, multiple steady state, non-isothermal reactor design: PFR / PBR, multi-bed reactor (interstage cooler / heater), multi-phase reactor design (multiple phase), non-ideal reactor design
Prerequisites: Chemical Reaction Engineering 1
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.
6. Levenspiel, O., Chemcial Reaction Engineering, 2nd Ed., John Wiley & Sons. Of 1972.
7. K. J. Leidler, Chemical Kinetics, 3rd ed., Harper Publish., 1987
8. Widodo, W. P., Slamet, Lecture diktat of Chemical Kinetics and Reactor Design, TGP-UI, 2002

ENCE606026
PROCESS EQUIPMENT DESIGN
3 CREDITS

Learning Objectives: Students are able to design chemical process equipment in accordance with the applicable standards.
Syllabus: Pumps, compressors, piping, pressure vessels and tanks, distillation columns, heat exchangers.
Prerequisites: Fluid Mechanics, Heat Transfer, Mass Transfer, Corrosion Materials Science.
Textbook:
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.

ENCE606027
CHEMICAL PRODUCT DESIGN
4 CREDITS

Learning Objectives: Students are able to design chemical products systematically and structured, and analyze the technical and economic feasibility.
Syllabus: An understanding of consumer needs, product specifications, creating and selecting the product concept, product formulation, manufacturing, supply chain, economic.
Prerequisites: Mass and Energy balances, fluids and mechanics particle, mass transfer, heat transfer, Chemical Reaction Engineering, Engineering Economics
Textbook:
1. Cussler, L., G.D. Moggridge, 2011, Chemical Product Design, Cambridge University Press.
2. Seider W.D., Seader J.D., Lewin D.R. Soemantri W., 2009, Product and Process Design Principles. Synthesis, Analysis and Evaluation, Wiley and Sons Inc.
3. Wesselingh J.A., Kiil, S. and Vigild M.E., 2007, Design and Development of Biological, Chemical, Food and Pharmaceutical Products, John Wiley & Sons, Ltd.
4. Ulrich K.T., Eppinger S.D., Product Design and Development, 5th edition, McGraw Hill
5. Birgit Kamm, Patrick R. Grubber, Michael Kamm, Wiley-VCH, Swiss 2005, Biorefineries – Industrial Processes and Products
6. Peter, M.S. and K.D. Timmerhaus, 1991, Plant Design and Economic for Chemical Engineering 4th edition, McGraw Hill.
7. Dolgui A., Soldek J. and Zaikin O., 2005, Supply Chain Optimization: Product/Process Design, Facility Location and Flow Control, Springer
8. Douglas, J.M., 1998, Conceptual Design of Chemical Processes, McGraw Hill.
9. Kirk-Othmer, 1991, Enyclopedia of Chemical Technology, 3rd edition, McGraw Hill.
10. Perry's chemical Handbook

TERM 7

ENCE607028
NATURAL GAS PROCESSING
3 CREDITS

Learning Objectives: Students are able to design the most appropriate process for the removal of natural gas impurities with the process simulator and able to evaluate the energy consumption of refrigeration system and natural gas liquefaction system
Syllabus: Front-end natural gas processing and products, the physical properties of hydrocarbon systems, systems of units of gas, natural gas dehydration (absorption, adsorption), gas sweetening, sulfur recovery, mercury removal, LPG processing, processing CNG, LNG processing.
Prerequisite: Chemical Process Simulation
Textbook:

1. Gas Conditioning and Processing Vol. 1
2. Gas Conditioning and Processing Vol. 2

ENBE607029

INDUSTRIAL PROJECT MANAGEMENT
2 CREDITS

Learning Objective :
Students are able to apply project management in their field of works exactly as well as apply it in other areas exclude main field
Syllabus :
Project-production concept, Life Cycle Project, Selection Project, Planning Project, Implementation Project, and Completion & Evaluation Project
Pre-requisites : -
Textbook : Suharto, Imam, Manajemen Proyek, 1990

ENBE600030
PLANT DESIGN
4 CREDITS

Learning Objectives: Student able to design process and plant of natural product and analysis their economic value.
Syllabus: the concepts in designing process/ plant, flow diagram processes, synthesis and analysis process using heuristic, process simulation,rule of thumb to construct process and material of equipment design, integration heat/process, plant flow sheet, and economic analysis
Prerequisite: process controll, equipment process design, chemical process simulation, engineering economics
Textbook :
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. Peter, M. S. dan K. D. Timmerhaus, Plant design and Economic for Chemical Engineering, 4th Ed., McGraw Hill.
12. SuperPro Designer Manual. Intelligen, Inc

ENBE600031
INTERNSHIP
2 CREDITS

Learning Objectives:
Students are able to gain field experience, able to analyze process/ system/ operation product that available in Chemical industries and anle to apply various communication process : problem solving, intrepersonal communication, study in a group , and conduct a research.
Syllabus: -
Prerequisite: Students had to take a minimum of 110 SKS (minimum value of D) with a 2.0 GPA.
Textbook: -

ENBE600032
RESEARCH METHODOLOGY AND SEMINARS
2 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, technics of identifying problem and make a hypothesis, thinking logically, technics of scientific writing, technics of writing research proposal, technics of designing research, presentation technics, technics of collecting, analyzing, and presenting data.
Prerequisite: Students had to take a minimum of 90 SKS (minimum value of D) with a 2.0 GPA.
Textbook :
1. Handout
2. Research proposal format

TERM 8
ENBE600033
UNDERGRADUATE THESIS/ FINAL PROJECT
4 CREDITS

Learning Objectives: Able to design, conduct and analyze research in Chemical Engineering ; Present scientific research in writing and oral.
Syllabus: Material of thesis according to conducted research
Prerequisite: Research method and seminar
Textbook:
1. Guide book of undergraduate thesis, Depok, 1999.

ENBE600034
CAPITA SELECTA
2 CREDITS

Learning Objectives: Able to explain the development of industry and engineering, business opportunities and the problems it faces in general.
Syllabus: Held with invited guest lecturers who are competent in fields that fit the requirement of each program study (can be different in each semester).
Prerequisite: Students had to take a minimum of 90 SKS
Textbook: -

ELECTIVE COURSES

ELECTIVE COURSE FOR ODD SEMESTER

ENCE803101
OLEOCHEMICAL INDUSTRY
3 CREDITS

Learning Objectives: Students are able to know the various processes that are commonly used in the oleochemical industry, and able to make a plan to develop the manufacture 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

ENCE801101
FOOD TECHNOLOGY
3 CREDITS

Learning Objectives: Students are 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 the process from 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

ENCE803102
PROTEIN ENGINEERING
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

ENCE801102
HERBAL TECHNOLOGY
3 CREDITS

Learning Objectives: Students are able to explain the development of herbal technology, herbal separation technology, herbal formulatioin 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

ENCE801103
COMPOSITE MATERIAL
3 CREDITS

Learning Objectives: Students are able to:
1. Explain the characteristics of composite materials and compare it with conventional materials.
2. 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.

ENCE813103
APPLIED THERMODYNAMICS
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

ENCE803104
DINAMIC SYSTEM
3 CREDITS

Learning Objectives: Students are 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

ENCE811104
THERMODYNAMIC SYSTEM OF HYDROCARBON
3 CREDITS

Learning Objectives: Students are 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.

ENCE801105
LUBRICANT ENGINEERING
3 CREDITS

Learning Objectives: Students are able to explain the working principles of lubrication, lubricant function and several parameter 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

ENCE803105
CRYOGENIC ENGINEERING
3 CREDITS

Learning Objectives: Students are 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.

ENCE801106
COMBUSTION ENGINEERING
3 CREDITS

Learning Objectives: Students are 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.

ENCE803106
PLASMA AND OZONE ENGINEERING
3 CREDITS

Learning Objectives: Students are 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.

ENCE801107
HETEROGENEOUS CATALYST
3 CREDITS

Learning Objectives: Students are 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. Satterfield, C. N., heterogeneous Catalysis in Industrial Practice, McGraw-Hill Inc., New York, 1991.
2. Rase, F. R., Commercial Catalyst, CRC Press, New York, 1991
3. Richardson, T, J., Principles of Catalyst Development, Plenum Press, New York, 1989
4. Thomas J.M. And WJ Thomas, Principles and Practice of Heterogenous Catalysis, VCH, Weinhem, Germany, 1997
5. Emmet, R. H., Catalysis, Reinhold Publishing Corporation, New York, 1961

ENCE801108
SUSTAINABLE ENERGY
3 CREDITS

Learning Objectives: Students are able to explain the relationship of energy with 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

ENCE803107
RISK MANAGEMENT
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 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

ENCE803108
SPECIAL TOPIC 1
3 CREDITS

ELECTIVE COURSE FOR EVEN SEMESTER

ENCE802101
PACKAGING AND STORAGE TECHNOLOGY
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 : hidratasi, 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 : -
Textboox : Examining Food Technology by Anne Barnett. Heinemann Secondary,1996

ENCE802102
BIOINFORMATICS
3 CREDITS

Learning Objective : Students 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

ENCE802103
DRUGS AND COSMETICS TECHNOLOGY
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

ENCE802104
BIOMATERIAL
3 CREDITS

Learning Objective : Students are able to describe the principle and concept of material technologies through biological as well as life cycle assesment (LCA), organic and inorganic materials for biomaterial, apply and develop knowledge about biomaterial for life
Syllabus: Introduction, solids structure, characteristics of materials, metal material for implant, bioceramic materials, structural properties of biomaterial, the respons of tissues to biomaterial implant, the replacement of soft tissues , the replacement of hard tissues, transplantation, and biological tissues engineering
Prerequisite :-
Textbook :
1. Joon Park, R.S. Lakes. Biomaterials an Introduction, springer
2. Biomaterials: Principles and Applications by Joon B. Park, Joseph D. Bronzino. CRC Press

ENCE802105
PETROLEUM PROCESSING
3 CREDITS

Learning Objectives: Students are able to explain petroleum characteristic and its refine 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

ENCE802106
PETROCHEMICAL PROCESSING
3 CREDITS

Learning Objectives: Students are 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 industry through methane, olefins and aromatics; able to analyze 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.

ENCE802107
PHOTOCATALYSIS TECHNOLOGY
3 CREDITS

Learning Objectives: Students are able to understand the basic concepts and photocatalysis and apply it in the various the simple daily problem, especially related with 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 c 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.

ENCE812108
POLYMER ENGINEERING
3 CREDITS
Learning Objectives: Students are able to explain the basic principles and characteristics of polymer manufacturing until being able to keep abreast of the latest technology.
Syllabus: The concept of polymer and polymer characteristics, synthesis / polymerization, kinetics of polymerization, the polymer solution, characterization, process of making plastics.
Prerequisites: Organic Chemistry
Textbook:
1. R. J. Lovell, Introduction to Polymers, P. A. Lovell, Chapman & Hall.
2. R. B., Seymour, Polymers for Engineering Applications, ASM International.
3. F. W. Billmeyer, Textbook of Polymer Science, Wiley.
4. R. J. Crawford, Plastic Engineering, Pergamon Press.
5. Donald R. Woods, Problem Based Learning: How to gain the most PBL, 1994, Mc-Master University, Hamilton, ON L8S 4L8.

ENCE802109
POLLUTION PREVENTION
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.

ENCE802110
EXPLORATION AND PRODUCTION OF HYDROCARBON
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 HYDRAT 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.

ENCE802111
UTILITIES AND PLANT MAINTENANCE
3 CREDITS

Learning Objectives: Students are 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. 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.

ENCE802112
NATURAL GAS TRANSPORTATION AND UTILIZATION
3 CREDITS

ENCE812113
DRUG CONTROLLED RELEASED TECHNOLOGY
3 CREDITS
Learning objective : Students are able to describe the principle of control drug releasedor 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/microsfer, diffusion and permeasi, strategy of control released, case study
Prerequisite : Organic Chemistry
Textbook :
1. Saltzman, W.M., Drug Delivery: Engineering Principles for Drug Therapy, Oxford University Press, 2001.
2. Wen, H. and Park, K, ed., Oral Controlled Release Formulation Design and Drug Delivery, Wiley, 2010.

ENCE802114
ANALYSIS AND SYNTHESIS OF CHEMICAL PROCESSES
3 CREDITS

Learning Objectives: Students are able to analyze and synthesize the chemical processes in an integrated system of technical and economic aspects
Syllabus: The strategy of synthesis and analysis process, design concepts development and the determination of the best flow sheet, a preliminary optimization process, the retrofit process, the use of computer aided design system for simulation and analysis process.
Prerequisites: Simulation of Chemical Processes
Textbook:
1. James M Douglas, Conceptual Design of Chemical Process, McGraw-Hill International Edition, 1988.
2. Hartman, Klaus, and Kaplick, Klaus, Analysis and Synthesis of Chemical Process Systems
3. Lorenz T Biegler, Systematic Methods of Chemical Process Design, Prentice Hall Inc., 1997.

ENCE802115
GEOTHERMAL TECHNOLOGY
3 CREDITS

ENCE802116
PROBLEM-SOLVING SKILLS
3 CREDITS

ENCE802117
SPECIAL TOPIC 2
3 CREDITS

UNDERGRADUATE PROGRAM

4.11. UNDERGRADUATE PROGRAM IN BIOPROCESS ENGINEERING

Program Specification

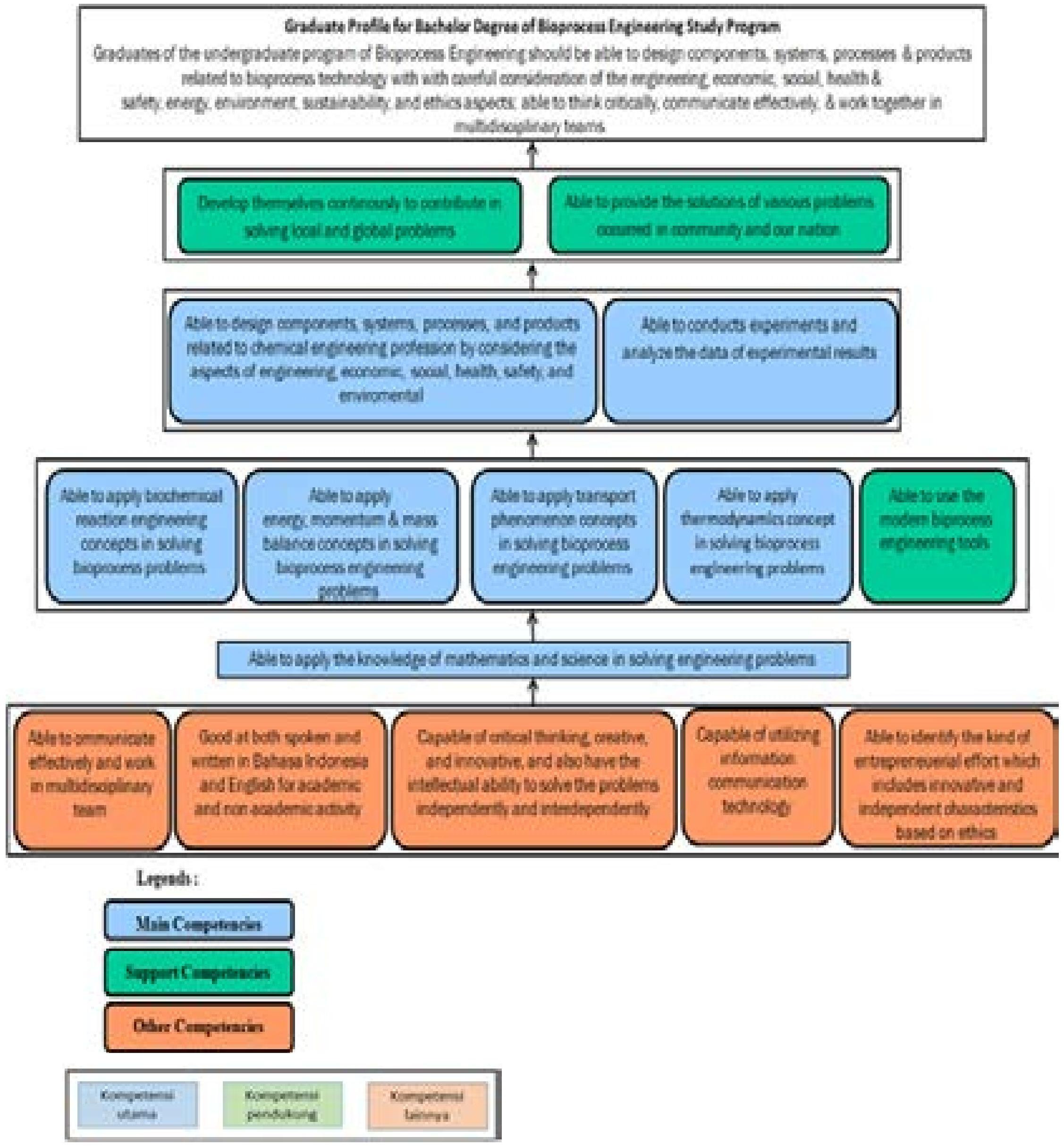
1	**Awarding Institution**		Universitas Indonesia
2	**Teaching Institution**		Universitas Indonesia
3	**Programme Title**		Undergraduate Program in Bioprocess Engineering
4	**Type of Class**		Regular
5	**Degree Given**		Sarjana Teknik (S.T)
6	**Accreditation status**		BAN-PT: A Accredited
7	**Medium Language**		Indonesia
8	**Study Scheme(Full time/Part time)**		Full time
9	**Entry requirement**		High School
10	**Duration of Study**		Scheduled for 4 years
	Type of Semester	Number of semester	Number of weeks /semester
	Regular	8	16
	Short (optional)	3	8
11	**Graduate Profiles:** *Bioprocess Engineering Graduates who are able to design components, systems, processes, and products related to bioprocess engineering profession by considering the aspects of*		
12	**Expected Learning Outcomes:** 1. Able to communicate effectively and work in multidisciplinary team. 2. Capable of critical thinking, creative, and innovative, and also have the intellectual ability to solve the problems at individual and group level. 3. Good at both spoken and written in Bahasa Indonesia and English for academic and non-academic activity. 4. Able to identify the kind of entrepreneurial effort which includes innovative and independent characteristic based on ethics 5. Capable of utilizing information communication technology. 6. Able to apply the knowledge of the mathematics and sciences in solving engineering problems. 7. Able to apply energy, momentum and mass balance concepts in solving bioprocess problems. 8. Able to apply bioenergetics concept in solving bioprocess problems. 9. Able to apply transport phenomena concepts in solving problems. 10. Able to apply bioprocess reaction engineering concepts in solving bioprocess problems. 11. Able to use the modern bioprocess engineering tools. 12. Able to conducts experiments and analyse the data of experiment results. 13. Able to design components, systems, processes, and products related to bioprocess engineering profession by considering the aspects of the engineering, economic, social, 14. Able to provide the solutions of various problems occurred in community, nation, and country. 15. Develop themselves continuously to contribute in solving local and global problems.		

13	Course Composition		
No	Type of Course	Credits	Percentage
i	University General Subjects	18	12.5 %
ii	Basic Engineering Subjects	25	17.4 %
iii	Core Subjects	85	59.0 %
iv	Elective Subjects	9	6.3 %
v	Internship , Seminar, Undergraduate Thesis, Project	7	4.9 %
	Total	144	100 %
14	Total Credit Hours to Graduate		144 SKS

Employment Prospects
The graduates be able to carrier in food industry; pharmaceutical ,cosmetics and biotechnology industries; oleochemicals; consulting and engineering company; environmental and renewable energy industry; govermnent; education and so on.

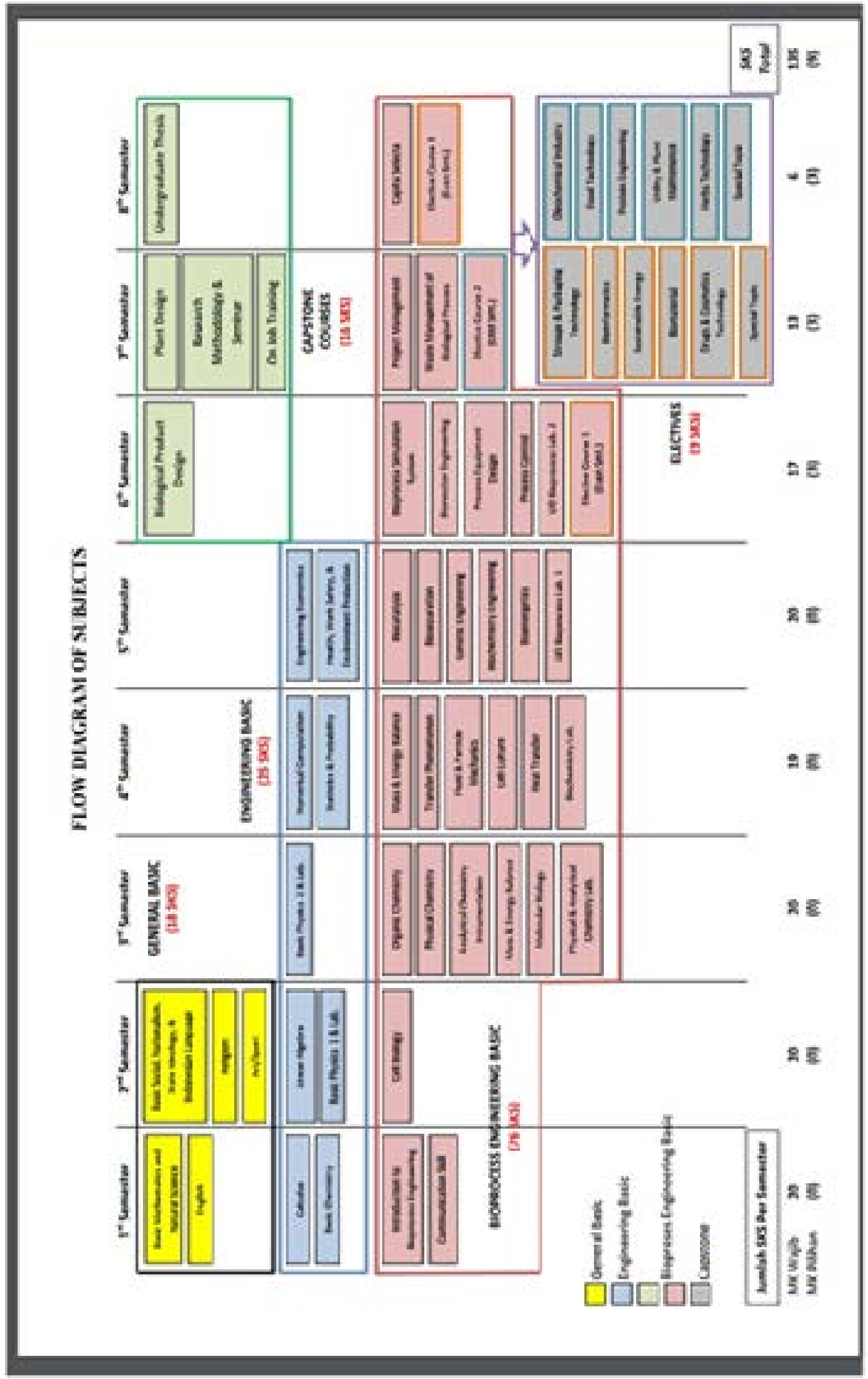
UNDERGRADUATE PROGRAM

NETWORK COMPETENCE



FACULTY OF ENGINEERING

BIOPROCESS ENGINEERING



CURRICULUM STRUCTURE
UNDERGRADUATE BIOPROCESS ENGINEERING

KODE	SUBJECT	CREDIT
CODE	1st Semester	
UIGE600002	Integrated Character Building B	6
UIGE600003	English	3
ENGE600003	Calculus	4
ENGE600009	Basic Chemistry	2
ENBE601002	Intro to Bioprocess Engineering	3
ENBE601003	Communication skills	2
	Total Credit Term 1	20
	2nd Semester	
UIGE600001	Integrated Character Building A	6
ENGE600005	Physics (Mechanics and Thermal)	3
ENGE600004	Linear Algebra	4
ENBE602003	Cell Biology	3
UIGE600010-15	Religion	2
UIGE600020 - 48	Sport / Art	1
ENGE600006	Physics (Mechanics and Thermal) Lab	1
	Total Credit Term 2	20
	3rd Semester	
ENGE600007	Physics (Electricity, MWO)	3
ENBE603004	Organic Chemistry	3
ENBE603005	Instrumental Analytical Chemistry	3
ENBE603006	Physical Chemistry	3
ENBE603007	Physic Chemistry & Analytics Lab	1
ENBE603008	Mass and Energy Balance	3
ENBE603009	Molecular Biology	3
ENGE600008	Physics (Electricity, MWO) Lab	1
	Total Credit Term 3	20
	4th Semester	
ENBE604010	Transport Phenomena	3
ENBE604011	Fluid and Particle Mechanics	3
ENBE604012	Numerical Computation	3
ENBE604013	Cell Culture	3
ENBE604014	Heat Transfer	3
ENBE604015	Biochemistry Laboratory	2
ENGE600010	Statistic and Probability	2
	Total Credit Term 4	19
	5th Semester	
ENBE605016	Biocatalysis	3
ENBE605017	Separation	3
ENGE600011	Engineering Economics	3
ENBE605018	Genetic Engineering	3
ENBE605019	Bioprocess Unit Operation Lab I	1
ENBE605020	Biochemical Engineering	3
ENGE600012	HSE Protection	2
ENBE605021	Bioenergetics	2
	Total Credit Term 5	20

	6th Semester	
ENBE606012	Bioprocess System Simulation	3
ENBE606013	Bioprocess Unit Operation Lab II	1
ENBE606014	Bioreactor Engineering	3
ENBE606015	Bioprocess Equipment Design	3
ENBE606016	Bio Product Design	4
ENBE606017	Process Controll	3
	Elective 1	3
	Total Credit Term 6	20
	7th Semester	
ENBE607018	Bioprocess Waste Treatment	3
ENBE607019	Industrial Project Management	2
ENBE607020	Plant Design	4
ENBE600021	Internship	2
ENBE600022	Research Methodology & Seminar	2
	Elective 2	3
	Total Credit Term 7	16
	8th Semester	
ENBE600023	Scription	4
ENBE608024	Capita Selecta	2
	Elective 3	3
	Total Credit Term 8	9

ELECTIVES

Kode	Elective Course for Odd Semester	Credit
ENCH801101	Foor Technology	3
ENCH801102	Herbal Engineering	3
ENCH801103	Composite Material	3
ENCH801104	Hydrocarbon Thermodynamic	3
ENCH801105	Lubricants Engineering	3
ENCH801106	Combustion Engineering	3
ENCH801107	Heterogenous Catalyst	3
ENCH803101	Oleochemistry Industry	3
ENCH803102	Protein Engineering	3
ENCH803103	Applied Thermodynamics	3
ENCH803104	Dynamics System	3
ENCH803105	Cryogenics	3
ENCH803106	Plasma & Ozone Engineering	3
ENCH803107	Special Topics 1	3
ENCH803201	Renewable Energy	3
Kode	Elective Course for Even Semester	Credit
ENCH802105	Storage & Packaging Techno	3
ENCH802106	Bioinformatics	3
ENCH802107	Cosmetics and Drugs	3
ENCH802108	Biomaterial	3

ENCH802109	Crude Oil Processing	3
ENCH802110	Petrochemical Process	3
ENCH802111	Photocatalysis Engineering	3
ENCH802112	Polimer	3
ENCH802113	Polution Prevention	3
ENCH802114	Explor & Product of Hydrocarbon	3
ENCH802115	Plant Utility and Maintenance	3
ENCH802116	Drug Controlled Release Techno	3
ENCH802117	Analysis & Synthesis of Process	3
ENCH802118	Geothermal Engineering	3
ENCH802119	Problem Solving Skills	3
ENCH802120	Special Topics 2	3
ENCH802201	Trans & Utilization of Natural Gas	3
ENCH802203	Risk Management	3

Resume	Wajib Universitas	18
	Wajib Fakultas	25
	Wajib Program Studi	92
	Jumlah	135
	Pilihan	9
	Total Beban Studi	144

SYLLABUS OF UNIVERSITY SUBJECTS

INTEGRATED CHARACTER BUILDING A
UIGE600001/UIGE610001
6 sks
Syllabus : Integrated Character Building A facilitates students to understand the basics of character formation and master the basics of cognitive power that is logic. Furthermore, to apply cognitive powers in generating good behaviors which are useful to themselves and society. The establishment of ethical behaviors based on ethics is also facilitated. Students are able to develop the basic strength of character and to know themselves as a human being, both as individuals and as part of a group so that they can develop themselves well enough. In a group, the students need to have skills that are needed to maintain an effective relationship in order to improve the quality of human life. Particularly as a citizen of Indonesia, students need to understand the nature of citizenship and basic philosophy of Pancasila in order to act and behave in accordance with the character of the Indonesian nation.
Core Competencies :
1. Students are able to analyze problems in depth individually, comprehensively, logicaly and critically, and generate solutions using the logical and ethical principles and rules of logic and ethics
2. Students are capable of analyzing the problem individually, thoroughly and deeply about the human being as an individual or as part of group
3. Students are individually able to understand, make critical reasoning and to build an open and critical mind to the problem of nationhood, statehood and citizenship in this dynamic world situation
4. Students are able to create and display a work that depicts the character in accordance with the principles of Pancasila

Learning Method : interactive lecture, Experiential Learning, Collaborative Learning, Problem Based Learning, Project-Based Assignment
Prerequisites : OBM (New Student Orientation)

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))

INTEGRATED CHARACTER BUILDING B
UIGE600002/UIGE610004
6 sks
Syllabus : Integrated Character Building B facilitates students to practice identifying, analyzing, and resolving problems of nature and the environment by making use of integrative and quantitative information. This lecture aims to prepare the future generation who care about nature issues through the balanced development of hard skills and soft skills and have the skills of ICT (Information and Communication Technology).
Core Competencies:
1. Students have an ethic, moral, personality and good character in completing the task at hand;
2. Students role as citizens who take pride and love of the homeland and support the continuity of life;
3. Students are able to work together and have a high sensitivity and awareness to the community and the environment;
4. Students are able to think logically, critically and creatively;
5. Students are able to use mathematics to solve problems quantitatively;
6. Students are able to use information and communication technology (ICT) for development;
7. Students are able to analyze the system of nature integratively and comprehensively;
8. Students are able to act as wise managers of nature to build and maintain the preservation of nature for a better and sustainable life.

Learning Method : Blended e-Learning, Collaborative Learning (CL), Problem Based Learning (PBL) and Group Discussion (GD)
Prerequisites : OBM (New Student Orientation)
Textbook : Digital Form can be downloaded from Scele

ISLAMIC STUDY
UIGE600010/UIGE610005
2 sks
General instructional objectives : The cultivation of students who have concern for social, national 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 practice 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 STUDY
UIGE600011/UIGE610006
2 sks
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 STUDY
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 STUDY
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 STUDY
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 STUDY
UIGE600015
2 sks

ART
UIGE600020-30
1 sks
The option of subjects that can be choosen :
Appreciation of Film (UIGE600020), Batik (UIGE600021), Photography (UIGE600022), Calligraphy (UIGE600023), Javanese Karawitan (UIGE600024), Balinese Dance and Karawitan (UIGE600025), Comic (UIGE600026), Painting (UIGE600027), Music and Vocal (UIGE600028), Theater (UIGE600029), Wayang (UIGE600030)

SPORT
UIGE600040-48
1 sks
The option of subjects that can be choosen :
Basketball (UIGE600040), Volley Ball (UIGE600041), Badminton (UIGE600042), Futsal (UIGE600043), Hockey (UIGE600044), Football (UIGE600045), Softball (UIGE600046), Tennis (UIGE600047), Table Tennis (UIGE600048)

SYLLABUS OF BASIC ENGINEERING SUBJECTS

CALCULUS 1
ENGE600001/ENGE610001
3 sks
Syllabus : This subject gives the opportunity for students to understand the basic concept of calculus and to be able to solve applied calculus problems. Students are also given the opportunity to understand basic concepts the functions of one variable, derivatives and integral functions of one variable, and its application.

CALCULUS 2
ENGE600002/ENGE610002
3 sks
Syllabus : This subject gives the opportunity for students to understand the basic concept of calculus and to be able to solve applied calculus problems. Students are also given the opportunity to understand the basic concept the function of two variables, or variables, total derivative and integral of the function of two or more variables and application. In addition, students can understand the basic concepts of sequence and series.

CALCULUS
ENGE600003/ENGE610003
4 sks
Syllabus : This subject gives the opportunity for students to understand the basic concept of calculus and to be able to solve applied calculus problems. Students are also given the opportunity to understand the basic concept the function of two variables, the total derivative of the function of two or more variables and its application. Students are also expected to understand the basic concept of sequence and series and the basic concept of vector and analytical geometry.

LINEAR ALGEBRA
ENGE600004/ENGE610004
4 sks
Syllabus : This subject gives the opportunity for students to master the basic techniques of Linear Algebra and gain knowledge on how to implement said techniques in solving System of linear equationss, determining the bases and dimension of vector space, as well as calculating eigen values and eigen vectors. This subject also gives students the opportunity to work with other objects, especially vectors and matrices.

PHYSICS (MECHANICS AND THERMAL)
ENGE600005/ENGE610005
3 sks
Syllabus : Physics (Mechanics and Thermal) subject includes the topics of mechanics and thermodynamics. Calculus is use as a mathematic helping tool in the learning process. Students are given the opportunity to learn how to unite their understanding of the basic concept of the analytical capability, their numeracy in learning mechanics and thermodynamics. During the course of this subject, students are not only aim to increase the students' knowledge of the basic physics concepts but also to increase their capability in using information technology and computer and to train their skills, such as: independent and group work and their communication skill.
Students will also be train on how to explain and analyse the nature phenomenon and the result of human engineering exist in their everyday lives by using the basic physics concept and applied them in their daily lives. Students are also taught to develop their synthesis ability and evaluating both quantitative and qualitative natural phenomenon and the result of human engineering in their surrounding environment by using basic physics concept. This subject will give students the opportunity to develop their ability to develop their presentation ability analyse the nature phenomenon and the result of human engineering from the mathematics and natural science point of view integrative and comprehensively.

PHYSICS (MECHANICS AND THERMAL) LABORATORY
ENGE600006/ENGE610006
1 sks
Syllabus : Practical of Mechanics: Measurement, Moment of inertia, Gravity acceleration, Fluid density, Scratch coefficient, Collision, Swing torque, Viscosity of water, Young's modulus, Viscosity of Newtonian fluid, Fluids surface tension, Oscillation, Practical of Heat: Coefficient of linear expansion, Heat conductivity, Thermocouple calibration, Calorimeter, Joule Constant, Laplace Constant, Heat Collector, Determining of air Cp/Cv, Expansion of fluids and water anomaly.
Notes: For Architecture and Interior Architecture Program, practical is not mandatory.

PHYSICS (ELECTRICITY, MWO)
ENGE600007/ENGE610007
3 sks
Syllabus : Physics (Electricity, MWO) subject includes the topics of electricity, magnet, wave, and optics. Calculus is use as a mathematic helping tool in the learning process. Students are given the opportunity to learn how to unite their understanding of the basic concept of the analytical capability, their numeracy in learning mechanics and thermodynamics. During the course of this subject, students are not only aim to increase the students' knowledge of the basic physics concepts but also to increase their capability in using information technology and computer and to train their soft skills, such as: independent and group work and their communication skill. Students will also be train on how to explain and analyze the nature phenomenon and the result of human engineering exist in their everyday lives by using the basic physics concept and applied them in their daily lives. Students are also taught to develop their synthesis ability and evaluating both quantitative and qualitative natural phenomenon and the result of human engineering in their surrounding environment by using basic physics concept.

PHYSICS (ELECTRICITY, MWO) LABORATORY
ENGE600008/ENGE610008
1 sks
Syllabus : Practical of Electricity: Electrolysis, Wheatstone bridge, Kirchhoff law, Earth's magnetic field, Temperature coefficient, Characteristic of series RLC circuit, Ohm law, Transformer. Practical of Optics: Polarimeter, Lens, Photometry, Prisms bias index, Spectrometer, Diffraction grid, Newton's ring.

BASIC CHEMISTRY
ENGE600009/ENGE610009
2 sks
Syllabus : As an engineer, you must have understanding on the chemistry that provides not only the basis for much of what goes on in our world but also that it is a vital, continually developing science. In this study the students will learn many subjects such as matter and measurement; atoms, molecules, and ions; stoichiometry; aqueous reactions; thermochemistry; properties of solutions; chemical kinetics; chemical equilibrium; and electrochemistry.
Learning activities will be conducted through various method, which consists of: problem based learning (PBL), interactive lecture, question-based learning, discussion, demonstration and unguided structured assignments. Assessment will be made continuously through a set of exercises, group discussion, mid semester exam and final exam.

STATISTIC AND PROBABILITY
ENGE600010/ENGE610010
2 sks
Syllabus : Statistics and probability has been known as applied mathematics which is widely used in collecting, organizing, presenting, interpreting and analyzing data to support valid conclusions. Furthermore, these conclusions will be used as recommendation in decision making. The course of Statistics and Probability is intended to give a basic ability for students to handle quantitative data and information. There are two stages that are delivered which is descriptive and inductive/inference stages. Descriptive stage includes collecting, organizing, and presenting the data in a scientific manner. Then, inductive/inference stage includes the process of estimating and drawing conclusion based on available data and relations between variables. Hence, students are expected to apply their knowledge of statistics in conducting experiments in laboratory works/assignments as well as research studies in their final projects.

ENGINEERING ECONOMICS
ENGE600011/ENGE610011
3 sks
Syllabus : This course introduces students to the basic of engineering economy. It covers the time value of money (TVOM) and interest rate; tools for evaluating project alternatives for both non discounted and discounted methods, for instance present worth analysis, annual worth analysis, future worth analysis, rate of return (ROR) analysis and benefit/cost analysis; and choosing the best alternative, break even analysis, and effect of depreciation and after tax analysis and sensitivity analysis, and replacement analysis.
Learning activities will be conducted through various methods, which consist of: interactive lectures, question-based learning, discussion, and structure assignments. Assessment will be made thoroughly through sets of exercises/quizzes, group discussion, midterm and final exam. To expose students on the latest utilization of engineering economy and train them how to use it, a project will be assigned. As an integral part of course, computer utilization such as Microsoft Excel will be demonstrated and discussed on the class.

HEALTH, SAFETY AND ENVIRONMENTAL PROTECTION
ENGE600012/ENGE610012
2 sks
Syllabus : The teaching of Safety, Health and Environmental (SHE) protection to undergraduates studying engineering courses is an important part of the education of future engineers at all levels. It is the generally expressed view amongst practitioners in industry, business and other organisations

that all engineers need to be equipped to appreciate, understand and implement the requirements of SHE management and practice to meet the working needs of industry and of their company (or other organisation). Whilst the level of risk and degree of control is dependant on the industry sector concerned the basic principles do not change. In addition, according to code of ethics of engineers, engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties.
The module covers the regulation framework and standards, risk perception, assessment, and management and detail discussion on physical, chemical and process hazards, and related engineering and management controls. Maintenance of safety conditions, personal protective equipments, audit, incident and emergency planning are discussed in accordance to measures for improving students awareness to their daily activities within the campus premises and local environment.
Learning activities will be conducted through various methods, which consist of: interactive lecture, question-based learning, discussion, demonstration and unguided structured assignments. Assessment will be made continuously through a set of exercises, group discussion, mid semester exam and final exam

SYLLABUS OF BIOPROCESS ENGINEERING

TERM 1
UIGE600002
INTEGRATED CHARACTERISTIC BUILDING SUJECT B
6 CREDITS

Learning Objectives
Syllabus
Prerequisites
Textbook

UIGE600003
ENGLISH
3 CREDITS

Learning Objectives
Students able to use English for suporting study in Universitas Indonesia as well as continuing language learning indepedently.
Syllabus
1. Study Skills: (Becoming an active learner, Vocabulary Building: word formation and using the dictionary Listening strategies Extensive reading).
2. Grammar: (Revision of Basic grammar Types of sentences Adjective clauses, Adverb clauses Noun clauses, Reduced clauses).
3. Reading: (Reading skills: skimming, scanning, main idea, supporting ideas, Note-taking Reading popular science article, Reading an academic text)
4. Listening: (Listening to short conversations, Listening to a lecture and note-taking, Listening to a news broadcast, Listening to a short story)
5. Speaking: (Participating in discussions and meetings, Giving a presentation)
6. Writing: (Writing a summary of a short article Describing graphs and tables, Writing an academic paragraph, Writing a basic academic essay (5 paragraphs)

Prerequisites : -
Textbook : Poerwoto, C. et.al. - Reading Comprehension for Engineering Students

ENGE 6 0 0003
CALCULUS
4 CREDITS

Learning Objectives
After attending this subject, students are expected to capable of:
1. Understanding calculus basic concepts and competent to solve applied calculus problems.
2. Understanding the basic concepts of two or more variables function with its application.
3. Understanding the basic concepts of sequences and series as well as basic concepts of vectors and analytic geometry.

Syllabus :

Real number system, non-equivalency, Cartesians Coordination System, mathematic induction, Function and Limit, Continuous Function. Differential including chain's rule, implicit differential, and advanced differential function. Transcendent and differential Function. Applied Differential. Integral, basic integral function, Integration technique. Integral application on Cartesians and polar coordinate, indefinite. Sequences and infinite series. Spare rows and rows of positive change sign, Taylor and McLaurin series. Function of many variables and its derivatives. Maximum and Minimum. Lagrange Methods. Integral folding and its application.
Prerequisites : -
Textbook :
1. D.E.Vanberg and E.J, Purcell, Calculus with Analytic Geometry, 7th ed., Aplleton-Century-Crofts, 1996.
2. D.E.Vanberg, E.J Purcell, A.J Tromba, Calculus, 9th. Prentice-Hall, 2007.
3. G.B Thomas & R.L Finney, Calculus & Analytic Geometry 9th ed., 1996, Addison-Wesley

ENGE 6 0 0009
BASIC CHEMISTRY
2 CREDITS

Learning Objectives
1. Students able to resolve the problems of qualitative chemistry and indicate the reasons clearly as well as integrate various ideas in problem solving.
2. Students able to explain and model chemical and physical processes in the molecul level to explain the macroscopics properties.
3. Students able to classify materials based on conditions and bond properties by using periodic table as refference.
4. Students able to apply important theories such as kinetics of molecules or thermochemistry in chemical proble solving

Syllabus :
1. Materials and Measurements
2. Atoms, molecules, ions, and the Periodic Table
3. Stoichiometry: Calculations by using formulas of chemical equations
4. Chemical Reactions in Solution and stoichiometric solution
5. Thermochemistry; Chemical equilibrium
6. Acid and base
7. Electrochemistry
8. Chemical Kinetics
9. Application of Chemicals

Prerequisites : -
Textbook :
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

ENBE601002
INTRODUCTION TO BIOPROCESS ENGINEERING
3 CREDITS

Learning Objectives
Students able to explain the scope of bioprocess engineering and the related industries
Syllabus
Microbial Structure, Microbial Growth, Nutrition & Culture Medium Control of biochemistry, physiology, stoichiometry and kinetics of growth and metabolism, Basic of prokaryotes and fungi genetic engineering, Food Industry, Healthcare Industry. Energy Industry.
Prerequisites : -
Textbook :
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

ENBE601002
Communication Skill
2 Credits

Learning Objectives
Students are able to propose communication products through the analysis of audience then arrange into a series of coherent messages, as well as present it effectively by using appropriate media technology
Syllabus :
Effective communications, analysis of audiences, writing process, creating memo, resuming abstract, structural engineering papers, oral presentation

Prerequisites : -
Textbook :
Donald R. Woods, Communicating effectively, McMaster University Bookstore, 1996.

TERM 2

UIGE600001
INTEGRATED CHARACTERISTIC BUILDING SUJECT A
6 CREDITS

ENGE 6 0 0005
PHYSICS MECHANICS AND HEAT
3 CREDITS

Learning Objectives
Students are able to understand the concepts and basic laws of mechanics physics and applied in a systematic and scientific problem solving which influenced by the force for both moving and not moving objects.

Syllabus
1. Scale, kinematics of point objects, mechanics of point objects, law of conservation of linear momentum and energy, harmonic motion, gravity, dynamics and kinematics of rigid objects.
2. Introduction and basic concept (pressure, thermodynamic system, state of the system, temperature), expansion, equilibrium energy (thermal state equation), heat transfer, ideal gas.
3. First law of thermodynamics, enthalpy and entropy, The first law of thermodynamics application for open and closed system, Second law of thermodynamics, kinetic theory of ideal gas.

Prerequisites : -
Textbook :
1. Halliday.D, R Resnick, Fisika I, edisi terjema-han P Silaban, Penerbit Erlangga 1986.
2. Ganijanti AS, Mekanika,Penerbit Salemba Teknik, 2000.
3. Tipler PA, Fisika I, ed III, terjemahan Lea Prasetio, Penerbit Erlangga, 1998.
4. Giancoli D.C, General Physics, Prentice Hall Inc, 1984.
5. Sears-Salinger, Thermodinamics, Kinetic theory and statistical thermodynamics, Wesley, 1975.
6. Giancoli, D.C, Physics: principles with aplica-tions, Prentice Hall Inc, 2000

ENGE 6 0 0006
PHYSICS MECHANICS AND HEAT LAB
1 CREDIT

Syllabus :
Practical of Mechanics: Measurement, Moment of inertia, Gravity acceleration, Fluid density, Scratch coefficient, Collision, Swing torque, Viscosity of water, Young's modulus, Viscosity of Newtonian fluid, Fluids surface tension, Oscillation, Practical of Heat: Coefficient of linear expansion, Heat conductivity, Thermocouple calibration, Calorimeter, Joule Constant, Laplace Constant, Heat Collector, Determining of air Cp/Cv, Expansion of fluids and water anomaly. Notes: For Architecture and Interior Architecture Program, practical is not mandatory.

ENGE 6 0 0004
LINIEAR ALGEBRA
4 CREDITS

Learning Objectives: Students are able to explain/understand/apply linear algebra and associate this subject with other subjects.
Syllabus: Introduction of elementary linear algebra, Matrix, Determinant, Vectors in R2 and R3. Euclideas vector space, General vector space, Review of vector space, Product space, Value and diagonalization eigen vector, Linier Transformation, Application on the system of differential equation, Application on the quadratic surface, Decomposition of LU, Least Squares.
Prerequisite: -
Textbook:
1. H. Anton, Elementary Linear Algebra, 9th ed, John Wiley& Sons, 2005.
2. G.Strang, Introduction to Linear Algebra, Wellesley-Cambridge Press, 2007.

ENBE601002
CELL BIOLOGY
3 CREDITS

Learning Objectives: Student able to explain the difference between prokaryotic cells, arkhea and eukaryotic cells,cell genetic and organization, the technics to see and manipulate the cells, and the interaction between cells and cells life cycle.
Syllabus: Cells and tissues, microscopy technics and analysis of cells, membranes and organels, role of DNA and protein, energy in cells, potential work, intercellular communication, mechanical molecule, cell life cycle, apoptosis.
Prerequisite: -
Handbook:
1. Bolsover et al., Cell Biology, John Willey and Son 2004

2. Essential Cell Biology by Bruce Alberts, Dennis Bray, Karen Hopkin and Alexander Johnson (Mar 27, 2009). Garland Science
3. Molecular Cell Biology (Lodish, Molecular Cell Biology) by Harvey Lodish, Arnold Berk, Chris A. Kaiser and Monty Krieger. W. H. Freeman; 6th edition
4. Biological Science Volume 1 (4th Edition) by Scott Freeman (Feb 13, 2010). Benjamin Cummings

UIGE600010-15
RELIGIOUS STUDIES
2 CREDITS

General instructional objectives: Students have a concern for social issues, national and state based on religious moral values applied in the development of knowledge through intellectual skills.
Learning Objectives: After attending this subject, when students given a problem, students can:
1. Analyzed based on values their religion.
2. Analyzed by applying the steps to active learn.
3. Discuss and express their opinions by using Bahasa Indonesia in right and good manner, both in discussion and paper.
Syllabus: Adapted to the respective religion.
Prerequisite: -
Textbook: Adapted to the problem subject.

UIGE600020 – 48
Sports/Arts
1 Credit
Learning Objectives
Syllabus
Prerequisites
Textbook

TERM 3

ENGE 6 0 0007
PHYSICS ELECTRICITY, MAGNETS, WAVE, AND OPTICS
3 CREDITS

Learning Objectives: Students are able to understand:
1. The concept and basic law of physics – electricity and magnetism and apply it systematically and scientifically in solving everyday magnetism and electricity physics problem.
2. The concept and basic law of wave and optical physics and apply systematic and scientific problem solving in a natural wave phenomenon or wave that arises from technical, physical properties of light and geometric optics.

Syllabus: Electric charge and Coulomb law, Electric field, Static and Gauss law, Electric potential, Capacitor, Direct electric current and basic circuit analysis, Magnetic field, Induction and electromagnetic, Faraday law and inductance, Material magnetism properties, A series of transient, Alternating current, Waves, Sounds, Polarization, Interference, Diffraction, Optical geometry, Lighting and photometry.
Prerequisite: -
Textbook:
1. Halliday, D, R. Resnick, Fisika II,edisi terjema-han P. Silaban, Penerbit Erlangga, 1986.
2. Ganijanti AS, Gelombang dan Optik, ed III, Jurusan Fisika FMIPA UI, 1981.
3. Tipler P.A, Fisika II, ed III terjemahan Bam-bang Sugiyono, Penerbit Erlangga, 2001.
4. D.C.Giancoli, General Physics, Prentice Hall Inc, 1984.

ENGE 6 0 0008
PHYSICS ELECTRICITY, MAGNETS, WAVE, AND OPTICS LAB
1 CREDIT
Syllabus:
Practical of Electricity: Electrolysis, Wheatstone bridge, Kirchhoff law, Earth's magnetic field, Temperature coefficient, Characteristic of series RLC circuit, Ohm law, Transformer. Practical of Optics: Polarimeter, Lens, Photometry, Prisms bias index, Spectrometer, Diffraction grid, Newton's ring.
Prerequisite : Physics electricity, magnets and optics

ENBE603004
ORGANIC CHEMISTRY
3 CREDITS

Learning Objectives:
Students are able to:
Explain the link structure and stereochemistry, IUPAC name, physical properties, chemical reactivity, and reaction mechanisms
Determine the mechanisms of some organic chemical reactions and be able to estimate how to synthesize a simple organic chemical compounds.
Syllabus:
Naming of organic compounds,
the role of structure and stereochemistry of the physical / chemical an organic compound, the cracking reactions or free radicals alkane, polymerization of alkenes, aromatic electrophilic sub-

stitution on benzene, substitution and elimination reactions acylation and esterification reactions, dehydration-polymerization reactions
Prerequisites: -
Textbook:
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 notes

ENBE603005
INSTRUMENTAL ANALYTICAL CHEMISTRY
3 CREDITS

Learning Objectives: Students are able to explain and compare the various basic principles methods of analytical chemistry and apply it for qualitative and quantitative analysis of pure and mixture compounds
Syllabus: Skill workshop, Electrochemistry process, Potentiometry, Atomic Spectroscopy (AAS), Molecular spectroscopy (IR), Chromatography gas.
Prerequisite: -
Textbook:
1. Day R.A. dan A. L. Underwood, Analisis Kimia kuantitatif (terjemahan), Erlangga, 1986, atau buku aslinya dalam bahasa Inggris.
2. D. A. Skoog, et.al., Fundamentals of Analytical Chemistry, 5th. Ed., Saunders College Publishing, 1988. Atau edisi terbaru
3. G. D. Christian and J. E O'Reilly, Instrumental Analysis, 2nd. Ed., Allyn Bacon Inc., 1986.
4. Donald R. Woods, Problem based learning: How to gain the most from PBL, 2994, Mc-Master University, Hamilton, ON L8S 4L8.

ENBE603006
PHYSICAL CHEMISTRY
3 CREDITS

Learning Objectives: Students are able to understand the basic concepts of physical chemistry including the topics of thermodynamics, equilibrium reactions, and molecular spectroscopy, and apply these concepts to solve simple problems of chemical physics
Syllabus: pvT properties: gas properties: ideal gas laws, kinetic theory of gases, the viscosity of gas; the properties of liquids and solutions: fluid viscosity, colligative properties of solution, electrolyte solution, Arrhenius and Debye-huckel theory; chemical bond and spectroscopy: atomic orbital, molecular orbital, hybrid orbital, visible light / infrared / ultraviolet spectroscopy; phase and chemical equilibrium: liquid-vapor phase equilibrium and Raoult's law, the application of Le Chatelier's principle to equilibrium reactions.
Prerequisites: -
Textbook:
1. Levine, IN, Physical Chemistry, 6th ed., McGraw-Hill, 2008.
2. Atkins & de Paula, Atkin's Physical Chemistry, 9th ed., Oxford University Press, 2009

ENBE603007
PHYSICAL CHEMISTRY AND ANALYTICAL CHEMISTRY LAB
1 CREDIT

Learning Objectives:
Students are able to conduct pre-eliminary report which is supported laboratory module theories, practicing experiments in laboratory, and arrange final report that contains the results of processing and analysis data experiments as well as explain the phemomena
Syllabus: Isothermal adsorption, effect of concentration and temperature on reaction rate, colligative properties of solution, chemical equilibrium determination, determination of molecular properties based on gas density, potentiometric methods, spectrophotometry visible light, conductometric methods, Chromatoghraphy Gas
Prerequisite: Basic Chemistry, Physical Chemistry and Analytical Chemistry Instrumental
Textbook:
1. Physical Chemistry Lab Instructions FTUI TGP-1989.
2. Guidance of Physical Chemistry and Analytical Chemistry Lab, Chemical Engineering, Universitas Indonesia.
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

ENBE603008
MASS AND ENERGY BALANCE
3 CREDITS

Learning Objectives: Students are able to solve the problem of mass balances, energy balances, and the combination of it.
Syllabus: Basic concept of mass and energy balance in the chemical process, chemical equations and stoichiometry, the principles of mass balance, mass balance with and without chemical reactions, recycle, bypass and purge, the mass balance in the system with lots of tools, general equation of energy balance, enthalpy changes, energy balance application for the system without and with chemical reactions, the solution of system combined heat balance and energy balance.
Prerequisites: -
Textbook:
1. Himmelblau D.M. Basic Principles and Calculation in Chemical Engineering, 6th ed, Prentice Hall 1996
2. G. Reklaitis V. Introduction to Material and Energy Balances, John Wiley 1983
3. Felder, R.M. & R.W. Rousseau. Elemnetary Principle of Chemical Process. John Wiey & Sons inc. 2005.
4. Dictates of Mass and Energy Balance 2001

ENBE603009
MOLECULAR BIOLOGY
3 CREDIT

Learning Objectives: Students are able to explain the relation of nucleic acids, protein, carbohydrate, as well as lipid with its functions, synthesis, and the metabolisme of chemical compounds in cell.
Syllabus: Molecular biology, nucleic acids, structure and replication of DNA and RNA, transcription and translation, amino acids, synthesis and structure of proteins, enzymes, and metabolism.
Prerequisite: -
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)

TERM 4

ENBE604010
TRANSPORT PHENOMENA
3 CREDITS

Learning Objectives: 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.
Prerequisites:
Textbook:
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

ENBE604011
FLUIDS AND MECHANICS PARTICLE
3 CREDITS

Learning Objectives: Students are able to apply the phenomenon of fluid flow and particle (continuity equation, Bernoulli, etc) to solve problem in process unit through calculation of energy and force, etc, especially in the fluid flow system of piping, rate measurer and fluid transportation tool, and in the system of fluid-solid flow (fluidization, filtration, sedimentation, particle motion in gas.
Syllabus: Fluid properties; static fluid and its application; basic equation of fluid flow (mass balance and continuity equation, energy balance and Bernoulli Equation); the application of Bernoulli equation to measuring flow rate; friction loss in fluid flow through piping, The equipment of fluid transport: pump, compressor, turbine; high velocity gas flow; particle motion in fluid; fluidization; filtration; sedimentation.
Prerequisite: Transport Phenomena
Textbook:
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.

ENBE604012
NUMERICAL COMPUTATION
3 CREDITS

Learning Objectives
Students are able to solve chemical and biological process through computational methods

Syllabus
1. Binary computing system
2. Computer memory
3. Algorithms and efficiency of the system
4. Dynamic and MonteCarlo
5. Stocastic and random
6. Error and mistakes reduction

Prerequisites : -
Textbook : -

ENBE604013
CELL CULTURE
3 CREDITS

Learning Objectives:
Students are able to explain technique of cells culture including procaryotic cells, eucariotic cells, mammals, and plant cell) and able to design cell culture in industrial level.
Syllabus: introduction to cell culture medium, procedures of cell culture, developing of growth media, bioprocess development of line cell.
Prerequisite: Cell Biology
Handbook:
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.

ENBE604014
HEAT TRANSFER
3 CREDITS

Learning Objectives: Students are able to develop knowledge in heat transfer as well as longterm learning skills to follow avance knowledge and technology that related to heat transfer
Syllabus: Introduction, skills workshop process, steady-state conduction, unsteady-state conduction, natural and forced convection, radiation.
Prerequisite: Transport Phenomena
Textbook:
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, 1994, McMaster University, Hamilton, ON L8S 4L8.

ENBE604015
BIOCHEMISTRY LAB
2 CREDITS
Learning Objectives: Student is able to arrange initial report about theory of the experiments, perform lab experiments, analys the data of experiments, and submit final reports.

Syllabus:
1. Physical and Chemical properties
2. Separation and purification of subtances
3. Metal reactions with acids
4. Crystal Water
5. Identification of hydrocarbon compounds
6. Identification of alcohol and Phenol
7. Identification of lipid compounds
8. Nucleic acids
9. Carbonil
10. Carbohydrate
11. Lipid Analysis
12. Extraction and identification of lipid acid from corn oil
13. Bacteria culture

Prerequisite: natural organic chemistry, molecular byologi and cell culture
Textbook :
1. Fessenden, alih 1. 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
10. Mathews, Kensal E. van Holde and Kevin
11. G. Ahern (Dec 10, 1999)

ENGE 6 0 0010
STATISTICS AND PROBABILITY
2 CREDITS

Learning Objectives
Syllabus
Prerequisites
Textbook

TERM 5

ENBE605016
BIOCATALYSIS
3 CREDITS

Learning Objectives: Student able to explain biocatalyst in chemical and biological reactions and the factors influenced it and its application in industry.
Syllabus: catalysis and biocatalysis, enzymes classification and activity, immobilization of enzyme methods, the factors influence biocatalyst performance, inactivations of biocatalyst, biocatalyst reaction kinetics, enzyme productions, methods, product recovery, applications of biocatalyst in industry.
Prerequisite: Molecular biology and Biochemical Engineering
Textboook :
1. Enzyme biocatalysis: principles and applications by Andres Illanes. Springer 2008
2. Biocatalysts and Enzyme Technology by Klaus Buchholz , Volker Kasche , Uwe Theo Bornscheuer. Wiley-VCH, 2005
3. James E. Bailey, David F. Ollis, Biochemical Engineering Fundamentals, McGraw-Hill International Editions, second edition, 1986.
4. Douglas S Clark, Harvey W Blanch, Biochemical Engineering, Marcel Dekker Inc, 1997.
5. Heri Hermansyah, Kinetika Reaksi Biokatalisis, UI Press, 2010
6. Ching T Hou, Handbook of Industrial Biocatalysis, CRC Press, 2005

ENBE605017
SEPARATION
3 CREDITS

Learning Objectives :Understanding basic separation technic, able to design separation process which is effective and efficient, able to design quality control process from the isolated product.
Syllabus: separation concept, mass transport concept, Distillation, Absorption and Stripping, Extraction, Leaching, Membrane process, Ion exchange, cristalization, Bubble and Foam Separation, chromatography, Ultrafiltration dan Reverse osmosis, Membrane dialysis process, selection strategy of separation process.
Prerequisite: Transport phenomena
Handbook:
1. Warren L. McCabe, Julian C. Smith, PeterHarriot. 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

UNDERGRADUATE PROGRAM
BIOPROCESS ENGINEERING

ENGE 6 0 0011
ENGINEERING ECONOMICS
3 CREDITS

Learning Objectives
Students are able to explain fundamentals of decision-making and feasibilty study by using ecp-nomic approach
Syllabus :
1. The principels of engineering economics
2. Equivalence

3. Compound Interest Factor

4. Alternative Evaluation by equivalance value method

5. Alternative Evaluation by IRR Method

6. Comparing Alternatives

7. Benefit-cost ratio Method to cost (B/C ratio)

8. Depreciation

9. Income tax

10. Evaluation after Tax

Prerequisites : Statistics and Probability
Textbook :
1. Blank, L and Tarquin, A., Engineering Economy, McGraw Hill, New York, 2002
2. Sulivab, G. W., Bontadelli, J. A. and Wicks, E. M., Engineering Economy, 11th ed., Prentice Hall, New Jersey, 2000
3. Stermole, Frank J., Economic Evaluation and Investment Decision Methods, Investment Evaluations Corporation, Golden
4. Newman, Donald G., Engineering Economic Analysis, Engineering Press, Inc., san Jose, 1988
5. Bakuan Kompetensi INTAKINDO-2007

ENBE605018
GENETICS ENGINEERING
3 CREDITS

Learning Objectives : Students are able to explain basic concept, techniques used as well as application from genetics engineering process.
Syllabus : Introduction, bacic principles of genetics, Cutting and joining DNA, Plasmid, Cloning strategy and genetics engineering technology
Prerequisites : Cell Byology and Molecular Byology
Textbook :
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

ENBE605019
BIOPROCESS UNIT OPERATION LAB I
1 CREDIT

Learning Objectives: Student have experience to operate process equipment and conduct the experiment, able to analysis and explain the phenomena occurred in each experiment acticity.
Syllabus: Fluid sircuit mechanic, conduction heat transfer in multiple pipe systems, filtrationprocess, fluidization process and its effect on heat transfer system, fermentation process in biofermentor reactor system.
Prerequisite: Bioseparation, fluids mechanics and particle, Biochemical Engineering
Handbook:
1. Buku Petunjuk Praktikum Proses dan Operasi Bioproses 1, DTK FTUI
2. Literatur untuk mata kuliah prasyarat

ENBE605020
BIOCHEMICAL ENGINEERING
3 CREDITS

Learning Objectives: Students are able to explain the concepts of biochemistry engineering in cell growth, metabolism and product of biochemistry process.
Syllabus: metabolic reactions, energetic, catabolism , carbon, respiration, photosynthesis,biosynthesis, transport in cell membrane, the last product of metabolism, microbes and cell growth, substrate utilization, product synthesis
Prerequisite: Physical Chemistry
Handbook:
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 DekkerInc, 1997.

ENGE 6 0 0012
HEALTH, SAFETY AND ENVIRONMENT
2 CREDIT

Learning Objectives: Students are able to:
1. Identify various types of hazards, characterization, proposes a method which is suitable for risk reduction and mitigation and safety management system design.
2. Increase awareness of health and safety industry, and understand the regulatory framework and standard of safety and environmental programs.

Syllabus: Introduction to Regulation and Standards; Risk Perception, Assessment and Management; Machinery Hazards; Noise Hazards; Process Safety Hazard; Fire and Explosion Hazard; Electrical Hazard; Toxicology in The Workplace; Environmental Protection; Environmental Protection Control Processes; Hazard Communication to Employees; Personal Protective Equipment (PPE): Types of PPE and Selection of PPE; Safety Audits, Incident and Emergency Planning.
Prerequisite: -
Textbook:
1. Charles A. Wentz, Safety, Health and Environ-mental Protection, MGH, 1998.
2. Asfahl, C.R., Rieske, D.W., Industrial Safety and Health Management, 6th Ed., Pearson Education, Inc. 2010.
3. United Kingdom – Health and Safety Executive, http://www.hse.gov.uk/
4. Undang-undang dan Peraturan Nasional terkait dengan Sistem Manajemen K3 dan Lingkungan.
5. Related Journal, standards and Publications.

ENBE605021
BIOENERGETICS
2 CREDIT
Learning Objectives: Students are able to apply basic concept of bioenergetics in simple problems that related to energy changes accompanying biochemical reactions.
Syllabus : Energy demands, thermodynamics Law, ATP and Chemical energy transfer, ATP synthesis setting : kinetical aspects, Biological oxidation, respiration energy. Photosynthesis in plant and bactreia
Prerequisites : Physics Mechanics and Heat
Textbook :
1. Robert A. Alberty, Thermodynamics of Biochemical Reactions, Wiley Interscience, 2003.
2. Lehninger A., Bioenergetics The Molecular Basis of Biological Energy Transformation 5th edition, The Benjadmin/Cummings Publishing Company, 2008
3. Lehninger A., Principles of Biochemistry 5th edition, W.H. Freeman and Company, 2009

TERM 6

ENBE606012
BIOPROCESS SYSTEM SIMULATION
3 CREDITS

Learning Objectives: Students are capable of synthesizing and modeling the biological chemistry process,and have an experience with commercial simmulation software.
Syllabus: benefits and position of bioprocess simulation, software requirement (installation, unit structure, task, economic, etc), simple system: fermentation and filtration, pure components registration which are available/not available on software, mixture components registration, unit selection, case study: galactosidase.
Prerequisite: Numerical Computation
Textbook :
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.

ENBE606013
BIOPROCESS UNIT OPERATION LAB II
1 CREDIT

Learning Objectives: Student have experience to operate process equipment and conduct the

experiment, able to analysis and explain the phenomena occurred in each experiment acticity.
Syllabus: Absorption process, Flow control,Wet Wetted Column, Pressure Control, Biofilter/Biofixation CO2.
Prerequisite: Bioseparation and process controll
Handbook:
1. Buku Petunjuk Praktikum Proses dan Operasi Bioproses 1, DTK FTUI
2. Literatur untuk mata kuliah prasyarat

ENBE606014
BIOREACTOR ENGINEERING
3 CREDITS

Learning Objectives: Students are able to design bioreactor.
Syllabus: Introduction to reactor and bioreactor, fermentation technology, reactor engineering for animal and plant cell, ideal reactor, modeling of stirred-tank bioreactor, modeling bubble column bioreactor, reactor dynamic, non-ideal bioreactor, sterilization of bioreactor,bioreactor multiphase, philosophy and rule of thumb in designing bioreactor, design agitation system, analysis and design bioreactor.
Prerequisite: Biochemistry engineering
Handbook:
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

ENBE606015
PROCESS EQUIPMENT ENGINEERING
3 CREDITS

Learning Objective : Sudents are able to design chemical and biological process based on applicable standard
Syllabus : pump, compressor, pipeline, presure vessel and Tank, distillation column and heat exchanger.
Prerequisite : fluids and mechanics particle and bioseparation
Textbook :
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.

ENBE606016
BIOLOGICAL PRODUCT DESIGN
4 CREDITS

Learning Objectives: students are able to design product based on natural resource and analysis their economic value.
Syllabus: Understanding consumer needs, product spesification, product formulation,product manufacturing, supply chain and economics
Prerequisite: process equipment design (passed or parallel), economic engineering.
Handbook:
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

ENBE606017
PROCESS CONTROLLING
3 CREDITS

Learning Objective : Students are able to design single loop control system as well as combine process dinamics witk work.
Syllabus : Introduction to process cintrolling, objective and controlling benefits, the principle of mathemtics modelling, modelling and analysis of process controlling, specific dynamics process system properties, identification of empirical methods, feedback loop, controller PID, setting PID controller, stability analysis
Prerequisite : Numerical computation
Textbook :
1. Smith & Corripio, Principles and Practice of Automatic Process Control,1985, John Wiley
2. Bequette, R. W., Process dynamic: Modelling, Analysis, and Simulation, Prenctice Hall, 1998

TERM 7

ENBE607018
WASTE MANAGEMENT OF BIOLOGICAL PROCESS
3 CREDITS

UNDERGRADUATE PROGRAM

Learning Objectives: Understanding the concepts of pollution prevention and waste management in clean production, and also design waste management system.
Syllabus: Introduction to pollution prevention concepts, waste water treatment and its preparation, physical, biological, and chemical waste water, unit operation, bioremediation,bioseparation and biodegradation, advanced oxidation process, waste gas treatment, B3 treatment, solid waste treatment, inconventional liquid and gas waste treatment.
Prerequisite: Cell Biology
Handbook:
1. Biowaste and biological waste treatment by Gareth Evarts. James & James, 2001

ENBE607019
INDUSTRIAL PROJECT MANAGEMENT
2 CREDITS

Learning Objective :
Students are able to apply project management in their field of works exactly as well as apply it in other areas exclude main field
Syllabus :
Project-production concept, Life Cycle Project, Selection Project, Planning Project, Implementation Project, and Completion & Evaluation Project
Pre-requisites : Engineering Economics
Textbook : Suharto, Imam, Manajemen Proyek, 1990

ENBE607020
PLANT DESIGN
4 CREDITS

Learning Objectives: Student able to design process and plant of natural product and analysis their economic value.
Syllabus: the concepts in designing process/ plant, flow diagram processes, synthesis and analysis process using heuristic, process simulation,rule of thumb to construct process and material of equipment design, integration heat/process, plant flow sheet, and economic analysis
Prerequisite: Process controlling, engineering economic, Bioprocess system simulation, process equipment design.
Textbook :
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

ENBE600021
INTERNSHIP
2 CREDITS

Learning Objectives:
Students are able to gain field experience, able to analyze process/ system/ operation product that available in Chemical industries and anle to apply various communication process : problem solving, intrepersonal communication, study in a group , and conduct a research.
Syllabus: -
Prerequisite: Students had to take a minimum of 110 SKS (minimum value of D) with a 2.0 GPA.
Textbook: -

ENBE600022
RESEARCH METHODOLOGY AND SEMINARS
2 CREDITS

BIOPROCESS ENGINEERING

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, technics of identifying problem and make a hypothesis, thinking logically, technics of scientific writing, technics of writing research proposal, technics of designing research, presentation technics, technics of collecting, analyzing, and presenting data.
Prerequisite: Students had to take a minimum of 90 SKS (minimum value of D) with a 2.0 GPA.
Textbook :
1. Handout
2. Research proposal format

TERM 8
ENBE600023
UNDERGRADUATE THESIS/ FINAL PROJECT
4 CREDITS

Learning Objectives: Able to design, conduct and analyze research in bioprocess technology ; Present scientific research in writing and oral.
Syllabus: Material of thesis according to conducted research
Prerequisite: Research method and seminar
Textbook:
1. Guide book of undergraduate thesis, Depok, 1999.

ENBE608024
CAPITA SELECTA
2 CREDITS

Learning Objectives: Able to explain the development of industry and engineering, business opportunities and the problems it faces in general.
Syllabus: Held with invited guest lecturers who are competent in fields that fit the requirement of each program study (can be different in each semester).
Prerequisite: Students had to take a minimum of 90 SKS
Textbook: -

ELECTIVE COURSES

ELECTIVE COURSE FOR ODD SEMESTER

ENCE803101
OLEOCHEMICAL INDUSTRY
3 CREDITS

Learning Objectives: Students are able to know the various processes that are commonly used in the oleochemical industry, and able to make a plan to develop the manufacture 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

ENCE801101
FOOD TECHNOLOGY
3 CREDITS

Learning Objectives: Students are 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 the process from 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

ENCE803102
PROTEIN ENGINEERING
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

ENCE801102
HERBAL TECHNOLOGY
3 CREDITS

Learning Objectives: Students are able to explain the development of herbal technology, herbal separation technology, herbal formulatioin 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

ENCE801103
COMPOSITE MATERIAL
3 CREDITS

Learning Objectives: Students are able to:
1. Explain the characteristics of composite materials and compare it with conventional materials.
2. 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.

ENCE813103
APPLIED THERMODYNAMICS
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

ENCE803104
DINAMIC SYSTEM
3 CREDITS

Learning Objectives: Students are 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

ENCE811104
THERMODYNAMIC SYSTEM OF HYDROCARBON
3 CREDITS

Learning Objectives: Students are 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.

ENCE801105
LUBRICANT ENGINEERING
3 CREDITS

Learning Objectives: Students are able to explain the working principles of lubrication, lubricant function and several parameter 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

ENCE803105
CRYOGENIC ENGINEERING
3 CREDITS

Learning Objectives: Students are 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.

ENCE801106
COMBUSTION ENGINEERING
3 CREDITS

Learning Objectives: Students are 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.

ENCE803106
PLASMA AND OZONE ENGINEERING
3 CREDITS

Learning Objectives: Students are 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.

ENCE801107
HETEROGENEOUS CATALYST
3 CREDITS

Learning Objectives: Students are 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. Satterfield, C. N., heterogeneous Catalysis in Industrial Practice, McGraw-Hill Inc., New York, 1991.
2. Rase, F. R., Commercial Catalyst, CRC Press, New York, 1991
3. Richardson, T, J., Principles of Catalyst Development, Plenum Press, New York, 1989
4. Thomas J.M. And WJ Thomas, Principles and Practice of Heterogenous Catalysis, VCH, Weinhem, Germany, 1997
5. Emmet, R. H., Catalysis, Reinhold Publishing Corporation, New York, 1961

ENCE801108
SUSTAINABLE ENERGY
3 CREDITS

Learning Objectives: Students are able to explain the relationship of energy with 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

ENCE803107
RISK MANAGEMENT
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 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

ENCE803108
SPECIAL TOPIC 1
3 CREDITS

ELECTIVE COURSE FOR EVEN SEMESTER

ENCE802101
PACKAGING AND STORAGE TECHNOLOGY
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 : hidratasi, 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 : -
Textboox : Examining Food Technology by Anne Barnett. Heinemann Secondary,1996

ENCE802102
BIOINFORMATICS
3 CREDITS

Learning Objective : Students 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

ENCE802103
DRUGS AND COSMETICS TECHNOLOGY
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

ENCE802104
BIOMATERIAL
3 CREDITS

Learning Objective : Students are able to describe the principle and concept of material technologies through biological as well as life cycle assesment (LCA), organic and inorganic materials for biomaterial, apply and develop knowledge about biomaterial for life
Syllabus: Introduction, solids structure, characteristics of materials, metal material for implant, bioceramic materials, structural properties of biomaterial, the respons of tissues to biomaterial implant, the replacement of soft tissues , the replacement of hard tissues, transplantation, and biological tissues engineering
Prerequisite :-
Textbook :
1. Joon Park, R.S. Lakes. Biomaterials an Introduction, springer
2. Biomaterials: Principles and Applications by Joon B. Park, Joseph D. Bronzino. CRC Press

ENCE802105
PETROLEUM PROCESSING
3 CREDITS

Learning Objectives: Students are able to explain petroleum characteristic and its refine 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

ENCE802106
PETROCHEMICAL PROCESSING
3 CREDITS

Learning Objectives: Students are 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 industry through methane, olefins and aromatics; able to analyze 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.

ENCE802107
PHOTOCATALYSIS TECHNOLOGY
3 CREDITS

Learning Objectives: Students are able to understand the basic concepts and photocatalysis and apply it in the various the simple daily problem, especially related with 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 c 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.

ENCE812108
POLYMER ENGINEERING
3 CREDITS
Learning Objectives: Students are able to explain the basic principles and characteristics of polymer manufacturing until being able to keep abreast of the latest technology.
Syllabus: The concept of polymer and polymer characteristics, synthesis / polymerization, kinetics of polymerization, the polymer solution, characterization, process of making plastics.
Prerequisites: Organic Chemistry
Textbook:
1. R. J. Lovell, Introduction to Polymers, P. A. Lovell, Chapman & Hall.
2. R. B., Seymour, Polymers for Engineering Applications, ASM International.
3. F. W. Billmeyer, Textbook of Polymer Science, Wiley.
4. R. J. Crawford, Plastic Engineering, Pergamon Press.
5. Donald R. Woods, Problem Based Learning: How to gain the most PBL, 1994, Mc-Master University, Hamilton, ON L8S 4L8.

ENCE802109
POLLUTION PREVENTION
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.

ENCE802110
EXPLORATION AND PRODUCTION OF HYDROCARBON
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 HYDRAT 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.

ENCE802111
UTILITIES AND PLANT MAINTENANCE
3 CREDITS

Learning Objectives: Students are 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. 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.

ENCE802112
NATURAL GAS TRANSPORTATION AND UTILIZATION
3 CREDITS

ENCE812113
DRUG CONTROLLED RELEASED TECHNOLOGY
3 CREDITS
Learning objective : Students are able to describe the principle of control drug releasedor 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/microsfer, diffusion and permeasi, strategy of control released, case study
Prerequisite : Organic Chemistry
Textbook :
1. Saltzman, W.M., Drug Delivery: Engineering Principles for Drug Therapy, Oxford University Press, 2001.
2. Wen, H. and Park, K, ed., Oral Controlled Release Formulation Design and Drug Delivery, Wiley, 2010.

ENCE802114
ANALYSIS AND SYNTHESIS OF CHEMICAL PROCESSES
3 CREDITS

Learning Objectives: Students are able to analyze and synthesize the chemical processes in an integrated system of technical and economic aspects
Syllabus: The strategy of synthesis and analysis process, design concepts development and the determination of the best flow sheet, a preliminary optimization process, the retrofit process, the use of computer aided design system for simulation and analysis process.
Prerequisites: Simulation of Chemical Processes
Textbook:
1. James M Douglas, Conceptual Design of Chemical Process, McGraw-Hill International Edition, 1988.
2. Hartman, Klaus, and Kaplick, Klaus, Analysis and Synthesis of Chemical Process Systems
3. Lorenz T Biegler, Systematic Methods of Chemical Process Design, Prentice Hall Inc., 1997.

ENCE802115
GEOTHERMAL TECHNOLOGY
3 CREDITS

ENCE802116
PROBLEM-SOLVING SKILLS
3 CREDITS

ENCE802117
SPECIAL TOPIC 2
3 CREDITS

4.12. UNDERGRADUATE PROGRAM IN INDUSTRIAL ENGINEERING

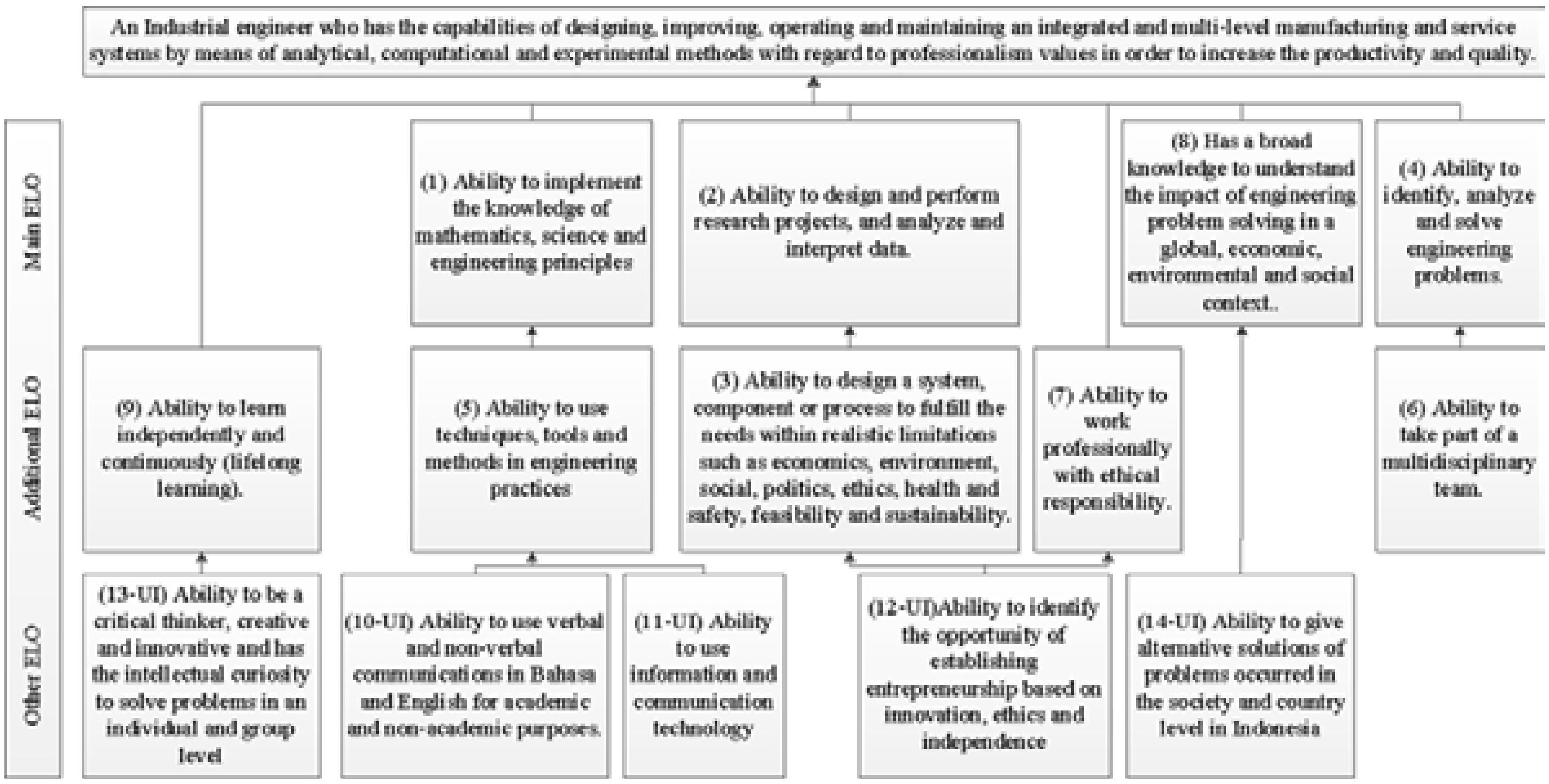
Program Specification

1	**Awarding Institution**		Universitas Indonesia
2	**Teaching Institution**		Universitas Indonesia
3	**Programme Title**		Undergraduate Program in Industrial Engineering
4	**Class**		Regular, Parallel, International
5	**Final Award**		Sarjana Teknik (S.T)
6	**Accreditation / Recognition**		BAN-PT: A - accredited AUN - QA
7	**Language(s) of Instruction**		Bahasa Indonesia and English
8	**Study Scheme (Full Time / Part Time)**		Full Time
9	**Entry Requirements**		High school /equivalent, or D3 / Polytechnique / 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:** *An Industrial engineer who has the capabilities of designing, improving, operating and maintaining integrated and multi-level manufacturing and service systems by means of analytical, computational and experimental methods with regard to professionalism values in order to increase the productivity and quality.*		
12	Expected Learning Outcomes: 1. Ability to implement the knowledge of mathematics, science and engineering principles. 2. Ability to design and perform research projects, and analyze and interpret data. 3. Ability to design a system, component or process to fulfill the needs within realistic limitations such as economics, environment, social, politics, ethics, health and safety, feasibility and sustainability. 4. Ability to identify, analyze and solve engineering problems. 5. Ability to use techniques, tools and methods in engineering practices. 6. Ability to take part of a multidisciplinary team. 7. Ability to work professionally with ethical responsibility. 8. Has a broad knowledge to understand the impact of engineering problem solving in a global, economic, environmental and social context. 9. Ability to learn independently and continuously (lifelong learning). 10. Ability to use verbal and non-verbal communications in Indonesian language and English for academic and non-academic purposes. (UI competency) 11. Ability to use information and communication technology. (UI competency) 12. Ability to identify the opportunity of establishing entrepreneurship based on innovation, ethics and independence (UI competency). 13. Ability to be a critical thinker, creative and innovative and has the intellectual curiosity to solve problems in an individual and group level (UI competency). 14. Ability to give alternative solutions of problems occurred in the society and country level in Indonesia (UI competency).		

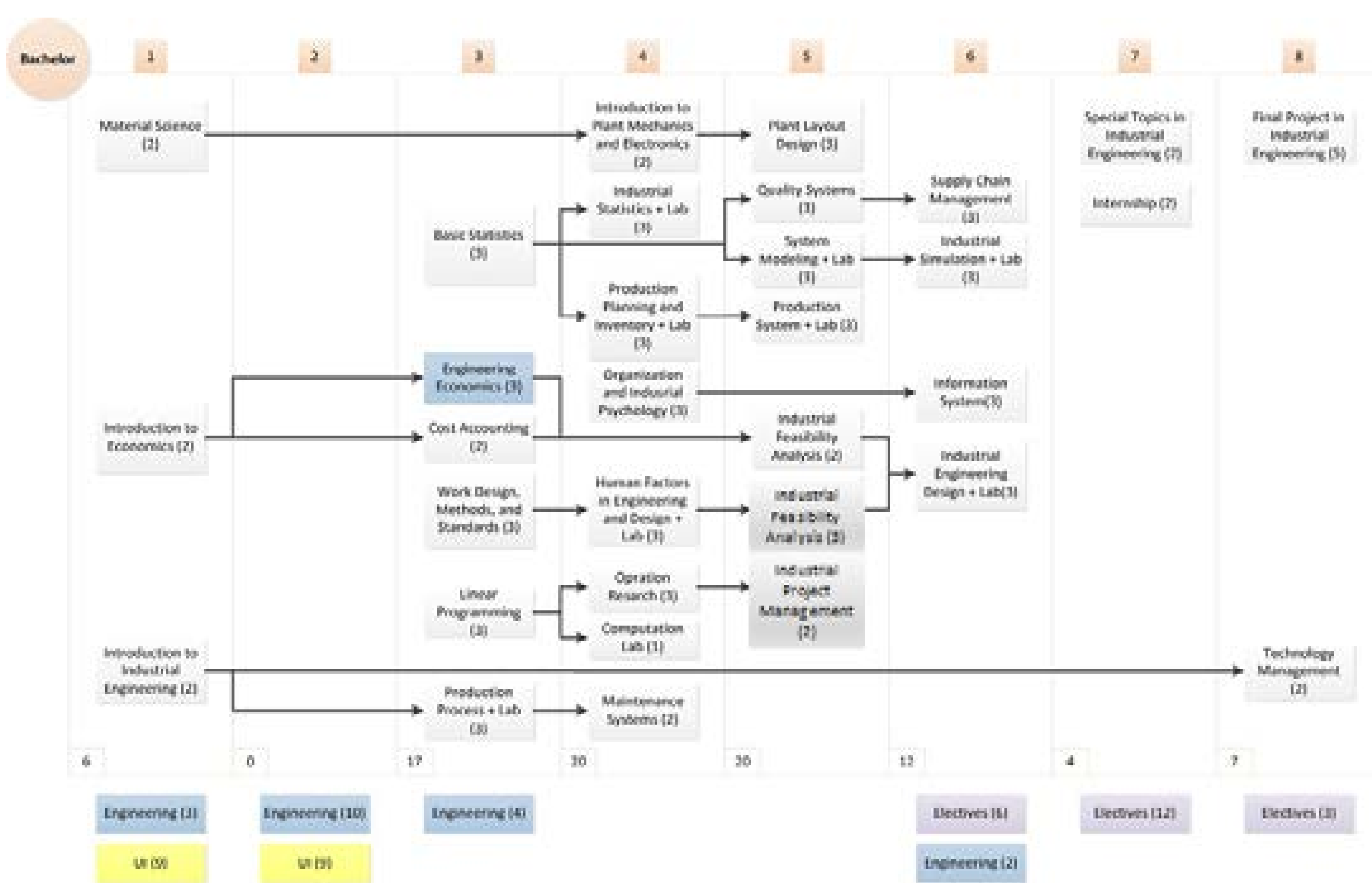
13	**Classification of Subjects**		
No	Classification	Credit Hours (SKS)	Percentage
i	University General Subjects	18	12.5 %
ii	Basic Engineering Subjects	25	17.4 %
iii	Core Subjects	71	49.3 %
iv	Elective Subjects	21	14.6 %
v	Internship, Seminar, Undergraduate Thesis, Project	9	6.2 %
	Total	144	100 %
14	**Total Credit Hours to Graduate**		**144 SKS**

Career Prospects
Public or private manufacturing and service industries, such as production management, HR, maintenance system, logistics and supply chain management, data scientist, operations researchers, system dynamics expert, finance and banking, management and IT consulting services.

Flow Diagram of Expected Learning Outcomes (ELOs)

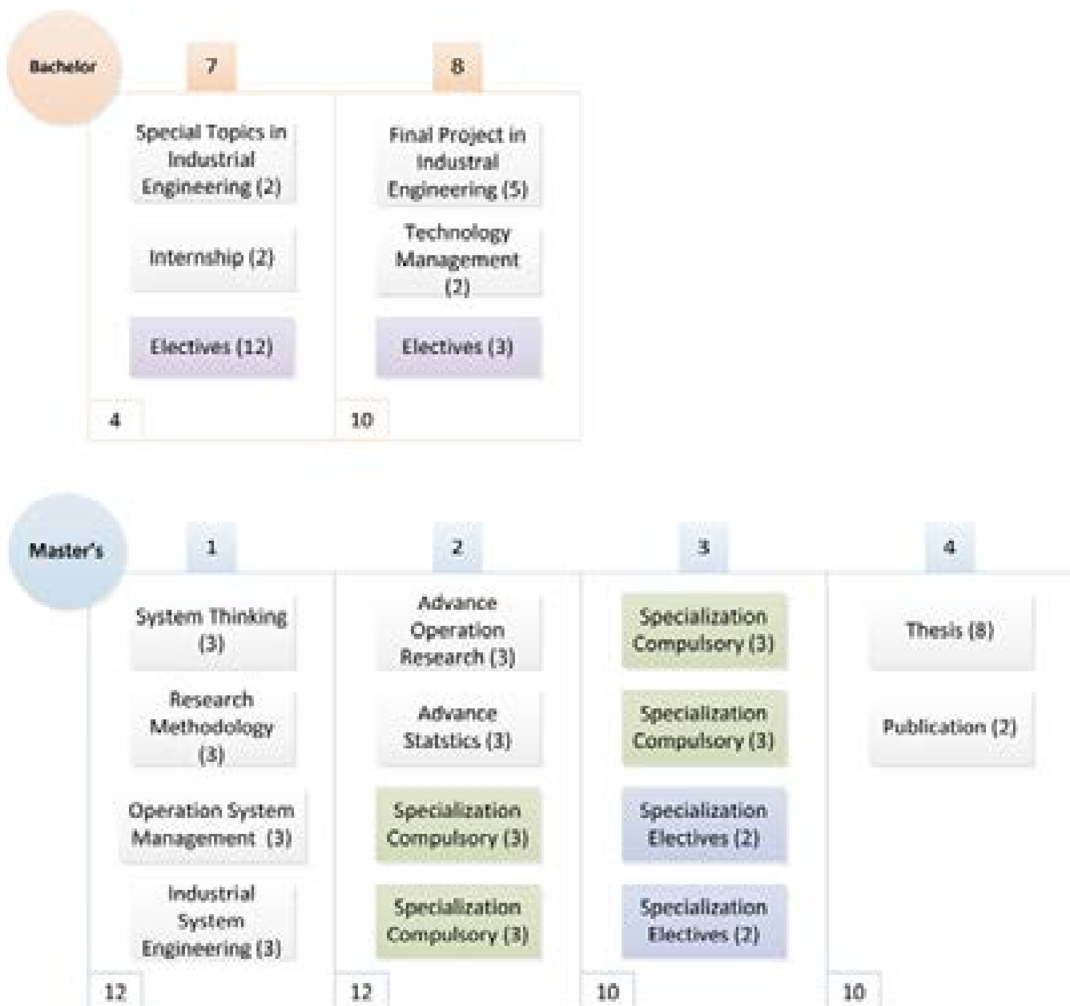


Flow Diagram of Subjects



UNDERGRADUATE PROGRAM

Flow Diagram for Fast Track Students (Leading to Master's)



CURRICULUM STRUCTURE UNDERGRADUATE INDUSTRIAL ENGINEERING

KODE	SUBJECT	SKS
	1st Semester	
UIGE600002	Integrated Character Building B	6
UIGE600003	English	3
ENGE600001	Calculus 1	3
ENIE601001	Intro to Industrial Engineering	2
ENIE601002	Introduction to Economics	2
ENIE601003	Material Sciences	2
	Sub Total	**18**
	2nd Semester	
UIGE600010-15	Religion	2
ENGE600004	Linear Algebra	4
ENGE600005	Physics (Mechanics and Thermal)	3
ENGE600006	Physics (Mechanics and Thermal) Lab	1
UIGE600001	Integrated Character Building A	6
UIGE600020 - 48	Sport / Art	1
ENIE602001	Engineering Drawing	2
	Sub Total	**19**
	3rd Semester	
ENGE600007	Physics (Electricity, MWO)	3
ENGE600008	Physics (Electricity, MWO) Lab	1
ENIE603003	Work Design, Methods & Standards	3
ENIE603004	Cost Accounting	2
ENIE603005	Production Process + Lab	3
ENGE600011	Engineering Economics	3
ENIE603006	Basic Statistics	3
ENIE603007	Linear Programming	3
	Sub Total	**21**
	4th Semester	
ENIE604008	Intro to Mechanics & Electronics Factory	2
ENIE604009	Human Factor in Eng. & Design + Lab	3
ENIE604010	Maintenance Systems	2
ENIE604011	Industrial Statistics + Lab	3
ENIE604012	Production Plan & Inventory Control + Lab	3
ENIE604013	Organization & Industrial Psychology	3
ENIE604014	Operations Research	3
ENIE604015	Computation Lab	1
	Sub Total	**20**

	5th Semester	
ENIE605016	Plant Layout Design	3
ENIE605017	Product Design + Lab	3
ENIE605018	Industrial Feasibillity Analysis	3
ENIE605019	Quality Systems	3
ENIE605020	System Modeling + Lab	3
ENIE605021	Production Systems + Lab	3
ENIE605022	Industrial Project Management	2
	Sub Total	**20**
	6th Semester	
ENGE600012	HSE Protection	2
ENIE606024	Supply Chain Management	3
ENIE606025	Industrial Simulation + Lab	3
ENIE606026	Industrial Engineering Design + Lab	3
ENIE606027	Information System	3
ENIE606028	Elective 1	3
ENIE606029	Elective 2	3
	Sub Total	**20**
	7th Semester	
ENIE607028	Special Topics in Industrial Engineering	2
ENIE600029	Internship	2
	Electives	3
	Electives	3
	Electives	3
	Electives	3
	Sub Total	16
	8th Semester	
ENIE600030	Undergraduate Thesis in Industrial Engineer	5
ENIE608031	Technology Management	2
	Electives	3
	Sub Total	**10**
	TOTAL	**144**

Resume

University General Subjects	**18**
Basic Engineering Subjects	**20**
Core Subjects	**85**
Sub-Total	**123**
Electives Subjects	**21**
Total	**144**

INDUSTRIAL ENGINEERING

ELECTIVES

Code	SUBJECT	SKS
ENIE605032	Multivariate Analysis	3
ENIE605033	Interpersonal Skills	3
ENIE605034	Product Life Cycle Management	3
ENIE605035	Macro Ergonomics	3
ENIE605036	Finance and Investments	3
ENIE605037	Innovation Management	3
ENIE605038	Customer Relationship Management (CRM)	3
ENIE605039	Lean Operations	3
ENIE605040	Reconfigurable Manufacturing System	3
ENIE605041	Linear and Stochastic Programming	3
ENIE605042	Queueing Theory	3
ENIE606043	Data Mining	3
ENIE606044	Systems Engineering	3
ENIE606045	Enterprise Competitiveness Analysis	3
ENIE606046	Advanced Optimization	3
ENIE606047	Sustainable Manufacturing and Innovation	3
ENIE606048	Human Digital Modeling and Simulation	3
ENIE606049	Decision, Uncertainties and Risk	3
ENIE606050	Maritime Logistics	3
ENIE606051	Energy Management	3
ENIE606052	Design Thinking	3
ENIE606053	Numerical Methods and Application	3
ENIE606054	Business Process Reengineering	3
ENIE606055	Algorithm and Programming	3
ENIE606056	Heuristic Methods in Optimization	3
ENIE606057	Constraint Programming	3

INDUSTRIAL ENGINEERING

UNDERGRADUATE PROGRAM

COURSE STRUCTURE INTERNATIONAL UNDERGRADUATE INDUSTRIAL ENGINEERING

CODE	SUBJECT	Credits
	1st Semester	
UIGE610002	Integrated Character Building Course B	6
UIGE610002	Academic Writing	3
ENGE610001	Calculus 1	3
ENIE611001	Introduction to Industrial Engineering	2
ENIE611002	Introduction to Economics	2
ENIE611003	Material Sciences	2
	Sub Total	**18**
	2nd Semester	
UIGE610005 -9	Religion	2
ENGE610004	Linear Algebra	4
ENGE610005	Physics (Mechanics and Thermal)	3
ENGE610006	Physics(Mechanics and Thermal) Laboratory	1
UIGE610001	Integrated Character Building Course A	6
UIGE610003	Sport/ Art	1
ENIE612001	Engineering Drawing	2
	Sub Total	**19**
	3rd Semester	
ENGE610007	Physics (Electric, Magnet,Wave & Optic)	3
ENGE610008	Physics (Electric, Magnet,Wave & Optic)Laboratory	1
ENIE613003	Work Design, Methods, and Standards	3
ENIE613004	Cost Accounting	2
ENIE613005	Production Process + Lab	3
ENGE610011	Engineering Economics	3
ENIE613006	Basic Statistics	3
ENIE613007	Linear Programming	3
	Sub Total	**21**
	4th Semester	
ENIE614008	Introduction to Mechanics and Electronics Factory	2
ENIE614009	Human Factor in Engineering & Design + Lab	3
ENIE614010	Maintenance Systems	2
ENIE614011	Industrial Statistics + Lab	3
ENIE614012	Production Planning and Inventory Control + Lab	3
ENIE614013	Organization & Industrial Psychology	3
ENIE614014	Operations Research	3
ENIE614015	Computation Lab	1
	Sub Total	**20**

	5th Semester	
ENIE615016	Plant Layout Design	3
ENIE615017	Product Design + Lab	3
ENIE615018	Industrial Feasibillity Analysis	2
ENIE615019	Quality Systems	3
ENIE615020	System Modeling + Lab	3
ENIE615021	Production Systems + Lab	3
ENIE615022	Industrial Project Management	3
	Sub Total	**20**
	6th Semester	
ENIE616023	Occupational, Health, Safety & Environment	2
ENIE616024	Supply Chain Management	3
ENIE616025	Industrial Simulation + Lab	3
ENIE616026	Industrial Engineering Design + Lab	3
ENIE616027	Information System	3
	Electives	3
	Electives	3
	Sub Total	**20**
	7th Semester	
ENIE617028	Special Topics in Industrial Engineering	2
ENIE610029	Internship	2
	Electives	3
	Electives	3
	Electives	3
	Electives	3
	Sub Total	16
	8th Semester	
ENIE618030	Final Project in Industrial Engineering	5
ENIE618031	Technology Management	2
	Electives	3
	Sub Total	**10**
	TOTAL	**144**

Resume

University General Subjects	18
Basic Engineering Subjects	20
Core Subjects	85
Sub-Total	123
Elective Subjects	21
Total	144

Electives

Code	Electives	Credit
ENIE615032	Multivariate Analysis	3
ENIE615033	Interpersonal Skills	3
ENIE615034	Product Life Cycle Management	3
ENIE615035	Macro Ergonomics	3
ENIE615036	Finance and Investments	3
ENIE615037	Innovation Management	3
ENIE615038	Customer Relationship Management (CRM)	3
ENIE615039	Lean Operations	3
ENIE615040	Reconfigurable Manufacturing System	3
ENIE615041	Linear and Stochastic Programming	3
ENIE615042	Queueing Theory	3
ENIE616043	Data Mining	3
ENIE616044	Systems Engineering	3
ENIE616045	Enterprise Competitiveness Analysis	3
ENIE616046	Advanced Optimization	3
ENIE616047	Sustainable Manufacturing and Innovation	3
ENIE616048	Human Digital Modeling and Simulation	3
ENIE616049	Decision, Uncertainties and Risk	3
ENIE616050	Maritime Logistics	3
ENIE616051	Energy Management	3
ENIE616052	Design Thinking	3
ENIE616053	Numerical Methods and Application	3
ENIE616054	Business Process Reengineering	3
ENIE616055	Algorithm and Programming	3
ENIE616056	Heuristic Methods in Optimization	3
ENIE616057	Constraint Programming	3

Electives can also be taken at the Partner University starting from 6th Semester. Detail List of Courses will be provided by the Partner Universities as soon as possible.

SYLLABUS OF UNIVERSITY SUBJECTS

INTEGRATED CHARACTER BUILDING A
UIGE600001/UIGE610001
6 sks
Syllabus : Integrated Character Building A facilitates students to understand the basics of character formation and master the basics of cognitive power that is logic. Furthermore, to apply cognitive powers in generating good behaviors which are useful to themselves and society. The establishment of ethical behaviors based on ethics is also facilitated. Students are able to develop the basic strength of character and to know themselves as a human being, both as individuals and as part of a group so that they can develop themselves well enough. In a group, the students need to have skills that are needed to maintain an effective relationship in order to improve the quality of human life. Particularly as a citizen of Indonesia, students need to understand the nature of citizenship and basic philosophy of Pancasila in order to act and behave in accordance with the character of the Indonesian nation.
Core Competencies :
1. Students are able to analyze problems in depth individually, comprehensively, logicaly and critical, and generate solutions using the logical and ethical principles and rules of logic and ethics
2. Students are capable of analyzing the problem individually, thoroughly and deeply about the human being as an individual or as part of group
3. Students are individually able to understand, make critical reasoning and to build an open and critical mind to the problem of nationhood, statehood and citizenship in this dynamic world situation
4. Students are able to create and display a work that depicts the character in accordance with the principles of Pancasila

Learning Method : interactive lecture, Experiential Learning, Collaborative Learning, Problem Based Learning, Project-Based Assignment
Prerequisites : OBM (New Student Orientation)

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))

INTEGRATED CHARACTER BUILDING B
UIGE600002/UIGE610004
6 sks
Syllabus : Integrated Character Building B facilitates students to practice identifying, analyzing, and resolving problems of nature and the environment by making use of integrative and quantitative information. This lecture aims to prepare the future generation who care about nature issues through the balanced development of hard skills and soft skills and have the skills of ICT (Information and Communication Technology).
Core Competencies:
1. Students have an ethic, moral, personality and good character in completing the task at hand;
2. Students role as citizens who take pride and love of the homeland and support the continuity of life;
3. Students are able to work together and have a high sensitivity and awareness to the community and the environment;
4. Students are able to think logically, critically and creatively;
5. Students are able to use mathematics to solve problems quantitatively;
6. Students are able to use information and communication technology (ICT) for development;
7. Students are able to analyze the system of nature integratively and comprehensively;
8. Students are able to act as wise managers of nature to build and maintain the preservation of nature for a better and sustainable life.

Learning Method : Blended e-Learning, Collaborative Learning (CL), Problem Based Learning (PBL) and Group Discussion (GD)
Prerequisites : OBM (New Student Orientation)
Textbook : Digital Form can be downloaded from Scele

ISLAMIC STUDY
UIGE600010/UIGE610005
2 sks
General instructional objectives : The cultivation of students who have concern for social, national 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 practice 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 STUDY
UIGE600011/UIGE610006
2 sks
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 STUDY
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 STUDY
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 STUDY
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 STUDY
UIGE600015
2 sks

ART
UIGE600020-30
1 sks
The option of subjects that can be choosen :
Appreciation of Film (UIGE600020), Batik (UIGE600021), Photography (UIGE600022), Calligraphy (UIGE600023), Javanese Karawitan (UIGE600024), Balinese Dance and Karawitan (UIGE600025), Comic (UIGE600026), Painting (UIGE600027), Music and Vocal (UIGE600028), Theater (UIGE600029), Wayang (UIGE600030)

SPORT
UIGE600040-48
1 sks
The option of subjects that can be choosen :
Basketball (UIGE600040), Volley Ball (UIGE600041), Badminton (UIGE600042), Futsal (UIGE600043), Hockey (UIGE600044), Football (UIGE600045), Softball (UIGE600046), Tennis (UIGE600047), Table Tennis (UIGE600048)

SYLLABUS OF BASIC ENGINEERING SUBJECTS

CALCULUS 1
ENGE600001/ENGE610001
3 sks
Syllabus : This subject gives the opportunity for students to understand the basic concept of calculus and to be able to solve applied calculus problems. Students are also given the opportunity to understand basic concepts the functions of one variable, derivatives and integral functions of one variable, and its application.

CALCULUS 2
ENGE600002/ENGE610002
3 sks
Syllabus : This subject gives the opportunity for students to understand the basic concept of calculus and to be able to solve applied calculus problems. Students are also given the opportunity to understand the basic concept the function of two variables, or variables, total derivative and integral of the function of two or more variables and application. In addition, students can understand the basic concepts of sequence and series.

CALCULUS
ENGE600003/ENGE610003
4 sks
Syllabus : This subject gives the opportunity for students to understand the basic concept of calculus and to be able to solve applied calculus problems. Students are also given the opportunity to understand the basic concept the function of two variables, the total derivative of the function of two or more variables and its application. Students are also expected to understand the basic concept of sequence and series and the basic concept of vector and analytical geometry.

LINEAR ALGEBRA
ENGE600004/ENGE610004
4 sks
Syllabus : This subject gives the opportunity for students to master the basic techniques of Linear Algebra and gain knowledge on how to implement said techniques in solving System of linear equationss, determining the bases and dimension of vector space, as well as calculating eigen values and eigen vectors. This subject also gives students the opportunity to work with other objects, especially vectors and matrices.

PHYSICS (MECHANICS AND THERMAL)
ENGE600005/ENGE610005
3 sks
Syllabus : Physics (Mechanics and Thermal) subject includes the topics of mechanics and thermodynamics. Calculus is use as a mathematic helping tool in the learning process. Students are given the opportunity to learn how to unite their understanding of the basic concept of the analytical capability, their numeracy in learning mechanics and thermodynamics. During the course of this subject, students are not only aim to increase the students' knowledge of the basic physics concepts but also to increase their capability in using information technology and computer and to train their skills, such as: independent and group work and their communication skill.
Students will also be train on how to explain and analyse the nature phenomenon and the result of human engineering exist in their everyday lives by using the basic physics concept and applied them in their daily lives. Students are also taught to develop their synthesis ability and evaluating both quantitative and qualitative natural phenomenon and the result of human engineering in their surrounding environment by using basic physics concept. This subject will give students the opportunity to develop their ability to develop their presentation ability analyse the nature phenomenon and the result of human engineering from the mathematics and natural science point of view integrative and comprehensively.

PHYSICS (MECHANICS AND THERMAL) LABORATORY
ENGE600006/ENGE610006
1 sks
Syllabus : Practical of Mechanics: Measurement, Moment of inertia, Gravity acceleration, Fluid density, Scratch coefficient, Collision, Swing torque, Viscosity of water, Young's modulus, Viscosity of Newtonian fluid, Fluids surface tension, Oscillation, Practical of Heat: Coefficient of linear expansion, Heat conductivity, Thermocouple calibration, Calorimeter, Joule Constant, Laplace Constant, Heat Collector, Determining of air Cp/Cv, Expansion of fluids and water anomaly.
Notes: For Architecture and Interior Architecture Program, practical is not mandatory.

PHYSICS (ELECTRICITY, MWO)
ENGE600007/ENGE610007
3 sks
Syllabus : Physics (Electricity, MWO) subject includes the topics of electricity, magnet, wave, and optics. Calculus is use as a mathematic helping tool in the learning process. Students are given the opportunity to learn how to unite their understanding of the basic concept of the analytical capability, their numeracy in learning mechanics and thermodynamics. During the course of this subject, students are not only aim to increase the students' knowledge of the basic physics concepts but also to increase their capability in using information technology and computer and to train their soft skills, such as: independent and group work and their communication skill. Students will also be train on how to explain and analyze the nature phenomenon and the result of human engineering exist in their everyday lives by using the basic physics concept and applied them in their daily lives. Students are also taught to develop their synthesis ability and evaluating both quantitative and qualitative natural phenomenon and the result of human engineering in their surrounding environment by using basic physics concept.

PHYSICS (ELECTRICITY, MWO) LABORATORY
ENGE600008/ENGE610008
1 sks
Syllabus : Practical of Electricity: Electrolysis, Wheatstone bridge, Kirchhoff law, Earth's magnetic field, Temperature coefficient, Characteristic of series RLC circuit, Ohm law, Transformer. Practical of Optics: Polarimeter, Lens, Photometry, Prisms bias index, Spectrometer, Diffraction grid,

Newton's ring.

BASIC CHEMISTRY
ENGE600009/ENGE610009
2 sks
Syllabus : As an engineer, you must have understanding on the chemistry that provides not only the basis for much of what goes on in our world but also that it is a vital, continually developing science. In this study the students will learn many subjects such as matter and measurement; atoms, molecules, and ions; stoichiometry; aqueous reactions; thermochemistry; properties of solutions; chemical kinetics; chemical equilibrium; and electrochemistry.
Learning activities will be conducted through various method, which consists of: problem based learning (PBL), interactive lecture, question-based learning, discussion, demonstration and unguided structured assignments. Assessment will be made continuously through a set of exercises, group discussion, mid semester exam and final exam.

STATISTIC AND PROBABILITY
ENGE600010/ENGE610010
2 sks
Syllabus : Statistics and probability has been known as applied mathematics which is widely used in collecting, organizing, presenting, interpreting and analyzing data to support valid conclusions. Furthermore, these conclusions will be used as recommendation in decision making. The course of Statistics and Probability is intended to give a basic ability for students to handle quantitative data and information. There are two stages that are delivered which is descriptive and inductive/inference stages. Descriptive stage includes collecting, organizing, and presenting the data in a scientific manner. Then, inductive/inference stage includes the process of estimating and drawing conclusion based on available data and relations between variables. Hence, students are expected to apply their knowledge of statistics in conducting experiments in laboratory works/assignments as well as research studies in their final projects.

ENGINEERING ECONOMICS
ENGE600011/ENGE610011
3 sks
Syllabus : This course introduces students to the basic of engineering economy. It covers the time value of money (TVOM) and interest rate; tools for evaluating project alternatives for both non discounted and discounted methods, for instance present worth analysis, annual worth analysis, future worth analysis, rate of return (ROR) analysis and benefit/cost analysis; and choosing the best alternative, break even analysis, and effect of depreciation and after tax analysis and sensitivity analysis, and replacement analysis.
Learning activities will be conducted through various methods, which consist of: interactive lectures, question-based learning, discussion, and structure assignments. Assessment will be made thoroughly through sets of exercises/quizzes, group discussion, midterm and final exam. To expose students on the latest utilization of engineering economy and train them how to use it, a project will be assigned. As an integral part of course, computer utilization such as Microsoft Excel will be demonstrated and discussed on the class.

HEALTH, SAFETY AND ENVIRONMENTAL PROTECTION
ENGE600012/ENGE610012
2 sks
Syllabus : The teaching of Safety, Health and Environmental (SHE) protection to undergraduates studying engineering courses is an important part of the education of future engineers at all levels. It is the generally expressed view amongst practitioners in industry, business and other organisations that all engineers need to be equipped to appreciate, understand and implement the requirements of SHE management and practice to meet the working needs of industry and of their company (or other organisation). Whilst the level of risk and degree of control is dependant on the industry sector concerned the basic principles do not change. In addition, according to code of ethics of engineers, engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties.
The module covers the regulation framework and standards, risk perception, assessment, and management and detail discussion on physical, chemical and process hazards, and related engineering and management controls. Maintenance of safety conditions, personal protective equipments, audit, incident and emergency planning are discussed in accordance to measures for improving students awareness to their daily activities within the campus premises and local environment.
Learning activities will be conducted through various methods, which consist of: interactive lecture, question-based learning, discussion, demonstration and unguided structured assignments. Assessment will be made continuously through a set of exercises, group discussion, mid semester exam and final exam

Course Syllabus

MPKT B / INTEGRATED CHARACTER BUILDING B
General Intructional Objective: Develop students paticipation to improve awareness of social issues, national state, and the environment that is based on faith and piety, manners, and ethics in the context of academis science and technology development.
Learning Objectives: Students are expected to capable of: (1) Understanding, explaining, and analyzing the philosophy and logical science, attitude, social and culture in Indonesia. (2) Understanding academic and nation values from social and cultural diversity in Indonesia. (3) Understanding the problems by applying step learning actively and using information technology (4) Using Indonesian language in discussion andacademic writing as well.
Syllabus: Topic which appropriate with target and method learning, problem based learning (PBL), Collaborative Learning (CL) and Computer mediated learning (CML)
Pre-requisite(s): -
Text Book(s): Appropriated with topic

ACADEMIC WRITING
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))
Pre-requisite(s): -
Text Book(s): Poerwoto, C. et.al. Reading Comprehension for Engineering Students

INTRODUCTION TO INDUSTRIAL ENGINEERING
Learning Objective(s): Early understanding about the Industrial Engineering Discipline scope and contributions, which includes concepts, methods and tools and how it relates to each other in service or manufacturing industry.
Syllabus: History of Industrial Engineering, Scope of Industrial Engineering, Brief introduction and explaination of component system which build Industrial Engineering, Explanation of curriculum structure in Industrial Engineering, Example of contribution of Industrial Engineers in service and manufacturing industry, Development of Industrial Engineering in the future, Profesionalism definition and Ethics Engineering, and Cases in Ethics and Profesionalism.
Pre-requisite(s): -
Text Book(s):
1. Maynard Harold B. (ed.), Maynard's Handbook of Industrial Engineering. McGraw-Hill Professional, 2001.
2. Badiru, Adedeji B., Handbook of Industrial and System Engineering, CRC Taylor-Francis, 2006.

INTRODUCTION TO ECONOMICS (2 SKS)

Learning Objective(s): Introduce the scope of economics science and business as an integral part of human activities to survive.
Syllabus: Basic Concepts. Supply, Demand and Market. Workforce, Land and Assets. Trade and Tax. Economic activities and National Income. Consumption and Investment. Money, Financial Market and Moneter. Unemployment, Inflation, and Economic Policy. Growth and Development. The purpose of Business. Business Plan. Start up. Business Operations. Capital. Marketing Principles. Financial Management. Resource Management. Service, Productivity and Information.
Pre-requisite(s): -
Text Book(s):
1. Samuelson, Paul E. dan William 1. D. Nordhaus. 2005. Economics. Boston: McGraw-Hill.).
2. Griffin, Ricky W. and Ronald J. Ebert. 2002. Business. Upper Saddle River: Prentice Hall.

INTRODUCTION TO ENGINEERING MATERIALS
Learning Objective(s): 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 basic concept in materials testing.
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 : -
Textbooks :
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

ISLAMIC STUDY
General instructional objectives: The cultivation of students who have concern for social, national and country's 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 practice 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)
Prerequisite(s): MPKT
Textbooks: Adjusted to topics

CATHOLIC STUDY
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.**Prerequisite(s):** MPKT
Textbooks: Adjusted to topics

CHRISTIAN STUDY
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.
Prerequisite(s): MPKT
Textbooks: Adjusted to topics

BUDHIST STUDY
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)
Prerequisite(s): MPKT
Textbooks: Adjusted to topics

HINDU STUDY
Syllabus: Character, History (Character in 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.
Prerequisite(s): MPKT
Textbooks: Adjusted to topics

LINEAR ALGEBRA
Learning Objectives: Students can explain/ understand/apply linear algebra and associate this subject with some other subjects.
Syllabus: Introduction of elementary linear algebra, Matrix, Determinant, Vectors in R2and R3. Euclideas vector space, General vector space, Review of vector space, Product space, Value and diagonalization eigen vector, Linier Transformation, Application on the system of differential equation, Application on the quadratic surface, Decomposition of LU, Least Squares.
Prerequisite: -
Handbook:
1. H. Anton, Elementary Linear Algebra, 9th ed, John Wiley& Sons, 2005.
2. G.Strang, Introduction to Linear Algebra, Wellesley-Cambridge Press, 2007.

SPORTS / ARTS
The Art subject discuss on how to develop the student's participation and appreciation to fully understand, develop awareness, have aesthetic concerns, have imagination, have creativity to create work of art and culture in the form of art works such as: painting, batik, photography, calligraphy, comic or in the form of performance art such as: film appreciation, Bali dance and music, Javanese music, theatre and traditional puppet performance. The Sport subject discuss the general knowledge of sport (history, rules of the games and how to lead a match) and sport skills (physical aspects of movement, technique, tactics and mentality)

MECHANIC AND THERMAL PHYSICS + LAB
Learning Objectives: Students understand the concepts and basic laws of mechanic physics and applied in a systematic and scientifically problem solving that influenced by the force, both moving or not moving objects.
Syllabus: Scale, kinematics of point objects, mechanics of point objects, law of conservation of linear momentum and energy, harmonic motion, gravity, dynamics and kinematics of rigid objects, Introduction and basic concept (pressure, thermodynamic system, state of the system, temperature), expansion, equilibrium energy (thermal state equation), heat transfer, ideal gas, first law of thermodynamics, enthalpy and entropy, The first law of thermodynamics application for open and closed system, Second law of thermodynamics, kinetic theory of ideal gas.
Practical of Mechanics: Measurement, Moment of inertia, Gravity acceleration, Fluid density, Scratch coefficient, Collision, Swing torque, Viscosity of water, Young's modulus, Viscosity of Newtonian fluid, Fluids surface tension, Oscillation, **Practical of Heat**: Coefficient of linear expansion, Heat conductivity, Thermocouple calibration, Calorimeter, Joule Constant, Laplace Constant, Heat Collector, Determining of air Cp/Cv, Expansion of fluids and water anomaly.
Prerequisite: -
Handbook:
1. Halliday.D, R Resnick, Physics I, 4th ed Wiley 1991.
2. Ganijanti AS, Mekanika, Penerbit Salemba Teknik, 2000.
3. Tipler PA, Fisika I, ed III, terjemahan Lea Prasetio, Penerbit Erlangga, 1998.
4. Giancoli D.C, General Physics, Prentice Hall Inc, 1984.
5. Sears-Salinger, Thermodynamics, Kinetic theory and statistical thermodynamics, Wesley, 1975.
6. Giancoli, D.C, Physics: principles with applications, Prentice Hall Inc, 2000

MPKT A / INTEGRATED CHARACTER BUILDING A
General Intructional Objective: To develop student's participation in raising their awareness towards issues within the society, country, nation, and surrounding environment based on their faith, piety, manners, and academic ethics in order to develop Science and Technology.
Learning Objectives: Students are expected to capable of:

1. Understanding, explaining, and analyzing the philosophy and logical science, attitude, social and culture in Indonesia.
2. Understanding academic and nation values from social and cultural diversity in Indonesia.
3. Understanding the problems by applying step learning actively and using information technology.
4. Using Bahasa Indonesian in discussion and academic writing as well.

Syllabus: Topic which appropriate with target and method learning, problem based learning (PBL), Collaborative Learning (CL) and Computer mediated learning (CML)
Prerequisite: -
Handbook: Appropriated with topic

Engineering Drawing
Learning Objective(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.
Syllabus: 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): -
Text Book(s):
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-Mitchell-Spencer-Hill-Dygdon-Novak, Technical Drawing, Prentice Hall Inc.

OPTICS, ELECTRICITY, AND WAVE PHYSICS + LAB
Learning Objectives: Students understand the concept and basic law of Magnet and Electricity physics and apply it systematically and scientifically in solving everyday magnet and electricity physics problem, can understand the concepts and basic law of Optical and Wave physics and apply systematic and scientific problem solving in a natural wave phenomenon or wave that arises due to technical, physical properties of light and geometric optics.
Syllabus: Electric charge and Coulomb law, Electric field, Static and Gauss law, Electric potential, Capacitor, Direct electric currentand basic circuit analysis, Magnetic field, Induction and electromagnetic, Faraday lawand inductance, Material magnetism properties, A series of transient, Alternating current, Waves, Sounds, Polarization, Interference, Diffraction, Optical geometry, Lighting and photometry. Practical of Electricity: Electrolysis, Wheatstone bridge, Kirchhoff law, Earth's magnetic field, Temperature coefficient, Characteristic of series RLC circuit, Ohm law, Transformer. Practical of Optics: Polarimeter, Lens, Photometry, Prisms bias index, Spectrometer, Diffraction grid, Newton's ring.
Prerequisite: -
Handbook:
1. Halliday, D, R. Resnick, Physics II, 5th ed, Wiley, 2001.
2. Ganijanti AS, Gelombang dan Optik, ed III, Jurusan Fisika FMIPA UI, 1981.
3. Tipler P.A, Fisika II, ed III terjemahan Bambang Sugiyono, Penerbit Erlangga, 2001.
4. D.C.Giancoli, General Physics, Prentice Hall

METHODS, STANDARDS AND WORK DESIGN +
LAB Learning Objective(s): Course participants are able to measure, analyze, design and

increase the effectiveness and efficiency of human work through methods improvements and work standards.
Syllabus: Introduction of Human Factors, History of Human Factors and Future Trends, Problem Solving Tools, Operation Analysis, Man Machine Chart and Flow Process Chart, Anthropometry, Time Study, Performance Rating & Allowances, Work Sampling. Standard Data, Predetermined Time Study, Wage Design, Training and Learning Curves.
Pre-requisite(s): Statistics and Probability
Text Book(s):
1. Method, Standard and Work Design, 11th edition, Benjamin Niebel & Andris Freivalds, McGraw-Hill International, 2003
2. The Ergonomics Kit for general industry, dan Macleod, Taylor & Francis, 2006
3. Motion and Time Study: Design and Measurement of Work, Barnes, Ralph M., John Wiley and Sons, 1980

COST ACCOUNTING
Learning Objective(s): Course participants understand accounting principles and are able to 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: Accounting Equation. Basic Production Cost of Manufacturing. Cost of Goods Sold (COGS).Profit and Loss Statement. Balance Sheets. Penilaian Persediaan (Perusahaan Dagang). Depresiasi. Working Capital. Profit Planning and Control. Overhead Cost Allocation. Activity Based Costing. Job Order Cost Accounting. Process Cost Accounting.
Pre-requisite(s): Introduction to Economics
Text Book(s):
1. Lawrence H. Hammer, William K. Carter, Milton F Usry, Cost Accounting, ITP Co., Ohio, 2004
2. Weygrandt, Kieso, Kell, Accounting Principles, John Willey and Sons CO., Canada, 2003

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PRODUCTION PROCESS + LAB (3 SKS)
Learning Objective(s): Course participants have the knowledge about technology and process to understanding how a product is made through manufacturing processes.
Syllabus: Casting and Cost Analysis. Heat Forming. Cold Forming. Plastics, Ceramics and Composite Forming. Pressure forming and cost analysis. Extraction & cost analysis. Gas Flame Process and Arc Process. Resistance Welding and Other Welding Process. Joining and Fastening.
Pre-requisite(s): Introduction to Industrial Engineering
Text Book(s):
Kalpakjian, Serope, Manufacturing Engineering and Technology, 3rd edition, Addison-Wesley, 1995

LINEAR PROGRAMMING
Learning Objective(s): Course participants are able to implement mathematical model in developing solutions for engineering and management problems.
Syllabus: Linear programming model & graphical solutions, Simplex methods, Duality and sensitivity analysis, Transportation models, Assignment model, Integer Programming. Multi-Goal Mathematical Programming, Network.
Pre-requisite(s): -
Text Book(s):
1. Hamdy A. Taha, Operations Research, 7th ed., Prentice-Hall, Inc. 2006
2. Hellier, Liebermen, Introduction to Operations Research, Mc Graw Hill, 2005

Introduction to Mechanics and Electronics Factory
Learning Objective(s): Course participants understand basic concepts from engineering mechanics and also can identify various factory facility based on prime movers and electric power.
Syllabus: Introduction to engineering mechanics; Introduction to prime movers; Gasoline Ignition Engine; Diesel Ignition Engine; Turbine Principle; Basic definition of electric power system; Electric power system element (Transformator, Machine AC, Machine DC); PLC; Pneumatic System.
Pre-requisite(s): Material Sciences
Text Book(s):
1. Timoshenko, Strength of Material, Prentice Hall, 1976
2. Popov, Mechanics of Materials, MIR Publisher, 1979

Human Factor in Engineering & Design + Lab
Learning Objective(s): Course participants are able to analyze and design a human machine interaction and its workplace
Syllabus: Introduction to human factors in engineering design, Interface design, Human controls systems, Work tools and hand tools, Workplace layout and design, Applied anthropometry, Interpersonal aspects in Engineering and Design, Climate and Lights, Human Error, Overview of Occupational Health and Safety.
Pre-requisite(s): -
Text Book(s):
1. Sanders, Mark S. & Ernest J. McCormick. Human Factors in Engineering and Design. McGraw-Hill. New York. 1993
2. Chapanis, Alphonse. Human Factors in Systems Engineering. John Wiley & Sons. New York. 1996
3. Wickens, D Christoper,. An Introduction to Human Factors Engineering, 2nd Edition. Prentice-Hall. 2004

Maintenance Systems
Learning Objective(s): Course participants understand the important aspects in the maintenance system management and the type of approach that is currently used in the industry.
Syllabus: 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
Pre-requisite(s): Production Process
Text Book(s):
1. Lawrence Mann, Jr., Maintenance Management, Lexington Books, 1978
2. Seiichi Nakajima, Introduction to Total Productive Maintenance, 1988
3. Antony Corder, di alih bahasa oleh Ir. Kusnul Hadi, Teknik Manajemen Pemeliharaan, Erlangga, 1996.
4. Palmer, Doc Richard., Maintenance Planning and Schedulling Handbook 2nd Edition. McGraw-Hill Professional. 2004.

Industrial Statistics + Lab
Learning Objective(s): Course participants are able to organize the collection, process, and analysis of data using statistics and engineering principles to support decision making process, within DOE - Design of Experiment.
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.
Pre-requisite(s): Statistics and Probability
Text Book(s):
1. Design and Analysis of Experiments, Douglas C. Montgomery. John Wiley & Sons, 2000
2. Design and Analysis of Experiments, Angela Dean and Daniel Voss, Springer-Verlag, 2000
3. Experimental Design with Applications in Management, Engineering, and the Sciences, Paul D. Barger and Robert E. Maurer, Thomson Learning, 2002

Production Planning and Inventory Control + Lab
Learning Objective(s): Course participants are able to analyze, design, implement and evaluate an integrated production planning and control system by controlling information flow, scheduling of production resources and internal processes, resulting a high quality product at the right time and the right cost.
Syllabus: Production planning system, Master Requirement Planning (MRP), Material Requirement Plan, Capacity planning, Inventory control, Lot sizing, Production scheduling, Sequencing and evaluation, TOC/DBR concepts, PPIC game.
Pre-requisite(s): -
Text Book(s):
1. Arnold, J.R. Tony and Chapman, Stephen N.; Prentice Hall; Introduction to Materials Management; 2004
2. Chapman, Stephen N.; The Fundamentals of Production Planning and Control; Pearson - Prentice Hall, 2006

Organization & Industrial Psychology
Learning Objective(s): Course participants are able to analyze the influencing factors of design and organizations management in industry including human capital assets.
Syllabus: Organizational Design. Culture.. Strategic Role of HRM & Effective Management of People. Ability Motivation & Opportunity. Job Analysis & Planning & Recruitment. Testing, Selection & Interview. Training & Development. Appraising & Managing Performance. Managing Careers & Fair Treatment. Establishing Strategic Pay Plans. Pay for Performance & Incentives. Benefits and Services. Labor Relations & Collective Bargaining. Employee Safety & Health. Linking to Organizational Outcomes. Human Resource Capital Management. Human Resource System
for TQM.
Pre-requisite(s): -
Text Book(s):
1. Strategic Human Resource. Management, Mike Millmore, Philip Lewis, Prentice Hall 2007
2. Human Resource Management, Gary Dessler, Prentice Hall, 10th edition, 2007
3. Human Resource Strategy, Dreher & Dougherty, Mc Graw Hill, 2001

PLANT LAYOUT DESIGN
Learning Objective(s): Course participants are able to design the layout of a plant based on constraint and optimum goals.
Syllabus: Design function, Design procedure, Process planning, Material flow planning, Analysis technique, Relationship planning between activities, Plant and production support services, Space calculations, Area allocation, Material handling equipment, Plant layout development, Plant location considerations.
Pre-requisite(s): -
Text Book(s):
1. Richard L. F., Facility Layout and Location, Prentice Hall, 1992
2. Plant Layout and Material Handling, John Wiley & Sons, 1977.
3. Meyers, E Fred,. Plant Layout and Material Handling 1st Edition. Prentice-Hall. 1993

PRODUCT DESIGN + LAB
Learning Objective(s): Course participants are able to create new product or service concept ideas according to structural market study based on marketing mix
Syllabus: Idea Generation, Description of Marketing Management, Global Marketing, Consumer Behavior, Marketing Mix, Marketing System, Selling Skill, Blue Ocean Strategy, Strategic Brand Management, Market Research, Consumer Needs Identification, Product Specification Determination, Concept Design, Concept Selection and Testing, Product Architecture, Design for Manufacturing, Design for Assembly, Prototyping, Project Presentation.
Prerequisite(s): Human Factors in Engineering
and Design
Text books:

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1. Karl. T. Ulrich & Steven D. Epingger. Product Design Development. 3rd Edition. Mc Graw-Hill. 2004
2. Dieter. “Design Engineering”, 3rd edition, Mc.Graw Hill 2000
3. James G. Bralla. Design For Excellence. McGrawHill - 1996
4. Milton D. Rosenav, Jr. et. al. The PDMA Handbook of New Product Development, John Willey & Sons. 1996
5. Hamid Noor & Russel Radford. Production & Operation Management. McGrawHill. 1995

INDUSTRIAL FEASIBILITY ANALYSIS (3 SKS(
Learning Objective(s): Course participants know the aspects used to analyze industry feasibility and able to identify and analyze investment of facility feasibility
Syllabus: Project feasibility study, scope function, market and marketing aspects, engineering and technology aspects, operation management aspect, environment aspect, law aspect, economics aspect, financial aspect
Prerequisite(s): Cost Accounting, Engineering Economics
Text books:
1. Clifton, Fyffe, Project Feasibility Analysis, John Wiley, 1997
2. Siswanto Sutojo, Studi Kelayakan Proyek, PPM, 1995

QUALITY SYSTEM (3 SKS)
Learning Objective(s): Course participants are able to design a quality improvement system that able to do assurance and improvement of continuous product and process quality based on the fact (number) using mathematical (statistical) method with world’s quality standard consideration
Syllabus: 3 quality basics: continuous improvement, customer focus and total participation, PDCA concept, 7 tools and 7 new tools, technique of process mapping, standard role, internal standard (SOP, WI, etc), and external standard (ISO, JIS, etc), Lean Six Sigma
Prerequisite(s): Statistics and Probability
Text books:
1. The Six Sigma Way Team Fieldbook, Peter S Pande et.al. McGraw-Hill, New York, 2002
2. QC Problem Solving Approach: Solving Workplace Problems the Japanese Way, Katsuya Hosotani, 3A Corporation, Tokyo, 1982
3. The Quality Toolbox Taguen Nancy R., ASQ Quality Press. Milwaukee. Wisconsin. 2005

SYSTEM MODELLING + LAB
Learning Objective(s): Course participants are able to design a computerized model based on discrete-event modeling from micro industrial system, simulating that model to do feasibility analysis and generating recommendation from the model (becoming discrete-event model)
Syllabus: Modeling concept, general method of system modeling: conceptualization, development,
simulation and analysis, modeling case study, validation and verification of discrete model, user requirement method, technique of report design, and presentation of modeling result
Prerequisite(s): Statistics and Probability
Text books:
1. Mastering the Requirement Process, Suzanne Robertson & James Robertson, 2nd Edition, Addison Wesley Professional, 2006
2. Scenarios, Stories and Use Cases: Through the Systems Development Life-Cycle, Ian Alexander and Neil Maiden, John Wiley & Sons. 2004
3. Excel® Dashboards & Reports, Michael Alexander and John Walkenbach, Wiley Publishing, Inc. 2010
4. Information Dashboard Design, Stephen Few, O’Reilly, 2006.

PRODUCTION SYSTEM + LAB
Learning Objective(s): Course participants are able to analyze, design, implement and improve the performance of an operation system, especially with significant impact to the long term strategic goals of the organization to produce the right product for the customer.
Syllabus: Production Strategy. Product and Process Development. Location Analysis. Product

and Process Layout Analysis. Capacity Analysis.Process Design, Analysis and Performance. Distribution Planning. JIT/Lean Production System. Resource planning, scheduling and allocation Kanban production system (kanban game).
Pre-requisite(s): Production planning and inventory control
Text Book(s):
1. Chase and Aquilano; Operations Management; Pearson-Prentice Hall; 11th , Edition, 2006
2. Heizer, Jay and Render, Barry; Operations Management; Pearson-Prentice Hall; 2006
3. Kanban for The Shopfloor, The Productivity Press; 2002

INDUSTRIAL PROJECT MANAGEMENT (2 SKS)
Learning Objective(s): Course participants are able to plan, conduct, and control projects in industry
Syllabus: Project management description, system theory, project of PMDA organization, project of human resource, staff organization and project team, time management, special topic of PERT, project graph, cost control
Prerequisite(s): Operational Research
Text books:
1. Kerzner, Harold T., Project Management : A System Approach to Project Planning, scheduling, and Controlling, John Wiley &Sons, 10th edition, 2009

Operation Research
Learning Objective(s): Course participants are able to use mathematical optimization model to solve engineering and management problems that could be converted to deterministic and stochastic quantitative model
Syllabus: Dynamic Programming. Markov Analysis. Decision Tree. Game Theory. Non-Linear Programming. Queuing theory. Optimization Simulation
Pre-requisite(s): Linear Programming
Text Book(s):
1. Hamdy A. Taha, Operations Research, 7th ed., Prentice-Hall, Inc. 2006
2. Hellier, Liebermen, Introduction to Operations Research, McGraw-Hill, 2005

Computation Lab
Learning Objective(s): Course participants are able to use computational language tools, such as flow charts, pseudo codes, and IDEF to make an algorithm. Participants should also be able to solve a problem in the field of Industrial Engineering using computational programs.
Syllabus: Design tools, branching, loop, data structure, sorting, and optimization.
Pre-requisite(s): Linear Programming
Text Book(s):
1. 1 Walkenbach, J. (2007). Excel 2007 Power Programming with VBA.
2. Robert Sedgewick, Kevin Wayne. (2011). Algorithms 4th Edition Algorithms (4th Edition)

Occupational, Health, Safety & Environment
Learning Objective(s): Course participants are able to identify various hazard, characterization, propose suitable method for minimizing and mitigating risks, and also designing management system of safety work. Students is also expected to increase their awareness about health and safety in industry, and understand about framework and safety standard regulation and also environment program.
Syllabus: Introduction to Regulation and Standards; Risk Perception, Assessment and Management; Machinery Hazards; Noise Hazards; Process Safety Hazard; Fire and Explosion Hazard; Electrical Hazard; Toxicology in The Workplace; Environmental Protection; Environmental Protection Control Processes; Hazard Communication to Employees; Personal Protective Equipment (PPE): Types of PPE and Selection of PPE; Safety Audits, Incident and Emergency Planning.
Pre-requisite(s): -
Text Book(s):
1. Charles A. Wentz, Safety, Health and Environmental Protection, MGH, 1998.
2. Asfahl, C.R., Rieske, D.W., Industrial Safety and Health Management, 6th Ed., Pearson Education, Inc. 2010.
3. National Regulations on Safety and Health Management

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Supply Chain Management
Learning Objective(s): Course participants are able to understand about concept and application of SCM to analyze and evaluate the role of operators in a whole supply chain
Syllabus: Introduction to SCM, Strategy and Planning, Enterprise Resource Planning, Purchasing, Transportation Method, Shortest Path, Traveling Salesman Problem, Vehicle Routing Problem, warehousing management, reverse logistics, location theory, network planning process, SCM development
Prerequisite: Quality System
Text Book(s):
1. Novack, R.A., Supply Chain Management: A Logistics Perspectives, 2008.

Industrial Simulation + Lab
Learning objective(s): Course participants are able to design a complex computerized model from industrial systems and simulate and conduct a simple feasibility study and design a recommendation from model simulation result (becoming a continuous system modeler)
Syllabus: Concept of continuous modeling, method of continuous modeling, causal loop diagram, stock and flow diagram, comprehending of behavior overtime, model development based on real case study, technique of scenario development, validation and verification of continuous model, introduction of study concept based on simulation game
Prerequisite: System Modeling
Text books:
1. Information Dashboard Design, Stephen Few, O'Reilly, 2006.
2. Charles Harrell, Biman K. Ghosh, and Royce O. Bowden, Jr., Simulation Using Promodel, McGraw-Hill Higher Education, New York. 2003
3. SEMS Courses Module, 2011

Industrial Engineering Design + Lab
Learning objective(s): Course participants are able to conduct product development process by considering the interaction between material, human resources and production process and able to analyze technical and financial aspects of the NPD project for commercialization.
Syllabus: Introduction to NPD Process, Overview of Stage-Gate Model and Concurrent Engineering, Analysis of Material and Technology Utilization, Design Considerations, Financial Analysis of Project, Market and Functionality Testing, Production Capacity Planning, Commercialization, Implementation of NPD Process, Presentation of NPD Project.
Prerequisites: Perancangan Produk, Analisa Kelayakan Industri
Text Book(s):
1. George, E.D., Engineering Design : *A Material and Processing Approach*, McGraw-Hill, New York, 2000.
2. Trott, P. (2008). *Innovation Management and New Product Development*, 4th Edition.
3. Cooper, R.G. (2007), *Winning at New Products*, 3rd Edition.

Information System
Learning Objective(s): Course participants understand the role of information system management and technology in the industry to face the globalization era.
Syllabus: Introduction to information system. Information system as a competitive advantage. IT and Electronic Commerce, Enterprise Information System (ERP), Electronic Commerce. Database dan Relational Database Management System. System Analysis and Design. Business Process, MIS and ist relation with RQM dan QS. CBIS. Accounting Information System. Decision Support System. Executive Information System. Marketing, Manufacturing Information System. Financial, Human esource Information System.
Pre-requisite(s): Organization and Industrial Psychology
Text Book(s):
1. McLeod, Management Information System, 10th edition, Prentice Hall, 2006

2. Kenneth C. Laudon, Management Information Systems , Prentice Hall, 2011

SPECIAL TOPICS IN INDUSTRIAL ENGINEERING
Learning Objective(s): Course participants will have a broad description about the current progress in the service and manufacturing industry, and how industrial engineering could contribute to the enhancement of efficiency and effectiveness.
Syllabus: Inviting guest lecturers from various field of expertise
Pre-requisite(s): 7th semester or above students
Text Book(s): -

INTERNSHIP (2 SKS)
Learning Objective(s): Course participants are able to understand about industrial engineering implementation in industry and implement all the subjects that have been studied in real world
Syllabus:
Prerequisite(s): Notice the SOP of internship
Text books: -

UNDERGRADUATE THESIS
Learning objective(s): Course participants are able to identify problems and opinion in scientific discussion systematically, clearly, and accurately. Capable of sorting ideas/solutions/opinions in a scientific writing based on scientific writing guideline that integrates a whole knowledge.
Syllabus: Industrial Engineering to solve a case in real world
Prerequisite(s): Notice SOP of final project
Text books: Guideline of Undergraduate Thesis in University of Indonesia
Technology Management
Learning objective(s): Course participants are able to identify technology development that have an impact to industry, identify that technology, and translate into technology plan for improving organization competitiveness **Syllabus:** Introduction to technology management, business model concept, innovation and technology, chasm and tornado, competence, introduction to change management, introduction to risk management, patents in Indonesia, sustainability issue in technology, outsourcing, ERP trend
Prerequisite(s): Introduction to Industrial Engineering
Text books:
1. Burgelman, Maidique and Wheelwright, Strategic Management of Technology and Innovation, 5th Edition, 2009
2. Tarek Khalil, Management of Technology: The Key to Competitiveness and Wealth Creation, McGraw-Hill, 2000

Multivariate Analysis
Learning Objective(s): Course participants are able to organize the extraction, process & analysis of multivariate data in a right way to make decisions.
Syllabus: of Basic Statistical Concepts, Multiple Regression. Manova. Principal Component Analysis. Factor Analysis. Cluster Analysis. Discriminant Analysis. Logit Analysis. Canonical Correlation. Multidimensional Scaling. Structural Equation Modeling.
Pre-requisite(s): Statistics and Probability, Industrial Statistics
Text Book(s):
1. Hair,J.F.,B. Black, B. Babin, and R.E. Anderson (2005) Multivariate Data Analysis, Sixth Edition, Prentice Hall.
2. Richard Johnson and Winchern (1998) Applied Multivariate Statistical Analysis, Fourth Edition, rentice Hall.
3. W.R. Dillon and M. Goldstein (1984) Multivariate Analysis: Methods and Applications, John Wiley & Sons.

Interpersonal Skills
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*, 3rd Edition, De Janasz, Suzanne C, Karen O. Dowd and eth Z. Schneider, McGraw-Hill International Edition. New York. 2009.

Product Life Cycle Management
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): Product Design
Text Book(s):
1. Stark, J, (2011). *Product Life Cycle Management, 21th Century Paradigm for Product Realisation*, 2nd Edition. Springer.
2. Grieves, M. (2005). *Product Lifecycle Management. Driving the Next Generation of Lean Thinking*, McGrawHill.

Macro Ergonomics
Learning Objective(s): Course participants are able to understand comprehensively about work system design that consists of interacting variables such as hardware and software within internal and external physical environment, organization structure and process in order to make it better. Ability to understand how to implement ergonomic science.
Syllabus: Introduction to macroergonomics, method and tools that are used in work system design and analysis, introduction to organization integration in productivity, safety, health and quality of work life context
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.

Finance and Investments
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. Root, Franklin R. 1978. International Trade Investment. Cincinnati: South-Western Publishing Co.
2. Grubel, Herbert G. 1981. International Economics, Homewood: Richard D. Irwin Co.
3. 3. Shapiro, Alan C. 2003. Multinational Financial Management. Hoboken: John Wiley & Sons Inc.

Innovation Management
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. Cooper, R.G. (2007), *Winning at New Products*, 3rd Edition.
2. Schilling, M.A. (2010). *Strategic Management of Technological innovation*, 3rd Edition, McGrawHill.
3. Trott, P. (2008). *Innovation Management and New Product Development*, 4th Edition.
4. Tidd, J., Bessant, J., Pavitt, K. (2001). *Managing Innovat ion - Integrat ing Technological, Market and Organisational Change*, Second Edition, John Wiley & Sons Ltd., West Sussex, England.

Customer Relationship Management
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. Peppers, D. (2011). *Managing Customer Relationships: A Strategic Framework*, John Wiley & Sons.
2. Francis Buttle (2009). Customer Relationship Management, Elsevier.

Lean Operations
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
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 Programming
Learning objective(s): Course participants could understand the theory and basics of linear and stochastic programming, able to use advance methods in linear and stochastic programming, and could use software to solve problems in linear and stochastic programming.
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.
Textbooks:
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

UNDERGRADUATE PROGRAM

Learning objective(s): Course participants are able to understand simple, network and cycle queuing models. Participants are also able to understand methods for solving queuing models and translating real-world problems into a queuing model.
Syllabus: Introduction, Simple Markovian model, Advanced Markovian model, Networks, Series, Cyclic Queues, Networks, Series, Cyclic Queues, Fluid Models, Stability and Optimization, Traffic, Dependency.
Textbooks:
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
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
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
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
Pre-requisite(s): Cost Accounting
Text books:
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
Learning Objective(s): Course participants are able to design and implement various heuristic

INDUSTRIAL ENGINEERING

FACULTY OF ENGINEERING

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
Text Book(s):
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.

Sustainable Manufacturing and Innovation
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. Seliger, G. (2011). *Advances in Sustainable Manufacturing*, Springer.
2. Jovane, F. (2010). *The Manufuture Road: Towards Competitive and Sustainable High- Adding-Value Manufacturing*, Springer.
3. Allen, D.T. (2012). *Sustainable Engineering: Concepts, Design and Case Studies*, Prentice-Hall.
4. Hermosilla, J.C. (2009). *Eco-Innovation: When Sustainability and Competitiveness Shake Hands.*

Human Digital Modeling and Simulation
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.
Text books:-
1. Duffy, G V. 2010. Advances in Applied Digital Human Modelling. CRC Press.
2. Jack Software Module dari Ergonomic **Centre**

Decision Uncertainties and Risk
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
Text books:
1. Parmigiani, G. (2009). *Decision Theory: Principles and Approaches* , John Wiley.

Maritime Logistics
Learning objective(s): Course participants are able to design, analyze and decrease workflow of a maritime logistic system, container terminal and scheduled shipping (liner).
Syllabus: Maritime Economy, Containerization, Scheduled Shipping, Berth Allocation Problem, Quay Crane Allocation Problem, Stacking problem, Stowage Planning, Integration phase, Intermodality, Synchomodality, LPG supply chain, Fuel supply chain, Integration phase.
Textbooks:
1. Duinkerken, M., & Günther, H.-O. (2007). Container Terminals and Cargo Systems. Berlin: Springer Berlin Heidelberg. http://doi.org/10.1007/978-3-540-49550-5
2. Inst, G. (1987). Indonesia ' s Sea Transport System - A Series of Maps, 491–502.
3. Ligteringen, H., & Velsink, H. (2014). Ports and Terminals. Delft: Delft Academic Press.
4. Meisel, F. (2009). Seaside Operations Planning in Container Terminals. http://doi.org/10.1007/978-3-7908-2191-8
5. Notteboom, T., & Rodrigue, J. P. (2009). The future of containerization: Perspectives from maritime and inland freight distribution. GeoJournal, 74(1), 7–22. http://doi.org/10.1007/s10708-008-9211-3
6. Stahlbock, R., & Voß, S. (2008). Operations research at container terminals: A literature update. OR Spectrum, 30(1), 1–52. http://doi.org/10.1007/s00291-007-0100-9

Energy Management
Learning objective(s): Course participants are able to understand the energy management principles, including energy supply and demand, which grows sense of the importance of energy and include it in decision making.
Syllabus: Energy and civilization, sources of energy and sustainability, energy future, economic and life cycle cost analysis, Life cycle analysis, lighting, ventilation and refrigeration systems, system of sustainable transport, effective energy management program, effective program management of energy, Modeling policy and energy planning
Textbooks
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

Design Thinking
Learning objective(s): Course participants could understand design and its implementation; also the advantage of using design thinking in the design process, decision process and problem solving activity.
Syllabus: Philosophy of Design Thinking, Steps and Phases in Design Thinking, Design Centric Culture, User Centric Design, , Lean UX, Design Thinking and Problem Solving
Textbooks:
1. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, Harper Collins Publisher, 2009
2. Thomas Lockwood, Design Thinking: Integrating Innovation, Customer Experience, and Brand Value, Allworth Press, 2009

Numerical Methods and Application
Learning objective(s): Course participants could understand the logic of numerical methods in solving mathematical and physical problems found in the field of engineering, social and economy. Course participants are able to solve difficult problems using dynamic systems which use iteration methods in industrial engineering cases.
Syllabus: simple problems in function theory (average rate, effect of linearization of a multi ranked function, roots and zero point of a function, interpolations and extrapolations); calculating the area and volume of an object without any form using numerical approach based on the formula of integration; Solving multi-variables equation system (including simulations on models of the equation system); multi-variables regression models; Eigenvalue and eigenvector problems; Start Value and End Value probles; Partial differential.
Textbooks:
1. 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: John Wiley & Sons

Business Process Reengineering

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.
Textbooks:
1. Rengineering Corporation , Michael Hammer & James Champy, Harper-London (2006)
2. Business Process Reengineering–Text and Cases, R Radhakrisnan, PHI-New Delhi (2010)
3. The Practical Guide to Business Process Reengineering using IDEF0, Feldmann Clarence.G, (1998), Donet Publishing New York
4. Process Mapping: How to Reengineer your Business Process., Hunt, Daniel.V., (1996), John Wiley and Sons Inc, New York
5. Process Innovation, Reengineering work through information technology, Davenport, Harvard Business School Press 2004.

Algorithm and Programming
Learning objective(s): Course participants know and are able to use computer programming techniques. They are able to design and implement algorithms to solve problems in the field of Industrial Engineering. Course participants could analyse how efficient an algorithm is.
Syllabus: Introduction to programming language and algorithm; Types, variables, operators; Loops and arrays; Objects and classes; Sorting: Insertion Sort and Merge Sort; Asymptotic Notation; Recurrences; Substitution, Master Method; Divide-and-Conquer: Strassen, Fibonacci, Polynomial Multiplication; Quicksort, Random Number, Randomized Algorithms; Tree, Hashing, Hash Functions; Greedy Algorithms, Minimum Spanning Trees; and Shortest Paths: Dijkstra's Algorithm, Breadth-first Search.
Prerequisite(s): Basic Statistics
Text books:
1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, *"Introduction to Algorithm"*, The MIT Press, Cambridge, Massachusetts London, England.

Heuristic Methods in Optimization
Learning objective(s): Course participants are able to design heuristic and metaheuristic 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.
Buku Ajar:
1. El-Ghazali Talbi, Metaheuristics: From Design to Implementation, Wiley:2009

Constraint Programming
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.

CHAPTER 5
PROFESSIONAL PROGRAM

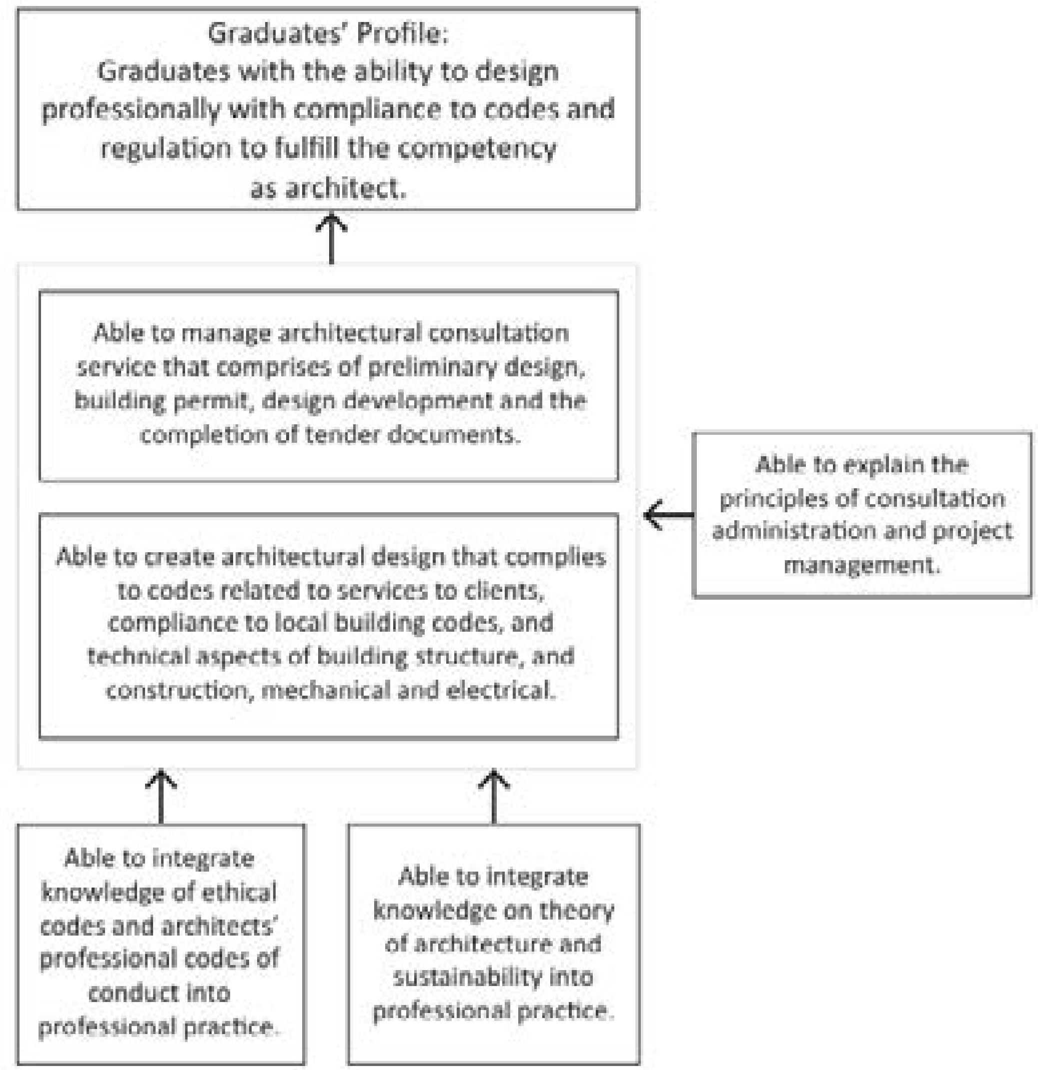
PROFESSIONAL PROGRAM

5. PROFESSIONAL PROGRAM FOR ARCHITECT

Program Specification

1	**Awarding Institution**	Universitas Indonesia	
2	**Teaching Institution**	Universitas Indonesia	
3	**Program**	Architects Professional Program	
4	**Class**	Regular	
5	**Degree Offered**	Arsitek (Ar.)	
6	**Accreditation / Recognition**	-	
7	**Language of Instruction**	Bahasa Indonesia	
8	**Study Scheme (Full Time / Part Time)**	Full Time	
9	**Entry Requirement**	Graduate from Undergraduate Architecture Program	
10	**Duration of Study**	1 year	
	Semester	Total Semester	Weeks/semester
	Regular	2	17
	Short (optional)	-	-
11.	**Graduates profile:** Graduates with the ability to design professionally with compliance to codes and regulation to fulfill the competency as architect.		
12.	**Graduates' Competencies:** 1. Able to create architectural design that complies to codes related to services to clients, compliance to local building codes, and technical aspects of building structure, and construction, mechanical and electrical. 2. Able to manage architectural consultation service that comprises of preliminary design, building permit, design development and the completion of tender documents. 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.		
13	**Course Composition**		
No	**Type of Courses**	**Credits**	**Percentage**
	University General Subjects	**0**	**0%**
	Basic Engineering Subjects	**0**	**0%**
	Architecture Core Subjects	**21**	**87,5%**
	Electives	**3**	**12,5%**
	Total	**24**	**100%**
14.	**Total Credits for Graduation**		**24 Credit Semester Unit**

NETWORK COMPETENCIES



COURSE STRUCTURE
PROFESSIONAL PROGRAM FOR ARCHITECT

KODE	SUBJECT	sks
	Semester 1	
ENAR701001	Design Project 1	6
ENAR701003	Professional Ethics and Practice	3
ENAR701004	Technology & Sustainable Environment	3
	Sub Total	12
	Semester 2	
ENAR702002	Design Project II	6
ENAR702005	Architectural Design Theory	3
	Elective*)	3
	Sub Total	12
	Total	24

*In addition to taking courses Elective Subjects for Professional Program, student can also take Compulsory Subjects and Elective Subjects available in Master of Architecture Program or other department which are equal with the Program.

Resume

Wajib Program Studi	**21**
Peminatan	
Jumlah	**21**
Pilihan	**3**
Total Beban Studi	**24**

ELECTIVES

KODE	SUBJECT	SKS
ENAR700006	Building Information Modelling	3
ENAR700007	Capita Selecta	3

COURSE DESCRIPTION

ENAR701001
DESIGN PROJECT I
6 CREDIT UNITS

Learning Objectives:
Students shoud 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 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. Peraturan Daerah Provinsi DKI Nomor 1 Tahun 2014 tentang Rencana Detail Tata Ruang dan Peraturan Zonasi
11. Peraturan Daerah Provinsi DKI Nomor 7 Tahun 2010 tentang Bangunan Gedung
12. Pedoman Detail Teknis Ketatakotaan Pemerintah Daerah Provinsi DKI Jakarta 1995
13. Peraturan Kepala Dinas DKI Jakarta (Perkadis) Nomor 3 Tahun 2014
14. Peraturan Menteri PU Nomor 26 Tahun 2008 tentang Persyaratan Teknis Sistem Proteksi Kebakaran pada Bangunan Gedung dan Lingkungan
15. Peraturan Menteri PU Nomor 30 Tahun 2006 tentang Pedoman Teknis Fasilitas dan Aksesibilitas pada Bangunan Gedung dan Lingkungan
16. Peraturan Gubernur Provinsi DKI Nomor 38 Tahun 2012 tentang Bangunan Gedung Hijau

ENAR701003
PROFESSIONAL ETHICS AND PRACTICE
3 CREDIT UNITS

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

ENAR701004
TECHNOLOGY AND SUSTAINABLE ENVIRONMENT
3 CREDIT UNITS

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. Y. B. Mangunwijaya, *Teknologi dan Dampak Kebudayaannya*, Jakarta: Yayasan Obor Indonesia. 1993
2. T. Jacob, *Menuju Teknologi Berperikemanusiaan: Pikiran-Pikiran Tentang Indonesia*, Jakrta: Yayasan Obor Indonesia. 1996
3. Max Hueber Verlog Munchen, *Man and Technology*, Gesamthersellung: Verlagsanstalt Man Dillingen/Donau. 1963
4. Charles Susskind, *Understanding Technology*, The Hopkins University Press. 1973
5. A. Charis Zubair, *Etika Rekayasa Menurut Konsep Islam*, Yogyakarta: Pustaka Pelajar Offset, 1997
6. Peter Graham, *Building Ecology: First Principles For A Sustainable Built Environment*, Blackwell Publishing. 2003
7. *Architecture For A Sustainable Future*, Institute For Building Environmet and Energy Conservation (IBEC). 2005
8. Edward Burtynsky, *Manufactured Landscapes*, Zeitgeist Video. 2007
9. Discovery Channel, *Extreme Engineering: Turning Torso*, Discovery Communication. 2010
10. Discovery Channel, *Next World: Future Megatropolis*, Discovery Communication. 2010

ENAR702002
DESIGN PROJECT II
6 CREDIT UNITS

Learning Objectives:
Student should be able to understand and apply knowledge on design presentation technique, ethics, code of compliances which are related to the production of complete tender document and project supervision; Student should be able to describe construction management process that covers interdisciplinary coordination, adaptation of design to site condition, and regular site supervision; Students should be able to make decision regarding the use of building materials in the design.

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. Peraturan Daerah Provinsi DKI Nomor 1 Tahun 2014 tentang Rencana Detail Tata Ruang dan Peraturan Zonasi
11. Peraturan Daerah Provinsi DKI Nomor 7 Tahun 2010 tentang Bangunan Gedung
12. Pedoman Detail Teknis Ketatakotaan Pemerintah Daerah Provinsi DKI Jakarta 1995
13. Peraturan Kepala Dinas DKI Jakarta (Perkadis) Nomor 3 Tahun 2014
14. Peraturan Menteri PU Nomor 26 Tahun 2008 tentang Persyaratan Teknis Sistem Proteksi Kebakaran pada Bangunan Gedung dan Lingkungan
15. Peraturan Menteri PU Nomor 30 Tahun 2006 tentang Pedoman Teknis Fasilitas dan Aksesibilitas pada Bangunan Gedung dan Lingkungan
16. Peraturan Gubernur Provinsi DKI Nomor 38 Tahun 2012 tentang Bangunan Gedung Hijau

ENAR702005
ARCHITECTURAL DESIGN THEORY
3 CREDIT UNITS

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.

ENAR700006
BUILDING INFORMATION MODELING
3 CREDIT UNITS

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.

Pere-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

ENAR700007
CAPITA SELECTA
3 CREDIT UNITS

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: -

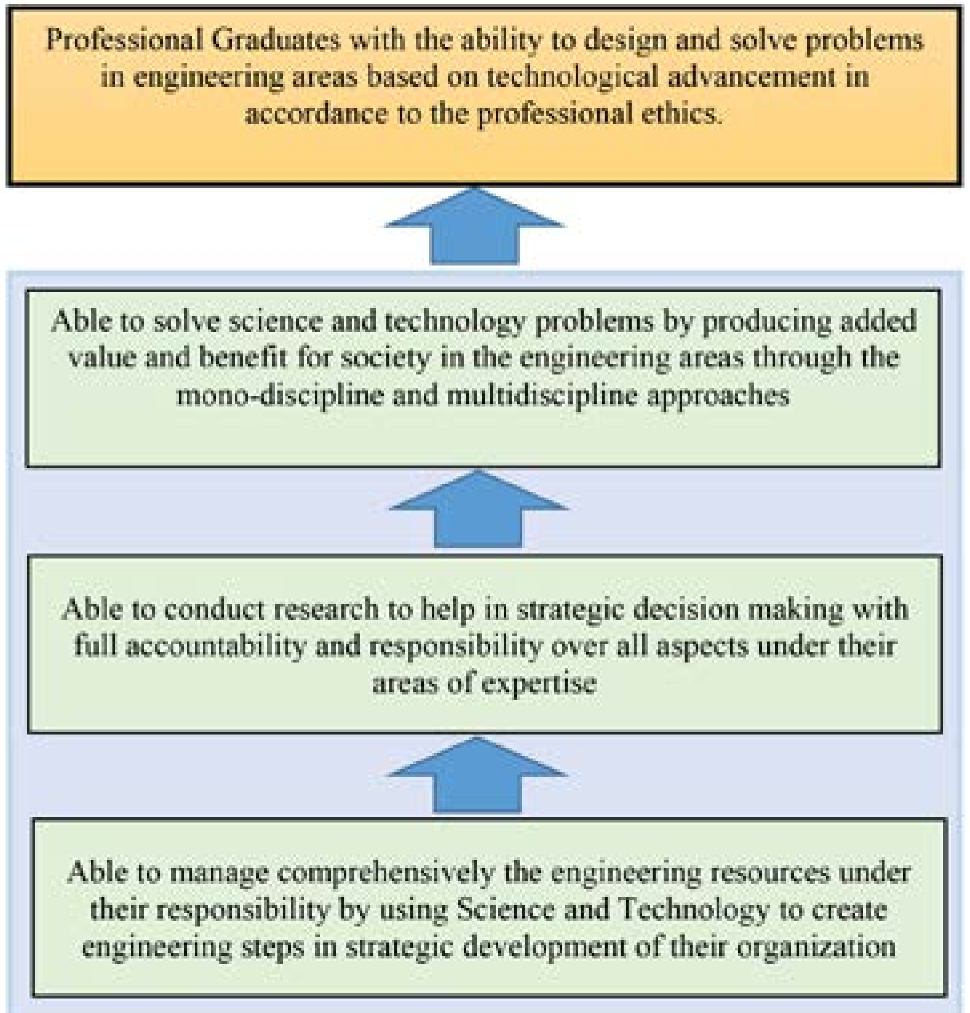
References: Relevant references to the topic offered.

5. STUDY PROGRAM
PROFESSIONAL PROGRAM FOR ENGINEERS

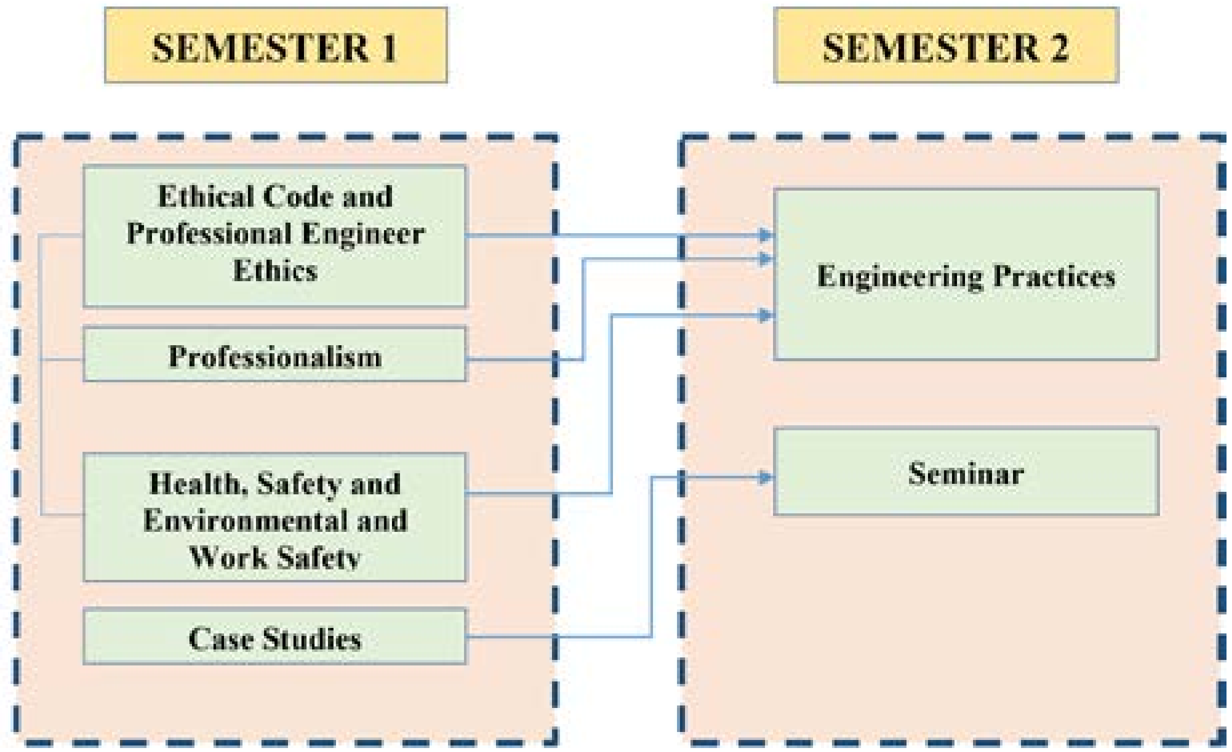
Program Specification

1	**Awarding Institution**	Universitas Indonesia	
2	**Teaching Institution**	Fakultas Teknik Universitas Indonesia	
3	**Program**	Professional Program for Engineers	
4	**Class**	Regular	
5	**Degree Offered**	Insinyur (Ir.)	
6	**Accreditation / Recognition**	-	
7	**Language of Instruction**	Bahasa Indonesia	
8	**Study Scheme (Full Time / Part Time)**	Full Time	
9	**Entry Requirement**	Graduate from Undergraduate Engineering Program with 2 (two) years working experience.	
10	**Duration of Study**	1 year (2 semesters)	
	Semester	Number	Number of weeks/semester
	Regular	2	17
11.	**Graduates profile:** Professional Graduates with the ability to design and solve problems in engineering areas based on technological advancement in accordance to the professional ethics.		
12.	Graduates Competencies (Indonesia National Qualification Framework (KKNI) Level 7): 1. Able to manage comprehensively the engineering resources under their responsibility by using Science and Technology to create engineering steps in strategic development of their organization. 2. Able to conduct research to help in strategic decision making with full accountability and responsibility over all aspects under their areas of expertise. 3. Able to solve science and technology problems by producing added value and benefit for society in the engineering areas through the mono-discipline and multidiscipline approaches.		
13	**Course Composition**		
No	**Type of Courses**	**Credits**	**Percentage**
i	Ethical Code and Professional Engineer Ethics	2	8.3%
ii	Professionalism	2	8.3%
iii	Health, Safety and Environmental and Work Safety	2	8.3%
iv	Engineering Practices	12	50%
v	Case Studies	4	16.6%
vi	Seminar, Workshop, and Discussion	2	8.3%
	Total	**24**	**100 %**
14.	**Total Credits for Graduation**		**24 Credit Semester Unit**

Competency Framework
Professional Engineer Study Program



Course Network
Professional Engineer Study Program



The Relation between Graduate Competencies, Assessment Materials, and Courses
Professional Engineer Study Program

Competency	Assessment Materials	Courses
The ability to plan and manage the engineering resources under their responsibility, and comprehensively evaluate by using Science and Technology to create engineering steps in strategic development of their organization	Basic Knowledge Professional Basic Competency	• Ethical Code and Professional Engineer Ethics • Professionalism. • Health, Safety and Environmental and Work Safety. • Case Studies
The ability to solve science and technology problems by producing added value and benefit for society in the engineering areas through the mono-discipline and multidiscipline approaches	Practice ability and case studies	• Engineering Practices • Case Studies • Seminar
Able to conduct research to help in strategic decision making with full accountability and responsibility over all aspects under their areas of expertise	Behavior Skills	• Engineering Practices • Case Studies • Seminar

Learning Outcomes
Professional Engineer Study Program

KKNI Level 7	General Competency	Outcomes
Able to manage comprehensively the engineering resources under their responsibility by using Science and Technology to create engineering steps in strategic development of their organization.	Able to manage consulting services in the engineering areas including the creation of pre-design, licensing process, the development of design, and the completion of bidding documents.	Pre-design report Design development report Bidding documents
Able to conduct research to help in strategic decision making with full accountability and responsibility over all aspects under their areas of expertise.	Able to integrate the knowledge on ethical codes and the rules for engineering behavior into professional practice. Able to describe the consultancy administration principles and project management	Pre-design report and design development which shows codes compliance and the implementation of continuous engineering science theory.
Able to solve science and technology problems by producing added value and benefit for society in the engineering areas through the mono-discipline and multidiscipline approaches.	Able to design technological solution by following the codes relating to services to clients, in accordance to the local regulation and engineering issues. Able to integrate the theoretical knowledge of continuous engineering science into professional practices.	Case studies report on ethical codes and the rules for engineering behavior. Design report which showed project administration aspects.

CURRICULUM STRUCTURE
Professional Engineer Study Program

No	Courses	Credits	Course Code
Semester 1			
1	Code of Ethics and Ethics of Engineers	2	ENIR701001
2	Professionalism	2	ENIR701002
3	Health, Safety and Environmental and Work Safety	2	ENIR701003
4	Case Study	4	ENIR701004
	Sub Total	**10**	
Semester 2			
1	Engineering Practices	12	ENIR702005
2	Seminar	2	ENIR702006
	Sub Total	**14**	
	TOTAL	**24**	

PROFESSIONAL PROGRAM

COURSE SYLLABUS

Code of Ethics and Ethics of Engineers
ENIR701001
2 credits
Description:
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 increased 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).

Professionalism
ENIR701002
2 credits
Description:
1. Student understand how to implement planning and design to give added value.
2. Student understand in respect of health, safety, and environmental preservation.
3. Student understand the influence of technical and non-technical factors and the implementation of professional ethics in the implementation of work.
4. Student understand the Engineering Standard.
5. Student understand how to conduct data analysis and evaluation.
6. Student is able to recognize the ability, weakness and strength of work space.
7. Student is able to work together in a team in a limited period of time.
8. Student is able to perform feasibility and appropriateness selection for decision making process.
9. Student is able to communicate and coordinate.

“EXPLANATION”
The title is change into a noun: the desired planned learning impact was too broad, since – Engineer Professionalism – is the end result desired. The time constraint is the reason why more than 50% of the learning impact is understanding. Thus, the focus of this teaching method is “ENGINEERING ROLE PLAY” by using life cycle simulations of planning, designing and implementation. The teaching materials for this course includes the preparation stages and simulation of engineering practices.

Safety, Health, Work and Environmental Safety
ENIR701003
2 credits
Description:
1. Students are able to identify the purpose of each safety, health, work safety and environment policy, procedures, and benefit in their line of work.
2. Students are able to demonstrate their understanding on the background of inves-

tigation concept and report system by using the ICS (Incident Command System) method.
3. Students are able to do evaluation based on behavior industry in implementing predetermined investigative procedures.
4. Students are able to provide insight on “Emergency Preparedness Process & System Concept”, thus enabling them to prepare Emergency Preparedness System in their work.
5. Students are 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. Students have an awareness in the form of responsible behavior in carrying out health, safety and work environment.

Case Study
ENIR701004
4 credits
Description:
1. Students are encouraged to have analytical abilities towards practical engineering issues arising.
2. Students are able to independently develop ideas and solutions and implement their theoretical knowledge in solving problems.
3. Students are able to prepare themselves in handling crisis situation in various professional engineering/ industry environment (in accordance to UU-11).
4. Students are able to comprehend multidiscipline communication and have an appreciation to other discipline.
5. Students understand the core problem and essence and how to address engineering problems.

Engineering Practices
ENIR702005
12 credits
Description:
1. Students understand the engineering philosophy through experience by conducting on the job training.
2. Students understand the trend on engineering science through their experience in their on the job training.
3. Students 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. Students are able to solve problems in their on the job training.
5. Students are 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. Students are able to present and communicate their engineering results as part of their on the job training outputs.

Seminar
ENIR702006
2 credits
Description:
1. Students understand the Term of Reference (TOR) as speaker in seminar, workshop, or discussion.
2. Students understand the requested general theme and the subtheme.
3. Students are able to compile materials.
4. Students are able to convey said materials consecutively and structurally within the allocated time frame.
5. Students are able to understand and answer questions.
6. Students are able to have a discussion and communicate.

CHAPTER 6

MASTER PROGRAM

6. MASTER PROGRAM

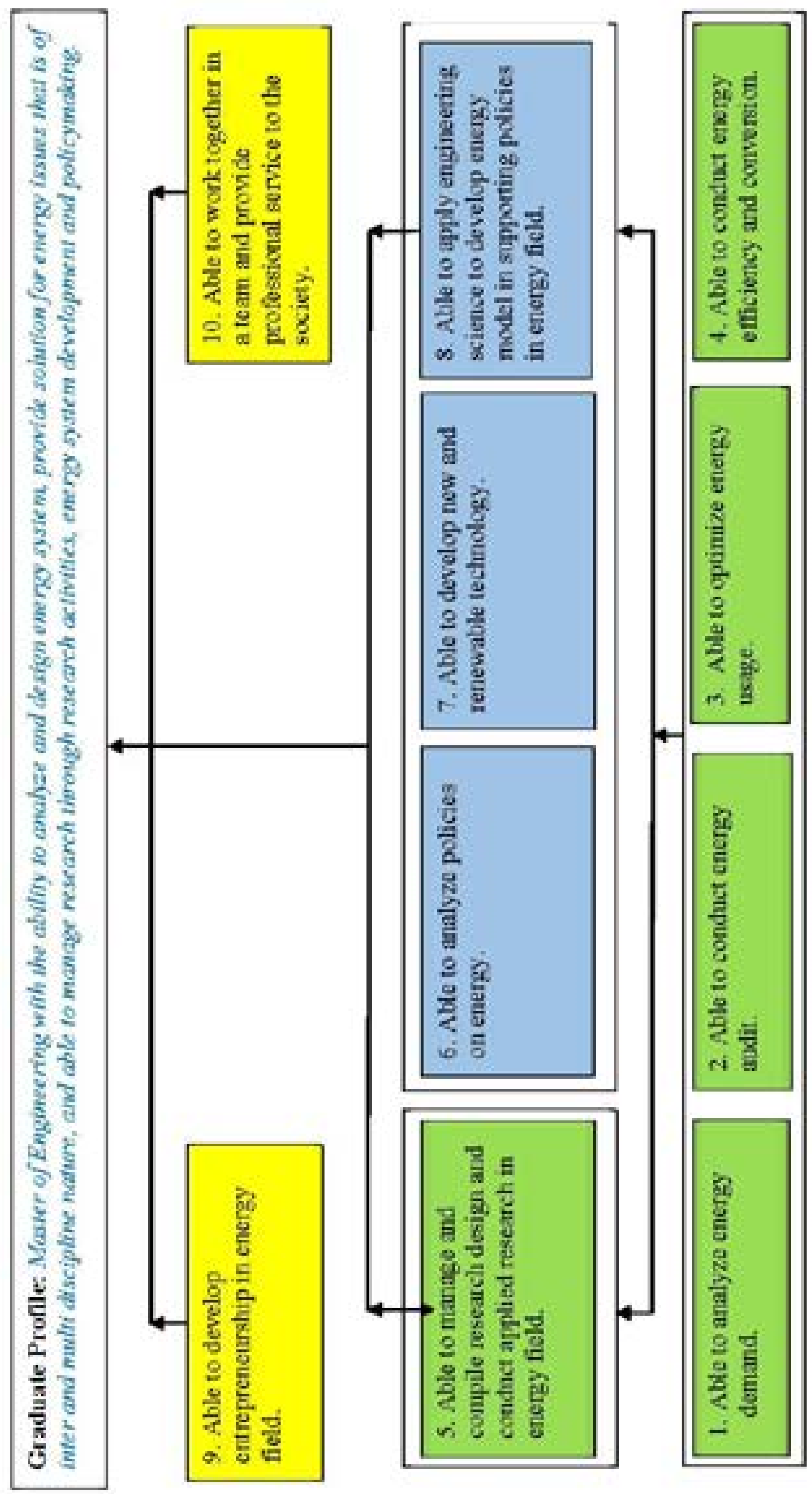
6.1 MASTER PROGRAM IN ENERGY SYSTEM ENGINEERING

Program Specification

1.	**Awarding Institution**	Universitas Indonesia	
2.	**Teaching Institution**	Faculty of Engineering Universitas Indonesia	
3.	**Programme Title**	Energy System Engineering	
4.	**Class**	Special Class	
5.	**Final Award**	Magister Teknik (M.T.)	
6.	**Accreditation / Recognition**	-	
7.	**Language(s) of Instruction**	Bahasa Indonesia	
8.	**Study Scheme (Full Time / Part Time)**	Full Time	
9.	**Entry Requirements**	Bachelor degree in Engineering/ Bachelor degree in Engineering Education/ Bachelor degree in science in relation with Energy.	
10.	**Study Duration**	Designed for 2 years (4 semesters)	
	Type of Semester	Number of Semester	Number of weeks / semester
	Regular	4	16-17
11.	**Graduate Profiles:** 1. Benefitted to the society 2. Produce innovative work 3. Have advantage in their field 4. Have leadership in their field 5. Have interest on the development of science and technology 6. Have acknowledge skill		
12.	Expected Learning Outcomes: 1. Able to develop knowledge, technology, and /or art in their respective field or professional practice through research that resulted in innovative and tested work. 2. Able to solve problems on science, technology and/or art in their respective field through inter and multi discipline approach. 3. Able to manage research and development which benefitted to society and science and able to get national and international recognition.		
13	**Classification of Subjects**		
No.	Classification	Credit Hours (SKS)	Note
i	**Study Program Subjects**	**28**	**Compulsory study program core expertise subject**
ii	**Elective Subjects**	**16**	**Elective subjects**
	Total	**44**	
14.	**Total Credit Hours to Graduate**		**44 Credits**

MASTER PROGRAM

Competence Network
Master Program of Energy System Engineering



LEARNING COMPETENCE
(Equivalent to the Indonesia Competence Framework / KKNI Level 8)
Master Program of Energy System Engineering

No.	KKNI Level 8	General Competence	Outcome
1	Able to develop knowledge, technology, and or art in their area of expertise or professional work through research resulting in innovative and tested result.	1. Able to analyze energy demand. 2. Able to optimize energy usage 3. Able to perform energy efficiency and conservation in industry. 4. Able to develop new and renewable technology on energy.	Thesis, Paper, Publication, including Thesis summary with UI repository journal format. Course assignment report.
2	Able to solve science, technology, and or art issues in their area of expertise through inter or multidiscipline approach.	1. Able to conduct industry energy audit. 2. Able to analyze energy policies. 3. Able to applied engineering science to develop energy model in supporting energy field policies.	Thesis, Paper, Publication, including Thesis summary with UI repository journal format. Course assignment report.
3	Able to manage research and development that might be useful to the society and scientific field and able to gain national and international recognition.	1. Able to manage and compile research design and conduct applied research in the energy-engineering field. 2. Able to develop entrepreneurship in energy field. 3. Able to work together in a team and provide professional service to the society.	Thesis, Paper, Publication, including Thesis summary with UI repository journal format. Course assignment report.

CURRICULUM STRUCTURE

No	Code	Subject	Credit
		Semester 1	
1	ENES801001	Advanced Engineering Mathematics	4
2	ENES801002	Sustainable Energy Systems	4
3	ENES801003	Energy Technology	4
		Sub-Total	12
		Semester 2	
1	ENES802004	Technical Research Method	3
2		Elective 1	4
3		Elective 2	4
		Sub-Total	11
		Semester 3	
1	ENES803005	Energy Planning and Policy	3
2		Elective 3	4
3		Elective 4	4
		Sub-Total	11
		Semester 4	
1	ENES804006	Thesis	8
2	ENES804007	Scientific Publications	2
		Sub-Total	10
		TOTAL	44

Elective Subjects for Energy System Engineering Study Program

No	Code	Elective Course	Credit
1	ENES802008	Energy Modelling and Policy Analysis	3
2	ENES803017	Energy Economy	3
3	ENES802009	Basic to Nuclear Engineering	4
4	ENES802010	Nuclear Thermohydrolics	4
5	ENES803018	Nuclear Power Plant System	4
6	ENES803019	Nuclear Safety and Security System	4
7	ENES802011	Engineering Material and Material Structure	4
8	ENES802012	Energy Materials	4
9	ENES803020	Energy Conservation	4
10	ENES803021	Solar Cell and Fuel Cell	4
11	ENES802013	Intelligent Network and Scattered Generator	4
12	ENES802014	New and Renewable Energy	4
13	ENES803015	Regulation and Market of Electricity	4
14	ENES803016	Human Resources Management	4

Cross Department Elective Subjects

SUBJECT	CREDIT	SEMESTER	DEPARTMENT
Waste to Energy	3	2	Civil Engineering Department
Emission Control	3	2	
Environmental System Dynamics	3	2	
Energy Management System	4	1	Mechanical Engineering Department
Energy Management Engineering	4	2	
Thermal Power Generation	4	1	
Energy Audit	4	1	
Ocean Energy	4	1	
Optimization of Energy System	4	2	
Management of Maritime Energy	4	2	
Power Generation Operation and Control	3	1	Electrical Engineering Department
Electric Utility Power Generation Economic	3	1	
Dynamic System and Modelling	3	2	
Economics Energy and Management	3	2	
Electric Power System Planning	3	1	
Energy and Environment	3	1	
Explor and Product of Hydrocarbon	3	1	Chemical Engineering Department
Natural Gas Processing	3	1	
Natural Gas Project Management	3	1	
Natural Gas Economics	3	2	
Transportation and Utilization of Natural Gas	3	2	
Renewable Energy	3	1	
Logistics System	3	1	Industrial Engineering Department
Conceptual System Planning	2	1	
Logistics and Support for System Engineering	2	1	
Technology Policy Modelling with System Dynamics	2	1	

COURSE SYLLABUS

COMPULSORY SUBJECT:
ADVANCED ENGINEERING MATHEMATICS
ENES801001
4 credits
Course description: This subject will discuss advanced engineering mathematic concept in solving engineering problems. The subject will be done by using interactive class method and active learning via small group discussion and problem-based learning. Assessment for this subject is done through individual assignment, group assignment, quiz, midterm examination, and final examination. This subject is delivered in Bahasa Indonesia.
Syllabus: Introduction to Differential Equation, Order Differential Equation 1, Order Differential Equation
2, Advanced Order Differential Equation, Vector Analysis, Vector Differential, Grad Operation, Divergence and Curl, Vector Integral, Laplace Transformation, Solving Differential Equation using Laplace Transformation, Fourier Transformation, Convolution, Numeric Method: Equation Root, Numeric Differential, Numeric Integral: Partial Differential Equation Solution.

SUSTAINABLE ENERGY SYSTEM
ENES801002
4 credits
Course Description: This subject will give a description on the development of energy technology, energy source and the use of energy today. The subject will be done by using interactive class method and active learning via small group discussion and problem-based learning. Assessment for this subject is done through individual assignment, group assignment, quiz, midterm examination, and final examination. This subject is delivered in Bahasa Indonesia.
Syllabus: Sustainable Energy, Estimation and Evaluation of Energy Source, Engineering Performance, Energy System, Fossil Fuel and Fossil Energy, Nuclear Power, Biomass Energy, Transportation Service, Industrial Energy Usage, Synergize Complex System, and Energy Selection.

ENERGY TECHNOLOGY
ENES801003
4 credits
Course description: This subject will discuss the concept of Energy Technology in solving engineering problems. The subject will be done by using interactive class method and active learning via small group discussion and problem-based learning. Assessment for this subject is done through individual assignment, group assignment, quiz, midterm examination, and final examination. This subject is delivered in Bahasa Indonesia.
Syllabus: Power Plant and Electricity Distribution; Engine Heat and Heat Exchanger; Earth and Geothermal Energy; Origin of Fossil Fuel; Fossil Energy; Sun Energy; Solar Electric Technology; Energy Mass Transformation; Nucleosynthesis; Nuclear Energy; Alternative Energy: Wind and Water; Energy, Economy, and Environment; Energy Mix of the 21st Century.

TECHNICAL RESEARCH METHODS
ENES802004
3 credits
Course description: This subject will discuss the basic concept and the nature of research; variety of research; research steps and methods that are used in engineering research. The subject will be done by using interactive class method and active learning via small group discussion and problem-based learning. Assessment for this subject is done through individual assignment, group assignment, quiz, midterm examination, and final examination. This subject is delivered in Bahasa Indonesia.
Syllabus: Engineering Research, Review and Literature Search, Research Plan Development, Statistic Analysis, Optimization Way, Survey Research Method, Research Presentation, and Publication.

ENERGY PLANNING AND POLICY
ENES803005
3 credits
Course description: This subject will give the concept for Planning and Energy Policy in solving engineering problems. The subject will be done by using interactive class method and active learning via small group discussion and problem-based learning. Assessment for this subject is done through individual assignment, group assignment, quiz, midterm examination, and final examination. This subject is delivered in Bahasa Indonesia.
Syllabus: 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 and Price 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.

THESIS
ENES804006
8 credits

SCIENTIFIC PUBLICATION
ENES804007
2 credits

ELECTIVE SUBJECTS:
ENERGY ECONOMY
ENES803017
3 credits
Course description: This subject will give the concept of Energy Economy in solving engineering problems. The subject will be done by using interactive class method and active learning via small group discussion and problem-based learning. Assessment for this subject is done through individual assignment, group assignment, quiz, midterm examination, and final examination. This subject is delivered in Bahasa Indonesia.
Syllabus: 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.

ENERGY MODELLING AND POLICY ANALYSIS
ENES802008
3 credits
Course description: This subject will give the concept for Energy Modelling and Policy Analysis in solving engineering problems. The subject will be done by using interactive

MASTER PROGRAM

class method and active learning via small group discussion and problem-based learning. Assessment for this subject is done through individual assignment, group assignment, quiz, midterm examination, and final examination. This subject is delivered in Bahasa Indonesia.
Syllabus: Conceptual Framework; Basic Engineering; Sub-sectoral Analysis; Sectoral Integration; Implementation.

BASIC NUCLEAR ENGINEERING
ENES802009
4 credits
Course description: This subject will give the concept for nuclear technology by focusing on fiction reaction as their energy source, generator design, reactor, instrumentation, safety and waste management. The subject will be done by using interactive class method and active learning via small group discussion and problem-based learning. Assessment for this subject is done through individual assignment, group assignment, quiz, midterm examination, and final examination. This subject is delivered in Bahasa Indonesia.

NUCLEAR THERMOHYDROLICS
ENES802010
4 credits
Course description: This subject is focusing on the thermos-hydraulic analysis on nuclear energy system, mass conversion, movement, energy, reactor response. The subject will be done by using interactive class method and active learning via small group discussion and problem-based learning. Assessment for this subject is done through individual assignment, group assignment, quiz, midterm examination, and final examination. This subject is delivered in Bahasa Indonesia.

NUCLEAR POWER PLANT SYSTEM
ENES803018
4 credits
Course description: This subject is giving the explanation on design and key features on nuclear energy generator, including: reactor, control system and operation, and safety. The subject will be done by using interactive class method and active learning via small group discussion and problem-based learning. Assessment for this subject is done through individual assignment, group assignment, quiz, midterm examination, and final examination. This subject is delivered in Bahasa Indonesia.

NUCLEAR SAFETY AND SECURITY SYSTEM
ENES803019
4 credits
Course description: This subject will give the explanation on basic safety element and safety from nuclear plant facility. The subject will be done by using interactive class method and active learning via small group discussion and problem-based learning. Assessment for this subject is done through individual assignment, group assignment, quiz, midterm examination, and final examination. This subject is delivered in Bahasa Indonesia.

ENGINEERING MATERIAL AND MATERIAL STRUCTURE
ENES802011
4 credits
Course description: This subject will give basic materials theory that support energy

engineering which includes: atomic theory, atomic bond, bonding system, crystal structure, materials structure and characteristic, iron material selection, marking classification and steel specification, low steel alloy, heat treatable carbon steel and low alloy steel, tool steel selection, stainless steel selection, cast iron, non-ferrous material selection (Al, Ti, Mg and Ni and their fusion). The subject will be done by using interactive class method and active learning via small group discussion and problem-based learning. Assessment for this subject is done through individual assignment, group assignment, quiz, midterm examination, and final examination. This subject is delivered in Bahasa Indonesia.

ENERGY MATERIALS
ENES802012
4 credits
Course description: This subject will give the explanation on materials for energy field and other connected area, with the application in energy production and conservation with the main concept in renewable energy. The subject will be done by using interactive class method and active learning via small group discussion and problem-based learning. Assessment for this subject is done through individual assignment, group assignment, quiz, midterm examination, and final examination. This subject is delivered in Bahasa Indonesia.

ENERGY CONSERVATION
ENES803020
4 credits
Course description: This subject will focus on the specific material used as energy storage. The subject will be done by using interactive class method and active learning via small group discussion and problem-based learning. Assessment for this subject is done through individual assignment, group assignment, quiz, midterm examination, and final examination. This subject is delivered in Bahasa Indonesia.

SOLAR CELL AND FUEL CELL
ENES803021
4 credits
Course description: This subject will give the basic materials theory used in collar cell and fuel cell. The subject will be done by using interactive class method and active learning via small group discussion and problem-based learning. Assessment for this subject is done through individual assignment, group assignment, quiz, midterm examination, and final examination. This subject is delivered in Bahasa Indonesia.

INTELLIGENT NETWORK AND SCATTERED GENERATOR
ENES802013
4 credits
Course description: This subject will give the concept of Smart Network and Dispersed Generator in solving engineering problems. The subject will be done by using interactive class method and active learning via small group discussion and problem-based learning. Assessment for this subject is done through individual assignment, group assignment, quiz, midterm examination, and final examination. This subject is delivered in Bahasa Indonesia.
Syllabus: Contextual regulation: what, why, how, if, and when for Smart Grid; Smart Supply: Integrating Renewable Generation & Distribution; Smart Infrastructure, Smart Price, Smart Device, Smart Customer, Smart Demand; Study Case & Application.

NEW AND RENEWABLE ENERGY
ENES802014
4 credits
Course description: The subject will study the concept for new and renewable energy in solving engineering problems. The subject will be done by using interactive class method and active learning via small group discussion and problem-based learning. Assessment for this subject is done through individual assignment, group assignment, quiz, midterm examination, and final examination. This subject is delivered in Bahasa Indonesia.
Syllabus: Earth Energy Source; Recycle; Alternative Vehicle for Gasoline; Petroleum Refining; Clean Energy Innovation; Green Building Design; Energy in Solid Biomass; Future Demand.

REGULATION AND MARKET OF ELECTRICITY
ENES803015
4 credits
Course description: This subject will discuss the concept of Regulation and Electricity Market in solving engineering problems. The subject will be done by using interactive class method and active learning via small group discussion and problem-based learning. Assessment for this subject is done through individual assignment, group assignment, quiz, midterm examination, and final examination. This subject is delivered in Bahasa Indonesia.
Syllabus: The Industry so far; Current Policy Problems; The Future.

HUMAN RESOURCES MANAGEMENT
ENES803016
4 credits
Course description: This subject will discuss the concept of Human Resources Management in solving Engineering Problems. The subject will be done by using interactive class method and active learning via small group discussion and problem-based learning. Assessment for this subject is done through individual assignment, group assignment, quiz, midterm examination, and final examination. This subject is delivered in Bahasa Indonesia.
Syllabus: Introduction to Human Resources; Human Resources Management and Business Environment; Human Resources Organization; Human Resources Strategy; Talent Source; Employee Relations.

6.2 MASTER IN CIVIL ENGINEERING

Program Specification

1.	**Awarding Institution**	Universitas Indonesia	
2.	**Teaching Institution**	Universitas Indonesia	
3.	**Programme Title**	Graduate Program in Civil Engineering	
4.	**Class**	Regular	
5.	**Final Award**	Master Teknik (M.T)	
6.	**Accreditation / Recognition**	BAN-PT: A - accredited	
7.	**Language(s) of Instruction**	Bahasa Indonesia and English	
8.	**Study Scheme (Full Time / Part Time)**	Full Time	
9.	**Entry Requirements**	Bachelor Degree (S1)	
10.	**Study Duration**	Designed for 2 years	
	Type of Semester	Number of Semester	Number of weeks / semester
	Regular	4	17
	Short (optional)	3	8
11.	**Graduate Profiles:** Magister of Civil Engineering who has specialization, profesional ethic and an ability to conduct independent research and to pursue study.		
12.	Expected Learning Outcomes: 1. Problem Recognation and Solving: <u>*Synthesize*</u> *the solution to an ill-defined engineering problem into a broader context that may include public policy, social impact, or business objectives. (L5)* 2. Experiment: <u>*Specify*</u> *an experiment to meet a need and conduct the experiment, analyze and* <u>*explain*</u> *the resulting data (L5)* 3. Technical Specialization *Evaluate a design of a complex design or process, or evaluate a validity of newly created knowledge or technologies in a traditional or emerging advanced specialized* technical area appropriate to civil engineering. *4. Sustainability: Analyze* systems of engineered works, whether traditional or emergent, for sustainable performance. (L4) *5. Communication: Plan, compose, and integrate* the verbal, written, virtual, and graphical communication of a project to technical and nontechnical audiences (L5). *6. Lifelong Learning: Identify* additional knowledge, skills, and attitudes appropriate for professional practice. (L4)		
13	**Classification of Subjects**		
No.	**Classification**	**Credit Hours (SKS)**	**Percentage**
i	**Program Study Subjects**	**9**	**21**
ii	**Specialization Subjects**	**12 - 21**	**28-49**
iii	**Elective Subjects**	**3 - 12**	**7-28**
iv	**Seminar, Thesis, Scientific Publications**	**10**	**23**
	Total	**43**	**100 %**
14.	**Total Credit Hours to Graduate**		**43 Credits**

Learning Outcomes

Graduate Profile:
Magister of Civil Engineering who has specialization, profesional ethic and an ability to conduct independent research and to pursue study

Evaluate *a design of a complex design or process, or* ***evaluate*** *a validity of newly created knowledge or technologies in a traditional or emerging advanced specialized technical area appropriate to civil engineering (L6)*

Synthesize the solution to an ill-defined engineering problem into a broader context that may include public policy, social impact, or business objectives. (L5)

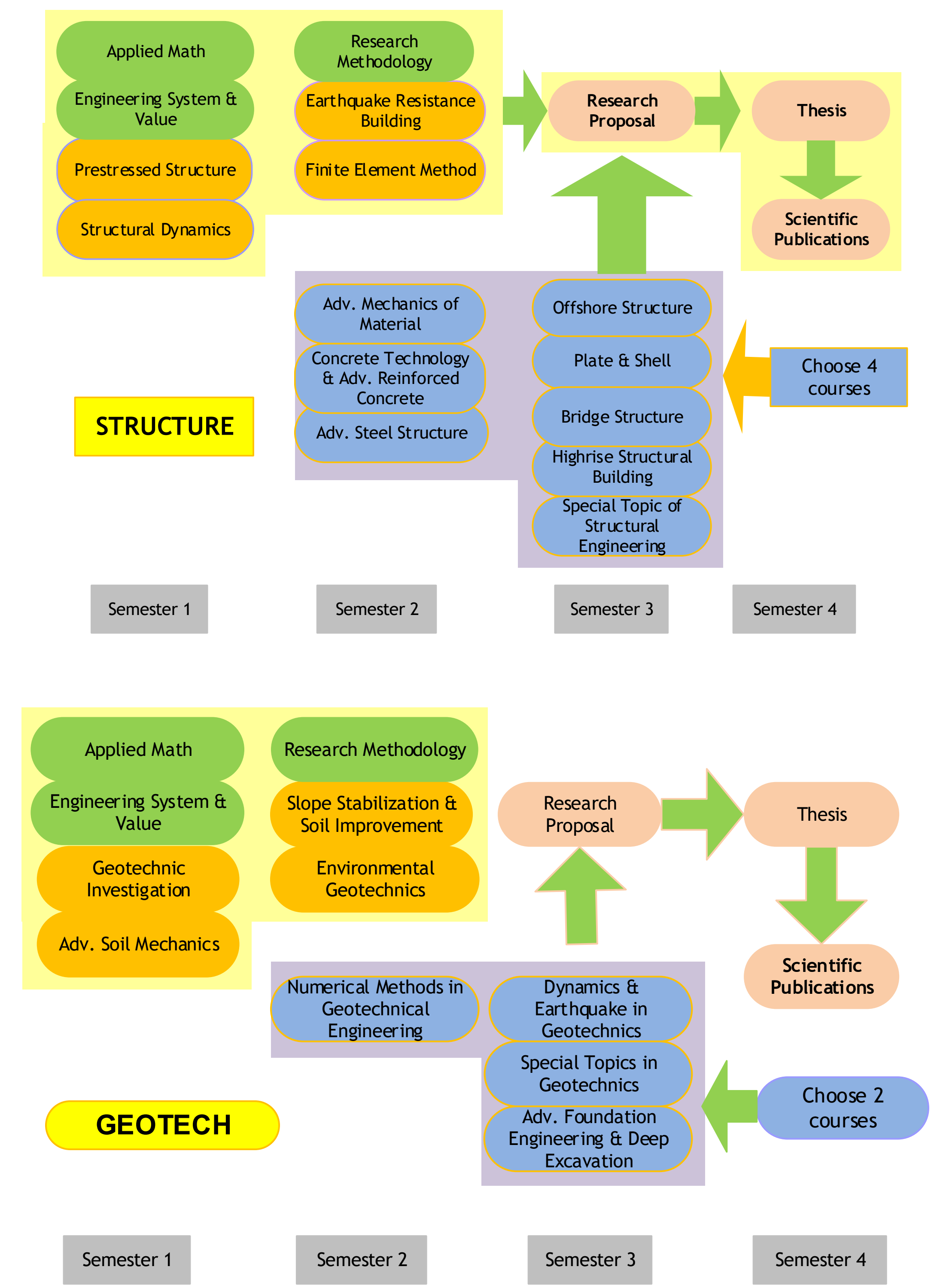
Specify *an experiment to meet a need and conduct the experiment, analyze and* ***explain*** *the resulting data (L5)*

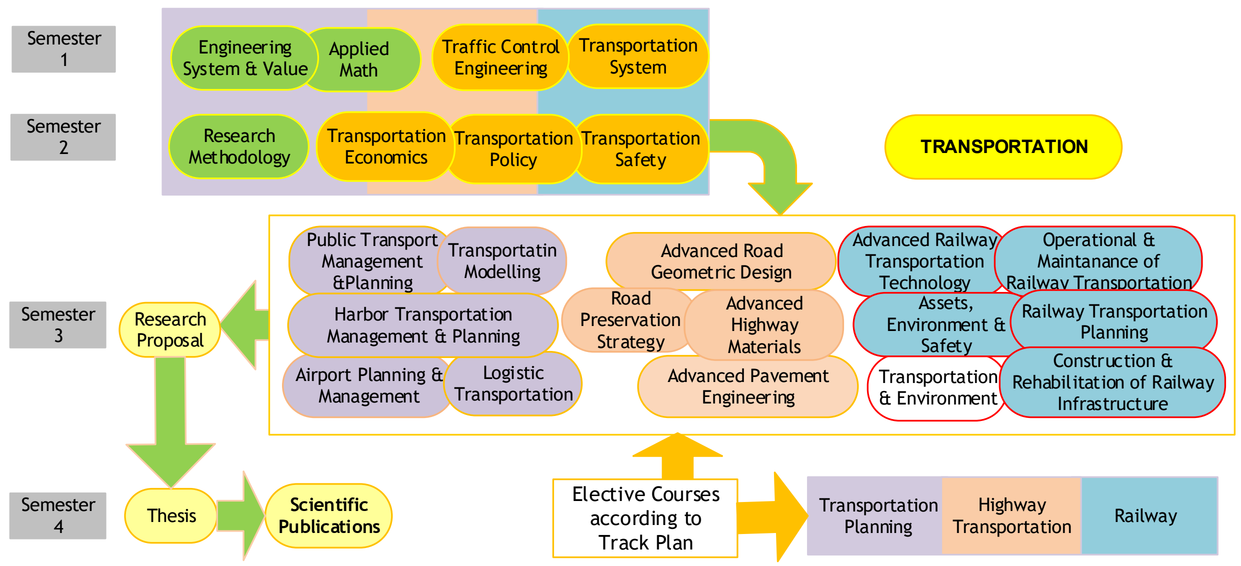
Plan, compose, and ***integrate*** the verbal, written, virtual, and graphical communication of a project to technical and nontechnical audiences (L5).

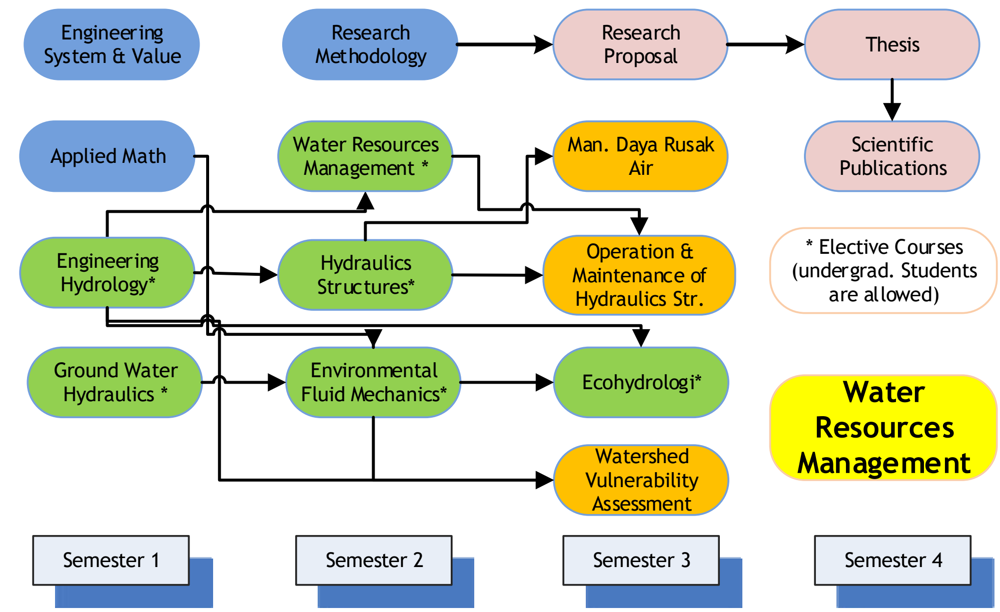
Identify additional knowledge, skills, and attitudes appropriate for professional practice. (L4)

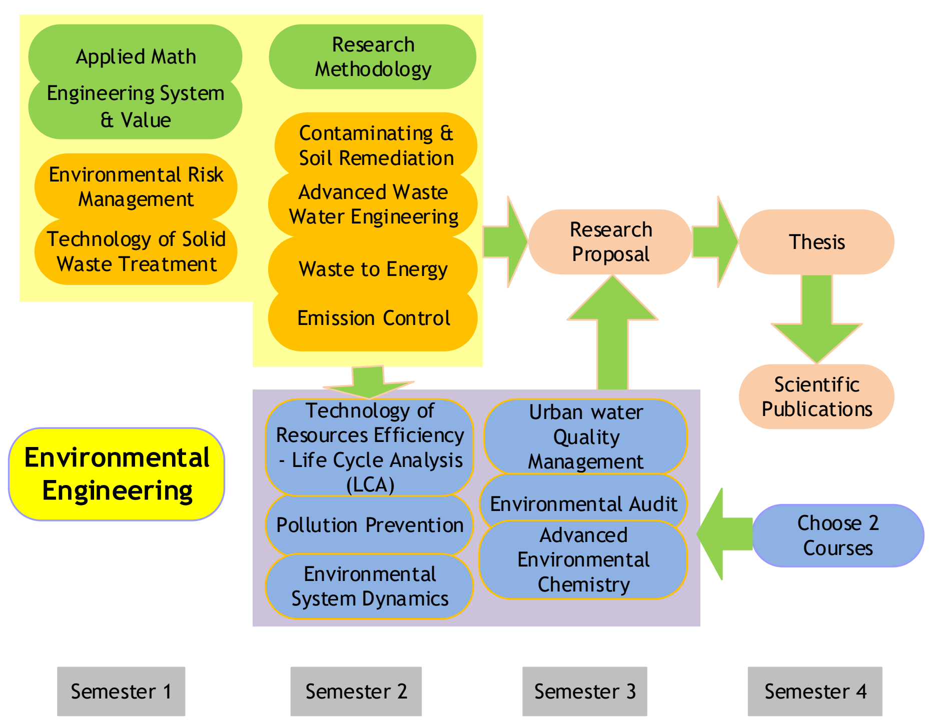
Analyze systems of engineered works, whether traditional or emergent, for Sustainable performance. (L4)

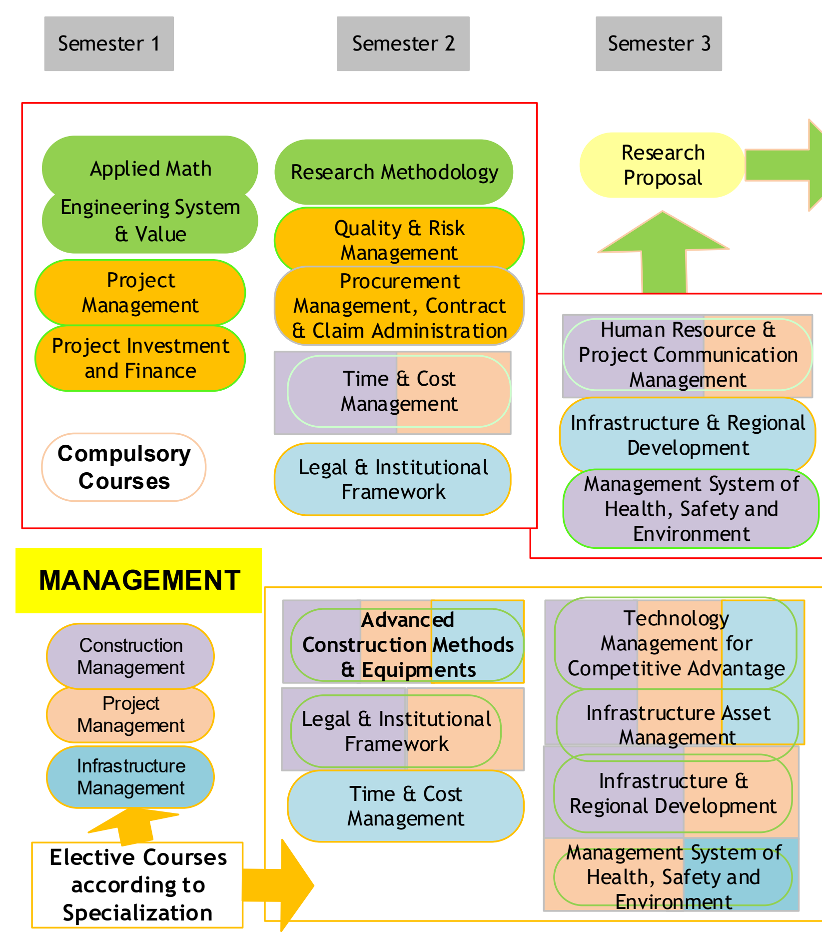
Flow Diagram of Subjects - Graduate Program on Civil Engineering




Semester 1
Semester 2
Semester 3
Semester 4
Engineering System & Value
Applied Math
Traffic Control Engineering
Transportation System
Research Methodology
Transportation Economics
Transportation Policy
Transportation Safety
TRANSPORTATION
Public Transport Management &Planning
Transportatin Modelling
Advanced Road Geometric Design
Advanced Railway Transportation Technology
Operational & Maintanance of Railway Transportation
Harbor Transportation Management & Planning
Road Preservation Strategy
Advanced Highway Materials
Assets, Environment & Safety
Railway Transportation Planning
Airport Planning & Management
Logistic Transportation
Advanced Pavement Engineering
Transportation & Environment
Construction & Rehabilitation of Railway Infrastructure
Research Proposal
Thesis
Scientific Publications
Elective Courses according to Track Plan
Transportation Planning
Highway Transportation
Railway


Engineering System & Value
Research Methodology
Research Proposal
Thesis
Applied Math
Water Resources Management *
Man. Daya Rusak Air
Scientific Publications
Engineering Hydrology*
Hydraulics Structures*
Operation & Maintenance of Hydraulics Str.
* Elective Courses (undergrad. Students are allowed)
Ground Water Hydraulics *
Environmental Fluid Mechanics*
Ecohydrologi*
Water Resources Management
Watershed Vulnerability Assessment
Semester 1
Semester 2
Semester 3
Semester 4


Applied Math
Research Methodology
Engineering System & Value
Contaminating & Soil Remediation
Environmental Risk Management
Advanced Waste Water Engineering
Technology of Solid Waste Treatment
Waste to Energy
Emission Control
Research Proposal
Thesis
Scientific Publications
Environmental Engineering
Technology of Resources Efficiency - Life Cycle Analysis (LCA)
Urban water Quality Management
Pollution Prevention
Environmental Audit
Advanced Environmental Chemistry
Environmental System Dynamics
Choose 2 Courses
Semester 1
Semester 2
Semester 3
Semester 4


Semester 1
Semester 2
Semester 3
Semester 4
Applied Math
Research Methodology
Research Proposal
Thesis
Engineering System & Value
Quality & Risk Management
Scientific Publications
Project Management
Procurement Management, Contract & Claim Administration
Project Investment and Finance
Time & Cost Management
Human Resource & Project Communication Management
Infrastructure & Regional Development
Compulsory Courses
Legal & Institutional Framework
Management System of Health, Safety and Environment
MANAGEMENT
Construction Management
Advanced Construction Methods & Equipments
Technology Management for Competitive Advantage
Project Management
Legal & Institutional Framework
Infrastructure Asset Management
Infrastructure Management
Time & Cost Management
Infrastructure & Regional Development
Elective Courses according to Specialization
Management System of Health, Safety and Environment

CURRICULUM STRUCTURE OF GRADUATE PROGRAM ON CIVIL ENGINEERING

Kode	Subject	SKS	Major							
			STR	GT	TR	SDA	TL	MP	MK	MI
	1st Semester									
ENCV801001	Applied Math	3	3	3	3	3	3	3	3	3
ENCV801002	Engineering System & Value	3	3	3	3	3	3	3	3	3
ENCV801101	Prestressed Concrete Structure	3	3							
ENCV801102	Structural Dynamics	3	3							
ENCV 801 201	Advanced Soil Mechanics	3		3	P					
ENCV 801 202	Geotechnic Investigation	3		3						
ENCV 801 301	Traffic Control Engineering	3			3					
ENCV 801 302	Transportation System	3			3					
ENCV 801 401	Engineering Hydrology	3				3				
ENCV 801 402	Ground Water Hydraulics	3				3				
ENCV801501	Environmental Risk Management	3					3			
ENCV801502	Technology of Solid Waste Treatment: Operational and Design	3					3			
ENCV 801 601	Project Investment and Finance	3						3	3	3
ENCV 801 602	Project Management	3						3	3	3
	Major Compulsary Courses		6	6	6	6	6	6	6	6
	Sub Total		**12**	**12**	**12**	**12**	**12**	**12**	**12**	**12**
	2nd Semester									
ENCV802003	Research Metodology	3	3	3	3	3	3	3	3	3
ENCV802101	Earthquake Resistance Building	3	3							
ENCV802102	Finite Element Method	3	3							
ENCV802103	Advanced Mechanics of Material	3	P							
ENCV802104	Advanced Steel Structure	3	P							
ENCV802105	Concrete Technology & Adv. Reinforced	3	P							
ENCV802201	Slope Stabilization and Soil Improvement	3		3						
ENCV802202	Environmental Geotechnics	3		3						
ENCV802203	Numerical Methods in Geotechnical Engineering	3		P						
ENCV 802 301	Transportation Economics	3			3					
ENCV 802 302	Transportation Policy	3			3					
ENCV 802 303	Transportation Safety	3			3					
ENCV802401	Environmental Fluid Mechanics	3				3				
ENCV802402	Water Resources Management	3				3				
ENCV802403	Hydraulics Structures	3				3				
ENCV802501	Contaminating and Soil Remediation	3					3			
ENCV802502	Advanced Waste Water Engineering	3					3			
ENCV802503	Waste to Energy	3					3			
ENCV802504	Emission Control	3					3			
ENCV802505	Technology of Resources Efficiency - Life Cycle Analysis (LCA)	3					P			
ENCV802506	Pollution Prevention	3					P			
ENCV802507	Environmental System Dynamics	3					P			
ENCV802601	Time & Cost Management	3						3	3	P
ENCV802602	Quality & Risk Management	3						3	3	3
ENCV802603	Procurement Management, Contract & Claim Administration	3						3	3	3
ENCV802604	Advanced Construction Methods & Equipments	3						P	P	P
ENCV802605	Legal & Institutional Framework	3						P	P	3
	Major Compulsary Courses		6	6	9	9	12	9	9	9
	Sub Total		**9**	**9**	**12**	**12**	**15**	**12**	**12**	**12**
	3rd Semester									
ENCV803101	Offshore Structure									
ENCV803102	Bridge Structure									
ENCV803103	Highrise Structural Building									
ENCV 803 201	Adv. Foundation Engineering & Deep									
ENCV 803 202	Dynamics & Earthquake in Geotechnics									
ENCV 803 203	Special Topics in Geotechnics									
ENCV 803 301	Transportation Modelling									
ENCV 803 302	Public Tranport Management and Planning									
ENCV 803 303	Harbor Transportation Management and Planning									
ENCV 803 304	Airport Planning and Management									
ENCV 803 305	Advanced Road Geometric Design									
ENCV803306	Advanced Pavement Engineering									
ENCV803307	Advanced Highway Materials									
ENCV803308	Road Preservation Strategy									
ENCV803309	Railway Transportation Planning									
ENCV803310	Assets, Environment and Safety									
ENCV803311	Construction & Rehabilitation of Railway Infrastructure									
ENCV803312	Advanced Railway Transportation Technology									
ENCV803313	Operational & Maintanance of Railway Transportation									
ENCV803314	Transportation & Environment									
ENCV 803 315	Logistic Transportation									
ENCV 803 401	Ecohydrology									
ENCV803402	Water Related Disaster Management									

ENCV803403	Watershed Vulnerability Assessment									
ENCV803404	Operation & Maintanance of Hydraulics									
ENCV803501	Urban water Quality Management									
ENCV803502	Environmental Audit									
ENCV803503	Advanced Environmental Chemistry									
ENCV 803 601	Human Resource and Project Communi-cation Management									
ENCV803602	Technology Management for Competitive Advantage									
ENCV 803 603	Infrastructure and Regional Development									
ENCV 803 604	Infrastructure Asset Management									
ENCV 803 605	Management System of Health, Safety and Environment									
ENCV800001	Research Proposal									
	Major Compulsary Courses		0	6	0	3	0	3	6	3
	Sub Total		**1**	**7**	**1**	**4**	**1**	**4**	**7**	**4**
	4th Semester									
ENCV 804 101	Special Topics on Structural Engineering		P							
ENCV 800 002	Thesis		**8**	**8**	**8**	**8**	**8**	**8**	**8**	**8**
ENCV800003	Scientific Publications	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**
	Sub Total									
	Total Credits of Civil Engineering Com-pulsary Courses		9	9	9	9	9	9	9	9
	Total Credits of Major Compulsary Courses		12	18	15	18	18	18	21	18
	Total Credits of Elective courses		12	6	9	6	6	6	3	6
	T O T A L		**44**	**44**	**44**	**44**	**44**	**44**	**44**	**44**

STR = Structure
GT = Geotech
TR = Transportation
SDA = Water Resources Management
TL = Environmental Engineering
MP/MK/MI = Construction/Project/Infrastructure Management

COURSE SYLLABUS OF GRADUATE PROGRAM ON CIVIL ENGINEERING

ENCV801001
Applied Math
3 SKS
Learning Outcomes:

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

Competence in Curriculum: Prior knowledge for problem recognation & solving
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

ENCV801002
Engineering System & Value
3 SKS
Learning Outcomes: Able to evaluate system engineering including analysing, simulating and optimizing to produce a better designed and more valuable system engineering.
Competence in Curriculum: Prior knowledge for problem recognation & solving
Syllabus: Course Overview; Introduction to Systems Definitions & Concepts; Introduction to Sustain-ability Development; Optimization and Reliability, Design & Operation, Decision Making; Issues on Human, Organizational and Technology; Value Engineering and Innovation; New Product Develop-ment; 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-Inter-science
7. Ulrich, Karl T. and Eppinger, Steven D (2004) *Product Design and Development*, 3rd Edition, McGraw-Hill, New York

ENCV802003
Research Methodology
3 SKS
Learning Outcomes:

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)

Competence in Curriculum: *Prior knowledge for research/experiment* dan *WA10 (communication)*

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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

ENCV800001
Seminar
1 SKS
Learning Outcomes: Students should be able to apply the knowledge from the specificity / specialization that has been gained in preliminary studies, analyze the results and describe it orally (presentation) and written (seminar book)
Competence in Curriculum: Prior knowledge for Research/Experiment, WA10 (communication) and WA12 (lifelong learning)
Syllabus:
Prerequisites: Research Methodology

ENCV 800 002
Thesis
7 SKS
Learning Outcomes:
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

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)
Syllabus: -
Prerequisites: Research Methodology and Seminar
Text Books:

ENCV800003
Scientific Publication
2 SKS
Learning Outcomes:
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.

Competence in Curriculum: Prior knowledge untuk WA10 (communication)
Syllabus: -
Prerequisites: Thesis
Text Books:

Course Syllabus of Structure Specialization

ENCV801101
Prestressed Concrete Structure
3 SKS
Learning Outcomes:
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

Competence in Curriculum: Technical Specialization, Communication
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.

ENCV801102
Structural Dynamics
3 credits
Learning Outcomes: Students should be able to analyze civil engineering buildings subjected to dynamic forces.
Competence in Curriculum: Technical Specialization
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; general-

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ization 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

ENCV802101
Earthquake Resistance Building
3 credits
Learning Outcomes: Students should be able to analyze the effect of earthquakes on civil engineering buildings and able to design earthquake proof buildings
Competence in Curriculum: Technical Specialization
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

ENCV802102
Finite Element Method
3 Credits
Learning Outcomes:
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.

Competence in Curriculum: Technical Specialization
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

ENCV802103
Advanced Mechanics of Material
3 Credits
Learning Outcomes:
Able to deeply analyze the structure response due to static load or temperature with considering material and structure properties in elastic and inelastic condition.
Competence in Curriculum: Technical Specialization
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

ENCV802104
Advanced Steel Structure
3 Credits
Learning Outcomes:
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.
Competence in Curriculum: Technical Specialization
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

ENCV802105
Concrete Technology & Adv. Reinforced Concrete
3 Credits
Learning Outcomes:
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.

Competence in Curriculum: Problem Recognition and Solving, Technical Specialization
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

ENCV803101
Offshore Structure
3 Credits
Learning Outcomes:
Able to design offshore buildings structures.
Competence in Curriculum: Technical Specialization
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
1. Cliff Gerwick, Construction of Marine and Off-shore Structures, CRC Press 1999

ENCV803102
Bridge Design
3 Credits

Learning Outcomes:
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.

Competence in Curriculum: Technical Specialization
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

ENCV803103
Highrise Structural Building
3 Credits
Learning Outcomes:
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.

Competence in Curriculum: Technical Specialization
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

ENCV803104
Plate and Shells
3 Credits
Learning Outcomes:
1. Able to apply finite element method to analyze and designing of plate and shells structure.

Competence in Curriculum: Technical Specialization
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

ENCV 804 101
Special Topics in Structural Engineering
3 Credits
Learning Outcomes:
1. Knowing the latest technology or topics on structure specificity as well as the development of structural knowledge in the future.

Competence in Curriculum: Technical Specialization
Syllabus:
Selected topics in structure specificity.
Prerequisite:
Reference Book: Selected Journal/Book

Course Syllabus of Geotechnics Specialization

ENCV 801 201
Advanced Soil Mechanics
3 Credits
Learning Outcomes:
1. Able to formulate the behavior of kinds of soil and soil condition.

Competence in Curriculum: Problem Recognition and Solving
Syllabus:

MASTER PROGRAM

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.

ENCV 801 202
Advanced Geotechnical Investigation
3 Credits
Learning Outcomes:
1. Able to formulate complex geotechnical investigation program

Competence in Curriculum: Problem Recognition and Solving, Experiment/Research
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.

ENCV802202
Slope Stabilization and Soil Improvement
3 Credits
Learning Outcomes:
1. Able to create synthesis of complex slope stabilization solution and the necessary strengthening.

Competence in Curriculum: Problem Recognition & Solving; Experiments/Research, Technical Specialization, Sustainability **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:
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.

ENCV802202
Environmental Geotechnics
3 Credits

FACULTY OF ENGINEERING

Learning Outcomes:

1. Able to make synthesis of geotechnical solution from complex environmental issue.

Competence in Curriculum: Problem Recognition & Solving, Sustainability; Technical Specialization

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.

ENCV802203
Numerical Method in Geotechnical Engineering
3 Credits
Learning Outcomes:

1. Able to determine, executing, and analyzing the result of complex geotechnics issue.

Competence in Curriculum: Problem Recognition and Solving, Experiments and Research

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.

ENCV 803 201
Adv. Foundation Engineering & Deep Excavation
3 Credits
Learning Outcomes:

1. Able to make synthesis of complex deep excavation solution

Competence in Curriculum: Problem Recognition and Solving, Experiment/Research, Technical Specialization.

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

ENCV 803 202
Diynamics & Earthquake in Geotechnic
3 Credits
Learning Outcomes:

1. Able to create synthesis solution of various problem of geotechnics against earthquake and able to formulate machine foundation solution.

Competence in Curriculum: Problem Recognition and Solving, Sustainability, Technical Specialization.

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

ENCV 803 203
Special Topics in Geotechnics
3 Credits
Learning Outcomes:

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.

Competence in Curriculum: Problem Recognition & Solving, Experiments/Research, Technical Specialization**.**

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

ENCV 801 301
Traffic Control Engineering
3 Credits
Learning Outcomes:

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.

Competence in Curriculum: Technical Specialization
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.

ENCV 801 302
Transportation System
3 Credits
Learning Outcomes:

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.

Competence in Curriculum: Problem Recognition and Solving
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.

Blunden, W. and Black, J., 1984. *The Land-Use / Transport System* 2nd ed., Pergamon-Press

ENCV 802 301
Transportation Economics
3 Credits
Learning Outcomes:

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.

Competence in Curriculum: Problem Recognition and Solving, Sustainability

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

ENCV 802 302
Transportation Policy
3 Credits
Learning Outcomes:

1. Able to bring the uniqueness and originality from suggestion of transportation policy arrangement.

Competence in Curriculum: Experiment/Research, Technical
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.

ENCV 802 303
Transportation Safety
3 Credits
Learning Outcomes:

1. Students able to design prevention program and transportation safety measures, road transportation (C5) and perform simple road transport audit.

Competence in Curriculum: Problem Recognition and Solving, Sustainability
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

ENCV 803 301
Transportation Modelling
3 Credits
Learning Outcomes:
1. Able to make a model based on transportation infrastructure network.

Competence in Curriculum: Problem Recognition and Solving
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: -

ENCV 803 302
Public Transport Management and Planning
3 Credits
Learning Outcomes:
1. Students are able to plan and design public transport system operation.

Competence in Curriculum: Technical Specialization
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

ENCV 803 303
Harbor Transportation Management and Planning
3 Credits
Learning Outcomes:
1. Able to plan a port based on the technical, operational and environmental aspect as well as to meet and reflect it in a planned and structured way to support the role and functions in the integrated development of port infrastructure.
2. Able to design the layout of the port (water and land space) and calculate the structure of the port buildings facilities facility while taking into account the global aspect of freight and container.

Competence in Curriculum: Technical Specialization
Syllabus: Introduction: Definition of port according to function, purpose, and type of ports; Port planning concepts; Major factors in the planning of port: type and size of vessel, space and land needed, current composition of existing goods and forecasting; Port Performance: The introduction of performance indicators in relation to the port facilities by considering the needs of Berth Occupancy Ratio (BOR), time of service, productivity and equipment utility; Port planning instruments: Strategic Plan for Ports, Ports main Plan, Land use plan. Determining the location and layout of port in terms of technical, operational and environmental. Analysis of the needs for port facility; Design of port facility: ships and its effect on port structure (the type and characteristics of the vessel, the forces due to ships, wind, waves, tides and currents). Wave retaining structures planning. Basics Port planning (determining the shape, port dimensions and maneuver ponds, determining the location and width of the groove for entering the port), fender system (definition of fender, fender type and the selection and calculation of fender) and dock. Freight transport: global and national freight transport growth, understanding of multimodal transport and the development of hinterland region in a port.
Prerequisite: Has taken concrete construction class.
Reference Book:
1. Thoresen, C., 2010. *Port Designern Handbook* 2nd ed., Thomas Telford Publishing.
2. UNCTAD, 1983. *Planning Land Use in Port Areas: Getting the Most Out of Port Infrastructure* Monographs., United Nations Conference on Trad and Development.
3. Yoshimi, G., Shigeo, T., Tadahiko, Y. and Shuji, Y., 2009. *Technical Standards and Commentaries for Port and Harbour Facilities in Japan*, The overseas Coastal Area Development Institute of Japan.
4. Direktorat Pelabuhan dan Pengerukan, 2003. *Pedoman Teknis Pemilihan dan Penetapan Lokasi*, Direktorat Jenderal Perhubungan Laut

ENCV 803 304
Airport Planning and Management
3 Credits
Learning Outcomes:
1. Able to plan and design land facilities of an airport with concerning recent issue that affect aviation world.

Competence in Curriculum: Technical Specialization
Syllabus:
The latest issues related to the airport and the aviation industry. Airport strategic planning. Multi-Airport Systems. Delay in flight. Airspace capacity in the airport. Airport configuration and landing area geometric design. Configuration of passenger terminal. Passenger terminal design. Distribution and airport access systems. Airport environmental impact.
Prerequisite:
Reference Book:
1. Neufville, R. de and Odoni, A., 2003. *Airport System Planning, Design, and Management*, McGraw-Hill.
2. Postorino, M., 2010. *Development of Regional Airports, Theoretical Analysis*, WIT Press.
3. Horonjeff, R., 2010. *Planning and Design of Airports*, McGraw-Hill.
4. ICAO, 2006, Aerodrome Design Manual Annex no 14, Part 1 and Part 2 (Runways - and - Taxiways, apron and holding bays.

ENCV 803 305
Advanced Road Geometry Design
3 Credits
Learning Outcomes:
1. Able to design road geometry, road supporting facility, junction, geometric and parking facility with considering certain aspects regarding road safety.

Competence in Curriculum: Technical Specialization
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.

ENCV803306
Advanced Pavement Engineering
3 Credits
Learning Outcomes:
1. Able to investigate and conducting experiment of flexible and rigid road pavement.
2. Able to calculate the thickness of road pavement based on Mechanistic-Empirical Pavement Design principle with considering the nature and rheology of material due to load from traffic and environment condition so it has Long Term Pavement Performance (LTPP) and fulfill the criteria provided.

Competence in Curriculum: Technical Specialization
Syllabus:
Reviewing the various types of road pavement viewed from basic analysis and planning approach, Various forming materials related to the nature and base characteristics, Main factor for stress strain analysis planning for flexible pavements; Analysis of stress and strain for rigid pavement; Material characterization based on modulus, Fatigue characteristics and deformation; Loading and type and characteristics of loading; The use of software to calculate pavement thickness. The design of flexible pavements based on the empirical and mechanistic principle; Design of rigid pavement.
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*

ENCV803307
Advanced Highway Materials
3 Credits
Learning Outcomes:
1. Able to analyze the nature and characteristic of material due to stress and strain as well as rheology of pavement material.

Competence in Curriculum: Technical Specialization
Syllabus: Modeling of concrete pavement: pavement response models and performance models; Asphalt rheology: rheological models of asphalt mix, asphalt binder rheology; Damage resistance characterization; Rigidity characterization: Modulus characterization of asphalt material and asphalt concrete; Asphalt concrete damage models: model of deflection (rutting), model of fatigue; Characteristics of asphalt concrete mixture:; stiffness characteristics, characteristics of deflection / wave; fatigue characteristics and water content, influence of load and temperature. Rheological models of asphalt binder and the usage of binder modification; The use of additive materials for improving the quality of asphalt and asphalt concrete: polymer, recycled materials. Waste and by-product materials. Complex modulus and resilient of indirect tensile test, development model in making asphalt concrete models.
Prerequisite: Material Properties, Pavement 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

ENCV803309
Railways Transportation Planning
3 Credits
Learning Outcomes:
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.

Competence in Curriculum: Technical Specialization
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

ENCV803311
Construction & Rehabilitation of Railway Infrastructure
3 Credits
Learning Outcomes:

1. Know the construction method for railways repair, able to monitor and assess the necessary repair and maintenance of railways.

Competence in Curriculum: Technical Specialization

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

ENCV 801 401
Engineering Hydrology
3 Credits
Learning Outcomes:

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).

Competence in Curriculum: Technical Specialization, Communication, Lifelong Learning

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.

ENCV 801 402
Groundwater Hydraulics
3 Credits
Learning Outcomes:

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.

Competence in Curriculum: Experiment/Research, Technical Specialization, Communication, Lifelong learning.

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

ENCV802401
Environmental Fluid Mechanics
3 Credits
Learning Outcomes:

1. Able to formulate equations of advection dispersion that accommodate chemical decay and precipitation in physics (sink / source), and
2. Able to write a paper about the model of dispersion of pollutants in water surface and underground, and present it orally.

Competence in Curriculum: Technical Specialization, Sustainability, Communication, Lifelong learning.

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

ENCV802402
Water Resource Management
3 Credits

Learning Outcomes:

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.

Competence in Curriculum: Problem Recognition and Solving, Sustainability, Communication, Lifelong Learning.
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.
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.

ENCV802403
Hydraulics Structures
3 Credits
Learning Outcomes:

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.

Competence in Curriculum: Problem Recognition and Solving, Communication, Lifelong Learning.
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

ENCV 803 401
Ecohydrology
3 Credits
Learning Outcomes:

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).

Competence in Curriculum: Problem Recognition and Solving, Sustainability, Communication, Lifelong Learning.
Syllabus: Green Infrastructure, Eco Urban Village, Low Impact Development
Prerequisite:
Reference Book:

ENCV803403
Watershed Vulnerability Assessment
3 Credits
Learning Outcomes:

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.

Competence in Curriculum: Problem Recognition and Solving, Sustainability, Communication, Lifelong Learning.
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:

ENCV803404
Operation & Maintenance of Hydraulics Structures
3 Credits
Learning Outcomes:

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.

Competence in Curriculum: Problem Recognition and Solving, Sustainability, Communication, Lifelong learning.
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

ENCV803402
Water Related Disaster Management
3 Credits
Learning Outcomes:

1. able to design disaster mitigation system related to water damage
2. able to provide follow-up recommendations for increasing community resilience

Competence in Curriculum: *Problem Recognation & Solving; Sustainability*
Syllabus: disaster life cyle, disaster risk management cycle, Risk scoring system, design of mitigation systems
Prerequisite:

Reference Book:

Course Syllabus of Environmental Engineering Specialization

ENCV801501
Environmental Risk Management
3 Credits
Learning Outcomes:
1. Able to analyze (C4) environmental risk based on toxicology approach to assess the impact of pollution to soil, air, and water.

Competence in Curriculum: Problem Recognition and Solving, Sustainability
Syllabus:
Introduction of environmental risks; Concepts, principles and usage of risk in environment; Risks typology and management methods; Techniques and methods for risk calculation; Integrated risk assessment; Ecological Risk Assessment (ERA) - Ecotoxicology; Human Risk Assessment (HRA) - Toxicology; The implementation of environmental risk assessment in industry; Application of environmental risk calculation in pollution case soil, air and water medium; Pollutant fate transport software usage, fugacity and risk assessment of chemicals in the environment.
Prerequisite: Has taken environmental chemistry class.
Reference Book:
1. Simon T (2014), Environmental Risk Assessment a Toxicological Approach
2. Lerche and Walter (2006), Environmental Risk Assessment: Quantitative Measures
3. International Journal of Risk Assessment and Management (IJRAM)
4. International Journal of Human and Ecological Risk Assessment (AEHS Foundation)

ENCV801502
Technology of Solid Waste Treatment: Operational and Design
3 Credits
Learning Outcomes:
1. Able to apply the knowledge regarding solid waste treatment in design process and treatment process.

Competence in Curriculum: Experiment/Research; Technical Specialization, Sustainability
Syllabus:
Overview of Integrated Solid Waste Management: the concept of sustainable solid waste management, Development of IWMS (case studies and analysis), Elements of IWM; Physical characteristics, chemical, biological and solid waste generation; biological treatment, mechanical, mechanical-biological; thermal processing, landfilling and coating technology; recirculation of solid waste; design, structure and planning for the operating units.
Prerequisite: Integrated Solid Waste Management Design
Reference:
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.

ENCV802501
Contaminating and Soil Remediation
3 Credits
Learning Outcomes:
1. Able to prepare remediation program design on contaminated land due to industrial activity or accident.

Competence in Curriculum: Problem Recognition and Solving
Syllabus: Activities that could potentially cause contamination of hazardous and toxic materials on the environment (soil and groundwater); Types and forms of hazardous and toxic pollutants; Patterns and characteristics of the travel and spread of contaminants in the soil; Impacts and risks that pollutant can cause to the environment; Elimination method for contaminants spread in the soil; Restoration method of hazardous and toxic contaminated land; Physical recovery, Chemistry and Biochemistry; Technical design of soil and groundwater remediation; Economic and financial aspects for remediation projects; Field case study.
Prerequisite: Environmental laboratory, Environment microbiology, Operating and Process Unit, Industrial waste and hazardous material management, Liquid waste management.
Reference Book:
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.

ENCV802502
Advanced Waste Water Engineering
3 Credits
Learning Outcomes:
1. Able to evaluate the implementation of waste treatment in the context resources recovery and analyze issues of sustainability in the operation and maintenance of waste treatment and combine the technical and non-technical aspect in ensuring the sustainability of wastewater treatment that based on resource recovery.

Competence in Curriculum: Problem Recognition and Solving
Syllabus: Nutrient recovery concept; Energy and water from waste; Sustainability in waste treatment in Indonesia; Sustainable waste treatment analysis; Nutrient recovery technology design; Energy and water (Biological Nutrient Removal, Anaerobic Digestion, Membrane Technology), Methods of pre-and post-processing of waste (processing mechanical, thermal and biological).
Prerequisite: Process and Operating Unit
Reference Book:
1. Metcalf and Eddy, 2014, Wastewater Engineering: Moving towards Resource Recovery
2. WEF, 2015, Moving Towards Resource Recovery Facilities
3. Kerstens et al, 2015, Feasibility analysis of wastewater and solid waste systems for application in Indonesia
4. Moss et al, 2013, Enabling the Future: Advancing Resource Recovery from Biosolids
5. Lohri, 2013, Feasibility assessment tool for urban anaerobic digestion in developing countries
6. Davis, 2010, Water and Wastewater Engineering

ENCV802503
Waste to Energy
3 Credits
Learning Outcomes:
1. Able to identify characteristics and requirements of waste, whether its solid or liquid that has the potential to be recovered as a source of alternative energy that are environmentally friendly.

Competence in Curriculum: Problem Recognition and Solving, Technical Specialization
Syllabus:
Calculation of thermo-chemical conversion and bio-chemistry against energy content in the waste material, technological alternatives that can be used and designing it applications. Lecture is held face-to-face, discussions, group work and presentations. Lectures conducted entirely in Indonesian, unless there is a teacher or guest speakers from abroad.
Prerequisite:
Reference Book:
1. Young, G.C. 2010. Municipal Solid Waste to Energy Conversion Processes. A John Wiley & Sons, Inc., Publication. New Jersey.
2. Tchobanoglous, G., Theisen, H., Vigil, S.A. 1993. Integrated Solid Waste Management. McGraw-Hill International. New York.
3. Tchobanoglous, G., Kreith, F. 2002. Handbook of Solid Waste Management. 2nd Edition. McGraw-Hill. New York.
4. UNEP. 2005. Solid Waste Management. Vol. I and II. Cal Recovery Incorporated. California.

5. Regulations (UU, PP, Perpres, Permen, Kepmen, Perda, Pergub, dll), Norms, standards, guidance, manuals, and others about waste management
6. On line references (Digital Journal and Clipping Media), Lecture handouts, and other reading materials relevant to this subject.

ENCV802504
Emission Control
3 Credits
Learning Outcomes:
Able to analyze and evaluate type and sources of greenhouse gas emission that were cause by solid waste treatment and the methods to control it.
Competence in Curriculum: Problem Recognition and Solving; Technical Specialization; Lifelong Learning
Syllabus:
Process in solid waste treatment that produce emission; Greenhouse gasses; Emission inventory; Emission control in landfill; Landfill design for emission control; Emission control with the usage of technology; Learning is done throughout interactive lecture, assignment, and assistances. Learning activities is also includes researches. Scope of the study is solid waste and its management, emission produced, as well as its prevention. Indonesian and English language are used during the process of learning.
Prerequisite: Air Pollution
Reference Book:
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*

ENCV802505
Technology of Resources Efficiency – Life Cycle Analysis (LCA)
3 Credits
Learning Outcomes:
1. Able to use a set of model to give an assessment on sustainable solid waste management.

Competence in Curriculum: Sustainability
Syllabus: Integrated solid waste management overview; Sustainable solid waste management concept; IWMS development (case study and analysis); IMW element; Solid waste generation and composition; Waste collection; Central sorting; Biological treatment; Thermal treatment; Landfilling; Material recycling; Model: STAN 2, Prognosis and IWM 2.
Prerequisite: Integrated Solid Waste Management
Reference Book:
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.

ENCV802506
Pollution Prevention
3 Credits
Learning Outcomes:
1. Able to assess the engineering process in pollution prevention in a particular industrial sector with mass balance analysis and economic benefits of pollution prevention programs oriented to the concept of pollution prevention completion in a process of production/ clean production and not an on of pipe solution.

Competence in Curriculum: Technical Specialization
Syllabus: Pollution prevention (P2) concept; Benefits and obstacles of P2; P2 application assessment procedure and case studies; Economic analysis of P2 program application; Introduction of eco-labeling and life cycle assessment; P2 program on construction design process and demolition of buildings, food industry, wood products, agencies and offices; P2 Case Study on an industry.
Prerequisite:
Reference:
1. Harry M. Freeman, INDUSTRIAL POLLUTION PREVENTION HANDBOOK, Mc Graw-Hill, New
2. York, 1995, 935 pages
3. United States Environmental Protection Agency (EPA), Facility Pollution Protection Prevention Guide (FP2G), epa/600/r-92/088, Washington DC, May 1992, 143 Pages
4. Paul Bishop, Fundamental and Practice, Pollution Prevention

ENCV802507
Environmental System Dynamics
3 Credits
Learning Outcomes:
1. Able to explain the basic principles of environment as a system with the interaction of environmental components (social, natural and artificial).
2. Able to formulate the amount, concentration, danger level and the impact of environmental pollutants.

Competence in Curriculum: Sustainability
Syllabus:
Definition of basic environmental system with natural environment subsystem, artificial and social; Dynamics of environmental system (integration of basic principles of environmental science: interaction, interdependence, diversity, harmony, and sustainability); Dynamics of physical environment system (cycle of matter and energy, hydrological cycle, food chain and environmental pollution harassment); Environmental physical system management model (determining factor, media and interaction of environmental physical component in an environment system) Social system management model (conflict management and environment mediation); Physical case studies; Social case study.
Prerequisite:
Reference Book:
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

ENCV803501
Urban water Quality Management
3 Credits
Learning Outcomes:
1. Student able to predict (C5) the capacity and load on the water surface with water quality modeling software.

Competence in Curriculum: Technical Specialization, Sustainability
Syllabus:
Introduction to urban water management in spatial planning and city infrastructure; Type of resources, allocation of water and water availability; Critical water quality and water usage in infrastructure perspective; Water quality and impact of urban waste in correlation with causality and health risks; Calculation of pollution load of solid and liquid waste; Determination of capacity and load on the water surface; Calculation of Total Maximum Daily Load (TMDL) on the water surface; Technology interventions and policy in controlling water quality and municipal waste; Water quality modeling (QUAL2E, Epanet, Aquatox ..); Application of case management of urban water quality using software.
Prerequisite: Has taken environmental chemistry and Domestic Waste Water Planning and Applied Mathematics class.
Reference Book:
1. Spoon R (2015), Water Quality Management Handbook, Ingram Publisher.

2. Aley R (2007) Water Quality Control Handbook, WEF Press
3. Wang LK et al. (2012) Advances in Water Resources Management, Springer (eBook)

ENCV803502
Environmental Audit
3 Credits
Learning Outcomes:

1. Able to perform audit and arrange environmental audit report

Competence in Curriculum: Sustainability
Syllabus:
Definitions, principles, concepts and environmental policy in environmental audit; Basic Law and the policy of the environmental audit regulation; Basic Principles of AL (Determination of the key issues and the scope of the audit); Understanding of ISO 1400: Improvement of Environmental Management and Sustainable Development; Study of the Environment Manage Plan/Environmental Management Plan (RKL / RPL); Basic Principles of Auditing (basic principles, procedures, hierarchies and processes in environmental auditing); Types of Audit (compliance audits, waste audits, audit processes); Audit method (procedures for determining, weight, importance and valuation of the environmental audit). Audit document; Audit Case Study (documents cases study).
Prerequisite:
Reference Book:

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.

ENCV803503
Advanced Environmental Chemistry
3 Credits
Learning Outcomes:

1. Able to analyze (C4) nutrient pollution problems and volatile organic substances in the environment and correlate with the sources of pollution, chemical reaction in water, air and soil, as well as equilibrium, thermodynamics and kinetics of these contaminants in various media.

Competence in Curriculum: Problem Recognition and Solving, Technical Specialization
Syllabus: Introduction to Environmental Chemistry (Material cycle before the era of anthropogenic, Cycles of major elements: carbon, nitrogen, sulfur), Water Chemistry (Water properties, water composition, acids and bases, gas in water vs. alkalinity, precipitation and complexation, soluble, water system using the basic concept of chemical equilibrium, thermodynamics, kinetics, anthropogenic versus natural cycles, pollution of water and material transfer of water bodies, Redox in water, adsorption-desorption, biotransformation, interaction phase and speciation), Atmospheric Chemistry (composition, photochemical, particulates, global atmosphere), Geosphere (Geosphere system and cycle, ground system), hazardous waste and Toxicology.
Prerequisite: Basic Chemistry
Reference Book:

1. Manahan, Stanley. 2010. Environmental Chemistry: Ninth Edition. CRC Press. Boca Raton, USA
2. Baird, Colin and Cann, Michael. 2008. Environmental Chemistry: Fourth Edition. WH Freeman. New York, USA
3. Van Loon, Gary W. and Duffy, Stephen. 2011. Environmental Chemistry – a global perspective: Third Edition. Oxford. Oxford, UK
4. Hemond, Harold and Fechner-Levy, Elizabeth J. 2000. Chemical Fate and Transport in the Environment. Elsevier. San Diego, USA
5. Stumm, Morgan, 1996. Aquatic Chemistry, third edition. Wiley and sons, USA

Course Syllabus of Construction/Project/Infrastructure Specialization

ENCV 801 601
Project Investment and Finance
3 Credits
Learning Outcomes:

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.

Competence in Curriculum: Problem Recognition and Solving
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

ENCV 801 602
Project Management
3 Credits
Learning Outcomes:

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.

Competence in Curriculum: Problem Recognition and Solving
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.

ENCV802601
Time and Cost Management
3 credits
Learning Outcomes:

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.

Competence in Curriculum: Problem Recognition and Solving, Technical Specialization
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

ENCV802602
Quality and Risk Management
3 Credits
Learning Outcomes:

1. Able to make synthesis (Identification, Evaluation, and strategic implementation) solution of issue regarding quality and risk management in construction project.

Competence in Curriculum: Problem Recognition and Solving, Technical Specialization
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

ENCV802603
Procurement Management, Contract & Claim Administration
3 Credits
Learning Outcomes:

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.

Competence in Curriculum: Problem Recognition and Solving, Technical Specialization
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

ENCV802604
Advanced Construction Methods & Equipment
3 credits
Learning Outcomes:

1. Able to make synthesis (identification, evaluation, and implementation strategy) solution of problems related to the method determination and construction equipment.
2. Able to develop methods and equipment in construction projects.

Competence in Curriculum: Problem Recognition and Solving, Technical Specialization
Syllabus:

Concept and definition of construction methods and examples of construction projects; Project life cycle and technology in construction; Construction projects implementation; Methods used for project implementation; Definition of project scope, Description of the project; In depth study of condition in the field of construction projects; Discussions regarding project layout condition; Determining the necessary resources; Explanations of technology for foundation construction; Determining the sequence of project activities; Explanations of technology for high-rise buildings construction; Project risk determination; Explanation of road construction technology; Determination of health and safety policy; Factors of incidents and loss prevention; Explanation of bridge construction technology; Evaluation of quality policy; Technology of tunnels and dams construction; Cost and budget determination; Resource consumption planning; Preparation of project reports.

Prerequisite:

Reference Book:

1. Construction Methods & Management (Nunnally) - Pearson Practice Hall
2. Clough, Richard H. 1986, Construction Contracting USA: John Wiley & Sons Inc
3. R.L Paurifoy, C J. Schexnayder, and A Shapira, Construction Planning, Equipment and Methods, McGraw - Hill
4. Halpin, Daniel W and Ronald - Woodhead, 1998, Construction Management, USA John Wiley & Sons Inc.
5. Barrie, D.S and Boyd Paulson, 1984 Professional Construction Management, New York: McGraw-Hill Book Company
6. Holroyd, T.M. Site Management for Engineers, Thomas Telford, London, 1999
7. Project Management Body of Knowledge, Project Management Institute – USA.
8. Project Management – Techniques in Planning and Controlling Construction Projects, Ahuja, H.N.
9. Manual of Practice, The Construction Specification Institute – USA.
10. Principles of Project Management – Negotiating & Contracting for Project Management, John R Adams.
11. Project Management for Engineering and Construction, Garold D. Oberlender

ENCV802605

Legal and Institutional Framework

3 Credits

Learning Outcomes:

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.

Competence in Curriculum: Problem Recognition and Solving

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

ENCV 803 601

Human Resource and Project Communication Management

3 Credits

Learning Outcomes:

1. Able to identify and analyze the process of human resource management and communication in construction projects.
2. Able to manage the organization and human resources required during the project

Competence in Curriculum: Technical Specialization

Syllabus:

HRM organization function; Scope and depth of HRM; HR planning; Develop Human Resource Plan; Project organization; Job Description, RAM / RACI, Job Analysis, Job value / Positional weight; Acquire project team; Procurement and placement of human resources; Develop project team; Process of improving competence; Manage project team; Project team performance assessment; Communication management, Process, Flow Document; Project Performance Report; Stakeholders Management; Measurement and evaluation of project performance; Calculating 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 System.
4. Armstrong, Michael (2008), Strategic Human Resources Management; A Guide to Action, 4th Edition, London: Kogan Page.

ENCV803602

Technology Management for Competitive Advantage

3 Credits

Learning Outcomes:

1. Able to explain the impact of competitive technologies in context of business, industry and economy, as well as cultural and organizations context in application.
2. Able to choose and compile competition strategy to increase competitiveness.
3. Able to innovate and creatively selecting and implementing technology in a process in order to meet VRIO (Valuable, Rare, inimitable and organized) criteria to enhance its competitiveness in the global competition.

Competence in Curriculum: Technical Specialization

Syllabus:

Technology in the context of economy, industry, business and company; Culture and organizational context; Competitive strategy; Technology, product and industry evolution; Intellectual property rights protection; Developing road map of application of technology management in business models.

Prerequisite:

Reference Book:

1. Gaynor, Handbook of Technology Management, McGraw Hill
2. Joshua S. Gans and Scott Stern 2003. “The product market and the market for “ideas”: commercialization strategies for technology entrepreneurs.” *Research Policy*
3. Saloner, Garth, Andrea Shepard, and Joel Podolny. 2001. *Strategic Management*. New York: John Wiley & Sons.
4. Christian N Madu, Management of New Technologies for Global Competitiveness, Jaico Publishing House
5. Barney J, Hesterley W.J, Pearson, 2012,Strategic Management and competitive advantage,
6. Burgelman & Maidique, Mc Graw Hill Irvin, 2003-Strategic Management of Technology and Innovation-
7. Nayaranan V.K., Prentice Hall, 2001Managing Technology and Innovation for Competitive Advantage-
8. Stuart Hart and Bernard Ramanantsoa Strategic Technology Management-Pierre Dussauge,
9. Khalil, Tarek M Management of Technology –
10. Davila, Toni, Epastien, Marc J, The Innovation Paradox, Berret-Kohler, 2014
11. Furr, Nathan, Dyre, Jeff, The Innovator’s Method, Harvard BusinessReview Press, 2014
12. Teece, D.J Dynamic Capability and Strategic Management, Oxford University Press, 2009

ENCV 803 603
Infrastructure and Regional Development
3 Credits
Learning Outcomes:

1. Able to identify and analyze infrastructure development in a region associated with the region's economy.
2. Able to explain the conception of the relations between planning and developing of infrastructure in a region and its relationship with the region's economy.

Competence in Curriculum: Technical Specialization
Syllabus: Introduction; Theory of regional development; Developing the concept of spatial transport and strategic area; Determining the area of regional influence; Urban and rural area development; Development and spatial planning of coastal areas; Future regional spatial planning; Developing economic corridor; Regional connectivity; Connectivity of ASEAN regional area; Financing regional development; Infrastructure in regional development; Infrastructure case study in regional Development.
Prerequisite:
Reference Book:

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 T ata 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.

ENCV 803 604
Infrastructure Asset Management
3 Credits
Learning Outcomes:

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.

Competence in Curriculum: Technical Specialization
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

ENCV 803 605
Management System of Health, Safety and Environment
3 SKS
Learning Outcomes:

1. Be able to identify and analyze the process of health management, occupational safety and environmental protection in construction projects.
2. Be able to implement MHSE in any construction projects in order to not damaging the environment as well as in efforts to create a working environment that is healthy, safe, and productive.

Competence in Curriculum: Technical Specialization, Sustainability
Syllabus: Basic principles and standards of HSE Management; Relevance of Work Productivity

6.3 MASTER PROGRAM IN MECHANICAL ENGINEERING

Program Specification

1	**Awarding Institution**		Universitas Indonesia
2	**Teaching Institution**		Universitas Indonesia
3	**Programme Title**		Master Program in Mechanical Engineering
4	**Class**		Regular
5	**Final Award**		Magister Teknik (M.T.)
6	**Accreditation / Recognition**		BAN-PT: A – accredited
7	**Language(s) of Instruction**		Bahasa Indonesia and English
8	**Study Scheme (Full Time / Part Time)**		Full Time
9	**Entry Requirements**		Bachelor Degree in Mechanical Engineering, Math and Physics; pass the entrance exam.
10	**Study Duration**		Designed for 2 years
	Type of Semester	Number of semester	Number of weeks /semester
	Regular	4	17
	Short (optional)	1	8
11	**Graduate Profiles:** Graduates who have the character of leadership and excellence in scholarship, research, expertise and professionalism in the field of Mechanical Engineering		
12	**List of Graduates Competences:** 1. Ability to develop a logical, critical, systematic, and creative thinking through scientific researches, design creation or art product in the field of science and technology, by also putting attention to humanities value related to his/her field of expertise; to formulate scientific concept and research result based on principles and scientific ethics in a form of thesis or other equivalent forms and is uploaded on the unversity's web page, as well as scientific article published by accredited international journal. 2. Ability to carry out an academic validation or in-depth study in the field of his/her expertise to solve problems in society or industry which is relevant for his/her knowledge and skill development 3. Ability to formulate ideas and scientific argument with responsibility and based on academic ethics, and to publish it through a media to the society 4. Ability to identify academic field which is his/her research object, and to position it in a research map via an interdisciplinary approach 5. Ability to take a decision in the context of problem solving of science and technology which puts attention to humanities values based on analytical study or experiment to a given information or data 6. Ability to manage, develop, and maintain working network with colleagues in wide research institutions and communities 7. Ability to self-improve his/her learning capacity 8. Ability to save/manage and subsequently find his/her research data for the purpose of guaranteeing originality and avoiding plagiarism 9. Ability to take responsibility toward society and to comply to professional ethics in solving engineering problems 10. Ability to carry out a life-long learning, including to get an access to knowledge of current issues		

MASTER PROGRAM

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As a Universitas Indonesia student, every graduate of Mechanical Engineering Undergraduate Program should have the following compenteces as follow:

1. Able to use information and communication technology;
2. Able to think critically, creatively, and innovatively and have intellectual curiosity to solve the individual and group problems;
3. Able to use verbal and writing communication in good bahasa Indonesia and English for academic or non-academic acitivity;
4. Has an integrity and able to respect others;
5. Able to identify entrepreneurship efforts which show innovation and autonomy based on ethics

In the 2016 Mechanical Engineering Graduate Program curriculum, there are 6 Specialization Programs that can be chosen by the students according to their academic ability dan interest, which are:

1. Energy Conversion
2. Bulding Utilities and Fire Safety
3. Design and Manufacture
4. Automation and Manufacture System
5. Vehicle Engineering and Heavy Equipment
6. Marine Resources and Technology

Specifically, besides the 10 points of Graduates Competences, the students of The Graduates Program will have the competences in accordance to their specialization.

1. Competence in the field of Energy Conversion: Ability to analyse, apply and design a mechanical system by utilizing the law and phenomenon from the cutting-edge technology related to the field of energy conversion and conservation.
2. Competence in the field of Building Utility System and Fire Safety: Ability to analyse, apply and design the building utility efficiently and the fire safety system based on performance for the office and industrial buildings.
3. Competence in the field of Design and Manufacturing: Ability to analyse, apply and desing a product, manfacture and assembly process by integrating the latest technology in the field of desing and manufacturing.
4. Competence in the field of Automation and Manufacturing System: Ability to analyse, apply and desingn a manufacturing system and automation that will be used for a development and product manufacturing process by utilizing the cutting-edge technology in the field of manufacturing and automation.
5. Competence in the field of Vehicle Engineering and Heavy Equipment: Ability to analyse and design a vehicle system and heavy equipment for several fields, such as: industrial, construction, minerals and energy.
6. Competence in the field of Maritime Resources and Technology: Ability to analyse and design a system and apply the maritime technology related to the utilization of sustainable maritime resources

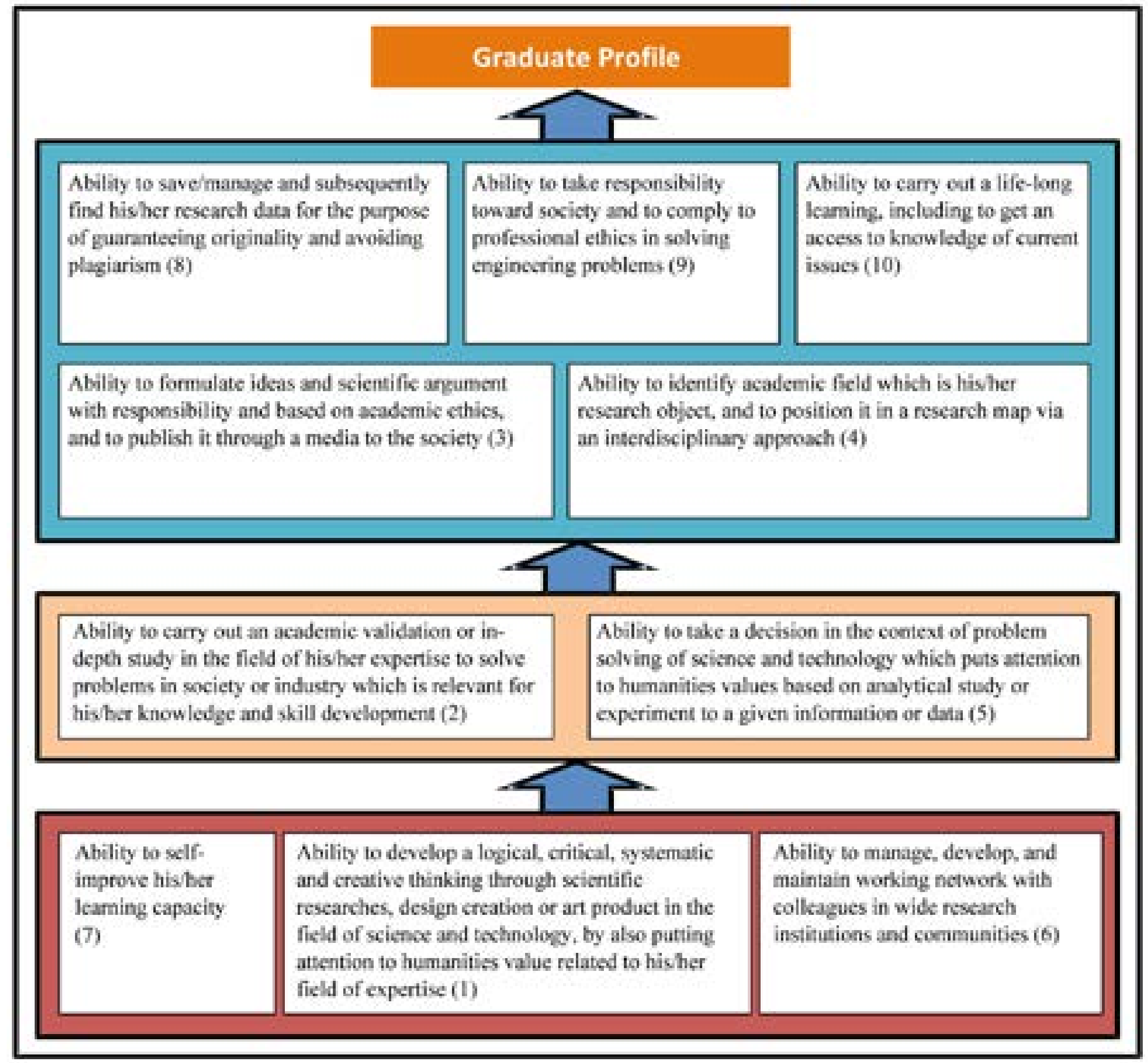
13 Classification of Subjects

No	Classification	Credit Hours (SKS)	Percentage
i	Core courses of study program	10	22,73 %
ii	Core courses of specialization	16	36,36 %
iii	Elective courses of specialization	8	18,18 %
iv	Scientific Publication, Thesis	10	22,73 %
	Total	44	100 %
14	**Total Credit Hours to Graduate**		44 SKS

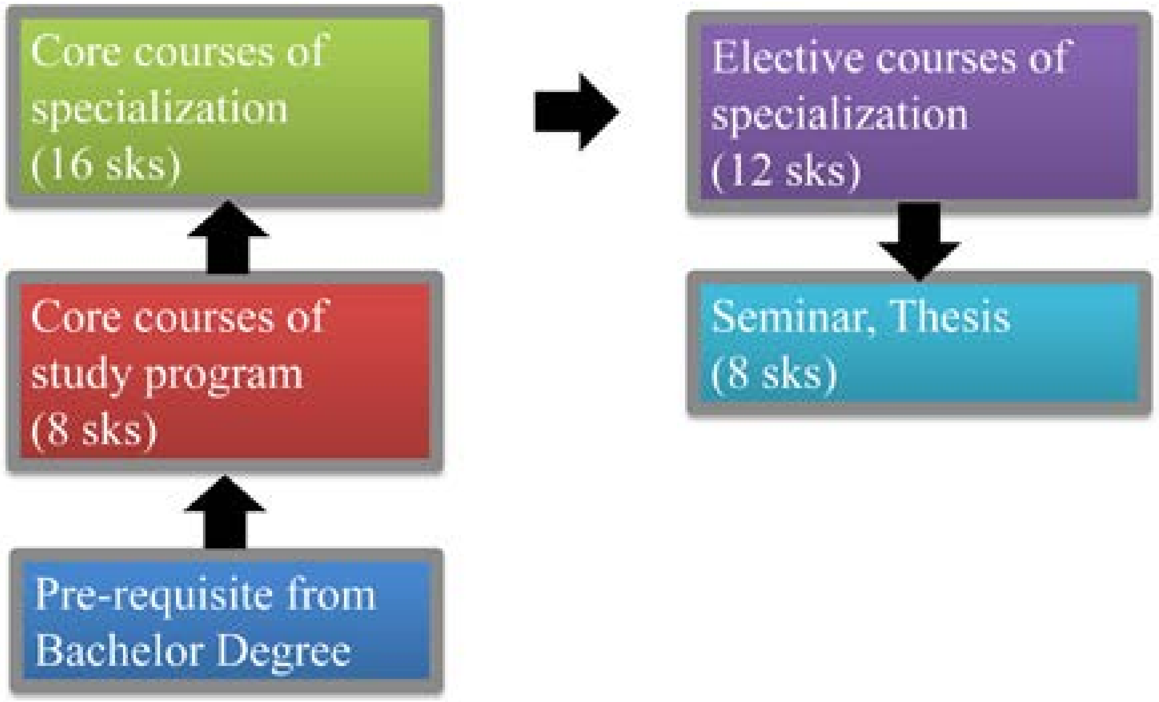
Career Prospects

Graduates of Mechanical Engineering has devoted itself in various fields, including automotive industry, oil and gas, heavy machinery, educational institutions, research institutions and other industries

Learning Outcomes Flow Diagram



Curriculum Structure

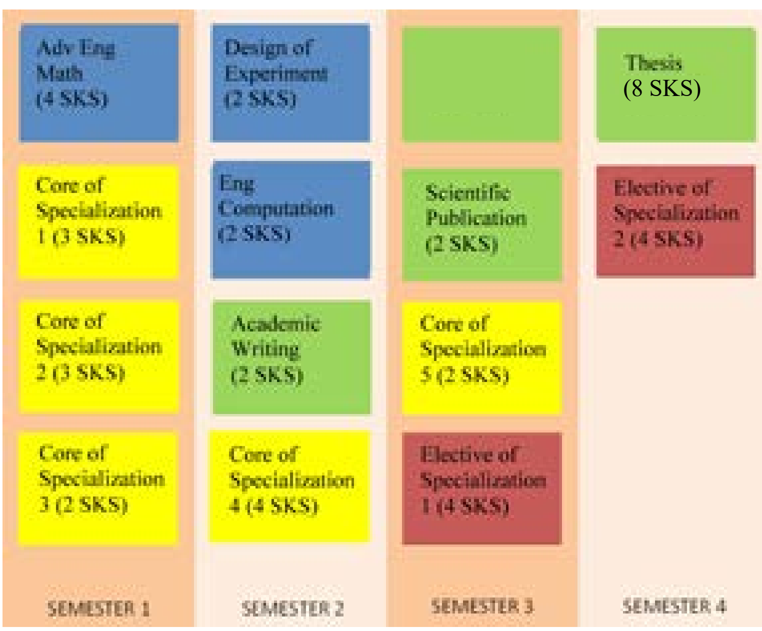


Flow Diagram of Subjects

Throughout the course of study, students of Magister Degree in Mechanical Engineering can opt and manage his/her subjects very flexibly, based on the credit of each subject. Given below are three different scenarios of flow diagram of subjects.

Scenario 1

Scenario 2



Scenario 3

CURRICULUM STRUCTURE OF MAGISTER PROGRAM OF MECHANICAL ENGINEERING

Code	SUBJECT	Credit
	1st SEMESTER	
ENME801001	Advanced Engineering Mathematics	4
	Specialization Compulsory	8
	Subtotal	12
	2nd SEMESTER	
ENME802002	Design of Experiment	2
ENME802004	Engineering Computation	2
ENME802003	Academic Writing	2
	Specialization Compulsory	4
	Subtotal	10
	3rd SEMESTER	
ENME800005	Scientific Publication	2
	Specialization Compulsory	4
	Specialization Electives	4
	Elective Course #1	4
	Subtotal	10
	4th SEMESTER	
ENME800008	Thesis	8
	Specialization Electives	4
	Subtotal	12
	Total	44

1. Major in Energy Conversion

Code	SUBJECT	Credit
	1st SEMESTER	
ENME801001	Advanced Engineering Mathematics	4
ENME801101	Advanced Thermodynamics	4
ENME801102	Advanced Fluid Dynamics & Heat Transfer	4
	Subtotal	12
	2nd SEMESTER	
ENME802002	Design of Experiment	2
ENME802003	Academic Writing	2
ENME802004	Engineering Computation	2
ENME802103	Optimization of Energy System	4
	Subtotal	10
	3rd SEMESTER	
ENME803104	Thermal Power Generation	4
ENME800005	Scientific Publication	2
	Specialization Electives #1	4

	Subtotal	10
	4th SEMESTER	
	Specialization Electives #2	4
ENME800008	Thesis	8
	Subtotal	12
	Total	44

List of Elective Courses in Energy Conversion Stream

Code	SUBJECT	Credit
	3rd SEMESTER	
ENME803105	Internal Combustion Engine	4
ENME803106	Flow Measurement and Visualization	4
ENME803107	CFD Application	4
ENME803196	Rocket and Jet Propulsion	4
ENME803125	Energy and Environment	4
ENME803124	Energy Audit	4
	4th SEMESTER	
ENME804109	Heat and Mass Transfer Engineering	4
ENME804110	Combustion Engineering	4
ENME804111	Aerodynamics Engineering	4
ENME804112	Turbo Machinery	4
ENME803108	Refrigeration Engineering	4

2. Major in Building Utilities and Fire Safety

Code	SUBJECT	Credit
	1st SEMESTER	
ENME801001	Advanced Engineering Mathematics	4
ENME801129	Thermofluid and Radiation	2
ENME801113	Ventilation & AC System	4
ENME801130	Indtroduction to Fire Dynamics	2
	Subtotal	12
	2nd SEMESTER	
ENME802002	Design of Experiment	2
ENME802003	Academic Writing	2
ENME802004	Engineering Computation	2
ENME802131	Fire Protection System	2
ENME802132	Building Mechanical Electrical System	2
	Subtotal	10
	3rd SEMESTER	
ENME803133	Design Assignm of Utility Sys for Building	2
ENME801121	Energy Management System	2
ENME800005	Scientific Publication	2

	Specialization Electives #1	4
	Subtotal	10
	4th SEMESTER	
	Specialization Electives #2	4
ENME800008	Thesis	8
	Subtotal	12
	Total	44

List of Elective Courses in Building Utilities and Fire Safety Stream

Code	SUBJECT	Credit
	3rd SEMESTER	
ENME803134	Enclosure Fire Dynamics Modelling	4
ENME803115	Clean Room	4
ENME803116	Plumbing and STP Systems	4
ENME803117	Building Environmental Assessment	4
ENME803135	Fire Fighting Strategy Engineering	4
ENME803136	Fire Safety Management in Building	4
KODE	4th SEMESTER	
ENME802103	Optimization of Energy System	4
ENME804118	Mechanical system for Building	4
ENME804119	Acoustics in Buildings	4
ENME804120	Building Utilities Management	4
ENME804137	Fire Investigation Engineering	4
ENME804138	Evaluation of Fire Protection System	4
ENME804139	Fire Protection in Process Industry	4

3. Major in Design and Manufacturing

Code	SUBJECT	Credit
	1st SEMESTER	
ENME801001	Advanced Engineering Mathematics	4
ENME801140	Materials and Manufacturing Processes	4
ENME801141	Product Design Methodology	4
	Subtotal	12
	2nd SEMESTER	
ENME802002	Design of Experiment	2
ENME802003	Academic Writing	2
ENME802004	Engineering Computation	2
ENME802142	Designing Manufacturing Technology	4
	Subtotal	10
	3rd SEMESTER	
ENME803143	Mechanical Failure	4
ENME800005	Scientific Publication	2
	Specialization Electives #1	4

	Subtotal	10
	4th SEMESTER	
	Specialization Electives #2	4
ENME800008	Thesis	8
	Subtotal	12
	Total	44

List of Elective Courses in Design and Manufacturing Stream

Code	SUBJECT	Credit
	3rd SEMESTER	
ENME803145	Composite Product Development	4
ENME803146	Finite Element and Multiphysics	4
ENME803147	Toy Production Design	4
ENME803161	Micro-machining	4
ENME803144	Dynamics of Mechanical System	4
ENME803147	Toy Production Design	4
	4th SEMESTER	
ENME804148	DESIGN FOR MANUFACTURE ASSEMBLY	4
ENME804149	Noise and Vibration	4
ENME804162	Laser Assisted Process	4

4. Major in Manufacturing System and Automation

Code	SUBJECT	Credit
	1st SEMESTER	
ENME801001	Advanced Engineering Mathematics	4
ENME801150	Management of Manufacturing IS	4
ENME801151	Manufacturing System and Processes	4
	Subtotal	12
	2nd SEMESTER	
ENME802002	Design of Experiment	2
ENME802003	Academic Writing	2
ENME802004	Engineering Computation	2
ENME802152	Automation and Robotics	4
	Subtotal	10
	3rd SEMESTER	
ENME803153	Machine Vision System	4
ENME800005	Scientific Publication	2
	Specialization Electives #1	4
	Subtotal	10
	4th SEMESTER	
	Specialization Electives #2	4
ENME800008	Thesis	8
	Subtotal	12

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	Total	44

List of Elective Courses in Manucfacuturing Technology and Automation Stream

Code	SUBJECT	Credit
	3rd SEMESTER	
ENME803154	Quality & Production Manag. System	4
ENME803174	Risk Management	4
	4th SEMESTER	
ENME804155	CAD/CAM	4
ENME804156	Manufacturing Performance Assesment	4

5. Major in Vehicle Engineering and Heavy Equipment

Code	SUBJECT	Credit
	1st SEMESTER	
ENME801001	Advanced Engineering Mathematics	4
ENME801163	Vehicle Engineering	4
ENME801164	Prime Mover & Drivetrain System	4
	Subtotal	12
	2nd SEMESTER	
ENME802002	Design of Experiment	2
ENME802003	Academic Writing	2
ENME802004	Engineering Computation	2
ENME802165	Vehicle Frame and Body Engineering	4
	Subtotal	10
	3rd SEMESTER	
ENME803166	Vehicle Control System	4
ENME800005	Scientific Publication	2
	Specialization Electives #1	4
	Subtotal	10
	4th SEMESTER	
	Specialization Electives #2	4
ENME800008	Thesis	8
	Subtotal	12
	Total	44

List of Elective Courses in Vehicle Engineering and Heavy Equipment Stream

Code	SUBJECT	Credit
	3rd SEMESTER	
ENME803167	Modern Vehicle Technology	4
ENME803195	Peralatan Pengeboran Minyak dan Gas	4

	4th SEMESTER	
ENME804168	Railway Vehicle Engineering	4
ENME804197	Crane Equipment and Machinery	4
ENME804198	Plane Stability and Control System	4

6. Major in Marine Resources and Technology

Code	SUBJECT	Credit
	1st SEMESTER	
ENME801001	Advanced Engineering Mathematics	4
ENME801179	Advanced Thermofluid	4
ENME801180	SMaritime Resources	4
	Subtotal	12
	2nd SEMESTER	
ENME802002	Design of Experiment	2
ENME802003	Academic Writing	2
ENME802004	Engineering Computation	2
ENME802181	Maritime Technology and Management	4
	Subtotal	10
KODE	3rd SEMESTER	
ENME803182	Ocean Energy	4
ENME800005	Scientific Publication	2
	Specialization Electives #1	4
	Subtotal	10
KODE	4th SEMESTER	
	Specialization Electives #2	4
ENME800008	Thesis	8
	Subtotal	12
	Total	44

List of elective courses in Marine Resources and Technology Study Program

Code	SUBJECT	Credit
	3rd SEMESTER	
ENME803183	Marine and Offshore Structure	4
ENME803184	Sea Transport and Port Management	4
ENME803185	Maritime Law and Regulation	4
	4th SEMESTER	
ENME804186	Special Ship	4
ENME804187	Ship Production Management	4
ENME802103	Optimization of Energy System	4
ENME804188	Management of Maritime Energy	4
ENME804189	Maritime Safety	4
ENME804190	Advanced Welding Engineering	4

COURSE DESCRIPTION

ENME800001
ADVANCED ENGINEERING MATHEMATICS (4 SKS)
Learning Objective(s):
Complete student's anylitical ability. Students understand and able to use the advances mathematical concepts in order to solve the engineering problems
Syllabus :
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): -
Text Book(s):
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

ENME800003
DESIGN OF EXPERIMENT (2 SKS)
Learning Objective(s):
This course provides knowledge on methods of planning, execution and reporting of the research in the field of engineering so that students are able to apply scientific principles in the preparation of the thesis in particular, as well as in a scientific publication from the research. Students should be able to manage an investigation that began from the planning stages, applying the correct procedure and constructs apparatus design, and apply instrumentation and measurement systems, to execute and perform the analysis and interpretation of data by the rules of statistics properly.
Syllabus:
Introduction: Introduction to Research Design, Problem Solving Approaches, Research Project Planning, Design and Application Measurement Systems: Elements of Functional Measurement Systems, Performance Measurement System Characteristics, Analysis of Accuracy (Uncertainty) Systems, Design and Construction of Apparatus Research, Planning Experiments, execution experiments: Construction of the apparatus, the apparatus Debugging, Datasheet and logbooks; Analysis and Interpretation of data; Communication Engineering: Principles of Communication Engineering, Report, Paper, and Research Articles.
Pre-requisite(s) : -
Text Book(s):
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

ENME802003
ACADEMIC WRITING (2 SKS)
Learning Objective(s):
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) : -

Text Book(s):

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.

ENME800002

ENGINEERING COMPUTATION (2 SKS)

Learning Objective(s):

The purpose of this course is that students know well and are able to apply the processes and methods (algorithms) calculations (numerical and analytic) of engineering in the real world of computing and computer-based parameters that affect the speed and accuracy of the calculation.

Syllabus :

The purpose of this course is that students know well and are able to apply the processes and methods (algorithms) calculations (numerical and analytic) of engineering in the real world of computing and computer-based parameters that affect the speed and accuracy of the calculation.

Pre-requisite(s): -

Text Book(s):

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

ENME800005

SCIENTIFIC PUBLICATION (2 SKS)

Learning Objective(s):

Student can develop logicial, critical, systematical and creative thinking using scientific research and/or creation of design in science and technology by consider and apply social values. And by using scientific concept and discussion, scientific way and ethics, the paper will be written and published in accredited scientific journal and accepted in international journal under supervision one or more supervisor.

Syllabus:

Pre-requisite(s): Academic Writing, Design of Experiment

Text Book(s):

1. Related papers to the current experiment

ENME800007

THESIS (8 SKS)

Learning Objective(s):

Student will study to apply the science and previous knowledge to conduct independent research under one or more supervisor(s). After completing this course, student should able to make research concept by applying related theories. Under supervision of supervisor, student

can design, integrate, implement and analyze concept and writing the research finding systematically and scientifically in thesis book. Student also should come to defend the design of experiment in front of board of examiner in thesis examination forum

Syllabus:

Pre-requisite(s): Passed 32 credit units

Text Book(s):

1. Panduan Teknik Penulisan Tugas Akhir Universitas Indonesia

ENME801101– ADVANCED THERMODYNAMICS (4 SKS)

Learning Objective(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'.

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): -

Text Book(s):

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

ENME801102 – ADVANCED FLUID DYNAMICS AND HEAT TRANSFER (4 SKS)

Learning Objective(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 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): -

Text Book(s):

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.

ENME802103 - ENERGY SYSTEM OPTIMIZATION (4 SKS)
Learning Objective(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.
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 Proper- ties; Big System Simulation under Steady Condition; Big Thermal System Simulation; Calculation of Variables in Optimum Conditions.
Pre-requisite(s): -
Text Book(s):
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.

ENME803104 – THERMAL POWER GENERATION (4 SKS)
Learning Objective(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.
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): -
Text Book(s):
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.

ENME803105 – INTERNAL COMBUSTION ENGINE (4 SKS)
Learning Objective(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.
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): -
Text Book(s):

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.

ENME803106 - APPLIED FLOW MEASUREMENT AND VISUALIZATION (4 SKS)
Learning Objective(s):
Applied flow diagnostic study measurement and visualization techniques which have wide ap- plication 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 ap- propriate 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 Assitested Method.
Pre-requisite(s): -
Text Book(s):
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

ENME803107 - CFD APPLICATIONS (4 SKS)
Learning Objective(s):
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; Mathemati- cal 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, Continu- ity 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): -
Text Book(s):
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.

ENME803108 - REFRIGERATION ENGINEERING (4 SKS)
Learning Objective(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 perfor- mance, 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): -
Text Book(s):

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.

ENME803124 – ENERGY AUDIT (4 SKS)
Learning Objective(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.
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): -
Text Book(s):

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.

ENME803125 – ENERGY AND ENVIROMENT (4 SKS)
Learning Objective(s)::
This course will provides an understanding of the impact of environmental damage caused by the processing and use of energy and the implementation of measures - preventive and remedial measures that are use in modern industrial processes.
Syllabus :
Ecological principles & energy flow, environment concerns of energy extraction, energy use & climate change, environmental and ethic concerns, International treaties & convention on environmental mitigation. Environmental technology and pollution prevention, planning and management of industrial processes in order to prevent potential damage to the environment, Process Safety, energy recovery from waste, sustainable development, combustion and gas explosions, alternative energy.
Pre-requisite(s): -

Text Book(s):

1. F.M. Vanek, L.D. Albright and L.T. Angenent. Energy Systems Engineering:Evaluation and Implementation, 2nd Edition. Mc. Graw Hill Companies, 2012.
2. Ristinen RA. Kaushaar JJ. Energy and the environment, 2nd edition, john willey& sons, 2006
3. Banerjee BP. Handbook of energy and environment in India, Oxford University Press, 2005, India
4. MC.Dass, fundamentals of ecology, Tata McGraw Hill, 1994
5. Kaushik ND. Kaushik K. Energy, Ecology & Environment, Capital Publishing, 2004
6. De AK. Environmental Chemistry, New Age International Publishers, 2005

ENME803196 – JET PROPULSION AND ROCKET (4 SKS)
Learning Objective(s):
Syllabus :
Text Book(s):

ENME804109 – HEAT AND MASS TRANSFER ENGINEERING (4 SKS)
Learning Objective(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.
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): -
Text Book(s):

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.

ENME804110 - COMBUSTION ENGINEERING (4 SKS)
Learning Objective(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.
Syllabus:
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 Chemistry, Basic Thermodynamics, Basic Fluid Mechanic, Heat and Mass Trasnfer.
Pre-requisite(s): -
Text Book(s):
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.

ENME804111 – AERODYNAMICS ENGINEERING (4 SKS)
Learning Objective(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.
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): -
Text Book(s):
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.

ENME804112 – TURBOMACHINERY (4 SKS)
Learning Objective(s)
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): -
Text Book(s):
1. Thermische Stroomung Machine by Traupel

MASTER PROGRAM

ENME801113 – VENTILATION AND AIR CONDITIONING SYSTEM (4 SKS)
Learning Objective(s) :
This course provide the understanding and basic competence in design the air conditioning system regarding a better air condition. The student will provided with knowledge about the environmentally friendly regrigerant.
Syllabus :
Basic of Air Conditioning: Air Cooled dan Water Cooled Chiller, Packaged Unit, Direct Expansion and Split Unit; Basic VAC Calculation : Design Condition, Load Estimating, Cooling Load; Sistem Ventilasi : Air Changes, Outdoor Air Requirement, Indoor Air Quality. Clean Space and Air Filter System in industry and hospotal; distribution system: Equal Friction Method and Static Regain, Duct and Piping Sizing; Air Conditioning System Components : Chiller, Cooling Tower, Fan, S and AHU; Control System in Building.
Pre-requisite(s): -
Text Book(s) :
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.

ENME801129 – THERMOFLUID AND RADIATION (2 SKS)
Learning Objective(s):
Students are able to understand and implement the knowledge of fluid mechanics and heat transfer convection and radiation to describe and analyze the phenomenon of fire and its effects on the environment.
Syllabus :
This course will discuss the knowledge of thermofluid, the phenomenon of heat transfer by convection and radiation, phenomena of thermofluid and radiation in various forms of combustion such as smoldering, pool fire, gasification, as well as the formation and the occurrence of radiation that turned to achieve ignition.
Pre-requisite(s): -
Text Book(s):
1. Drysdale, D., An Introduction to Fire Dynamics, John Wiley & Sons Ltd, 1985.
2. Munson, B.R., Fundamentals of Fluid Mechanics 4th Ed, John Wiley & Sons, Inc. 2000
3. Frank P Incropere, 1. David P De Witt, Fundamental heat and mass transfer, 5th Ed., John Wiley & Sons, 1996, New York
4. Holman JP, Heat Transfer, 9th, Mc Graw Hill, 2003.
5. Koestoer, RA, Perpindahan Kalor untuk Mahasiswa Teknik, Salemba Teknika, 2003.

ENME801130 – INTRODUCTION TO FIRE DYNAMICS (2 SKS)
Learning Objective(s):
Students understand the basic and important parameters in the process of the fire, the phenomenon of fire dynamics and fire hazards.
Syllabus :
The fundamental laws of aerothermochemistry such as combustion thermodynamics, fluid mechanics, heat transfer, combustion chemical reactions in fire dynamics calculations. Students can perform experimental activities in the lab to understand the dynamics of fire behavior, with the equipment available, such as the phenomenon of flame premixed and non-premixed, ignition, combustion of solid and liquid, forming plumes and smoke production.
Pre-requisite(s): -
Text Book(s):
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. Kuo., K., Principles of Combustion, John Wiley & Sons Ltd, 1986.
5. Turn, S.R., An Introduction to Combustion 2nd Edition, McGraw-Hill, Inc. 2000.

ENME802131– FIRE PROTECTION SYSTEM (2 SKS)
Learning Objective(s):
Students are able to understand the fire protection system both passive and active.
Syllabus :
Compartmentalization of fires, Strategy of passive fire protection, natural ventilation systems for controlling smoke and heat from fire, fire resistant material and installation, integration of automatic fire protection systems for passive fire protection strategies, the design of passive fire protection systems,fire modeling for the design of passive protection system. Physical and chemical phenomena that are relevant to a wide range of hardware and software of a fire protection system such as automatic sprinkler, gaseous agent, foam and powder chemical systems. Installation of fire protection systems according to prevailing standards. Refractory materials and installation.
Pre-requisite(s): -
Text Book(s):
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

ENME804118 – BUILDING MECHANICAL AND ELECTRICAL SYSTEM (4 SKS)
Learning Objective(s):
The course's objective is to deliver knowledge, skills and understanding of the mechanical and electrical systems in a modern building that has been increasing in its requirements in terms of sophistication, efficiency, and low energy use.
Syllabus:
General Building Mechanical System, Plumbing System: SNI, Calculation, Waste Water Management, Building Energy System; Building Automation System; Lift and Escalator: Types, Round Trip Time, Handling Capacity, Waiting Time, Installation and Control System; Escalator Types, Application and Installation, Building Automation System,
Pre-requisite(s): -
Text Book(s):
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

ENME801121 – ENERGY MANAGEMENT SYSTEM (4 SKS)
Learning Objective(s):
Students are able to understand the concept, analysis and strategy of continuous improvement of energy performance by implementing effective energy management practices and energy processes in accordance with the standards and rules of both local and international as well as the use of associated technical equipment.
Syllabus :
Introduction, Energy Policy, Energy Plan, Implementation and operation of energy management systems, Energy Management Organizational Preparation, planning, implementation and evaluation of Energy Management, Energy Management Review, software on an energy management system, case studies

Pre-requisite(s): -
Text Book(s):
1. Energy management handbook / by Wayne C. Turner & Steve Doty ©2007 by The Fairmont Press, Inc
2. Guide to energy management by Barney L. Capehart, Wayne C. Turner, William J. Kennedy--Fifth Edition--International Version ©2008 by The Fairmont Press.
3. Effective implementation of an ISO 50001 energy management system (EnMS) / Marvin T. Howell.American Society for Quality, Quality Press, Milwaukee 53203 © 2014

ENME803133 – ASSIGNMENT OF BUILDING UTILITY SYSTEM DESIGN (4 SKS)
Learning Objective(s):
Students are able to use and apply the concept of utility system design of the building that includes a ventilation system and HVAC, plumbing, fire protection, and sewage treatment.
Syllabus :
The course consists of the task of designing a system utility story buildings.
Pre-requisite(s): -
Text Book(s):
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

ENME803134 – ENCLOSURE FIRE DYNAMICS AND MODELLING (4 SKS)
Learning Objective(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.
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): -
Text Book(s):
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.

ENME803115 – CLEAN ROOM (4 SKS)
Learning Objective(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.
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): -
Text Book(s):
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.

ENME803116 - PLUMBING AND WASTE WATER TREATMENT SYSTEM (4 SKS)
Learning Objective(s):
This course will study the specialization expertise and understanding of the system plumbing systems found on modern buildings which are increasing demands in terms of sophistication, efficiency, and use of more energy-efficient.
Syllabus :
Plumbing system in general, the calculation of water needs and hot water, water tanks, plumbing equipment unit, pumps, water hammer application, wastewater treatment systems. Will be given an understanding of the plumbing system of clean water for many multi-storey buildings and sewerage system and the filth and the effects of the foam pressure.
Pre-requisite(s): -
Text Book(s):
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

ENME803117 - BUILDING ENVIRONMENT ASSESSMENT (4 SKS)
Learning Objective(s):
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): -
Text Book(s):
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

ENME803135 – FIRE FIGHTING ENGINEERING AND STRATEGY (4 SKS)
Learning Objective(s):
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): -
Text Book(s):
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

ENME803136 – FIRE SAFETY MANAGEMENT IN BUILDING (4 SKS)
Learning Objective(s):
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): -
Text Book(s):
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

ENME804118 – MECHANICAL SYSTEM FOR BUILDING (4 SKS)
Learning Objective(s):
These courses provide students a basic understanding and competency building mechanical system design that includes a ventilation system and HVAC, plumbing, fire protection, and sewage treatment.
Syllabus :
The course consists of the task of designing a buildings utility system.
Pre-requisite(s): -
Text Book(s):
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

ENME804119 – ACOUSTIC (4 SKS)
Learning Objective(s):
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): -
Text Book(s):
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).

ENME804120 – MAINTENANCE MANAGEMENT OF BUILDING UTILITY (4 SKS)
Learning Objective(s):
After following this course, students will understand the strategic role of maintenance of buildings based on the need for maintenance management of assets built that includes a needs assessment, planning and prioritizing, budgeting and adequate information systems.
Syllabus :
Introduction, Scoping of Maintenance Function and Demand in Buildings, Essentials of Built Assets Maintenance Management, Assignment: Contemporary Issues in Asset Maintenance Management, Seminars/workshops
Pre-requisite(s): -
Text Book(s):
1. Armstrong, J. & Saville, A. (2005). Managing your building services, The Chartered Institution ofBuilding Services Engineers, London.
2. Harris, J. & Hastings, P. (2004). Business-focussed maintenance, BSRIA Publications.
3. Canter, B. & Swallow P. (1996). Building Maintenance Management, Blackwell Science. (ISBN: 0-632-03419-X)
4. Wood, B. (2003). Building Care. Blackwell Publishing. UK. (ISBN 0-632-06049-2)
5. Wordsworth, P. (2001). Lee's Building Maintenance Management, 4th Ed., Blackwell Science, UK.(ISBN 0-632-05362-3)
6. Building Services Handbook, Sixth edition, Fred Hall and Roger Greeno, Butterworth-Heinemann, 2011
7. ASHRAE Guideline 0-2005, The Commissioning Process

ENME804137 – FIRE INVESTIGATION ENGINEERING (4 SKS)
Learning Objective(s):
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): -
Text Book(s):
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

ENME804138 – EVALUATION AND MAINTENANCE OF FIRE PROTECTION SYSTEM (4 SKS)
Learning Objective(s):

Students can evaluate the performance of the fire protection system and to know and be able to plan maintenance of fire protection systems.
Syllabus :
This course will provide engineering evaluation of the performance of fire protection systems are used in various types of buildings and engineering preparation of a management plan for decision-making. Fire protection systems will be elaborated into elements that can be evaluated quantitatively using various types of fire studies.
Pre-requisite(s):-
Text Book(s):
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

ENME804139 – FIRE PROTECTION IN PROCESS INDUSTRY (4 SKS)
Learning Objective(s):
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): -
Text Book(s):
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

ENME801140 – MATERIAL AND MANUFACTURING PROCESSES (4 SKS)
Learning Objective(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.
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): -
Text Book(s):
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

ENME801141 – PRODUCT DESIGN AND DEVELOPMENT METHODOLOGY (4 SKS)
Learning Objective(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.

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): -

Text Book(s):

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

ENME802142 – DESIGNING AND MANUFACTURING TECHNOLOGY INTEGRATION (4 SKS)

Learning Objective(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.

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): -

Text Book(s):

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.

ENME803143 – MECHANICAL FAILURE (4 SKS)

Learning Objective(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.

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): -

Text Book(s):

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

ENME803144 – DYNAMICS OF MECHANICAL SYSTEM (4 SKS)

Learning Objective(s):

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): -

Text Book(s):

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

ENME803145 - COMPOSITE PRODUCT DEVELOPMENT (4 SKS)

Learning Objective(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.

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): -

Text Book(s):

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

ENME803146 – FINITE ELEMENT AND MULTIPHYSICS (4 SKS)

Learning Objective(s):

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): -

Text Book(s):

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

ENME803147 - TOY PRODUCTION DESIGN (4 SKS)

Learning Objective(s):

Understanding the basics and design development of educational products in the industry props, product education, and game props.

Syllabus:

Brainstorming and express the ideas and opinions, Innovation and Development Themes, Basics of Toy Product Design, Basic Design Engineering and Mechanical, Basic Theory Make Sketch, Process Modeling Sketch Image, Design Aesthetics, Theory of Manufacturing and Selection of Materials for Viewer tool Games, Basic Theory Creation prototype, Portfolio Design, Presentation and Pitching Idea.

Pre-requisite(s): -

Text Book(s):

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.

ENME803161 – MICROFABRICATION AND PRECISION MANUFACTURING (4 SKS)

Learning Objective(s):

In this course provides expertise of micro manufacturing process widely used in the making 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): Basic mechanical design, Mechatronics, Design assignment, : Metrology and Measurement, Engineering Materials, Manufacturing Process and Materials Selection

Pre-requisite(s): -

Text Book(s):

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

ENME804148 - DESIGN FOR MANUFACTURE AND ASSEMBLY (4 SKS)

Learning Objective(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.

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): -

Text Book(s):

Boothroyd, Product Design for Manufacture and Assembly 3rd Ed, CRC Press, 2010

ENME804149 – NOISE AND VIBRATION (4 SKS)

Learning Objective(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

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): -

Text Book(s) :

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

ENME804162 – LASER ASSISTED PROCESS (4 SKS)

Learning Objective(s):
Students are expected to understand knowledges related to fabrication process assisted by laser, and its direct application
Mahasiswa dapat memahami ilmu yang terkait dengan proses fabrikasi yang dibantu dengan teknologi laser, dan aplikasi serta penerapan langsung dari proses fabrikasi yang dibantu oleh teknologi laser.
Syllabus :
Dasar – Dasar Teknologi Manufaktur berbasis Laser; Proses Pembentukan dibantu Laser; proses *joining* dengan dibantu teknologi laser; *Laser Assisted Surface Engineering;*Jenis-Jenis Laser, Penerapan Teknologi Laser, Dasar- Dasar interaksi laser dengan material dan Klasifikasi Proses Material dengan Teknologi Laser.
Pre-requisite(s): -
Text Book(s):
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

ENME801150 – MANUFACTURING INFORMATION SYSTEM MANAGEMENT (4 SKS)
Learning Objective(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.
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): -
Text Book(s):
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.

ENME801151– MANUFACTURING SYSTEM AND PROCESSES (4 SKS)
Learning Objective(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 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): -

Text Book(s):
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

ENME802152 - AUTOMATION AND ROBOTICS (4 SKS)
Learning Objective(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.
Syllabus:
Automation System; Classification Type Manufacturing Automation machinery; Actuator; Sensor System; PLC Control System in the Manufacturing Automation machinery; Robot- cs: 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): -
Text Book(s):
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.

ENME803153 - MACHINE VISION SYSTEM (4 SKS)
Learning Objective(s):
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): -
Text Book(s):
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.

ENME803154 - QUALITY AND PRODUCTION MANAGEMENT SYSTEM (4 SKS)
Learning Objective(s):
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): -
Text Book(s):
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

ENME803174 – RISK MANAGEMENT (4 SKS)
Learning Objective(s):
Students can explain and apply risk management in a risk assessment.
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 system, Operational Risk and its Basel II requirements.
Pre-requisite(s): -
Text Book(s):
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

ENME804155 - CAD/CAM (4 SKS)
Learning Objective(s):
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): -
Text Book(s):
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

ENME804156 - MANUFACTURING PERFORMANCE ASSESMENT (4 SKS)
Learning Objective(s):
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): -
Text Book(s):
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"

ENME801163 – VEHICLE ENGINEERING AND HEAVY DUTY EQUIPMENT (4 SKS)
Learning Objective(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.
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): -
Text Book(s):
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

ENME801164 – PRIME MOVER AND POWERTRAIN SYSTEM (4 SKS)
Learning Objective(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.
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): -
Text Book(s):

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

ENME802165 – VEHICLE FRAME AND BODY ENGINEERING (4 SKS)
Learning Objective(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

Syllabus :
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): -
Text Book(s):

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.

ENME803166 – VEHICLE CONTROL SYSTEM (4 SKS)
Learning Objective(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

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): -
Text Book(s):

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.

ENME803167 – MODERN VEHICLE TECHNOLOGY (4 SKS)
Learning Objective(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.

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): -

Text Book(s):

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.

ENME803195 – OIL AND GAS DRILLING EQUIPMENT (4 SKS)

Learning Objective(s):

Provides 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.

Syllabus:

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): -

Text Book(s):

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

ENME804168 – RAILWAY VEHICLE ENGINEERING (4 SKS)

Learning Objective(s):

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): -

Text Book(s):

1. Simon Iwnicki, handbook of railway vehicle dynamics, CRC Press, Taylor & Francis Group, 2006.

ENME804197 – MATERIAL HANDLING EQUIPMENT (4 SKS)

Learning Objective(s):

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): -

Text Book(s):

1. ASME. Handbook of Materials Handling.
2. Mc.Guiness. Mechanical and Electrical Equiment for Building.

ENME804198 – AIRCRAFT STABILITY AND CONTROL (4 SKS)

Learning Objective(s):

Provides the students with the knowledge and ability in analyzing the aircraft (A/C) stability and control.

Syllabus:

Systems of Aircraft Axes and Notation, Aircraft Static Equilibrium and Trim, The Equations of Aircraft Motion, Aircraft Longitudinal Dynamics, Aircraft Lateral–Directional Dynamics, Aircraft Maneuverability, Aircraft Stability, Aircraft Flying and Handling Qualities, Aircraft Stability

Augmentation, Aircraft Aerodynamic Modelling, Aircraft Aerodynamic Stability and Control Derivatives
Pre-requisite(s) -
Text Book(s) :
1. Cook, Michael V., Flight Dynamics Principles, Elsevier Aerospace Engineering Series, 2007.
2. Russell, J.B., Performance and Stability of Aircraft, Butterworth Heinemann, 2003.
3. Von Mises, Richard, Theory of Flight, Dover Books on Aeronautical Engineering, 1959

ENME801179 – ADVANCED THERMOFLUIDS (4 SKS)
Learning Objective(s):
Students are expected to understand the concepts of mass, momentum, heat, work, energy, and entrophy in the mechanics of thermofluid. Understanding the basic principle of hydrostatics, flow measurement, identification of tehrmofluids system or controlled volume and flow from mass, momentum, heat, and work which are related to the given problems. Understanding of lift force and drag force. Using the 1st and 2nd Laws of Thermodynamics in the thermofluids system.
Syllabus :
Introduction to thermoflids, hydrostatic, control volume approach, Bernoulli equation, streamlined curves, the basic concepts of thermodynamics, the relationship properties and ideal gases, application of the fist and
second law of thermodynamics, temperature, entropy, entropy of use, fuel, control volume analysis, steady flow, gas turbines and jet engines.
Pre-requisite(s) -
Text Book(s):
1. Cengel, Y.A. & Boles, M.A. Thermodynamics: An Engineering Approach
2. Homsy, G.M.(Ed.) Mechanics of Fluids
3. Moran, M.J. & Shapiro, H.N. Fundamentals of Engineering Thermodynamics
4. Nakayama, Y.; & Boucher, R.F. Introduction to Fluid Mechanics
5. Rogers, G.F.C. & Mayhew, Y.R. Engineering Thermodynamics
6. Samimy, M., Et Al. A Gallery of Fluid Motion
7. Sonntag, R.E., Borgnakke, C., & Van Wylen, G.J. Fundamentals of Thermodynamics
8. Van Dyke, M. An Album of Fluid Motion

ENME801180 – MARITIME RESOURCES AND TECHNOLOGIES (4 SKS)
Learning Objective(s):
This course provides an understanding of maritime resources and opportunities, as well as risks related to the exploited potentials. Students will learn knowledges of formation, exploration and production of maritime resources: not only oil and gas, but also other minerals, and ocean flora and fauna, including its impact on environmental sustainability.
Syllabus :
Oil and gas from the ocean, seabed mining, energy from the melting of ice, ocean energy, ocean flora and fauna, marine environmental sustainability.
Pre-requisite(s): -
Text Book(s):
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

ENME802181 – MARITIME ENGINEERING AND MANAGEMENT (4 SKS)
Learning Objective(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.
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): -
Text Book(s):
1. International Energy Authority Renewable Energy Technology Deployment (IEA-RETD),
2. Offshore Renewable Energy: Accelerating the Deployment of Offshore Wind, Tidal, and Wave Technologies., IEA-RETD 2012.
3. Chakrabarti, Handbook of Offshore Engineering, Elsevier. 2007

ENME803182 – OCEAN ENERGY (4 SKS)
Learning Objective(s):
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 : -
Text Book(s):
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.

ENME803183 - MARINE AND OFFSHORE STRUCTURE (4 sks)
Course Objective :
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

ENME803184 - SEA TRANSPORT AND PORT MANAGEMENT (4 sks)
Course Objective :
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

ENME803185 - MARITIME LAW AND REGULATION (4 sks)
Course Objective :
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

ENME804186 - SPECIAL SHIP PROJECT (4 sks)
Course Objective :
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.

ENME804187 - SHIP PRODUCTION MANAGEMENT (4 sks)
Course Objective :
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

ENME804188 – MARITIME ENERGY MANAGEMENT (4 SKS)
Learning Objective(s) :
This course provides an understanding about energy optimization analysis with minimum fuel consumption. Additionally, it also provides optimization analysis with minimum initial energy
Syllabus :
Principle and regulation of maritime energy, planning and operation of an efficient ship, energy management for off-shore structure, energy management for port, renewable energy, huma resources aspect of energy management.
Pre-requisite(s) : -
Text Book(s) :

1. Hongyi Lai, “Asian Energy Security: The Maritime Dimension”, Palgrave MacMillan, 2009
2. Steve Doty, Wayne C. Turner, “Energy Management Handbook 8th Ed.”, Fairmont Press, 2012
3. Petrecca, Giovann, “Energy Conversion and Management: Principles and Applications,” Springer, 2014

ENME804189 - MARITIME SAFETY (4 SKS)
Learning Objective(s) :
Provides knowledge and understanding related to the safety via regulations, management, and development of any forms of maritime transportation technology.
Syllabus :
SOLAS: Provisi Umum, konstruksi, alat keselamatan, radio komunikasi, navigasi keselamatan, pengangkutan barang, manajemen untuk keselamatan operasi kapal, MARPOL Annnex I-V peraturan untuk pencegahan polusi, keamanan maritim; ancaman perdangangan maritim, anca-

man terhadap pengapalan, evolusi keamanan maritim, implementasi ISPS Code, perencanaan keamanan.

Pre-requisite(s): -

Text Book(s):

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

ENME804190 - ADVANCED WELDING ENGINEERING (4 SKS)

Learning Objective(s):

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): -

Text Book(s):

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.

MASTER PROGRAM IN MECHANICAL ENGINEERING – FAST TRACK PROGRAM

For capable students who wish to continue their undergraduate study to Master Program in Mechanical Engineering via the Fast Track program, a credit transfer is allowed up to 22 sks. From the 22 sks, it is broken down into: 14 sks from the core subjects and another 8 sks from the elective subjects.

Transferrable core subjects and elective subjects are those admitted and are listed as options in the study program of Master in Mechanical Engineering.

Listed below are the requirements for students undertaking the Fast Track Program:

1. He/she must declare his/her intention in undertaking the Fast Track Program by writing an application letter to the head of the Department of Mechanical Engineering by also attaching a study plan in the form of subjects planning in the 6th-8th Semester (during the undergraduate degree) and in the 1st-4th Semester (during the Master Program) based on his/her specialization. This letter must be submitted by the end of the 5th Semester of his/her undergraduate degree course in Mechanical Engineering or Naval Architecture and Marine Engineering.
2. He/she must have an excellent academic performance, shown by the cumulative GPA (Grade Point Average, Bahasa Indonesia: IPK) of at least 3.2 in the 5th Semester and have passed all basic subjects.
3. He/she must have a guarantor and or a confirmed scholarship scheme to finish his/her undergraduate degree and master degree with the Fast Track Program.
4. He/she must declare his/her intention of undertaking the academic program under the Fast Track scheme in full-time.
5. If his/her application is accepted by the head of the Department/study program, then he/she must discuss with his/her academic advisor to finalize the study plan in the undergraduate degree and master degree program

The student of undergraduate degree program who have been accepted to enroll in the Fast Track program by the ehad of the Department needs to adjust his/her plan of taking which subjects in the 7th and 8th semester, especially by considering the available core and elective subjects available in the Master Degree Program according to his/her specialization.

6.4 MASTER PROGRAM IN ELECTRICAL ENGINEERING

Program Specification

1	**Awarding Institution**		Universitas Indonesia
2	**Teaching Institution**		Universitas Indonesia
3	**Programme Title**		Master Program in Electrical Engineering
4	**Class**		Regular
5	**Final Award**		Magister Teknik (M.T.)
6	**Accreditation / Recognition**		BAN-PT: A – accredited
7	**Language(s) of Instruction**		Bahasa Indonesia
8	**Study Scheme (Full Time / Part Time)**		Full Time
9	**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
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:** Magister of engineering who is able to formulate solution to complex problems in the field of electrical engineering trough advancement technology based research using inter and multydicipline approach in accordance with professional ethics.		

12 Expected learning outcomes:

General outcomes:
1. Able to model electrical engineering system into mathematical equations
2. Able to formulate the problem solving in electrical engineering with the proper research methods
3. Able to produce innovative independent scientific work
4. Able to apply concepts of professional management in the field of electrical engineering

Majoring in Electronics and Photonics:
- Able to design advanced electronics and photonics devices
- Able to design photonics system
- Able to study state of the art of technology in the field of electronics and photonics.

Majoring in Telecommunication and Radar Engineering
- Able to evaluate the performance of system and telecommunication network
- Able to design communication system and radar system
- Able to design communication system and radar system equipments
- Able to recommend the latest technology in the field of telecommunications and radar

Majoring in Control Engineering
- Able to evaluate control system performance
- Able to recommend the latest control methode based on the system need
- Able to desing the latest control in the real systems
- Able to study the latest research in fielf of control engineering

Majoring in Electrical Power Engineering and Energy:
- Able to specify technical and non-technical aspects in electric power industrial utilization
- Able to recommend strategy to improve eficiency, quality, and power quality in electrical engineering system
- Able to combine new and renewable generator to electrical network system
- Able to evaluate strategy and risk mitigation in the development of electric power system who are reliable, secure, enviromentally friendly

12 Majoring in Computer Engineering and Network:
- Able to design advanced information network
- Able to design advanced computer system
- Able to develop the latest technology based system in the field of information technology and multimedia

Majoring in Information Network Security:
- Able to design physical infrastructure in a comprehensive manner that meets high security rules
- Able to analyse information security management in new technological concept for national indonesia development
- Able to evaluate the information network security based on the rule of technology, legislation, and regulations that apply

Majoring in Telecommunication Management:
- Able to evaluate the technical and non-technical aspects of a telecommunication system
- Able to recommend strategies and technology for the improvement of the service quality system
- Able to develop insight of technology which oriented to national interests and indonesia development
- Able to evaluate strategic and regulative policies that are applied to the telecommunication system

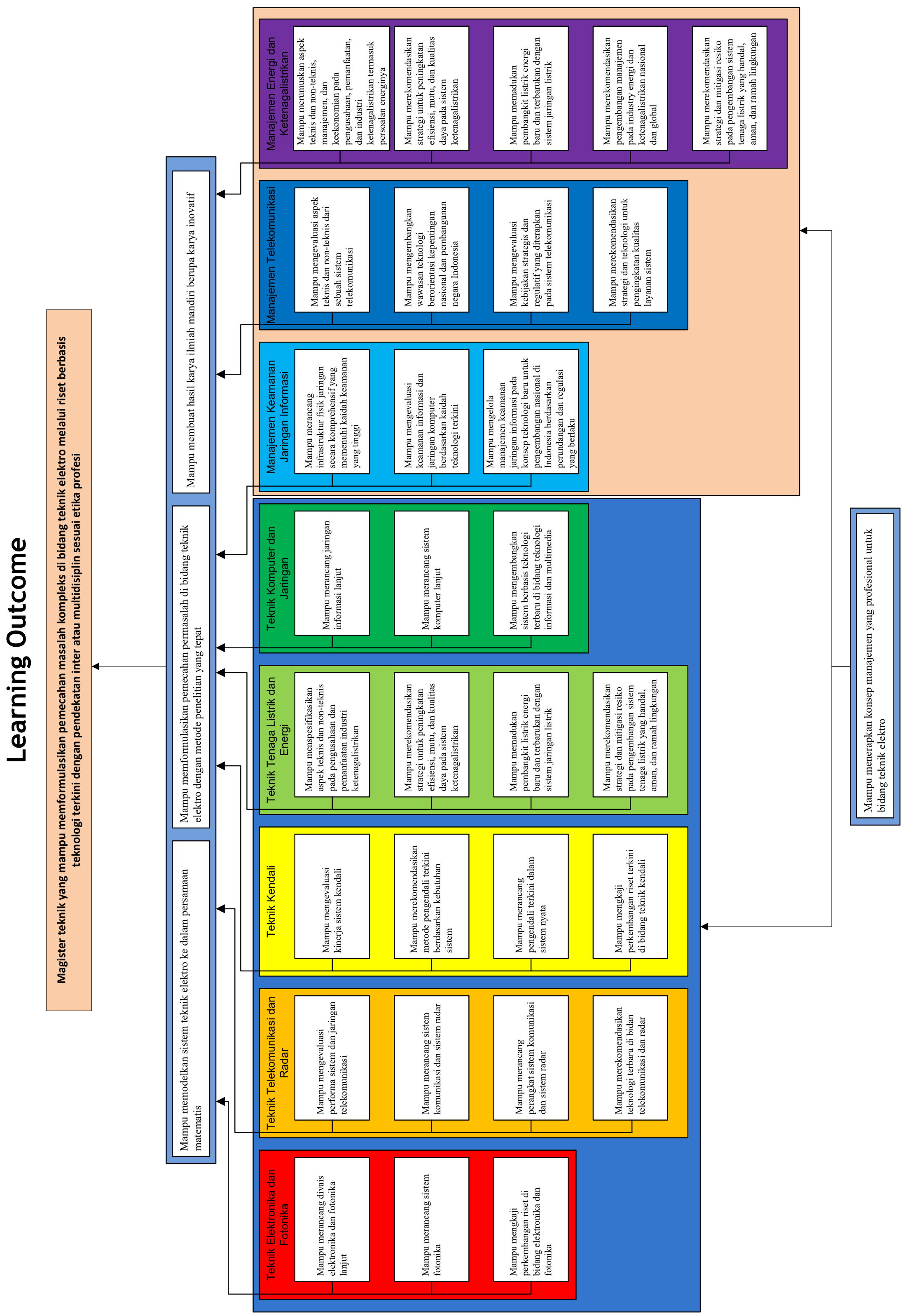
Majoring in Electrical Power Management and Energy:
- Able to formulate the technical and non-technical aspects, management, and business development and utilization on electrical power industrial economics including energy issues
- Able to recommend strategies for increased efficiency, quality, and the quality of the electrical power system
- Able to integrate new energy power generation and renewable electric network system
- Able to recommend risk mitigation strategies and on the development of electric power system which are reliable, secure, and environmentally friendly

13	**Classification of Subjects**		
No	Classification	Credit Hours (SKS)	Percentage
i	Core Subjects	19	45.23%
ii	Majoring Courses	23	54.77%
	Total		100 %
14	**Total Credit Hours to Graduate**		42 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 were even employed before the graduation.
Some occupation or job titles that are suitable for this program are electrical engineer, process engineer, control engineer, instrumentation engineer, program manager, project manager, technical manager and professional lecturers.

MASTER PROGRAM



FLEW DIAGRAM OF SUBJECTS

Diagram Alir Mata Kuliah Peminatan Teknik Elektronika dan Fotonika

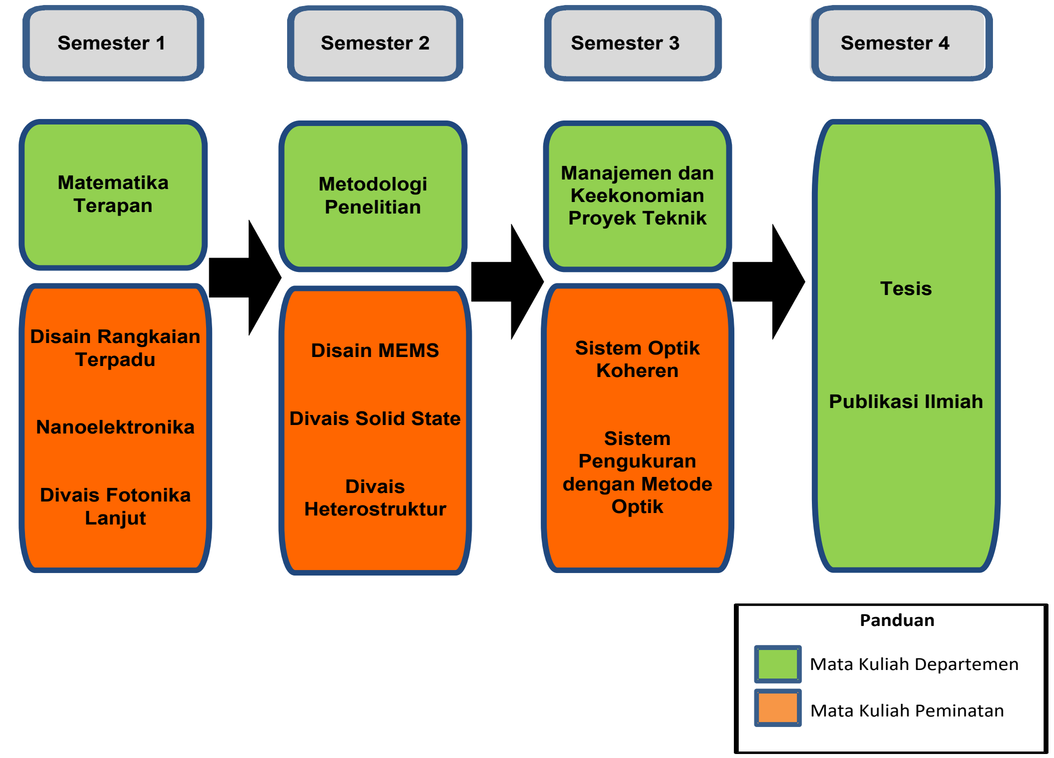


Diagram Alir Mata Kuliah Peminatan Teknik Telekomunikasi dan Radar

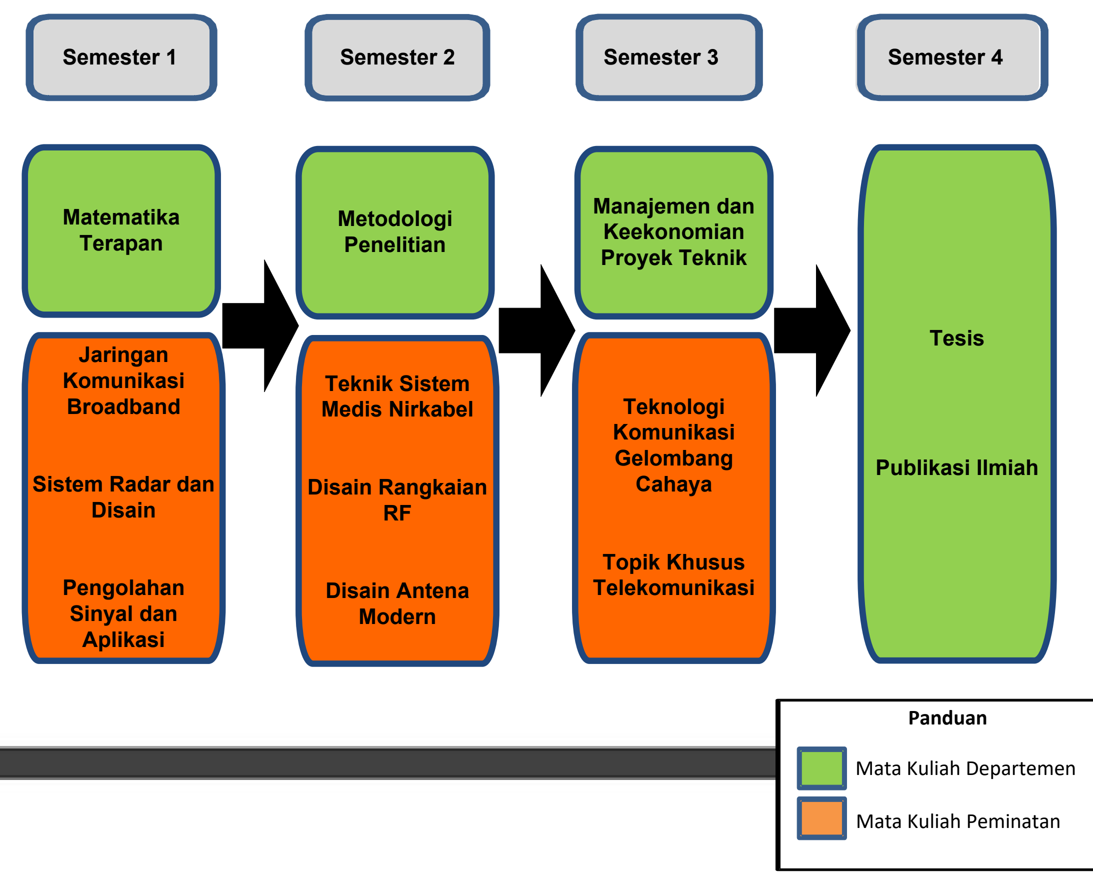


Diagram Alir Mata Kuliah Peminatan Teknik Kendali

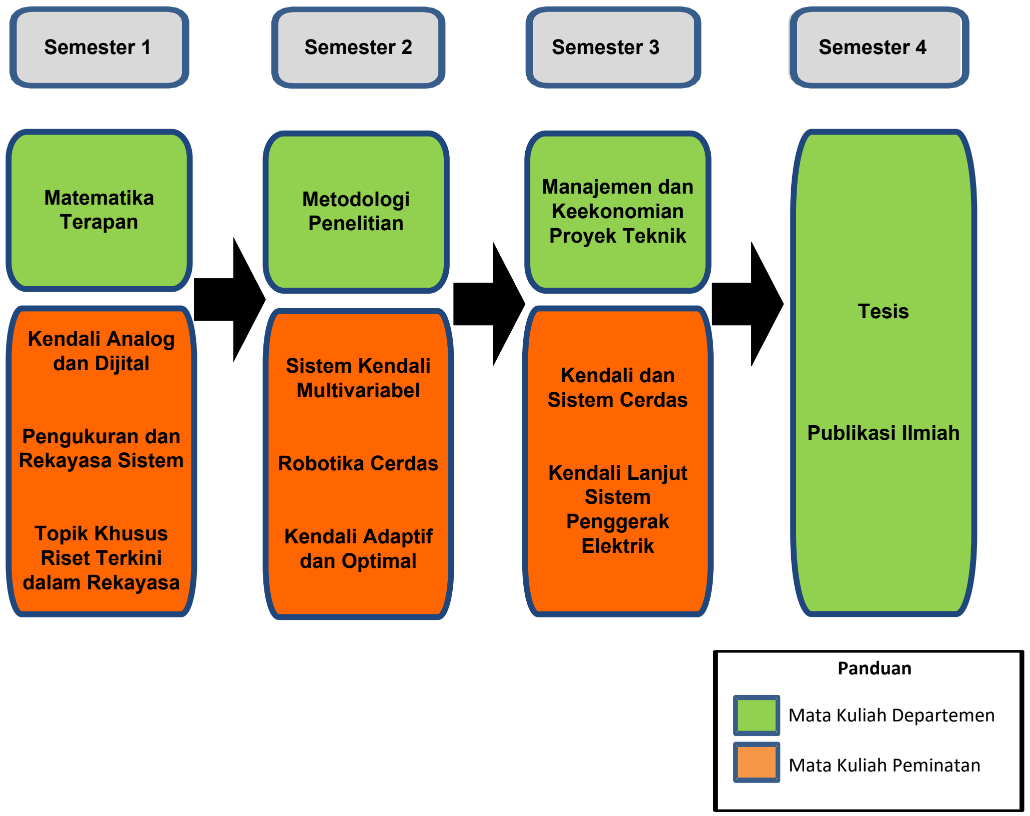


Diagram Alir Mata Kuliah Peminatan Teknik Komputer dan Jaringan

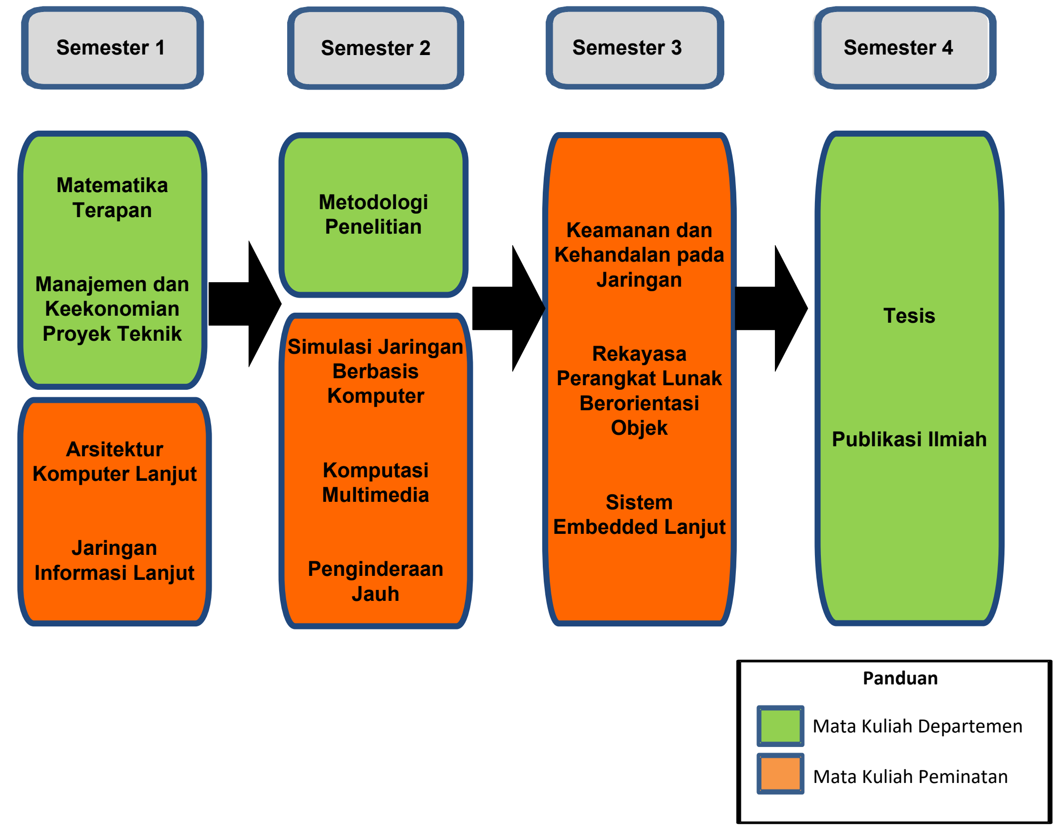


Diagram Alir Mata Kuliah Peminatan Teknik Tenaga Listrik dan Energi

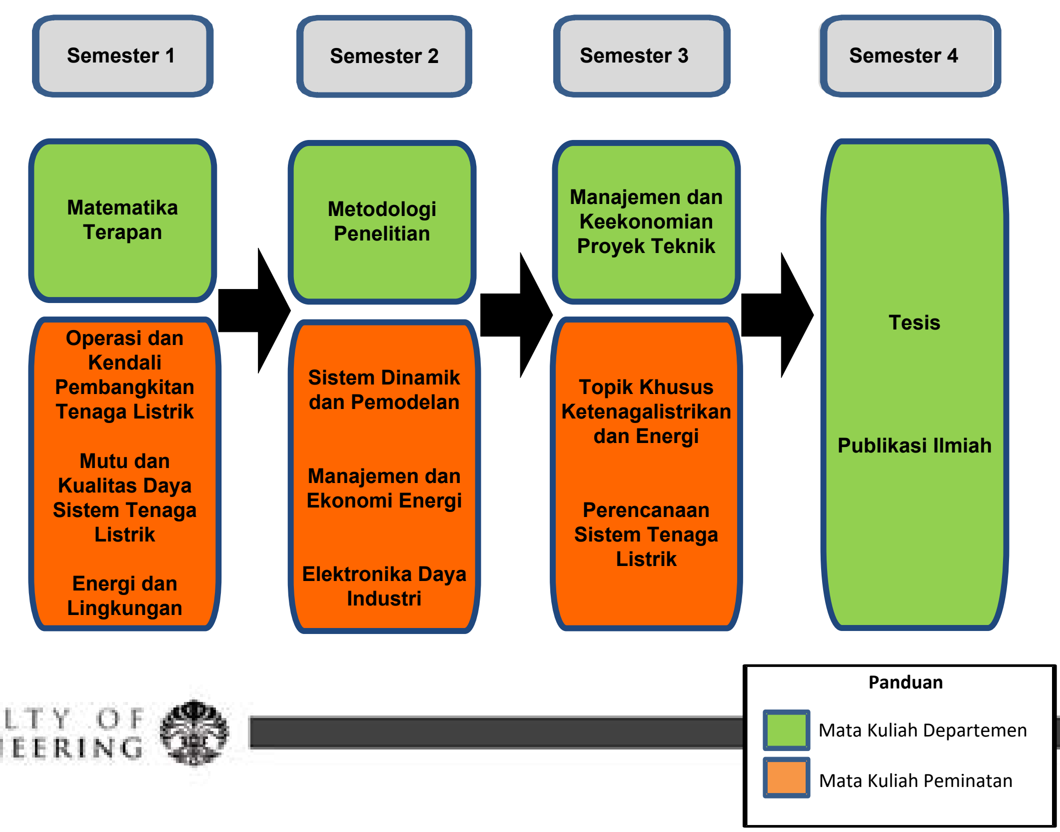


Diagram Alir Mata Kuliah Peminatan Manajemen dan Keamanan Jaringan Informasi

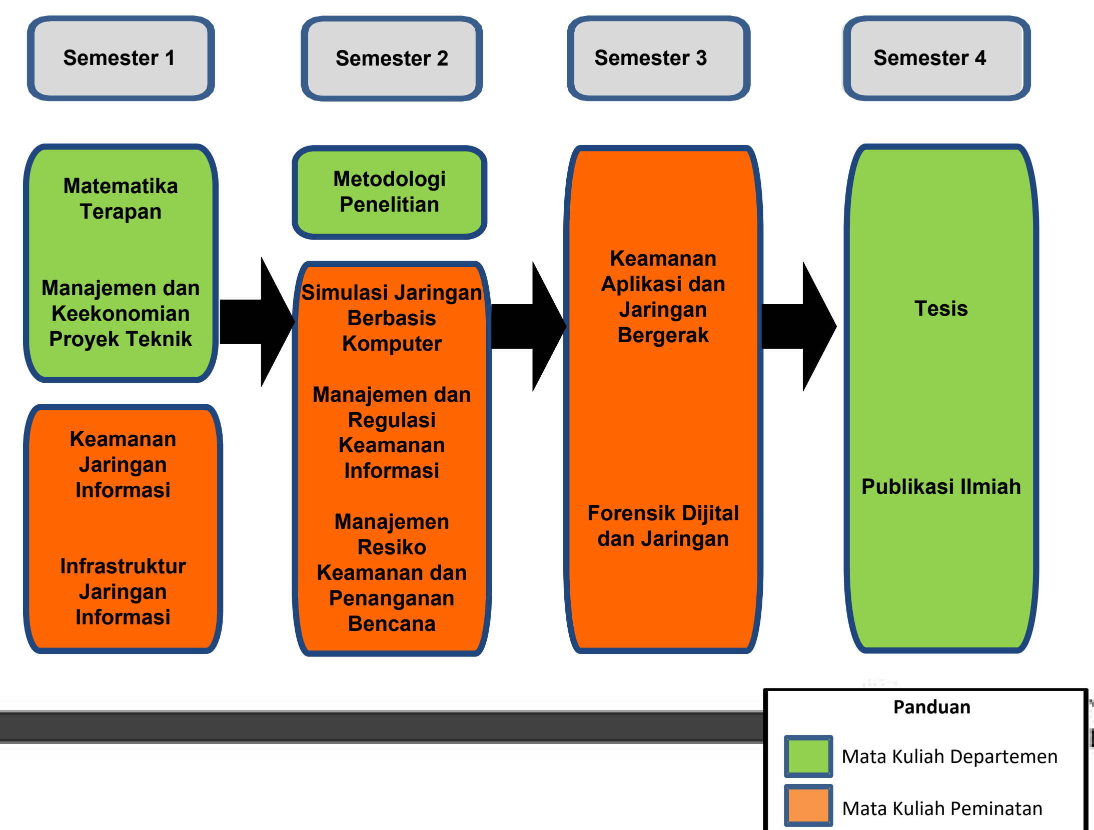


Diagram Alir Mata Kuliah Peminatan Manajemen Telekomunikasi

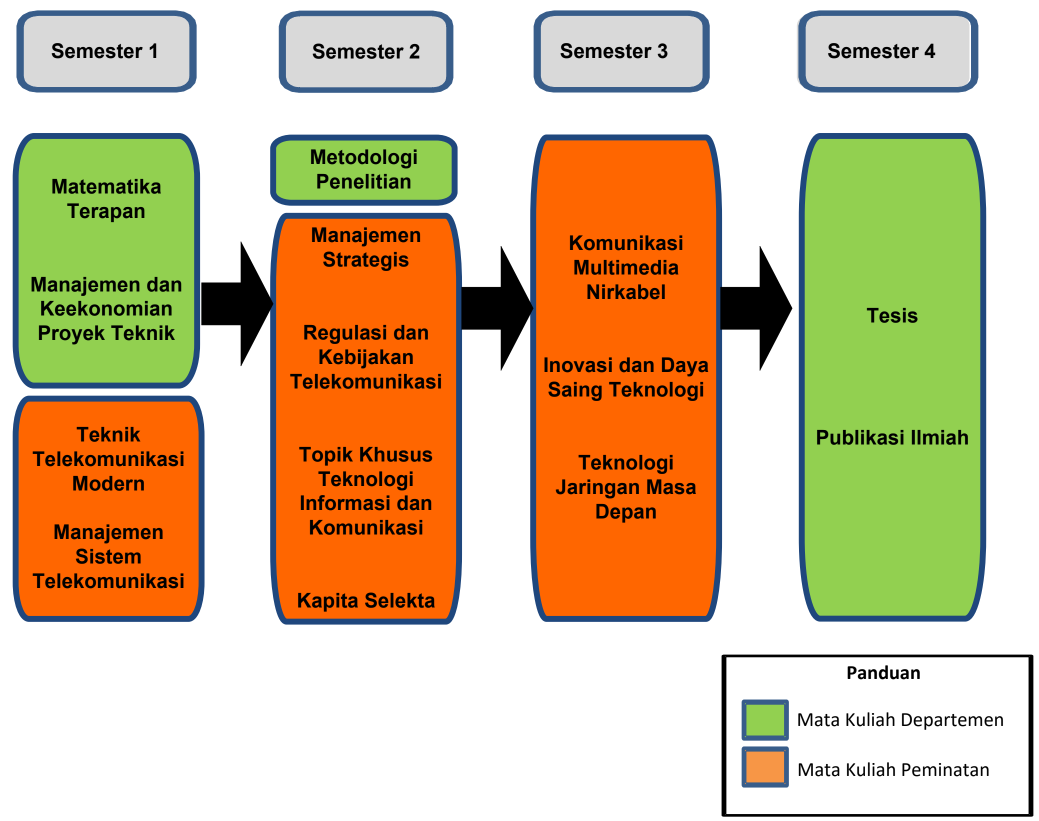
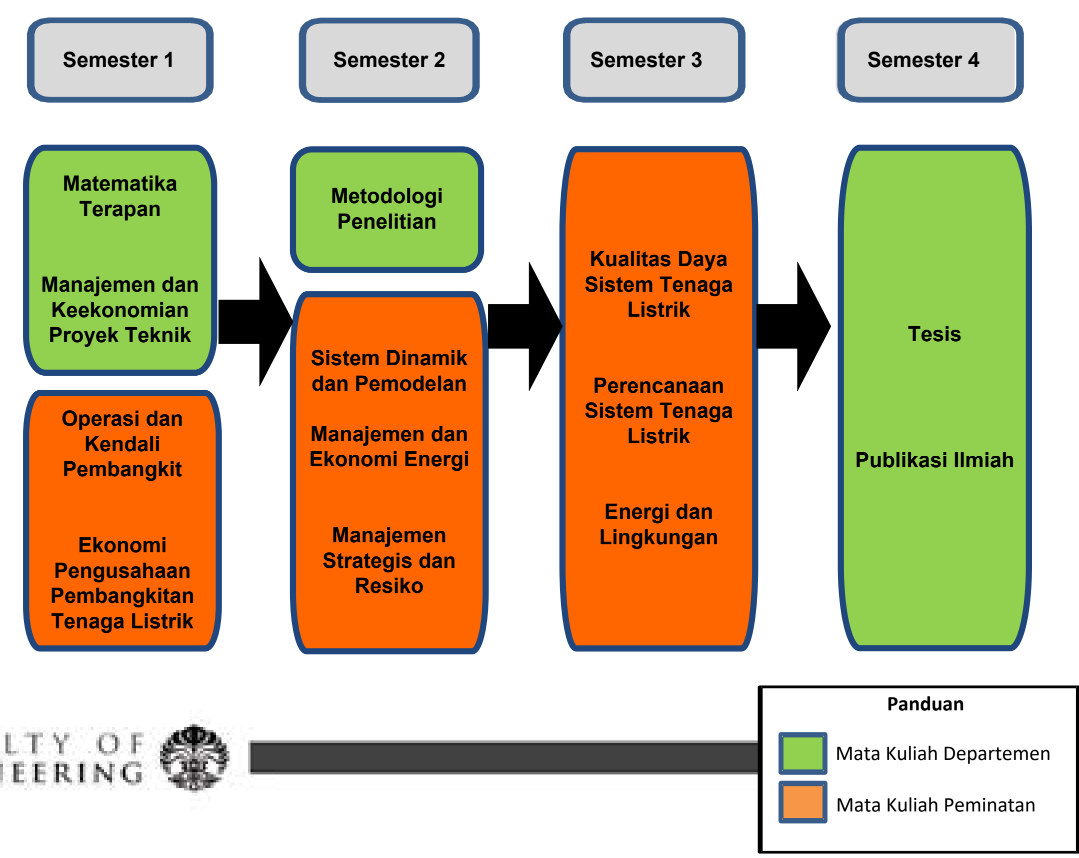


Diagram Alir Mata Kuliah Peminatan Manajemen Energi dan Ketenagalistrikan



MASTER PROGRAM

POST-GRADUATE CURRICULUM COURSES
DEPARTMENT OF ELECTRICAL ENGINEERING

ELECTRONICS AND PHOTONICS ENGINEERING

CODE	SUBJECT	CREDITS
	1st Semester	
ENEE801001	Applied Mathematics	3
ENEE801101	Integrated Circuit Design	3
ENEE801102	Nanoelectronics	3
ENEE801103	Advanced Photonic Devices	3
	Subtotal	12
	2nd Semester	
ENEE802002	Research Method	3
ENEE802104	MEMS Design	3
ENEE802105	Solid State Device	3
ENEE802106	Hetero-structure Devices	3
	Subtotal	12
	3rd Semester	
ENEE803003	Engineering Economy & Project Manag.	3
ENEE803107	Optical Coherent System	2
ENEE803108	Optical Method for Measurement	3
	Subtotal	8
	4rd Semester	
ENEE804004	Thesis	8
ENEE804005	Scientific Publication	2
	Subtotal	10
	TOTAL	42

TELECOMMUNICATIONS AND RADAR ENGINEERING

CODE	SUBJECT	CREDITS
	1st Semester	
ENEE801001	Applied Mathematics	3
ENEE801201	Mobile Broadband System Networks	3
ENEE801202	Radar Systems and Design	3
ENEE801203	Digital Signal Processing & Apps	3
	Subtotal	12
	2nd Semester	
ENEE802002	Research Method	3
ENEE802204	Wireless Medical System Eng.	3
ENEE802205	Advanced RF Design	3
ENEE802206	Modern Antenna Design	3
	Subtotal	12

	3rd Semester	
ENEE803003	Engineering Economy & Project Manag.	3
ENEE803207	Lightwave Communication Technology	3
ENEE803208	Special Topic in Telecommunication	2
	Subtotal	**8**
	4rd Semester	
ENEE804004	Thesis	8
ENEE804005	Scientific Publication	2
	Subtotal	**10**
	TOTAL	**42**

CONTROL ENGINEERING

CODE	SUBJECT	CREDITS
	1st Semester	
ENEE801001	Applied Mathematics	3
ENEE801301	Analog and Digital Control	3
ENEE801302	Special Topics on Advanced Research	3
ENEE801303	Modeling and System Engineering	3
	Subtotal	**12**
	2nd Semester	
ENEE802002	Research Method	3
ENEE802304	Multivariable Control Systems	3
ENEE802305	Intelligent Robotics	3
ENEE802306	Adaptive and Optimal Control	3
	Subtotal	**12**
	3rd Semester	
ENEE803003	Engineering Economy & Project Manag.	3
ENEE803307	Advanced Control on Electric Drive System	2
ENEE803308	Intelligent System and Control	3
	Subtotal	**8**
	4rd Semester	
ENEE804004	Thesis	8
ENEE804005	Scientific Publication	2
	Subtotal	**10**
	TOTAL	**42**

ELECTRICAL POWER AND ENERGY ENGINEERING

CODE	SUBJECT	CREDITS
	1st Semester	
ENEE801001	Applied Mathematics	3
ENEE801401	Power Generation Ops and Control	3
ENEE801402	Electrical Power System Quality	3
ENEE801403	Energi and Environment	3
	Subtotal	**12**
	2nd Semester	
ENEE802002	Research Method	3
ENEE802404	Dynamic System and Modeling	3
ENEE802405	Economics Energy and Management	3
ENEE802406	Industrial Power Electronics	3
	Subtotal	**12**
	3rd Semester	
ENEE803003	Engineering Economy & Project Manag.	3
ENEE803407	Topics in Power System and Energy	2
ENEE803408	Power System Planning	3
	Subtotal	**8**
	4rd Semester	
ENEE804004	Thesis	8
ENEE804005	Scientific Publication	2
	Subtotal	**10**
	TOTAL	**42**

COMPUTER ENGINEERING & NETWORKING

CODE	SUBJECT	CREDITS
	1st Semester	
ENEE801001	Applied Mathematics	3
ENEE801501	Object Oriented based Software Engineering	3
ENEE801502	Advanced Computer Architectures	3
ENEE801503	Advanced Information Networks	3
	Subtotal	**12**
	2nd Semester	
ENEE802002	Research Method	3
ENEE802504	Computer Based Network Simulation	3
ENEE802505	Multimedia Computing	2
ENEE802506	Remote Sensing	3
	Subtotal	11
	3rd Semester	
ENEE803003	Engineering Economy & Project Manag.	3
ENEE803507	Network Security and Reliability	3
ENEE803508	Advanced Embedded Systems	3
	Subtotal	**9**

	4rd Semester	
ENEE804004	Thesis	8
ENEE804005	Scientific Publication	2
	Subtotal	**10**
	TOTAL	**42**

CURRICULUM OF ELECTRICAL ENGINEERING DEPARTMENT SPECIAL CLASS IN SALEMBA

INFORMATION NETWORK SECURITY MANAGEMENT

CODE	SUBJECT	CREDITS
	1st Semester	
ENEE801001	Applied Mathematics	3
ENEE803003	Engineering Economy & Project Manag.	3
ENEE801601	Information Network Security	3
ENEE801602	Information Network Infrastructure	3
	Subtotal	12
	2nd Semester	
ENEE802002	Research Method	3
ENEE802504	Computer Based Network Simulation	3
ENEE802604	Information Security Manag. & Regulation	3
ENEE802605	Security Risk Manag & Disaster Recovery	3
	Subtotal	12
	3rd Semester	
ENEE803606	Application & Mobile Network Security	4
ENEE803607	Network and Digital Forensic	4
	Subtotal	**8**
	4rd Semester	
ENEE804004	Thesis	8
ENEE804005	Scientific Publication	2
	Subtotal	**10**
	TOTAL	**42**

TELECOMMUNICATIONS MANAGEMENT

CODE	SUBJECT	CREDITS
	1st Semester	
ENEE801001	Applied Mathematics	3
ENEE803003	Engineering Economy & Project Manag.	3
ENEE801701	Modern Telecommunications Eng.	3
ENEE801702	Manag. of Telecommunications System	3
	Subtotal	**1 2**
	2nd Semester	
ENEE802002	Research Method	3
ENEE802703	Strategic Management	3
ENEE802704	Telecommunications Policy & Regulation	2
ENEE802705	Special Topic in ICT	2
ENEE802706	Capita Selecta	2
	Subtotal	**12**
	3rd Semester	
ENEE803707	Multimedia Wireless Communications	2
ENEE803708	Tech. Innovation & Competitiveness	3
ENEE803709	Future Network Technology	3
	Subtotal	**8**
	4rd Semester	
ENEE804004	Thesis	8
ENEE804005	Scientific Publication	2
	Subtotal	**10**
	TOTAL	**42**

ELECTRIAL POWER AND ENERGY MANAGEMENT

CODE	SUBJECT	CREDITS
	1st Semester	
ENEE801001	Applied Mathematics	3
ENEE803003	Engineering Economy & Project Manag.	3
ENEE801401	Power Generation Ops and Control	3
ENEE801802	Electric Utility Power Generation Economic	3
	Subtotal	**12**
	2nd Semester	
ENEE802002	Research Method	3
ENEE802404	Dynamic System and Modeling	3
ENEE802405	Economics Energy and Management	3
ENEE802805	Strategic Management	3
	Subtotal	12
	3rd Semester	
ENEE803806	Electrical Power System Quality	2
ENEE803408	Power System Planning	3
ENEE801403	Energy and Environment	3
	Subtotal	**8**
	4rd Semester	
ENEE804004	Thesis	8
ENEE804005	Scientific Publication	2
	Subtotal	**10**
	TOTAL	**42**

Resume

Basic Electrical Engineering Subjects	19

MASTER PROGRAM

ELECTRONICS & PHOTONICS ENGINEERING SUBJECTS	23
Total	42
Elective	
Total Credit Hours to Graduate	42

Basic Electrical Engineering Subjects	19
TELECOMMUNICATION & RADAR ENGINEERING SUBJECTS	23
Total	42
Elective	
Total Credit Hours to Graduate	42

Basic Electrical Engineering Subjects	19
CONTROL ENGINEERING SUBJECTS	23
Total	42
Elective	
Total Credit Hours to Graduate	42

Basic Electrical Engineering Subjects	19
ELECTRICAL POWER AND ENERGY ENGINEERING SUBJECTS	23
Total	42
Elective	
Total Credit Hours to Graduate	42

Basic Electrical Engineering Subjects	19
COMPUTER ENGINEERING SUBJECTS	23
Total	42
Elective	
Total Credit Hours to Graduate	42

Basic Electrical Engineering Subjects	19
INFORMATION NETWORK SECURITY ENGINEERING SUBJECTS	23
Total	42
Elective	
Total Credit Hours to Graduate	42

Basic Electrical Engineering Subjects	19
MANAGEMENT OF TELECOMMUNICATION SUBJECTS	23
Total	42
Elective	
Total Credit Hours to Graduate	42

Basic Electrical Engineering Subjects	19
MANAGEMENT OF POWER SYSTEM AND ENERGY SUBJECTS	23
Total	42
Elective	
Total Credit Hours to Graduate	42

SYLLABUS OF SUBJECTS

ENEE802002
RESEARCH METHOD
3 CREDITS
Learning Outcomes: Capable to write research proposal
Syllabus: Research: a way of thinking & process; Formulating a research problem; Research design; Data collecting; Writing research proposal; Collecting data & processing; Writing research report
Prerequisite: -
References:
1. Technical guidelines on the writing of Thesis students of University of Indonesia
2. R. Kumar : Research Metodology, 3rd ed, Sage, 2012
3. IEEE Transactions on Parallel and Distributed Systems, vol. 21, no. 2, February 2010, “How To Write Research Articles in Computing and Engineering Disciplines”

ENEE804005
SCIENTIFIC PUBLICATION
2 CREDITS
Learning Outcomes: Syllabus:-
Prerequisite: -
Reference:

ENEE804004
THESIS
8 CREDITS
Learning Outcomes: In this course, students will be directed to develop independent research guided by a supervising professor or competent lecturer. After following this course the student is expected to be able to make a concept of research associated with existing theories. Under the guidance of a lecturer, students are expected to be able to design, integrate, implement, and analyze the concept, as well as write the results of his research into systematic paper in the form of thesis book. Students are also expected to be able to present and defend the concept and results of his research in front of the examiners in the thesis examination.
Syllabus:-
Prerequisite: Have taken at least 24 CREDITS
Reference:
1. Technical guidelines on the writing of Thesis students of University of 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”

ENEE801001
APPLIED MATHEMATICS
3 CREDITS
Learning Outcomes: After completing the coursework, the student is expected to be able to apply the mathematical equations to solve engineering problems. In the application in the field of technology management, the purpose of this course is also to introduce the students to the statistical methods that can be used to formulate solutions to technical and business problems in a system and technology application.

Syllabus: Series, Differential Equations And Partial Differential, As Well As Some Of The Transformation; Probability and optimization, statistics, statistical methods; Mathematical Modeling For Business; Decision Analysis; Forecasting; Business Research For Managers; Optimization in the business and engineering; Theory Survey.
Prerequisite: None
Textbook:
1. E. Kreyzig, “Advanced Engineering Mathematics 9th Edition, John Wiley, 2006.
2. E.K.P. S.H., Chong dan Zak, “An Introduction to Optimization”, 2nd Edition, John Wiley, 2001.
3. Safety Levin and D.S. Rubin, “Statistics for Management”, Prentice Hall, 1997.
4. D.R. Anderson, D.J. Sweeney, T.A. Williams, J.D. Martin Camm, R.K., “Quantitative Methods for Business”, South Western College Publication, 2009.

ENEE803003
ENGINEERING ECONOMY AND PROJECT MANAGEMENT
3 CREDITS
Learning Outcomes: this course aims to build the competency in evaluating economics and management aspects of the projects, so that students are expected to understand the basic theories to support investment and developing feasibility analysis of service/application technology.
Syllabus: Basics of project and project management; Organizational structure; Management function; Leadership in environmental projects; Conflict Management; Analysis of investment; Analysis of control for infrastructure development; Costs and allocation of wealth; Risk management and control.
Prerequisite: None
Textbook:
1. H. Kerzner, “Project Management: A Systems Approach to Planning, Scheduling and Controlling”, John Wiley & Sons, 2009.
2. J.R. Mantel, S.J., Meredith Jr. “Project Management: A production management Approach”, 6th Edition, John Wiley & Sons, 2006.

ENEF801001
INTEGRATED CIRCUIT DESIGN
3 CREDITS
Learning Outcomes: Capable of designing and analyzing a series of simple integrated electronics.
Syllabus: Technology component of integrated circuit; CMOS Technology; CMOS analog circuit modelling; Properties of device; Operational amplifier sub circuit with CMOS analog; CMOS amplifiers; Analog to Digital converter; Digital to Analog Converter; Computer-based electronic circuit design.
Prerequisite: None
Textbook:
1. R. S. Muller and T.I. Kamins, “Device Electronics for Integrated Circuits”, 2nd Edition, John Wiley and Sons, 1986.
2. Boyleslad R.L. & l. Nashelsky, “Electronic Devices & Circuit Theory”, 10th Edition, Prentice Hall, 2008.

ENEF803007
OPTICAL COHERENT SYSTEMS
3 CREDITS
Learning Outcomes: Able to design and simulate an optical coherent system
Syllabus: Narrowing Linewidth light source; Injection-locked for light source; Heterodyne receiver system; Integrated Devices for Optical Communication Systems; Direct Detection Optical Communication Systems; Coherent System Structure for high speed optical fiber

communication; Performance Degradation Sources in Coherent Optical Systems; Multilevel Coherent Optical Systems; Multichannel Optical Systems.
Prerequisite: None
Textbook:
1. S. Betti, g. d. Marchis & E Iannone, "Coherent Optical Communication systems", 1st Edition, John Wiley, 1995.
2. S. Ryu, "Coherent Lightwave Communication systems", Artech House Publishers, 1995.

ENEF803008
OPTICAL METHOD FOR MEASUREMENT SYSTEM
3 CREDITS
Learning Outcomes: after seriously following this course student are expected to be able to design using laser, optical fiber and for application in various types of measurement systems.
Syllabus: basic concepts of laser and its properties; Optical phenomena: diffraction and interference; Basic concepts of fiber optics and its properties; Fiber optic sensors which include intensity, polarization and interference; Examples of some applications to measure various types of measurement: temperature, pressure and displacement.
Prerequisite: None
Textbook:
1. W. s. c. Chang, "Principles of Lasers and Optics", 1st Edition, Cambridge University Press, 2005.
2. F.T.S. Yu, "Fiber Optic Sensors", Marcel Dekker Inc., 2002.
3. U.s. Moris, "Measurement and Instrumentation Principles", Butterworth-Heineman, 2001.

ENEF801003
ADVANCED PHOTONIC DEVICES
3 CREDITS
Learning Outcomes: This course aims to provide a systematic introduction on modern photonics and its subsystem devices for applications in the field of optical communications, optical sensing and imaging, optical data storage and computing as well as solid state illumination.
Syllabus: Guided wave optics; Fiber optics; Optical resonator; Optical photons; photons and atom; Photons in semiconductor; Laser amplifiers; Photon Source semi-Conductor; Photonic modulators: electro-optics, nonlinear optics and acousto optic.
Prerequisite: None
Textbook:
1. S.L. Chuang, "Physics of Western Digital my Devices", 2nd Edition, Wiley, 2009. ISBN-10:0470293195, ISBN-13:978-0470293195.
2. B.E.A. Saleh and M.C. Teich, "Fundamentals of Photonics", John Wiley & Sons, 1991.

ENEF802006
HETERO-STRUCTURE DEVICES
3 SKS
Learning Outcomes: Students are able to analyze the physical calculations regarding a hetero-structured device and principles of operations in a comprehensive manner.
Syllabus: Introduction to physical and the properties of the semi-conductor: direct and indirect bandgap; Heterojunctions; The design of the device of hetero-structure; Solar cells; Photo detectors; LEDs.
Prerequisite: None
Textbook:
1. S.M. Sze, C. Ng, "Physic of Semiconductor Devices", 3rd Edition, John Wiley & Sons, 2006.
2. J.P. McKelvey, "Solid State and Semiconductor Physics", Robert e. Krieger Publishing Company, 1986.

ENEF802005
SOLID STATE DEVICES
3 CREDITS
Learning Outcomes: After completing the coursework, the students are able to design a simple solid state devices such as: MIS Diode, Charge Couple Devices, Tunnel devices, IMPATT and Related Transit – Time Devices, Transferred Electron Devices
Syllabus: MIS Diode; Charge Couple Devices; Tunnel devices; IMPATT and Related Transit – Time Devices; Transferred Electron Devices
Prerequisite: None
Textbook:
1. S.M. Sze, C. Ng, "Physic of Semiconductor Devices", 3rd Edition, John Wiley & Sons, 2006.
2. R.F. Pierred, "Advanced Semiconductor Fundamentals", 2nd Edition, Pierson publishers, 2002.

ENEF802004
MICRO ELECTRO MECHANICAL SYSTEM, MEMS DESIGN
3 CREDITS
Learning Outcomes: After completing the coursework, students are able to design and analyze simple MEMS-based device. In addition, students will become acquainted with the process of fabrication of MEMS and micro-sensor and its application in the industry.
Syllabus: Introduction to MEMS; Materials for MEMS; Micromachining Process; The structure and system of MEMS on industrial and automotive applications; Structure and application of Photonic MEMS System; MEMS application in the life sciences; The structure and application of MEMS Structures on the application of RF; Packaging and reliability considerations for MEMS.
Prerequisite: None
Textbook:
1. Nadim Maluf Kirt & William, "An Introduction to Microelectromechanical Systems Engineering, Second Edition, Artech House Inc., 685 Canton Street Norwrod, MA02062, USA, 2004
2. Mohamed Gad El rights MEMS Handbook, CRC Press LLC, 222 Rosewood Drive-Denvers, MA01423, USA, 2004

ENEF801002
NANOELECTRONICS
3 CREDITS
Learning Outcomes: After completing the coursework, the student is able to evaluate nanoelectronic devices using quantum mechanics principle
Syllabus : Physical limit of IC and expectation of semiconductor nanostructures; basic quantum theory of nanoelectronics; solid state and low dimensional physics; numerical simulation for nanoelectronics; quantum well, wires, dots; nano structure and semiconductor device; tunneling effect and its application; resonance tunneling diodes and superlattice; quantum well laser; nano-photonics; organic electronics; single electron devices
Prerequisite: None
Textbook:
G.W. Hanson, "Fundamental of Nanoelectornics" CRC Press, 2005

ENET801001
BROADBAND COMMUNICATION NETWORK
3 CREDITS
Learning Outcomes: Able to analyze the performance of the latest generation of communication

systems.
Syllabus: High Data rates in Mobile Communication, LTE and SAE; OFDM Transmission; Single Carrier Transmission; Scheduling and Link Adaptation, LTE radio access; The LTE radio interface architecture; The downlink and uplink transmission schemes; LTE access procedure; Multipoint Coordination and transmission; Broadband Multimedia and Multicast Services, Spectrum and RF Last; Performance Evaluation
Prerequisite: None
Textbook:
E. Dahlman, s. Parkvall, Skold, j. p. Beming, "3 G Evolution: HSPA and LTE for Mobile Broadband," 2nd Edition, Elsevier, 2008.

ENET803007
LIGHTWAVE COMMUNICATION TECHNOLOGY
3 CREDITS
Learning Outcomes: After following this course, students are expected to analyze components of Optical network communications and to design optical communication network
Syllabus: Introduction: computer networks and telecommunication; Types of fiber; Physical impairment, DWDM System; Overview of optical communication technology; SONET/SDH: multiplexing, framing, control and management, protection, packet-over-SONET, generic framing procedure; Optical transport network: WDM network elements, optical protection layer and restoration G. 709, GMPLS optical control plane; Design of WDM networks: topology design of light path, routing and wavelength assignment, model dimensions maximum load; Optical access network: a network of hybrid fiber-coaxial, optical passive network; Recent Advances: Western Digital my packet switching.
Prerequisite: None
Textbook:
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.

ENET801002
RADAR SYSTEMS AND DESIGN
3 CREDITS
Learning Outcomes: Able to evaluate the performance of the radar system.
Syllabus: Radar Equation; Influence of propagation; Radar-cross section target; Detection of signals in noise and pulse compression; Radar antenna; Short-range radar & cluster; Signal processing techniques of MTI & Pulse Doppler; Tracking & parameter estimation; The transmitter and receiver.
Prerequisite: None
Textbook:
1. Skolnik, "Introduction to Radar systems," 3rd ed
2. M.A. Richard, J.A. Scheer, W.A. Holm, "Principle of Modern Radar: Basic principles," Scitech Publishing Inc., 2010.
3. Kang, E.W. "Radar System Analysis, Design and Simulation," Artech House ENEE800103, 2008.

ENET801003
SIGNAL PROCESSING AND APPLICATIONS

3 CREDITS
Learning Outcomes: Students are able to evaluate algorithms of signal processing by using FFT and transformation of signals.
Syllabus: Signal Analysis; Transient and frequency response; FT-Discrete FFT; Z transformation and its application in signal processing; Correlation and convolution; Digital filters: FIR and IIR; Multi-rate Signal Processing; Advanced Transformation (WHT, DCT, Wavelet transform) and its application; Project.
Prerequisite: None
Textbook:
1. E. C. Ifeachor and B.W. Jervis, "Digital Signal Processing: A Practical Approach", 2nd Edition, Addison Wesley, 2002.
2. S.M. Kuo, B.H. Lee & Ws Thian, "real-time DSP Implementations: & Applications", John Willey & Sons publishers, 2006.

ENET802006
MODERN ANTENNA DESIGN
3 CREDITS
Learning Outcomes: Able to design antennas for variety wireless technologies in particular the use of the micro strip antenna.
Syllabus: Basic theory of electromagnetic interference: Maxwell's equations, boundary conditions, equations of wave vector, Image theory; The antenna loop and wire; The ideal dipole; Synthesis Of Antennas; Antenna Aperture: the principle of equivalent; The basic parameters of the antenna measurement techniques. Micro-strip antenna includes slot patch antennas, Fractals antennas, bias technique, broadband technique, multiband technique, stacking antenna, miniaturization, EBG (Electromagnetic Bandgap) and Metamaterial. Mikrostrip antenna applications such as on GPS, wireless telecommunications, RFID antenna research and trend nowadays.
Prerequisite: None
Textbook:
1. C. Balanais, "Antenna Theory Analysis and Design –," 3rd Edition, Willey, 2005.
2. W.L. Stutzman and Gerald A. Thiele, "Antenna Theory & Design," John Willey & Sons, 2002.

ENET802004
WIRELESS MEDICAL SYSTEMS ENGINEERING
3 CREDITS
Learning Outcomes: Able to evaluate the influence of body tissue against wireless communication systems from within and around the human body; Able to identify wearable devices; Able to analyze Body-centric UWB communications; Able to analyze Body-sensor networks; Able to analyze Medical implant communication systems; Able to analyze wireless medical diagnosis.

Syllabus: The introduction of the rankings; Communication Wireless Body-Centric; Electromagnetic properties and modeling of the human body; Wearable device; UWB Communication Body-Centric; Body censor Network; Medical implant communication system; Diagnosis : Wireless medical Magnetic Resonance Imaging (MRI), MRI safety; Wireless medical diagnosis: computed tomography microwave (CT), Ultrasound, imaging techniques further (PET, SPECT, Hybrid Method);Treatment technology of wireless; Interference Electromagnetic interference (EMI) on medical devices; Technology wireless power for medical

implant devices.
Prerequisite: None
Textbook:
1. J.D. Bronzino & D.R. Peterson, The Biomedical Engineering Handbook, 4th ed., CRC Press, 2000.
2. P. Hall, "Antennas and Propagation for Wireless Communications BodyCentric," ArtechHouse, 2006.

ENET802005
ADVANCED RADIO FREQUENCY DESIGN
3 CREDITS
Learning Outcomes: Able to design RF components, able to evaluate the performance of RF devices.
Syllabus: RF radio access networks design and essential: modulation, demodulation and multiple access techniques; LNA and Mixer design; Oscillator; Frequency Synthesizers; Design of Filter; Design of PA; Design of the wireless communication systems; Wireless LAN technology.
Prerequisite: None
Textbook:
1. D. m. Pozar, "Microwave Engineering" 3rd ed, Prentice Hall, 2008
2. A. Hussain, "Advanced RF Engineering for Wireless Systems and Networks", John Wiley and Sons, 2004.

ENET803008
SPECIAL TOPIC IN TELECOMMUNICATION
2 SKS
Learning Outcomes: Able to evaluate recent advancements in telecommunications technology
Syllabus:
Prerequisite:
Textbook:

ENEC801001
ANALOG AND DIGITAL CONTROL
3 CREDITS
Learning Outcomes: This course is an introduction to basic modeling, analysis, and feedback control systems design. This will give students insights into the problems of control and intuition about the methods available for resolving a problem. Both the frequency response and the state space method for analysis and design of the system of continuous time and discrete time are considered.
Syllabus: Open-loop control systems and closed loop; Basic concepts and definitions; Block diagrams; Nyquist diagram; Bode diagram design and analysis; Error analysis of steady-state; Root locus analysis and design; State space equations; Observabilities and controllability; The solution of equation of State; Design of controller using the pole placement method; Design observer full orders; The Transformation Of Z; The mapping between the s-plane and z-plane; Discrete-time state space; Design of controller using pole assignment; Design observer State; Deadbeat controller.
Prerequisite: None
Textbook:
1. Nise, N.S. "Control Systems Engineering", 5th Edition, Wiley (December 10, 2007), ISBN-10:0471794759, ISBN-13:978-0471794752.

2. K. Ogata, "Discrete-Time Control Systems", Prentice Hall; 2nd Edition, 1997. ISBN-10:0130342815, ISBN-13:978-0130342812.

ENEC801002
CURRENT RESEARCH ON SPECIAL TOPICS IN ENGINEERING
3 CREDITS
Learning Outcomes:
Syllabus:
Prerequisite:
Textbook:

ENEC802004
MULTIVARIABLE CONTROL SYSTEM
3 CREDITS
Learning Outcomes: Able to understand the concept of interacting loops in Multivariable system, analyze the stability of multivariable systems and designing a multivariable controller and domain defined and time domain.
Syllabus: Domain is defined: Multivariable system representation, input-output model, the interaction loop, relative gain array, the method of decoupling Baksenbom-Hood, stability; Time domain: model state space, form a diagonal, form handler, form observable, the stability of multivariable systems, controllability and observabilities,
Poles and zeros, pole placement, method a method of decoupling Falb-design of Luenberger observer, Wolovich.
Prerequisite: None
Textbook:
1. P. Albertos and a. Sala, "Multivariable Control Systems: An Engineering Approach", SpringerVerlag, 2004.
2. K. Zhou, "Robust & Optimal Control", Prentice Hall, 1996.

ENEC801003
MODELING AND SYSTEMS ENGINEERING
3 CREDITS
Learning Outcomes: Able to simulate, identify and realize some of the physical model on certain software; In the application in the field of management of technology, this lecture also aims to model problems and cases that occur on the system technology so that it can support the ideal strategy design.
Syllabus: The basic Simulation and modeling: Physical Modeling, identification of Non-Parametric Models; Data Analysis: Least Square, Extended Least Square, Generalized Least Square Identification, Validation, Real-time. Modeling and Prototyping; Application Software: Matlab/Simulink, PSpice, A Network Simulator; Modeling For System Technology; Modeling Engineering Systems; Design for improving the performance and quality of Applications technology.
Prerequisite: None
Textbook:
1. A. Law, "Simulation Modeling and Analysis", 4th Edition, McGraw-Hill, 2006.
2. B.P. Zeigler, T.G. Kim & h. Praehofer, "Theory of Modeling and Simulation", 2nd Edition, Academic Press, 2000.

ENEC802005
INTELLIGENT ROBOTICS
3 CREDITS

Learning Outcomes: Provide the knowledge and expertise to students to design robots moving in closed loop controller with sensor fusion. When realized, the simulation model OpenGL followed implementation real-word runs.
Syllabus: The introduction and implementation of sensors and actuators; Introduction to control systems; C programming for ATMEL AVR Microcontroller; Simulation modeling with OpenGL; Modeling of moving robot with sensors and its simulation with openGL; Live recocking, concepts of real-time systems; Advanced control system and communication;
Navigation system; Monitoring Command-control; Localization; The concept of a knowledge-based system with the realization on the robot move.
Prerequisite: None
Textbook:
1. G. McComb Predko, m., "a Robot Builder Bonanza", 3rd Edition, McGraw-Hill, 2006, ISBN 0071468935/9780071468930.
2. J.M. Holland, "Designing Autonomous Mobile Robots: Inside the Mind of an Intelligent Machine", Newnes, 2004. ISBN-10:0750676833, ISBN-13:978-0750676830.

ENEC802006
ADAPTIVE AND OPTIMAL CONTROL
3 CREDITS
Learning Outcomes: Able to design controllers for slow time variation, process uncertainty and is not linear (local description depends on the operating point). This task can be realized with different types of Adaptive controller or controller-optimal where the control stick was replaced by off-line optimization made through limited worldview.
Syllabus: The Adaptive control structure; Online identification for process variation is slow as an extension method of least squares; Self-tuning controller-based estimates of the parameters and the combination of such different pole assignment controller and its variations to a minimum; Realization of adaptive control on Matlab; The realization of the practice: the time of sampling, modeling and supervision order online from loop control; Random processes; The function of the criteria; Robustness; quadratic linear controller; Kalman Filter; quadratic Gaussian linear controller; Reduced order controller.
Prerequisite: None
Textbook:
1. P.E. Wellstead and M.B. Zarrop, "Self-Tuning Systems: Control and Signal Processing," John Wiley and Sons, 1991.
2. J.B. Burl, "Linear Optimal Control: H2 and H ∞ Methods," Addison Wesley, 1999.

ENEC803007
CONTROL AND INTELLIGENT SYSTEMS
3 CREDITS
Learning Outcomes: Study of intelligent computing method to build intelligent control system modelled on systems biology and human cognitive ability, adaptability and classification. Real applications on a single input single output systems (ANTENNA) carried out experimentally.
Syllabus: An introduction to pattern recognition; Artificial neural network; Backpropagation; Self-organized map; Vector quantization; Identification system; System control; Experiment Of ANTENNA.
Prerequisite: None
Textbook:
1. Ham and F.M. i. Kostanic, "Principal of neuroconputing for science and engineering", McGraw-Hill, 2001.
2. J. Sarangapani, "Neural networks control of nonlinear discrete-time system", CRC Press, 2006.

ENEC803008
ADVANCED ELECTRIC DRIVE SYSTEM CONTROL
2 SKS
Learning Outcomes:
Prerequisite:
Textbook:

ENEP801001
THE OPERATION AND CONTROL OF ELECTRIC POWER GENERATION
3 CREDITS
Learning Outcomes: After completing the coursework, the student is able to operate the power plants geothermal and hydro power, distribution and power control systems and building electric power production cost models.
Syllabus: the properties of the power generation units; Economic Dispatch of Thermal Units; The influence of the transmission system; Unit Commitment; Generation with energy supply is limited; Hydrothermal Coordination; The model of production costs; Control generation; The exchange of power and energy.
Prerequisite: None
Textbook:
A.j. Wood and Wollenberg B.F., "Power Generation, Operation and Control", 2nd Edition, John Wiley & Sons Inc., 1996.

ENEP802004
DYNAMICAL SYSTEMS AND MODELING
3 CREDITS
Learning Outcomes: The student is able to design a dynamic model based on variable and determine parameters-owned model and compare the model obtained with various other models.
Syllabus:

Introduction to dynamical systems, cycle feedback, model Multivariable complex and multiobyektif, modeling and simulation, design models, dynamic urban changes, developments
Prerequisite: None
Textbook:
Claudius Gros, "Complex and Adaptive Dynamical Systems A Primer", Springer, 2008

ENEP801002
QUALITY AND QUALITY POWER ELECTRIC POWER SYSTEMS
3 CREDITS
Learning Outcomes: Able to analyze power system operating conditions, steady state on the condition and disrupt due to voltage swell/sag voltage and harmonic distortion.
Syllabus: Transient; Overvoltage; Undervoltage; Interruptions; Sags; Swells; Voltage Unbalance; Voltage fluctuations; Distortion of the wave form; Power frequency variation; Harmonic distortion; Current vs. Voltage distortion; Harmonic vs. Transient; Harmonic

Control; The Design Of The Filter; Benchmarking the quality of power; Power generation distribution and quality; Wiring and grounding; Checking the quality of the resources.
Prerequisite: None
Textbook:
R.c. Dugan, M.F. Mc. Granaghan, s. Santoso, H. W. Beaty, “Electrical Power System Quality”, 2nd Edition, Mc. Graw Hill, 2002.

ENME803006
ELECTRICAL POWER SYSTEM QUALITY
2 SKS
Learning Outcomes: Able to analyze power system operating conditions, steady state on the condition and disrupt due to voltage swell/sag voltage and harmonic distortion.
Syllabus: Transient; Overvoltage; Undervoltage; Interruptions; Sags; Swells; Voltage Unbalance; Voltage fluctuations; Distortion of the wave form; Power frequency variation; Harmonic distortion; Current vs. Voltage distortion; Harmonic vs. Transient; Harmonic Control; The Design Of The Filter; Benchmarking the quality of power; Power generation distribution and quality; Wiring and grounding; Checking the quality of the resources.
Prerequisite: None
Textbook:
R.c. Dugan, M.F. Mc. Granaghan, s. Santoso, H. W. Beaty, “Electrical Power System Quality”, 2nd Edition, Mc. Graw Hill, 2002.

ENEP803008
POWER SYSTEM PLANNING
3 CREDITS
Learning Outcomes: Able to analyze the identity request estimates of changes in economic variables and are able to estimate the reliability of the system on the changing economic conditions.
Syllabus: an estimate of the increase in demand for electric power; Electric power supply for the long term; The planning of electric power generation (production); Plant maintenance scheduling of power systems; The factors
electricity development strategic Indonesia; The prospect of the development of electricity in Indonesia; The model construction of electric power systems; Methods of optimization.
Prerequisite: None
Textbook:
1. X. Wang, J.R. McDonald, “Modern Power System Planning”, McGraw Hill Book Co., 1994.
2. Venus, “Ketenagalistrikan Indonesia” Ganesh, PT. Prima, April 1995.

ENEP802005
ECONOMICS ENERGY AND MANAGEMENT
3 CREDITS
Learning Outcomes: Able to design the energy management system by applying the supply/demand side management-related sources, both fossil and non-fossil.
Syllabus: Fossil and Non-Fossil sources; Power systems management: including generation, transmission and distribution of electric power; Supply management supply management and is known as the Integrated Resource Planning.
Prerequisite: None
Textbook:

1. J.M. Griffin, H.B. Steele, “Energy Economics and Policy”, Academic Press, New York, 1980.
2. Venus, “Ketenagalistrikan Indonesia” Ganesh, PT. Prima, April 1995.

ENEP802006
INDUSTRIAL POWER ELECTRONICS
3 CREDITS
Learning Outcomes: Able to design applications in the field of high power semiconductor devices in the field of industry and the military.
Syllabus: Introduction to electric power systems and Power Semiconductor Switches; Diode Rectifier; Controlled Rectifier; Inverters; Resonant Converters and Switching power supply for D.C.; Power Conditioners and Uninterruptible Power Supplies; Introduction To Motor Drives; D.c. Motor Drives; Synchronous Motor Drives; Residential; Industrial and electric utility applications; Optimization system of utility interface with electric power systems.
Prerequisite: None
Text Book:
N. Mohan, T.M. Undeland, W.P. Robbins, “Power Electronics”, 3rd Edition, John Wiley and Sons, 2003.

ENEP801003
ENERGY AND ENVIRONMENT
3 CREDITS
Learning Outcomes: Able to analyze the effects of the use of energy that is friendly to the environment.
Syllabus: global warming caused by the use of fossil and non-fossil energy; Problem solving environment nationally and globally; The implementation of the Kyoto Protocol in the form of a Clean Development Mechanism; CO2 trading.
Prerequisite: None
Textbook:
1. Nazaroff, W.W. 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.

ENEP803007

TOPIC IN POWER SYSTEM AND ENERGY

2 SKS

Learning Outcomes: Able to evaluate the latest technological developments in the field of electric power and energy as well as provide mitigation over problems that arise.

Syllabus: Fossil and non-fossil energy, renewable energy generation, the reliability of electric power systems, renewable energy penetration into the electricity network, planning the development of the electric power system, the factors that affect the growth of the load, the effect of conventional power generation on the environment, factors that affect the development of the system
Prerequisite: None

Textbook:

ENCN801001
ADVANCED COMPUTER ARCHITECTURES
3 CREDITS
Learning Outcomes: Able to describe the architecture of the computer system; capable of analyzing sequences of instruction set. Students are also able to explain the detailed architecture of pipelining, superscalar and parallel systems and be able to analyze the parallel algorithm in computer systems.
Syllabus: Review instruction set architecture and its influence on performance: execution of the instruction, the influence of micro bus and system clock, system memory, system cache; Pipelining architecture: advantages, data, address and control conflicts, re-ordering instruction; Superscalar architecture: execution of dual stream; CISC and RISC; RISC architecture and its features: the rules of the register, the register of windows engineering and its effect on performance; Parallel architecture: shared memory, distributed memory, loosely coupled and tightly coupled; Cache consistency issues: examples of load balancing algorithms, parallel, message passing, the idea on the performance of a parallel algorithm.
Prerequisite: None
Textbook:
1. W. Stallings, “Computer Organization and Architecture”, 7th Edition, Prentice Hall, 2007.
2. J.L. Hennessy, D.A. Patterson, “Computer Architecture, 5th Edition: A Quantitative Approach” (The Morgan Kaufmann Series in Computer Architecture and Design), 5th Edition, Morgan Kaufmann, 2011. ISBN-10:012383872X, ISBN-13:978-0123838728.
3. J.P. Shen and M.H. Lipasti, “Modern Processor Design: Fundamentals of Superscalar Processors”, McGraw Hill Book, 2003 (Beta Eds).

ENCN801002
ADVANCED INFORMATION NETWORKS
3 CREDITS
Learning Outcomes: Able to elaborate on the concept of advanced information networks, the IP Protocol and its relationship with the Quality of Services (QoS). Students are also able to describe wireless network protocols, and explains the characteristics of traffic in real-time and non-real time, analyze the needs of QoS for video, audio and data traffic. Students are also able to analyze the future of the network towards the Next Generation Networks, and being able to analyze the network merger of telecommunications technology now.
Syllabus: The idea of modern information networks, QoS-based networks that rely on IP and IP-like protocols; Wireless and wired backbone network, wireless and wired access network; The characteristics of the traffic, real time traffic, traffic, traffic non realtime class of service; Traffic reservation protocols: SIP, ATM, RSVP, etc.; The idea of Quality of Service (QoS), QoS parameters, implementation of QoS. End to end QoS on the network of the future; Traditional ATM network: class of services, label swapping, traffic congestion and the issue of reservation; MPLS network: Implementation Class of Services; Wireless networks: WiFi and WiMAX, QoS in WiMAX; Fiber-optic-based networks: IP issues at the top of the DWM; Next Generation Networks (NGN): incorporation of all types of telecommunications technology.
Prerequisite: None
Textbook:
W. Stallings, “High Speed Networks”, Prentice Hall, 2002.

ENCN802003
COMPUTER BASED NETWORK SIMULATION

MASTER PROGRAM

3 CREDITS
Learning Outcomes: After completing this course, the student is able to describe the role of network simulation research on a new Protocol in the internet and are able to implement and analyze network simulation using NS (Network Simulator) to conduct research in the network.
Syllabus: Introduction; Basic network simulation; NS basic: OTCL, an example of a simple simulation (topology, events, marking flows, monitoring a queue), architecture (nodes, links, applications, protocols, packets, loss modules, math support);
Event Scheduler; Network Components; Packet; Post Simulation: analyze the tracefile, the 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 the NS: Ns structure, OTCL linkage, adding new application and agent, queue; A new Protocol to NS: Header files, C++ code, the necessary changes, the TCL code; The introduction of the NS-3.
Prerequisite: None
Textbook:
1. J. f. Kurose and k. w. Ross, “Computer Networking A Top-Down Approach Featuring the Internet”, Addison Wesley, 2003
2. A. Law and d. 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.

ENCN802004
MULTIMEDIA COMPUTING
2 CREDITS
Learning Outcomes: After following this course the students are able to describe and implement the technology in the field of multimedia and forwarded through the network. Students are able to analyze the components of the multimedia files, file compression techniques of multimedia, real time delivery of multimedia files, multimedia QoS in a network of computers, and also capable of analyzing the characteristics of the network
to support distribution of multimedia files over the Internet.
Syllabus: The Concept Of Multimedia Computing; Digital representation of Audio: pictures and videos; The characteristics and requirements of multimedia data; Techniques and digital audio compression standards; Techniques and image and video compression standards; End to end QoS for digital audio and video communication; Multimedia communication network; Transport protocols; Support system for distributed multimedia applications; The terms and mechanisms of synchronization of multimedia network; Information indexing and acceptance of multimedia.
Prerequisite: None
Textbook:
1. G. Lu, “Communication & Computing for Distributed Multimedia Systems”, Artech House, 1998.
2. K.R. Rao, Zoran s. Bojkovic, D.A. Milovanovic, “Multimedia Communication System: Techniques, Standards and Networks”, Prentice Hall, PHTR, 2002.

ENCN802005
REMOTE SENSING
3 CREDITS
Learning Outcomes: After completing this course, students are able to describe and analyze the satellite remote sensing data processing using specific algorithms.

Syllabus: Introduction; Acquisition of images; Satellite observations of the land; Active and passive sensors (optical, Radar); Microwave; Analysis of Data: GIS (geographic information systems); The science buildings and land; Land use & land cover; Global remote Sensing.
Prerequisite: None
Textbook:
1. J.B. Campbell, "Introduction to Remote Sensing", Guilford press, New York, 1996.
2. C.H. Chen, "Signal and Image Processing for Remote Sensing," 2nd Edition, CRC Press, 2010.

ENCN803006
NETWORK SECURITY AND RELIABILITY
3 CREDITS
Learning Outcomes: After completing this course, the student is able to describe the protocol and model of a system of security in communications. Students are also able to analyze network vulnerabilities and implement security systems on the network and the web.
Syllabus: introduction to the issues of security and privacy related information systems; the basics on confidentiality, availability, integrities; Identity and authentication credentials; Protocols and data integrities; control access; The security model; Cryptographic systems and protocols for privacy; Network security & web; Intrusion detection and prevention; Vulnerabilities and attacks; Security risk analysis; Planning for recovery from disasters; Security rules; Audit security and ISO17799.
Prerequisite: None
Textbook:
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.

ENCN803007
OBJECT ORIENTED BASED SOFTWARE ENGINEERING
3 CREDITS
Learning Outcomes: After completing this course, the student is able to describe the concept of software engineering and model used in development of a software. Students are also able to analyze the problem, apply the critical stages of the life cycle of software, create documentation in software development, describes the specifications of the software based on software requirements and implement a verification method, implement the design in the form of programs, test program made, perform maintenance on the system, and generating complete documentation development system to create user instructions for a relatively complex system in the real world.
Syllabus: The concept of object-oriented software engineering; Problems in the development of software; Waterfall model; Approach to prototyping; Evolutionary developmental model; Estimation of costs; Configuration management; Software metrics; Requirements engineering; Project management and risk; TSP, PSP: analysis, definitions, specifications, documentation of the draft specification of the software; Functional requirements and non-functional; Mastery Of The Unified Modeling Language (UML); Designing for reusability; Adaptability and care; The quality of architectural design software; Implementation of software; Designing and testing its implementation; Data modeling; Software maintenance; Documentation of the system.
Prerequisite: None
Textbook:
1. E. Braude, "Software Engineering: An Object Oriented Perspective", John Wiley and Sons, 2000.
2. E. Braude, m. Bernstein, "Software Engineering: Modern Approaches", John Wiley and Sons, 2010.
3. C. Larman, "Applying UML and Patterns: An Introduction to Object-oriented Analysis and Design and the Unified Process, Prentice Hall International, 2004.
4. D. Brown, "An Introduction to Object Oriented Analysis, UML and Object in Plain English", John Wiley and Sons, 2002.
5. E. Yourdon, "Modern Structured Analysis", Prentice Hall International, 1992.
6. Sommerville, "Software Engineering", 9th Edition, Addison Wesley, 2010.
7. R. Pressman, "Software Engineering: a Practitioner's Approach", 7th Edition, McGraw-Hill, 2009.

ENCN803008
ADVANCED EMBEDDED SYSTEMS
3 CREDITS
Learning Outcomes: At the end of the course students will have the ability to analyze, design and develop an embedded systems.
Syllabus: Introduction to embedded systems; Introduction to the software; Real-time model and scheduling; Recurring tasks/aperiodic; Share resources; Real-time OS; Case study: Mars Pathfinder, system components, communication, low power design, FPGA synthesis architecture, introduction, sample project embedded FPGA-based systems, the design and manufacture of FPGA-based embedded systems.
Prerequisite: None
Textbook:
1. P. Marwedel, "Embedded System Design," Springer Verlag, 2005.
2. W. Wolf, "u.s. Computers Components – Principles of Embedded Systems Design," Morgan Kauffman Publishers, 2000.

ENMS801001
INFORMATION NETWORK SECURITY
3 CREDITS
Learning Outcomes: After completing this course, the student is able to describe the protocols and model of a system of security in communications. Students are also able to analyze network vulnerabilities and implement security systems on the network and the web. In addition, students will be able to do the authentication techniques in Cryptography.
Syllabus: introduction to the issues of security and privacy Related information systems; The basics of the confidentiality, integrity, availability, Authentication and Identity; Protocols and Data integrity; Access Control; The Security Model; Cryptographic systems and protocols for privacy; Network Security & Web; Intrusion detection and prevention; Vulnerabilities And Attacks; Security Risk Analysis; Planning for recovery from Disasters; Security Rules; Audit Security And ISO17799;Introduction To Cryptography; Encryption; Classic Encryption Technique; Standard Data encryption and password block; The Advanced Encryption Standard; Pseudo-Random Generation; Digital Signatures; Two-Party Protocols and Zero-Knowledge.
Prerequisite: None
Textbook:
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.

ENMS801002
INFORMATION NETWORK INFRASTRUCTURE
3 CREDITS
Learning Outcomes: After completing this course, students will be able to design, implement and analyze the design of the server farm. Students will also be able to manage the server farm.
Syllabus: 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: None
Textbook:
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.

ENMS802004
INFORMATION SECURITY MANAGEMENT AND REGULATION
3 credits
Learning Outcomes: At the end of this course the student is expected to understand the principles of information security and is able to apply those principles to design solutions for managing information security risk effectively. Students are expected to understand how to apply the principles of network security management of information in the context of the breadth and immediacy. Finally, the student is able to manage according to information network with the standard of the profession, ethics, regulation and legislation in force.
Syllabus: Management and security policy information; Threat management and weak information networks; Incident management and risk; Crisis management and Business Continuity; Cultural awareness and Security of information and information networks; Implementation Aspects Of Network Security Information; Legal aspects and regulations of information security; Certification of information security and information networks; SNI standard ISO/IEC 27001:2009.
Prerequisite: None
Textbook:
1. C.P. Pfleeger, Pfleeger, S.L. and “Security in Computing”, 4th Edition, Prentice Hall, 2008.
2. M. Subramanian, “Network Management Principles & Practices”, Pearson, 2010.

ENMS802005
SECURITY RISK MANAGEMENT AND DISASTER RECOVERY
3 CREDITS
Learning Outcomes: After completing this course, students are able to provide a standardized approach to regulating risk on network security through a proper framework to accommodate security strategies and their related costs. Students are also able to perform the recovery steps after the occurrence of the problem of network security information.
Syllabus: Introduction To The Security Risk Management; Risk Analysis; Approach To Risk Management; System Security Engineering; Regulation Of Security; The Issue Of Legality; Organizational Readiness Plan; Responding To The Incident; Plan a Strategy for the continuation of business; Disaster Recovery; Business continuation and crisis management.
Prerequisite: None
Textbook:
1. E. Wheeler, “Security Risk Management: Building an Information Security Risk Management Program from the Ground Up”, Syngress, 2011.
2. T. r. Peltier, “Information Security Risk Analysis”, 3rd Edition, Auerbach Publications, 2010.

ENMS803006
APPLICATION AND MOBILE NETWORK SECURITY
4 CREDITS
Learning Outcomes: After completing this course, the student is able to describe the forms of security attack on the application and the network computer, capable of analyzing the security issues on the application of either desktop based applications as well as web-based, as well as being able to implement the concept of security applications and computer networks.
Syllabus: Introduction to application security and computer networks; Detection Penetration Network; Detection Of The Penetration Of Web-Based Applications; The penetration detection in Wireless network; Secure coding in Java; Secure coding in PHP; Build a secure Database.
Prerequisite: None
Textbook:
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.

ENMS803007
NETWORK AND DIGITAL FORENSIC
4 CREDITS
Learning Outcomes: After following this course, the student is able to identify digital traces on the computer or on the network; being able to recognize forms of attack from the digital traces; able to analyze digital traces as well as being able to gather legal evidence.
Syllabus: Introduction to Digital Forensics and network; A Windows-Based Computer Forensics; The Linux-Based Computer Forensics; Forensics in computer network; Forensics on the mobile device.
Prerequisite: None
Textbook:
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, 2010.

ENMT801001
MODERN TELECOMMUNICATIONS ENGINEERING
3 CREDITS
Learning Outcomes: This lecture aims to evaluate the basic principles of telecommunication system that is focused on environmental aspects of the application of modern telecommunications. By following this course, the student is expected to analyze a telecommunication system and calculate its technical aspects.
Syllabus: Digital communication systems; Elements of the technology in the channel transmission; Backbone network and backhaul; Fiber Optic Technology; Wireless Communication

Technology; Analysis of the spectrum; Modulation and coding techniques; *Multiple Access Techniques; Evolution of 2 g-3 g-4 g Mobile Cellular Technology ; Fading power control Countermeasures; Capacity of Cellular Network*; The technology of *Broadband Wireless Access* more; IP based interconnection; The evolution of mobile moving towards 5 g; Wireless broadband access; Technology platform for the future: Digital TV, Satellite, Cloud Computing, Green IT; *Next Generation Network*; *Content Governance* ; Technology for Ubiquitous Network.
Prerequisite: None
Textbook:
1. R. Frieden, "International Telecommunications Handbook", Artech House, 1996.
2. R.L. Freeman, "Telecommunications System Engineering", Wiley-Interscience, 2004.
3. S. Park, "Strategies and Policies in Digital Convergence", Information Science Reference, 2007.
4. t. Rapaport, "Wireless Communications: Principles and Practice", Prentice Hall, 2002.

ENMT801002
MANAGEMENT OF TELECOMMUNICATIONS SYSTEM
3 CREDITS
Learning Outcomes: The material in this lecture will evaluate the basic concept of telecommunication management system including the concepts of the regulation for the implementation of the national telecommunication system.
Syllabus: Long-range planning; Business Feasibility Analysis; Wide Area Network; Telecommunications Operations – from fraud and disaster prevention to project management; Quality control and Security; Telecommunications Regulation; The Emerging Economics of Telecommunications; Economic Tools for the Telecommunications Strategies; Network and Marketing Plan; Analysis of Indonesian Telecommunications Act; Universal Service Obligation.
Prerequisite: None
Textbook:
1. J.K. Shaw, "Strategic Management in Telecommunications", Artech House Publishers, 2000.
2. J.K. Shaw, "the Telecommunications Deregulation and The Information Economy", 2nd Edition, Artech House Publishers, 2002.

ENMT802003
STRATEGIC MANAGEMENT
3 CREDITS
Learning Outcomes: After following this course, the participants of the lecture are expected to recommend the concept of strategic management to generate business excellence and competitiveness of the industry. Students are expected to understand the applied theories and develop relevant strategies on industrial technology.
Syllabus: The nature of management strategy; *Strategy in Practice; External factors evaluation; Internal factors analysis; Strategy Analysis and Choices; Strategy Control Review and Evaluation; Quality Management; Strategy Management Of Global Problems;* Risk Management; Business Ethics *; Corporate Level Strategy; Strategic Leadership*.
Prerequisite: None
Textbook:
1. David F.R. Friday, "Concepts of Strategic Management," 3rd Edition, Prentice Hall, 2010.
2. M.A. Hitt, R.D. Hoskisson, R.E., "Strategic Management: Concepts and Cases: Competitiveness and Globalization", 9th Edition, South-Western College Pub., 2010

ENMT802004
TELECOMMUNICATIONS POLICY AND REGULATION
2 SKS
Learning Outcomes: Able to evaluate aspects of national and international law, as well as the process of standardization in the telecommunications industry.
Syllabus: The International Telecommunication Organization; Indonesia's telecommunication laws and regulations; The making of public policy; Standardization process in it; International standardization body for the telecommunications industry; Universal Service Obligation; Case studies on policy and regulation of telecommunications in Indonesia and the world.
Prerequisite: None
Textbook:
1. Henry Julian Brand, "E.T." Leo, "The Law and Regulation of Telecommunications Carrier", Artech House Publishers, 1999.
2. P. de Bijl, m. Peitz, "Regulation and Entry into Telecommunications Markets", Cambridge University Press, 2002.

ENMT802005
SPECIAL TOPICS OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
2 SKS
Learning Outcomes: Able to evaluate the various advancements in the field of ICT (information and communication technology).
Syllabus: The topics will focus on the recent technological platform such as 5G *mobile communications*, engineering multimedia, Wireless Sensor Networks, and other aspects of the technology and innovation. The topic will also cover technological understanding covering from "*physical layer*" to "*application layer*".
Prerequisite: None
Textbook: -

ENMT802006
CAPITA SELECTA
2 SKS
Learning Outcomes: The courses aims to build leadership supporting the telecommunications-related strategic planning. **Syllabus:** It includes strategic planning and holistic insights through a process of sharing knowledge with the stakeholders of telecommunications industry (vendors, operators, government). The topic may also include the areas of innovation, convergence, macroeconomic, and another related issue.
Prerequisite: None
Textbook:
Handout

ENMT803007
MULTIMEDIA WIRELESS COMMUNICATIONS
3 CREDITS
Learning Outcomes: At the end of the lecture, students are able to design the design aspects of wireless multimedia technologies, including mobile and broadband network capable of calculating technical parameters.

Syllabus: Quality of Service; Compression techniques; Qualitative and Mathematical treatment of existing systems; Traffic Engineering for Wireless Communications; Mobility Management; Multimedia computing; Network Support for Multimedia communications; Interactive Multimedia System; Intersystem operation.
Prerequisite: None
Textbook:
1. T. Rapaport, "Wireless Communications: Principles and Practice", Prentice Hall, 2002.
2. K.R. Rao, Z.S. Bojkovic, D.A. Milovanovic, "Multimedia Communications System: Techniques, Standards and Networks", Prentice Hall, 2002.

ENMT803008
TECHNOLOGICAL INNOVATION AND COMPETITIVENESS
3 CREDITS
Learning Outcomes: At the end of this lecture, the student will be able to develop a holistic strategy of technological development for policy makers of the country or industry by considering the factors supporting system of innovation. In addition, students will also have insight into the leadership in using information and communication technologies so as to enhance the competitiveness of institutions and countries.
Syllabus: National and Sectoral Innovation System; Macroeconomic Theory and technological change; Evolutionary Theory; Innovation in the telecommunications industry; The management of R & D in telecommunications companies; Diffusion Of Technology; Innovation in ICT Services; Globalization, national competitiveness and economic growth; Science technology is preferred and Innovation Policy; Technological forecasting; Techno economy paradigm; Intellectual Property and Standardization; The Knowledge Economy and ICT paradigm; The Internet and economic policy; Policy and market in the era of the New Knowledge Economy
Prerequisite: None
Textbook:
1. J. Fagerberg, D.C. Mowery, r.r. Nelson, "The Oxford Handbook of Innovation", Oxford University Press, 2006.
2. R. Milson, d. Wilemon, "The Strategy of Managing Innovation and Technology", Prentice Hall, 2007. 3. R. Mansell Avgerou, c., d. Quah, r. Silverstone, "The Oxford Handbook of Information and Communication Technologies", Oxford University Press, 2007.

ENMT803009
FUTURE NETWORK TECHNOLOGY
3 SKS
Learning Outcomes The lecture aims to form a competency evaluation and design of technically related to telecommunication network System the latest technology both wireless and wireline, and telecommunications network management, management function
Syllabus: The function and role of the important telecommunications networks, modeling telecommunication networks, optical networking technologies, wireless network technology, the convergence of future network covering NGN and IMS, role and function of telecommunications network management,
Prerequisites: None
Textbook:
1. T. Plevyak, v. Sahin, "Next Generation Telecommunications Networks, Services and Management", Wiley-IEEE Press, 2010.

2. M. Guizaini, H.H. Chen, c. Wang, "The Future of Wireless Networks: Architectures, Protocols, and Services", CRC Press, 1999

ENME801002
ELECTRIC UTILITY POWER GENERATION ECONOMICS
3 CREDITS
Learning Outcomes: At the end of the lecture, a student is able to describe the method of operation of hydroelectric utilities efficiently without compromising with the development of the business.
Syllabus: Introduction; The utility of the organization; The principle of accounting accomplished; The value of time and money; Income requirements: fixed charge rate; Economic analysis methods; Electric utility system load; Operating system; The stability of the system: reserves, economic characteristics of generating units; Problems on the analysis of the total system; Renewable energy analysis and storage; A comparison of the unit directly; The development of the future.
Prerequisite: None
Textbook:
1. W.D. Marsh, "the 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.

ENME802005
STRATEGIC MANAGEMENT AND RISK
3 CREDITS
Learning Outcomes: This lecture aims to instill the concept of strategic management to generate business excellence and competitiveness of the industry. Students are expected to understand the applied theories and develop relevant strategies on industrial technology.
Syllabus: The nature of management strategy; Strategies in practice; Evaluation of external factors; Analysis of internal factors; Analysis of the strategies and options; Evaluation and control strategy; Quality management; Management strategy of global problems; Risk management; Business ethics; Corporate level strategy; Leadership strategies.
Prerequisite: None
Textbook:
1. David F.R. Friday, "Concepts of Strategic Management," 3rd Edition, Prentice Hall, 2010.
2. M.A. Hitt, R.D. Hoskisson, R.E., "Strategic Management: Concepts and Cases: Competitiveness and Globalization", 9^{th} Edition, South-Western College Pub., 2010

6.5 MASTER PROGRAM IN BIOMEDICAL TECHNOLOGY

Program Specification

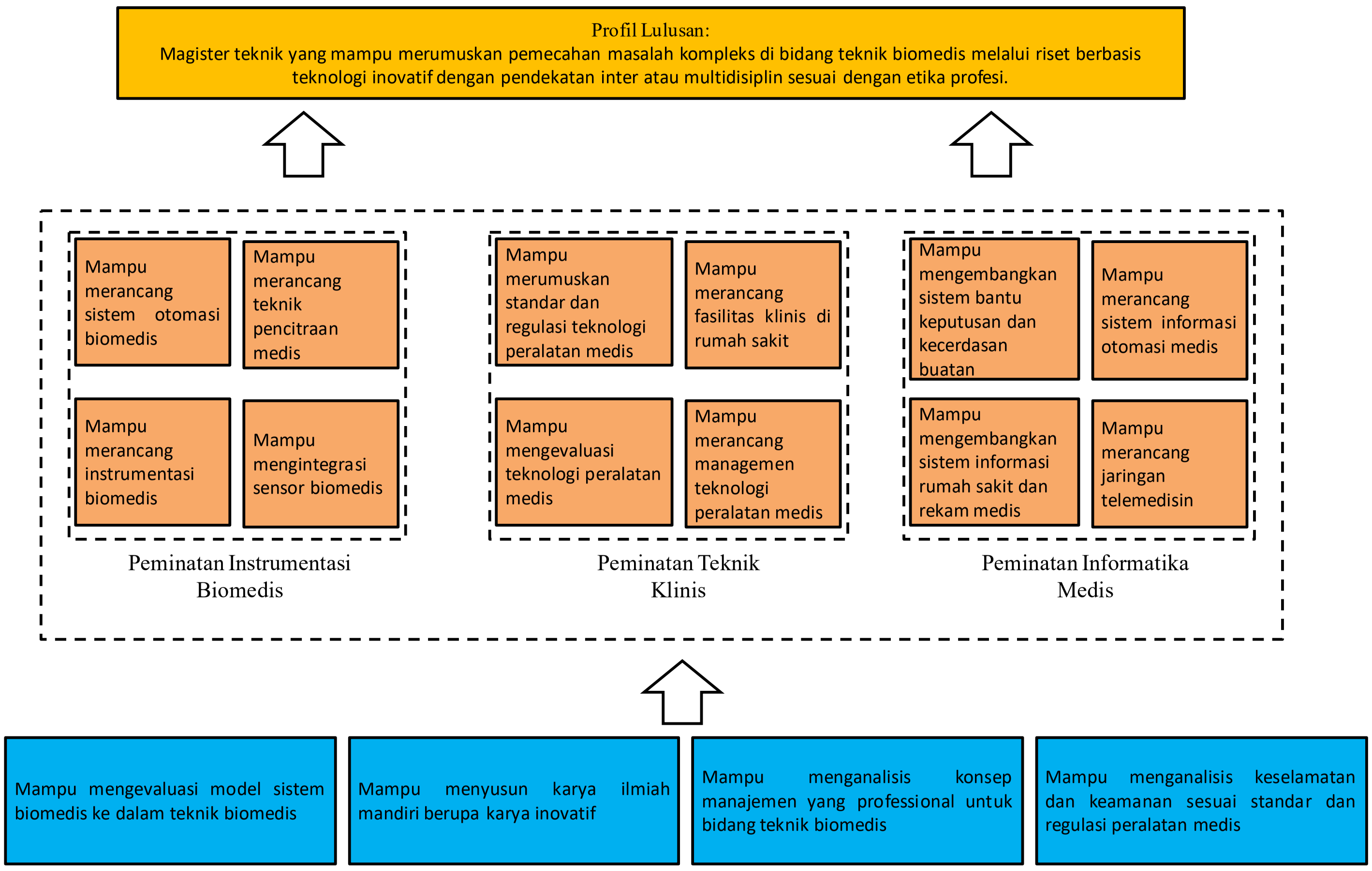
1	**Awarding Institution**		Universitas Indonesia
2	**Teaching Institution**		Universitas Indonesia
3	**Program Title**		Master Program in Biomedical Technology
4	**Class**		Regular
5	**Final Award**		Magister Teknik (M.T.)
6	**Accreditation / Recognition**		BAN-PT: Accreditation B
7	**Language of Instruction**		Bahasa Indonesia / English
8	**Study Scheme (Full Time / Part Time)**		Full Time
9	**Entry Requirements**		Pass the entrance exam, graduate from Bachelor/Diploma 4 in Biomedical Engineering, Medical, Engineering, Science, Computer, Pharmacy, and other subjects of equal.
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 Profile:** Master in Engineering that has the 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.		
12	**Expected Graduate Competence List:** Master in Biomedical Technology graduates are expected to have the following competence: 1. Able to evaluate the model of biomedical system into biomedical engineering. 2. Able to compile independent scientific work in the form of innovative work. 3. Able to analyse a professional management concept for biomedical engineering field. 4. Able to analyse the safety and security in accordance to the standard and regulation of medical equipment. Beside the above competence, a Master in Biomedical Engineering should also have the following specialized competence: Specialization in Biomedical Instrumentation: 1. Able to design biomedical instrumentation 2. Able to integrate biomedical sensor 3. Able to design biomedical automation system 4. Able to design medical imaging technique Specialization in Medical Information: 1. Able to develop hospital and medical record information system 2. Able to design telemedicine network 3. Able to design medical automation information system 4. Able to develop decision help system and artificial intelligence Specialization in Clinical Engineering: 1. Able to evaluate medical equipment technology 2. Able to design medical instrument technology management 3. Able to formulate the standard and regulation for medical equipment technology 4. Able to design clinical facility in hospital		
13	**Classification of Subjects**		
14	**Total Credit Hours to Graduate**		**42 SKS**

Carrier 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.

MASTER PROGRAM

ter Program in Biomedical Technology Competence Network



Picture 1 Biomedical Technology Competence Network

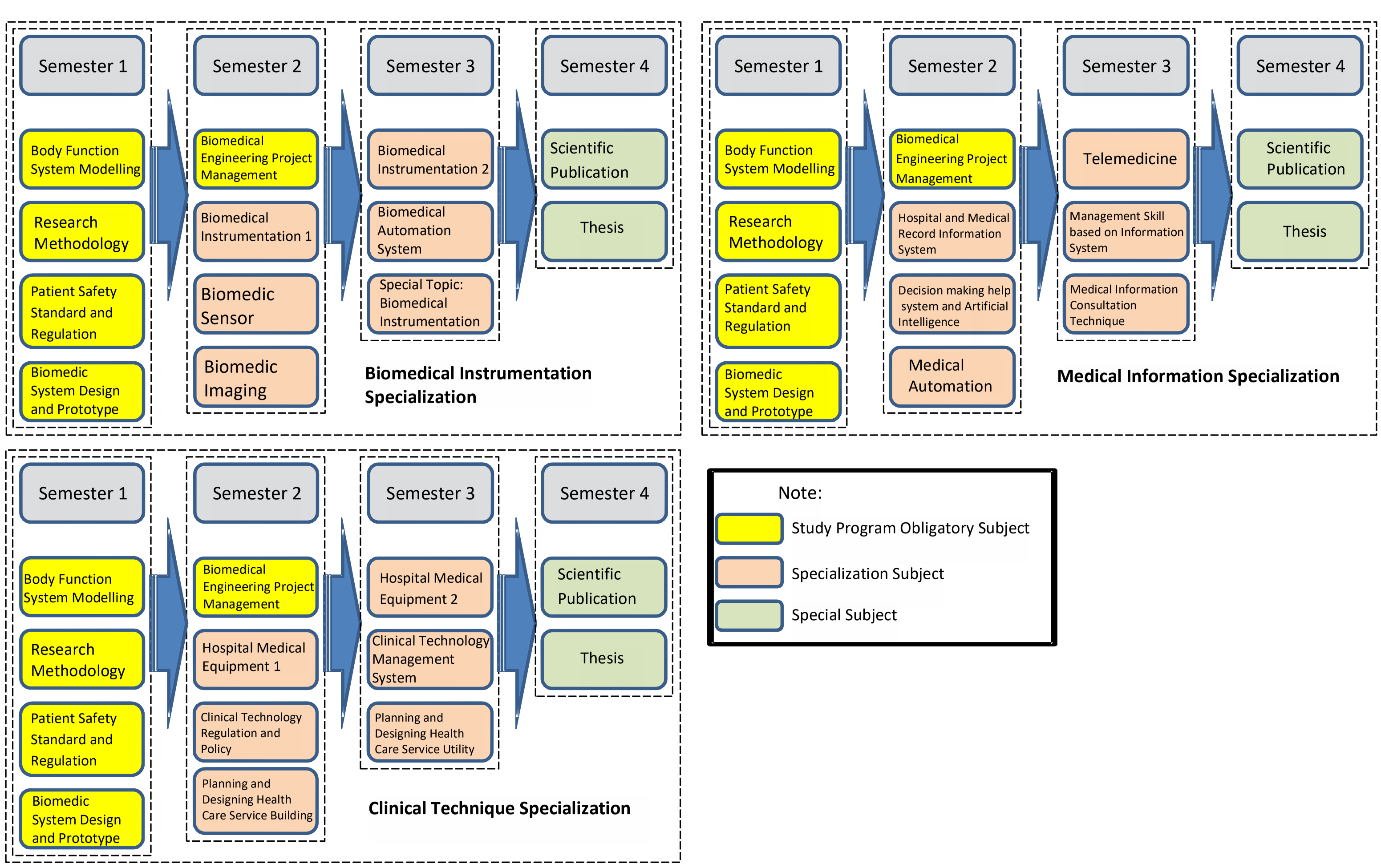
Matrix 0

Table 1. Matrix 0 Biomedical Technology Study Program Learning Outcomes

Master Level		
KKNI Level 8	General Competence	Output
Able to develop knowledge, technology, and/or art in their respective field or professional practice through research to produce innovative and tested work.	• Able to analyse professional management concept for biomedical engineering field. • Able to compile independent scientific work in the form of innovative work. • Able to design medical imaging technique • Able to design telemedicine network	Thesis Summary Paper Scientific Publication Study Report
Able to solve problems in science, technology, and/or art in their field of expertise through inter or multi discipline approach.	• Able to evaluate the biomedical system model into biomedical engineering. • Able to analyse safety and security in accordance to the standard and regulation of medical equipment. • Able to evaluate medical instrument technology • Able to design clinical facility in hospital	Thesis Summary Paper Scientific Publication Study Report
Able to manage research and development that is usefull for society and scientific society, and able to get acknowledgement nationally and internationally.	• Able to design biomedical instrumentation • Able to design biomedical automation system • Able to develop information system for hospital and medical record • Able to develop help system for decision making and artificial intelligence	Thesis Summary Paper Scientific Publication Study Report

Cluster Level	Main Competence	Supporting Competence
Scientific Field	1. Able to evaluate the biomedical system model to biomedical engineering 2. Able to analyse the safety and security in accordance to the standard and regulation of medical equipment	
Biomedical Instrumentation	1. Able to design biomedical instrumentation 2. Able to design biomedical automation system	1. Able to design medical imaging technique 2. Able to integrate biomedical sensor
Clinical Technique	1. Able to design medical equipment technology management 2. Able to formulate technological standard and regulation for medical equipment	1. Able to design clinical facility in hospital
Medical Information	1. Able to develop information system for hospital and medical record 2. Able to develop help system for decision making and artificial intelligence	1. Able to design telemedicine network 2. Able to design medical automation information system
Expertise Work	1. Able to compile independent scientific work in the form of innovative work 2. Able to evaluate medical equipment technology	
Expertise Behavior		
Society Life	Able to analyse a professional management concept in biomedical engineering field	

Course Flowchart for Master Program in Biomedical Technology Study Program



Picture 1 Course Flowchart for Master Program in Biomedical Technology Study Program

List of Subject

Study Program Obligatory Subject (14 credits)

Code	Subject Name	Credit
ENBE801001	Human Body Physiological System Modelling	3
ENBE801002	Research Methodology	2
ENBE801003	Patient Safety Standard and Regulations	3
ENBE801004	Design and Prototyping Biomedical System	3
ENBE802005	Project Management of Biomedical Engineering	3
	Total Credit	**14**

Specialization Subject (18 credits)
Biomedical Instrumentation Specialization

Code	Subject Name	Credit
ENBE802006	Biomedical Instrumentation 1	3
ENBE802007	Biomedical Sensors	3
ENBE802008	Medical Imaging	3
ENBE803009	Biomedical Instrumentation 2	3
ENBE803010	Biomedical System Automation	3
ENBE803011	Special Topic on Biomedical Instrumentation	3
	Total Credit	**18**

Specialization Subject (18 credits)
Medical Information Specialization

Code	Subject Name	Credit
ENBE802014	Hospital Information System and Medical Record	3
ENBE802015	Decision Making System and Artificial Intelligence	3
ENBE802016	Medical Automation	3
ENBE803017	Telemedicine	3
ENBE803018	Information Systems Based Management Skill	3
ENBE803019	Medical Informatics Consultancy	3
	Total Credit	**18**

Specialization Subject (18 credits)
Clinical Technique Specialization

Code	Subject Name	Credit
ENBE802020	Hospital Medical Equipment I	3
ENBE802021	Regulation and Policy of Clinical Technology	3
ENBE802022	Planning and Design of Health Service Building	3
ENBE803023	Hospital Medical Equipment II	3
ENBE803024	Clinical Engineering Management System	3
ENBE803025	Planning and Design of Health Service Utility	3
	Total Credit	**18**

Special Subjects (Scientific Publication, Thesis) (10 credits)

Code	Subject Name	Credit
ENBE804012	Scientific Publication	2
ENBE804013	Thesis	8
	Total Credit	**10**

CURRICULUM STRUCTURE

Curriculum structure for each semester can be found below:

A. Biomedical Instrumentation Specialization

CODE	SUBJECT	SKS
	1st Semester	
ENBE801001	Human Body Physiological System Modelling	3
ENBE801002	Research Methodology	2
ENBE801003	Patient Safety Standards and Regulations	3
ENBE801004	Design and Prototyping Biomedical System	3
	Subtotal	11
	2nd Semester	
ENBE802005	Project Management of Biomedical Engineering	3
ENBE802006	Biomedical Instrumentation 1	3
ENBE802007	Biomedical Sensors	3
ENBE802008	Medical Imaging	3
	Subtotal	12
	3rd Semester	
ENBE803009	Biomedical Instrumentation 2	3
ENBE803010	Biomedical System Automation	3
ENBE803011	Special Topic on Biomedical Instrumentation	3
	Subtotal	9
	4th Semester	
ENBE804012	Scientific Publication	2
ENBE804013	Thesis	8
	Subtotal	10
	TOTAL	42

B. Medical Information Specialization

CODE	SUBJECT	SKS
	1st Semester	
ENBE801001	Human Body Physiological System Modelling	3
ENBE801002	Research Methodology	2
ENBE801003	Patient Safety Standard and Regulations	3
ENBE801004	Prototype Biomedical System Design	3
	Subtotal	11
	2nd Semester	
ENBE802005	Project Management of Biomedical Engineering	3
ENBE802014	Hospital Information System and Medical Record	3
ENBE802015	Decision Making System and Artificial Intelligence	3
ENBE802016	Medical Automation	3
	Subtotal	12
	3rd Semester	
ENBE803017	Telemedicine	3
ENBE803018	Information Systems-Based Management Skill	3
ENBE803019	Medical Informatics Consultancy	3
	Subtotal	9
	4th Semester	
ENBE804012	Scientific Publication	2
ENBE804013	Thesis	8
	Subtotal	10
	TOTAL	42

C. Clinical Technique Specialization

CODE	SUBJECT	SKS
	1st Semester	
ENBE801001	Human Body Physiological System Modelling	3
ENBE801002	Research Methodology	2
ENBE801003	Patient Safety Standards and Regulations	3
ENBE801004	Design and Prototyping Biomedical System	3
	Subtotal	11
	2nd Semester	
ENBE802005	Project Management of Biomedical Engineering	3
ENBE802020	Hospital Medical Equipment I	3
ENBE802021	Regulation and Policy of Clinical Technology	3
ENBE802022	Planning and Desig of Health Service Building	3
	Subtotal	12
	3rd Semester	
ENBE803023	Hospital Medical Equipment II	3
ENBE803024	Clinical Engineering Management System	3
ENBE803025	Planning and Desig of Health Service Utility	3
	Subtotal	9
	4th Semester	
ENBE804012	Scientific Publication	2
ENBE804013	Thesis	8
	Subtotal	10
	TOTAL	42

SUBJECT SYLLABUS
STUDY PROGRAM OBLIGATORY SUBJECT

ENBE801001
HUMAN BODY PHYSIOLOGICAL SYSTEM MODELLING
3 credits
Learning Outcome: After finishing this subject, students are able to analyse physiology system modelling based on human body anatomy and physiology system.
Syllabus: Anatomy and physiology from internal organs, various body function system, human body physics; Modelling principal, mathematic system model and biomedical signal, parameter estimation method; modelling strategy, physiology system compartment model, cardiovascular system model and control, respiratory system model and control, movement control, artificial nerve network for physiology control, physiology method and identification system and fast eye movement control system based on the physiology system
Prerequisite: None
Reference Book:
1. Marieb EN and Hoen K. Human, Anatomy & Physiology. 10th ed. Else vier 2015
2. Cobelli C and Carson ER, Introduction to Modelling in Physiology and Medicine. 1st ed. A volume in Biomedical Engineering. 2008
3. Cobelli C and Carson ER. Modelling Methodology for Physiology and Medicine. 2nd ed. Elsevier 2013

ENBE801002
RESEARCH METHODOLOGY
2 credits
Learning Outcome:
Syllabus: -
Prerequisite: -
Reference Book:
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"

ENBE801003
PATIENT SAFETY STANDARDS DAN REGULATIONS
3 credit
Learning Outcome: This subject aim to analyse the patient's safety of medical device in hospital to guarantee a safer environment for the patient. The system's subsystems includes the safety of the patient, safety for personal and visitor, utilisation, optimization, regulation fulfilment, reduces harm, harm and risk control, preventing accident and injuries and safe condition maintenance.
Syllabus: In term of focusing the discussion on patient's safety in term of the implementation of clinical technology in health care service and the discussion of the role and function of clinical engineers in hospital's patient's safety, this subject will present the following topics of discussion: 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.

Prerequisite: None
Reference Book:
1. Joseph Dyro (ed.), Clinical Engineering Handbook, Elsevier Academic Press, 2004
2. Myer Kutz, Biomedical Engineering and Design Handbook (Volume 2: Applications), McGraw Hill, New York, 2nd edition, 2009.
3. Improving Patient safety: Insights from American, Australian and British Healthcare, ECRI Europe, 2012.
4. Elizabeth Mattox, Medical Devices and Patient Safety, AACN Journals Vol. 32, No.4 August 2014.

ENBE801004
DESIGN AND PROTOTYPING BIOMEDICAL SYSTEM
3 credits
Learning Outcome: Upon completion of this subject, students are expected to have the ability to design system or product/prototype of biomedical system by using knowledge and skill acquired. It is also expected that by taking this subject, students are able to work as a team, communicate, report, defend and present their final project.
Syllabus: Fundamental of Problems and Prototype Design Process; Working as a Team in Design; Design Process Planning; Understanding the Problem and Engineering Specifications Development; Concept Generation, Evaluation and Selection; Product Design Phase; Engineering Economic, Product/Prototype Design for manual assembly and automatic assembly design.
Prerequisite: None
Reference Book:
1. G.Ullman: The Mechanical Design Process, 4th ed. McGraw-Hill. 2009.
2. G. 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.
4. G. Boothroyd, P. Dewhurst, W.A. Knight: Product Design for Manufac ture and Assembly, 3rd Ed. CRC Press, 2011.

ENBE802005
PROJECT MANAGEMENT OF BIOMEDICAL ENGINEERING
3 credits
Learning Outcome: This subject aim to be able to design a professional management for biomedical engineering field, management evaluation and project economic aspects design. Thus students are expected to understand the basic theories to support feasibility analysis for investment and service development/application for biomedical technology.
Syllabus: Comprehension of project and project management; organizational structure; function management; Leadership in project environment; Conflict Management; Investment Analysis; Control Analysis for Infrastructure Development; Expense and the allocation of wealth; Risk Management and Quality Management, Work Breakdown Structure; Scheduling (Gantt Chart), Resource Budgeting, Controlling (S-curve).
Prerequisite: None
Reference Book:
1. H. Kerzner, "Project Management: A System Approach to Planning, Scheduling and Controlling", John Wiley & Sons, 2009.
2. J.R. Meredith, S.J. Mantel, Jr. "Project Management: A Managerial Approach", 6th Edition, John Wiley & Sons, 2006.

SPECIALIZATION SUBJECT
BIOMEDICAL INSTRUMENTATION SPECIALIZATION

ENBE802006
BIOMEDICAL INSTRUMENTATION 1
3 credits
Learning Outcome: Upon completion of this subject, students are able to explain the low and middle technology biomedical instrumentation in patient's diagnostic service in health care service facilities.
Syllabus: Introduction for major equipment used in health care facilities such as hospitals. The working principles for each instruments, operating steps, main features, method to test and evaluate equipment's performance and safety. Biomedical Instrumentation which will be discussed are: Fundamental of medical instrumentation system; Vital sign monitoring; External defibrillator; Cardiac Defibrillator; Ventilator system; Anaesthesia machine; Clinical laboratory equipment.
Prerequisite: None
Reference Book:
1. B. H. Brown et al., Medical Physics and Biomedical Engineering, Institute of Physics Publishing, Bristol, 1999.
2. John G. Webster (ed.), Medical Instrumentation: Application and Design, John Willey & Sons, 2010.
3. John G. Webster (ed.), Encyclopaedia of Medical Devices and Instrumentation, John Wiley & Sons, 2nd Ed., 2006.
4. S. Ananthi, A Textbook of Medical Instruments, New Age International Ltd, New Delhi 2005.
5. R.S. Khandpur, Biomedical Instruments: Technology and Applications, McGraw-Hill, 2nd Ed. New Delhi 2003.

ENBE802007
BIOMEDICAL SENSOR
3 credits
Learning Outcome: Upon completion of this subject, students are expected to:
• Determine the type of sensor and transducer for certain application.
• Understanding the requirement for special sensor that will be used in biomedical application.
• Able to explain how transducer can be connected and operated in several medical diagnostic equipment.
• Choosing the correct interface between transducer and the human body when making contact.
• Predicting the expected level of reliability for several types of sensor structure and application.
Syllabus: Introduction, Sensor Technologies, Basic Sensor Structures, Sensing Effects, Physical Sensors and Their Applications in Biomedicine, Sensors for Measuring Chemical Quantities in Biomedicine, Biosensors, Biocompatibility of Sensors.
Prerequisite: None
Reference Book:
1. T. Togawa, T. Tamura, P.Å. Oberg, Biomedical Sensors and Instruments, CRC Press, 2nd Ed. 2011.
2. G. Harsanyi, Sensors in Biomedical Applications: Fundamentals, Technology and Applications, CRC Press, 2000.

ENBE802008
MEDICAL IMAGING
3 credits
Learning Outcome: Upon completion of this subject, students are expected to:
• Able to identify the available medical imaging technology;
• Able to analyse the medical imaging processing method in reconstruc tion, improve image quality, create image segmentation, image analysis, image visualization, and management of medical imaging;
• Able to design medical imaging technique for certain application in health field.
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 pre-processing and acquisition artefacts, 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), visual imaging and digital, image transformation, colour representation, image enhancement (domain spatial), image enhancement (frequency domain), convolution and correlation, image segmentation, object feature characteristics, image compression, pattern recognition, image restoration, image morphology.
Prerequisite: None
Reference Book:
1. Handbook of Medical Imaging: Processing and Analysis Management, Isaac Bankman, Academic Press 2000, CA, USA.
2. Handbook of Medical Imaging, Vol. 2: Medical Image Processing and Analysis, M. Sonka & J.M. Fitzpatrick, SPIE Press, 2009, Washington, USA.
3. R.C. Gonzalez, R.E. Woods, and S.L. Eddins, "Digital Image Processing using MATLAB", 2nd Edition, Gatesmark Publishing, 2009.

ENBE803009
BIOMEDICAL INSTRUMENTATION 2
3 credits
Learning Outcome: Upon completion of this subject, students are able to explain the mid-level and high level biomedical technology instrumentation in patient's diagnostic service in the health care service facility.
Syllabus: Introduction to high technology in health care service facility like hospital. Working principles for each instruments, operating steps, main features, method to test and evaluate equipment's performance and safety. Biomedical Instrumentation that will be discussed: X-ray fundamental; Radiographic system; Fluoroscopic system; Computed tomography (CT Scanner); Magnetic resonance imaging (MRI); Positron-emission tomography (PET)y; Linear accelerator (LINAC); Nuclear Medicine Equipment System.
Prerequisite: None
Reference Book:
1. John G. Webster (ed.), Encyclopaedia of Medical Devices and Instru mentation, John Wiley & Sons, 2nd edition, 2006.
2. Joseph Bronzino (ed.), The Biomedical Engineering Handbook: Medical Devices and Systems, CRC Press, 3rd edition, 2006.

3. Myer Kutz, Biomedical Engineering and Design Handbook (Volume 1: Fundamentals), McGraw Hill, New York, 2nd edition, 2009.
4. S. Ananthi, A Textbook of Medical Instruments, New Age International Ltd, New Delhi 2005.
5. R.S. Khandpur, Biomedical Instruments: Technology and Applications, McGraw-Hill, 2nd Ed. New Delhi 2003.

ENBE803010
BIOMEDICAL SYSTEM AUTOMATION
3 credits

Learning Outcome: Upon completion of this subject, students are expected to be able to understand the concept of biomedical automation system and modelling, able to develop mathematical model for biomedical system, able to analyse biomedical system model, able to define the problem and automation need for biomedical system, able to applied automation method in biomedical system, able to design biomedical automation system.

Syllabus: Basic concept for system-model-simulation for biomedical system, State Space Equation and biomedical system transfer function, model analysis via simulation, parameter identification biomedical system model, parameter estimation method, biomedical system model simulation, biomedical system optimizing model, PID control and optimal, biomedical automation system design, biomedical automation system simulation and analysis.

Prerequisite: None

Reference Book:
1. Michael C. K. Khoo," Physiological Control Systems: Analysis, Simulation, and Estimation", Institute of Electrical and Electronics Engineers 2000.
2. Shimon Y. Nof, "Springer Handbook of Automation", Springer Verlag 2009.
3. John D. Enderle, Joseph D. Bronzino, "Introduction to Biomedical Engineering", Elsevier Inc. 2012.

ENBE803011
SPECIAL TOPIC ON BIOMEDICAL INSTRUMENTATION
3 credits

Learning Outcome: Upon completion of this subject, students are expected to be able to explain the biomedical instrumentation technology used in diagnostic or the latest therapy in support of health care service.

Syllabus: Follow the previously set special topic

Prerequisite: None

Reference Books:
1. R.S. Khandpur, Biomedical Instruments: Technology and Applications, McGraw-Hill, 2nd Ed. New Delhi 2003.
2. Joseph Bronzino (ed.), The Biomedical Engineering Handbook: Medical Devices and Systems, CRC Press, 3rd edition, 2006.

SPECIALIZATION SUBJECT
MEDICAL INFORMATION SPECIALIZATION

ENBE802014
HOSPITAL INFORMATION SYSTEM AND MEDICAL RECORD
3 credits

Learning Outcome: Upon completion of this subject, students are expected to be able to develop Hospital information system and able to develop Medical Record Information System.

Syllabus: Hospital Law, Regulation from the Ministry of Health regarding Hospital, Regulation from the World Health Organization, Hospital Clinical Information System, Hospital Management Information System, Regulation from the Ministry of Health regarding Medical Record, ICD 10, Coding, In-CBGs.

Prerequisite: None

Reference Books:
1. Sabarguna, B.S, Sistem Informasi pada Peralatan Medis Rumah Sakit, UI Press, Jakarta, 2016
2. Carnivero, J & Fernandez, A, e-Health Handbook, SEIS Technical Secretary's Office: CEFIC Enrique Larreta St., 5, bajo izda. 28036 -Madrid (Spain)

ENBE802015
DECISION MAKING SYSTEM AND ARTIFICIAL INTELLIGENCE
3 credits

Learning Outcome: Upon completion of this subject, students are expected to be able to develop Medical Information System, able to develop Decision Making Help System, able to develop Expert System, able to develop Artificial Intelligence.

Syllabus: Electronic Hospital, Clinical Information System, Clinical Decision Making Help System, Hospital Decision Making Help System, Expert System in the Clinical Information System, Enterprise Resource Planning (ERP), Artificial Intelligence System in Medical Information field.

Prerequisite: Hospital Information System and Medical Record

Reference Book:
1. Sabarguna, B.S., Atlas of Managing Information In Hospital, Sagung Seto, 2009
2. Sabarguna, B.S., Management Decision Skill, UI Press, UI Press, 2006

ENBE802016
MEDICAL AUTOMATION
3 credits

Learning Outcome: Upon completion of this subject, students are expected to develop automation system in Medical Information and able to develop Medical Robot.

Syllabus: Medical Information System Model, Medical Service Automation Installation, Supporting Robot, Independent Robot.

Prerequisite: None

Reference Books:
1. Sabarguna, B.S., Sistem Robot Medis, UI Press, 2010
2. Shimon Y. Nof, Springer Handbook of Automation, Springer: Berlin, Heidelberg, 2009.

ENBE803017
TELEMEDICINE
3 credits

Learning Outcome: Upon completion of the subject, students are expected to:
- Able to develop telemedicine concept, able to develop telemedicine infrastructure;
- Able to develop and implement telemedicine practice;
- Able to develop Telemedicine Management Service

Syllabus: Telemedicine concept and service; Infrastructure, including tools, system, network, guidance, building, electricity; Operational, including Preparation, imple-

mentation, report, and evaluation; Management, including planning, budgeting, evaluation, and follow up.
Prerequisite: None
Reference Books:
1. Sabarguna, B.S., Telemedisin, UI Press, 2017,
2. WHO, Telemedicine, Tersedia di: http://www.who.int/goe/publications/goe_telemedicine_2010.pdf

ENBE803018
INFORMATION SYSTEMS BASED MANAGEMENT SKILL
3 credits
Learning Outcome: Upon completion of this subject, students are able to implement systematic and innovative thinking skill in supporting professional conduct, able to implement personal management skill in supporting professional conduct, able to implement management skill with others in supporting professional conduct, able to implement management skill based on information system in supporting professional conduct.
Syllabus: Systematic thinking, Innovative thinking, Innovative based Learning; Listening, Reading, Scientific Writing; Presentation, Motivation, Communication, Meeting, Coaching, Bargaining, On Line Discussion, Team Building, Management Tools, Management Technique, Management Accounting.
Prerequisite: None
Reference Books:
1. Sabarguna, B.S., Keterampilan Manajemen Berbasis Sistem Informasi, UI Press, 2009
2. Hoyt, R.E., Medical Informatics: practical guide for the healthcare professional, Lulu.com, ISBN-13: 978-0-557-13323-9, 2009.

ENBE803019
MEDICAL INFORMATICS CONSULTANCY
3 credits
Learning Outcome: Upon completion of this subject, students are expected to:
- Posses the ability as a consultant,
- Able to create consultancy tools,
- Able to market medical information consultancy service.
- Possess the skill as a consultant,
- Able to create consultancy equipment,
- Able to market medical information consultancy service

Syllabus: Consultant Characteristic, Successful Consultant, Consultant Training, Master Plan, Feasibility Study, Business Plan, Medical Information System Maintenance, Medical Information System Development, Medical Information Consultant Service Marketing.
Prerequisite: Management Skill based on Information System
Reference Books:
1. Sabarguna, B.S., Manajemen Strategik RS Berbasis Sistem Informasi, Konsorsium, 2006
2. Sabarguna, B.S., Sistem Informasi untuk Perencanaan dan Pengendalian Pemasaran RS, Konsorsium, 2006
2. A Career in Health Care Informatics: The Outlook and Options, Univ. of San Diego, Tersedia di website: http://resourceconnect.ahima.org/uploads/assets/3838/document/0003USDGuideHealthCareFinal.pdf

SPECIALIZATION SUBJECT
CLINICAL TECHNIQUE SPECIALIZATION

ENBE802020
HOSPITAL MEDICAL EQUIPMENT I
3 credits
Learning Outcome: This subject is aimed to provide knowledge to students on Hospital Instrumentation Technology in patient diagnostic service.
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;
• Anaesthesia 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.

ENBE802021
REGULATION AND POLICY OF CLINICAL TECHNOLOGY
3 credits
Learning Outcome: the aim of this subject is to study and analyse the standard and regulation for clinical technology both globally and nationally that are used to support the conformity of clinical technology management quality in health service in hospital.
Syllabus: This subject will study the following topics: Primer on Standards and Regulations; Medical Device Regulatory and Technology Assessment Agency; Healthcare Quality and ISO 9001: 2016; Hospital Facilities Safety Standards; JCI Accreditation; KARS Accreditation (Hospital Accreditation Committee/ Komite Akreditasi Rumah Sakit); Indonesia National Standard for Clinical Technology; KARS 2012 Facility Management Standard; Regulation and Law for Clinical Technology in Indonesia; Indonesia's Health Law, Indonesia's Hospital Kaw; Public Policy in Clinical Technology; Rules and Regulation on Medical Equipment in Indonesia; Case Study on Policy and Regulation of Clinical Technology in Indonesia.
Prerequisite: None
Reference Books:
1. WHO (2003), Medical device regulations: Global overview and guiding principle, Geneva.

2. Joseph Dyro (ed.), Clinical Engineering Handbook, Elsevier Academic Press, 2004
3. GHTF Regulatory Model Working, Global Harmonization Task Force Medical De vice Regulation Model, GHTF, 2009
4. ISO 13485: 2016 Medical devices -- Quality management systems -- Require ments for regulatory purposes.

ENBE802022
PLANNING AND DESIGN OF HEALTH SERVICE BUILDING
3 credits
Learning Outcome: This subject is aimed to study the Planning and Design for Hospital Building in relation to technical requirements for patient, staff and visitor safety.
Syllabus: Patient's safety in health care facility is the main goal for planning program and building planning in clinical environment. In this study, a proactive management program is very important to ensure a safe environment for the patient, visitor and hospital staff. The topics that will be discussed in this subject includes:
• Planning and designing of a new hospital;
• General requirement of healthcare facilities;
• Requirements of operating theatre;
• Requirements of radiology department;
• Requirements of intensive care unit;
• Requirements of medical laboratory
Prerequisite: None
Reference Books:
1. G. D. Kunders, Hospitals Facilities Planning and Management, Tata Mc-Graw-Hill, 2005.
2. American Institute of Architects. Guidelines for Design and Construction of Hos pital and Health CarenFacilities. Washington, DC, American Institute of Archi tects, 2001.
3. Kemenkes RI, Pedoman Teknis Bangunan Rumah Sakit Kelas B, 2012.
4. Kementerian Kesehatan RI, Permenkes No. 2306 Tahun 2011 tentang Persyaratan Teknis Prasarana Instalasi Elektrikal Rumah Sakit.

ENBE803023
HOSPITAL MEDICAL EQUIPMENT II
3 credits
Learning Outcome: This subject focuses in giving students the knowledge on Hospital instrumentation technology in patient's diagnostic service.
Syllabus: Study on high technology equipment used by health professionals in Hospital. This study includes the physiology principles in each clinical technology equipment, operation principles, main features, method for testing and evaluating work display and equipment safety, a review on equipment currently available. The clinical equipment discussed in this subject includes:
• X-ray fundamental;
• Radiographic system;
• Fluoroscopic system;
• Computed tomography (CT Scanner);
• Magnetic resonance imaging (MRI);
• Positron-emission tomography (PET)y;
• Linear accelerator (LINAC);

• Nuclear Medicine Equipment System
Prerequisite: None
Reference Books:
1. John G. Webster (ed.), Encyclopaedia of Medical Devices and Instrumentation, A John Wiley & Sons, 2nd edition, 2006.
2. Joseph Bronzino (ed.), The Biomedical Engineering Handbook: Medical Devices and Systems, CRC Press, 3rd edition, 2006.
3. Myer Kutz, Biomedical Engineering and Design Handbook (Volume 1: Fundamen tals), McGraw Hill, New York, 2nd edition, 2009.
4. Myer Kutz, Biomedical Engineering and Design Handbook (Volume 2: Applica tions), McGraw Hill, New York, 2nd edition, 2009.

ENBE803024
CLINICAL ENGINEERING MANAGEMENT SYSTEM
3 credits
Learning Outcome: To study and understand the development and implementation of comprehensive technology management program with systematic approach, since technology management program must also includes not only the engineering and maintenance aspect of health equipment, but also the development of the institution's policy in regulating the procurement, usage, replacement and placement of equipment.
Syllabus: The materials that will be discussed in this subject includes: 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 management 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, and Clinical engineering program indicators.
Prerequisite: None
Reference Books:
1. Joseph Dyro (ed.), Clinical Engineering Handbook, Elsevier Academic Press, 2004.
2. Joseph Bronzino, Management of Medical Technology: A Primer for Clinical Engi neers. Boston, Butterworth/Heinemann, 1992.
3. Cram, N. Using Medical Technology Assessment as a Tool for Strategic Planning, J Clin Eng 24(2): 113-123, 1999.
4. AAMI, Recommended Practice for a Medical Equipment Management Program, American National Standard ANSI/AAMI EQ56, 1999.

ENBE803025
PLANNING AND DESIG OF HEALTH SERVICE UTILITY
3 credits
Learning Outcome: Analyse planning and designing Hospital Building Utility in regard to patient's safety issues, design requirements, suitable specification and criteria, the operation and usage requirement of medical facilities.
Syllabus: Patient's safety in health care facilities is the main topic of the planning and designing building utility program in clinical environment. In this perspective, a proactive management program is very important to ensure a safe environment for the patient, visitor and hospital staff. The topic that will be discussed includes: Physical Plant; Heating, Ventilation and Air Conditioning; Electrical Power in Health-

care Facilities; Medical Gas System; Radiation Safety; Sanitation; Water System in Healthcare facilities; Fire System in Healthcare Facilities; Disaster Planning.
Prerequisite: None
Reference Books:
1. G. D. Kunders, Hospitals Facilities Planning and Management, Tata Mc-Graw-Hill, 2005.
2. American Institute of Architects. Guidelines for Design and Construction of Hos pital and Health CarenFacilities. Washington, DC, American Institute of Architects, 2001.
3. Kemenkes RI, Pedoman Teknis Bangunan Rumah Sakit Kelas B, 2012.
4. Kementerian Kesehatan RI, Permenkes No. 2306 Tahun 2011 tentang Persyaratan Teknis Prasarana Instalasi Elektrikal Rumah Sakit.

SPECIAL SUBJECT
ENBE804012
SCIENTIFIC PUBLICATION
2 credits
Learning Outcome: Students are expected to write scientific paper, present it in a national or international seminar and publish said paper in a publicize edition of proceeding or journal.
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. How to Write & Publish a Scientific Paper, Robert A. Day, Publisher: Oryx Press 5th Ed., 1998.
2. Technical Guidance for Universitas Indonesia Students' Final Project
3. IEEE - Publish a Paper with IEEE (www.ieee.org)

ENBE804013
THESIS
8 credits
Learning Outcome: In this subject, students are directed to develop an independent research under the guidance of a supervisor. Upon completion of this subject, students are expected to be able create a research concept by involving existing theory. Under the guidance of a supervisor, students are expected to be able to design, integrate, implement and analyse that concept and compile the research in a systematic scientific work in the form of thesis book. Students should also present and defend the concept and their research result in front of a panel of examiners in a Thesis examination.
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"

6.6 MASTER PROGRAM IN METALLURGY AND MATERIALS ENGINEERING

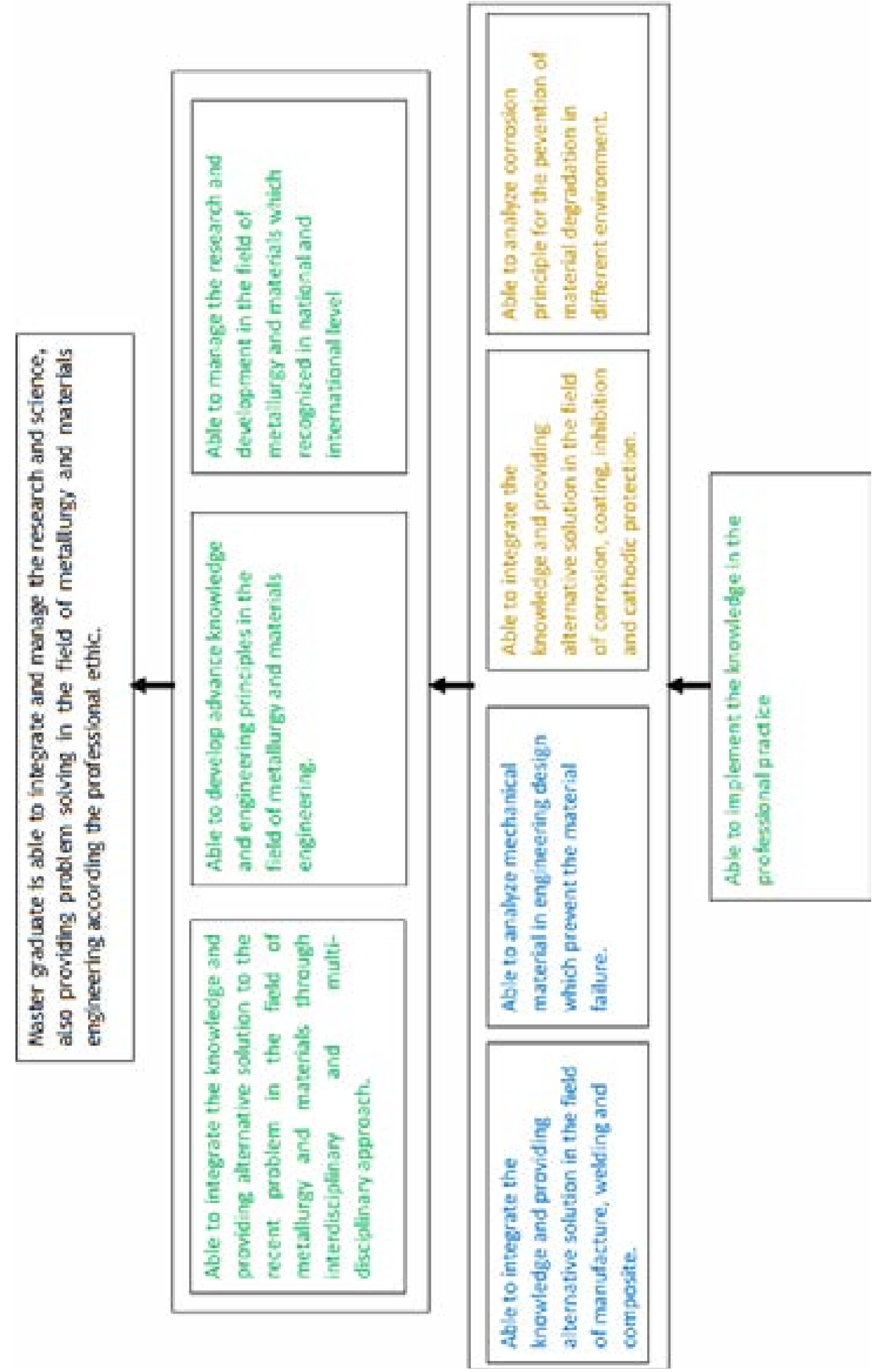
Program Specification

1	**Degree Awarding Institution**		Universitas Indonesia Double degree : Universitas Indonesia & partner universities
2	**Organizing Institution**		Universitas Indonesia Double degree : Universitas Indonesia & partner universities
3	**Name of Study Program**		Graduate Program in Metallurgy and Materials Engineering
4	**Type of class**		Regular, Special
5	**Awarding Degree**		Magister Teknik (M.T.) Double Degree: Magister Teknik (M.T.) dan Master of Engineering (M.Eng.)
6	**Grade of Accreditation**		BAN-PT: "A" Grade AUN-QA: Accredited
7	**Literate Language**		Bahasa (Indonesia) and English
8	**Scheme of Learning (Full-time / Part-time)**		Full-time
9	**Study requirements**		Bachelor Graduate (S1) / equivalent
10	**Term of Study**		Programmed for 2 years
	Type of Semester	Number of semester	Number of weeks /semester
	Regular	4	17
	Short (optional)	1	8
11	**Specialization:** Materials Specialization Corrosion Specialization		
12	**Graduate profile:** Master graduate is able to integrate and manage the research and science, also providing problem solving in the field of metallurgy and materials engineering according the profesional ethic.		
13	**List of Competence Graduates:** 1. Able to develop advance knowledge and engineering principles in the field of etallurgy and materials engineering. 2. Able to implement the knowledge in the profesional practice 3. Able to integrate the knowledge and providing alternative solution to the recent problem in the field of metallurgy and materials through interdisplinary and multidisplinary approach. 4. Able to manage the research and development in the field of metallurgy and materials which recognized in national and international level 5. Able to analyze mechanical material in engineering design which prevent the material failure. 6. Able to integrate the knowledge and providing alternative solution in the field of manufacture, welding and composite. 7. Able to analyze corrosion principle for the pevention of material degradation in different environment. 8. Able to integrate the knowledge and providing alternative solution in the field of corrosion, coating, inhibition and cathodic protection.		
14	**Course Composition**		
No	Types of Courses	(SKS)	Percentage
i	Compulsory Courses	33	75 %
ii	Elective Courses	3	7 %
iii	Seminar and Thesis	8	18 %
		44	100 %
14	**Total Credits to Graduate**		**44 SKS**

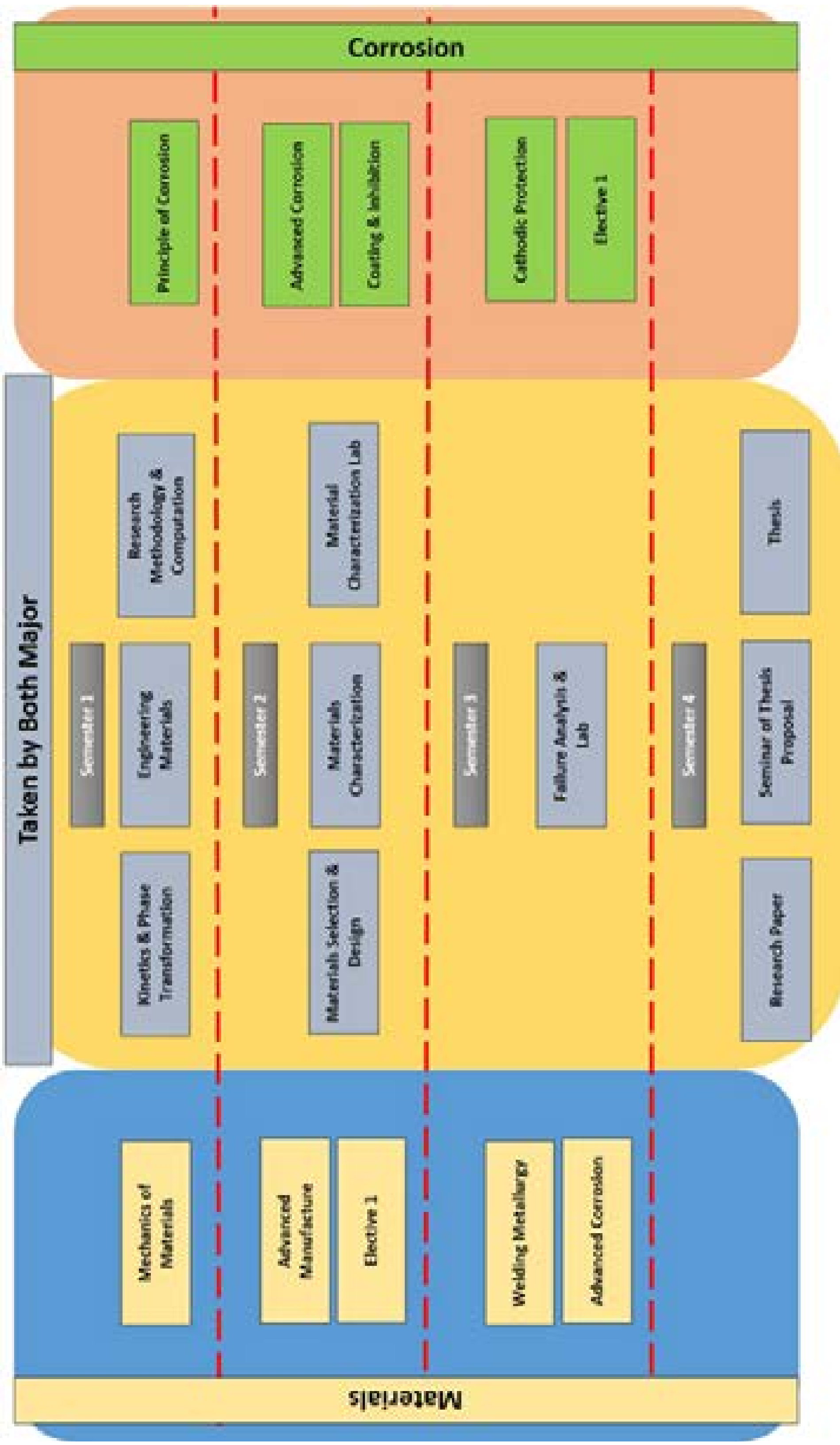
FACULTY OF ENGINEERING

With the increasing development of technology-based industrial materials, the Department of Metallurgical Engineering & Material continuously seek to improve the curriculum in accordance with technological developments. Metallurgy and Materials engineering is a discipline that studies the production, characterization, materials selection and engineering design (engineering materials). Functionally, the role of a master engineering such as designing new materials / modification, develop new manufacturing processes / modifications, material selection, structural characterization (nano, micro and macro) and properties of the material and analyzing the event of a failure in its use.
Master's program curriculum in the field of metallurgical engineering and materials designed to provide opportunities for learners are able to design, select and develop metallurgical processes and material technology, new materials characterization / modifications and be able to control the damage / degradation of material due to media and the environment through corrosion protection techniques and material selection. To that end, the curriculum syllabus 2012 master program FTUI metallurgical engineering and materials designed for 2 (two) types of specialization are:

1. Specialisation of Materials (Materials)
2. Specialisation Corrosion (Corrosion)



MASTER PROGRAM



COURSE STRUCTURE MASTER METALLURGY & MATERIALS ENGINEERING

Rekayasa Material

CODE	SUBJECT	Credit
	1st Semester	
ENMT 8 0 1 001	Kinetics & Phase Transformation	3
ENMT 8 0 1 002	Engineering Materials	2
ENMT 8 0 1 003	Research & Computational Methods	3
ENMT 8 0 1 104	Mechanics of Materials	3
	Sub Total	**11**
	2nd Semester	
ENMT 8 0 2 006	Design & Selection of Materials	3
ENMT 8 0 2 007	Material Characterization	3
ENMT 8 0 2 008	Material Characterization Lab.	1
ENMT 8 0 2 109	Advanced Manufacture	3
	Electives 1	3
	Sub Total	**13**
	3rd Semester	
ENMT 8 0 3 012	Failure Analysis & Lab.	4
ENMT 8 0 3 114	Welding Metallurgy	3
ENMT 8 0 3 113	Advanced Composites	3
	Sub Total	**10**
	4th Semester	
ENMT 8 0 0 016	Research Paper	2
ENMT 8 0 0 017	Seminar of Thesis Proposal	2
ENMT 8 0 0 018	Thesis	6
	Sub Total	**10**

Korosi & Proteksi

CODE	SUBJECT	Credit
	1st Semester	
ENMT 8 0 1 001	Kinetics & Phase Transformation	3
ENMT 8 0 1 002	Engineering Materials	2
ENMT 8 0 1 003	Research & Computational Methods	3
ENMT 8 0 1 205	Principles of Corrosion	3
	Sub Total	**11**
	2nd Semester	
ENMT 8 0 2 006	Design & Selection of Materials	3
ENMT 8 0 2 007	Material Characterization	3
ENMT 8 0 2 008	Material Characterization Lab.	1
ENMT 8 0 2 210	Advanced Corrosion	3
ENMT 8 0 2 211	Coating & Inhibition of Materials	3
	Sub Total	**13**

	3rd Semester	
ENMT 8 0 3 012	Failure Analysis & Lab.	4
ENMT 8 0 3 115	Cathodic Protection	3
	Electives 1	3
	Sub Total	10
	4th Semester	
ENMT 8 0 0 016	Research Paper	2
ENMT 8 0 0 019	Thesis	8
	Sub Total	10

Resume

Wajib Program Studi	29
Peminatan Korosi & Proteksi	12
Jumlah	41
Pilihan	3
Total Beban Studi	44

ELECTIVES

CODE	ELECTIVES ODD SEMESTER	Credit
ENMT 8 0 3 919	Project Management	3
ENMT 8 0 3 920	Electronic Materials	3
ENMT 8 0 3 921	Polymer Derivatives	3
ENMT 8 0 3 922	RBI & Integrity	3
CODE	ELECTIVES EVEN SEMESTER	Credit
ENMT 8 0 4 923	Advanced Polymer Manufacturing	3
ENMT 8 0 4 924	Advanced Extractive Metallurgy	3
ENMT 8 0 4 925	Advanced Surface Engineering	3
ENMT 8 0 4 926	Polymer Manufacturing Technology	3
ENMT 8 0 4 927	Nano Technology	3

Curriculum of 2016 – Subjects Syllabus
Master Degree - Dept. of Metallurgy & Materials Engineering

ENMT 801001 - KINETICS & PHASE TRANSFORMATION- (3 Credit Points)
Review on Thermodynamics andPhase Equilibrium: Single Component System,Binary Component System, The Phase Rule, BinaryPhase Diagrams, Reactions in the solid state; Fe-Fe3C Phase Diagram; Ternary System Representation, Ternary System containing 2 phase; Diffusion in Materials: Atomic mechanism ofdiffusion, Interstitial diffusion, Substitutional diffusion, Tracer diffusion in binary alloys, Diffusionin multiphase binary system, Journal review; Crystal Interface and Microstructure: Interfacialfree energy, Grain boundary, Interphase interfacesin solids, Interface migration, Morphology ofprecipitates, Case study in Crystal Interface; Solidifiation: Nucleation in pure metals, Growthof pure solid, Cellular and dendritic solidifiation,Solidifiation of alloy, Application of solidifiation theory in casting and welding, Solidifiationduring quenching from the melts, Case study; diffusional Transformation in Solids: Homogeneous and heterogeneous nucleation in solids,Precipitate growth, Transformation kinetics, Eutectoid transformation, Ordering transformation,Case study; (8) Diffusionless Transformation inSolids: Theories of martensite nucleation, Martensite growth, Tempering of ferrous martensite,Martensite transformation in nonferrous metals,Spinodal transformation, Case study in Diffusionless transformation

ENMT 801002 - ENGINEERING MATERIALS – (2 Credit Points)
Fundamental theories of materials including theories of atom, atomic bonding, bonding system; crystal structures; material structures and properties; ferrous material selection: classifiation designation and specifications of steel, low alloy steel, heat treatable carbon steel, and low alloy steel; selection of tool steels, stainless steels, cast irons; non-ferrous material selection(Al, Ti, Mg, Ni, and their alloys); shape memory alloys (smart materials); inorganic materials: ceramics and glasses, mechanical behaviour of ceramics; polymer materials, selection of plastics, polymerisation and composite materials.

ENMT 801003 - RESEARCH AND COMPUTATIONAL METHODS – (3 Credit Points)
Scientific understanding, researchmethod, problem specifiation, hypothesis, literature study, data collection and processing,elaboration of research proposal and scientific work presentation; Computation, matlab basics,logical expression, vectorisation, flow controlusing if and while, loop in matlab, function andm-file, test output, programming matlab, binarynumber, flating point numbers, device precision,linear equation, curve fiting, differential equation, statistics and analysis of process data.

ENMT 801104 - MECHANICS OF MATERIALS – (3 Credit Points)
Introduction to mechanics of materials,types of material failure, engineering and selection of materials, elastic deformation and theoryof strength, inelastic deformation, metals and alloys processing, composites, ceramics and glasses,polymers, concept of stress and strain, rheologicalmodel, plastic deformation, creep deformation,anisotropic materials, theory of mechanicaltesting of materials, stress-strain properties,tendency of tensile behaviour, interpretation oftrue stress-strain, compression, hardness, impact,bending and torsion testings, plane stress, planestrain, three dimensional stress condition, stresson octahedral plane, complex strain condition,common form of failure criteria, concept offracture mechanics, fracture toughness value,application of K value in design and analysis, fatigue based on stress, loading cycle, stress-timecurve, average stress, multiaxial stress, fatiguecrack growth, fatigue based on strain, strain vsage, effect of average stress, lifetime estimationof structural components and creep.

ENMT 801205 - PRINCIPLES OF CORROSION – (3 Credit Points)
Fundamental concepts of electrochemistry and its application, defiition of corrosion,forms of corrosion, cost of corrosion, electricalconcept relevant to corrosion, relevant concept ofchemistry and electrochemistry, thermodynamicprediction of corrosion propensity, electrolyte,Kinetics of corrosion, over-potential (polarisation), passivation, corrosion rate measurement,metallurgical aspects, forms of corrosion and jointpotential theory, corrosion testing (weight losscoupon method, electrochemistry).

ENMT 802006 - DESIGN AND SELECTION OF MATERIALS – (3 Credit Points)
Classifiation of engineering materials,factors and systematics of design and selectionofmaterials, material property chart and performance index, design for corrosion resistance,design of high temperature materials and designof wear and fatigue resistant materials, designof plastics and composites, design of variouscarbon steel, cast iron and steel alloys (toolsteel, stainless steel, heat resistant steel, wearresistant steel), super alloys, and case studies ofmaterial selections.

ENMT 802007 - MATERIALS CHARACTERIZATIONS – (3 Credit Points)
ENMT 802008 - LABORATORY – (1 Credit Points)
Introduction, standards and procedureof testing, principles and methods of advancedanalysis for engineering materials chemicalcomposition (AAS, OES, EDS, XPS), identifiationof crystal structure (x-ray diffraction), advancedmetallography (SEM, EPMA, TEM), and thermalanalysis (DTA, TGA, DSC, TMA).

ENMT 802109 ADVANCED MANUFACTURE – (3 Credit Points)
Metal forming as part of design andmanufacture process; general principles, phenomena and mechanism related to casting of metals;mold (sand, ceramics, metals), gating system,and simulation. Solidifiation process of castiron and aluminium, liquid treatment for ferrousmetal (innoculation, Mg treatment) and nonferrous (modifir, grain refier), various methodsof casting, casting defects; General principles,phenomena and mechanism of solid phase metals through forging, rolling, extrusion, drawing,sheet metal forming, and thermo mechanicaltreatment. The phenomenon and mechanism ofpowder metallurgy, fabrication of metal powder,and mechanism of powder formation, characterisation and characters of powder, mechanicalalloying, pre compaction process, compaction,preform characteristics, sintering, and powderconsolidation, full density processing; types ofsintering devices and related aspects, applicationand utilization of powder metallurgy products.Case study of processing selection and evaluationof manufacturing process.

ENMT 802210 - ADVANCED CORROSION – (3 Credit Points)
Introduction, thin and aqueous solution, thermodynamics aspects of aqueous corrosion, kinetics of corrosion, application of aqueouscorrosion in practice (sea water corrosion, undersoil corrosion, corrosion on soil environment),application of corrosion for non-ferrous metal,atmospheric corrosion, oxidation reaction athigh temperature, thermodynamics of oxidation,growth of oxide later, characteristics and properties of oxides, pilling-bedworth ratio, oxidationreaction rate, effect of oxygen pressure corrosionin specifi environment, carburization at hightemperature, decarburization, metal dusting, hotcorrosion, high temperature corrosion testing,material protection at high temperature, hightemperature resistant material, coating (aluminizing, chromizing, siliconizing). Case studies.

ENMT 802211 - COATING & INHIBITION OF MATERIALS – (3 Credit Points)
Coating: metallic coating , type andclassification of metallic coating, protectionmechanism, electroplating and electroless plating, anodizing, phosphating, chromatting, hotdip galvanizing, Service lie prediction, OrganicCoating (paints), properties of organic coating,classifiation and formulation of paints, mechanism of protection, standard of surface preparation, application method, coating defects andpainting failure. Inhibition; types, classifiation,and mechanism of inhibition (anodic, cathodic,and mixed inhibitor), formulation of corrosioninhibitor in general, application and limitation(in automotive, water coolant, drinking watersystem, petrochemical and refiery plant) VCI,layer forming corrosion resistant materials

ENMT 803012 - FAILURE ANALYSIS + LAB – (4 Credit Points)
Defiition and goals of failure analysis,general factors contributing to material failure,general procedure in failure analysis techniques,classifiation of failure origins, characteristics &mechanism of failure analysis, ductile fracture,brittle fracture, fatigue fracture, and failure orbrittleness affected by environmental conditions(thermal/ creep, corrosion, and wear), methodand tool selections on failed material, yieldcriteria, initiation of plastic deformation, stressconcentration, residual stress, static failure, fundamental principles of fracture mechanics, failureanalysis case study analisa and report making andpresentation of failure analysis results.

MASTER PROGRAM

ENMT 803113 - WELDING METALLURGY – (3 Credit Points)
Introduction to material joining, classifiation, basic principles and process characteristics of electric arc welding and its benefiTsand drawbacks, classifiation & characteristicsof welding machines and welding electrodes,flx and gas, parameter of welding and heatinput, fundamental principles of welding metallurgy, metal transfer inside electric arc welding,microstructure of weld joint, alloying effect,temperature change in welding (HAZ), factorsaffecting cooling rate of weld metal, weldabilityof ferrous metal (steel and alloys, heat resistantsteel and cast iron) & non-ferrous (Al, Cu, Mg, Ni,and their alloys), welding defects and prevention,heat treatment for welding (preheating & PWHT),weld joint quality control, case studies.

ENMT 803114 - ADVANCED COMPOSITES – (3 Credit Points)
Concepts, defiition and classifiationof composites, matrix and reinforcement, composite fabrication, rule of mixture, interfacialand wetting theory, nano composites, compositesmechanics, geometric aspect in composites, lamina and laminate, elastic behaviour, fire endeffect, theory of laminate, unidirectional strengthof lamina, strength of laminate, strength of shortfire composites, fracture energy of composites,and case studies of composites.

ENMT 803215 - CATHODIC PROTECTION – (3 Credit Points)
Fundamental theory of cathodicprotection, protection criteria, cathodic protection system using sacrifiial anode, properties ofsacrifiial anode material and its selections, application of sacrifiial anode cathodic protection,impressed current corrosion protection system(ICCP), instrument for corrosion protection, cathodic protection in sea water, soil, and internalstructure of concrete (cement) environment,classifiation of material, specific relation ofmaterial and environment, corrosion protectiondesign guidelines, resistant properties of stainlesssteel and super duplex SS, corrosion resistance ofcommonly used engineering materials (cast iron,carbon steel, low alloy steel, nickel, aluminium,copper, zinc, titanium, and their alloys), corrosion resistance of non metallic material (rubber,plastic, composite, ceramic).

ENMT 800016 - RESEARCH PAPER – (2 Credit Points)
Research result written in journal paper format and published in minimum of national journal or international proceeding.

ENMT 800019 - THESIS – (8 Credit Point)
Application of various courses attended in an integral manner in a research to solve a metallurgical and materials engineering problem.Thesis proposal must be presented in a seminar, in front of a panel of lecturer. This proposal includes problem, hypothesis, methodology, & discussions. The research result is written to a scientific reportand presented before a panel of lecturer.

ELECTIVES

ENMT 803919 - PROJECT MANAGEMENT – (3 Credit Points)
The concept of project management system and system approach, engineering systems and procedures, basic planning,cost estimation and budgeting, project qualitymanagement, execution and project control,project organization, and context of projectmanagement, project communication, andproject risk management.

ENMT 803920 - ELECTRONIC MATERIALS – (3 Credit Points)
concepts of electron theory (wave – particle duality, free electrons, nearly free electrons, band structure, insulators – conductors – semiconductors). Modern theory of solids (band theory of solids, density of states, Boltzmann and Fermi-Dirac statistics, electron effective mass and Fermi energy). Electrical conduction in materials (classical electron theory, quantum mechanical considerations, magnetism, superconductivity, dielectrics and insulator, thermoelectric phenomena). Semiconductors (intrinsic and extrinsic semiconductors, degenerate semiconductors, recombination ad minority carrier junction, Schottky junctions and Ohmic contacts, semiconductor devices)

ENMT 803921 - POLYMER DERIVATIVES – (3 Credit Points)
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.

ENMT 803922 - RBI & INTEGRITY – (3 Credit Points)
Definition: Asset Integrity & Risk Based Inspection, Policy including Health, Safety & Environment (HSE), Strategy /Prioritization, Program Planning, Hazard/Threat Identification, Damage Mechanism, Probability of Failure, Consequence of Failure, Asset Register, Risk Assessment, Program Implementation, Data Compilation-Evaluation-Interpretation, Corrective Actions & Recommendations, Inspection Interval, Inspection Methods,Inspection Scope, Inspection Work package.

ENMT 803923 - ADVANCED POLYMER MANUFACTURING – (3 Credit Points)
Fabrication steps of polymer production (formulation, establishment and finalization). Purpose and process of finalizingthe type of polymer products (deflashing,smoothing and polishing, sawing and cutting,drilling, grinding and sanding, routing, milling& turning, tapping & threading, cleaning, annealing, assembling, and decoration). Typesof assembling processes (mechanical joining,welding and adhesive bonding). This type ofdecorating process (painting, plating, thermal spray coating, vacuum metalizing, hotstamping, coloring). Construction machineryand mechanisms work fialization processes.The selection of the process of fializing thefabrication of a polymer product. Case studies on the fabrication process of fializing theproduct packaging (rigid and flxible), automotive, electronics and construction equipment.

ENMT 803924 - ADVANCED EXTRACTIVE METALLURGY – (3 Credit Points)
Waste characterization processes forraw materials. Innovation wet metallurgical process (hydrometallurgy) and metallurgical heat(pyrometallurgy) for low grade raw materialsand energy effiiency: reaction mechanisms andapplications, such as metal Extraction with plasma,microwave. Metal recycling process. Slag processing, metallurgical dust and ash particles. Processing and utilization of by-products (by product):the use of slag, dross processing, processing of flash. Obtaining metals from waste processes (suchas tailings, residue, sludges) from the mineralprocessing tailings, red mud from metal recovery, metal recovery from waste sludge. The newtechnology of metal recycling process.

ENMT 803925 - ADVANCED SURFACE ENGINEERING – (3 Credit Points)
Fundamental of surface engineering, conventional surface engineering, advanced surface engineering practices, surface coatings and surface modifications, advanced topics on characterizations for thin film

ENMT 803926 - POLYMER MANUFACTURING TECHNOLOGY – (3 Credit Points)
Polymer introduction and its product. Types and steps of polymer manufacturing machines. Extrusion and its derivatives (blown film, callendering, blow molding, thermoforming and pultrusion). Rotational molding. Reinforcing process. Laminating process. Casting process. Injection molding and its derivatives (strecth blow molding and RIM). Machine types for rubber product (formulation and fabrication). General construction and work mechanism in rubber product processing.

ENMT 803927 - NANO TEHCNOLOGY – (3 Credit Point)
Scope and definition of nanotechnology, physical and chemical of solid surface, nanostructures (zero, one and two dimensional), special nanomaterials, fabrication processes (lithography, nanolithography, soft lithography, assembly), nanomaterial characterizations (physical, chemical and structural) and applications (MEMS, DNA chips, photonics, crystal)

6.5. MASTER PROGRAM IN ARCHITECTURE

Program Specification

1	Awarding Institution		Universitas Indonesia
2	Teaching Instituion		Universitas Indonesia
3	Program		Master Prorgram in Architecture
4	Class		Regular
5	Degree Offered		Magister Arsitektur (M.Ars)
6	Accreditation / Recognition		A Accredited from BAN PT; AUN-QA
7	Language of Instruction		Bahasa Indonesia and English
8	Study Scheme (Full time/Part time)		Full time
9	Entry requirement		S1 Graduate/equivalent
10	Duration of Study		2 years-Program
	Type of Semester	Number of semester	Number of weeks /semester
	Regular	8	17
	Short (optional)		
11	**Graduates profile:** Magister Arsitektur is a graduate who achieve mastery of architectural knowledge within their fields and demonstrate the novelty and state of the art in research and innovation in research and design methods.		
12	**Graduates Competence:** 1. Able to construct advanced architectural knowledge within particular fields. 2. Able to manage independent research in architecture within particular fields. 3. Able to synthesize and integrate knowledge and methods to reveal architectural phenomena and to solve architectural design problems. 4. Able to demonstrate critical attitude in individual position in relation to other people and as a part of the society, through attitudes and thinking skills that support successful contribution in the society, teamwork and responsive acts toward the surrounding environment.		
13	**Course Composition**		
No	Type of Courses	Credits	Percentage
i	Architecture Subjects	13	32.5%
ii	Fields Subjects	13	32.5%
iii	Electives	6	15%
iv	Thesis	8	20%
	Total	40	100 %
14	**Total Credits for Graduation**		**40 credits**

Job Opportunity
Job opportunities to the alumnus of Master of Architecture program are: architecture practitioner, academician, researcher, government consultant, businessmen, and actuator in humanities environment sector.

COURSE STRUCTURE MASTER PROGRAM ARCHITECTURE

Kode	Subjects	Peminatan					
		AD	UD	UHS	P	ATH	AS
Semester 1							
ENAR801001	Advanced Design and Research Methods	4	4	4	4	4	4
ENAR801002	Advanced Architectural Theories	3	3	3	3	3	3
ENAR801106	Architectural Design Studio 1	5					
ENAR801209	Urban Design Studio 1		5				
ENAR801312	Urban Housing & Settlement Studio 1 1			5			
ENAR801415	Property Workshop 1				5		
ENAR801518	History & Theory Workshop 1					5	
ENAR801621	Arch & Sustainability Workshop 1						5
	Sub Total	**12**	**12**	**12**	**12**	**12**	**12**
Semester 2							
ENAR802107	Architectural Design Theories	3					
ENAR802210	Urban Design Theories		3				
ENAR802313	Urban Housing & Settlement Theories			3			
ENAR802416	Property Theories				3		
ENAR802519	Architectural Theory and History					3	
ENAR802622	Architecture & Sustainability Theory						3
ENAR802108	Architectural Design Studio 2	5					
ENAR802211	Urban Design Studio 2		5				
ENAR802314	Urban Housing & Settlement Studio 2			5			
ENAR802417	Property Workshop 2				5		
ENAR802520	History & Theory Workshop 2					5	
ENAR802623	Arch & Sustainability Workshop 2						5
	Elective	3	3	3	3	3	3
	Sub Total	**11**	**11**	**11**	**11**	**11**	**11**
Semester 3							
ENAR800003	Pre-Thesis	4	4	4	4	4	4
	Elective	3	3	3	3	3	3
	Sub Total	**7**	**7**	**7**	**7**	**7**	**7**
Semester 4							
ENAR800004	Scientific Publication	2	2	2	2	2	2
ENAR800005	Thesis	8	8	8	8	8	8
	Sub Total	**10**	**10**	**10**	**10**	**10**	**10**
	Total	**40**	**40**	**40**	**40**	**40**	**40**

Bidang Peminatan - Stream:
AD = Architectural Design (Perancangan Arsitektur)
UD = Urban Design (Perancangan Perkotaan)
UHS = Urban Housing and Settlement (Perumahan dan Permukiman Perkotaan)
P = Property (Properti)
ATH = Architectural Theory and History (Teori dan Sejarah Arsitektur)
AS = Architecture and Sustainability (Arsitektur dan Sustainabilitas)

Resume

Wajib Program Studi	**21**
Peminatan	**13**
Jumlah	**34**
Pilihan	**6**
Total Beban Studi	**40**

ELECTIVES

Code		Credit
ENAR800524	Ethnic Architecture	3
ENAR800525	Architecture & Cinematic Space	3
ENAR800526	Architecture and Text	3
ENAR800327	Coastal Architecture	3
ENAR800228	Architecture, City, and Power	3
ENAR800529	Heritage Architecture	3
ENAR800630	Energy-Saving Building	3
ENAR800131	Desain Komputasi	3
ENAR800632	High-Rise Building Facades	3
ENAR800133	Geometry and Architecture	3
ENAR800334	Housing Policy	3
ENAR800135	Everyday and Architecture	3
ENAR800636	Project Management	3
ENAR800337	Understanding Phenomenon: Plato to Derrida	3
ENAR800238	Perencanaan Kota	3
ENAR800039	Independent Study	3
ENAR800040	Capita Selecta	3
ENAR800041	Topic on Architectural Design	3
ENAR800042	Topic on Urban Design	3
ENAR800043	Topic on Urban Housing and Settlement	3
ENAR800044	Special Topic on Property	3
ENAR800045	Topic on Arch History, Theory & Critics	3
ENAR800046	Special Topic on Sustainability	3
ENAR800047	Teaching Assistantship	3

MASTER PROGRAM

CURRICULUM STRUCTURE FOR FAST TRACK PROGRAM

COURSE	CREDIT	COURSE	CREDIT
Semester 7		Semester 1	
Mata Ajar Pilihan S1: Metode Perancangan Lanjut dan Penelitian	4	Mata Ajar Wajib S2: Metode Perancangan Lanjut dan Penelitian	4
Mata Ajar Pilihan S1: Teori Arsitektur Lanjut	3	Mata Ajar Wajib S2: Teori Arsitektur Lanjut	3
Mata Ajar Pilihan S1			
(diambil dari Mata Ajar Pilihan S2)	3	Mata Ajar Pilihan S2	3
		Sub Total	10
Semester 8		Semester 2	
Mata Ajar Pilihan S1: Teori Kekhususan	3	Mata Ajar Wajib S2: Teori Kekhususan	3
Mata Ajar Pilihan S1 (diambil dari Mata Ajar Pilihan S2)	3	Mata Ajar Pilihan S2	3
		Studio/Workshop Kekhususan 2	5
		Sub Total	11
		Semester 3	
		Studio/Workshop Kekhususan 1	5
		Pra-Tesis	4
		Sub Total	9
		Semester 4	
		Tesis	8
		Publikasi Ilmiah	2
		Sub Total	10
Total sks Transfer Kredit	16 (40%)	Total sks S2	40

COURSE DESCRIPTION (COMPULSORY COURSES)

ENAR801001
ADVANCED DESIGN AND RESEARCH METHODS
4 CREDITS

Learning Objectives:
Student should be able to explore the theory and design method that earns many critics' attention in architecture and design world. Student can choose appropriate design approach for good architectural research which related to architecture design research, urban design, urban housing and settlement, history and theory, property and building technology

Syllabus:
Research method: architectural thinking and research; terminology (ontological, psychological); architectural text and language style; research questions; research arguments; research logic; assumption and paradigm; research strategy and tactics; research proposal making.
Advanced design method: Design research, relation between research and design; thesis statement; architecture arguments' form; exploration of design theory and method that are argued by professional critics in architecture and design world.

Pre-requisites:
None for Architecture Master's Program student. By permission for Architecture Undergraduate student.

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

ENAR801002
ADVANCED ARCHITECTURAL THEORIES
5 CREDITS

Learning Objectives:
Students are introduced to advanced architectural theories in general and provides the basic of research for each field, which include advanced architectural design (creative process); architecture and humanities, and architecture and technology (especially sustainability). The focus remains on the architectural phenomenon – aspects of space, place and form/shape; in a scale from private spaces to urban areas.

Syllabus:
Architecture as a discipline: space, place/non-place (topia, utopia, heterotopia, dystopia); Architectural form, design thinking and process (positivism, rationalism, tame/wicked problem, IBIS, pattern language, diagram);
Architecture and property development (real estate);
Socio-cultural aspects in architecture: historiography, evolution/ history of human settlement (human life-cycle space, culture and the politics of space);
Architecture and sustainability: building physics, construction and technology.

FACULTY OF ENGINEERING

Pre-requisites: -

References:

1. -----, *The Appraisal of Real Estate 13th edition*, Appraisal Institute, 2008
2. Christopher Alexander, *Notes on the Synthesis of Form,* Harvard University Press Publication, 1964
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

ENAR801106
ARCHITECTURAL DESIGN STUDIO 1
5 CREDITS

Learning Objectives:
Students should be able to explore and develop arguments for architectural design concepts based on research and design method in urban context.

Syllabus:
The development of logical argument based on design research, method and design in the studio related to design concept, issue, keywords, design theory, and program on urban context based on specific idea. Data collection is based on specific parameters externally and internally which define certain form. Identification of issues that are related to environmental sustainability and tropical climate context, and formulation of program as spatial journey. Tectonic aspects cover form, structure, and building system. The knowledge on design based on tipology and topology. The consideration on safety and health aspects. The mastery on architectural expression includes model, sketches, architectural drawings, and digital media.

Pre-requisites: -

Buku Ajar:

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.

ENAR801209
URBAN DESIGN STUDIO 1
5 CREDITS

Learning Objectives:
Students should be able to understand the basic of analysis and have the skills to apply urban design regulation gradually, from urban elements to urban guidelines until certain scale, with a strip or a mixed use environment as the object of study. Students should also be able to understand the basic of urban design application using in-depth analysis and to demonstrate critical understanding of environmental contexts and issues.

Syllabus:
The chosen site is a strip or complex environment that has variety of city elements that could give opportunity for students to do multiple analysis. To understand and apply the idea of place making in private nor public area, open space nor building, to materialize individual needs nor community/public. To critically reviewing in wider scale and context in various plans and city regulation including master plan, zoning, UDGL, etc.

Pre-requisites: -

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

ENAR801312
URBAN HOUSING AND SETTLEMENT STUDIO 1
5 CREDITS

Learning Objectives:
Students should be able to design housing project based on market mechanism; design program including market potential research, market economy, location, and types of housing.

Syllabus:
The potential housing project covers market demand, housing economy; Design process covers precedent literature based on overseas and local resources; design development; housing project model; design report including housing economy, techical design including model/maquette from housing project.

Prerequisites: -

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

ENAR801415
PROPERTY WORKSHOP 1
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: -

ENAR801518
HISTORY AND THEORY WORKSHOP 1
5 CREDITS

Learning objectives:
Students should be able to master research in history which are related to historiography and architectural artifact.

Syllabus:
Architectural Historiography: use various methodologies to create architectural historiography; Artifact: Heritage of architecture and cities; introducing city/architecture heritage as significant artifact to be documented.

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

ENAR801621
ARCHITECTURE AND SUSTAINABILITY WORKSHOP 1

MASTER PROGRAM

5 CREDITS

Learning Objectives:
Students should be able to develop and appy building technology theory in a small scale design project research.

Syllabus:
Thermal comfort measurement and passive cooling, design and evaluation of natural lighting, noise controlling and evaluation method, planning of using alternative energy.

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*.

ENAR802107
ARCHITECTURAL DESIGN THEORIES
3 CREDIT HOURS

Learning Objectives:
Students should be able to understand and have the ability to do critical analysis to architectural ideas in classic and contemporary architecture, and also able to find the relation between discourses of theory and practice in architectural design.

Syllabus:
The development architecture shaping mechanism since classic architecture to contemporer; recent ideas in the discourses of architecture design theory and practice discourses; ideal ideas in architecture; multi-discipline approach (art, mathematics, science, and social) in architecture theory and design.

Prerequisities:
Students have taken Advanced Architectural Theores

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.

ENAR802210
URBAN DESIGN THEORIES
3 CREDIT HOURS

Learning Objectives:
Students should be able to explain how planning built environment design have contribution in shaping better cities through urban design theory analysis, including traditional and contemporary, also analysis on how in certain situation urban design is formulated; questioning how urban design

ideas could elevate physical character of built-environment and why the idea is expected to facilitate the enhancement of urban lifestyle in cities; to do social and spatial analysis from targeted environment; analysis and critic to perceptual and performative of urban design.

Syllabus:
Review to understanding of urban design. Historical research and discourses on the meaning "good city" through the view of theorists, for example: cosmological belief, formalist, fungsionalists, picturesques, organics, utopians, livability, ecological. Questioning "performance dimension" in urban design theories and understanding the relation between urban design and perceptual/visual/social dimension. After the students are introduced to theorists point of view, in this section they will explore various ways of interpretating and understanding urban environment. Discussion on how urban environment has different meaning to different people, based on their cultural, economy, race, and gender background. Short review on connection between urban design activity and politic-economy context from urban development process.

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

ENAR802313
URBAN HOUSING AND SETTLEMENT THEORIES
3 CREDIT HOURS

Learning Objectives:
Students should be able to have critical understanding on urban housing and settlement in developing countries. Especially Indonesia; understanding on public and private policy affecting economy and housing development, especially local economy; Giving review and critic on strategy and policy to low-income or poor society in cities.

Syllabus:
Settlement and urban housing in Indonesia; group communication problem: knowledge-power-space; daily life of urban communities; urban architecture and also the habitus of various groups in society in urban; individual housing career, family in accessing housing facilities in cities; 'slump' urban settlement and social-economy and politic network; housing financing; housing policy: provider vs enabler, critical analysis on Indonesia as archipelago country in relation of settlement and development in coast area.

Prerequisites: Students have taken Advanced Architectural Theories.

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

ENAR802416
PROPERTY THEORIES 1
3 CREDIT HOURS

Learning Objectives:
This course is designed to develop students' insight and knowledge in: understanding roles that are related to real estate development with wide-range spatial environment aspect; mastering methods and ability to apply it to various things related to wider issue and problems in real estate.

Syllabus:
First section will elaborate the basics and concept of appraisal/valuation. Second section will cover the environment development issues that are connected to urban management. In the next sections, students will learn variety of issues related to environment development, which is fundamental construction, and cost and benefit analysis, which are risk management technique, funding resources and taxation, market and marketing, asset/property management. Learning is emphasized on understanding the rules and concept in Real Estate in urban context without neglecting method and technical calculation. Through the particular approach, students are expected to understand the development of Real Estate as a concept that could be used to help variety of problems that will be faced in workplace.

Prerequisites: Students have taken 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

ENAR802519
ARCHITECTURAL THEORY AND HISTORY
3 CREDIT HOURS

Learning Objectives:
Students will be introduced to theories related to world historiography, and historical ideas to test theorytical and historical aspects in invidual research.

Syllabus:
Phenomenology, semiology (structuralism, post-structuralism, deconstruction), modern and post-modern, colonialism and post-colonialism, Gender in Architecture

Prerequisites: Students have taken Advanced Architectural Theories.

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 (Archi- text)*, 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

ENAR802622
ARCHITECTURE AND SUSTAINABILITY THEORY
5 CREDIT HOURS

Learning Objectives:
Students should be able to explain building technology theory, especially in the field of material, structure, building/environment safety.

Syllabus:
Structural material characteristics, building structure and robustness, sustainable development, ecology, building economy, advanced engineering, management aspect in building design and maintenance, energy conservation, law and regulation on built environment.

Prerequisites: Students have taken 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 Contem- porary 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

ENAR802108
ARCHITECTURAL DESIGN STUDIO 2
5 CREDIT HOURS

Learning Objectives:
Students should be able to develop the ability in creating space as architectural design concept that is defined individually in a specific design theme, which includes the consideration environment and sustainability.

Syllabus:
Exploration on design concept based on typology. Exploration on sustainable idea in various contexts. Urban space typology, building typology, program and site analysis. Theme and spatial ideas in ecological concept. Architectural research: translating program in conceptual diagram, layout, circulation, space integration by sketches, architectural drawings, and models. Tectonic exploration: relation between tectonic theme and architectural typology which relates to design concept. Verbal and visual communication aspects.

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

ENAR802211
URBAN DESIGN STUDIO 2
5 CREDIT HOURS

Learning Objectives:
By taking the benefit of UI Depok campus location that is close to capital city, the main goal in the studio is to expand students’ insight, understanding, knowledge, mastery to sustainable urban design principals, by taking case study in Jakarta and also Bodetabek. Students are encouraged to explore the complexity of city problems which are faced by Jakarta as megacity, in example density, urbanization, flood, energy, and climate change. In expectation, those issues will be able to spark students’ creativity to provide innovative urban design that’s also responsible scientifically, from the social aspects and also environment.

Syllabus:
As the continuity in Urban Design Studio 1, in this studio students are asked to do connectivity exploration on various aspects in urban design through re-design project in mixed-use area (commercial housing). Students are encouraged to re-design environment that are in the process of transition because of radical changes. Studio is organized with early premises that public space plays a significant role to create a comfortable city and life, but the design platform should also rely on user aspiration. The challenge in this studio is the position of urban design that has to give rewards and attention to other aspects in architectural way and also physical reality of a city. Other than that, in finishing urban design project, the students are challenged to make ‘local character’ as keyword.

Prerequisites: Students have taken 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

ENAR802314
URBAN HOUSING AND SETTLEMENT STUDIO 2
5 CREDIT HOURS

Learning Objectives:

Students will be faced to design solution of urban housing and settlement to low-income community with eco-architecture approach.

Syllabus:
Socio-economy problem exploration related to the complexity of housing provision for low-income urban community; housing planning and design based on ecological principal.

Prerequisities: Students have taken Urban Housing and 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

ENAR802417
PROPERTY WORKSHOP 2
5 CREDIT HOURS

Learning Objectives:
Students should be able to learn the connection between urban architecture and real estate activity in a big-scale project that connected to urban management, role and also public and private sector in the urban area development, reposition, and revitalization, etc.

Syllabus:
(1) Private sector/commercial development project, development of area around 50 ha. Property product (enacted physical regulations). Project funding and buying scheme: e.g. mortgage. Developers' and region government's rights and obligations (developer: on site, off site, cash payment, etc. Region government: holiday tax, incentive, public facilities, etc.). Implementation plan (rights and obligations + development's time schedule) (2) The development of urban facilities that are related to property development (public-private development): investigation/exploration on a public project through recovery chances by putting in unsure property development as the development of educational area/science center, MRT/busway/tollway, which connected to property development along the path. The creation of public facilities.

Prerequisites: Students have taken Property Workshop 1

References: -

ENAR802520
HISTORY AND THEORY WORKSHOP 2
5 CREDIT HOURS

Learning Objectives:
Students should be able to master history research that related to representation and application/ practice in architectural history.

Syllabus:
The representation of architecture: architecture as text; architecture as profession; architecture as film; architecture as identity (race and gender); architecture as memory; architecture and disaster; application of architectural history: teaching architectural history; exhibiting architecture; architecture on television/ radio; architectural journalism.

Prerequisites: Students have taken 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

ENAR802623
ARCHITECTURE AND SUSTAINABILITY WORKSHOP 2
5 CREDIT HOURS

Learning Objectives:
Students should be able to develop and aplly building technology theory in a small-scale research project.

Syllabus:
Ecological aspect in technology utilization, material utilization affects to building safety, economy aspect in technology utilization, resources engineering, resources technology management in building/design, the effects of technology utilization in design to project management, energy efficiency measurement in design, the effects of law and regulation in technology utilization.

Prerequisites: Students have taken Architecture and Sustainability Workshop 1

References:
1. James Cowan, *Architectural Accoustics: Design Guide*, McGraw-Hill, 2000
2. Frei Otto, *Tensile Structure*, MIT Press, 1997
3. Harold J. Rosen, *The Professional Practice of Architectural Detailing*, John Wiley & Sons, 1999
4. Soeryani Moh ed, *Lingkungan: Sumberdaya Alam dan Kependudukan dalam Pembangunan*, UI Press, 1987
5. Finatya Legoh dan Siti Handjarinto, *Buku Ajar Akustik*, 2002
6. Ganijanti AS, *Mekanika*, Penerbit Salemba Teknik, 2000

ENAR800003
PRE-THESIS
3 CREDIT HOURS

Learning Objectives:
Students should be able to produce a research proposal (for research thesis) or design proposal (for design thesis) which comprises of minimum 4.000 words. Students who choose research thesis should provide a research proposal which contains findings from theoretical analysis which shows the mastery level in the investigation of issues, formulates preposition and develops research methods. Students who choose design thesis should produce a design proposal that contains theoretical analysis that shows mastery level in designing, and proposes a design statement that is ready to be followed-up and developed through design process.

Syllabus:
Formulation of research question and issues; theoretical analysis through relevant literature research; development of method to respond to design issues or to respond to research questions.

Pre-requisites:
Students have passed Advanced Design and Research Methods with minimum score 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

ENAR800004
SCIENTIFIC PUBLICATIONS
2 CREDIT HOURS

Learning Objectives:
Students should be able to produce scientific papers or research with decent quality for being published at dissemination forum in the national or international level.

Syllabus:
The principles of scientific writing; various modes of scientific writing; strategy for formulating the argument in the scientific literature that explicitly indicates the position of the existing knowledge; procedure of publication in national/international seminars/conferences; procedures of publications in international journals; review of articles in internationally reputable journals that are related to the fields of architecture

Pre-requisites:
Students have taken Advanced Design and Research 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

ENAR800005
THESIS
8 CREDIT HOURS

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.

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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: Students have 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

COURSE DESCRIPTION (ELECTIVES)

ENAR800524
ETHNIC ARCHITECTURE
3 CREDITS

Learning Objectives:
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, building process.

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 Overlook 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

ENAR800525
ARCHITECTURE AND CINEMATIC SPACE
3 CREDITS

Learning Objectives:
Students should be able to demonstrate knowledge of modernity and post modernity urban history through the cinematic lens. Based on Indonesian context, this course also reviewing how student read and understand cities, focused on culture, society, and urban space represented on Indonesian cinema today and on 1965-1998. By considering how the real and reel city confess to each other on mutual representation practice, this course discuss about history and cinematic space interpretation through space and time, by the way of movies that represented different modernity.

Syllabus:
Modernity, Post Modernity, Globalization: The traditional small town; the industrial modern city; modernist dystopias, cynical modernity; postmodern city themes; postmodern dystopia; the voyeuristic city; the city through different eyes; social class ; the contested city/alternative modernity (race, ethnicity and urban experience); the anti city: nostalgic imaginaries; culture, passion and piety.

Prasyarat: -

References:

1. Louis Wirth, "Urbanism as a Way of Life", in *American Journal of Sociology*, 1938, pp. 38-83
2. Georg Simmel, "The Metropolis and Mental Life", in N. Leach, ed, *Rethinking Architecture,* New York: Routledge, pp.68-79
3. John Berger, *Ways of Seeing*, London: Penguin Books, 1977.
4. S. Watson and Gibson (eds). *Postmodern Cities and Spaces*. Cambridge: Basil Blackwell, 1995.
5. Aihwa Ong & Ananya Roy, *Worlding Cities: Asian Experiment and the Art of Being Global*, Rouledge.
6. Alan Marcus, Dietrich Neumann (eds),*Visualizing the City (Architext*), Routledge, 2008
7. Wolfgang Natter, "The City as Cinematic Space: Modernism and Place in Berlin, Symphony of a City" in S. Aitken and P Zonn (eds). *Place, Power and Spectacle*. London: Rowman and

MASTER PROGRAM

Littlefield Publishers, 1994, pp.203-227.
8. Scott Bukatman, *Terminal Identity: The Virtual Subject in Post-Modern Science Fiction*, Durham: Duke University Press, 1993.
9. J. Rutherford (ed). *Identity: Community, Culture, Difference*. London: Lawrence & Wishart. 1990.
10. Nezar AlSayyad, *Consuming Tradition, Manufacturing Heritage*. London: Routledge, 2001.
11. A. King (ed). *Culture, Globalization and the World System*. London: Macmillan. 1991
12. Dietrich Neumann, *Film Architecture: From Metropolis to Blade Runner*, Prestel Publishing, 1999.
13. Nezar AlSayyad, "The Cinematic City: Between Modernist Utopia and Postmodernist Dystopia" in *Built Environment* 26:4, 2000, pp.268-281.
14. Nezar AlSayyad, *Cinematic Urbanism: A History of the Modern from Reel to Real*. Routledge, 2006.
15. Katherine Shonfield, *Walls Have Feelings: Architecture, Film and the City*, London: Routledge, 2000.
16. D. Clarke (ed). *The Cinematic City*, London: Routledge, 1997.
17. F. Penz and T Thomas (eds). *Cinema and Architecture*, London: British Film Institute. 1997.
18. M. Lamster (ed). *Architecture and Film*, New York: Princeton Architectural Press, 2000.
19. M. Shiel and T. Fitzmaurice (eds), *Cinema and the City*, Oxford: Blackwell, 2001.
20. Gabriel, Teshome. *Third Cinema in the Third World: An Aesthetic Liberation*, Ann Arbor, MI: University of Michigan Press, 1983.
21. Martin Roberts, *Cinema and Nation*, London: Routledge, 2000
22. Philip Kitley, *Television, Nation and Culture in Indonesia*, Athens, OG: Ohio University Center for International Studies, 2000
23. Intan Paramadina, "City and Desire in Indonesian Cinema," *Inter-Asia Cultural Studies: Runaway Cities/Leftover Spaces*, Volume 12, Number 4, 2011
24. Ariel Heryanto, *Identity and Pleasure: The Politics of Indonesian Screen Culture*, Singapore: NUS Press, 2014
25. Krishna Sen, *Indonesian Cinema Framing New Order*, London: Zed Books, 1994
26. Bell Hooks, *Reel to Real: Race, Gender and Class at the Movies*, Routledge Classics, 2012
27. **Films selection (among others)**: Cinema Paradiso; It's a Wonderful Life; Berlin: Symphony of a City; Modern Times; Metropolis; Brazil; End of Violence; Rear Window; Manhattan; Taxi Driver; Blade Runner; Do the Right Thing; My Beautiful Launderette; The Truman Show; Los Angeles Plays Itself; Drakula Mantu (1974); Jakarta Jakarta (1978); Pengemis dan Tukang Becak (1978); Matahari-Matahari (1985); Daun di Atas Bantal (1998); *Cul-de-Sac* (1998); Eliana, Eliana (2002); Arisan! (2003); Mengejar Matahari (2004); Rindu Kami Padamu (2004); Berbagi Suami (2006); Naga Bonar Jadi Dua (2007); Ayat-Ayat Cinta (2008); Perempuan Berkalung Sorban (2009); and related films as needed.

ENAR800526
ARCHITECTURE AND TEXT
3 CREDITS

Learning Objectives:
Students should be able to understand architecture as a text based on the connection between text and its context.

Syllabus:
"*Il n'y a pas de hors-texte*" (there is nothing outside the text) – Jacques Derrida. Text are often be understood as a written communication, but in this course, text are is not limited to the written words. For example face expressions, traffic signs and paintings are also text. "Text", the word which has connection with the word "Texture" and "Context" coming from the latin word *texere*, which means knit. As an introduction to the architecture as a text, this course gives us knowledge, how to read architectural work as text, how to read architecture as knitting between architectural work and its architect experience, society condition, etc.

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)

ENAR800327
COASTAL ARCHITECTURE
3 CREDITS

Learning Objectives:
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: Students have taken Design Theories & Methods in Architecture

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
1. Malcolm Newson, *Land, Water and Development: River Basin Systems and their Sustainable Development*, Routledge,1992
2. Koen Olthuis and David Keuning, *Float!. Building on Water to Combat Urban Congestion and Climate Change*, Frame Publishers, 2010
3. Djoko Pramono, *Budaya Bahari*, Gramedia Pustaka Utama, 2005
4. Alan P. Trujillo and Harold V. Thurman, *Essentials of Oceanography, Ninth Edition*, Pearson Education *Ltd, 2008*
5. Heather Vies and Tom Spencer, *Coastal Problems: Geomorphology, Ecology and Society at the Coast*, Edward Arnold, 1995
6. Ary Wahyono, AR Patji, SS Laksono, R. Indrawasih, Sudiyono dan Surmiati Ali, *Hak Ulayat Laut di Kawasan Indonesia Timur*, Media Presindo Yogjakarta, 2000

ENAR800228
ARCHITECTURE, CITY AND POWER
3 CREDITS

Learning Objectives:
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

ENAR800529
HERITAGE ARCHITECTURE
3 CREDITS

Learning Objectives:
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

ENAR800630
ENERGY-SAVING BUILDING
3 CREDITS

Learning Objectives:
Students should be understand the principle of energy-saving building technology and apply it on design.

Syllabus:
Renewable energy, site and climate, sun geometry, passive cooling, shading, natural & artificial lighting and solar cell.

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

ENAR800131
COMPUTATIONAL DESIGN AND PARAMETRIC MODELLING
3 CREDITS

Learning Objectives:
Students should be able to use computation media as part of design process, using parametric and computer programing approach.

Syllabus:
Introduction to computation design tools, parametric approach, algorithmic architectura, and scripting software.

Prerequisites: Students have basic knowledge of NURBS and CAD modelling

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

ENAR800632
HIGH RISE BUILDING FACADE
3 CREDITS

Learning Objectives:
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

ENAR800133
GEOMETRY AND ARCHITECTURE
3 CREDITS

Learning Objectives:
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

ENAR800334
HOUSING POLICY
3 CREDITS

Learning Objectives:

Students should be able to understand that housing policy is a concept to manage housing sector in a country. Scope of housing policy: undertstanding, purpose, characteristic, motive, scope and implementation. Also, the relation to politic, social, economy, culture and environment and its impact to housings management.

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

Prerequisites: -

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

ENAR800135
EVERYDAY AND ARCHITECTURE
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

ENAR800636
PROJECT MANAGEMENT
3 CREDITS

Learning Objectives:
Student should be able to develop knowledge about project management and process in design and built environment, particularly administration of technical aspects and building economy from early stage of the project, design, construction, to the the end of the project; should be able to analyze the content of project management documents, building regulation and standard; should be able to create proposal, TOR, auction document, design administration, construction administration, or Project Manual of construction service in small scale project, including working with real client.

Syllabus:
As a product, project management is record of series of project activities as a holistic process, including as a working guide, coordination tools, and as a control for a project. As a process, project management is series of activities that produce responsibilities toward the quantity of records of the whole stages of project management, in one multidiscipline function. This subject introduces the skills required to manage project along its stages through chronological model.

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

ENAR800337
UNDERSTANDING PHENOMENON: PLATO TO DERRIDA
3 CREDITS

Learning Objectives:
Students should have knowledge about architecture philosophy, especially the differences of knowledge and empirical verification, and metaphysics explanation to understand architecture. Students also should be able to demonstrate critical thinking of each architectural phenomenon observation.

Syllabus:
Shapes and forms of physic and metaphysic, ontological understanding about 'what' and 'whatness' of architectural shape from empiric and metaphysic, Plato and Khora. Husserl phenomenon and phemnomenology (essentialism) and Heiddeger (existentialism), semiotic sign, myth, simulacra and 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

ENAR800238
CITY PLANNING
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 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 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.
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

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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.

ENAR800039
INDEPENDENT STUDY
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.

ENAR800040
CAPITA SELECTA
3 CREDITS

Learning Objective:
Students should be able to expand their knowledge on various topics that support acquisition of architectural knowledge and design skills.

Sylabus:
Selected topics that are relevant to architectural knowledge, design skills and their recent development.

Prerequisite: -

References: Relevant references to the topic offered.

ENAR800041
SPECIAL TOPIC ON ARCHITECTURAL DESIGN
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.

ENAR800042
SPECIAL TOPIC ON URBAN DESIGN
3 CREDITS

Learning Objectives:
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.

Prerequisite: -

References: Relevant references to the topic offered.

ENAR800043
SPECIAL TOPIC ON URBAN HOUSING AND SETTLEMENT
3 CREDITS

Learning objectives:
Students should be able to demonstrate knowledge on current development of urban housing and settlement.

Silabus:
Studies on the development of urban housing and settlement theories; studies on current issues that are relevant to urban housing and settlement.

Prerequisite: -

References: Relevant references to the topic offered.

ENAR800044
SPECIAL TOPIC ON PROPERTY
3 CREDITS

Learning objectives:
Students should be able to demonstrate knowledge on current development of property.

Silabus:
Studies on the property development; studies on current issues that are relevant to property development.

Prerequisite: -

References: Relevant references to the topic offered.

ENAR800045
SPECIAL TOPIC ON ARCHITECTURAL HISTORY, THEORY, AND CRITICISM
3 CREDITS

Learning Objectives:
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.

Prerequisite: -

References: Relevant references to the topic offered.

ENAR800046
SPECIAL TOPIC ON SUSTAINABILITY
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.

ENAR800047
TEACHING ASSISTANTSHIP
3 SKS

Learning Objectives:
Students should be able to understand the learning principles and able to teach as studio or course facilitator in undergraduate program.

Syllabus:
Basic learning: Learning theory: behaviorism, cognitive constructivism and social constructivism; instructional method and techniques to facilitate architecture learning; evaluation methods and assessment; design studio learning process.

Prerequisites: -

References:

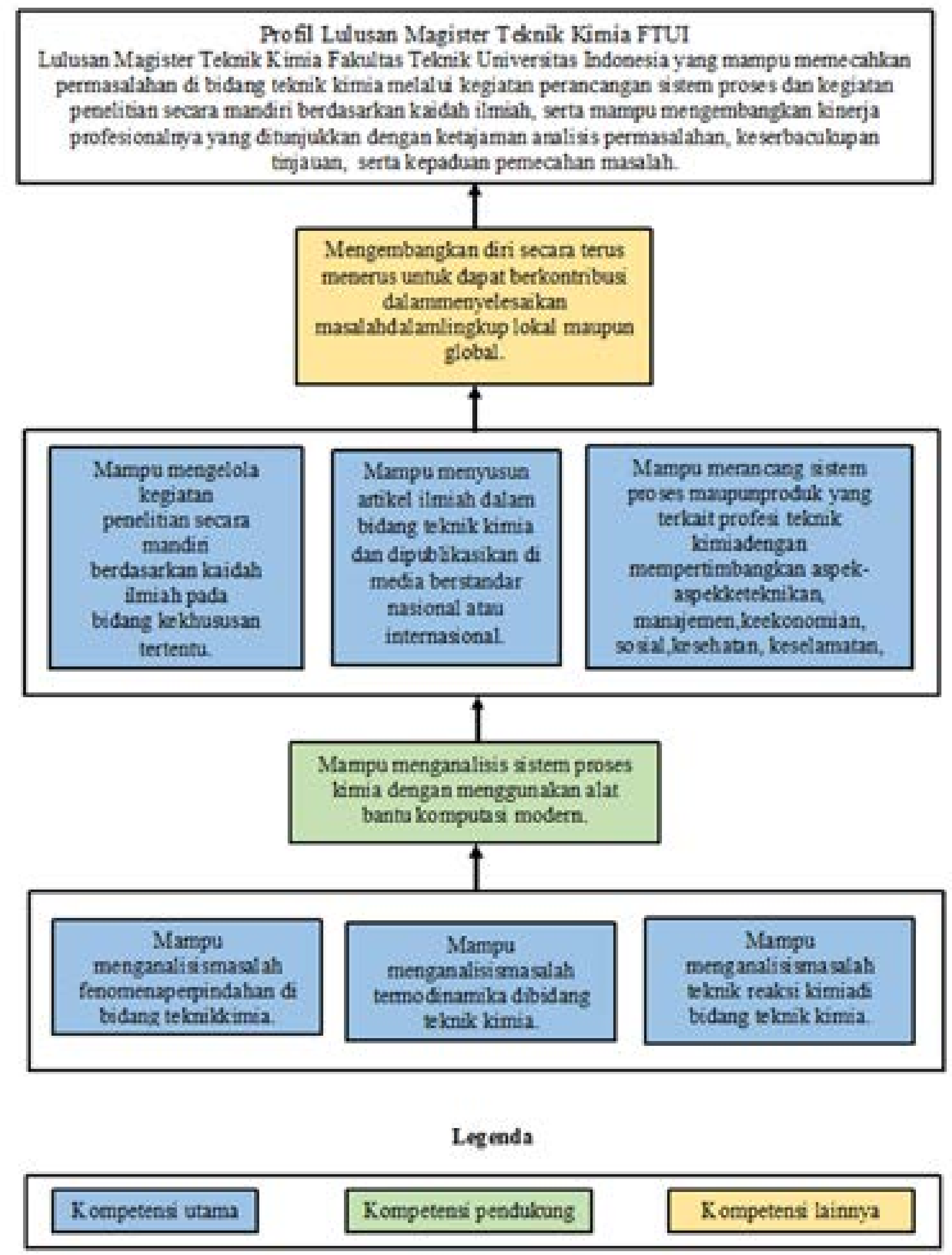
1. Heather Fry, Steve Ketteridge and Stephanie Marshall (eds.), *A Handbook for Teaching and Learning in Higher Education: Enhancing Academic Practice* (Third edition), Routledge, 2009.
2. David Nicol and Simon Pilling, *Changing Architectural Education: Towards a New Professionalism*, Taylor & Francis, 2000.
3. Rosie Parnell et al., *Crit: An Architecture Student's Handbook*, Routledge, 2007

6.7. MASTER PROGRAM IN CHEMICAL ENGINEERING

Program Specification

1	Awarding institution		Universitas Indonesia
2	Organized Instituion		Universitas Indonesia
3	Study Program Name		Chemical Engineering Master Program
4	Type of Class		Regular / Gas Management
5	Degree given		Magister Teknik (MT)
6	Accreditation status		BAN-PT: Akreditasi A
7	Medium Language		Indonesia
8	Study Scheme (Full time/Part time)		Full time
9	Entry requirement		Bachelor Degree
10	Study Duration		Designated for 2 years
11.	Type of Semester	Number of semester	Number of weeks /semester
	Regular	4	17
	Short (optional)	-	-
12	**Graduate Profile:** Master of Chemical Engineering, Faculty of Engineering, Universitas Indonesia who is able to do problem-solving in chemical engineering field through system process design and independent research activities based on scientific principles as well as able to develop professional performance as indicated by keenness of problem analysis, multifariousness aspects, and linearity in troubleshooting.		
13	**Expected learning outcome:** 1. Able to analyze problems in transport phenomena in Chemical Engineering field. 2. Able to analyze problems in thermodynamics in Chemical Engineering field 3. Able to analyze problems in chemical reaction engineering in Chemical Engineering field 4. Able to analyze problems in chemical process system in Chemical Engineering field 5. Able to manage research activities independently based on scientific principles in certain specific fields. 6. Able to design process system as well as related product in chemical engineering fields by considering engineering principles, management, economy, social, health, safety, and environment. 7. Able to prepare scientific articles in chemical engineering field and published in national or international media standards. 8. Continously develop one-self to contribute in solving problems locally as well as globally.		
13	**Classification of Subjects**		

No	Classification	Credit Hours (SKS)	Percentage
i	Total compulsary credits	17	40%
ii	Total elective credits	15	36%
iii	Seminar and Thesis	10	24%
	Total	42	100%
14	**Total Credit Hours to Graduate**		**42 SKS**



CHEMICAL ENGINEERING

CURRICULUM STRUCTURE MASTER PROGRAM CHEMICAL ENGINEERING

Teknik Kimia Reguler asal S1 Teknik Kimia - Chemical Engineering (Regular) Based on Chemical Engineering Undergraduate Program

KODE	SUBJECT	CREDIT
CODE	Term 2	
ENCH801001	Adv Chemical Eng Thermodynamics	3
	Elective 1	3
	Elective 2	3
	Elective 3	3
	Total	12
	Term 2	SKS
ENCH802101	Advanced Transport Phenomena	3
ENCH802102	Advanced Chemical Reaction Engineering	3
ENCH802103	Adv Chemical Eng. Modeling	3
ENCH802104	Research Methodology	3
	Total	12
	Term 3	SKS
ENCH800002	Pra Tesis	2
	Elective 4	3
	Elective 5	3
	Total	8
	Term 4	SKS
ENCH800003	Tesis	8
ENCH800004	Scientific Publication	2
	Total	10
	Sub Total	42

Teknik Kimia Reguler asal S1 non-Teknik Kimia - Chemical Engineering (Regular) Based on non-Chemical Engineering Undergraduate Program

KODE	SUBJECT	CREDIT
CODE	Term 1	
Matrikulasi	Transport Phenomena	
Matrikulasi	Numerical Computation	
Matrikulasi	Chemical Reaction Engineering 1	
	Elective 1	3
	Elective 2	3
	Total	6
	Term 2	
Matrikulasi	Chemical Eng Thermodynamics	
ENCH802101	Advanced Transport Phenomena	3
ENCH802102	Advanced Chemical Reaction Engineering	3
ENCH802103	Adv Chemical Eng. Modeling	3
ENCH802104	Research Methodology	3
	Total	12
	Term 3	
ENCH801001	Adv Chemical Eng Thermodynamics	3
ENCH800002	Pra Tesis	2
	Elective 3	3
	Elective 4	3
	Total	11
	Term 4	
ENCH800003	Tesis	8
ENCH800004	Scientific Publication	2
	Elective 5	3
	Total	13
	Sub Total	42

Managemen Gas - Gas Management

KODE	SUBJECT	CREDIT
CODE	Term 1	
ENCH801203	Explor & Product of Hydrocarbon	3
ENCH801202	Natural Gas Processing	3
ENCH801204	Natural Gas Project Management	3
ENCH801001	Adv Chemical Eng Thermodynamics	3
	Total	12
	Term 2	
ENCH802201	Trans & Utilization of Natural Gas	3
ENCH802202	Natural Gas Economics	3
ENCH802203	Risk Management	3
ENCH802204	Management Systems Eng.	3
	Total	12
	Term 3	
ENCH803201	Renewable Energy	3
ENCH803202	OHS in Natural Gas Industry	3
ENCH800002	Pra Tesis	2
	Total	8
	Term 4	
ENCH800003	Tesis	8
ENCH800004	Scientific Publication	2
	Total	10
	Sub Total	42

MATA KULIAH PILIHAN / ELECTIVE COURSE

Kode	Elective Course for Odd Semester	Credit
ENCH801101	Food Technology	3
ENCH801102	Herbal Engineering	3
ENCH801103	Composite Material	3
ENCH801104	Hydrocarbon Thermodynamic	3
ENCH801105	Lubricants Engineering	3
ENCH801106	Combustion Engineering	3
ENCH801107	Heterogenous Catalyst	3
ENCH803101	Oleochemistry Industry	3
ENCH803102	Protein Engineering	3
ENCH803103	Applied Thermodynamics	3

ENCH803104	Dynamics System	3
ENCH803105	Cryogenics	3
ENCH803106	Plasma & Ozone Engineering	3
ENCH803107	Special Topics 1	3
ENCH803201	Renewable Energy	3

Kode	Elective Course for Even Semester	Credit
ENCH802105	Storage & Packaging Tech	3
ENCH802106	Bioinformatics	3
ENCH802107	Cosmetics and Drugs	3
ENCH802108	Biomaterial	3
ENCH802109	Natural Gas Processing	3
ENCH802110	Petrochemical Process	3
ENCH802111	Photocatalysis Engineering	3
ENCH802112	Polimer	3
ENCH802113	Polution Prevention	3
ENCH802114	Explor & Product of Hydrocarbon	3
ENCH802115	Plant Utility and Maintenance	3
ENCH802116	Drug Controlled Release Tech	3
ENCH802117	Analysis & Synthesis of Process	3
ENCH802118	Geothermal Engineering	3
ENCH802119	Problem Solving Skills	3
ENCH802120	Special Topics 2	3
ENCH802201	Trans & Utilization of Natural Gas	3
ENCH802203	Risk Management	3

SYLLABUS OF MASTER PROGRAM CHEMICAL ENGINEERING DEPARTMENT
A. CHEMICAL ENGINEERING (REGULAR) BASED ON CHEMICAL ENGINEERING UNDERGRADUATE PROGRAM

TERM 1

ENCE801001
ADVANCED CHEMICAL ENGINEERING MODELLING
3 CREDITS

Learning Objectives: Students are able to develop physicochemical model systems in chemical processes and solve it by using numerical methods with assistance of software programme

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.

ENCE801002
ADVANCED CHEMICAL ENGINEERING THERMODYNAMICS
3 CREDITS

Learning Objectives: Students are 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 the system using the several form 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.

TERM 2
ENCE802001
ADVANCED TRANSPORT PHENOMENA
3 CREDITS

Learning Objectives: Students are 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 phase
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: Peristiwa Perpindahan.

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.

ENCE802002
ADVANCED CHEMICAL REACTION ENGINEERING
3 CREDITS

Learning objectives: Students are 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 multi phase 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.

ENCE800001
RESEARCH METHODOLOGY
3 CREDITS

Learning Objectives : Students are 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

TERM 3
ENCE800002
SEMINAR
3 CREDITS

Learning Objectives : Students are able to 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.
Prasyarat: -

Buku ajar: -

TERM 4

ENCE800003
THESIS
7 CREDITS

Learning Objectives : Students are able to design, conduct, and analyze research in Chemical fields ; present reserch result in oral andwriting

Syllabus : Thesis material based on research topic

Prerequisite: Based on regulation

Textbook :

Buku petunjuk praktis pelaksanaan MK Tesis, Depok, 1999.

ENCE800004
SCIENTIFIC PUBLICATIONS
2 CREDITS
Learning Objective :
Syllabus
Prerequisite
Textbook

B. CHEMICAL ENGINEERING (REGULAR) BASED ON NON-CHEMICAL ENGINEERING UNDERGRADUATE PROGRAM

Matriculation
TRANSPORT PHENOMENA
3 CREDITS

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.

Matriculation
CHEMICAL REACTION ENGINEERING 1
3 CREDITS

Learning Objective: Students are 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: Kimia Fisik

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.

TERM 2

CHEMICAL ENGINEERING THERMODYNAMICS
4 CREDITS

Learning Objective: Students are 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.

NUMERICAL COMPUTATION
3 CREDITS

Tujuan pembelajaran:

Students are able to solve Mathematical problems by using numerical methods : method of calculating 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, numerical differentation.

Prerequisite: Calculus

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.

ENCE802001
ADVANCED TRANSPORT PHENOMENA
3 CREDITS

Learning Objectives: Students are 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 phase
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: Peristiwa Perpindahan.

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.

ENCE802002
ADVANCED CHEMICAL REACTION EGINEEERING
3 CREDITS

Learning objectives: Students are 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 multi phase 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:

4. Fogler, H.S., Elements of Chemical Reaction Engineering, Prentice-Hall, 4th Ed., 2006.
5. Smith, J.M., Chemical Engineering Kinetics, 3rd ed., 1981, McGraw-Hill.
6. Thomas, JM, and Thomas WJ., Principles and Practice of Heterogeneous Catalysis, VCH Weinheim, 1997.

ENCE801001
ADVANCED CHEMICAL ENGINEERING MODELLING
3 CREDITS

Learning Objectives: Students are able to develop physicochemical model systems in chemical processes and solve it by using numerical methods with assistance of software programme

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.

ENCE801002
ADVANCED CHEMICAL ENGINEERING THERMODYNAMICS
3 CREDITS

Learning Objectives: Students are 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 the system using the several form 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.

ENCE800001
RESEARCH METHODOLOGY
3 CREDITS

Learning Objectives : Students are 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

ENCE800002
SEMINAR
3 CREDITS

Learning Objectives : Students are able to 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.
Prasyarat: -

Buku ajar: -

TERM 4

ENCE800003
THESIS
7 CREDITS

Learning Objectives : Students are able to design, conduct, and analyze research in Chemical fields ; present reserch result in oral andwriting

Syllabus : Thesis material based on research topic

Prerequisite: Based on regulation

Textbook :

Buku petunjuk praktis pelaksanaan MK Tesis, Depok, 1999.

ENCE800004
SCIENTIFIC PUBLICATIONS
2 CREDITS
Learning Objective :
Syllabus
Prerequisite
Textbook

C. GAS MANAGEMENT

TERM 1
ENGM801003
HYDROCARBON EXPLORATION AND PROCESSING
3 CREDITS
Learning Objectives: Students are able to explain the economic concept of natural gas as well as analyze the economic of exploration oil and natural gas production
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 HYDRAT GAS)
Prerequisite: -

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.

ENGM801002
NATURAL GAS PROCESSING
3 CREDITS
Learning Objectives : Students are able to synthesing natural gas processing, simulating as well as analyzing.

Syllabus: natural gas processing technology, gas-condensate separation, acid gas removal, gas dehydration, mercury removal, sulfur recovery.

Prerequisite -

Textbook :

1. Maddox, R.N. and Morgan, D.J., Gas conditioning and processing, Vol 4: Gas treating and sulfur recovery, Campbell Petroleum Series, 1998.
2. Kohl, A. and Nielsen, R., Gas purification, 5th Ed, Gulf Publishing Company, 1997.
3. Kidnay, A.J. and Parrish, W.R., Fundamentals of natural gas processing, Taylor & Francis, 2006.

ENGM801004
NATURAL GAS PROJECT MANAGEMENT
3 CREDITS
Learning Objectives: Students are able to apply project management in their fields with appropriate as well as apply it in out main fields.

FACULTY OF ENGINEERING

Syllabus: Concept Project - Production, Project Life Cycle, Project Selection, Project Planning, Project Implementation, Project Completion & Evaluation.
Prerequisite -

Textbook :

Suharto, Imam, Manajemen Proyek,1990

ENGM801001
ADVANCED CHEMICAL ENGINEERING THERMODYNAMICS
3 CREDITS
Learning Objectives: Students are 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 the system using the several form 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.

TERM 2
ENGM802002
NATURAL GAS ECONOMICS
3 CREDITS
Learning Objective :
Syllabus
Prerequisite
Textbook

ENGM802001
NATURAL GAS TRANSPORTATION AND UTILIZATION
3 CREDITS
Learning Objective :
Syllabus
Prerequisite
Textbook

ENGM802003
RISK MANAGEMENT
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 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

ENGM802004
ENGINEERING SYSTEM MANAGEMENT
3 CREDITS
Learning Objectives: Students are able to describe analysis system, simulation, and related processes until become an engineering product which is apropriate with consumer needs

syllabus: design, manufacture, and complex system operatin that is a main challenge from manager nowadays. This system have strict schedule as well as financial limitation by pressure in technological development, requires new tools for project planning, organizing, and controlling. This course gives esential knowledge for new management system development as well as modified complex system. This course also gives brief understanding about 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.

Prerequisite -

Textbook: -

TERM 3
ENGM803001
SUSTAINABLE ENERGY
3 CREDITS
Learning Objectives: Students are able to explain the relationship of energy with 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

ENGM800001
RESEARCH METHODOLOGY AND SEMINAR
3 CREDITS
Learning Objectives : Students are 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

ENGM803002
HEALTH AND SAFETY IN NATURAL GAS INDUSTRY
3 CREDITS
Learning Objectives: Students are able to identify the condition of health and safety in the geothermal industry and propose the 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

TERM 4
ENGM800002
THESIS
7 CREDITS

Learning Objectives : Students are able to design, conduct, and analyze research in Chemical fields ; present reserch result in oral andwriting

Syllabus : Thesis material based on research topic

Prerequisite: Based on regulation

Textbook :

Buku petunjuk praktis pelaksanaan MK Tesis, Depok, 1999.

ENGM800003
SCIENTIFIC PUBLICATIONS
2 CREDITS
Learning Objective :
Syllabus
Prerequisite
Textbook

ELECTIVE COURSES

ELECTIVE COURSE FOR ODD SEMESTER

ENCE803101
OLEOCHEMICAL INDUSTRY
3 CREDITS

Learning Objectives: Students are able to know the various processes that are commonly used in the oleochemical industry, and able to make a plan to develop the manufacture 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

ENCE801101
FOOD TECHNOLOGY
3 CREDITS

Learning Objectives: Students are 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 the process from 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

ENCE803102
PROTEIN ENGINEERING
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

ENCE801102
HERBAL TECHNOLOGY
3 CREDITS

Learning Objectives: Students are able to explain the development of herbal technology, herbal separation technology, herbal formulatioin 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
ENCE801103
COMPOSITE MATERIAL
3 CREDITS

Learning Objectives: Students are able to:
1. Explain the characteristics of composite materials and compare it with conventional materials.
2. 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.

ENCE813103
APPLIED THERMODYNAMICS
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

ENCE803104
DINAMIC SYSTEM
3 CREDITS

Learning Objectives: Students are 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

ENCE811104
THERMODYNAMIC SYSTEM OF HYDROCARBON
3 CREDITS

Learning Objectives: Students are 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.

ENCE801105
LUBRICANT ENGINEERING
3 CREDITS

Learning Objectives: Students are able to explain the working principles of lubrication, lubricant function and several parameter 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

ENCE803105
CRYOGENIC ENGINEERING
3 CREDITS

Learning Objectives: Students are 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.

ENCE801106
COMBUSTION ENGINEERING
3 CREDITS

Learning Objectives: Students are 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, Mc-Graw 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.

ENCE803106
PLASMA AND OZONE ENGINEERING
3 CREDITS

Learning Objectives: Students are 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.

ENCE801107
HETEROGENEOUS CATALYST
3 CREDITS

Learning Objectives: Students are 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. Satterfield, C. N., heterogeneous Catalysis in Industrial Practice, McGraw-Hill Inc., New York, 1991.
2. Rase, F. R., Commercial Catalyst, CRC Press, New York, 1991
3. Richardson, T, J., Principles of Catalyst Development, Plenum Press, New York, 1989
4. Thomas J.M. And WJ Thomas, Principles and Practice of Heterogenous Catalysis, VCH, Weinhem, Germany, 1997
5. Emmet, R. H., Catalysis, Reinhold Publishing Corporation, New York, 1961

ENCE801108
SUSTAINABLE ENERGY
3 CREDITS

Learning Objectives: Students are able to explain the relationship of energy with 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

ENCE803107
RISK MANAGEMENT
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 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

ENCE803108
SPECIAL TOPIC 1
3 CREDITS

ELECTIVE COURSE FOR EVEN SEMESTER

ENCE802101
PACKAGING AND STORAGE TECHNOLOGY
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 : hidratasi, 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 : -
Textboox : Examining Food Technology by Anne Barnett. Heinemann Secondary,1996

ENCE802102
BIOINFORMATICS
3 CREDITS

Learning Objective : Students 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

ENCE802103
DRUGS AND COSMETICS TECHNOLOGY
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

ENCE802104
BIOMATERIAL
3 CREDITS

Learning Objective : Students are able to describe the principle and concept of material technologies through biological as well as life cycle assesment (LCA), organic and inorganic materials for biomaterial, apply and develop knowledge about biomaterial for life
Syllabus: Introduction, solids structure, characteristics of materials, metal material for implant, bioceramic materials, structural properties of biomaterial, the respons of tissues to biomaterial implant, the replacement of soft tissues , the replacement of hard tissues, transplantation, and biological tissues engineering
Prerequisite :-
Textbook :
1. Joon Park, R.S. Lakes. Biomaterials an Introduction, springer
2. Biomaterials: Principles and Applications by Joon B. Park, Joseph D. Bronzino. CRC Press

ENCE802105
PETROLEUM PROCESSING
3 CREDITS

Learning Objectives: Students are able to explain petroleum characteristic and its refine 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

ENCE802106
PETROCHEMICAL PROCESSING
3 CREDITS

Learning Objectives: Students are 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 industry through methane, olefins and aromatics; able to analyze 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.

ENCE802107
PHOTOCATALYSIS TECHNOLOGY
3 CREDITS

Learning Objectives: Students are able to understand the basic concepts and photocatalysis and apply it in the various the simple daily problem, especially related with 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 c 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.

ENCE812108
POLYMER ENGINEERING
3 CREDITS
Learning Objectives: Students are able to explain the basic principles and characteristics of polymer manufacturing until being able to keep abreast of the latest technology.
Syllabus: The concept of polymer and polymer characteristics, synthesis / polymerization, kinetics of polymerization, the polymer solution, characterization, process of making plastics.
Prerequisites: Organic Chemistry
Textbook:

1. R. J. Lovell, Introduction to Polymers, P. A. Lovell, Chapman & Hall.
2. R. B., Seymour, Polymers for Engineering Applications, ASM International.
3. F. W. Billmeyer, Textbook of Polymer Science, Wiley.
4. R. J. Crawford, Plastic Engineering, Pergamon Press.
5. Donald R. Woods, Problem Based Learning: How to gain the most PBL, 1994, Mc-Master University, Hamilton, ON L8S 4L8.

ENCE802109
POLLUTION PREVENTION
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.

ENCE802110
EXPLORATION AND PRODUCTION OF HYDROCARBON
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 HYDRAT 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.

ENCE802111

UTILITIES AND PLANT MAINTENANCE
3 CREDITS

Learning Objectives: Students are 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. 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.

ENCE802112
NATURAL GAS TRANSPORTATION AND UTILIZATION
3 CREDITS

ENCE812113
DRUG CONTROLLED RELEASED TECHNOLOGY
3 CREDITS
Learning objective : Students are able to describe the principle of control drug releasedor 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/microsfer, diffusion and permeasi, strategy of control released, case study
Prerequisite : Organic Chemistry
Textbook :

1. Saltzman, W.M., Drug Delivery: Engineering Principles for Drug Therapy, Oxford University Press, 2001.
2. Wen, H. and Park, K, ed., Oral Controlled Release Formulation Design and Drug Delivery, Wiley, 2010.

ENCE802114
ANALYSIS AND SYNTHESIS OF CHEMICAL PROCESSES
3 CREDITS

Learning Objectives: Students are able to analyze and synthesize the chemical processes in an integrated system of technical and economic aspects
Syllabus: The strategy of synthesis and analysis process, design concepts development and the determination of the best flow sheet, a preliminary optimization process, the retrofit process, the use of computer aided design system for simulation and analysis process.
Prerequisites: Simulation of Chemical Processes
Textbook:

1. James M Douglas, Conceptual Design of Chemical Process, McGraw-Hill International Edition, 1988.
2. Hartman, Klaus, and Kaplick, Klaus, Analysis and Synthesis of Chemical Process Systems
3. Lorenz T Biegler, Systematic Methods of Chemical Process Design, Prentice Hall Inc., 1997.

ENCE802115
GEOTHERMAL TECHNOLOGY
3 CREDITS

ENCE802116
PROBLEM-SOLVING SKILLS
3 CREDITS

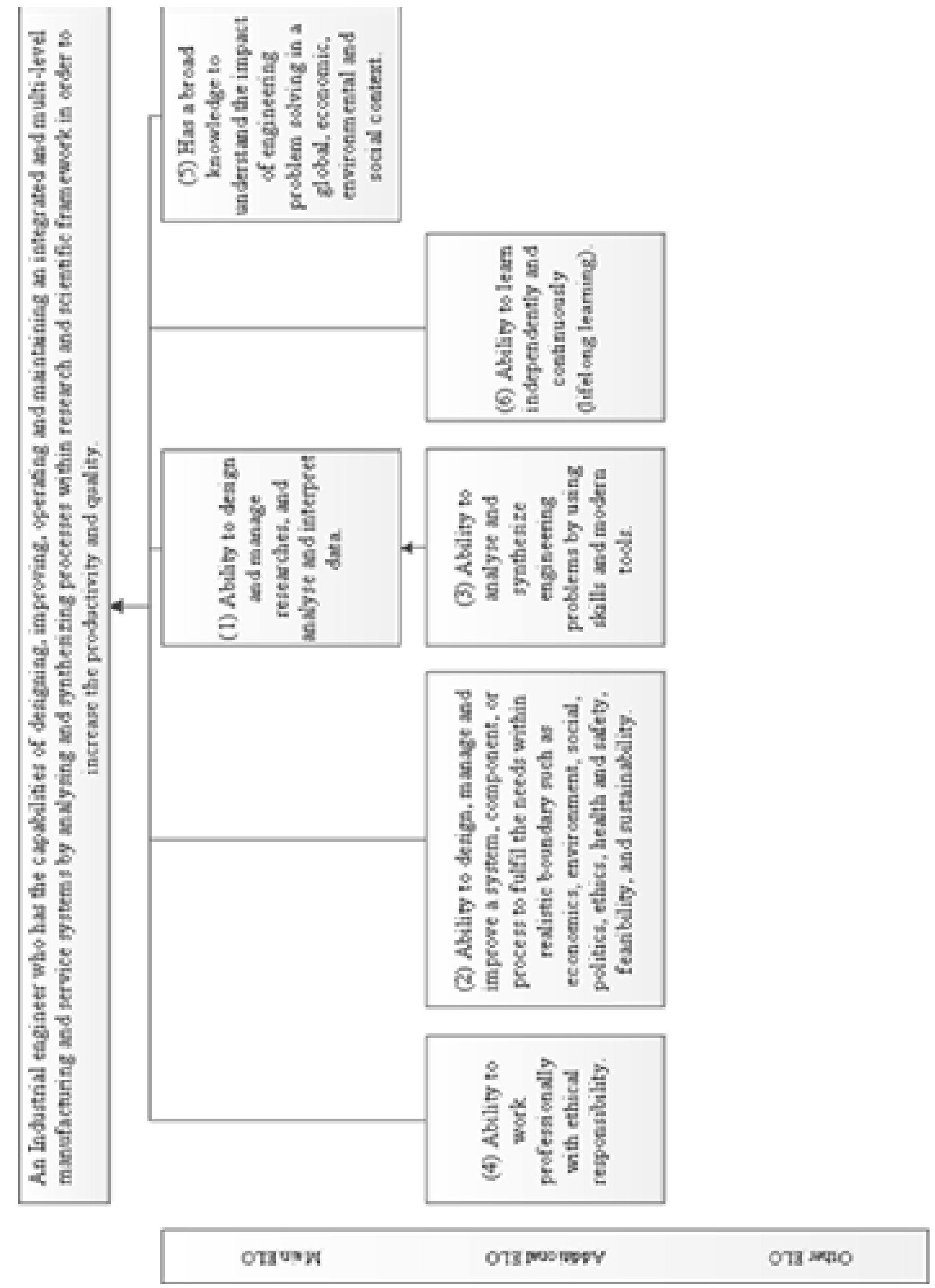
ENCE802117
SPECIAL TOPIC 2
3 CREDITS

6.8. MASTER PROGRAM IN INDUSTRIAL ENGINEERING

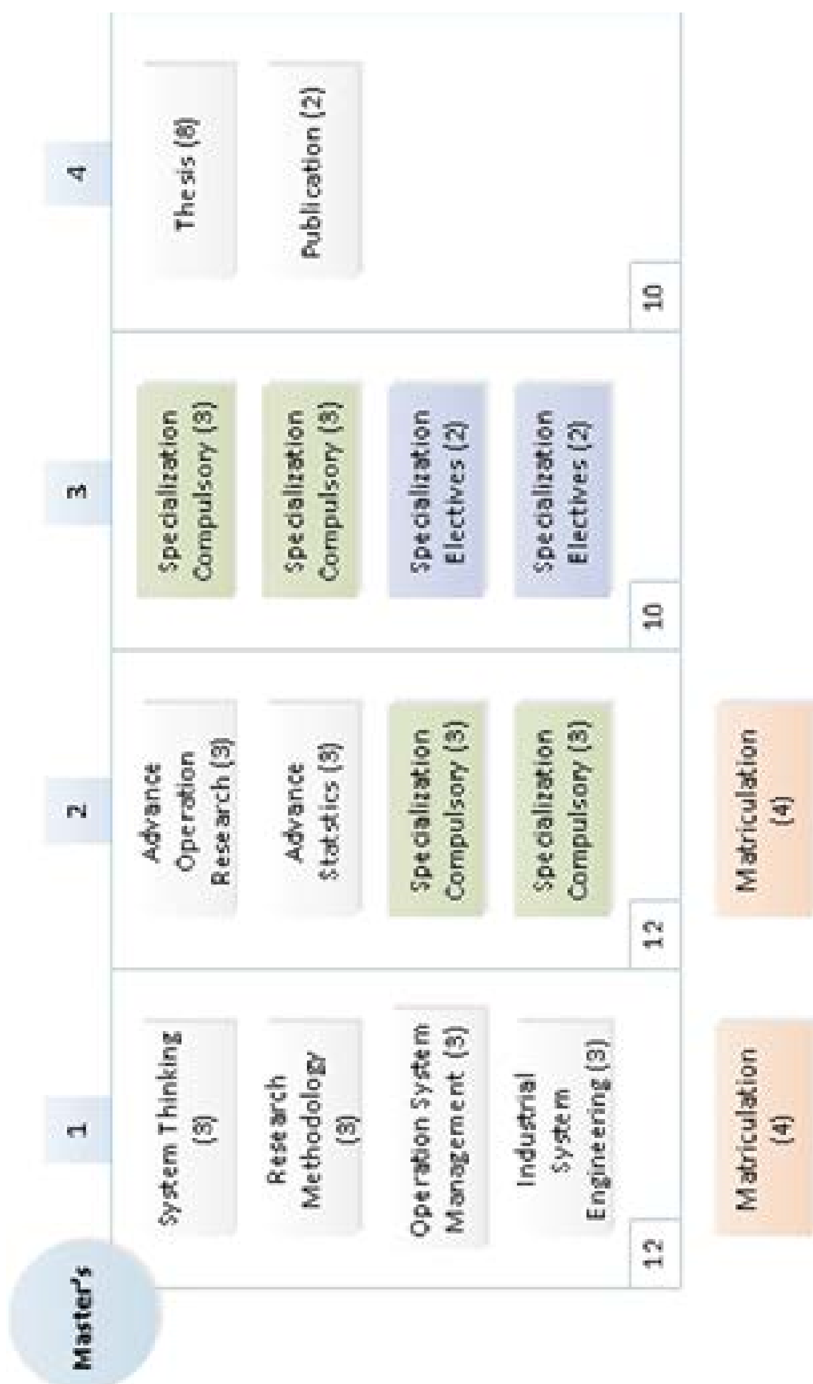
Program Specification

1	**Awarding Institution**		Universitas Indonesia
2	**Teaching Institution**		Universitas Indonesia
3	**Programme Title**		Master Program in Industrial Engineering
4	**Class**		Regular Depok; Special Salemba
5	**Final Award**		Magister Teknik (M.T)
6	**Accreditation / Recognition**		BAN-PT: B - Accredited
7	**Language(s) of Instruction**		Bahasa Indonesia and English
8	**Study Scheme (Full Time / Part Time)**		Full Time
9	**Entry Requirements**		Bachelor (S1) from science and engineering field AND pass the 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:** *An Industrial engineer who has the capabilities of designing, improving, operating and maintaining integrated and multi-level manufacturing and service systems by analyzing and synthesizing processes within research and scientific framework in order to increase the productivity and quality.*		
	Expected Learning Outcomes: 1. Ability to design and manage researches, and analyse and interpret data. 2. Ability to design, manage and improve a system, component, or process to fulfil the needs within realistic boundary such as economics, environment, social, politics, ethics, health and safety, feasibility, and sustainability. 3. Ability to analyse and synthesize engineering problems by using skills and modern tools. 4. Ability to work professionally with ethical responsibility. 5. Has a broad knowledge to understand the impact of engineering problem solving in a global, economic, environmental and social context. 6. Ability to learn independently and continuously (lifelong learning).		
13	**Classification of Subjects**		
No	Classification	Credit Hours (SKS)	Percentage
i	Compulsory Subjects	18	41%
ii	Stream Subjects	12	27%
iii	Elective Subjects	4	9%
iv	Seminar, Thesis & Publication	10	23%
	Total	44	100 %
14	**Total Credit Hours to Graduate**		**44 SKS**

Flow of Expected Learning Outcomes (ELOs)



Flow of Subjects



COURSE STRUCTURE MASTER PROGRAM
INDUSTRIAL ENGINEERING

CODE	SUBJECT	Credits
	1st Semester	
ENIE801001	Systems Thinking	3
ENIE801002	Research Methodology	3
ENIE801003	Operations Management	3
ENIE801004	Industrial Systems Design	3
	Sub Total	12
	2nd Semester	
ENIE801005	Advanced Operations Research	3
ENIE801006	Advanced Statistics	3
	Specialization Compulsory 1	3
	Specialization Compulsory 2	3
	Sub Total	12
	3rd Semester	
	Specialization Compulsory 3	3
	Specialization Compulsory 4	3
	Specialization Electives 1	2
	Specialization Electives 2	2
	Sub Total	12
	4th Semester	
ENIE800007	Publication	2
ENIE800008	Thesis	8
	Sub Total	10

Resume

Wajib Program Studi	28
Wajib Peminatan	12
Jumlah	40
Pilihan	4
Total Beban Studi	44

Compulsory Specialization Subjects

	Innovations and Ergonomics	
CODE	Subject	Credits
ENIE802108	Product and Service Innovation	3
ENIE802109	Safety Engineering and Management	3
ENIE803110	Industrial Technology Management	3
ENIE803111	Macro Ergonomics	3
	Sub Total	12

	Production System and Logistics	
CODE	Subject	Credits
ENIE802216	Manufacturing System	3
ENIE802217	Inventory System	3
ENIE803218	Logistics System	3
ENIE803219	Transportation System	3
	Sub Total	12
	Industrial Management	
CODE	Subject	Credits
ENIE802324	Industrial Economics	3
ENIE802325	Industrial Resource Management	3
ENIE803326	Industrial Project Development	3
ENIE803327	Industrial Strategic Management	3
	Sub Total	12
	Statistics and Quality Engineering	
CODE	Subject	Credits
ENIE802432	Data Mining	3
ENIE802433	Data Engineering	3
ENIE803434	Reliability and Quality	3
ENIE803433	Multivariate Data Analysis	3
	Sub Total	12
	Systems Engineering	
CODE	Subject	Credits
ENIE802537	Decision and Risk in System Engineering	3
ENIE802538	System Based Analysis	3
ENIE803539	Systems Engineering Management	3
ENIE803540	Performance Modeling and Analysis	3
	Sub Total	12

MATA AJAR PILIHAN PEMINATAN

	Innovations and Ergonomics	
CODE	Subject	Credits
ENIE803112	Knowledge Management	2
ENIE803113	Cognitive Ergonomics	2
ENIE803114	Technopreneurship	2
ENIE803115	Human Performance Engineering	2
	Production System and Logistics	
CODE	Subject	Credits
ENIE803220	Total Quality Management	2
ENIE803221	Lean Manufacturing	2
ENIE803222	Industrial Organization	2
ENIE803223	Maritime Logistics	2

	Industrial Management	
CODE	Subject	Credits
ENIE803328	Corporate Finance	2
ENIE803329	Enterprise Information System	2
ENIE803330	Maintenance Management	2
ENIE803331	Supply Chain Management	2
	Data Engineering and Quality	
CODE	Subject	Credits
ENIE803437	Decision Uncertainties and Risk	2
ENIE803435	Consumer Relationship Management	2
ENIE803436	Advanced Optimization	2
	Systems Engineering	
CODE	Subject	Credits
ENIE803541	Conceptual System Planning	2
ENIE803542	Logistics& Support for Systems Engineering	2
ENIE803543	Game Theory	2
ENIE803544	Tech.Policy Modeling w. System Dynamics	2

Course Syllabus

SYSTEM THINKING (3 SKS)
Learning Objective(s) : Course participants are able to implement soft OR concept which is SSM (Soft System Methodology) as a thinking pattern to understand a systemic problem.
Syllabus: System Thinking Concept. Concept of Learning. Organization Hard OR vs Soft OR. Causal Loop Diagram. System Archetypes. Behavior Overtime Graph (BoT). SSM (Soft System Methodology): Entering the problem situation, Expressing the problem situation, Formulating root definitions of relevant systems, Building Conceptual Models of Human Activity Systems, Comparing the models with the real world, Defining changes that are desirable and feasible and Taking action to improve the real world situation.
Text Book(s):
1. The Fifth Discipline Fieldbook: Strategies and Tools for Building a Learning Organization, Peter M. Senge, Crown Business, 1994
2. Soft Systems Methodology in Action, Peter Checkland, Wiley, 1999

RESEARCH METHODOLOGY (3 SKS)
Learning Objective(s): Course participants are able to understand the basic steps necessary for a scientific research and publications and prepare themselves for the upcoming Thesis as part of the pre-requisites on receiving the master degree
Pre-requisite(s): Please Read Thesis SOP
Text Book(s):
1. Manual Penyusunan Tesis Universitas Indonesia dan Departemen Teknik Industri, 2008.

OPERATIONS MANAGEMENT (3 SKS)
Learning Objective(s): Course participants are able to analyze, design, and operate productive systems in order to create competitive products and services.
Sylllabus: Introduction: transformation processes. Aggregate planning & optimization. MPS & MRP. Process analysis & performances. Production processes. Little's Law, process & queing models. Supply chain processes & performances Location. Distribution system & logistics. Inventory policy decision. Theory of costraints (TOC). Service process selection. Case study.
Prerequisite(s): -
Textboks:
1. Operations & Supply Chain Management; Jacobs, Chase; Irwin McGraw-Hill; 13th Ed., 2011.
2. Operations Management; Nigel Slack, Stuart Chambers, Robert Johnston; Prentice Hall; 2010.
3. Operations Management – Along the Supply Chain; Roberta S. Russel; Bernard W. Taylor; John Wiley & Sons, Inc.; 6th Ed., 2009.

INDUSTRIAL SYSTEM ENGINEERING (3 SKS)
Learning Objective(s): Course participants are able to analyze implementation of NPD Process in an organization and know the approaches, tools and techniques used in each steps of the process according to the needs and characteristics of the organization in order to achieve competitive advantage.
Syllabus: Introduction to NPD Process, Models of NPD Process, Detail Design of of Stage-Gate Model dan Concurrent Engineering, Value Engineerng, Spiral NPD Model, Case Studies Implementation NPD.
Textbook(s):
1. Trott, P. (2008). *Innovation Management and New Product Development*, 4th Edition.
2. Cooper, R.G. (2011), *Winning at New Products: Creating Value Through Innovation*, 4th Edition.
3. Park, R.J.(1998), Value Engineering: A Plan for Invention, St.LuciePress.
2. Morgan, R.M, Liker,J.K (2006). *The Toyota Product Development System: Integrating People, Process and Technology*

INDUSTRIAL TECHNOLOGY MANAGEMENT (3 SKS)
Learning Objective(s): : Course participants are able to understand the steps of technology management in an organization.

Syllabus: State of the art 'Technology Management', Strategy in Technology Management, Technology Intelligence, Technology assessment, Technology Roadmapping, Usage of Technology in Innovation
Textbook(s):
1. Strategic Management of Technological Innovation: Melissa A. Schilling, 3rd Edition, 2010.
2. Product Innovation and Technology Strategy: Robert G. Cooper and Scott J. Edgett, 2009.
3. Tidd, J., Bessant, J., Pavitt, K. (2001). Managing Innovation – Integrating Technological, Market and Organisational Change, Second Edition, John Wiley & Sons Ltd., West Sussex, England.

ADVANCED OPERATIONS RESEARCH (3 SKS)
Learning Objective(s): Course participants are able to understand and implement mathematical model to optimize problem-solving within industrial management and technical issues, which later can be modeled quantitatively, deterministically and stochastically.
Syllabus: Dynamic Programming. Markov Analysis. Decision Tree. Game Theory. Non Linear Programming. Queue. Simulation.
Pre-requisite(s): -
Text Book(s):
1. Hamdy A. Taha, Operations Research, 7th

MACRO ERGONOMICS (3 SKS)
Learning Objective(s): Course participants are able to understand comprehensively about work system design that consists of interacting variables such as hardware and software within internal and external physical environment, organization structure and process in order to make it better. Ability to understand how to implement ergonomic science.
Syllabus: Introduction to macroergonomics, method and tools that are used in work system design and analysis, introduction to organization integration in productivity, safety, health and quality of work life context
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.

ADVANCED STATISTICS (3 SKS)
Learning Objective(s): Course participants are able to organize the collection, process, and analysis of data using statistics and engineering principles to support decision making process, within DOE - Design of Experiment.
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.
Pre-requisite(s): -
Text Book(s):
1. Design and Analysis of Experiments, Douglas C. Montgomery. John Wiley & Sons, 2000
2. Design and Analysis of Experiments, Angela Dean and Daniel Voss, Springer-Verlag, 2000
3. Experimental Design with Applications in Management, Engineering, and the Sciences, Paul D. Barger and Robert E. Maurer, Thomson Learning, 2002

SAFETY ENGINEERING AND MANAGEMENT (3 SKS)
Learning Objective(s): Course participants are expected to understand about the importance of work safety in various work fields. Students are also able to do observation, evaluation, and analysis of work safety program to enhance the benefit, in order to achieve effective and efficient work safety program and human-centered focus. Students also are able to understand about management and engineering design concept which is related to occupational safety in an industrial organization through suppression in control of hazardous materials, safety consideration in production facility and maintenance, and operation of effective safety program.

Syllabus: General introduction about work safety in various fields, performance and human error, work safety management program, human reliability assessment, risk management (for human/ worker), work safety management engineering in various work fields. Basic Safety, OSHA Standards, hazard identification and elimination, accident causes and prevention, hazard communication, safe work practice and description, function, and scope of safety engineering and management that are relevant with industry, especially that are related to safe production facility design and operation.
Prerequisite(s): -
Textbook(s):
1. Brauer. (2006). Safety and Health for Engineers, 2nd edition, John Wiley & Sons, Inc.
2. Thompson, Dan Hopwood., Workplace Safety : a Guide for Small and Midsized Companies, John Wiley & Sons, Inc., 2006
3. A. Ian Glendonet. al, Human Safety and Risk Management,CRC Press, 2006
4. George A. Peters, Barbara J. Peters, Human Error Causes and Control, CRC Press, 2006

MACRO ERGONOMICS (3 CREDITS)
Learning Objective(s): Course participants are able to understand comprehensively about work system design that consists of interacting variables such as hardware and software within internal and external physical environment, organization structure and process in order to make it better. Ability to understand how to implement ergonomic science.
Syllabus: Introduction to macroergonomics, method and tools that are used in work system design and analysis, introduction to organization integration in productivity, safety, health and quality of work life context
Pre-requisite(s): -
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.

KNOWLEDGE MANAGEMENT (3 SKS)
Learning Objective(s): Course participants are able to comprehend the concept of knowledge starting from creation, use, transfer, retention and disposal of knowledge to broaden the understanding about the importance of KM for achieving organizations objective.
Syllabus: Introduction to KM, Definition and Concept of KM, SECI Model, Information Management Body of Knowledge (IMBOK), Capitalization of Knowledge, Learning Organization, Implementation of KM in Organization , KM and Innovation, Knowledge Transfer and Open Innovation, Best Practices of KM Implementation.
Pre-requisite(s): -
Textbook(s):
1. Nonaka I., Takeuchi H. The Knowledge Creating Company: How Japanese Companies Create The Dynamics of Innovation, 1995.
2. Ackermann, M.S. etal. Sharing Expertise: Beyond Knowledge Management, MIT Press, 2003
3. Amrit Tiwana, The Knowledge Management Toolkit: Practical Techniques for Building A Knowledge Management System, Prentice-Hall, New Jersey, 2000.
4. Madanmohan Rao, Knowledge Management Tools and Techniques: Practitioners and Experts Evaluate KM Solutions, Elsevier Inc. Oxford – UK. 2005.
5. Murray Jennex, Case Studies in Knowledge Management, Idea Group Publishing, 2005.

COGNITIVE ERGONOMICS (2 SKS)
Learning Objective(s): Course participants are able to understand about basic principles of ergonomics and human factors in cognitive perspective. Students are expected to implement knowledge of cognitive ergonomics in workplace, and also be expected to measure, evaluate, and analyze performance and behavior of various fields and the relation to technology development and engineering. Students are also are expected to design Hierarchical Task Analysis (HTA) as a part of task design based on cognitive.
Syllabus: General introduction to ergonomics and human factors, cognitive aspect in umanmachine/

machine-environment interaction, cognitive aspect in industry, cognitive aspect in transportation, information technology and cognitive performance, behavior aspect and human cognitive performance in designing Hierarchical Task Analysis (HTA).
Text book(s):
1. Harris, Engineering Psychology and Cognitive Ergonomics,Springer, 2011
2. Erik Hollnagel, Handbook of Coqnitive Task Design,Lawrence Erlbaum Associates Publisher, 2003, New Jersey London
3. Candida Castro, Human factors of visual and cognitive performance in driving, CRC Press, 2009

TECHNOPRENEURSHIP (2SKS)
Learning Objective(s): Course participants are able to understand concept, method and application of technopreneurship.
Syllabus: Basic Principles of Entrepreneurship, Technology for Entrepreneur, Entrepreneurship and Innovation
Text book(s):
1. Trott, P. Managing Technology Entrepreneurship and Innovation, Routledge, Uk, 2014

HUMAN PERFORMANCE ENGINEERING (2SKS)
Learning Objective(s): Course participants are able to understand basic concept and implement the knowledge of human performance engineering. Participants should be able to calculate, evaluate and analyse performance and behaviour in real cases which also includes the advancement in technology and engineering,
Syllabus: Introduction to human performance engineering, tools and methods used in human performance engineering, human performance in usability engineering and product design.
Text book(s):
1. Bailey, R.W. Human Performance Engineering, Prentice Hall, 1982.
2. Jurnal dan artikel terkait HPE.

MANUFACTURING SYSTEM (3 SKS)
Learning Objective(s): Course participants are able to understand manufacturing system concept that converts raw material into valuable products and its implementation, including product design activities, process and facilities, and technology used to create competitive products.
Syllabus: Introduction to Manufacturing System. Processes. Manufacturing Facility & Technology. Product Design & Development. Green Manufacturing. Resource planning & ERP. Simulation. Introduction to Plant Simulation for Manufacturing System. JIT & Lean Production. Value Stream Mapping. Optimization Model and its application in production. Case study.
Prerequisite(s): -
Textbooks:
1. Operations Management-An Asian Perspective; William J. Stevenson, and Sum Chee Chuong ; McGraw-Hill; 2010
2. Manufacturing Planning and Control for Supply Chain Management; F. Robert Jacobs, William Berry, D. Clay Whybark, and Thomas Vollmann; McGraw-Hill; 2011.
3. The Fundamentals of Production Planning and Control; Stephen N. Chapman; Pearson - Prentice Hall, 2006.

TOTAL QUALITY MANAGEMENT (2 SKS)
Learning Objective(s): Course participants are able to use concepts and application of TQM as the basis for analysis and evaluation of quality improvement system.
Syllabus: TQM Studies vs Principles. MBNQA. Statistical QC. Cost of Quality. Organizing for Quality. QFD. Capability Process. Six Sigma.
Text Book(s):
1. Rao, et al. TQM : A Cross Functional Perspective, Prentice Hall.
2. Quality Management; Goetsch & Davis, 2000, Prentice Hall

SUPPLY CHAIN MANAGEMENT (2SKS)
Learning Objective(s): Course participants are able to understand about concept and application of SCM to analyze and evaluate the role of operators in a whole supply chain
Syllabus: Introduction to SCM, Strategy and Planning, Enterprise Resource Planning, Purchasing,

Transportation Method, Shortest Path, Traveling Salesman Problem, Vehicle Routing Problem, warehousing management, reverse logistics, location theory, network planning process, SCM development
Prerequisite:-
Text Book(s):
1. Novack, R.A., Supply Chain Management: A Logistics Perspectives, 2008.

DATA MINING (3SKS)
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): -
Text Book(s):
1. Nisbet, R. (2009). Handbook of Statistical Analysis and Data Mining Applications, Elsevier.

MULTIVARIATE ANALYSIS (3SKS)
Learning Objective(s): Course participants are able to organize the extraction, process & analysis of multivariate data in a right way to make decisions.
Syllabus: of Basic Statistical Concepts, Multiple Regression. Manova. Principal Component Analysis. Factor Analysis. Cluster Analysis. Discriminant Analysis. Logit Analysis. Canonical Correlation. Multidimensional Scaling. Structural Equation Modeling.
Pre-requisite(s): -
Text Book(s):
1. Hair,J.F.,B. Black, B. Babin, and R.E. Anderson (2005) Multivariate Data Analysis, Sixth Edition, Prentice Hall.
2. Richard Johnson and Winchern (1998) Applied Multivariate Statistical Analysis, Fourth Edition, rentice Hall.
3. W.R. Dillon and M. Goldstein (1984) Multivariate Analysis: Methods and Applications, John Wiley & Sons.

DECISION UNCERTAINTIES AND RISK (2SKS)
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): -
Text books:
1. Parmigiani, G. (2009). Decision Theory: Principles and Approaches , John Wiley.

CUSTOMER RELATIONSHIP MANAGEMENT (2SKS)
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): -
Textbooks:
1. Peppers, D. (2011). Managing Customer Relationships: A Strategic Framework, John Wiley & Sons.
2. Francis Buttle (2009). Customer Relationship Management, Elsevier.

ADVANCED OPTIMIZATION (2SKS)
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): -
Text Book(s):
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.

SYSTEM ENGINEERING MANAGEMENT (3SKS)

Learning Objective(s): Course participants understand the basics of system engineering management in the industry so they would be able to manage a process of design, installation, management and termination of a system
Syllabus: The concept and methodology of systems engineering, Life Cycle Systems: Concepts, Development, Production, Use and Support, and End Systems. Processes in Life Cycle System: Technical Process, Projects Process, Organization Processes and Acquisition Process of Goods or Services. SEMP- Systems Engineering Management Plan, Systems Engineering Organization, Systems Engineering Evaluation Program. CMMI-Capability Maturity Model Integration. Outsourcing Concept.
Text Book(s):
1. System Engineering Management, 3rd Edition, Benjamin S. Blanchard, John Wiley & Sons. Hoboken – New Jersey. 2004
2. 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
3. ISO/IEC 15288 Standard for Systems Engineering. International Organization Standard (ISO).

SYSTEM PERFORMANCE ANALYSIS AND MODELLING (3SKS)

Learning Objective(s): Course participants are able to specify, predict and evaluate the performance of the system designed by different system modeling
Syllabus: Micro-level performance modelling (Financial Modelling). Business Process Modelling, Macro-level performance modelling with dynamic systems approach.
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. ISO/IEC 15288 Standard for Systems Engineering. International Organization Standard (ISO).

TECHNOLOGY POLICY MODELING USING SYSTEM DYNAMICS (2SKS)

Learning Objective(s): Course participants understand the concepts, methods and tools for systems dynamics modelling to specify, predict and evaluate the impact of a policy so a better policy decision could be formulated.
Syllabus: Introduction to Policy and Technology Policy, Technology aspects of policy, Introduction to system dynamics, basic models of policy analysis using system dynamics, policy modelling case studies.
Text Book(s):

1. Model Pengenalan Pemodelan Sistem Dinamis SEMS
2. ISO/IEC 15288 Standard for Systems Engineering. International Organization Standard (ISO).

CONCEPTUAL SYSTEM DESIGN (2SKS)
Learning Objective(s): Course participants understand the concepts, methods and tools to develop a complete system based on the needs of multiple stakeholders, which could be transformed into a system with complete specifications.
Syllabus: Volere User Requirements Methodology, Design for Manufacturing, Design for Six Sigma, Design for Reliability, Maintainability, and Supportability, Use Case Modelling, Systems Architecting, Systems Specification, Design Structure Matrix (DSM)

Text Book(s):
1. ISO/IEC 15288 Standard for Systems Engineering. International Organization Standard (ISO).

GAME THEORY (2SKS)

Learning Objective(s): Course participants are able to know how to make decisions in a condition that involves multi-actor. Course participants are able to calculate the effects of strategic decisions or policy taken in an environment and take into account the response of that decision.
Syllabus: Types of strategic games, Nash equilibrium, Continuous and Discontinues Games, Evaluation and Learning in the game, Games with a non-perfect information, Nash bargaining action, repeated games, mechanism design, social choice and voting theory
Text Book(s):
1. Gibbons, R., Game Theory for Applied Economists, Princeton University Press, 1992. (Hereafter G)
2. Binmore, K., Game Theory: A Very short Introduction, Oxford University Press, 2007
3. Auman, R.J., Handbook of Game Theory with Economics Application, North-Holland Press, 2002

RESOURCE AND LOGISTIC SUPPORT FOR SYSTEM ENGINEERING (2SKS)

Learning Objective(s): Course participants understand the tools and methods of planning and managing of resources and logistical support in systems engineering process.
Syllabus: Outsourcing Principles and Methods, Acquisition and Supply, Logistics Planning, Principles of Supply Chain Management System, Scheduling and Sourcing for System Engineering.
Text Book(s):
1. ISO/IEC 15288 Standard for Systems Engineering. International Organization Standard (ISO).

THESIS (8 SKS)
Learning Objective(s): Course participants are able to systematically present his/her problems and idea during scientific forum with concise and correct.
Pre-requisite(s): Please Read Thesis SOP
Text Book(s):
1. Manual Penyusunan Tesis Universitas Indonesia dan Departemen Teknik Industri, 2008.

CHAPTER 7

DOCTORAL PROGRAM

7. 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 Specification

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 Chemical Engineering Engineering Doctoral Program in Architecture 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: A 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 B from BAN-PT Industrial Engineering Doctoral Program: Accreditation B from BAN-PT
7	**Language(s) of Instruction**		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**		Designed for 3 years
	Type of Semester	Number of semester	Number of weeks /semester
	Regular	6	14 - 17
	Short (optional)	none	none

DOCTORAL PROGRAM

11	**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* *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 two streams as follow:* • *Manufacturing and Quality Engineering* • *Service System Engineering*
12	**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.

FACULTY OF ENGINEERING

13	**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.		
14	**Classification of Subjects. (Course & Research)**		
No	Classification	Credit Hours	Percentage
i	Course Component	18	34 %
ii	Research Component	34	66 %
	Total	52	100 %
14	**Classification of Subjects. (Research)**		
No	Classification	Credit Hours	Percentage
i	Course Component	0	0 %
ii	Research Component	52	100 %
	Total	52	100 %
15	**Total Credit Hours to Graduate**		52 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.

The FTUI Doctoral Program is held in two program: Course and Research and Research.

1.1. 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

KODE/CODE	MATA AJARAN	SUBJECT	SKS
	Semester 1	**1st Semester**	
ENGE901001	Metode Penelitian Lanjut	Advanced Research Method	6
ENXX900001	Kekhususan I	Special Subject I	4
		Sub Total	**10**
	Semester 2	**2nd Semester**	
ENGE902002	Analisis Kualitatif & Kuantitatif	Qualitative & Quantitative Analysis	4
ENXX900002	Kekhususan II	Special Subject II	4
ENXX900004	Proposal Riset	Research Proposal	6
		Sub Total	**14**
	Semester 3	**3rd Semester**	
ENXX900006	Publikasi - Konferensi Internasional	Publication - International Conference	4
		Sub Total	**4**
	Semester 4	**4th Semester**	
ENXX900007	Ujian Hasil Riset	Research Result Examination	10
		Sub Total	**10**
	Semester 5	**5th Semester**	
ENXX900008	Publikasi II - Jurnal Internasional	Publication II - International Journal	8
		Sub Total	**8**
	Semester 6	**6th Semester**	
ENXX900010	Sidang Promosi	Doctoral Promotion	6
		Sub Total	**6**
Total			**52**

The Lecture Component includes four subjects:
a) Advanced Research Method, 6 sks
b) Qualitative and Quantitative Analysis, 4 sks
c) Special Subject I, 4 SKS.
d) Special Subject II, 4 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

1.2. 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

KODE/CODE	MATA AJARAN	SUBJECT	SKS
	Semester 1	**1st Semester**	
ENXX900003	Seminar Berkala Kelompok Ilmu	Research Group Periodic Seminar	8
		Sub Total	**8**
	Semester 2	**2nd Semester**	
ENXX900004	Proposal Riset	Research Proposal	6
		Sub Total	**6**
	Semester 3	**3rd Semester**	
ENXX900005	Publikasi I – Konferensi Internasional	Publication I – International Conference	6
		Sub Total	**6**
	Semester 4	**4th Semester**	
ENXX900007	Ujian Hasil Riset	Research Result Examination	10
		Sub Total	**10**
	Semester 5	**5th Semester**	
ENXX900008	Publikasi II – Jurnal Internasional	Publication II – International Journal	8
		Sub Total	**8**
	Semester 6	**6th Semester**	
ENXX900009 ENXX900010	Publikasi III – Jurnal Internasional Sidang Promosi	Publication III – International Journal Doctoral Promotion	8 6
		Sub Total	**14**
		Total	**52**

Description of Subjects

ENGE900001
ADVANCED RESEARCH METHOD
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:
Haryono Imam R dan C. Verhaak, Filsafat Ilmu Pengetahuan, Gramedia, Jakarta, 1995
Willie Tan, "Practical Research Methods", Prentice Hall, 2002.
R. Kumar, *Research Methodology, A Step-by-step Guide for Beginner*, 3rd ed., Sage Pub, 2012

ENGE900002
QUALITATIVE AND QUANTITATIVE ANALYSIS
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:
Miles M & Huberman M, Qualitative Data Analysis, London Sage Publications, (1994)
Montgomery, D.C., & Runger, G.C, Applied Statistics and Probability for Engineers 3rd Ed., John Wiley and Sons, Inc., New York, (2003)
Kirkup, L, Experimental Method: An Introduction to the Analysis and Presentation, John Wiley and Sons, Australia, Ltd., Queensland, (1994)
Montgomery, D.C, Design and Analysis of Experiments 6th Ed., John Wiley and Sons, Inc., New York, (2005)
Hair, J.F., B.Black, B.Babin and R.E Anderson, Multivariate Data Analysis 6th Ed., Pearson Education Inc., New Jersey, (2006)

ENXX900001
Special Subject 1
4 SKS

ENXX900002
Special Subject 2
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:

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.

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.

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

In the event where neither conditions is viable for the students, the Academic Advisor is allowed to conduct a class of said course.

ENXX900003
Research Group Periodic Seminar
8 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.

ENXX900004
Research Proposal
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.

ENXX900007

Research Output Examination

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.

ENXX900006
Publication – International Conference

4 SKS

ENXX900005

Publication I – International Conference

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.

ENXX900008

Publication II – International Journal

8 SKS

ENXX900009

Publication III – International Journal

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.

ENXX900008
Promotion Examination
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.

FACULTY OF ENGINEERING UNIVERSITAS INDONESIA

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