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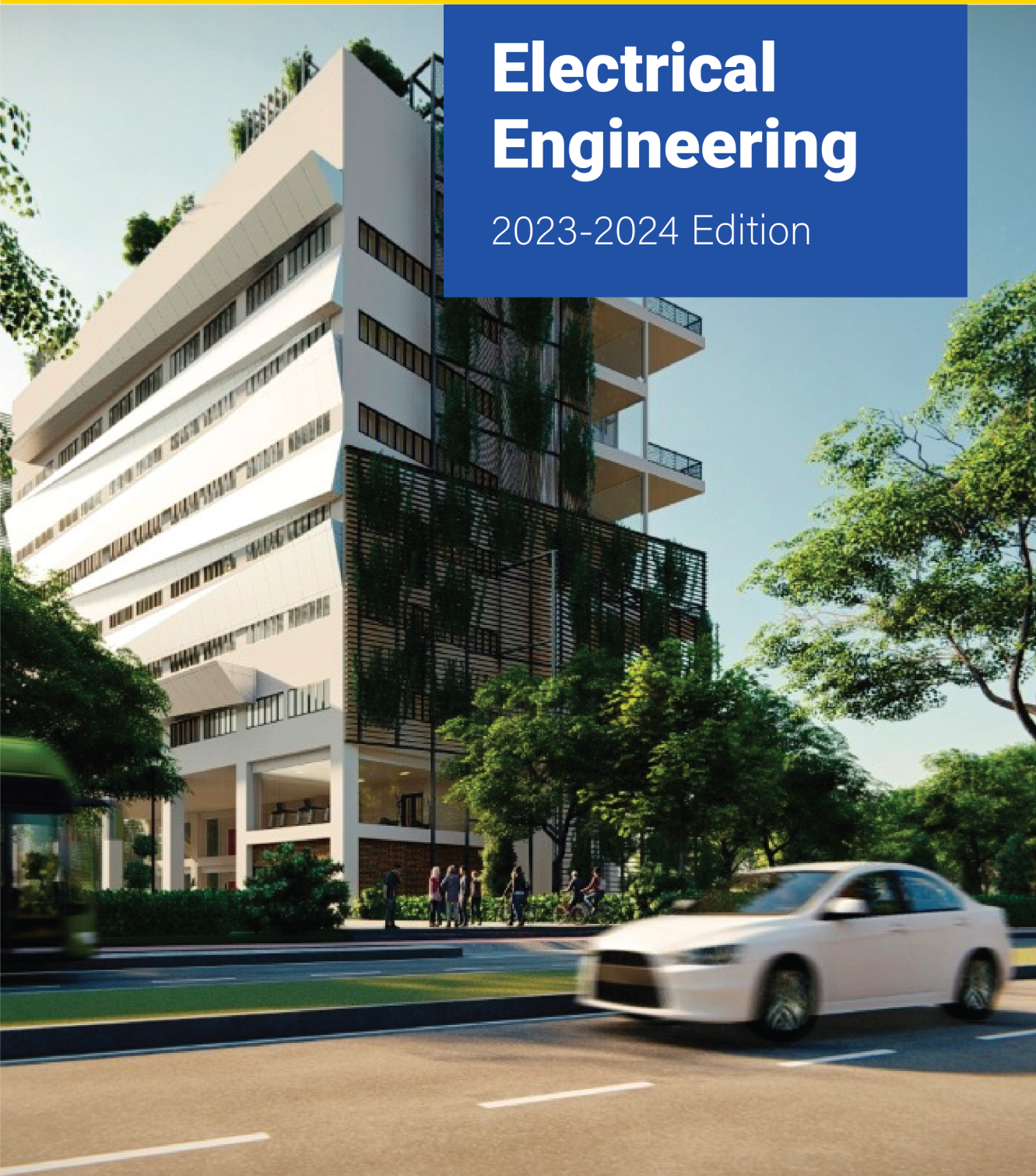

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ELECTRICAL ENGINEERING GUIDEBOOK

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PREFACE

Welcome to FTUI !

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

This 2023 Academic Guidebook is intended for all students of the Undergraduate Program (Regular, Non Reguler, International), Master Program, Professional Program, and Doctoral Program, to be used during their study at the Faculty of Engineering Universitas Indonesia. The curriculum, syllabus, and academic staff are listed, as well as all support information provided for you. The information contained within this book is also helpful for those considering continuing their study in the engineering field at the Universitas Indonesia.

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

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

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

Depok, November 2023
Faculty of Engineering Universitas Indonesia

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

Table of Content

CHAPTER 1

PROFILE OF DEPARTMENT

Profile of Departments

Department of Electrical Engineering

General

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

Objective

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

Vision

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

Missions

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

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

The Targets

Bachelor of Electrical Engineering

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

Bachelor of Computer Engineering

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

Bachelor of Biomedical Engineering

1. Able to design hardware and software needed in biomedical engineering.
2. Able to design biomedical engineering principles according to Health standards and regulations.
3. Able to design technology based on medical information/data related to the condition of human physiology.
4. Able to handle general and specific problems in biomedical engineering.
5. Able to apply the basic principles of mathematics, chemistry, physics, and health-safety in solving Biomedical Engineering problems.
6. Able to think critically, creatively, and innovatively and have an intellectual curiosity to solve problems at the individual and group level.
7. Able to identify varieties of entrepreneurial efforts that are characterized by innovation and self-reliance based on ethics.
8. Able to use the language both spoken and written in the Bahasa Indonesia and English for academic or non-academic activities.
9. Able to provide alternative solutions to problems that arise in the environment, society, nation, and country.
10. Able to utilize information communication technology.

Master of Electrical Engineering

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

Majoring in Power and Smart System

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

Majoring in Telecommunication and Smart Wireless System

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

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wireless telecommunications systems.

Majoring in Electronic and Intelligent Embedded System

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

Majoring in Cyber Security and Future Internet

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

Majoring in Automation and Data Analytic Engineering

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

Majoring in Data Engineering and Business Intelligence

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

Majoring in Telecommunication Management

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

Majoring in Power and Energy Management

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

Majoring in Information Network Security Management

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

Master of Biomedical Engineering

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

Majoring in Biomedical Instrumentation and Medical Imaging

1. Able to design biomedical instrumentation.
2. Able to develop biomedical sensor.
3. Able to design biomedical automation system.

4. Able to design medical imaging technique.

Majoring in Medical Informatics

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

Majoring in Clinical and Hospital Engineering

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

Electrical Engineering Staffs

Dr. Eng. Arief Udhiarto, S.T., M.T.
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CHAPTER 2

ACADEMICS SYSTEM AND REGULATION

Academic System and Regulation

General

Teaching and Learning Activities

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

Semester Credits Units (SKS)

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

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

Subjects

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

Grade Point Average

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

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

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

Semester Grade Point Average (SGPA)

Grade Point Average (GPA/IPK)

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

Academic Performance Evaluation

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

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

Grades

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

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

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

Table 2.1. Grade Value and Point

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

Length of Study and Academic Load

Undergraduate Program

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

As for the second semester, these following rules apply:

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

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

Master Program

The academic load in the FTUI's Master Program curriculum is set at 40-44 credits after finishing

the Undergraduate Program. The length of study is scheduled for 4 (four) semesters and can be completed in minimum 2 (two) semesters and a maximum of 6 (six) semesters; exclude short semester.

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

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

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

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

Matriculation for Master

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

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

Fast Track (Master – Doctoral Program)

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

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

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

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

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

1. For the Master program, that is according to the total credits in the master study program including 12 - 16 (twelve to sixteen) the credits include elective courses taken from the compulsory doctoral program;

2. For the Doctoral program, a minimum of 50 (fifty) credits, including 12 - 16 (twelve to sixteen) credits, are courses that are recognized through credit transfers.

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

Doctoral Program

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

The length of study is scheduled for 6 (six) semesters and can be completed in a minimum of 4 (four) semesters and a maximum of 10 (ten) semesters. Students in the Doctoral Program may be granted an extension of maximum 2 (two) semesters if they have never received an extension before, have

achieved a minimum grade of 'B' for research result examination, and have obtained a recommendation from their Promoter and a guarantee that they will complete their study within the granted extension period. The proposal for such extension is regulated in a Rector's Decree based on the proposal of the Dean.

Undergraduate Final Project (Skripsi)

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

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

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

Thesis (Master Program)

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

Requirements for a student to start writing a Thesis are:

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

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

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

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

Dissertation

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

Internship for Undergraduate Student

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

Supplementary Exam

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

Credit Transfer

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

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

Credit Transfer for Non Reguler Class Students of Diploma Graduates

As of 2011, all Extension Programs in FTUI are merged into Non Reguler Classes in the Undergraduate Program. For diploma graduates registered as students in these Non Reguler Classes, credits obtained from the previous diploma program will be transferred in blocks of credits equivalent to the

number of the first and second semester credits in their study program. Students begin their study in the third semester by taking a full academic load according to the package provided for the third semester. Afterward, they can take credits according to their SGPA in the following semester.

Study Abroad

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

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

Fast Track (Undergraduate – Master Program)

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

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

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

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

Requirements and Procedure for Fast Track Registration

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

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

Procedure for Fast Track Program:

1. Fast Track Program is open for all FTUI undergraduate study programs which have the same specialization with the Master programs (for undergraduate study programs that have specialization).
2. Students who are interested in participating in the Fast Track Program are required to fill out the Registration Form.
3. The Fast Track Registration Forms will be evaluated by a team headed by the Head of Department.
4. If the student's application to participate in

the Fast Track scheme is approved, they are required to counsel with his/her academic advisor for the finalization of his/her Undergraduate (S1) and Master (S2) Study Plan Form. The student's Study Plan Form for semester 7 and 8, especially for the undergraduate Elective Course selection must be in accordance with the Compulsory and Elective Courses in their respective Master study program in line with their specialization.

5. Undergraduate thesis and thesis of the student are expected to be of continuous research to maximize knowledge, experience and quality research result.
6. The funds for the Fast Track Program will be borne entirely by the student.

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

Fast Track (Undergraduate – Doctoral Program)

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

Merdeka Belajar Kampus Merdeka Program

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

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

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

The student may apply for the following elective courses scheme:

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

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

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

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

charge of perform verification, assign weighting, and propose assessment of student performance in student activities.

Administrative and Academic Registration

Academic Calendar

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

Term 1

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

Term 2

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

Short Semester

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

Note:

*) Schedules are subject to change

Note:

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

Registration and Course Guidelines

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

Administrative Registration

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

Academic Registration

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

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

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

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

Sanctions

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

Exception Administrative Registration

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

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

Prerequisite Courses

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

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

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

1. Achieve the minimum GPA as required at the end fourth semester for the 2+2 program;
2. Have passed all required subjects as listed in the Study Program curriculum with minimum C with a total of passed credits consistent with the total number of credits listed in the Study
3. Program curriculum for semester 1-4.
4. Achieve the minimum IELTS or TOEFL scores as

required.

5. If their GPA is less than required, the students must stay at UI and repeat some subjects to improve their GPA, while administratively and academically registered at FTUI.

6. If their GPA meets minimum requirement, but IELTS or TOEFL scores less than minimum requirement, they are suggested to improve their IELTS or TOEFL score in Indonesia and maintain administrative registration at FTUI. Other choice is to take English for Academic Purposes (EAP) at the partner university. Information on duration and schedule of EAP can be found at the partner university's website.

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

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

English Language Requirements for Undergraduate International Program Single Degree

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

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

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

1. Student choose a Partner University
   - Find out list of UI's Partner Universities
   - Information on Study Abroad/ Student Exchange Information from International Office UI through http:// international.ui.ac.id

2. Student contacted the selected partner University for Information on:
   - List of subjects offered and course description
   - List of requirements/documents needed.
   - Application and Tuition Fees.
   - Other Documents needed.

3. Student consulted their Academic Guidance Counselor or the Vice Head of Department to determine the subjects they will take in Partner University that can be credit transferred upon their return.

4. The Head of Department issued a Letter addressed to the Vice Dean stating:
   - Name and Student ID of student participating in the Study Abroad/Student Exchange Program
   - Name of Partner University and length of study of said program
   - List of subjects that the students will take at Partner University.

5. The Vice Dean will assigned the Associate Dean for Academic and Head of PAF to process the student's status to "overseas" or "student exchange and issued a Reference Letter and Academic Transcript for the student.

6. Student prepare the documents needed for their Study Abroad/ Student Exchange:
   - Application Form
   - IELTS/TOEFL iBT
   - Other language requirement
   - Reference Letter and Academic Transcript from the Faculty.

7. Student sends their application documents to Partnery University.

8. Student receives Letter of Offer dan Letter of Acceptance from Partner University.

9. Student makes payment and signed the Letter of Offer

10. Student applies for Student Visa to the Country where the Partner University is located.

11. Departure to Partner University

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

Graduate Predicate

Students are considered to have passed the Undergraduate Program and will earn a Bachelor's Degree (S.T. or S.Ars.) if they are registered as an active student in Universitas Indonesia during said semester, both administratively and academically; have passed all the compulsory courses and acquired a minimum of 144 credits in accordance with the applicable curriculum with 'C' as the lowest grade and completed all 8-semester scheduled academic load within 8-12 semesters; have completed all administrative obligations, including returning all borrowed library and laboratory collections; and have completed all obligations within their study period and/or all assignments given in accordance with the curriculum of the Study Program (including revising Final Project) with a GPA of ≥ 2.00 (two point zero). Honors predicate for a graduate is determined by the student's CGPA as follows: Summa cum laude (3.90-4.00), Cum Laude (3.61-3.89), Very Satisfactory (3.25-3.60), Satisfactory (2.76-3.24). For an undergraduate student to graduate Cum Laude, he/she must finish his/her study within 8 (eight) semesters with minimum GPA 3,51 and without retaking any courses.

Students are considered to have passed the Master Program and will earn a Master of Engineering or Master of Architecture Degree if they have passed all the required 40–44 credits; achieve a ≥ 3.00 GPA with 'C' as the lowest grade; do not exceed the maximum study period; and have met all administrative requirements. The honors predicate for a graduate is determined by the student's CGPA as follows: Summa cum laude (3.95-4.00), Cum Laude (3.76-3.94), Very Satisfactory (3.51-3.75), Satisfactory (3.00-3.50). For a Master Program student to graduate Cum Laude, his/her length of study must not exceed 4 (four) semesters with minimum GPA 3,76 and without retaking any courses.

Students are considered to have passed the Doctoral Program and will earn a Doctoral Degree if they have passed all the required 50 credits; achieve a minimum GPA of 3.00 with minimum 'C' for in-class courses and minimum 'B' for research courses; do not exceed the maximum study period; and have met all administrative requirements. Honors predicate for a graduate is determined by the student's CGPA as follows: Summa cum laude (3.95-4.00), Cum Laude (3.76-3.94), Very Satisfactory (3.51-3.75), Satisfactory (3.00-3.50). For a Doctoral Program student to graduate Cum Laude, his/her length of study must not exceed 8 (eight) semesters without retaking any courses or academic leave (except for a student with outstanding achievement based on the Promoter and examiner team's judgment, the length of his/her study must not exceed 10 (ten) semesters). The mark 'BS' is not counted as course repetition. If a student's GPA is within the 3.76–4.00 range but he/she fails to meet the other requirements, he/she will be awarded a 'Very Satisfactory' predicate.

Academic Performance Evaluation and Dropout Criteria

Undergraduate Program

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

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

Or:

- Have the following issues: have an inactive status (empty) for two semesters in a row, thus being declared as "resign" automatically from the status of Universitas Indonesia's student by the Rector's decree on Status Determination.
- It was proven to be in violation of rules or regulations that caused the student to lose his right as FTUI student.
- Deemed unfit to continue their study based on consideration from a team of Medical Doctors appointed by the Head of the University.

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

Master's Program

The Maximum length of study to earn a Master Degree in FTUI is at the latest 6 (six) semesters, starting from registration time to graduation. This

provision also applies to students who enroll in the FTUI Master program with a "probation" status. Students will lose their right to continue the study (dropping out) if:

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

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

Doctoral Program

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

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

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

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

- Students do not register academically and administratively for two consecutive semesters, thus automatically being considered to have resigned from UI.
- Students fail to obtain a minimum of 'B' for their research proposal examination or a similar exam at the end of their fourth semester.
- Students fail to complete a minimum of 50% of their research based on the judgment of the Promoter Team by the end of their sixth semester.
- Students fail to complete a minimum of 75% of their research based on the judgment of the Promoter Team by the end of their eighth semester.
- At the end of the study period (ten semesters), students fail to complete 4 points above.
- Students fail to do the following by the end of their study period of ten semesters: producing 1 (one) scientific paper based on research for their dissertation as the main writer that is presented at an international scientific conference and published in the proceedings as a full paper (6 credits); producing 1 (one)

scientific paper based on research for their dissertation as the main writer with an option to work with the Promoter Team as their co-writer that has been accepted to be published in an indexed international journal (8 credits); submitting 1 (one) scientific paper that has been accepted to be published in a nationally accredited journal; submitting proof of compliance with the foregoing requirement as part of the requirements for promotion exam; and submitting 1 (one) dissertation and participating in a promotion exam as the final step of the Doctoral Program (6-8 credits).

- Students exceed the maximum length of study (10 semesters).
- Students are proven to be in violation of rules or regulations that causes the students to lose their rights as an FTUI student.

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

Academic Leave

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

Procedures of Academic Leave

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

Faculty and Department Judiciums

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

Semester Grade Transcript, Diploma and Academic Transcripts

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

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

student request as required. A valid DNS is signed by the academic administration official in the Faculty level.

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

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

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

Offenses and Sanctions

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

1. Utilizing unauthorized materials/notes to enhance performance during on examination.
2. Attempting to observe the work of another student.
3. Taking an examination for another person, or permitting someone else to do so.
4. Collaborating improperly by joint effort on discussion in anyway expressly prohibited by lecturer.
5. When incidents, as enumerated above occurs, the following sanctions may be imposed (as per FTUI regulation):
   - The student may be assigned E for the subject in question
   - The student may be suspended for one semester
   - The student may be dismissed or expelled by FTUI
   - If necessary, a meeting of Panitia Penyelesaian Pelanggaran Tata Tertib (Offence Settlement Committee) (PT32) may be held.

Academic Sanction for Perpetrators of Academic Cheating In Exams

1. Academic sanction in the form of the revocation of the said exam (E grade) for the student caught or proven committing academic offence in the examination process, such as working with any other student, copying any other student's work or giving answer to any other student;
2. Academic sanction in the form of study period revocation (for all subjects) for the said semester for the student caught or proven committing academic offence in examination process such as opening books, notes or any other equipment prepared beforehand;
3. Academic sanction in the form of revocation of study period for the said semester and one semester suspension for the student caught or proven committing academic offence in the examination process due to collaborating with any third party outside of the examination room;
4. Academic sanction in the form of expulsion from the Faculty of Engineering, Universitas Indonesia, for the student caught or proven committing academic offence in the examination process by substituting any other examinee or by having someone else to take their place;
5. Academic sanction in the form of expulsion from the Faculty of Engineering, Universitas Indonesia, for the student

caught or proven committing academic offence in the examination process for planning and carrying out the plan to help any other examinee;

6. Other academic offence will be handled through a hearing by the Offence Settlement Committee (Panitia Penyelesaian Pelanggaran Tata Tertib (P3T2)), Faculty of Engineering, Universitas Indonesia;

7. Student is entitled to submit an appeal to the Faculty Academic Senate with the help of their Academic Advisor and the Vice Dean for Academic, Research, and Student Affairs, Faculty of Engineering, Universitas Indonesia..

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

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

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

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

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

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

Academic Regulation Of The Universitas Indonesia

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

General:

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

conduct on Campus Life in Universitas Indonesia

Education

1. Decree of the Rector Universitas Indonesia Number: 285/SK/R/UI/2003 on the Implementation Guidelines for Cross-Faculty Lectures in Universitas Indonesia
2. Decree of the Board of Trustees Universitas Indonesia Number: 006/MWA-UI/2004 on the Universitas Indonesia's Academic Curriculum
3. Decree of the Rector of Universitas Indonesia Number: 491/SK/R/UI/2004 on Universitas Indonesia Education Activities Conclusion Regulations
4. Decree of the Board of Trustees Universitas Indonesia Number: 001/TAP/MWA-UI/2005 on the Establishment of Academic Degrees in the Universitas Indonesia.
5. Decree of the Board of Trustees Universitas Indonesia Number 003/TAP/MWA-UI/2005 on General Guidelines for Implementation on Universitas Indonesia's Professional Programs
6. Regulation of the Board of Trustees Universitas Indonesia Number: 006/Peraturan/MWA-UI/2005 on Student Learning Outcomes Evaluation at Universitas Indonesia
7. Regulation of the Board of Trustees Universitas Indonesia Number: 007/Peraturan/MWA-UI/2005 on Academic Education Implementation Norms in Universitas Indonesia
8. Regulation of the Board of Trustees Universitas Indonesia Number: 008/Peraturan/MWA-UI/2005 on Professional Education Curriculum Norms in Universitas Indonesia
9. Decree of the Rector of Universitas Indonesia Number: 838/SK/R/UI/2006 on Administration of Universitas Indonesia Student's Learning Outcomes
10. Decree of the Rector of Universitas Indonesia Number: 012/SK/R/UI/2007 on Implementation of the of Students Learning Activity in Universitas Indonesia
11. Decree of the Rector of Universitas Indonesia Number: 450/SK/R/UI/2008 on the Implementation of E-Learning in the University Indonesia
12. Decree of the Dean of Faculty of Engineering Universitas Indonesia Number: 3 year 2019 on the English Requirements for Undergraduate International Program Single Degree and Double Degree Faculty of Engineering Universitas Indonesia.
13. Decree of the Rector of Universitas Indonesia Number : 24 year 2022 on the Implementation of Undergraduate Program in Universitas Indonesia
14. Decree of the Rector of Universitas Indonesia Number : 25 year 2022 on the Implementation of Master Program in Universitas Indonesia
15. Decree of the Rector of Universitas Indonesia Number : 26 year 2022 on the Implementation of Doctoral Program in Universitas Indonesia
16. Decree of the Rector of Universitas Indonesia Number : 29 year 2022 on the Implementation of Professional Education Programs in Universitas Indonesia
17. Decree of the Dean of Faculty of Engineering Universitas Indonesia Number: 622/D/SK/FTUI/IX/2016 on Academic Sanction for Academic Fraud Perpetrator in Faculty of Engineering Universitas Indonesia.
18. 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.
19. 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.
20. Decree of the Dean of Faculty of Engineering Universitas Indonesia Number : 2 year 2022 on the Scientific Publication Assessment Guide for Master Program and Doctoral Program in Faculty of Engineering Universitas Indonesia.
21. Decree of the Dean of Faculty of Engineering Universitas Indonesia Number : 703 year 2016 ont the Credit Transfer

Research

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

3. Decree of the Board of Trustees Universitas Indonesia Number 009/SK/MWA-UI/2008 on amendment of the Decree of the Board of Trustees of Universitas Indonesia Number 003/ MWA-UI/2008 on Research Policy in Universitas Indonesia

CHAPTER 3

FACILITIES AND CAMPUS LIFE

LIST OF NAMES OF HEADS OF LABORATORY AND ELECTRICAL ENGINEERING DEPARTMENT

YEAR 2023

No	Head of Laboratory	Laboratory	Laboratory Assistant	Subjects Related to Lab
1	Dr.Faiz Husnayain, S.T., M.Sc., M.T., M.Phil.	Electrical Energy Conversion Laboratory	Donni Bayuwono	Power Electronics, Electrical Power Engineering
2	Ir. I Made Ardita Y MT	Electrical Power System Laboratory	Donni Bayuwono	Electric Power Systems
3	Dr.-Ing. Budi Sudiarto, ST, MT	High voltage and Electrical Measurement Laboratory	Donni Bayuwono	Electric Circuits, Measurement of Electrical Quantities, High Voltage and Current Engineering
4	Dr.Eng. Mia Rizkinia, S.T., M	Digital Laboratory	Eko Herry Supramono	Basics of Digital Systems, Real Time Systems and IoT
5.	Taufiq Alif Kurniawan, S.T., M.T.	Electronics Laboratory	Eko Herry Supramono	Electronic Circuits, Embedded Systems
6.	Ruki Harwahyu, S.T., M.Sc., M.T., Ph.D.	Computer Network Laboratory	Eko Herry Supramono	Computer Basics, Computer Networks, Computer Network Security Practicum
7.	Abdul Muis, M.Sc., Ph.D.	Control Laboratory	Fahmi Huda	Control Engineering
8.	Dr. Catur Apriono, S.T., M.T., Ph.D.	Telecommunication Laboratory	Fahmi Huda	Introduction of Telecommunication System
9.	Optoelectronics Laboratory	Prof. Dr. Ir. Retno Wigajatri Purnamaningsih, M.T.	Fahmi Huda	
10.	Biomedical Engineering Laboratory	Siti Fauziyah Rahman, S.T., M.Eng., Ph.D.		Introduction of Biomedical Technology

CHAPTER 4

UNDERGRADUATE PROGRAM

Undergraduate Program in Electrical Engineering

Program Specification

1.	**Awarding Institution**	Universitas Indonesia Double Degree: Universitas Indonesia and partner university	
2.	**Teaching Institution**	Universitas Indonesia Double Degree: Universitas Indonesia and partner university	
3.	**Faculty**	Engineering	
4.	**Program Title**	Undergraduate Program in Electrical Engineering	
5.	**Vision and Mission**	**Vision** "to become a leading study programme that is able to provide the solutions to the problems and challenges at the national and global level" **Mission** The department has defined its mission to 1. Deliver education based on the concept of good university governance to produce graduates who are knowledgeable, internationally minded, and have an entrepreneurial spirit. 2. Organize facilities, funding, and participation in applied research and new findings that can provide solutions to national and global problems. 3. Apply appropriate sciences and technologies in community service activities that meet the needs of the communities and industries.	
6.	**Class**	Regular, Non Reguler, International	
7.	**Final Award**	Sarjana Teknik (S.T)	
8.	**Accreditation Status**	BAN-PT: A-accredited and AUN-QA International Assessment	
9.	**Language(s) of Instruction**	Bahasa Indonesia and English for International Class	
10.	**Study Scheme (Full Time / Part Time)**	Full Time	
11,	**Entry Requirements**	High school /equivalent or polytechnic/equivalent and pass the entrance exam	
12.	**Duration for Study**	Designed for 4 years	
	Type of Semester	Number of Semester	Number of weeks / semester
	Regular	8	16
	Short (optional)	3	8
13.	**Aims of the programme:** 1. To produce graduates that will have autonomous professional profile as follows: 2. Become a professional graduate who has technical, managerial, and entrepreneurial skills as well as global insight, and as an active learner who follows the latest developments in science and technology in the field of Electrical Engineering. 3. Become a graduate with character, ethics, and care for the environment.		
14.	**Graduate Profiles:** Engineering Graduates that can analyze and design the systems in the field of Electrical Engineering that can provide solutions to problems in society in accordance with professional ethics.		

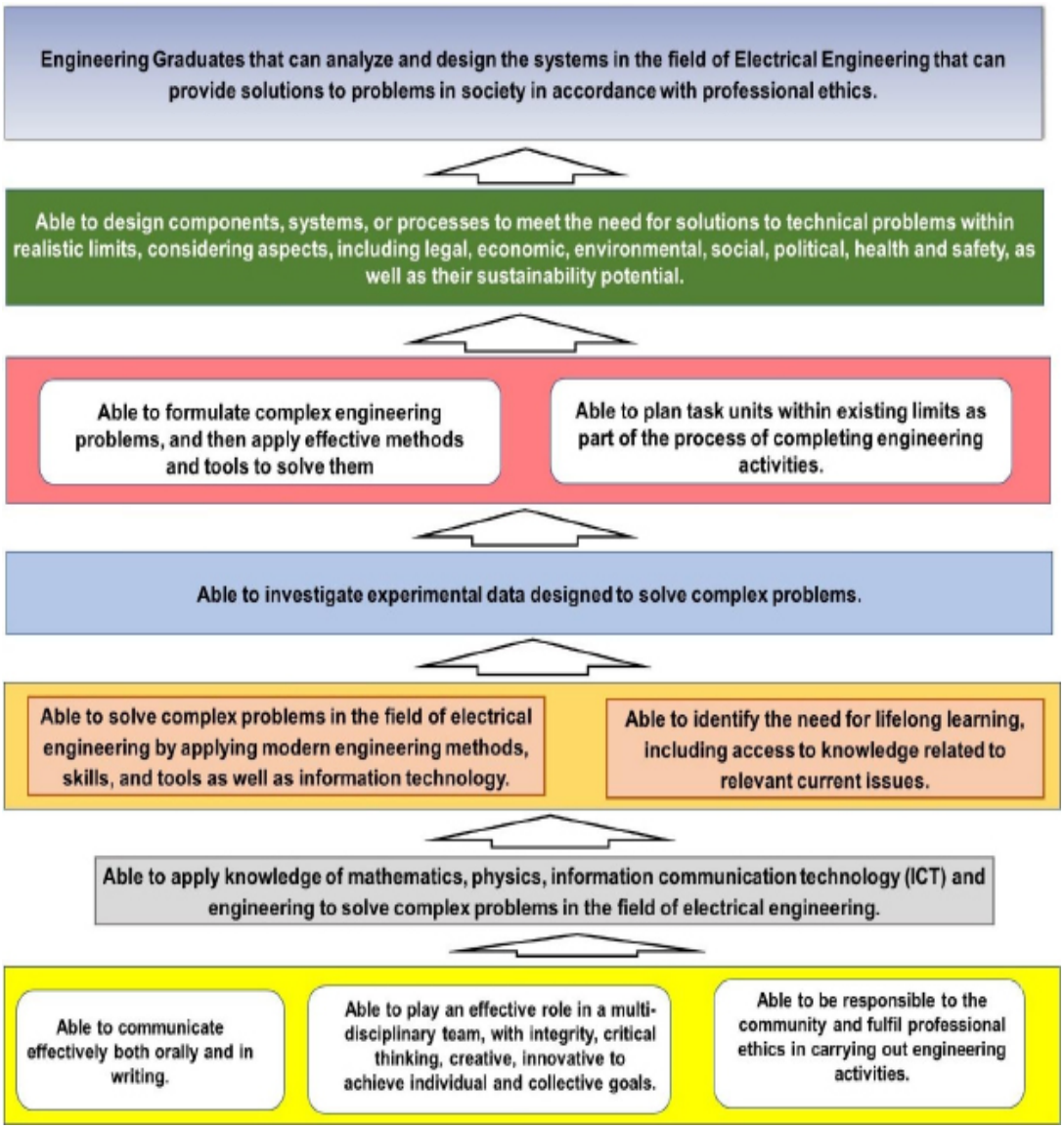
15.	**Expected Learning Outcomes:** Electrical Engineering Graduates are expected to have the following learning outcomes: 1. Able to design components, systems, or processes to meet the need for solutions to technical problems within realistic limits, considering aspects, including legal, economic,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

No.	Classification	Credit Hours (SKS)	Percentage
i	**University General Subjects**	**10**	**6,3%**
ii	**Faculty Subjects**	**18**	**12,5%**
iii	**Core Subjects**	**88**	**61,1%**
iv	**Elective Subjects**	**29**	**20,1**
	Total	**145**	**100 %**
	Total Credit Hours to Graduate		**145 SKS**

Career Prospects

Graduates of this study program can work in various types of companies such as the electric power industry, telecommunications and information technology, electronics, oil and gas, education, government, health industry, banking, and other related industries.

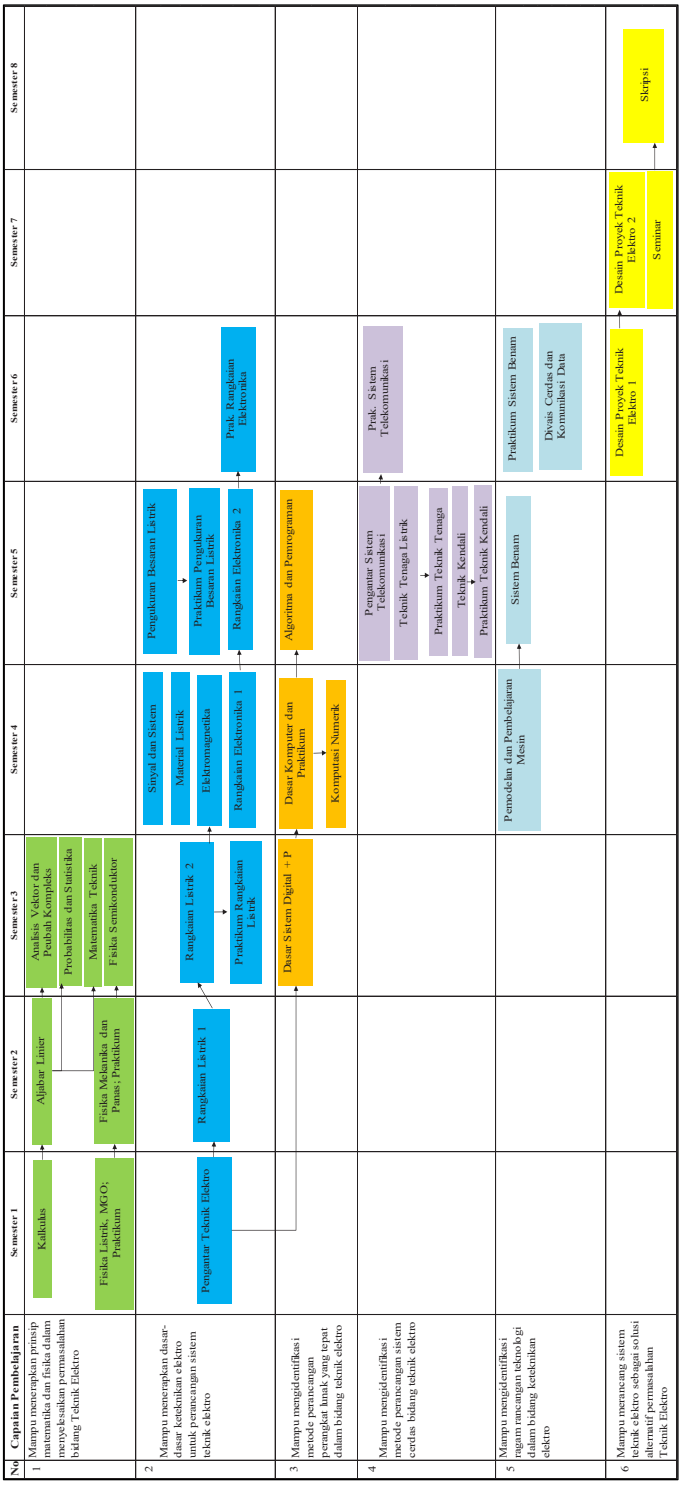
LEARNING OUTCOMES



Learning Outcome Matrix of Mandatory Subjects

Kode	Course	Credit	Sem	10	9	8	7	6	5	4	3	2	1
UIGEB00010-15	Religion	2	1		X								
UIGEB00003	English	2	1				X						
ENGEB00003	Calculus	4	1			X							
ENGEB00004	Linear Algebra	4	1			X							
ENGEB00007	Physics of Electricity, Magnetism, Optics, and Waves	3	1			X							
ENGEB00008	Physics of Electricity, Magnetism, Optics, and Waves Laboratory	1	1			X							
ENEEB01001	Introduction to Electrical Engineering	2	1		X		X		X				
UIGEB00001	Integrated Characteristic Building	5	2		X		X		X				
ENGEB00005	Physics of Mechanics and Heats	3	2			X							
ENGEB00006	Laboratory of Mechanics and Heats Physics	1	2			X							
ENEEB02002	Probability and Statistics	4	2			X							
ENEEB02003	Electric Circuit 1	3	2			X		X					
ENEEB02004	Vector Analysis and Complex Variable	2	2			X							
ENEEB02005	Fundamentals of Digital System and Laboratory	3	2			X		X					
ENEEB03006	Electric Circuit 2	3	3			X		X					
ENEEB03007	Electric Circuit Laboratory	1	3			X		X					
ENEEB03008	Engineering Mathematics	4	3			X							
ENEEB03009	Physics of Semiconductor	2	3			X							
ENEEB03010	Advanced Linear Algebra	2	3			X							
ENEEB03011	Electromagnetics	4	3			X		X					
ENEEB03012	Electric Measurements	2	3			X		X					
ENEEB03013	Electric Measurement Laboratory	1	3			X		X					
ENEEB03014	Basic Computer and Laboratory	3	3			X		X					
ENEEB04015	Electronic Circuits 1	2	4			X		X					
ENEEB04016	Electronic Circuits Laboratory	1	4			X		X					
ENEEB04017	Signal and Systems	3	4			X		X					
ENEEB04018	Electric Power Engineering	3	4					X		X			
ENEEB04019	Electric Power Engineering Laboratory	1	4			X		X					
ENEEB04020	Numerical Computation	2	4			X		X					
ENEEB04021	Electrical Materials	2	4					X					
ENEEB04022	Embedded System 1	3	4					X		X			
ENEEB04023	Algorithm and Programming	3	4					X		X			
ENEEB05024	Introduction to Telecommunication System	3	5					X		X			
ENEEB05025	Telecommunication System Laboratory	1	5					X		X			
ENEEB05026	Electronic Circuits 2	2	5					X		X			
ENEEB05027	Control Engineering	3	5					X		X			
ENEEB05028	Control Engineering Laboratory	1	5					X		X			
ENEEB05029	Embedded System 2	3	5							X			X
ENEEB05030	Embedded System Laboratory	1	5					X		X			
ENEEB05031	Modeling and a Machine Learning	3	5					X		X			
ENEEB05032	Innovation and Entrepreneurship	2	5						X			X	
ENGEB00012	Health, Safety & Environment	2	5	X									
ENEEB06033	Electrical Engineering Project Design 1	2	6		X		X				X	X	
ENEEB06034	Internship	2	6	X			X		X				
ENEEB07035	Electrical Engineering Project Design 2	3	7	X	X		X				X		X
ENEEB07036	Pra-Bachelor Theses	2	7				X		X			X	
ENEEB08037	Bachelor Theses	4	8	X			X	X			X		X

Course Flow Diagram



Course Structure Undergraduate Program (Regular/Non Reguler) in Electrical Engineering

Code	Course	SKS
	1st Semester	
UIGE600010-15	Religion	2
UIGE600003	English	2
ENGE600003	Calculus	4
ENGE600004	Linear Algebra	4
ENGE600007	Physics of Electricity, Magnetism, Optics, and Waves	3
ENGE600008	Physics of Electricity, Magnetism, Optics, and Waves Laboratory	1
ENEE601001	Introduction to Electrical Engineering	2
	Subtotal	**18**
	2nd Semester	
UIGE600007	Integrated Characteristic Building	6
ENGE600005	Physics of Mechanics and Heats	3
ENGE600006	Laboratory of Mechanics and Heats Physics	1
ENEE602002	Probability and Statistics	4
ENEE602003	Electric Circuit 1	3
ENEE602004	Vector Analysis and Complex Variable	2
ENEE602005-MB	Fundamentals of Digital System and Laboratory	3
	Subtotal	**22**
	3rd Semester	
ENEE603006	Electric Circuit 2	3
ENEE603007	Electric Circuit Laboratory	1
ENEE603008	Engineering Mathematics	4
ENEE603009	Physics of Semiconductor	2
ENEE603010	Advanced Linear Algebra	2
ENEE603011	Electromagnetics	4
ENEE603012	Electric Measurements	2
ENEE603013	Electric Measurement Laboratory	1
ENEE603014-MB	Basic Computer and Laboratory	3
	Subtotal	**22**
	4th Semester	
ENEE604015	Electronic Circuits 1	2
ENEE604016	Electronic Circuits Laboratory	1
ENEE604017	Signal and Systems	3
ENEE604018	Electric Power Engineering	3
ENEE604019	Electric Power Engineering Laboratory	1
ENEE604020	Numerical Computation	2
ENEE604021	Electrical Materials	2
ENEE604022	Embedded System	3
ENEE604023-MB	Algorithm and Programming	3
	Subtotal	**20**
	5th Semester	
ENEE605024	Introduction to Telecommunication System	3
ENEE605025	Telecommunication System Laboratory	1
ENEE605026	Electronic Circuits 2	2
ENEE605027	Control Engineering	3
ENEE605028	Control Engineering Laboratory	1
ENEE605029	Embedded System 2	3
ENEE605030	Embedded System Laboratory	1
ENEE605031	Modeling anda Machine Learning	3
ENEE605032-MB	Innovation and Entrepreneurship	2
ENGE600012-MB	Health, Safety & Environment	2
	Subtotal	**21**

	6th Semester	
ENEE606033	Electrical Engineering Project Design 1	2
ENEE606034-MB	Internship	2
MB	Major Elective Course	8
MB	Electives	4
	Subtotal	**16**
	7th Semester	
ENEE607035	Electrical Engineering Project Design 2	3
ENEE607036	Pra-Bachelor Thesis	2
MB	Major Elective Course	8
MB	Electives	2
	Subtotal	**15**
	8th Semester	
ENEE608037	Bachelor Theses	4
MB	Major Elective Course	5
MB	Electives	2
	Subtotal	**11**
	TOTAL	**145**

Elective Courses of Electric Power Engineering Field

Code	Course	SKS
	6th Semester	
ENEE606101	Energy Conversion and Renewable Energy	2
ENEE606102	Power Electronics and Laboratory	3
ENEE606103	Management and Engineering Economics	2
	Subtotal	**7**
	7th Semester	
ENEE607104	Electric Power System and Laboratory	3
ENEE607105	High Current & Voltage Engineering and Laboratory	3
ENEE607106	Building Electrical Installation	2
ENEE607107	Special Topics of Electric Power Engineering 1	2
	Subtotal	**10**
	8th Semester	
ENEE608108	Smart Grid	2
ENEE608109	Electric Power System Protection	2
ENEE608110	Special Topics of Electric Power Engineering	2
	Subtotal	**6**

Elective Courses of Electronic Engineering Field

Code	Course	SKS
	6th Semester	
ENEE606201	Design of Electronic Circuits	3
ENEE606202	Advanced Electronic Devices	3
ENEE606203	Design of Electronics Instrumentation	2
	Subtotal	**8**
	7th Semester	
ENEE607204	Optoelectronic Devices	3
ENEE607205	Design of VLSI Circuits	3
ENEE607206	Introduction to Nano-electronics	2
ENEE607207	Special Topics of Electronics 1	2
	Subtotal	**10**
	8th Semester	
ENEE608208	Advanced Embedded System	3
ENEE608209	Special Topics of Electronics	2
	Subtotal	**5**

Elective Courses of Telecommunication Engineering Field

Code	Course	SKS
	6th Semester	
ENEE606301	Digital Communication	3
ENEE606302	Telecommunication System Devices	3
ENEE606303	Optical Communications	2

	Subtotal	**8**
	7th Semester	
ENEE607304	Antenna and Propagation	3
ENEE607305	Wireless Communication and Convergence Networks	3
ENEE607306	Capita Selecta of Telecommunication Ecosystems	2
ENEE607307	Special Topics of Telecommunication 1	2
	Subtotal	**10**
	8th Semester	
ENEE608308	Signal Processing and Multimedia Service	3
ENEE608309	Special Topics of Telecommunication	2

Elective Courses of Control Engineering Field

Code	Course	SKS
	6th Semester	
ENEE606401	Electric Motor Control System	3
ENEE606402	Adaptive and Predictive Control System	3
ENEE606403	Industrial Automation System	2
	Subtotal	**8**
	7th Semester	
ENEE607404	Mechatronics	3
ENEE607405	Knowledge-based System	3
ENEE607406	Robotic System	2
ENEE607407	Special Topics of Control Engineering 1	2
	Subtotal	**10**
	8th Semester	
ENEE608408	Autonomous Vehicle System	3
ENEE608409	Special Topics of Control Engineering	2
	Subtotal	**5**

Course Structure of International Undergraduate Program

Code	Course	SKS
	1st Semester	
ENGE610003	Calculus	4
ENGE610007	Physics (Electric, Magnet, Optic, and Wave)	3
ENGE610008	Physics (Electric, Magnet, Optic, and Wave) Laboratory	1
ENGE610004	Linear Algebra	4
ENEE611001	Introduction to Electrical Engineering	2
ENEE611002	Fundamentals of Digital System and Laboratory	3
UIGE610002	Academic Writing	2
	Subtotal	**19**
	2nd Semester	
ENGE610005	Physics (Mechanics and Heat)	3
ENGE610006	Physics (Mechanics and Heat) Laboratory	1
ENEE612003	Basic Computer and Laboratory	3
ENEE612004	Probability and Statistics	4
ENEE612005	Vector and Complex Variable Analysis	2
ENEE612006	Electric Circuit 1	3
ENEE612007	Physics of Semiconductor	2
ENEE612008	Engineering Mathematics	4
	Subtotal	**22**
	3rd Semester	
ENEE613009	Electric Circuit 2	3
ENEE613010	Electric Circuit Laboratory	1
ENEE613011	Signal & Systems	3
ENEE613012	Electromagnetics	4
ENEE613013	Introduction to Telecommunication System	3

ENEE613014	Telecommunication system Laboratory	1
ENEE613015	Electronic Circuits 1	2
ENEE613016	Electronic Circuits Laboratory	1
ENEE613017	Electrical Measurements	2
ENEE613018	Advanced Linear Algebra	2
	Subtotal	**22**
	4th Semester	
ENEE614019	Control Engineering	3
ENEE614020	Control Engineering Laboratory	1
ENEE614021	Electronic Circuits 2	2
ENEE614022	Electrical Measurements Laboratory	1
ENEE614023	Numerical Computation	2
ENEE614024	Electrical Materials	2
ENEE614025	Embedded System 1	3
ENEE614026	Electrical Power Engineering	3
ENEE614027	Electrical Power Engineering Laboratory	1
ENEE614028	Algorithm and Programming	3
	Subtotal	**21**
	5th Semester	
UIGE600007	Integrated Characteristic Building	6
UIGE610005-9	Religion	2
ENEE615029	Embedded System 2	3
ENEE615030	Embedded System Laboratory	1
ENEE615031	Power Electronics and Laboratory	3
ENEE615032	Electric Motor Control System	3
ENEE615033	Wireless Communication and Convergence Networks	3
ENEE615034	Electronic Instrumentation Design	2
	Subtotal	**22**

	6th Semester	
ENEE616035	Autonomous Vehicle System	3
ENEE616036	Modeling and Machine Learning	3
ENEE616037	Electrical Engineering Project Design 1	2
ENEE616038	Introduction to Nanoelectronics	2
ENEE616039	Electric Power System and Laboratory	3
ENEE616040	Telecommunication System Devices	3
ENEE616041	Internship	2
ENEE616042	Innovation and Entrepreneurship	2
	Subtotal	**20**
	7th Semester	
ENGE610012	Health, Safety & Environment	2
ENEE617043	Electrical Engineering Project Design 2	3
ENEE617044	Optoelectronic Devices	2
ENEE617045	Pra-Bachelor Thesis	2
	Electives	3
	Subtotal	**12**
	8th Semester	
ENEE618047	Bachelor Thesis	4
	Electives	2
	Subtotal	**6**
	Total	**144**

Course Syllabus of University Subjects

INTEGRATED CHARACTER BUILDING
UIGE600007/UIGE600007
6 credits

Syllabus :

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

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

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

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

Graduate Learning Outcomes :

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

Course Learning Outcomes :

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

Prerequisite : -

ACADEMIC WRITING
UIGE610002
2 credits
The Objectives :

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

To enable students to develop the learning strategies and study skills needed to finish their study successfully and o continue learning on their

own after taking the MPK program (to develop independent learners)

Main Competencies :

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

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

Prerequisite :

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

ENGLISH
UIGE600003
2 credits
Learning Objectives :

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

Syllabus :

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

ISLAMIC STUDIES
UIGE6000010/UIGE610005
2 credits
General Instructional Objectives :

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

Learning Objectives :

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

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

Syllabus :

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

CATHOLIC STUDIES
UIGE6000011/UIGE610006
2 credits
General Instructional Objectives :

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

Be scholars who believe in God according to the

teachings of Jesus Christ by continuing to be responsible of his faith in life in church and society.

Syllabus :

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

CHRISTIAN STUDIES
UIGE6000012/UIGE610007
2 credits
General Instructional Objectives :

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

Learning Objectives :

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

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

Syllabus :

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

HINDU STUDIES
UIGE6000013/UIGE610008
2 credits

Syllabus :

Hindu religion, Hindu history), Source and scope of Hinduism (the Veda as the source of Hindu religion teachings, the scope of the teachings in Hindu religion), The concept of the God (Brahman) according to the Veda, the Path to Brahman (Catur Marga Yoga, Mantra and Japa), Human Nature (The purpose of human life, Human's duties, obligations, and responsibilities both individually or collectively), Ethics and morality (Principles teaching, self-control), in-depth understanding of the scripture (deep understanding of the Bhagawadgita, deep understanding of the Sarasamuschaya), The Role of Hinduism in science, technology, and art (Hinduism benefits in science and technology in accordance with each department, benefit / the role of Hinduism in the arts), Cohesion and community's prosperity / independence (Benefits of unity in the religious plurality, independent community (kerthajagathita) as a common goal, Tri Pitakarana), Culture as an expression of Hindu religious practice, Contribution to the Hindu religion teachings in the political life of nation and country, laws and the enforcement of justice, Awareness of and obeying the Rita / Dharma.

BUDDHIST STUDIES
UIGE6000014/UIGE610009
2 credits

Syllabus :

Almighty God and the God Study (Faith and piety, Divine Philosophy/Theology), Human (Human Nature, Human Dignity, Human Responsibility), Moral (Implementation of Faith and Piety in everyday life), Science, Technology and Art (Faith, Science and Charity as a unity, the Obligation to study and practice what you are taught, Responsibility for nature and environment), harmony between religion (religion is a blessing for all mankind, the essence of the religious plurality and togetherness), community (the role of religious society in creating a prosperous independent society, the responsibility of religious society in the realization of human rights and democracy), Culture (the responsibility of religious society in the realization of critical thinking (academic), work hard and fair), Politics (Religion contribution in the political life of nation and country), Law (Raise awareness to obey and follow God's law, the role of religion in the formulation and enforcement of law, the function of religion in the legal profession).

KONG HU CU STUDY
UIGE6000015/UIGE610010
2 credits

Syllabus of Faculty Subjects

CALCULUS 1

ENGE600001/ENGE610001
3 credits
Course Learning Outcomes:

Able to use the basic concepts of calculus related to -a function of one variable, the derivative and integration of the function of one variable in order to solve its applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, basic engineering, and engineering specialization to be used in solving complex engineering problems.

Syllabus :
Introduction, Functions and Limits, The Derivative, Applications of the Derivative, The Definite Integral, Applications of The Definte Integral, Transcendental Functions, Techniques of Integration, Indeterminate Forms and Improper Integrals.

Prerequisite: None

Textbooks:

Main reference:
D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., Pearson, Prentice Hall, 2007.

Additional eferences:
1. George B. Thomas Jr., Thomas' Calculus Early Transcendental, 12th ed., Addison–Wesley Pearson, 2009.
2. Howard Anton, Calculus, 10th ed., John Wiley and Sons, 2012.

CALCULUS 2
ENGE600002/ENGE610002
3 SKS
Course Learning Outcomes:

Students are able to use the concepts of sequences, series, conic sections, and the basic concepts of calculus which involve the function of two or three variables to solve their applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus: :
Infinite sequences and infinite series, Test for convergence of positive series and alternating series, Power series and operation on operations, Taylor and MacLaurin series, Conic sections , Calculus in polar coordinates, Derivatives, limits, and continuity of multi-variables functions, Directional derivatives and gradients, Chain Rule, Tangent planes and Approximations, Lagrange multipliers. Double integrals in Cartesian coordinates and polar coordinates, triple integrals in Cartesian coordinates, cylindrical coordinates and spherical coordinates, Applications of double and triple Integral.

Prerequisite: Calculus 1

Textbooks:
1. D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., PEARSON, Prentice Hall, 2007.
2. Thomas, Calculus Thirteenth Edition Volume 2, Erlangga, 2019.

CALCULUS
ENGE600003/ENGE610003
4 SKS
Course Learning Outcomes:

Students are able to use the basic concepts of calculus involving functions of one to three variables to solve their applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :

Introduction, Functions and Limits, Derivatives, Derived Applications, Indeterminate Integral, Integral Applications, Infinite Row, and Series. Derivatives with many variables, Duplicate Integral (2 and 3), Duplicate Integral Application.

Prerequisite: None

Textbooks:

Main :
D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., Pearson, Prentice Hall, 2007.

George B. Thomas Jr., Thomas' Calculus Early Transcendental, 12th ed., Addison – Wesley Pearson, 2009.

LINEAR ALGEBRA
ENGE600004/ENGE610004
4 SKS
Learning Outcomes:
Able to explain the concepts of vectors and matrices and their applications; Able to apply vector and matrices operations in solving engineering problems; Able to apply the techniques of solving Linear Equation Systems, Determinants, Norm Vectors, Values and Eigenvectors, and Linear Transformations

Topics:

Matrics, Vector, Matrics and vector operation, linear system equation, determinant, vector space, vector norm, inner product, vector geometry, eigenvalue,

eigenvector, linear transformation

Prerequisite: None

Textbooks:
1. S. Friedberg, A. Insel, L. Spence, "Linear Algebra, 4th edition", Pearson, 2014.
2. W. Keith Nicholson, "Linear Algebra with Applications, 7th edition", McGraw-Hill, 2013.

MECHANICAL AND HEAT PHYSICS
ENGE600005 / ENGE610005
3 credits
Course Learning Outcomes:

Able to explain the basic concepts of mechanics and thermodynamics, and be able to apply them to understand natural phenomena and human engineering, including their applications.

Graduate Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus:

Units, Magnitudes and Vectors, Motion Along Straight Lines, Motion in Two and Three Dimensions, Newton's Laws of Motion, Applications of Newton's Laws, Kinetic Energy, and Work, Potential Energy and Energy Conservation, Center of Mass, Linear Momentum, Rotation, Rolling Motion, Torque, Angular Momentum, Oscillation, Mechanical and Sound Waves, Gravity, Statics and Elasticity, Fluid Mechanics, Temperature, Heat, Law I Thermodynamics, Ideal Gas and Kinetic Theory of Gas, Heat Engine, Entropy, and Law II Thermodynamics.

Prerequisite: none

Textbooks:
1. Halliday, Resnick, and Walker, Principles of Physics 10th Edition, Wiley, 2014.
2. Serway Jewett, Physics for Scientists and Engineers 9th Edition, Thomson Brooks / Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008

ELECTRICAL MAGNETIC, OPTICAL AND WAVE PHYSICS
ENGE600007 / ENGE610007
3 credits
Course Learning Outcomes:

Students are able to apply the basic concepts of electrical physics, magnetism, waves, and optics to solve problems in the engineering field.

Graduate Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus:

Unit, Magnitude, Vector, Electric Charge, Electric Field, Gauss Law, Electric Potential, Capacitance, Electric Current, Resistance, Direct Current, Magnetic Field Due to Electric Current, Magnetic Field Source, Induced GGL, Inductance, Alternating Current, Electromagnetic Waves, Light Properties and Propagation, Optical Geometry.

Prerequisite: none

Textbooks :
1. Halliday, Resnick, and Walker, Principles of Physics 9th Edition, Wiley, 2011.
2. Serway Jewett, Physics for Scientists and Engineers 9th Edition, Thomson Brooks / Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008.

BASIC CHEMISTRY
ENGE600009 / ENGE610009
2 credits
Course Learning Outcomes:
Students are able to analyze the principe of basic chemistry for application in engineering.

Graduates' Learning Outcomes:
Able to apply mathematics, science, and basic engineering to be used in solving complex engineering problems.

Syllabus:

Material and measurements, atoms, molecules and ions, stochiometry, water phase reactions and solution stochiometry, thermochemistry, chemical equilibrium, acid and base equilibrium, electrochemistry, chemical kinetics, and chemical applications.

Prerequisite: none

Textbooks :
1. Ralph H. Petrucci, General Chemistry: Principles and Modern Applications, 8th Ed. Prentice Hall Inc., New York, 2001.
2. John McMurry, Robert C. Fay, Chemistry (3rd ed.), Prentice Hall, 2001.
3. Raymond Chang, Williams College, Chemistry (7th ed.), McGraw-Hill, 2003.

ENGINEERING ECONOMY
ENGE600011 / ENGE610011
3 credits
Course Learning Outcomes:

Students are able to analyze the economic and finan-

cial feasibility of making economic practice decisions.

Graduate Learning Outcomes:

Able to apply the principles of technical management and decision making based on economic considerations, in individual and group, as well as in project management.

Syllabus:

Introduction to Engineering Economics, Time Value of Money, Combining Factors, Interest Rates, Money Worth Analysis, Rate of Return Analysis, Effects of Inflation, Benefit Cost & Break-Even Point Analysis, Sensitivity Analysis, Depreciation, Tax Analysis, Cost Estimation & Allocation, Capital Budgeting & Replacement Analysis.

Prerequisite:
1. Civil Engineering : -
2. Environmental Engineering : -
3. Naval Engineering : -
4. Industrial Engineering : must pass the introductory Economic course and have completed 38 credits
5. Chemical Engineering : -
6. Bioprocess Engineering : -

Textbooks:
1. Blank, Leland and Tarquin, Anthony. 2018. Engineering Economy 8th Ed. McGraw Hill.
2. Park, Chan S. 2016. Contemporary Engineering Economics 6th Ed. Pearson. Upper Saddle River.
3. White, Case and Pratt. 2012. Principles of Engineering Economic Analysis 6th ed. John Wiley and Sons.

STATISTICS AND PROBABILISTICS
ENGE600010 / ENGE610010
2 credits
Course Learning Outcomes:

Students are able to handle quantitative data/ information starting from the descriptive stage (collection, organization, and presentation) to the inductive stage, which includes forecasting and drawing conclusions based on the relationship between variables for decision making.

Graduate Learning Outcomes:
1. Apply descriptive statistics and probability theory to data processing and serving
2. Apply probability distribution to data processing and serving
3. Apply the principles of sampling and estimation for decision making
4. Apply hypothesis test samples for decision making

Syllabus:

Introduction to Statistics for Engineering Studies, Probability Theory, Dasar Basic concepts and definitions, Distribution Probability, Sampling, Estimation, Hypothesis testing, Hypothesis test 1 sample at an average value, Regression

Prerequisite: none

Textbooks :
1. Harinaldi, Basic Principles of Statistical Engineering and Science, Erlangga, 2004
2. Montgomery, DC., And Runger, GC., Applied Statistics and Probability for Engineers, John Wiley Sons, 2002

HSE PROTECTION
ENGE600012 / ENGE610012
2 credits
Course Learning Outcomes:

Upon completion of this subject students are expected to be able to carried out hazard identification, and characterization, to propose appropriate methods for risk reduction and mitigation, and to design safety management system. The student is also expected to improve their awareness on industrial safety and health, and understanding on safety regulation framework and standards as well as environmental program.

Graduate Learning Outcomes:
1. Students are expected to understand safety, health and environmental aspect as an integral part of fundamental principal in engineering code of ethics.
2. Students are expected to be able to carry out process of risk assessments by considering risk factors in the impact of hazards on people, facilities, and the surrounding community and environemt.
3. Students are expected to understand the regulatory framework and standard related to the stages of life cycle of machine, building structure, construction, and process.
4. Students are able to design and propose an effective hazard communication, management and engineering control, and risk mitigation through an engineering assignment project.
5. Students are able to identify the knowledge required to perform risk assesment, investigation and design improvement through a multidisiplinary case of incident and accident.

Syllabus:

Introduction to SHE Regulation and Standards, SHE Perception (Risk and Environment), Identification, Assessment and Management, Construction, machinery and Noise hazards, Process safety hazard and analysis technique, Fire and explosion

hazard, Electrical hazard, Toxicology in the Workplace, Ergonomy Aspect, Hazard communication to employees, Environmental Protection, Case studies, Safety Health and Environment audits.

Prerequisite: none

Textbooks :

1. Charles A. Wentz, Safety, Health and Environmental Protection, McGraw Hill, 1998.
2. Asfahl, C.R., Rieske, D. W., Sixth Edition Industrial Safety and Health Management, Pearson Education, Inc., 2010.
3. United Kingdom - Health and Safety Executive, http://www.hse.gov.uk/
4. National laws and regulations related to the K3 Management System and the Environment.
5. Related Journal (http://www.journals.elsevier.com/safety-science/) etc, related standards and publications.

Electrical Engineering Course

INTRODUCTION TO ELECTRICAL ENGINEERING
ENEE601001/ENEE611001
2 CREDITS
Learning Outcomes:
Able to describe the profession and mindset of engineer, able to describe the scope of the field of electrical engineering, able to show a simple application in the field of electrical engineering
Topics:
The profession and role of the engineer in the field of electrical engineering, innovation, and entrepreneurship in the field of electrical engineering, mindset of the engineer, science and its application in the field of electrical engineering, exploration of electrical technologies.
Prerequisites: none
Textbook:

1. Diktat Pengantar Teknik Elektro UI
2. Dr. Raymond B. Landis, "Studying Engineering: A Road Map to a Rewarding Career, Chapter 2", 3rd edition, Discovery Press, 2019

PROBABILITY AND STATISTICS
ENEE602002/ENEE612004
4 CREDITS
Learning Outcomes:
Able to explain the stapes and methods in data processing and analysis as well as the principle of uncertainty in data; able to use data representation/modeling methods; able to apply data representation/modeling methods in engineering, especially electrical engineering
Topics:
General concepts of probability and statistics, population, sample, data preparation and explanation (frequency distribution, data presentation in tables/graphs, mean, standard deviations, variances, medians), random variables (discrete, continuous), types of probabilities, various types of probability distributions, sampling methods, sampling distributions, Bayes' Theorem, mean inference (point estimation, interval estimation, maximum likelihood estimation), variance inference (variance estimation, hypothesis), and proportion inference (proportion estimation, hypothesis, goodness of fit), Optimization, least squared method, linear regression (single, multiple), correlation
Prerequisites: none
Textbook:

1. R. Lyman, Michael Longnecker, "An Introduction to Statistical Methods & Data Analysis",7th Edition, Cengage Learning, 2016.
2. Irwin Miller, Marylees Miller, "Mathematical Statistics with Application", 8th Edition, Pearson Education, 2014.
3. Richard L. Scheaffer, Linda J. Young, "Introduction to Probability and Its Applications", Cengage Learning, 2010.

ELECTRIC CIRCUITS 1
ENEE602003/ENEE612006
3 CREDITS
Learning Outcomes:
Able to apply analysis techniques of complex electrical circuit; able to apply electrical circuit analysis methods; able to perform analysis of electrical circuit variables.
Topics:
Current, voltage, power and energy; voltage source, current source (free/ bound), resistor, and capacitor; series and Non Reguler resistive circuits; RL, RC, RLC circuits; node analysis, supernode, mesh, supermesh; the superposition theorem, source transformation, and Thevenin-Norton; operational amplifier; time and frequency response of the RLC circuit
Prerequisite: Calculus, Physics (Electricity, MWO).
Textbook:

1. James W. Nilsson, Susan A. Riedel, "Electric Circuits, (Chapter 1-9)", 10th Edition, Pearson, 2015.
2. David E. Johnson, Johnny R. Johnson, John L. Hilburry, Peter D. Scott, "Electric Circuit Analysis, (Chapter 1-8)", 3rd Edition, Wiley, 1997.

VECTOR ANALYSIS COMPLEX VARIABLE
ENEE602004/ENEE612005
2 CREDITS
Learning Outcomes:
Able to explain the concepts of differential and integral vectors; able to describe the application of differential and integral vectors in solving electrical engineering problems, able to apply appropriate mathematical operations on differential and integral vectors, able to apply mathematical operations methods in complex variables and functions.

Topics:
Differential vector, gradient, hessian, jacobian, divergence, curl, integral vector, line integral, Green theorem, surface integral, Gauss and Stokes divergence theorem, complex variabel and function, complex differential and integral.
Prerequisite: Calculus
Textbook:
1. Erwin Kreyszig, "Advanced Engineering Mathematics (chapter 9, 10, 13, 14, 15)", 10th Edition, Wiley Publisher 2010.
2. Glyn James, "Advanced Modern Engineering Mathematics (Chapter 3,)", 4th Edition, Pearson Education, 2011.

FUNDAMENTAL OF DIGITAL SYSTEM & LABORATORY
ENEE602005/ENEE611002
3 CREDITS
Learning Outcomes:
Able to explain the components of a digital system circuit, able to use simple digital circuit design methods, able to analyze a logic circuit
Topics:
Boolean Algebra Principles and applications; Interface Logic Families; Number System & Data Encoding; Basic Logic Circuits; Basic Modular Design of Combinational Circuits; Basic Modular Design of Sequential Circuits.
Practical work: Module 1-Introduction and introduction to Digital Circuit Basics, Module 2 - Boolean Algebra and Elementary logic gates, Module 3 – Karnaugh Map, Module 4 – complex logic gate, Module5 - Decoder and Encoder, Module 6 - Multiplexer and De-multiplexer, Module 7- Digital Arithmetic Circuit, Module 8 - Flip-Flop and Latch, Module 9-Registers and Counters, Module 10 – Group Project
Prerequisite: none
Textbook:
1. M. Morris R. Mano, Charles R. Kime, Tom Martin, Logic & Computer Design Fundamentals, 5th ed, Prentice Hall, 2015
2. Ronald J. Tocci, Neal S. Widmer, and Gregory L. Moss, Digital Systems: Principles and Applications, 11th Ed., Prentice Hall, 2010
3. Modul Praktikum Dasar Sistem Digital

ELECTRIC CIRCUITS 2
ENEE603006/ENEE613009
3 CREDITS
Learning Outcomes:
Able to apply laplace transform in electrical circuit analysis including deriving transfer function, able to apply filter design method and its analysis method using fourier transformation, able to analyze 3-phase electric circuit
Topics:
Electric power calculation; 3 phase ecircuits, laplace transformation; circuit analysis with laplace transforms; Fourier series and transformation; Fourier series analysis; active filter circuit; 4 poles circuits
Prerequisite: Electric Circuit 1
Textbook:
1. James W. Nilsson, Susan A. Riedel, "Electric Circuits, (Chapter 10-18)", 10th Edition, Pearson, 2015.
2. David E. Johnson, Johnny R. Johnson, John L. Hilburry, Peter D. Scott, "Electric Circuit Analysis, (Chapter 9-17)", 3rd Edition, Wiley, 1997.

ELECTRIC CIRCUIT LABORATORY
ENEE603007/ENEE613010
1 CREDITS
Learning Outcomes:
Able to explain the phenomenon of electric circuit variables, able to calculate electrical circuit variables using node, supernode, mesh, supermesh methods, able to analyze complex electrical circuit responses
Topics:
Analysis of nodes, supernode, mesh, supermesh; superposition theorem, source transformation, Thevenin-Norton, 3-phase circuit; inductance circuit; 4 poles circuit; active filter circuit
Prerequisite: Electric Circuits 1
Textbook: Modul Praktikum Rangkaian Listrik – Laboratorium Tegangan Tinggi dan Pengukuran Listrik.

ENGINEERING MATHEMATICS
ENEE603008/ENEE612008
4 CREDITS
Learning Outcomes:
Able to describe ordinary differential equations with constant/non-constant or linear/non-linear coefficients, partial differential equations, discrete differential equations, able to derive solutions of ordinary differential equations, able to apply the method of laplace/fourier/z transformation in solving differential equations
Topics:
Ordinary Differential Equations (Constant and Non-Constant Coefficient, linear, non-linear), Partial Differential Equations, Discrete Differential Equations, Laplace Transforms, Fourier Transforms, Z Transformations
Prerequisite: Vector Analysis and Complex Variables
Textbook:
1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley Publisher 2010.
2. Glyn James, "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education, 2011.

PHYSICS OF SEMICONDUCTOR
ENEE603009/ENEE612007
2 CREDITS
Learning Outcomes:

Able to explain the principles of semiconductor physics, able to apply the concepts of semiconductor physics in the analysis of semiconductor devices

Topics:

bond, Crystal, defect, band structures, mechanical properties, optical properties, heterostructures, nanostructure, polirized semiconductor, magnetic semiconductor

Prerequisite: Physics (Electricity, MWO).

Textbook:

1. Marius Grundmann, "The Physics of Semiconductors: An Introduction Including Devices and Nanophysics", Springer-Verlag, 2006.
2. Massimo Rudan," Physics of Semiconductor Devices, 2nd edition", Springer-Verlag, 2018.

ADVANCED LINEAR ALGEBRA

ENEE603010/ENEE613018

2 CREDITS

Learning Outcomes:

Able to apply matrix decomposition and differentiation techniques, able to apply matrix operation techniques in data analysis, able to apply optimization methods.

Topics:

matrix geometry analysis (length, distance, angle, orthonormal, orthogonal), matrix decomposition (Cholesky decomposition, SVD, eigen decomposition), vector calculus (matrix gradient, computation), optimization (problem statements, computational optimization, gradient descent), applications Matrix Operations (PCA)

Prerequisite: Calculus, Linear Algebra

Textbook:

1. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, "Mathematics for Machine Learning", Cambridge University Press, 2019.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley Publisher 2010.

ELECTROMAGNETICS

ENEE603011/ENEE613013

4 CREDITS

Learning Outcomes:

Able to describe the concept of electromagnetic fields (electrostatic, magnetostatic, dynamic fields, plane waves), able to explain the application of electromagnetic concepts in the field of electrical engineering, able to anylze electromagnetic field in certain applications of electrical engineering

Topics:

Electrostatic, Magneto-static, Electromagnetic dynamic, Plane Waves, Maxwell's Laws, Electromagnetic Interference, transmission line

Prerequisite: Vector Analysis and Complex Variables

Textbook:

1. Fawwaz T Ulaby, Umberto Ravaioli, "Fundamental of Applied Electromagnetics, 7th edition", Pearson, 2015.
2. William H. Hayt, Jr., John A. Buck, "Engineering Electromagnetics, 6th edition", Mc Graw-Hill, 2001.

ELECTRIC MEASUREMENTS

ENEE603012/ENEE613017

2 CREDITS

Learning Outcomes:

Able to explain the basics of electrical measurement; Able to apply correct and safe measurement techniques; Able to evaluate measurement results

Topics:

Introduction of measuring instruments, the fault/ error in measurement, the security and safety in Electrical Measurements, Measuring Electrical Quantities in General, measurement of Grounding Prisoners (Grounding Resistance), an Oscilloscope, Digital gauge

Prerequisite: Electric Circuit 1

Textbook:

1. Rudy Setiabudy, "Pengukuran Besaran Listrik," LP-FEUI, 2007.
2. Klaas B. Klaassen, "Electronic Measurement and Instrumentation," Cambridge University Press, 1996.

ELECTRIC MEASUREMENTS LABORATORY

ENEE603013/ENEE614022

1 CREDIT

Learning Outcomes:

Capable of measuring electrical quantities; Able to choose the measuring instrument to suit the needs of measurement topics:

Topics:

Gauge 1 phase, 3 phase measurement tool, the tool to measure the energy and power, grounding measuring instrument

Prerequisite: Electric Measurements

Textbook:

Modul Praktikum Pengukuran Besaran Listrik - Laboratorium Tegangan Tinggi dan Pengukuran Listrik.

BASIC COMPUTER AND LABORATORY

ENEE603014-MB/ENEE612003

3 CREDITS

Learning Outcomes:

Able to explain computer systems (hardware, software, networks), able to explain the principles of algorithm design, able to apply algorithm design methods: Pseudocode; Flow chart; Iteration; Selection/Branching; Able to analyze the results of the algorithm design

Topics:

The history of the computer, computer hardware Components, operating systems, computer networks; Pseudocode; Flowchart; Looping; Selection/Branching; Matlab Script; Structure and control in the C language

Prerequisite: Fundamentals of Digital System and

Laboratory

Textbook:

1. Alan Evans, Kendall Martin, Mary Anne Poatsy, "Technology in Action (TiA)," 12th Edition, PrenticeHall, 2015.
2. Gary b. Shelly Misty e. Vermaat and, "Discovering Computers 2011: Living in a Digital World," Course Technology, Cengage Learning, 2011.
3. Deitel & Deitel, "C How to Program," 8th Edition, Pearson Education, 2015.

ELECTRONIC CIRCUIT 1

ENEE604015/ENEE613015

2 CREDITS

Learning Outcomes:

Able to apply analysis methods in the design of simple electronic circuits, able to analyze the response of simple electronic circuits

Topics:

Diode circuits, bipolar circuits of junction transistor, MOSFET circuits, transistor power supply circuit configurations, MOSFET power supply circuit configurations, transistor applications, and frequency responses

Prerequisite: Electric Circuit 1

Textbook:

Boylestad R, Nashhelsky L, "Electronic Devices and Circuit Theory 9th Edition", Prentice Hall, 2006.

ELECTRONIC CIRCUIT LABORATORY

ENEE604016/ENEE613016

1 CREDIT

Learning Outcomes:

Able to use experiment tools properly, able to practice the working principles of diodes, transistors, circuit configuration, frequency response, and amplifiers, able to analyze the dynamics of electronic circuit variables

Topics:

Diode circuits, transistor circuits, transistor power supply circuit configurations, transistor applications, frequency responses, and amplifier circuits.

Prerequisite: Electronic Circuit 1

Textbook:

Modul Praktikum Rangkaian Elektronika – Laboratorium Elektronika.

SIGNAL AND SYSTEM

ENEE604017/ENEE613011

3 CREDITS

Learning Outcomes:

Able to explain signals (discrete, continuous), systems and methods of transformation, able to apply methods of transformation and analysis of continuous and discrete systems, able to analyze the response of filter designed

Topics:

Signal and system definitions, Linear Time Invariant (LTI) Continuous and discrete systems, time domain representation and Fourier LTI systems, applications, Discrete Time Fourier Series (DTFS), Discrete Time Fourier Transform (DTFT), Laplace and z transformation applications, filter applications

Prerequisite: Engeneering Mathematics

Textbook:

1. Simon Haykin & Barry Van Veen, "Signals and System", 2nd Edition John Wiley & Sons Publisher, 2005.
2. Alan V. Oppenheim, Alan S. Willsky, S. Hamid Nawab, "Signals and Systems", Prentice Hall; 2nd Edition, 1996.

ELECTRIC POWER ENGINEERING

ENEE604018/ENEE614026

3 CREDITS

Learning Outcomes:

Able to identify problems of generation, transmission and distribution of electric power system, transformers, motors, generators; able to provide recommendations for components in an electric power system

Topics:

Electric power system, electric power generation, transmission and distribution, transformator, motor, generator

Prerequisite: Electric Circuit 2

Textbook:

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

ELECTRIC POWER ENGINEERING LABORATORY

ENEE604019/ENEE614027

1 CREDIT

Learning Outcomes:

Able to practice the working of transformer, generator, motor; able to use measuring devices, able to analyze the performance of electric power system components

Topics: Transformator, generator, motor

Prerequisite: Electric Power Engineering

Textbook:

Modul Praktikum Teknik Tenaga Listrik- Laboratorium Konversi Energi Tenaga Listrik

NUMERICAL COMPUTATION

ENEE604020/ENEE614023

2 CREDITS

Learning Outcomes:

Able to make numerical computational algorithm, able to analyze the results of numerical computational.

Topics:

Designing numerical computation for root search, solving linear equation systems, curve fitting searches, integrals and differentials, ordinary differential equations, Interpolation, optimization

Prerequisite: Advanced Linear Algebra

Textbook:

Steven Chapra, Raymond Canale. "Numerical

Methods for Engineer 7th Edition", McGraw Hill. 2014.

ELECTRICAL MATERIAL

ENEE604021/ENEE614025

2 CREDITS

Learning Outcomes:

Able to explain the general properties of electrical materials, able to classify types of electrical materials based on their properties and characteristics, able to examine the characteristics and specifications of various types of electrical materials in an application

Topics:

Atoms in solids; Dielectric Polarization; Dielectric losses; Classification of electrical materials: solids, ceramics, polymers; Insulation material: gas and liquid; material characteristics: conductivity, thermal, electrical, optical; Damage to insulation, optical material

Prerequisite: Physics of Semiconductor, Electric Circuit 1

Textbook:

1. Rudy Setiabudy, "Material Teknik Listrik", UI Press, 2007
2. R. E. Hummel, "Electronic Properties of Materials", Third Edition, Springer, 2000

EMBEDDED SYSTEM 1

ENEE604022/ENEE614025

3 CREDITS

Learning Outcomes:

Able to explain the components of embedded systems, microprocessors, microcontrollers; able to implement Asembly / C programming in embedded systems; able to choose the programming method that meet the need.

Topics:

Microprocessor Addressing Mode; Assembly/C Programming Language for microprocessors, microcontroller architecture, Input Output, serial communication, ADC, interruptions, microcontroller programming

Prerequisite: Basic Computer and Laboratory

Textbook:

1. Manuel Jimenez, Rogelio Palomera, Isidoro Couvertier, "Introduction to Embedded System Using Microcontroller and the MSP 430", Springer, 2014.
2. Perry Xiao,"Designing Embedded Systems and IOT with ARM MBED", Wiley, 2018.
3. Steven F. Barret, "Embedded System Design with Atmel AVR Microcontroller – Part I & II", Morgan & Claypol,2010.

ALGORITHM AND PROGRAMMING

ENEE604023/ENEE614028

3 CREDITS

Learning Outcomes:

Able to apply concepts: Modular; Iteration and Recursion; Sorting; Searching; Arrays; pointers; Linked List, able to analyze programming results in C language, able to recommend a programming design.

Topics:

Modular; Iteration and Recursion; Sorting; Searching; Array; Pointers; Linked List; Static and Dynamic Data Structure in C Language

Prerequisite: Basic Computer and Laboratory

Textbook:

1. Thomas H. Cormen, "Introduction to Algorithms", 3rd Edition, MIT Press, 2009
2. Robert Sedgewick & Kevin Wayne, "Algorithms", 4th Ed., Addison-Wesley Professional, 2011

INTRODUCTION TO TELECOMMUNICATION SYSTEM

ENEE605024/ENEE613013

3 CREDITS

Learning Outcomes:

Able to explain the parts in the telecommunications equipment system, able to identify concepts and technologies in the telecommunications system (modulation, transmission, numbering techniques)
Able to explain the parts of telecommunications system, able to identify concepts and technology in telecommunications systems (modulation, transmission, numbering techniques), able to choose a design of telecommunications system that suits the needs.

Topics:

Introduction to Telecommunications, Analog and Digital Communication Systems and Devices. Telecommunications Networks, Distortion, Decibel Principles (dB), Switching, Signaling, Queing and Routing Theory, Numbering Techniques, Transmission Lines: Wired and Wireless, Analog Modulation Principles: Amplitude and Frequency Modulation

Prerequisite: Signal and System, Electromagnetics

Textbook:

1. Simon Haykin, "Communication Systems", 5th Edition, John Wiley & Sons Inc., 2008.
2. Roger L. Freeman, "Telecommunication Systems Engineering", 4th Edition, John Wiley & Sons Inc., 2004.

TELECOMMUNICATION SYSTEM LABORATORY

ENEE605025/ENEE613014

1 CREDIT

Learning Outcomes:

Able to use telecommunication system measuring tools, able to practice basic concepts of telecommunication system, able to choose design of telecommunication system

Topics:

Multimedia information, Analog to Digital Conversion (ADC)-Digital to Analog Conversion (DAC), Information encodings, Digital Modulation-Demodulation, Analog Modulation-Modulation,

Multiplexing (OFDM), Antenna Design, Transmission Channels.

Prerequisite: Introduction to Telecommunication System

Textbook:

Laboratory Workbook–Telecommunication Engineering Laboratory.

ELECTRONIC CIRCUITS 2

ENEE605026/ENEE614021

2 CREDITS

Learning Outcomes:

Able to apply methods of analysis and design of electronic circuits, able to analyze the performance of electronic circuit designs, able to provide recommendations for electronic circuit designs for certain purposes

Topics:

Power amplifier circuit, digital circuit with digital bipolar circuit, high-order active filter, oscillator circuit, Schmidt Trigger, and voltage regulators

Prerequisite: Electronic Circuits 1

Textbook:

Boylestad R, Nashhelsky L (2006), Electronic Devices and Circuit Theory 9th Edition, Prentice Hall, New Jersey, USA.

CONTROL ENGINEERING

ENEE605027/ENEE614019

4 CREDITS

Learning Outcomes:

Able to explain the concept of discrete & continuous control techniques and their methodology, able to apply discrete and continuous system analysis methods with block diagrams, Time Response, stability and steady-state errors, root locus, frequency response, able to choose control design methods (discrete and continuous) with according to the model and needs

Topics:

Continuous and discrete control system models, Block diagrams; response time; stability; steady-state error, root locus; frequency response, controller design with root locus; controller design with bode diagram, discrete / continuous state-space model, controller design in discrete / continuous state-space model

Prerequisite: Signal and System

Textbook:

1. N. Nise, "Control Systems Engineering", 9th Edition, Wiley, 2019.
2. Katsuhiko Ogata, "Modern Control Engineering" 5th Edition, Pearson, 2010.
3. Charles L. Phillips,H. Troy Nagle, Aranya Chakrabortty, "Digital Control System: analysis and design, 4th edition", Pearson, 2015.

CONTROL ENGINEERING LABORATORY

ENEE605028/ENEE614021

1 CREDIT

Learning Outcomes:

Able to apply time response analysis method, system stability and steady-state error, root locus, frequency response, controller design with root locus, controller design with Bode diagram, state-space, able to analyze control system design performance, able to provide alternative controller design methods

Topics:

Time response, system stability and steady error, root locus, frequency response, controller design with root locus, controller design with bode diagram, state-space

Prerequisite: Control Engineering

Textbook:

Laboratory Workbook–Control Systems Laboratory.

EMBEDDED SYSTEM 2

ENEE605029/ENEE615030

3 CREDITS

Learning Outcomes:

Being able to describe the components of the IoT system, being able to explain the application of a practical IoT system, being able to choose the right technology in the design of the IoT, able to design IoT system.

Topics:

Basics of Internet of Things, sensors, actuators, data communications, data communication protocols, radio layer, modem layer, MAC layer, cloud computing configuration for IoT networks (azzure and aws)

Prerequisite: Embedded System 1

Textbook:

1. Daniel Chew, "The Wireless Internet of Things", Wiley, 2019
2. Perry Xiao," Designing Embedded Systems and IOT with ARM MBED", Wiley, 2018.

EMBEDDED SYSTEM LABORATORY

ENEE605030/ENEE615031

1 CREDIT

Learning Outcome:

Able to implement programming methods in Assembly/C language in embedded systems for certain applications, able to analyze embedded system designs, able to investigate design performance

Topics: Microcontroller on Development Board, programming using assembly/C language

Prerequisite: Embedded System 1

Textbook:

Modul praktikum

MODELING AND MACHINE LEARNING

ENEE605031/ENEE616029

3 CREDITS

Learning Outcomes:

Able to explain the concept of data reduction, able to apply the PCA method in data reduction, able to

use the matrix decomposition method, able to apply optimization methods in modeling, able to derive dynamic models from the data, able to choose a model evaluation method, able to choose a machine learning method according to the problem

Topics:

Data reduction, PCA, Optimization, dynamic and data modeling, dynamic model parameter estimation, supervised and unsupervised learning, clustering, classification, model evaluation, MSE, MAP, use of machine learning software

Prerequisite: Numerical Computation

Textbook:

1. Jeremy Watt, Reza Borhani, Anngelos K. Katsaggelos, "Machine Learning Refined: Foundations, Algoritms, and Applications", Cambridge University Press, 2016.
2. Ethem Alpaydin, "Introduction to Machine Learning", 2nd Edition, MIT Press, 2010
3. Harold Klee, Randal Allen," Simulation of Dynamic Systems with MATLAB and Simulink", CRC Press, 2011

INNOVATION AND ENTREPRENEURSHIP

ENEE605032/ENEE616042

2 CREDITS

Learning Outcomes:

Able to perform analysis and make business plans in expertise/product innovation in accordance with the development of information technology; Able to implement entrepreneurial concepts and skills in the field of electrical engineering

Topics:

Innovation, engineering business, Charging for Expertise, Think, Plan, Act Like Entrepreneur, Making a Business Successful, Taking the Initiative, Enabling an E-Business, Providing Outsourced Services & Building a Contracting Business, guest lecture

Prerequisite: none

Textbook:

1. New Venture Creation – Entrepreneurship for the 21st Century, 6th Edition, J.A. Timmons and S. Spinelli, McGraw-Hill Irvin, 2004.
2. Materi kuliah yang diberikan oleh praktisi wirausaha

ELECTRICAL ENGINEERING PROJECT DESIGN 1

ENEE606033/ENEE616037

2 CREDITS

Learning Outcomes:

Able to define product requirements and specifications, able to understand technical, financial and standard aspects in engineering products, able to understand aspects of market needs in planning, able to prepare electrical engineering project proposals

Topics:

Professional ethics, product engineering ideas, needs analysis, product specifications, technical feasibility, financial feasibility, engineering and product standards, business canvas, marketing, project proposal writing techniques

Prerequisite: Embedded System 1, Modeling and Machine Learning

Textbook:

1. Bruce R. Barringer, R. Duane Ireland, "Entrepreneurship: Successfully Launching New Ventures", 4th Edition, Pearson, 2012.
2. Bruce R. Barringer, R. Duane Ireland, "Entrepreneurship: Successfully Launching New Ventures", 4th Edition, Pearson, 2012.
3. Tim Clark, Alexander Osterwalder, Yves Pigneur, "Business Model: YOU", Wiley, 2012.
4. Paul Swamidass," Engineering Entrepreneurship from Idea to Business Plan", Cambridge University Press, 2016.
5. Pedoman Teknis Penulisan Tugas Akhir Mahasiswa Universitas Indonesia.

ELECTRICAL ENGINEERING PROJECT DESIGN 2

ENEE607035/ENEE617043

3 CREDITS

Learning Outcomes:

Able to work in a team, able to present the results of the design in oral and written, able to design technology in the field of electrical engineering

Topics: Project Implementation

Prerequisite: Electrical Engineering Project Design 1

Textbook:

Harvey F. Hoffman, "The Engineering Capstone Course: Fundamentals for Students and Instructors", Springer 2014.

Course of Electric Power Engineering Field

ENERGY CONVERSION AND RENEWABLE ENERGY

ENEE606101

2 CREDITS

Learning Outcomes:

Able to describe various types of energy resources for electric power generation, able to calculate various energy potential for electric power generation, able to analyze the process of electrical energy conversion, able to recommend the technology of electrical energy supply.

Topics:

Fundamental of Energy Conversion, Energy Resources, Renewable Energy, Electric Power Conversion Technologies, Thermal Power Plants, Non-Thermal Power Plants.

Textbook:

1. Djiteng Marsudi, "Pembangkitan Energi Listrik," Penerbit Erlangga, 2005.
2. Abdul Kadir, "Pembangkitan Tenaga Listrik," Penerbit UI, 1996.
3. D. Yogi Goswami, Frank Kreith, "Energy Conver-

sion," Penerbit CRC Press, 2007.
4. Bent Sørensen, "Renewable Energy Conversion, Transmission and Storage," Elsevier, 2007.

POWER ELECTRONICS AND LABORATORY
ENEE606102/ENEE615032
3 CREDITS
Learning Outcomes:
Able to explain the philosophy of power electronics equipment, able to calculate parameters in the power electronics circuit, able to design power electronic system application
Topics:
Power electronics introduction, power electronics components, AC-AC conveters, AC-DC converters, DC-DC converters, DC-AC converters, power electronics applications
Prerequisite: Electric Power Engineering.
Textbook:
1. Muhammad H. Rashid, "Power Electronics Circuit, Devices and Applications," Prentice Hall Fourth Edition, 2013.
2. Modul Praktikum Elektronika Daya - Laboratorium Konversi Energi Listrik

MANAGEMENT AND ENGINEERING ECONOMY
ENEE606103
3 CREDITS
Learning Outcomes:
Able to classify energy fields, able to calculate the economics of electricity, able to analyze the comparison of alternative technologies, able to analyze the latest technology in the field of energy conversion, able to analyze the technical and economical aspects of energy project, able to provide technical and economic technology solutions in the energy and electricity sector
Topics:
Basic concepts of management, types of organization, organizational resources, economic concepts, correlation of money and time values, comparative studies, replacement analysis, basics of energy management, energy costs, calculation of energy potential
Prerequisite: Electric Power Engineering.
Textbook:
1. William G. Sullivan, Elin M. Wicks, James T. Luxhoj, "Engineering Economy," 13th Edition, Pearson Education International, 2006.
2. Andrew C. Paine, John V. Chelsom, Lawrence R.P. Reavill, "Management for Engineers," John Wiley and Sons, 1996.

ELECTRIC POWER SYSTEM AND LABORATORY
ENEE607104/ENEE616039
3 CREDITS
Learning Outcomes:
Able to calculate the parameters of the electric power network, able to model the components of the electric power system, able to analyze the flow of power in the electric power system, able to analyze short circuit disturbances in the electric power system, able to analyze the stability of the system, able to design an electric power system with an approach simulation
Topics:
Introduction of electric power systems, components of electric power systems, power flow analysis, short circuit analysis, system stability analysis, economic dispatch
Prerequisite: Electric Power Engineering
Textbook:
B.M. Weedy, B.J. Cory, "Electric Power Systems," 4th Edition, John Wiley and Sons, 2001.

HIGH CURRENT & VOLTAGE ENGINEERING AND LABORATORY
ENEE607105
3 CREDITS
Learning Outcomes:
Able to explain the phenomenon of high electric and magnetic fields, able to test electric power equipment, able to analyze the occurrence of interference due to high field phenomena, able to provide design solutions for high voltage technology
Topics:
The concept of high voltage, high voltage testing, high voltage generation, direct current and alternating current testing, electrical equipment testing
Prerequisite: Electric Power Engineering
Textbook:
1. Artono Arismunandar, "Teknik Tegangan Tinggi," Pradnya Paramita, Jakarta, Cetakan ke-7, 1994.
2. E. Kuffel, W.S. Zaengl, "High Voltage Engineering Fundamentals," Pergamon Press, 1984.
3. Modul Praktikum Teknik Arus dan Tegangan Tinggi - Laboratorium Tegangan Tinggi dan Pengukuran Listrik.

BUILDING ELECTRIC INSTALLATION
ENEE607106
2 CREDITS
Learning outcomes:
Able to make building electric installations plan; Able to calculate the parameters of electrical installations in buildings; Able to provide a building electrical installation design that suits the needs
Topics:
Basic of electrical installation, electrical installation components, electrical installation requirements, electrical installation security, lighting technology, security and safety technology, and electrical installation procedures for buildings
Prerequisite: Electric Power Engineering
Textbook:
1. William K Y Tao, Richard R Janis, "Mechanical and Electrical System in Building," Prentice Hall 1997.

2. Brian Scaddan, "Electrical Installation Work". Elsevier Publishing, 2005.

SPECIAL TOPICS OF ELECTRIC POWER ENGINEERING
ENEE607107
2 CREDITS
Learning Outcomes:
Able to identify problems, technology and current issues in the field of electric power engineering
Topics:
Presentation of material from practitioners and academics in the field of electric power engineering
Prerequisite: -
Textbook: -

SMART GRID
ENEE608108
2 CREDITS
Learning Outcomes:
Able to explain the concept of a smart grid and its difference with conventional systems, able to evaluate smart grid infrastructure, able to provide smart grid design solutions
Topics:
Definitions, characteristics, and advantages of smart grids, smart grid differences with conventional systems, data communication infrastructure, smartgrid standards, smart grid applications in distribution systems
Prerequisite: Electric Power Engineering
Textbook:
Salman K. Salman, "Introduction to the Smart Grid: Concepts, Technologies and Evolution", The Institution of Engineering and Technology, 2017.

ELECTRIC POWER SYSTEM PROTECTION
ENEE608109
2 CREDITS
Learning Outcomes:
Able to explain the philosophy of electric power system protection, able to calculate electrical protection systems, able to evaluate the electric power system protection, able to design electric power system protection
Topics:
Philosophy of electric power system protection, types of protection relays, the working principle of protection relays, the setting of protection relays, coordination principles of protection relays
Prerequisite: Electric Power Engineering
Textbook:
1. G.E.C. Alsthom, "Protective Relays Application Guide," U.K., 2015

SPECIAL TOPICS OF ELECTRIC POWER 2
ENEE608110
2 CREDITS
Learning Outcomes:
Able to explain current issues related to the electric power engineering field
Topics:
Presentation of practitioners and academics in electric power engineering fields
Prerequisite: -
Textbook: -

Course of Electronic Engineering Field

DESIGN OF ELECTRONIC CIRCUITS
ENEE606201
3 CREDITS
Learning Outcomes:
Able to design prototype of electronic circuit for several applications with the required specifications
Topics:
Review of Fundamentals of Devices and Circuits. Overall Design Process. The Design of the Power Supply and Overall Power Management. The Analogue World and Preprocessing of Signals. Essentials of the Data Conversion Process. Processing of the Digital Information. Role of Simulation as a Tool for Design Confirmation. Signal Integrity and Clock Distribution, PLL and Frequency Synthesisers, Signal Sources. System on a Chip (SoC) Concepts. Prototyping and Testing of the Product/Release of a Design and Documentation.
Prerequisite: Electronic Circuits 2
Textbook:
Nihal Kularatna, "Electronic Circuit Design: From Concept to Implementation", CRC Press, 2019

ADVANCED ELECTRONIC DEVICES
ENEE606202
3 CREDITS
Learning Outcomes:
Able to explain semiconductor device fabrication processes; Able to use fabrication process design tools; Able to design semiconductor fabrication processes in microelectronic devices.
Topics:
History of the semiconductor industry, semiconductor materials, crystal growth and wafer preparation, contamination control, oxidation, lithography, diffusion, ion implantation, etching, deposition, use of Supreme ver.4
Prerequisite: Electronic Circuits 2
Textbook:
1. Peter Van Zant, "Microchip Fabrication," 8th Edition, International Edition, McGraw-Hill, 2004.
2. Modul Praktikum Fabrikasi divais semikonduktor - Laboratorium Elektronika

DESIGN OF ELECTRONICS INSTRUMENTATION
ENEE606203/ENEE615035
2 CREDITS
Learning Outcomes:
Able to design electronic instrumentation
Topics:
Industrial electronics instrumentation technology,

medical electronic instrumentation, RF electronic instrumentation, IoT electronic instrumentation

Prerequisite: Electronic Circuits 2

Textbook:

Halit Eren, "Electronic Portable Instruments: Design and Applications", CRC Press, 2003

OPTOELECTRONIC DEVICES

ENEE607204

3 CREDITS

Learning Outcomes:

Able to explain the working principles of passive and active photonics, able to apply mathematical and physical principles to calculate photonic device variables, able to determine photonic device variables, able to formulate problems in optoelectronic device design

Topics:

Theory of light: Snellius's law, Fresnel's law, Maxwell's law, Fermat's equation, polarization, diffraction, NA, attenuation, mode understanding, dispersion, dispersive power, resolving power, free spectral range, coherence, vectors, matrix Jones, passive photonic devices: and optics, grating, polarisator; Active photonic devices: laser diode, LED and photodetector.

Prerequisite: Electronic Circuits 2

Textbook:

1. B.E.A. Saleh and M.C. Teich, "Fundamentals of Photonics," New York, NY: John Wiley and Sons, 1991. ISBN: 0471839655.
2. D. Griffiths, "Introduction to Quantum Mechanics," Second Edition, Upper Saddle River, NJ: Prentice Hall, 1995, ISBN: 0131118927.
3. Modul Praktikum Pilihan - Laboratorium Elektronika

OPTOELECTRONIC DEVICES

ENEE617044

2 CREDITS

Learning Outcomes:

Able to explain the working principles of passive and active photonics, able to apply mathematical and physical principles to calculate photonic device variables, able to determine photonic device variables, able to formulate problems in optoelectronic device design

Topics:

Theory of light: Snellius's law, Fresnel's law, Maxwell's law, Fermat's equation, polarization, diffraction, NA, attenuation, mode understanding, dispersion, dispersive power, resolving power, free spectral range, coherence, vectors, matrix Jones, passive photonic devices: and optics, grating, polarisator; Active photonic devices: laser diode, LED and photodetector

Prerequisite: Electronic Circuits 2

Textbook:

1. B.E.A. Saleh and M.C. Teich, "Fundamentals of Photonics," New York, NY: John Wiley and Sons, 1991. ISBN: 0471839655.
2. D. Griffiths, "Introduction to Quantum Mechanics," Second Edition, Upper Saddle River, NJ: Prentice Hall, 1995, ISBN: 0131118927.
3. Modul Praktikum Pilihan - Laboratorium Elektronika

DESIGN OF VLSI CIRCUITS

ENEE607205

3 CREDITS

Learning Outcomes:

Able to design VLSI circuits

Topics:

Review semiconductor device fabrication on CMOS, Design rules, Scale of Lambda, Asynchrony, Logic Gate Design, Inverter, NAND, NOR, Full custom design, Semi custom design, Validation, Packaging / IO, Design for fabrication, error modeling and test design, Coding for synthesis, Estimated characteristics and circuit performance, High level design optimization, Programmable logic array, CMOS subsystem Design, Properties of Logic: Area, Power, Delay, Time optimization, Sequential engine, and regular VLSI Structure.

Prerequisite: Electronic Circuits 2

Textbook:

N. Weiste & Kamran Eshraghian, "Principles of CMOS VLSI Design: A perspective," Second Edition, Addison Wesley 2002.

INTRODUCTION TO NANOELECTRONICS

ENEE607206/ENEE616038

2 CREDITS

Learning Outcomes:

Able to analyze the latest developments in the field of electronics and photonics; Able to analyze the workings of nanoelectronic and nanofotonic devices.

Topics:

Nano technology and its application in electronics, from micro to nano, miniaturization of electronic devices, transistor dimension scaling, the workings of single electron transistors, molecular electronics principles, fabrication and characterization of nano devices, nano technology and its applications in the field of photonics, the workings of single- photon detector, how the OLED works

Prerequisite: Electronic Circuits 2

Textbook:

1. Massimiliano Di Ventra, et al. Introduction to NST ch.11 Kluwer Acad. Publisher 2004.
2. Vladimir V. Mitin, Viatcheslav A. Kochelap, Michael A. Stroscio, "Introduction to Nanoelectronics", Cambridge University Press, 2008

SPECIAL TOPICS OF ELECTRONICS

ENEE6072017

2 CREDITS

Learning Outcomes:

Able to explain current issues related to the

electronic field

Topics:

Presentation of practitioners and academics in electronic fields

Prerequisite: -

Textbook: -

ADVANCED EMBEDDED SYSTEM

ENEE608208

3 CREDITS

Learning Outcomes:

Able to design embedded systems with the latest methods

Topics:

Characteristics of embedded systems; minimum microcontroller system design; hardware and software data communication; sensor data acquisition and actuators.

Prerequisite: Electronic Circuits 2

Textbook:

Perry Xiao, "Designing Embedded Systems and the Internet of Things (IoT) with the ARM® Mbed™", Wiley, 2018

SPECIAL TOPICS OF ELECTRONICS 2

ENEE608209

2 CREDITS

Learning Outcomes:

Able to explain current issues related to the electronic field

Topics:

Presentation of practitioners and academics in electronic fields

Prerequisite: -

Textbook: -

Course of Telecommunication Engineering Field

DIGITAL COMMUNICATION

ENEE606301

3 CREDITS

Learning Outcomes:

Able to analyize telecommunication phenomenon using simulatuon devices, able to provide solutions for digital communication technology applications

Topics:

Mathematic for telecommunication, information theory, coding tehcniques, signal processing for telecommunication, Digital Modulation: ASK, FSK, and PSK, channel capacity analysis.

Prerequisite: Introduction to Telecommunication System

Textbook:

1. Martin Sibley, "Modern Telecommunications: Basic Principles and Practices", CRC Press, 2018.
2. V. K. Khanna, "Digital Communications", S. Chand & Company Ltd. 2009.

TELECOMMUNICATION SYSTEM DEVICES

ENEE606302/ENEE616040

3 CREDITS

Learning Outcomes:

Able to analyze the sub-system of communications devices, able to analyze transmission channel, equalizer, resonator, filter, amplifier, LNA, oscillator, mixer, able to analyze amplifier, LNA, ascillator, and mixer, able to design sub system of active communications devices

Topics: Pasif RF devices, Active RF devices

Prerequesite: Introduction to Telecommunication System

Textbook:

1. D. M. Pozar, "Microwave Engineering", Addison-Wesley, 1998.
2. Gonzalez, "Microwave Transistor Amplifiers: Analysis and Design", 2nd Edition, Prentice Hall, 1997.

OPTICAL COMMUNICATIONS

ENEE606303

2 CREDITS

Learning Outcomes:

Able to explain transmission channel using fiber and its principle; able to explain component of optical communication systems; able to analyze optical communication system, Able to provide application solutions for optical communication technology.

Topics:

Structure and optical fiber waveguide, signal degradation in on optical fiber, optical sources, optical components, optical coherent fiber communication; the techniques of modern systems; The techniques and coding theory; Performance analysis of optical communication systems

Prerequesite: Introduction to Telecommunication System.

Textbook:

1. Govind P. Agrawal, "Fiber-Optic Communication Systems", 3rd Edition, Wiley Interscience, 2002.
2. G. Keiser, "Optical Fiber Communications", 3rd Edition, McGraw Hill, 2000.

ANTENNA AND PROPAGATION

ENEE607304

3 CREDITS

Learning outcomes:

Able to describe wave propagation and transmission system and its implications on the performance of communication systems; Able to explain various mechanisms of propagation of electromagnetic waves; Able to explain the working principle of antenna and antenna performance parameters; Being able to describe the various types of antenna as a means for transmitting signals; Able to calculate the performance of the simple antenna systems which good in theory or application; Able to calculate the performance of a single element antenna such as a dipole, yagi, antenna loop, funnels, slot antenna

and micro-strip antenna; Able to design a simple antenna and measure it; able to analyze the types of wave propagation and select the correct antenna for wireless communication system, bble to design simple antennas

Topics:

Working principles of the basic parameters of antenna, the antenna measurement techniques, several types of antennas: dipole antenna, monopole, antenna stacking, aperture antenna and antenna with reflector. Radio wave propagation (ground surface wave, wave, wave, space sky wave, and microwave and millimeter wave);

Prerequisite: Introduction to Telecommunication System.

Textbook :

1. Constantine A. Balanis, "Antenna Theory, Analysis and Design," Third Edition, John Willey and Son, Inc., 2005.
2. Saunders R. Simon, "Antennas and Propagation for Wireless Communication Systems," First Edition, John Wiley and Son, Inc., 1999.
3. Jurnal IEEE transaction Antenna and Propagation

WIRELESS COMMUNICATION AND CONVERGENCE NETWORKS

ENEE607305/ENEE615034

3 CREDITS

Learning Outcomes:

Able to explain concepts, techniques and components of wireless and mobile communication, able to apply wireless communication analysis methods, able to analyze the performance of various mobile wireless communication systems, able to provide alternative solutions for mobile wireless communication technology applications

Topics:

Overview of Wireless Communications, Cellular Concept/Fundamentals, Large Scale Fading/Path Loss, Small Scale Fading, Modulation Techniques, Equalization, Diversity, Channel Coding / Error Control Coding Overview, Multiple Access, Emerging Wireless Technologies: WLAN, 3G and WCDMA, 4G and LTE, Mobile Adhoc Networks, Body Area Networks and Mobile Health, Future Wireless System.

Prerequisite: Introduction to Telecommunication System

Textbook:

1. Martin Sauter, "From GSM to LTE-Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband", John Wiley & Sons, 2017.
2. Savo G. Glisic, "Advanced Wireless Communications and Internet: Future Evolving Technologies, 3 edition", John Wiley & Sons, 2017.
3. T. S. Rappaport, "Wireless Communications: Principles and Practice", Upper Saddle River, New Jersey: Prentice Hall, 2nd Ed., 2002.

CAPITA SELECTA OF TELECOMMUNICATION ECOSYSTEMS

ENEE607306

2 CREDITS

Learning Outcomes:

Able to describe the latest issues related to telecommunications systems (technical, regulatory, industrial, business), able to provide evaluations of the latest technology of telecommunications systems, able to provide solutions for the latest technology application of telecommunications systems

Topics:

Lecturing from telecommunication engineer and expert.

Textbook: -

SPECIAL TOPICS OF TELECOMMUNICATION 1

ENEE607307

2 CREDITS

Learning Outcomes:

Able to explain current issues related to the telecommunication engineering field

Topics:

Presentation of practitioners and academics in telecommunication engineering fields

Prerequisite: -

Textbook: -

SIGNAL PROCESSING AND MULTIMEDIA SERVICES

ENEE608308

3 CREDITS

Learning Outcomes:

Able to explain concept of broadband multimedia services, able to apply analytical methods to a multimedia signal, able to evaluate the dynamics of multimedia signals, able to provide solutions for multimedia signal applications

Topics:

Multimedia concept, sinal processing based model: Probability, Bayes Inference, Least Square Error, Wiener-Kolmogorov Filters, Adaptive Filter: Kalman, RLS, LMS; Linear Prediction Models, Hidden Markov Models, Eigenvector Analysis, Principal Component Analysis and Independent Component Analysis, Machine Learning, Signal Processing for Multimedia application and telecommunication system.

Prerequesite: Introduction to Telecommunication System.

Textbook:

1. Guojun Lu, "Communication and Computing for Distributed Multimedia Systems," John Wiley and Sons
2. Luis Correia, "Mobile Broadband Multimedia Networks," Elsevier, UK, 2006
3. Multimedia Signals and Systems: Basic and Advanced Algorithms for Signal Processing,

Second Edition

SPECIAL TOPICS OF TELECOMMUNICATION 2
ENEE608309
2 CREDITS
Learning Outcomes:
Able to explain current issues related to the telecommunication engineering field
Topics:
Presentation of practitioners and academics in telecommunication engineering fields
Prerequisite: -
Textbook: -

Course of Control Engineering Field

ELECTRIC MOTOR CONTROL SYSTEM
ENEE606401/ENEE615033
3 CREDITS
Learning Outcomes:
Able to analyze the components of the electric drive control system; able to evaluate the performance of the electric drive system by simulation; Able to design simple motor drive systems
Topics:
Electric drive systems, electric motor modeling (DC, PMSM, IM), power transfer circuits (3 phase inverter PWM), brushless DC servo motors, speed and position controllers, reference frame concepts, vector controllers, electric drive system simulations.
Prerequisite: Control Engineering
Textbook:
1. Peter Vas, "Electrical Machines and Drives: A Space-Vector Theory Approach", Oxford University Press UK, 1993.
2. Peter Vas, "Sensorless Vector and Direct Torque Control", Oxford University Press, 1998.

ADAPTIVE AND PREDICTIVE CONTROL SYSTEM
ENEE606402
3 CREDITS
Learning Outcomes:
Able to identify adaptive and predictive models and applications; able to analyze discrete control systems, the stability of non-linear systems using the Lyapunov method; able to evaluate the performance of adaptive and predictive control systems; able to design adaptive and predictive discrete controllers
Topics:
The basic concepts of adaptive and predictive control, recursive parameter estimation, pole placement method, minimum variance method, dynamic matrix control, algorithmic control model, generalized predictive control, predictive control of state space model
Prerequisite: Control Engineering
Textbook:
1. P.E. Wellstead and M.B. Zarrop, "Self-tuning Systems: Control and Signal Processing", John Wiley and Sons, 1991.
2. J.M. Maciejowski, "Predictive control with constraints", Prentice Hall, 2000

INDUSTRIAL AUTOMATION SYSTEM
ENEE606403
2 CREDITS
Learning Outcomes:
Able to explain important components in industrial automation systems, able to describe technical specifications and performance of industrial automation systems, able to evaluate the performance of industrial automation systems, able to design simple industrial automation systems
Topics:
Important components of industrial automation systems, sensors, actuators, data communication systems, automation control methods, industrial control system modules (DCS, PLC), cyber security of industrial automation.
Prerequisite: Control Engineering
Textbook:
1. Shimon Y. Nof, "Handbook of Automation", Springer, 2009
2. Terry Bartelt, "Industrial Control Electronics: Devices, Systems, and Applications", Thomson Delmar Learning, 2006

MECHATRONICS
ENEE607404
3 CREDITS
Learning Outcomes:
Able to analyze the control components; able to analyze the limitations of mechatronic system components; able to design an integrated control system on a simple mechatronic system; able to design mechatronic systems for robotics applications by accommodating the limitations of components
Topics:
Introduction of mechatronic systems, characteristics and limitations of mechatronic systems Methods for increasing the reliability of mechatronic system components, mechatronic system design, electromechanical system modeling, design and development of application software, compliant control, telerobotics, bilateral control.
Prerequisite: Control Engineering
Textbook:
Robert Bishop, "Mechatronics and Introduction", 2006.

KNOWLEDGE-BASED SYSTEM
ENEE607405
3 CREDITS
Learning Outcomes:
Able to apply algorithms in programming languages for knowledge-based systems; Able to identify knowledge-based dynamic system models; Able to analyze the performance of artificial neural networks; Able to design algorithms in a knowledge-based system application

Topics:
The working system of neurons, cells, artifcial neural network architecture (JST); the learning method is JST; back propagation neural networks (BPNN); algorithms and analysis of programming error, function of BPNN in Matlab; optimization of parameters; application of BPNN program asthe system identifer of the pattern, the system control based neural network: an analysis of the use of methods of control, as a system of BPNN identifcation of neural network-based systems: representation of data and the use of BPNN as identifcation system, program development system identifcation using the BPNN full-based system, the development of BPNN and analysis theory and its application, program development system control using the BPNN full system integration based BPNN.
Prerequisite: Control Engineering
Textbook:
1. Lefteri H.,Tsoukalas and Robert E. Uhrig, "Fuzzy and Neural Approaches in Engineering", John Wiley & Sons, Inc., Singapore, 1997.
2. John Yen and Reza Langari, "Fuzzy Logic, Intelligence, Control and Information", Prentice Hall, Inc. New Jersey, 1999.

ROBOTIC SYSTEM
ENEE607406
2 CREDITS
Learning Outcomes:
Being able to identify the needs of robotics components; Able to analyze robot kinematics; Able to evaluate the robotics drive system; Able to design an integrated control system on a simple robotics system; Able to design robotics kinematics.
Topics:
Robotics automation system components (actuators, sensors, controllers), principle of robotics system working, robot kinematics, robotics control systems (position control) based on robot kinematics, interconnecting robotics system components, robot design techniques, robot programming, simulation using OpenGL, introduction to high level robot
Prerequisite: Control Engineering
Textbook:
1. Robotika: desain, kontrol, dan kecerdasan buatan, penerbit Andi, karangan Endra Pitowarno, 2006.
2. Introduction to Robotics: mechanics and control, 3rd Edition, John Craig, Pearson, 2009.

SPECIAL TOPICS OF CONTROL 1
ENEE607407
2 CREDITS
Learning Outcomes:
Able to explain current issues related to the control engineering
Topics:
Presentation of practitioners and academics in control engineering fields
Prerequisite: -
Textbook: -

AUTONOMUS VEHICLE SYSTEM
ENEE608408/ENEE616036
3 CREDITS
Learning Outcomes:
Able to explain the components of autonomous vehicle control systems, able to implement control system designs on autonomous vehicles, able to analyze the performance of autonomous vehicle control system components, able to provide simple application solutions for autonomous vehicle system technology
Topics:
Vehicle dynamic systems, vehicle navigation systems, vehicle wheel drive systems, autonomous vehicle simulation systems
Prerequisite: Control Engineering
Textbook:
1. Hong Cheng, "Autonomous Intelligent Vehicles: Theory, Algorithms, and Implementation", Springer-Verlag, 2011.
2. Jitendra R. Raol, Ajith K. Gopal, "Mobile Intelligent Autonomous System", CRC Press, 2013.

SPECIAL TOPICS OF CONTROL 2
ENEE608409
2 CREDITS
Learning Outcomes:
Able to explain current issues related to the control engineering field
Topics:
Presentation of practitioners and academics in control engineering fields
Prerequisite: -
Textbook: -

ACADEMIC WRITING
ENEE611003
2 CREDITS
Learning Outcomes:
Able to make proposals and scientifc papers for publication.
Topics:
Systematics of scientifc writing; experimental variables and sets up; statistical analysis tools; The use of the Bahasa Indonesia in scientifc works; The use of English languages in scientifc works; Word processing software; styling; referencing tools
Prerequisite: none
Textbook:
1. Ranjit Kumar, Research Methodology: A Step by Step Guide for Beginners, 3rd ed. Sage Publication, 2012
2. Robert a. Day and Barbara Gastel, How to Write and Publish a Scientifc Paper, 6th ed. Greenwood Press, London, 2006

Special Course

INTERNSHIP

ENEE616041

2 CREDITS

Learning Outcomes:

In this course students will undertake work internships in industries or laboratories related to the field of electrical engineering. In this course students are expected to be able to apply the technical knowledge they have gained during previous lectures and new material provided by practical work advisers. Students are also expected to be able to show professionalism in working, including the ability to work together in teams, disciplined behavior, responsibilities, initiatives & interests, leadership, able to participate in teams to complete work; able to presnt the results of internship

Topics: none

Prerequisite: Have passed the 90 credits

PRA-BACHELOR THESIS

ENEE607036/ENEE617045

2 CREDITS

Learning Outcomes:

Able to make proposal for designing a system, component, and process; able to write a research proposal; able to present research proposals.

Topics: none

Prerequisite: Have passed 120 credits

References:

1. Pedoman Teknis Penulisan Tugas Akhir Mahasiswa Universitas Indonesia.
2. IEEE Citation Reference.
3. Ivan Stojmenovic, "How To Write Research Articles in Computing and Engineering Disciplines," IEEE Transactions on Non Reguler And Distributed Systems, Vol. 21, No. 2, February 2010.

BACHELOR THESIS

ENEE618037/ENEE608037

4 CREDITS

Learning Outcomes:

Able to design systems, components and processes; able to carry out research plan; able to analyze the results of research; able to present research results in a bachelor thesis defense

Topics: none

Prerequisite: seminar

Referencees:

1. Pedoman Teknis Penulisan Tugas Akhir Mahasiswa Universitas Indonesia.
2. IEEE Citation Reference.
3. Ivan Stojmenovic, "How to Write Research Articles in Computing and Engineering Disciplines," IEEE Transactions on Non Reguler and Distributed Systems, Vol. 21, No. 2, February 2010.

Undergraduate Program in Computer Engineering

Program Specification

1.	**Awarding Institution**	Universitas Indonesia	
2.	**Teaching Institution**	Universitas Indonesia	
3.	**Faculty**	Engineering	
4.	**Program Title**	Undergraduate Program in Computer Engineering	
5.	**Vision and Mission**	**Vision** To be an excellent and competitive study program in education and research in the field of Computer Engineering to contribute to society nationally and globally. **Mission** The department has defined its mission to 1. Preparing graduates of computer engineering study program that is highly intellectual, innovative, adaptive to the needs of the society with ethics and integrity, has a spirit of nationality, and able to compete globally. 2. Conducting quality education and research, including improving community service, and being able to answer national and global challenges by responding, and providing solutions to problems in the community.	
6.	**Class**	Regular, Non Reguler	
7.	**Final Award**	Sarjana Teknik (S.T)	
8.	**Accreditation Status**	BAN-PT: Accreditation-Excellent AUN: More than adequate (5) IABEE: General Accreditation	
9.	**Language(s) of Instruction**	Bahasa Indonesia	
10.	**Study Scheme (Full Time / Part Time)**	Full Time	
11,	**Entry Requirements**	High Shool /equivalent graduates and pass the entrance selection	
12.	**Duration for Study**	8 (eight) semesters or 4 (four) years	
	Type of Semester	Number of Semester	Number of weeks / semester
	Regular	8	16
	Short (optional)	3	8
13.	**Aims of the programme:** Produce graduates who have professional profiles as follows: 1. Become a professional who is capable of designing, analyzing and developing systems, processes and applications in the field of computer engineering to produce alternative solutions to the problem in their fields. 2. To be an inclusive computer engineer professional, including being part of stakeholders who have concern for the development of computer technology that has an impact on improving people's quality of life 3. Become an individual or professional who has innovation and entrepreneurial spirit with integrity and ethics.		

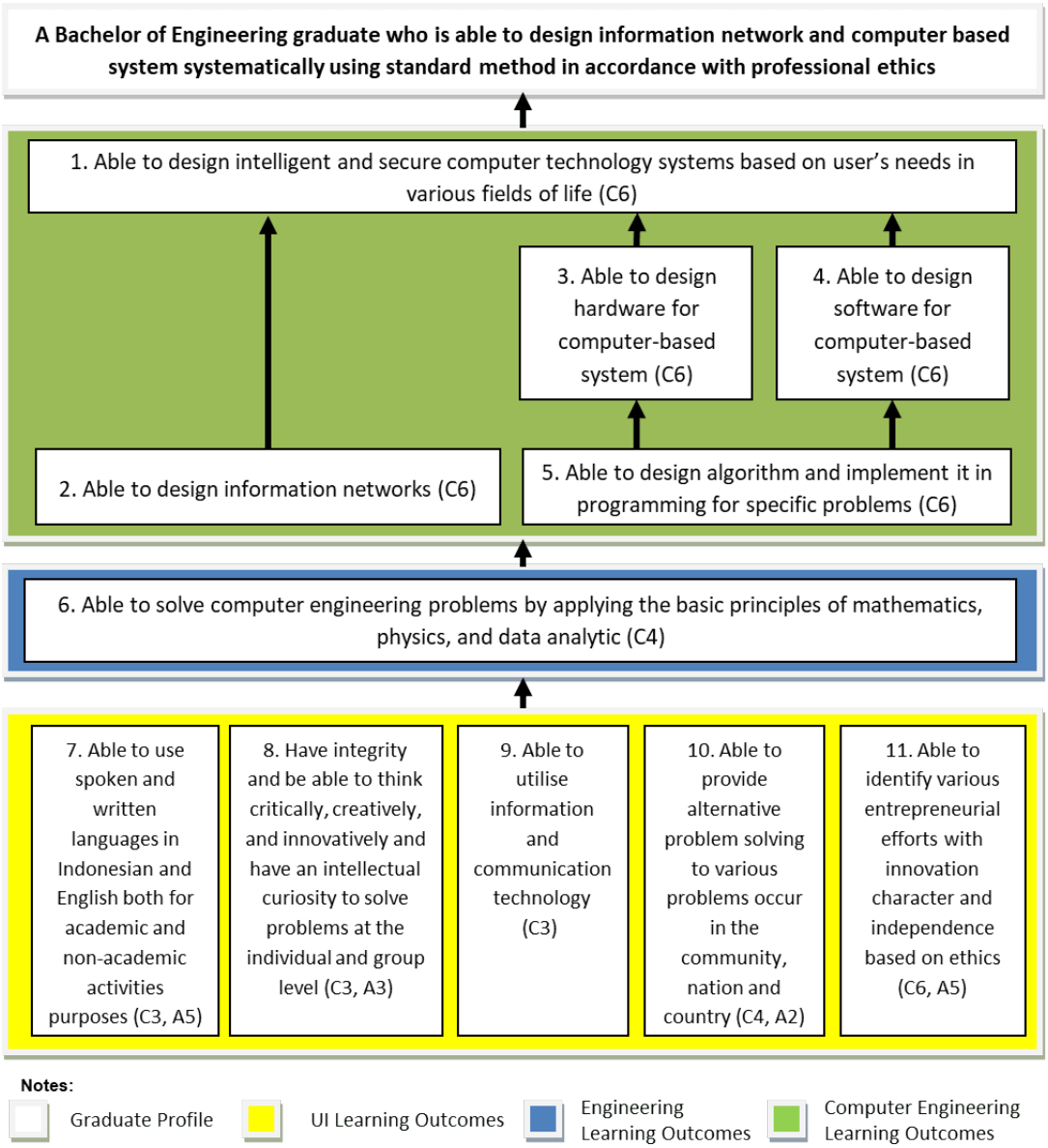
14.	**Graduate Profile:** Bachelor of Engineering who is able to design information networks and computer-based systems systematically using standard methods in accordance with professional ethics
15.	**Expected Learning Outcomes:** 1. Able to design intelligent and secure computer technology systems based on user's needs in various fields of life (C6) 2. Able to design information network plan (C6) 3. Able to design hardware for computer based system (C6) 4. Able to design software for computer based system (C6) 5. Able to design algorithm and implement it in programming (C6) 6. Able to implement the basic principles of mathematics, physics, and statistic in solving computer-engineering problems (C4) 7. Able to use spoken and written language of Bahasa Indonesia and English in academic and nonacademic activities (C3, A5) 8. Have integrity and able to think critically, creatively, and innovatively and have the intellectual knowledge to solve problems in individual and group level (C4, A4) 9. Able to utilize communication information technology(C3) 10. Able to provide alternatives of solutions for various problems within the society, country, and nation (C4, A2) 11. Able to identify the various entrepreneurship efforts characterized with innovation and independence based on ethics (C4, A5)
16.	**Composition of Subjects**

No.	Classification	Credit Hours (SKS)	Percentage
i	University General Subjects	10	6.3%
ii	Basic Engineering Subjects	16	11.0%
iii	Electrical Engineering Department Subjects	9	6.3%
iv	Computer Engineering Core Subjects	78	54.1%
v	Electives	24	16.7%
vi	Special Subjects (Practical Work, Seminars, Thesis)	8	5.6%
	Total Credit Hours to Graduate	145	100 %

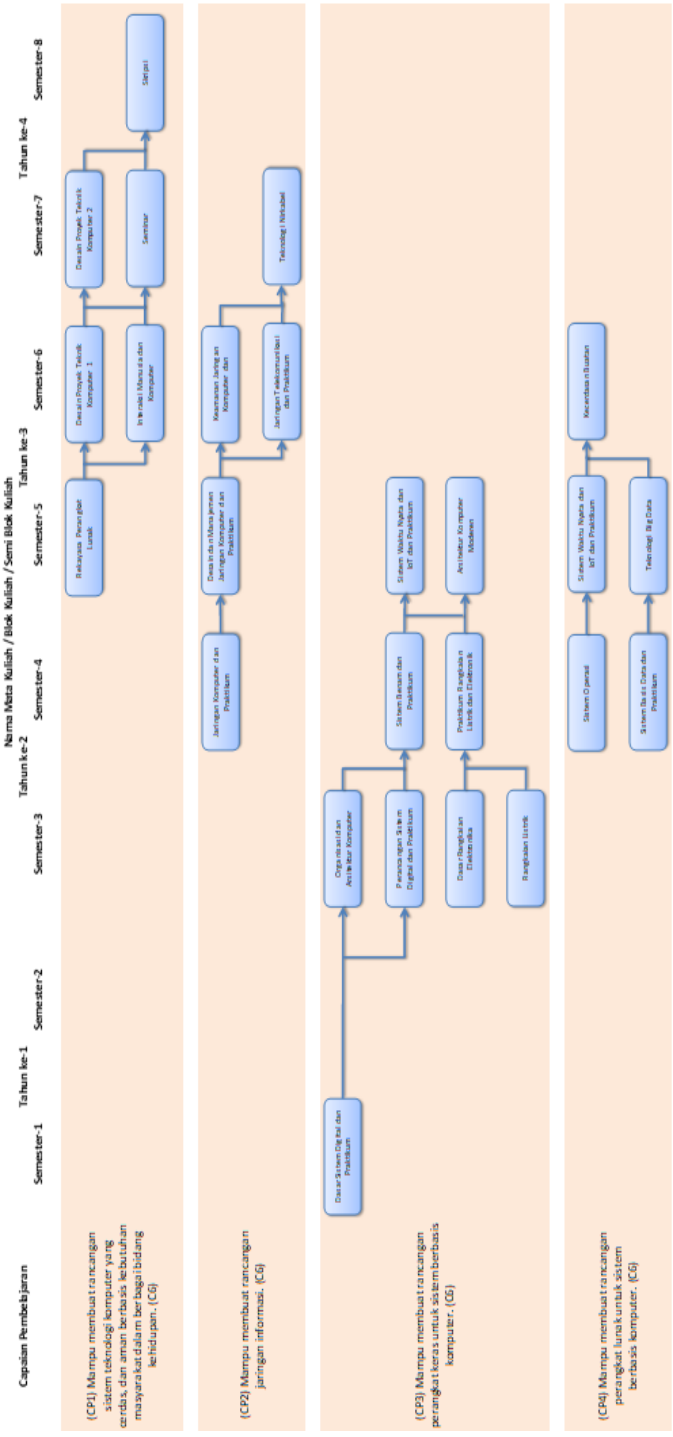
Employment Prospects

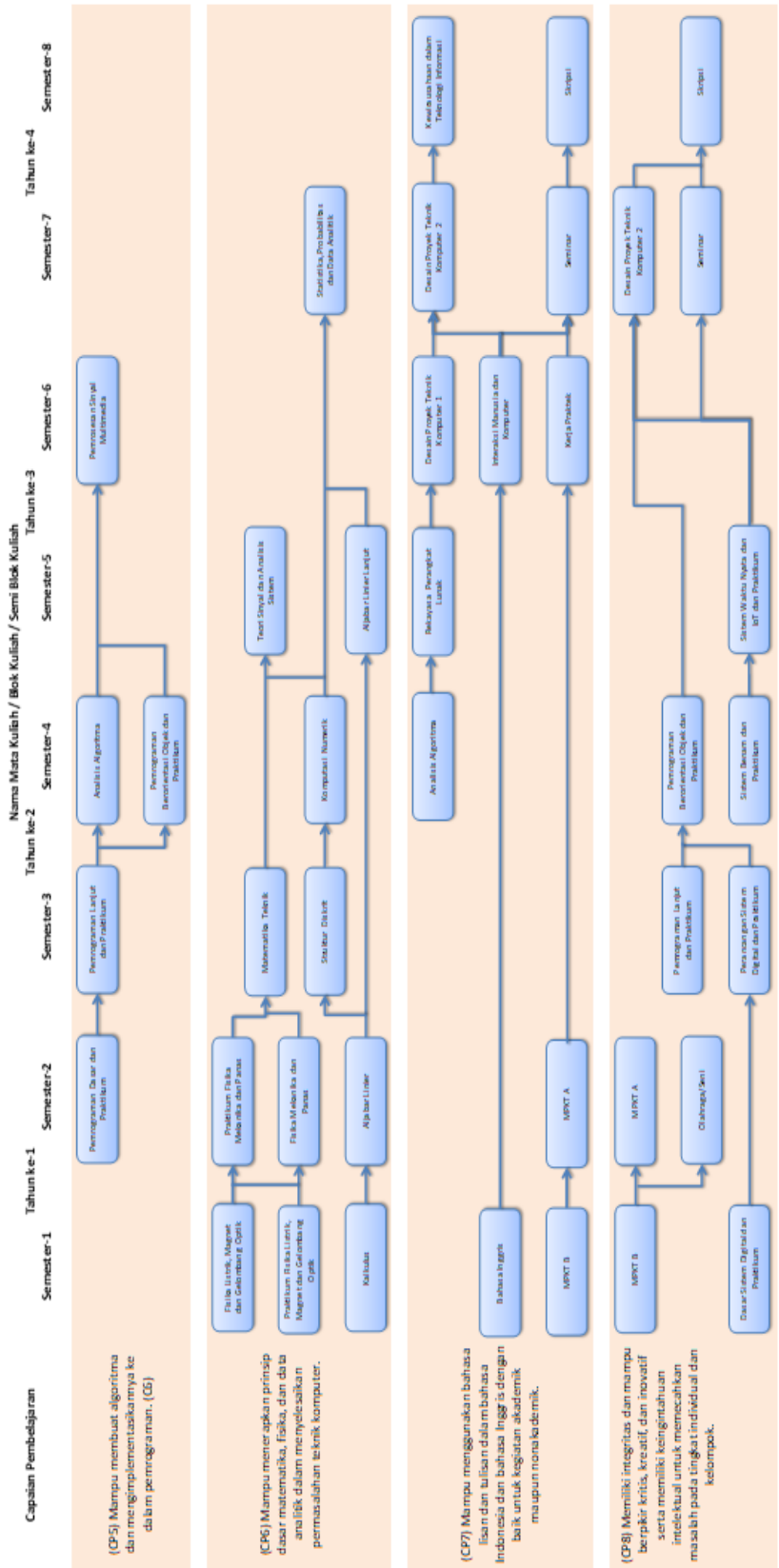
The program graduates are needed in almost all fields of work, e.g. industry, services, banking and all fields requiring the application IT (Information technology). Some professional profiles that are suited to this program's graduate are IT Manager, Project Manager, Program Manager, Programmer, System Analyst, Software Developer, Data Analyst, Product Specialist, Software Engineer, Computer Hardware Engineer, System Administrator, IT Support, etc.

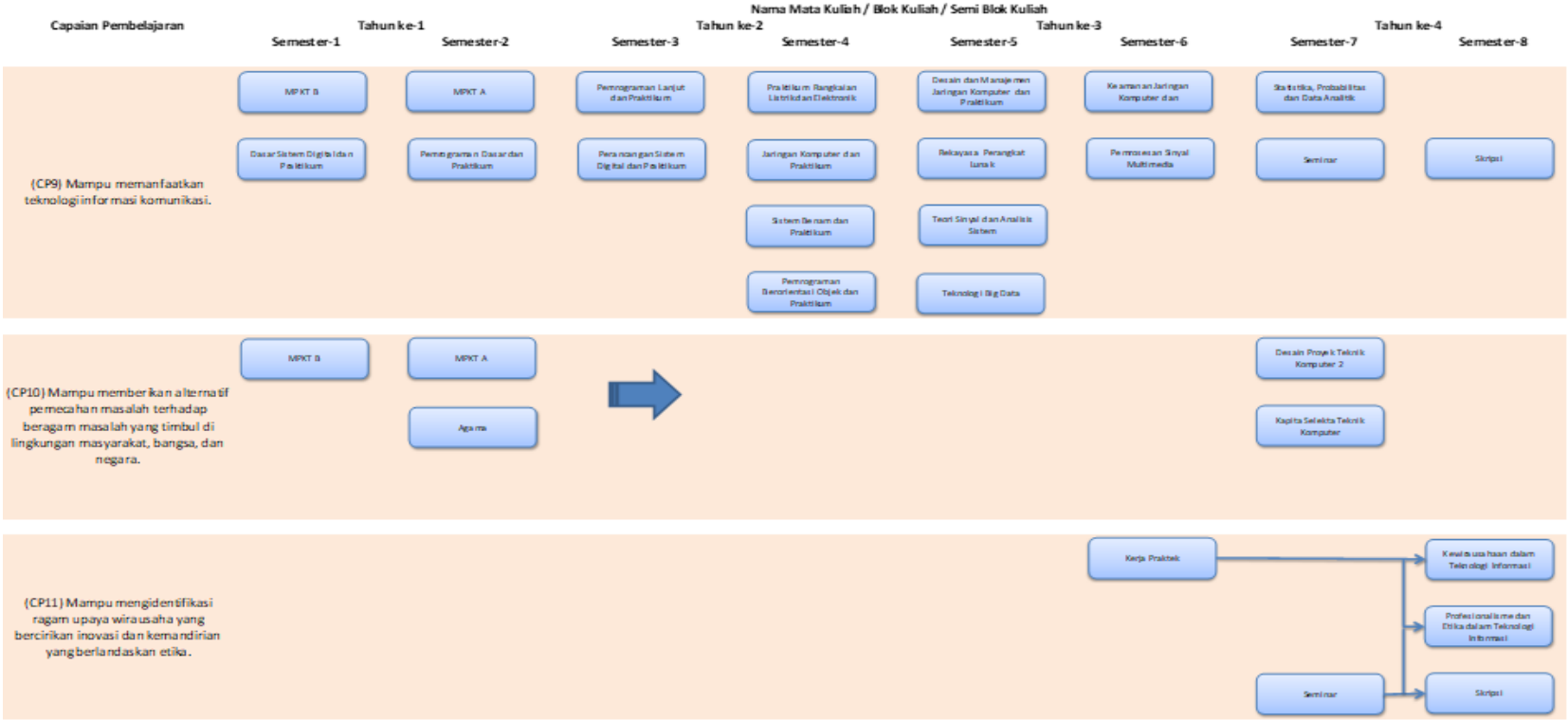
Block Diagram of Expected Learning Outcomes (ELO)



Flow Diagram for Achieving ELO in Computer Engineering Undergraduate Program




Nama Mata Kuliah / Blok Kuliah / Semi Blok Kuliah
Capaian Pembelajaran
Tahun ke-1
Semester-1
Semester-2
Tahun ke-2
Semester-3
Semester-4
Tahun ke-3
Semester-5
Semester-6
Tahun ke-4
Semester-7
Semester-8
(CP5) Mampu membuat algoritma dan mengimplementasikannya ke dalam pemrograman. (CG)
Pemrograman Dasar dan Praktikum
Pemrograman Lanjut dan Praktikum
Analisis Algoritma
Pemrosesan Sinyal Multimedia
Pemrograman Berorientasi Objek dan Praktikum
(CP6) Mampu menerapkan prinsip dasar matematika, fisika, dan data analitik dalam menyelesaikan permasalahan teknik komputer.
Fisika Listrik, Magnet dan Gelombang Optik
Praktikum Fisika Mekanika dan Panas
Matematika Teknik
Teori Sinyal dan Analisis Sistem
Praktikum Fisika Listrik, Magnet dan Gelombang Optik
Fisika Mekanika dan Panas
Struktur Diskret
Komputasi Numerik
Statistika, Probabilitas dan Data Analitik
Kalkulus
Aljabar Linier
Aljabar Linier Lanjut
(CP7) Mampu menggunakan bahasa lisan dan tulisan dalam bahasa Indonesia dan bahasa Inggris dengan baik untuk kegiatan akademik maupun non akademik.
Analisis Algoritma
Rekayasa Perangkat Lunak
Desain Proyek Teknik Komputer 1
Desain Proyek Teknik Komputer 2
Kewirausahaan dalam Teknologi Informasi
Bahasa Inggris
Interaksi Manusia dan Komputer
Seminar
Bahasa Inggris
MPKT B
MPKT A
Kerja Praktek
Seminar
Skripsi
(CP8) Memiliki integritas dan mampu berpikir kritis, kreatif, dan inovatif serta memiliki keingintahuan intelektual untuk memecahkan masalah pada tingkat individual dan kelompok.
MPKT B
MPKT A
Pemrograman Lanjut dan Praktikum
Pemrograman Berorientasi Objek dan Praktikum
Desain Proyek Teknik Komputer 2
Olahraga/Seni
Seminar
Skripsi
Pemrograman Sistem Digital dan Praktikum
Sistem Benam dan Praktikum
Sistem Waktu Nyata dan IoT dan Praktikum
Dasar Sistem Digital dan Praktikum


Nama Mata Kuliah / Blok Kuliah / Semi Blok Kuliah
Capaian Pembelajaran
Tahun ke-1
Semester-1
Semester-2
Tahun ke-2
Semester-3
Semester-4
Tahun ke-3
Semester-5
Semester-6
Tahun ke-4
Semester-7
Semester-8
(CP9) Mampu memanfaatkan teknologi informasi komunikasi.
MPKT B
Dasar Sistem Digital dan Praktikum
MPKT A
Pemrograman Dasar dan Praktikum
Pemrograman Lanjut dan Praktikum
Perancangan Sistem Digital dan Praktikum
Praktikum Rangkaian Listrik dan Elektronik
Jaringan Komputer dan Praktikum
Sistem Berkas dan Praktikum
Pemrograman Berorientasi Objek dan Praktikum
Desain dan Manajemen Jaringan Komputer dan Praktikum
Rekayasa Perangkat Lunak
Teori Sinyal dan Analisis Sistem
Teknologi Big Data
Keamanan Jaringan Komputer dan
Pemrosesan Sinyal Multimedia
Statistika, Probabilitas dan Data Analitik
Seminar
Skripsi
(CP10) Mampu memberikan alternatif pemecahan masalah terhadap beragam masalah yang timbul di lingkungan masyarakat, bangsa, dan negara.
MPKT B
MPKT A
Agama
Desain Proyek Teknik Komputer 2
Kapita Selekta Teknik Komputer
(CP11) Mampu mengidentifikasi ragam upaya wirausaha yang bercirikan inovasi dan kemandirian yang berlandaskan etika.
Kerja Praktek
Kewirausahaan dalam Teknologi Informasi
Profesionalisme dan Etika dalam Teknologi Informasi
Seminar
Skripsi

Course Structure Undergraduate Program in Computer Engineering

Code	Subject	SKS
	1st Semester	
UIGE600010-15	Religion	2
UIGE600003	English	2
ENGE600003	Calculus	4
ENGE600007	Physics (Electricity, MWO)	3
ENGE600008	Physics (Electricity, MWO) Laboratory	1
ENCE601001	Basic Programming and Laboratory	3
ENEE605033	Fundamental of Digital System and Laboratory	3
	Sub Total	**18**
	2nd Semester	
UIGE600007	Integrated Character Building	6
ENGE600004	Linear Algebra	4
ENGE600005	Physics (Mechanics and Thermal)	3
ENGE600006	Physics (Mechanics and Thermal) Laboratory	1
ENCE602002	Computer Organization and Architecture	3
ENCE602003	Advanced Programming and Laboratory	3
	Sub Total	**20**
	3rd Semester	
ENCE603004	Digital System Design and Laboratory	3
ENCE603005	Discrete Structures	3
ENCE603006	Computer Networks and Laboratory	4
ENCE603007	Object Oriented Programming and Laboratory	3
ENCE603008	Basics of Electronic Circuit	2
ENCE603009	Electric Circuit	2
ENCE603010	Statistics	3
	Sub Total	**20**
	4th Semester	
ENCE604011	Advanced Linear Algebra	2
ENCE604012	Cyber-physical System and Laboratory	3
ENCE604013	Algorithm Analysis	3
ENCE604014	Operating System	2
ENCE604015	Design and Management of Computer Networks and Laboratory	4
ENCE604016	Database System and Laboratory	3
ENEE603008	Engineering Mathematics	4
ENCE604017	Electric and Electronic Circuit Laboratory	1
	Sub Total	**22**
	5th Semester	
ENCE605018	Software Engineering	3
ENCE605019	Real Time System and IoT and Laboratory	3
ENCE605020	Computer Networks Security and Laboratory	3
ENCE605021	Telecommunication Networks and Laboratory	3
ENCE605022	Modern Computer Architecture	2
ENCE605023	Probability and Stochastic Process	2
ENCE605024	Signal Theory and System Analysis	2
	Electives	3
	Sub Total	**21**
	6th Semester	
ENCE606025	Computer Engineering Project Design 1	2
ENCE606026	Multimedia Signal Processing	3
ENCE606027	Artificial Intelligence	3
ENCE606028	Internship	2
ENCE606029	Entrepreneurship in Information Technology	2
ENCE606030	Professionalism and Ethics in Information Technology	2
	Electives	6
	Sub Total	**20**

	7th Semester	
ENCE607031	Computer Engineering Project Design 2	3
ENCE607032	Seminar	2
	Electives	9
	Sub Total	**14**
	8th Semester	
ENCE608033	Bachelor Thesis	4
	Electives	6
	Sub Total	**10**
	Total	**145**

Electives Computer Engineering Program

Code	Subject	SKS
	5th Semester	
ENCE605034	Big Data Technology	3
	Sub Total	3
	6th Semester	
ENCE600035	Cloud Computing	2
ENCE600036	Human Computer Interaction	**2**
ENCE600037	Wireless Technology	**2**
	6th Semester	
ENCE607038	Geospatial Technology	2
ENCE607039	Capita Selecta in Computer Engineering	2
ENCE607040	Professional Engineer Development - 1	**2**
ENCE607041	Regulation & Public Policy on ICT Sector	**3**
	Sub Total	9
	6th Semester	
ENCE607042	Blockchain Technology	3
ENCE607043	Professional Engineer Development - 2	2
ENCE607044	Cryptography	2
ENCE607045	VLSI Design	2
	Sub Total	9

Transition Guidance

1. Curriculum 2020 is implemented starting from the Even Semester 2020/2021. In principle, after the 2020 Curriculum is implemented, only courses in the 2020 Curriculum will be opened.
2. The 2020 curriculum is effective from the class of 2020.
3. Class of 2019 and previous will participate in Curriculum 2020 with transition rules.
4. A transition period of 1 year is applied, namely from the Even Semester of the academic year 2020/2021 to the Odd Semester of the academic year 2021/2022.
5. For courses that change in the location of the semester in Curriculum 2020 (from Even to Odd, or vice versa), if necessary, will be opened in both semesters during the transition period.
6. For students who have not passed the compulsory courses in curriculum 2016, it is required to take the same or equivalent compulsory courses in curriculum 2020 (refer to Table of Equality Courses).
7. In the event of a change in the credit (SKS) of the course, then the number of SKS taken into account is the number of SKS at the time the course was taken last.
   - For example, the same course or equivalent has a different SKS, if repeated will be listed with a new name and calculated with the weight of the new SKS.
8. New compulsory courses in Curriculum 2020 that do not have equality to the Curriculum 2016, are not required to be taken by students of the class of 2019 and earlier.
9. If the compulsory courses in Curriculum 2016 are removed and there is no equality in Curriculum 2020, for students who have passed the course, then it is still counted as a mandatory course in the calculation of SKS for graduation (144 SKS). For students who have not passed the course, he/she can take a new compulsory course or electives in Curriculum 2020 to complete 144 SKS.
10. Special rules for Integrated Character Building (MPKT A and B) courses: For the transition period, MPKT (5 credits) courses should only be taken by students of the Class of 2020. For students of class 2019 and previously who have passed one of the MPKT A or B courses, do not have to take both courses. For the transition period, students of Class 2019 and earlier can still repeat MPKT A and B courses.
11. Special rules for Class of 2017 (and before):

IT Project Management course is open for the Class of 2017 (and before) during the transition period. If a student does not pass the course in the transition period, then it is mandatory to take Computer Engineering Project Design 1 (in even semester 2021/2022) and Computer Engineering Project Design 2 (in Odd Semester 2022/2023). Class of 2018 and 2019 remains obliged to take Computer Engineering Project Design 1 &2.

Table of Equality Courses in Undergraduate Chemical Engineering Study Program in Curriculum 2016 and Curriculum 2020

Name of Courses in Curriculum 2016	SKS 2016	Semester	Name of Courses in Curriculum 2020	SKS 2020	Semester
MPKT A MPKT B	6 6	2 1	Integrated Character Building	6	2
Introduction to Computer Engineering +Lab.	3	2	Basic Programming and Laboratory	3	1
Advanced Programming	3	3	Advanced Programming and Laboratory	3	2
Vector Analysis and Complex Variables	2	3	Advanced Linear Algebra	2	4
Embedded Systems 1	2	5	Cyber Pyhsical Systems and Laboratory	3	4
Algorithm	3	4	Algorithm Analysis	3	4
Operating Systems	3	5	Operating Systems	2	4
Embedded Systems 2 and Laboratory	3	6	Real Time Systems and IoT and Laboratory	3	5
Telecommunication Networks	3	6	Telecommunication Networks and Laboratory	3	5
Probability and Stochastic Process	3	5	Probability and Stochastic Process	2	5
Signal and Systems	3	4	Signal Theory and System Analysis	2	5
Project Management in IT	3	8	Computer Engineering Project Design 1	2	6
			Computer Engineering Project Design 2	2	7
Data Analysis Engineering	3	P-1	Artifial Intelligence	3	6
Wireless Technology	1	4	Wireless Technology	2	P-6
Human Computer Interaction	4	4	Human Computer Interaction	2	P-6
Capita Selecta in Computer Engineering	2	6	Capita Selecta in Computer Engineering	2	P-7

Fast-Track Curriculum (S1 and S2)

Students of Computer Engineering Undergraduate Program can join fast track program to master degree. The curriculum structure for the fast track program for Semester 1 up to Semester 6 is similar to the regular program, while for Semester 7 to Semester 10 is differentiated based on the major chosen for the Graduate Program

Course structure for Fast Track Program Bachelor of Computer Engineering and Master of Electrical Engineering Majoring in Cyber Security and Future Internet

	7th Semester	
ENCE607031	Design of Computer Engineering Project 2	3
ENCE607032	Seminar	2
ENEE801001	Data Processing and Analytic	4
ENEE801002	Research Methodology	4
ENEE801401	Network Security and Data Protection	2
ENEE801402	Advanced Network Computer Systems	
	Sub Total	**17**
	8th Semester	
ENCE607033	Bachelor Thesis	4
ENEE802405	Security Operation and Incident Handling	2
ENEE802406	Network & Digital Forensics	2
ENEE802407	Convergence Information Network NG	2
	Sub Total	**14**
	9th Semester	
ENEE801403	Network Security and Data Protection	2
ENEE803003	Technology Innovation and Entrepreneurship	3
ENEE803408	Cyber Threat Intelligence and Incident Analysis	2
ENEE803409	Security Risk Assessment and Analysis	2
	Elective Course	**2**
	Sub Total	**11**
	10th Semester	
ENEE802404	Applied Cryptography & Blockchain Technology	3
	Elective Course	2
ENEE804004	Thesis	4
ENEE804005	Publication	2
	Sub Total	**11**
TOTAL		**49**

Course structure Fast Track Program for Bachelor of Computer Engineering and Master of Electrical Engineering Majoring in Data Engineering and Business Intelligence

	7th Semester	
ENCE607031	Design of Computer Engineering Project 2	3
ENCE607032	Seminar	2
ENEE801001	Data Processing and Analytic	4
ENEE801002	Research Methodology	4
ENEE801601	Digital Enterprise Software Architecture	2
ENEE801603	Imaging Technology and Computer Vision	2
	Sub Total	**17**
	8th Semester	
ENCE607033	Bachelor Thesis	4
ENEE802604	Big Data Technology and Architecture	3
ENEE802605	Advanced Artificial Intelligence	2
ENEE802606	Advance Data Engineering	2
	Sub Total	**11**
	9th Semester	
ENEE801602	Business Analytics and Visualization	2
ENEE803003	Technology Innovation and Entrepreneurship	3
ENEE803608	Enterprise Cyber Threat Analysis	2

ENEE803609	Advanced IT Project Management	2
	Elective Course	2
	Sub Total	**11**
	10th Semester	
ENEE802607	Ethics and Professionalism	2
	Elective Course	2
ENEE804004	Thesis	4
ENEE804005	Publication	2
	Sub Total	**10**
TOTAL		**49**

Course Syllabus of University Subject

INTEGRATED CHARACTER BUILDING
UIGE600007/UIGE600007
6 credits

Syllabus :

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

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

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

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

Graduate Learning Outcomes :

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

Course Learning Outcomes :

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

correct Indonesian as well as the latest information and communication technology (C5, A5)

Prerequisite : -

ACADEMIC WRITING
UIGE610002
2 credits
The Objectives :

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

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

Main Competencies :

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

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

Prerequisite :

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

ENGLISH
UIGE600003
2 credits
Learning Objectives :

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

Syllabus :

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

ISLAMIC STUDIES
UIGE6000010/UIGE610005
2 credits
General Instructional Objectives :

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

Learning Objectives :

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

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

Syllabus :

Islam history: the meaning of Islam, the characteristic of Islam, the sources of Islamic teachings, Muhammad SAW as prophet and history figure, introduction of Islam in Indonesia, the teaching essence of Islam: the basic principle of Islam teachings, the unity of Allah, worship prac-tice in live, eschatology and work ethics, human's basic rights and obligation, social structure in Islam: sakinah mawaddah and ramhah family, the social implication of family life,

Mosque and the development of Islam, zakat and the economic empowerment of the people, Islam society, Science: reason and revelation in Islam, Islam's motivation in development of science, science characteristics, source of knowledge, IDI (each Faculty and Department/Study Program).

CATHOLIC STUDIES
UIGE6000011/UIGE610006
2 credits
General Instructional Objectives :

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

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

Syllabus :

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

CHRISTIAN STUDIES
UIGE6000012/UIGE610007
2 credits
General Instructional Objectives :

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

Learning Objectives :

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

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

Syllabus :

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

HINDU STUDIES
UIGE6000013/UIGE610008
2 credits

Syllabus :

Hindu religion, Hindu history), Source and scope of Hinduism (the Veda as the source of Hindu religion teachings, the scope of the teachings in Hindu religion), The concept of the God (Brahman) according to the Veda, the Path to Brahman (Catur Marga Yoga, Mantra and Japa), Human Nature (The purpose of human life, Human's duties, obligations, and responsibilities both individually or collectively), Ethics and morality (Principles teaching, self-control), in-depth understanding of the scripture (deep understanding of the Bhagawadgita, deep understanding of the Sarasamuschaya), The Role of Hinduism in science, technology, and art (Hinduism benefits in science and technology in accordance with each department, benefit / the role of Hinduism in the arts), Cohesion and community's prosperity / independence (Benefits of unity in the religious plurality, independent community (kerthajagathita) as a common goal, Tri Pitakarana), Culture as an expression of Hindu religious practice, Contribution to the Hindu religion teachings in the political life of nation and country, laws and the enforcement of justice, Awareness of and obeying the Rita / Dharma.

BUDDHIST STUDIES
UIGE6000014/UIGE610009
2 credits

Syllabus :

Almighty God and the God Study (Faith and piety, Divine Philosophy/Theology), Human (Human Nature, Human Dignity, Human Responsibility), Moral (Implementation of Faith and Piety in everyday life), Science, Technology and Art (Faith, Science and Charity as a unity, the Obligation to study and practice what you are taught, Responsibility for nature and environment), harmony between religion (religion is a blessing for all mankind, the essence of the religious plurality and togetherness), community (the role of religious society in creating a prosperous independent society, the responsibility

of religious society in the realization of human rights and democracy), Culture (the responsibility of religious society in the realization of critical thinking (academic), work hard and fair), Politics (Religion contribution in the political life of nation and country), Law (Raise awareness to obey and follow God's law, the role of religion in the formulation and enforcement of law, the function of religion in the legal profession).

KONG HU CU STUDY
UIGE6000015/UIGE610010
2 credits

Syllabus of Faculty Subjects

CALCULUS 1
ENGE600001/ENGE610001
3 credits
Course Learning Outcomes:

Able to use the basic concepts of calculus related to -a function of one variable, the derivative and integration of the function of one variable in order to solve its applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, basic engineering, and engineering specialization to be used in solving complex engineering problems.

Syllabus :
Introduction, Functions and Limits, The Derivative, Applications of the Derivative, The Definite Integral, Applications of The Definte Integral, Transcendental Functions, Techniques of Integration, Indeterminate Forms and Improper Integrals.

Prerequisite: None

Textbooks:

Main reference:
D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., Pearson, Prentice Hall, 2007.

Additional eferences:
1. George B. Thomas Jr., Thomas' Calculus Early Transcendental, 12th ed., Addison–Wesley Pearson, 2009.
2. Howard Anton, Calculus, 10th ed., John Wiley and Sons, 2012.

CALCULUS 2
ENGE600002/ENGE610002
3 SKS
Course Learning Outcomes:

Students are able to use the concepts of sequences, series, conic sections, and the basic concepts of calculus which involve the function of two or three variables to solve their applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus: :
Infinite sequences and infinite series, Test for convergence of positive series and alternating series, Power series and operation on operations, Taylor and MacLaurin series, Conic sections , Calculus in polar coordinates, Derivatives, limits, and continuity of multi-variables functions, Directional derivatives and gradients, Chain Rule, Tangent planes and Approximations, Lagrange multipliers. Double integrals in Cartesian coordinates and polar coordinates, triple integrals in Cartesian coordinates, cylindrical coordinates and spherical coordinates, Applications of double and triple Integral.

Prerequisite: Calculus 1

Textbooks:
1. D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., PEARSON, Prentice Hall, 2007.
2. Thomas, Calculus Thirteenth Edition Volume 2, Erlangga, 2019.

CALCULUS
ENGE600003/ENGE610003
4 SKS
Course Learning Outcomes:

Students are able to use the basic concepts of calculus involving functions of one to three variables to solve their applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :

Introduction, Functions and Limits, Derivatives, Derived Applications, Indeterminate Integral, Integral Applications, Infinite Row, and Series. Derivatives with many variables, Duplicate Integral (2 and 3), Duplicate Integral Application.

Prerequisite: None

Textbooks:

Main :
D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., Pearson, Prentice Hall, 2007.

George B. Thomas Jr., Thomas' Calculus Early Transcendental, 12th ed., Addison – Wesley Pearson, 2009.

LINEAR ALGEBRA
ENGE600004/ENGE610004
4 SKS
Course Learning Outcomes:
Students are able to calculate linear system problems to solve engineering problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :

Linear Systems and matrix equations, Determinants, Euclid vector spaces, Common vector spaces, eigenvalues and eigenvectors, inner product spaces, Diagonalization and General Linear Transformation.

Prerequisite: None

Textbooks:
1. Elementary Linear Algebra, Howard Anton & Chris Rorres, 11th edition, 2014
2. Gilbert Strang, Introduction to linear algebra 3rd edition Wellesley Cambridge Press, 2003

MECHANICAL AND HEAT PHYSICS
ENGE600005 / ENGE610005
3 credits
Course Learning Outcomes:

Able to explain the basic concepts of mechanics and thermodynamics, and be able to apply them to understand natural phenomena and human engineering, including their applications.

Graduate Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus:

Units, Magnitudes and Vectors, Motion Along Straight Lines, Motion in Two and Three Dimensions, Newton's Laws of Motion, Applications of Newton's Laws, Kinetic Energy, and Work, Potential Energy and Energy Conservation, Center of Mass, Linear Momentum, Rotation, Rolling Motion, Torque, Angular Momentum, Oscillation, Mechanical and Sound Waves, Gravity, Statics and Elasticity, Fluid Mechanics, Temperature, Heat, Law I Thermodynamics, Ideal Gas and Kinetic Theory of Gas, Heat Engine, Entropy, and Law II Thermodynamics.

Prerequisite: none

Textbooks:
1. Halliday, Resnick, and Walker, Principles of Physics 10th Edition, Wiley, 2014.
2. Serway Jewett, Physics for Scientists and Engineers 9th Edition, Thomson Brooks / Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008

ELECTRICAL MAGNETIC, OPTICAL AND WAVE PHYSICS
ENGE600007 / ENGE610007
3 credits
Course Learning Outcomes:

Students are able to apply the basic concepts of electrical physics, magnetism, waves, and optics to solve problems in the engineering field.

Graduate Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus:

Unit, Magnitude, Vector, Electric Charge, Electric Field, Gauss Law, Electric Potential, Capacitance, Electric Current, Resistance, Direct Current, Magnetic Field Due to Electric Current, Magnetic Field Source, Induced GGL, Inductance, Alternating Current, Electromagnetic Waves, Light Properties and Propagation, Optical Geometry.

Prerequisite: none

Textbooks :
1. Halliday, Resnick, and Walker, Principles of Physics 9th Edition, Wiley, 2011.
2. Serway Jewett, Physics for Scientists and Engineers 9th Edition, Thomson Brooks / Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008.

BASIC CHEMISTRY
ENGE600009 / ENGE610009
2 credits
Course Learning Outcomes:
Students are able to analyze the principe of basic chemistry for application in engineering.

Graduates' Learning Outcomes:
Able to apply mathematics, science, and basic engineering to be used in solving complex engineering problems.

Syllabus:

Material and measurements, atoms, molecules and ions, stochiometry, water phase reactions and solution stochiometry, thermochemistry, chemical equilibrium, acid and base equilibrium, electrochemistry, chemical kinetics, and chemical applications.

Prerequisite: none

Textbooks :
1. Ralph H. Petrucci, General Chemistry: Principles and Modern Applications, 8th Ed. Prentice Hall Inc., New York, 2001.
2. John McMurry, Robert C. Fay, Chemistry (3rd ed.), Prentice Hall, 2001.
3. Raymond Chang, Williams College, Chemistry (7th ed.), McGraw-Hill, 2003.

ENGINEERING ECONOMY
ENGE600011 / ENGE610011
3 credits
Course Learning Outcomes:

Students are able to analyze the economic and financial feasibility of making economic practice decisions.

Graduate Learning Outcomes:

Able to apply the principles of technical management and decision making based on economic considerations, in individual and group, as well as in project management.

Syllabus:

Introduction to Engineering Economics, Time Value of Money, Combining Factors, Interest Rates, Money Worth Analysis, Rate of Return Analysis, Effects of Inflation, Benefit Cost & Break-Even Point Analysis, Sensitivity Analysis, Depreciation, Tax Analysis, Cost Estimation & Allocation, Capital Budgeting & Replacement Analysis.

Prerequisite:
1. Civil Engineering : -
2. Environmental Engineering : -
3. Naval Engineering : -
4. Industrial Engineering : must pass the introductory Economic course and have completed 38 credits
5. Chemical Engineering : -
6. Bioprocess Engineering : -

Textbooks:
1. Blank, Leland and Tarquin, Anthony. 2018. Engineering Economy 8th Ed. McGraw Hill.
2. Park, Chan S. 2016. Contemporary Engineering Economics 6th Ed. Pearson. Upper Saddle River.
3. White, Case and Pratt. 2012. Principles of Engineering Economic Analysis 6th ed. John Wiley and Sons.

STATISTICS AND PROBABILISTICS
ENGE600010 / ENGE610010
2 credits
Course Learning Outcomes:

Students are able to handle quantitative data/ information starting from the descriptive stage (collection, organization, and presentation) to the inductive stage, which includes forecasting and drawing conclusions based on the relationship between variables for decision making.

Graduate Learning Outcomes:
1. Apply descriptive statistics and probability theory to data processing and serving
2. Apply probability distribution to data processing and serving
3. Apply the principles of sampling and estimation for decision making
4. Apply hypothesis test samples for decision making

Syllabus:

Introduction to Statistics for Engineering Studies, Probability Theory, Dasar Basic concepts and definitions, Distribution Probability, Sampling, Estimation, Hypothesis testing, Hypothesis test 1 sample at an average value, Regression

Prerequisite: none

Textbooks :
1. Harinaldi, Basic Principles of Statistical Engineering and Science, Erlangga, 2004
2. Montgomery, DC., And Runger, GC., Applied Statistics and Probability for Engineers, John Wiley Sons, 2002

HSE PROTECTION
ENGE600012 / ENGE610012
2 credits
Course Learning Outcomes:

Upon completion of this subject students are expected to be able to carried out hazard identification, and characterization, to propose appropriate methods for risk reduction and mitigation, and to design safety management system. The student is also expected to improve their awareness on industrial safety and health, and understanding on safety regulation framework and standards as well as environmental program.

Graduate Learning Outcomes:
1. Students are expected to understand safety, health and environmental aspect as an integral part of fundamental principal in engineering code of ethics.
2. Students are expected to be able to carry out process of risk assessments by considering risk factors in the impact of hazards on people, facilities, and the surrounding community and environemt.
3. Students are expected to understand the regulatory framework and standard related to the stages of life cycle of machine, building struc-

ture, construction, and process.
4. Students are able to design and propose an effective hazard communication, management and engineering control, and risk mitigation through an engineering assignment project.
5. Students are able to identify the knowledge required to perform risk assesment, investigation and design improvement through a multidisiplinary case of incident and accident.

Syllabus:

Introduction to SHE Regulation and Standards, SHE Perception (Risk and Environment), Identification, Assessment and Management, Construction, machinery and Noise hazards, Process safety hazard and analysis technique, Fire and explosion hazard, Electrical hazard, Toxicology in the Workplace, Ergonomy Aspect, Hazard communication to employees, Environmental Protection, Case studies, Safety Health and Environment audits.

Prerequisite: none

Textbooks :
1. Charles A. Wentz, Safety, Health and Environmental Protection, McGraw Hill, 1998.
2. Asfahl, C.R., Rieske, D. W., Sixth Edition Industrial Safety and Health Management, Pearson Education, Inc., 2010.
3. United Kingdom - Health and Safety Executive, http://www.hse.gov.uk/
4. National laws and regulations related to the K3 Management System and the Environment.
5. Related Journal (http://www.journals.elsevier.com/safety-science/) etc, related standards and publications.

Electrical Engineering Department Subjects

FUNDAMENTAL OF DIGITAL SYSTEMS AND LABORATORY

ENEE602005

3 CREDITS

Learning Outcomes:

Able to explain the components of a digital system circuit, able to solve mathematical logic circuits, able to apply digital circuit concepts, able to use simple digital circuit design methods

Topics:

Boolean Algebra Principles and applications; Interface Logic Families; Number System & Data Encoding; Basic Logic Circuits; Basic Modular Design of Combinational Circuits; Basic Modular Design of Sequential Circuits.

Practical work: Module 1-Introduction and introduction to Digital Circuit Basics, Module 2 - Boolean Algebra and Elementary logic gates, Module 3 – Karnaugh Map, Module 4 – complex logic gate, Module5 - Decoder and Encoder, Module 6 - Multiplexer and De-multiplexer, Module 7- Digital Arithmetic Circuit, Module 8 - Flip-Flop and Latch, Module 9-Registers and Counters, Module 10 – Group Project

Prerequisite: none

Textbook:
1. M. Morris R. Mano, Charles R. Kime, Tom Martin, Logic & Computer Design Fundamentals, 5th ed, Prentice Hall, 2015
2. Ronald J. Tocci, Neal S. Widmer, and Gregory L. Moss, Digital Systems: Principles and Applications, 11th Ed., Prentice Hall, 2010
3. Modul Praktikum Dasar Sistem Digital

ENGINEERING MATHEMATICS

ENEE603008

4 CREDITS

Learning Outcomes:

Upon completing this course, students are expected to be able to describe ordinary differential equations with constant/non-constant, linear/nonlinear coefficients, partial differential equations, discrete differential equations (C3); Able to derive solutions of ordinary differential equations and partial differential equations (C4); Able to apply the Laplace/ Fourier/Z transformation method in the derivation of solutions to differential equations (C3); Able to explain the optimization concept of a mathematical problem (C2); And able to solve mathematical problems using the linear programming method/ infinite optimization method (C4).

Topics:

Ordinary Differential Equations (Constant and Inconstant Coefficients, linear, non-linear), Partial Differential Equations, Discrete Differential Equations, Laplace Transform, Fourier Transform, z Transformation, unconstrained optimization, linear programming

Textbook:
1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley Publisher 2010.
2. Glyn James, "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education, 2011.

Computer Engineering Subjects

BASIC PROGRAMMING AND LABORATORY

ENCE601001

3 CREDITS

Learning Outcomes:

This course is given for the first semester student of the Computer Engineering Study Program. In this course, students are introduced to ways of thinking and solving problems by creating algorithms, then translating those algorithms into programming

languages that can be run by computers. After attending this course, students are expected to be able to make simple procedural computer programs (C3) and be able to use computer-programming software proficiently (C3).

Topics:

Introduction to Computers, Algorithms, Pseudocode, Introduction to C language, Controlling programs in C language, Structured programs in C language, Functions, Arrays, Pointers, Struct, Union, Enumeration Pointer

Prerequisite: -

Textbook:

1. Deitel & Deitel, "C How to Program", 8th Edition, Pearson International Edition, 2015.

COMPUTER ORGANIZATION & ARCHITECTURE

ENCE602002

3 CREDITS

Learning Outcomes:

This course discusses the architecture and organization of computer systems. Upon completing this course, students will be able to design software based on a particular microprocessor organization and architecture (C4) and be able to use spoken language well for presentations on problems in organization and computer architecture (C3).

Topics:

Introduction, History of Microprocessor, Designing for Performance, Top Level view of Computer System, Processor Organization; Memory; Peripheral subsystems; Fundamental of Assembly Programming; Addressing Modes; Data Transfer; Arithmetic and Logic Instruction, Program Control, Programming the Microprocessor

Prerequisite: Basic Programming and Laboratory

Textbook:

1. W. Stallings, "Computer Organization and Architecture", 10th Edition, Pearson International, 2015
2. Brey, Barry B, The Intel Microprocessors: 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium 4, and Core2 with 64-bit Extensions, 8th Ed., PHI Inc, USA, 2011.

ADVANCED PROGRAMMING AND LABORATORY

ENCE602003

3 CREDITS

Learning Outcomes :

This is an advanced course for learning how to program computers. In this course, you will learn about programming using high-level languages with procedural types. After attending this course, it is expected that students will be able to design complex procedural computer programs with dynamic data structures (C6), be able to demonstrate a critical, creative, and innovative attitude and respect other people in the group to solve common problems and group assignments. Advanced Programming (C3, A3) , and able to use computer programming software for complex programs proficiently (C3).

Topics:

Data structures: linked list, queue, stack, tree; Problem-solving strategies: searching, sorting; Recursion; Multi-threading, Non Reguler programming

Prerequisite: Basic Programming and Laboratory

Textbook:

1. Deitel & Deitel, "C How to Program", 8th Edition, Pearson International Edition, 2015.

DIGITAL SYSTEM DESIGN AND LABORATORY

ENCE603004

3 CREDITS

Learning Outcomes:

In this course, it will discussed the principles in designing digital systems. After following this course, the student is expected to be able to design and analyze sequential and combinational circuit using a hardware modeling language definition language (HDL) and able to do synthesis into the PLD, CPLD and FPGA-like.

Topics:

Review of Sequential Circuit Design; VHDL; Control and datapath design; Design with programmable logic; System design constraints; Fault models, testing, and design for testability; Laboratory

Prerequisite: Basic Programming and Laboratory

Textbook:

1. Charles h. Roth, Jr., Lizy K John, Digital Systems Design Using VHDL, 2007
2. Bryan mealy, Fabrizio Tappero, Free Range VHDL, freerangefactory.org
3. Digital System Design Lab Modules

DISCRETE STRUCTURES

ENCE603005

3 CREDITS

Learning Outcomes:

In this course students will learn the basic principles of discrete mathematics and apply it to examine and study the modern computing techniques and build a foundation for analyzing problems in computer engineering and developing solutions. After following this course, the student will be able to create sets and functions, applying the techniques of proof, as well as being able to use the theory of graph, tree, iteration and recursion in various cases of problems in the field of computer engineering

Topics:

set; relation; function; Boolean algebra; proofing techniques; basic proof; graph; tree; iteration; recursion

Prerequisite: Basic Programming and Laboratory, Fundamental of Digital System and Laboratory

Textbook:

1. Kenneth h. Rosen, "Discrete Mathematics and Its Applications", 7th Edition , McGraw-

Hill Science/Engineering/Math; 2011
2. Richard Johnsonbaugh, "Discrete Mathematics", 7th Edition, Pearson Intl. Edition, Prentice-Hall, NJ, 2009

COMPUTER NETWORKS AND LABORATORY

ENCE603006

4 CREDITS

Learning Outcomes:

In this course, students learn topics about computer networks that are discussed comprehensively from layer 1 to layer 7. After attending this course, students are able to configure and implement simple computer networks according to existing protocol standards, are able to apply the concept of VLAN, Inter VLAN Routing , LAN Redundancy, Dynamic Addressing, LAN Security, Wireless LAN and Static Protocol Routing in a simple network

Syllabus :

Network Architecture and Topology, Network Protocols and Communications; OSI and TCP/IP Layers; Physical Layer, Data Link Layer, Ethernet Switching; Transport Layer, Application Layer; IPv4 Addressing; IPv6 Addressing; Subnetting; VLANs and Inter-VLAN Routing; Ether Channel; FHRP; DHCPv4; DHCPv6; LAN Security; Wireless LANs; Static Protocol Routing

Prerequisites: Fundamental of Digital System and Laboratory

Textbooks:

1. A. Tanenbaum, "Computer Networks", Prentice Hall, 5th Eds, 2010
2. CISCO Networking Academy Program: Network Fundamentals, CCNA Exploration ver 4, http://cisco.netacad.net

OBJECT ORIENTED PROGRAMMING AND LABORATORY

ENCE603007

3 CREDITS

Learning Outcomes:

In this course, students will learn how to create programs with object -oriented concepts. After completing the course, students will be able to implement the design of software into the languages of oriented object programming; Being able to declare the concept of oriented object programming (class, constructor, scope of variables); Able to describe basic objects (arrays, array lists, object collections, iterators); able to describe the concept of class design (coupling, cohesion , refactoring, inheritance, polymorph, substitution); able to implement GUI-based programming , exception handling and multithreading.

Syllabus:

Java Language Elements; Java Language Operation; Defining and Using Class; System, Strings, String Buffer, Math & Wrapper Classes; Array; Class & Inheritance; Graphical User Interface & Event Driven Design; Exceptions; Collections; Threads and Javadoc

Prerequisites: Advanced Programming and Laboratory

Textbooks:

1. David J. Barnes, "Objects First with Java: A Practical Introduction to Using BlueJ ", 5th Ed., Pearson, 2011
2. Bart Baesens et.al., "Beginning Java Programming: The Object-Oriented Approach", Wrox , 2015

BASICS OF ELECTRONICS CIRCUITS

ENCE603008

2 CREDITS

Learning Outcomes:

In this course students will learn the basic electronics components as well as its circuitry. At the end of this course, students will be able to describe the properties of materials and the operation of a basic electronics component, such as a diode, transistors, op-amps, filters etc.

Topics:

Electronics Materials, diodes, bipolar transistors and; MOS transistor circuit, timing, and power; Storage cell Architecture; Operational Amplifiers

Prerequisite: Physics (Electricity, Magnetism, Waves and Optics)

Textbook:

1. Robert Boylestad Louis Nashelsky, & "Electronic Devices And Circuit Theory", Ninth Edition, Prentice Hall, Upper Saddle River, New Jersey, Columbus, Ohio, 2006.

ELECTRIC CIRCUIT

ENCE603009

2 CREDITS

Learning Outcomes :

In this course, students will learn the basic electrical circuits. At the end of this course, students will be able

Undergraduate Program in Biomedical Engineering

Program Specification

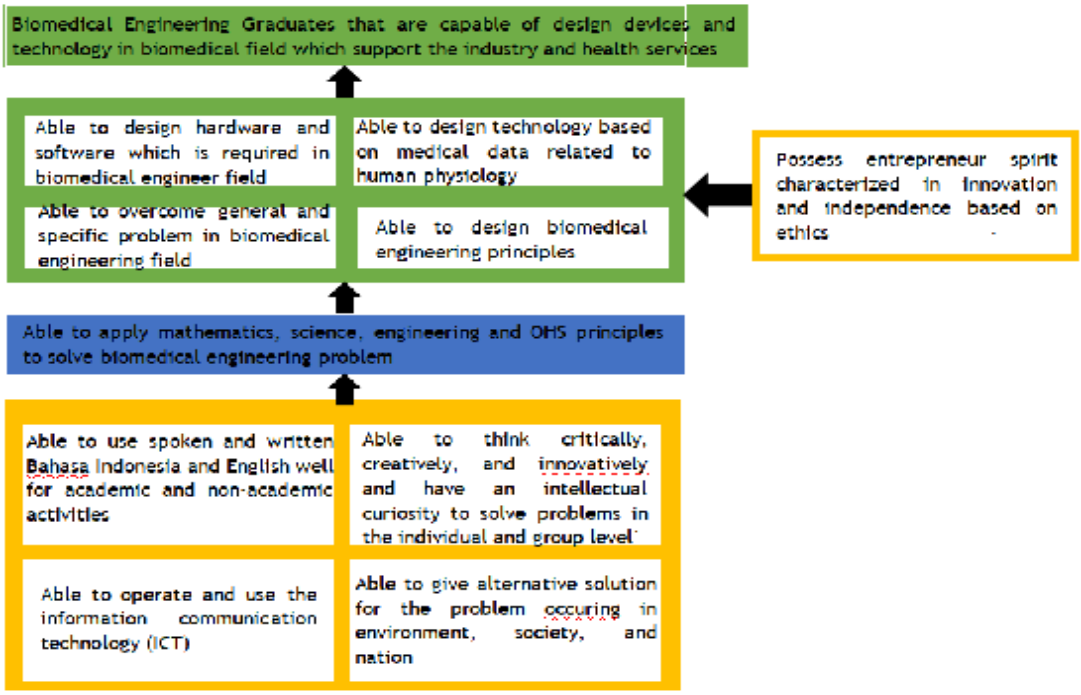
1.	**Awarding Institution**	Universitas Indonesia	
2.	**Teaching Institution**	Universitas Indonesia	
3.	**Programme Tittle**	Undergraduate Program in Biomedical Engineering	
4.	**Class**	Regular, Non Reguler	
5.	**Final Award**	Sarjana Teknik (S.T)	
6 .	**Accreditation / Recognition**	Early accreditation by BAN PT for new study program	
7.	**Language(s) of Instruction**	Bahasa Indonesia	
8.	**Study Scheme (Full Time / Part Time)**	Full Time	
9.	**Entry Requirements**	High school / equivalent, AND pass the entrance exam.	
10.	**Study Duration**	Designed for 4 years	
	Type of Semester	Number of Semester	Number of weeks / semester
	Regular	8	16
	Short (optional)	3	8
11.	**Graduate Profiles:** Biomedical Engineering Graduates that are capable of design devices and technology in biomedical field which support the industry and health services.		
12.	**Expected Learning Outcomes:** Biomedical Engineering Graduates are expected to have the following competence: 1. Able to design hardware and software which is required in biomedical engineer field. 2. Able to overcome general and specific problem in biomedical engineering field. 3. Able to design technology based on medical data related to human physiology. 4. Able to design biomedical engineering principles. 5. Able to apply basic mathematics, chemistry, and physics to solve biomedical engineering problem. 6. Able to think critically, creatively, and innovatively and have an intellectual curiosity to solve problems in the individual and group level. 7. Possess entrepreneur spirit characterized in innovation and independence based on ethics. 8. Able to use spoken and written Bahasa Indonesia and English well for academic and non-academic activities. 9. Able to give alternative solution for the problem occurring in environment, society, and nation. 10. Able to operate and use the information communication technology (ICT).		
13.	**Classification of Subjects**		

No.	Classification	Credit Hours (SKS)	Percentage
i	**University General Subjects**	**10**	**6.30%**
ii	**Faculty Subjects**	**18**	**12.50%**
iii	**Expertise Subjects**	**84**	**58.30%**
iv	**Elective Subjects**	**25**	**17.30%**
v	**Special Subjects (Internship, Pre-Thesis, and Undergraduate Thesis)**	**8**	**5.60%**
	Total	**145**	**100 %**

Career Prospects

Biomedical Engineering Study Program Graduate could work in various types of companies and health industries, information technology, education, government or regulator, and other industries related to health facilities, such as hospitals and health clinics.

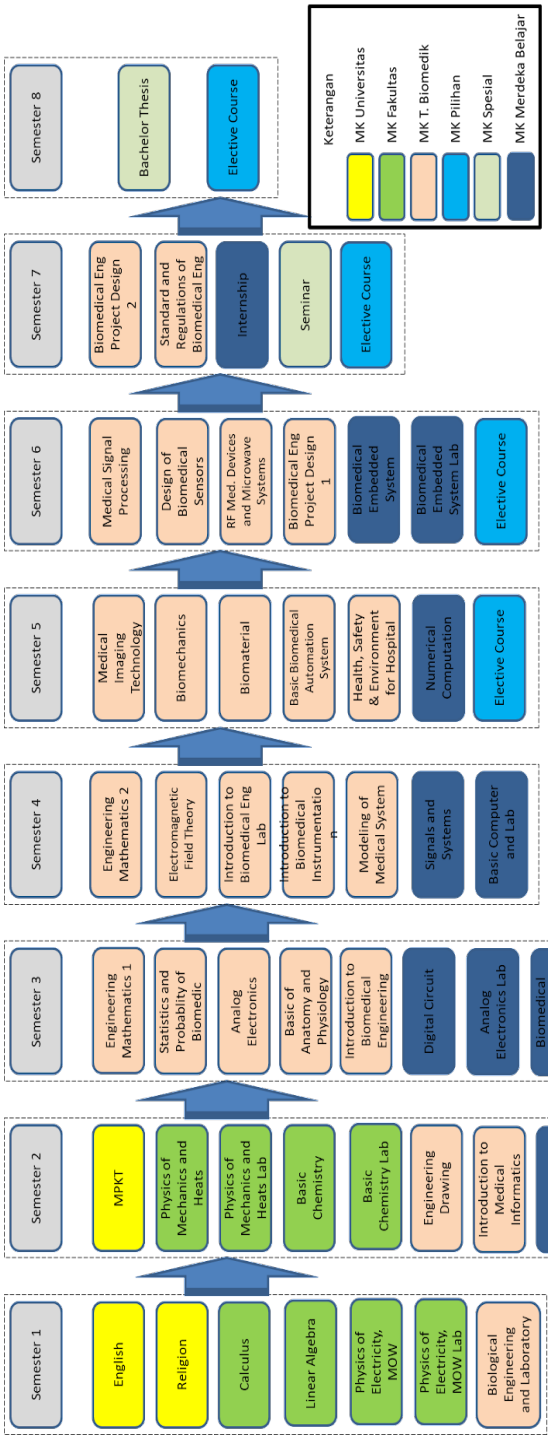
Learning Outcomes



Learning Output

No	KKNI Level 6	General Competency	Output
1	Able to apply their expertise and use science, technology, and/ or art in their respective fields in solving problems and able to adapt to any situation faced	Able to design system, component, or process n biomedical engineering field Able to apply tecnique, skill and modern assist tools such as hardware and software required in biomedical engineering Able to design imaging technique for biomedical engineering	• Undergraduate Thesis • Paper • Publication, including a summary article of undergraduate thesis with journal format on UI repository. • Internship training report.
2	Able to master theoretical concept in certain knowledge of a field in general and deep specialized theoretical concept in in said field and able to formulate problem-solving procedures	Able to design biomedical engineering principles Able to apply basic mathematics, chemistry, and physics to solve biomedical engineering problem	• Undergraduate Thesis • Paper • Publication, including a summary article of undergraduate thesis with journal format on UI repository. • Internship training report.
3	Able to make the correct decision based on information and data, and able to give instruction in choosing from a variety of solution alternatives both independently and in group.	Able to think critically, creatively, and innovatively and have an intellectual curiosity to solve problems in the individual and group level Able to give alternative solution for the problem occurring in environment, society, and nation	• Undergraduate Thesis • Paper • Publication, including a summary article of undergraduate thesis with journal format on UI repository. • Internship training report.
4	Be responsible for their own work and can be given responsibility in achieving organization's output	Able to give alternative solution for the problem occurring in environment, society, and nation Possess entrepreneur spirit characterized in innovation and independence based on ethics	• Undergraduate Thesis • Paper • Publication, including a summary article of undergraduate thesis with journal format on UI repository. • Internship training report.

Flow Diagram of Subjects



Course Structure Undergraduate Program in Biomedical Engineering

Code	Subject	SKS
	1st Semester	
UIGE600003	English	2
UIGE600010-15	Religion	2
ENGE600003	Calculus	4
ENGE600009	Basic Chemistry	2
ENGE600007	Physics of Electricity, Magnetism, Optics, and Waves	3
ENGE600008	Physics of Electricity, Magnetism, Optics, and Waves Laboratory	1
ENBE601001	Engineering Biology and Laboratory	3
ENEE602005	Digital System and Laboratory	3
	Sub Total	**20**
	2nd Semester	
UIGE600007	Integrated Characteristic Building Subject	6
ENGE600005	Physics of Mechanics and Heats	3
ENGE600006	Physics of Mechanics and Heats Laboratory	1
ENGE600004	Linear Algebra	4
ENBE602002	Basic Chemistry Laboratory	1
ENBE602003	Engineering Drawing	3
ENBE602004	Introduction to Medical Informatics	3
	Sub Total	**21**
	3rd Semester	
ENBE603005	Engineering Mathematics 1	3
ENBE603006	Statistics and Probablity of Biomedical Engineering	3
ENBE603007	Analog Electronics	3
ENBE603008	Basic of Anatomy and Physiology	3
ENBE603009	Introduction to Biomedical Engineering	3
ENBE603010	Electric Circuit	3
ENBE603011	Analog Electronics Laboratory	1
ENBE603012	Biomedical Engineering Ethics	2
	Sub Total	**21**
	4th Semester	
ENBE604013	Engineering Mathematics 2	4
ENBE604014	Electromagnetics	3
ENBE604015	Introduction to Biomedical Engineering Laboratory	1
ENBE604016	Introduction to Biomedical Instrumentation	3
ENBE604017	Modeling of Medical System	3
ENEE604017	Signals and Systems	3
ENEE603014	Basic Computer and Laboratory	3
	Sub Total	**20**
	5th Semester	
ENBE605018	Medical Imaging Technology	3
ENBE605019	Biomechanics	3
ENBE605020	Biomaterial	3
ENBE605021	Basic to Biomedical Automation System	3
ENEE604020	Numerical Computation	2
	Elective Course	5
	Sub Total	**19**
	6th Semester	
ENBE606022	Medical Signal Processing	3
ENBE606023	Biomedical Sensor Design	3
ENBE606024	RF Medical Devices and Microwave Systems	3
ENBE606025	Biomedical Engineering Project Design 1	2
ENBE606026	Standard and Regulations of Biomedical Engineering	2
	Elective Course	8
	Sub Total	**21**
	7th Semester	
ENBE607027	Biomedical Engineering Project Design 2	3
ENBE607028	Pre-Thesis	2
ENBE607029	Internship	2

	Elective Course	6
	Sub Total	**13**
	th Semester	
ENBE608030	Bachelor Thesis	4
	Elective Course	6
	Sub Total	**10**
	Total	**145**

Electives Subjects for Biomedical Study Program

Code	Subject	SKS
ENBE605031	Medical Communication System	3
ENBE605032	Health, Safety & Environment for Hospital	2
ENBE607033	Biomedical Special Topic 1	3
ENBE607034	Immune Engineering	3
ENBE607035	Basic Thermodynamics	3
ENBE607036	Artificial Intelligent	3
ENBE606037	Biomedical Embedded System	4
ENBE606038	Biomedical Embedded System Laboratory	1
ENBE608039	Biomedical Special Topic 2	3
ENBE608040	Bioinformatics and Genomics	3

Course Sylabus of University Subjects

INTEGRATED CHARACTER BUILDING
UIGE600007/UIGE600007
6 credits

Syllabus :

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

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

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

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

Graduate Learning Outcomes :

- CPL 1: Able to use spoken and written language in Indonesian and English both for academic and non-academic activities (C3, A5)
- CPL 2: Have integrity and are able to think critically, creatively, and innovatively and have

intellectual curiosity to solve problems at the individual and group level (C4, A3)

- CPL 3: Able to provide alternative solutions to various problems that arise in the community, nation, and country (C4, A2)
- CPL 4: Able to take advantage of information communication technology (C3)
- CPL 5: Able to identify various entrepreneurial efforts characterized by innovation and independence based on ethics (C2, A5)

Course Learning Outcomes :

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

Prerequisite : -

ACADEMIC WRITING

UIGE610002
2 credits
The Objectives :

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

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

Main Competencies :

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

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

Prerequisite :

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

ENGLISH

UIGE600003
2 credits
Learning Objectives :

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

Syllabus :

Study Skills : (Becoming an active learner, Vocabulary Building: word formation and using the dictionary Listening strategies Extensive reading) Grammar: (Revision of Basic grammar Types of sentences Adjective clauses, Adverb clauses Noun clauses, Reduced clauses) Reading: (Reading skills: skimming, scanning, main idea, supporting ideas, Note-taking Reading popular science arti-cle, Reading an academic text) Listening: (Listening to short conversations, Listening to a lecture and notetaking,

Listening to a news broadcast, Listening to a short story) Speaking: (Participating in discussions and meetings, Giving a presentation) Writing: (Writing a summary of a short article Describing graphs and tables, Writing an academic paragraph, Writing a basic academic essay (5 paragraphs).

ISLAMIC STUDIES

UIGE6000010/UIGE610005
2 credits
General Instructional Objectives :

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

Learning Objectives :

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

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

Syllabus :

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

CATHOLIC STUDIES

UIGE6000011/UIGE610006
2 credits
General Instructional Objectives :

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

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

Syllabus :

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

CHRISTIAN STUDIES

UIGE6000012/UIGE610007
2 credits
General Instructional Objectives :

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

Learning Objectives :

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

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

Syllabus :

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

HINDU STUDIES

UIGE6000013/UIGE610008
2 credits

Syllabus :

Hindu religion, Hindu history), Source and scope of Hinduism (the Veda as the source of Hindu religion teachings, the scope of the teachings in Hindu religion), The concept of the God (Brahman) according to the Veda, the Path to Brahman (Catur Marga Yoga, Mantra and Japa), Human Nature (The purpose of human life, Human's duties, obligations, and responsibilities both individually or collectively), Ethics and morality (Principles teaching, self-control), in-depth understanding of the scripture (deep understanding of the Bhagawadgita, deep understanding of the Sarasamuschaya), The Role of Hinduism in science, technology, and art (Hinduism benefits in science and technology in accordance with each department, benefit / the role of Hinduism in the arts), Cohesion and community's prosperity / independence (Benefits of unity in the religious plurality, independent community (kerthajagathita) as a common goal, Tri Pitakarana), Culture as an expression of Hindu religious practice, Contribution to the Hindu religion teachings in the political life of nation and country, laws and the enforcement of justice, Awareness of and obeying the Rita / Dharma.

BUDDHIST STUDIES
UIGE6000014/UIGE610009
2 credits

Syllabus :

Almighty God and the God Study (Faith and piety, Divine Philosophy/Theology), Human (Human Nature, Human Dignity, Human Responsibility), Moral (Implementation of Faith and Piety in everyday life), Science, Technology and Art (Faith, Science and Charity as a unity, the Obligation to study and practice what you are taught, Responsibility for nature and environment), harmony between religion (religion is a blessing for all mankind, the essence of the religious plurality and togetherness), community (the role of religious society in creating a prosperous independent society, the responsibility of religious society in the realization of human rights and democracy), Culture (the responsibility of religious society in the realization of critical thinking (academic), work hard and fair), Politics (Religion contribution in the political life of nation and country), Law (Raise awareness to obey and follow God's law, the role of religion in the formulation and enforcement of law, the function of religion in the legal profession).

KONG HU CU STUDY
UIGE6000015/UIGE610010
2 credits

Syllabus of Faculty Subjects

CALCULUS 1
ENGE600001/ENGE610001
3 credits
Course Learning Outcomes:

Able to use the basic concepts of calculus related to -a function of one variable, the derivative and integration of the function of one variable in order to solve its applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, basic engineering, and engineering specialization to be used in solving complex engineering problems.

Syllabus :
Introduction, Functions and Limits, The Derivative, Applications of the Derivative, The Definite Integral, Applications of The Definte Integral, Transcendental Functions, Techniques of Integration, Indeterminate Forms and Improper Integrals.

Prerequisite: None

Textbooks:

Main reference:
D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., Pearson, Prentice Hall, 2007.

Additional eferences:
1. George B. Thomas Jr., Thomas' Calculus Early Transcendental, 12th ed., Addison–Wesley Pearson, 2009.
2. Howard Anton, Calculus, 10th ed., John Wiley and Sons, 2012.

CALCULUS 2
ENGE600002/ENGE610002
3 SKS
Course Learning Outcomes:

Students are able to use the concepts of sequences, series, conic sections, and the basic concepts of calculus which involve the function of two or three variables to solve their applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus: :
Infinite sequences and infinite series, Test for convergence of positive series and alternating series, Power series and operation on operations, Taylor and MacLaurin series, Conic sections , Calculus in polar coordinates, Derivatives, limits, and continuity

of multi-variables functions, Directional derivatives and gradients, Chain Rule, Tangent planes and Approximations, Lagrange multipliers. Double integrals in Cartesian coordinates and polar coordinates, triple integrals in Cartesian coordinates, cylindrical coordinates and spherical coordinates, Applications of double and triple Integral.

Prerequisite: Calculus 1

Textbooks:
1. D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., PEARSON, Prentice Hall, 2007.
2. Thomas, Calculus Thirteenth Edition Volume 2, Erlangga, 2019.

CALCULUS

ENGE600003/ENGE610003
4 SKS
Course Learning Outcomes:

Students are able to use the basic concepts of calculus involving functions of one to three variables to solve their applied problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :

Introduction, Functions and Limits, Derivatives, Derived Applications, Indeterminate Integral, Integral Applications, Infinite Row, and Series. Derivatives with many variables, Duplicate Integral (2 and 3), Duplicate Integral Application.

Prerequisite: None

Textbooks:

Main :
D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., Pearson, Prentice Hall, 2007.

George B. Thomas Jr., Thomas' Calculus Early Transcendental, 12th ed., Addison – Wesley Pearson, 2009.

LINEAR ALGEBRA

ENGE600004/ENGE610004
4 SKS
Course Learning Outcomes:
Students are able to calculate linear system problems to solve engineering problems.

Graduates Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus :

Linear Systems and matrix equations, Determinants, Euclid vector spaces, Common vector spaces, eigenvalues and eigenvectors, inner product spaces, Diagonalization and General Linear Transformation.

Prerequisite: None

Textbooks:
1. Elementary Linear Algebra, Howard Anton & Chris Rorres, 11th edition, 2014
2. Gilbert Strang, Introduction to linear algebra 3rd edition Wellesley Cambridge Press, 2003

MECHANICAL AND HEAT PHYSICS

ENGE600005 / ENGE610005
3 credits
Course Learning Outcomes:

Able to explain the basic concepts of mechanics and thermodynamics, and be able to apply them to understand natural phenomena and human engineering, including their applications.

Graduate Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus:

Units, Magnitudes and Vectors, Motion Along Straight Lines, Motion in Two and Three Dimensions, Newton's Laws of Motion, Applications of Newton's Laws, Kinetic Energy, and Work, Potential Energy and Energy Conservation, Center of Mass, Linear Momentum, Rotation, Rolling Motion, Torque, Angular Momentum, Oscillation, Mechanical and Sound Waves, Gravity, Statics and Elasticity, Fluid Mechanics, Temperature, Heat, Law I Thermodynamics, Ideal Gas and Kinetic Theory of Gas, Heat Engine, Entropy, and Law II Thermodynamics.

Prerequisite: none

Textbooks:
1. Halliday, Resnick, and Walker, Principles of Physics 10th Edition, Wiley, 2014.
2. Serway Jewett, Physics for Scientists and Engineers 9th Edition, Thomson Brooks / Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008

ELECTRICAL MAGNETIC, OPTICAL AND WAVE PHYSICS

ENGE600007 / ENGE610007
3 credits
Course Learning Outcomes:

Students are able to apply the basic concepts of elec-

trical physics, magnetism, waves, and optics to solve problems in the engineering field.

Graduate Learning Outcomes:

Able to apply mathematics, science, and basic engineering and an engineering specialization to be used in solving complex engineering problems.

Syllabus:

Unit, Magnitude, Vector, Electric Charge, Electric Field, Gauss Law, Electric Potential, Capacitance, Electric Current, Resistance, Direct Current, Magnetic Field Due to Electric Current, Magnetic Field Source, Induced GGL, Inductance, Alternating Current, Electromagnetic Waves, Light Properties and Propagation, Optical Geometry.

Prerequisite: none

Textbooks :

1. Halliday, Resnick, and Walker, Principles of Physics 9th Edition, Wiley, 2011.
2. Serway Jewett, Physics for Scientists and Engineers 9th Edition, Thomson Brooks / Cole, 2013.
3. Giancoli, Physics for Scientists and Engineers 4th Edition, Pearson, 2008.

BASIC CHEMISTRY

ENGE600009 / ENGE610009
2 credits
Course Learning Outcomes:
Students are able to analyze the principe of basic chemistry for application in engineering.

Graduates' Learning Outcomes:
Able to apply mathematics, science, and basic engineering to be used in solving complex engineering problems.

Syllabus:

Material and measurements, atoms, molecules and ions, stochiometry, water phase reactions and solution stochiometry, thermochemistry, chemical equilibrium, acid and base equilibrium, electrochemistry, chemical kinetics, and chemical applications.

Prerequisite: none

Textbooks :

1. Ralph H. Petrucci, General Chemistry: Principles and Modern Applications, 8th Ed. Prentice Hall Inc., New York, 2001.
2. John McMurry, Robert C. Fay, Chemistry (3rd ed.), Prentice Hall, 2001.
3. Raymond Chang, Williams College, Chemistry (7th ed.), McGraw-Hill, 2003.

ENGINEERING ECONOMY

ENGE600011 / ENGE610011
3 credits
Course Learning Outcomes:

Students are able to analyze the economic and financial feasibility of making economic practice decisions.

Graduate Learning Outcomes:

Able to apply the principles of technical management and decision making based on economic considerations, in individual and group, as well as in project management.

Syllabus:

Introduction to Engineering Economics, Time Value of Money, Combining Factors, Interest Rates, Money Worth Analysis, Rate of Return Analysis, Effects of Inflation, Benefit Cost & Break-Even Point Analysis, Sensitivity Analysis, Depreciation, Tax Analysis, Cost Estimation & Allocation, Capital Budgeting & Replacement Analysis.

Prerequisite:

1. Civil Engineering : -
2. Environmental Engineering : -
3. Naval Engineering : -
4. Industrial Engineering : must pass the introductory Economic course and have completed 38 credits
5. Chemical Engineering : -
6. Bioprocess Engineering : -

Textbooks:

1. Blank, Leland and Tarquin, Anthony. 2018. Engineering Economy 8th Ed. McGraw Hill.
2. Park, Chan S. 2016. Contemporary Engineering Economics 6th Ed. Pearson. Upper Saddle River.
3. White, Case and Pratt. 2012. Principles of Engineering Economic Analysis 6th ed. John Wiley and Sons.

STATISTICS AND PROBABILISTICS

ENGE600010 / ENGE610010
2 credits
Course Learning Outcomes:

Students are able to handle quantitative data/ information starting from the descriptive stage (collection, organization, and presentation) to the inductive stage, which includes forecasting and drawing conclusions based on the relationship between variables for decision making.

Graduate Learning Outcomes:

1. Apply descriptive statistics and probability theory to data processing and serving
2. Apply probability distribution to data processing and serving

3. Apply the principles of sampling and estimation for decision making
4. Apply hypothesis test samples for decision making

Syllabus:

Introduction to Statistics for Engineering Studies, Probability Theory, Dasar Basic concepts and definitions, Distribution Probability, Sampling, Estimation, Hypothesis testing, Hypothesis test 1 sample at an average value, Regression

Prerequisite: none

Textbooks :
1. Harinaldi, Basic Principles of Statistical Engineering and Science, Erlangga, 2004
2. Montgomery, DC., And Runger, GC., Applied Statistics and Probability for Engineers, John Wiley Sons, 2002

HSE PROTECTION
ENGE600012 / ENGE610012
2 credits
Course Learning Outcomes:

Upon completion of this subject students are expected to be able to carried out hazard identification, and characterization, to propose appropriate methods for risk reduction and mitigation, and to design safety management system. The student is also expected to improve their awareness on industrial safety and health, and understanding on safety regulation framework and standards as well as environmental program.

Graduate Learning Outcomes:
1. Students are expected to understand safety, health and environmental aspect as an integral part of fundamental principal in engineering code of ethics.
2. Students are expected to be able to carry out process of risk assessments by considering risk factors in the impact of hazards on people, facilities, and the surrounding community and environemt.
3. Students are expected to understand the regulatory framework and standard related to the stages of life cycle of machine, building structure, construction, and process.
4. Students are able to design and propose an effective hazard communication, management and engineering control, and risk mitigation through an engineering assignment project.
5. Students are able to identify the knowledge required to perform risk assesment, investigation and design improvement through a multidisiplinary case of incident and accident.

Syllabus:

Introduction to SHE Regulation and Standards, SHE Perception (Risk and Environment), Identification, Assessment and Management, Construction, machinery and Noise hazards, Process safety hazard and analysis technique, Fire and explosion hazard, Electrical hazard, Toxicology in the Workplace, Ergonomy Aspect, Hazard communication to employees, Environmental Protection, Case studies, Safety Health and Environment audits.

Prerequisite: none

Textbooks :
1. Charles A. Wentz, Safety, Health and Environmental Protection, McGraw Hill, 1998.
2. Asfahl, C.R., Rieske, D. W., Sixth Edition Industrial Safety and Health Management, Pearson Education, Inc., 2010.
3. United Kingdom - Health and Safety Executive, http://www.hse.gov.uk/
4. National laws and regulations related to the K3 Management System and the Environment.
5. Related Journal (http://www.journals.elsevier.com/safety-science/) etc, related standards and publications.

Course Syllabus of Biomedical Engineering

ENGINEERING BIOLOGY AND LABORATORY
ENBE601001
3 CREDITS
Learning Outcomes:

After completing this course, students will be able to analyze comprehensive knowledge from engineering biology to biomedical engineering and health sciences.

Topics:

General structure of cells and their functions; the chemical components of cells and the shape and structure of proteins; DNA, chromosomes and genomes; the central dogma of molecular biology (replication, transcription and translation); metabolism (anabolism and catabolism), cell communication; cell division (mitosis and meiosis).

Prerequisites: None

Textbook:
1. Neil A. Campbell, Jane B. Reece, Lisa A. Urry, Michael L.Cain, Steven A. Wasserman, Peter V.Minrosky, Robert B. Jackson. Biology, Eight Edition, 2009.
2. Bruce Albert, Alexander Johnson, Julian Lewis, Martin Raff, Keith Robertsm Peter Walter.

Molecular Biology of The Cell, Fifth Edition, 2008.

BASIC DIGITAL SYSTEM AND LABORATORY

ENEE602005
3 CREDITS
Learning Outcomes:

After completing this course, students are able to design combination circuits and sequential circuits by optimizing the function.

Topics:

Information Representation and Computer Structure, Number System, binary, octal and hexadecimal, Boolean Algebra Formulas, Combinational Logic Circuit, Simplification of Functions, - Karnough map, - NAND-NOR Gate, - X-OR Gate, - Don't Care Condition, Combinational Logic Design, - Combination Circuit, Decoder and Encoder, - Multiplexer, Arithmatic Function and Circuit, - Adder, Half Adder, - Subtractor, Multiplication, - Binary Subtraction Complement, Sequential Circuit, - Analysis Procedure, - Design Procedure, - Seq Circuit Analysis , Sequential Circuit, - Analysis Procedure, - Design Procedure - Seq Circuit Analysis, Register and Counter.

Prerequisites: None

Textbook:
1. Morris R. Mano, Charles R. Kime, Tom Martin, Logic & Computer Design Fundamentals, 5th ed, Prentice Hall, 2015
2. Ronald J. Tocci, Neal S. Widmer, and Gregory L. Moss, Digital Systems: Principles and Applications, 11th Ed., Prentice Hall, 2010
3. Basic Digital Systems Laboratory Module

BASIC CHEMISTRY LABORATORY

ENBE602002
1 CREDIT
Learning Outcomes:

After completing this course, students are able to apply the basic principles of mathematics, chemistry, and physics in solving Biomedical Engineering problems

Topics:

Physical and chemical properties; Separation and purification of the substance; Identification of alkali metal ions, alkaline earth, ammonium, sulfate, iodid, bromide and nitrate; acid-base titration; metal and acid reaction; Water crystals.

Prerequisites: None

Textbook: Basic Chemistry Laboratory Module

ENGINEERING DRAWING

ENBE602003
3 CREDITS
Learning Outcomes:

Students are able to design the principles of biomedical engineering according to health standards and regulations.

Topics:

Illustrations, Basic understanding of geometry, Visualization of geometry (3D), Intersections and openings, Orthogonal projection (2D).

Prerequisites: None

Textbook:
1. ISO 1101, Technical Drawings, International Organization for Standardization.
2. A.W. Boundy, Engineering Drawing, McGraw-Hill Book Company.
3. Colin Simmons & Dennis Maguire, Manual of Engineering Drawing, Edward Arnold.
4. Warren J. Luzadder, Fundamentals of Engineering Drawing, Prentice- Hall, Inc.
5. Giesecke-Mithcell-Spencer-Hill-Dygdon-Novak, Technical Drawing, Prentice Hall Inc.

INTRODUCTION TO MEDICAL INFORMATICS

ENBE602004
3 CREDITS
Learning Outcomes:

After this course, students are expected to:
1. Able to understand the basic concept of information technology for application in the medical field.
2. Able to implement information basic method by combining basic knowledge of programming to acquire, organize, combine, and analyze health data sources.

Topics:

Introduction to Medical Informatics, Controlled Medical Terminology, The Electronic Health Record (EHR), Health Information Systems in Clinical Settings, Health Information Systems in Public Health, Informatics Issues in Virtual Healthcare, Telemedicine, and Expert Systems, Medical Informatics and Clinical Decision Making, Future Technologies, Fundamental Algorithms & Methods of Medical Informatics, Medical Data Resources: Acquisition, Processing, and Classification.

Prerequisites: None

Textbook:
1. Biomedical Informatics: Computer Applications in Health Care and Biomedicine (Health Informatics) 4th ed. 2014 Edition.

2. Method in Medical Informatics: Fundamentals of Healthcare Programming in Perl, Python, and Ruby, Jules Berman, CRC Press 2010.

ENGINEERING MATHEMATICS 1

ENEE603005
3 CREDITS
Learning Outcomes:

After completing this course, students are expected to:

1. Able to identify properties of vector properties and complex changers, as well as their relation to Maxwell's law in the phenomenon of electromagnetic waves.
2. Able to identify the properties of complex changer properties, to solve complex problems in the field of electrical engineering

Topics:

Basic vectors and scalars in the definition of algebra which includes multiplication and subtraction, Differential vectors and their various types such as: Gradient, Divergence and Curl, Vector integrals, which are followed by several Theorems that support Maxwell Equations, including: Divergence Theorem, Stoke's Theorem and Green Theorem, Understanding of complex numbers and their application in various functions, Complex integrations and differentiations, Power Series and Taylor Series in the context of numbers complex.

Prerequisites: Calculus.

Textbook:
1. Advanced Engineering Mathematics, by Edwin Kreyszig, Wiley International Edition, 9th Edition
2. Theory and Problems of Vector Analysis, by Murray R. Spiegel, Schaum's Outline Series, McGraw-Hill Book Company

BIOMEDICAL STATISTIC AND PROBABILITY

ENBE603006
3 CREDITS
Learning Outcomes:

After completing this course, students are able to analyze data and quantitative information, starting from the descriptive stage, which includes collecting, organizing, and presenting data by the scientific method, to the inductive or inferential stage, which includes the process of estimating and drawing conclusions based on available data and relationships between variables.

Topics:

Descriptive statistical methods, probability probability and distribution, discrete probability distribution, continuous probability distribution, estimation theory, hypothesis tests, regression and correlation methods, design and analysis of techniques for epidemiological studies, hypothesis tests: person-time data, Planning Experiments partitioning variation and construction a model, ANOVA, interpretation of analysis: from hypothesis tests to biology, category data, and nonparametric methods.

Prerequisites: None

Textbook:
1. Budiarto, Eko. 2001. Biostatistika Untuk Kedokteran dan Kesehatan Masyarakat. Jakarta: EGC
2. Forthofer R. N., Lee E. S., Hernandez, M. 2007. Biostatistics. A Guide to Design, Analysis, and Discovery 2nd Edition. Elsevier. Academic Press
3. McCleery, R.H., T.A. Watt, T. Hart. 2007. Introduction to Statistics for Biology 3rd Edition. CRC Press
4. Rosner, B. 2015. Fundamentals of Biostatistics 8th Edition. Cengage Learning
5. Walpole, R.E., R.H. Myers, S.L. Myers., K. Ye. 2016. Probability & Statistics for Engineers & Scientists 9th Edition. Pearson

ELECTRONIC ANALOG

ENBE603007
3 CREDITS
Learning Outcomes:

After completing this course, students are able to design a series of analog electronics in the field of biomedical engineering.

Topics:

The material presented in this course includes analog electronics components, such as diodes, bipolar junction transistors (BJT), field effect transistors (FETs), operational-amplifiers (Op-Amp), and filters.

Prerequisites: -

Text Books

1. Robert L. Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson Education, Inc., Uppersaddle River, New Jersey 07458, USA, 2006.
2. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, and Robert G. Meyer, Analysis and Design of Analog Integrated Circuits, John Wiley & Sons, Inc., Singapore, 2003.

BASIC ANATOMY AND PHYSIOLOGY

ENBE603008
3 CREDITS
Learning Outcomes:

After finishing this course, students are able to

correlate various systems in the human body based on their anatomy and physiology.

Topics:

The concept of cells to organ systems, The concept of homeostasis, The concept of the integumentary system, the musculoskeletal system, the nervous system, the endocrine system, the sense system, the cardiovascular system, the immune system, the respiration system, the digestive system, the urinary system, and the reproductive system, Pathophysiological mechanisms of certain diseases.

Prerequisites: None

Textbook:

1. Martini FH, et al. 2014. Fundamentals of Anatomy and Physiology. Pearson Education.
2. Silverthorn, DU. 2016. Human Physiology: An Integrated Approach. Pearson Education.

INTRODUCTION TO BIOMEDICAL TECHNOLOGY

ENBE603009
3 CREDITS
Learning Outcomes:

After finishing this course, students are expected to have the following abilities:

1. Explain the concept of engineering system application to solve human biology problems.
2. Explain the concept of devices for monitoring human physiology signals.
3. Apply the basic principles of engineering to the biomedical field.

Topics:

Basics of biomedical engineering, biomaterials, biomechanics, Medical Instrumentation, Imaging, Biosensors, Bioinformatics, Bioelectric Phenomena.

Prerequisites: None

Textbook:

1. The Biomedical Engineering Handbook, J.D. Bronzino & D.R. Peterson, 4th Ed., CRC Press, 2006.
2. Standard Handbook of Biomedical Engineering and Design, M. Kutz, McGraw-Hill, 2003.
3. The biomedical Engineering Handbook, Biomedical Signals, Imaging and Informatics. J.D. Bronzino & D.R. Peterson,CRC Press, 2014
4. Wang, Biomedical Sensors and Measurements, 2011
5. Ibrahim, K. S., G. Gurusubramanian, Zothansanga, R. P. Yadav, N. S. Kumar, S. K. Pandian, P. Borah, S. Mohan, Bioinformatics – A Student's Companion, Springer 2017

ELECTRICAL CIRCUIT

ENBE603010
3 CREDITS
Learning Outcomes:

After finishing this course, students are expected to be able to design basic electrical circuits for applications in the field of biomedical engineering.

Topics:

Definition and definition of charge, current, voltage, energy and power of passive and active elements; The concept of Kirchoff's law, Ohm's law, Series and Non Reguler circuits, Series of replacements for Thevenin and Norton; Application: Ammeter, Voltmeter and Ohmmeter; The principle of use of node, mesh, supernode, supermesh, and superposition analysis; A circuit with a non-free source; OpAmp basic suite: inverting, non – Inverting, summing, differentiator and integrator; Capacitor, Energy in capacitor, Circuit with capacitor; Inductor, Energy on inductor, Circuit with inductor; DC steady state response; Unsourced RC and RL circuits, Time constants, First-order circuits without sources; RC and RL circuits with DC source, Superposition on first-order circuits; Step unit function, Step input response and pulse; RLC circuit, Second-order equation; Natural response, Forced response, Total response, Step unit response; Properties of sinusoidal waves, Complex sources; Phasor, Law of voltage current for phasor, Impedance and Admittance, Phasor circuit.

Prerequisites: Calculus, Electrical Physics

Textbook:

1. James W. Nilsson, Susan A. Riedel, "Electric Circuits, (Chapter 1-9)", 10th Edition, Pearson, 2015

ELECTRONIC ANALOG LABORATORY

ENBE603011-MB
1 CREDIT
Learning Outcomes:

After finishing this course, students are expected to able:

1. Analyzing simple electronic circuits based on physical phenomena
2. Using hardware and electronic analysis software.

Topics:

Electronic circuit components: diode, BJT, FET, OpAmp; Application of electronic circuits.

Prerequisites: Electrical Circuit

Textbook:

1. Electrical Circuit Laboratory Module
2. Robert Boylestad & Louis Nashelsky, "Electronic Devices And Circuit Theory", Ninth Edition, Prentice Hall, Upper Saddle River, New Jersey Columbus, Ohio, 2006

ETHICS OF BIOMEDICAL TECHNOLOGY

ENBE603012
2 CREDITS
Learning Outcomes:
Students are expected to be able to correlate various aspects with an ethical point of view in accordance with the conditions and regulations that apply when activities in the field of biomedical technology.

Topics:

Definition and ethical principles of biomedical technology (bioethics), Procedures and ethics that must be followed to test research subjects, Ethical dilemmas in biomedical engineering research and the importance of thinking about all sides of the problem, The impact of health technology on society, Some principles of justice related to gender, culture, and ethics in the development of biomedical technology.

Prerequisites: None

Textbook:
1. Ethics, Research Methods and Standards in Biomedical Engineering, Monique Frize, Publisher: Morgan & Claypool, 2011.
2. Biomedical Ethics for Engineers, Daniel A Vallero, Publisher: Elsevier, 2007.

ENGINEERING MATHEMATICS 2

ENBE604013
4 CREDITS
Learning Outcomes:

After finishing this course, students are expected to:

1. Analyzing engineering problems mathematically
2. Implementing mathematical equations in the field of engineering.

Topics:

First-order differential equations, Second-order differential equations, High-order differential equations, Partial differential equations, Fourier series, Laplace transformations.

Prerequisites: Calculus

Textbook:
1. Erwin Kreyszig, "Advanced Engineering Mathematics"9th Edition, Wiley Publisher 2006
2. Glyn James, "Advanced Modern Engineering Mathematics", 2nd Edition, Prentice Hall Publisher 1999

ELECTROMAGNETIC FIELD THEORY

ENBE604014
3 CREDITS
Learning Outcomes:

After finishing this course, students are expected to able to apply the basic principles of mathematics and physics through engineering in accordance with professional ethics.

Topics:

Electrostatics, Magnetostatics, Dynamic Fields, Maxwell Equations, Wave Equations and Plane Waves, Transmission Line, Waveguide, Antenna.

Prerequisites: Engineering Mathematics 1

Textbook:
1. Stuart M. Wentworth, "Fundamentals of Electromagnetics with Engineering Applications," John Wiley, 2005.
2. William H. Hayt and John A. Buck, "Engineering Electromagnetics," McGraw-Hill Companies: 6th Ed. 2001.

INTRODUCTION TO BIOMEDICAL TECHNOLOGY LABORATORY

ENBE604015
1 CREDIT
Learning Outcomes:

After completing this course, students are able to:

1. Conducting experiments on instrumentation related to biomedical engineering (C3)
2. Conducting experiments on software related to biomedical engineering (C3)
3. Conducting experiments related to biosensor (C3).

Topics:

Tensimeter for blood pressure, ECG, USG, Ventilator, Materials characterization, Bioinformatics database, Virtual lab of immunology, and Biosensor.

Prerequisites: Introduction to Biomedical Technology

Textbook:

Biomedical Engineering Laboratory Module

INTRODUCTION TO BIOMEDICAL INSTRUMENTATION

ENBE604016
3 CREDITS
Learning Outcomes:

After finishing this course, students are able to make

a basic design of measurement systems in the field of biomedical technology.

Topics:

Understanding and role of biomedical engineering instrumentation in the medical field, Characteristics of measuring instruments, Errors in measuring physical quantities, Sensors and transducers, Signal condition (filtering and amplification), Signal Acquisition and Processing Data, Biomedical Instrumentation (ECG, EEG, Mobile Health, Wearable Health Devices, Wireless Implanted Medical, Respiratory System Devices), Security systems in instrumentation systems and tools in the field of biomedical technology.

Prerequisites: Calculus, Electrical Physics – Magnetism – Waves and Optics, Electrical Circuits

Textbook:

1. Principle of Biomedical Instrumentation, Andrew G. Webb, Cambridge University Press, 2018
2. Biomedical Instrumentation and Measurement, Leslie Cromwell et al, Prentice Hall.

MODELING OF MEDICAL SYSTEM

ENBE604017
3 CREDITS
Learning Outcomes:

After completing this course, students are able to analyze a system model for certain physiological cases.

Topics:

Physiological complexity, physiological process modeling, systems modeling, data modeling, parametric modeling, parametric model estimation, bioelectric phenomena, introduction to MATLAB Simulink and SymBiology, and simulation case studies.

Prerequisites: Basic Anatomy and Physiology

Textbook:

1. Cobelli C and Carson ER, Introduction to Modeling in Physiology and Medicine. 1st ed. A volume in Biomedical Engineering. 2008
2. Enderle, J. D., Bioelectric Phenomena, Elsevier 2012
3. https://www.mathworks.com/support/learn-with-matlab-tutorials.html

SIGNAL AND SYSTEM

ENEE604017
3 CREDITS
Learning Outcomes:

After completing the lecture, students are expected to:

1. Demonstrates understanding of the concept of linear time invariant (LTI) system characteristics and signal manipulation
2. Analyzing continuous and discrete time LTI systems and their application in the field of Electrical Engineering through the application of transformation analysis and convolution engineering.

Topics:

Definition of signals and systems, Types of signals: continuous, discrete, basic signals, deterministic, and random signals, Types of systems and their characteristics, LTI systems in the time domain, LTI systems in the frequency domain, Signal transformation methods in the Laplace domain (s domain), Signal transformation methods in the Z domain, Methods of filtering digital signals using Matlab software-based FIR and IIR digital filters.

Prerequisites: None

Textbook:

1. Simon Haykin and Barry Van Veen, "Signals and System", 2nd Edition John Wiley & Sons Publisher, 2003

Additional:

2. Dennis Freeman, 2011, Lecture Notes, MIT. Dapat diakses di: https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-003-signals-and-systems-fall-2011/lecture-notes/
3. Dadang Gunawan, Filbert H Juwono, Pengolahan sinyal digital dengan pemrograman Matlab, 2012

BASIC COMPUTER AND LABORATORY

ENEE603014
3 CREDITS
Learning Outcomes:

After completing this course, students are expected to:

1. Able to design simple programming problem solving and implement them into programming languages.
2. Using computer programming software proficiently.

Topics:

Introduction: Computers and the Internet, Introduction: Programming basics and Algorithms, Structured programming, Program Control, Functions, Arrays, Pointers, Structures, Unions, Enumerations.

Prerequisites: None

Textbook:
1. Deitel & Deitel, "C How to Program," 8th Edition, Pearson Education, 2015.
2. Basic Programming Laboratory Module

MEDICAL IMAGING TECHNOLOGY

ENBE605018
3 CREDITS
Learning Outcomes:

After this course, students are expected to:
1. Able to design medical imaging techniques for applications in the health sector.
2. Able to recommend medical image processing techniques for applications in the health sector.

Topics:

Introduction to Medical Imaging Technologies (X-Ray and CT, MRI, Ultrasound, PET and SPECT, Electrical Impedance Tomography), Image formation and Reconstruction (Acquisition, Digitization, Image Reconstruction Methods), Image Enhancement (Fundamentals of enhancement techniques, Image enhancement with linear, nonlinear, fixed, adaptive, and pixel-based methods), Image Segmentation and Analysis (Fundamentals of Medical Image Segmentation, Image preprocessing and acquisition artifacts, Thresholding, Edge-based techniques, Region-based segmentation, Classification, Morphological Methods for Biomedical Image Analysis), Image Visualization (2-dimensional visualization, 3-dimensional visualization methods: surface rendering, volume rendering, Algorithm for 3-D visualization), Image Management (Fundamentals of Standards Compression Storage and Communication, Image archive and retrieval, three-dimensional compression).

Prerequisites: None

Textbook:
1. Joseph D. Bronzino, The Biomedical Engineering Handbook, Third Edition, "Medical Devices and Systems," CRC Press: 2006, Section II.
2. Avinash C. Kak and M. Slaney, "Principle of Computerized Tomographic Imaging," IEEE Press: 1999.
3. Isaac Bankman, "Handbook of Medical Imaging: Processing and Analysis Management," Academic Press: 2000, CA, USA.
4. E. S. Gopi, "Digital Signal Processing for Medical Imaging Using Matlab," Springer:2013, New York.
5. Medical Image Processing, Reconstruction and Restoration: Concepts and Methods, Jirí Jan, CRC Press: Taylor & Francis Group 2006, Boca Raton, FL, USA.

Additional:
6. Handbook of Medical Imaging, Vol. 2: Medical Image Processing and Analysis, M. Sonka & J.M. Fitzpatrick, SPIE Press, 2009, Washington, USA
7. Biomedical Image Processing, Thomas M. Deserno, Springer-Verlag Berlin Heidelberg, 2011
8. Biomedical Signal and Image Processing, Kayvan Najarian and Robert Splinter, CRC Press: Taylor & Francis Group 2012, Boca Raton, FL, USA.

BIOMECHANICS

ENBE605019
3 CREDITS
Learning Outcomes:

After completing this course, students are able to diversify the basic and applied sciences of biomechanics, as well as the application of biomechanics to various biomedical and clinical problems.

Topics:

Basics of mechanics: statics, kinematics, and dynamics. The cultivation of biomechanical technology design capabilities is fostered through biomechanical design materials. Furthermore, the material studied is the biomechanics of cells, tissues and musculoskeletal systems. Not only basic materials, materials discussing the application of biomechanics in the biomedical and clinical world were also studied, which included tissue engineering mechanics and the application of biomechanics to medical rehabilitation, orthopedics, sports, and gait analysis.

Prerequisites: None

Textbook:
1. N. Ozkaya, and M. Nordin, "Fundamental of Biomechanics: Equilibrium, Motion and Deformation", 2nd Ed., Springer, 1998.
2. E. Okuno, and L. Fratin, "Biomechanics of the Human Body", Springer, 2013.

BIOMATERIALS

ENBE605020
3 CREDITS
Learning Outcomes:

At the end of the course, students are expected to be able to:

1. Recommend the right biomaterial for a particular disease
2. Designing Finite Element Analysis (FEA) for Biomaterials.

Topics:

Introduction to biomaterials; physical, chemical, mechanical characterization of the biomaterial; the phenomenon of degradation, protein-adsorbed, and biocompatibility of the biomaterial; fabrication

of biomaterials; application of biomaterials; finite element analysis.

Prerequisites: None

Textbook:
1. Introduction to Biomaterials: Basic Theory with Engineering Applications, C. Mauli Agrawal, Joo L. Ong, Mark R. Appleford, Gopinath Mani, Cambridge Texts in Biomedical Engineering, United Kingdom, 2014.
2. Tissue Engineering second edition, C. A. van Blitterswijk and J. de Boer. Elsevier 2015
3. Adsorbed Protein on Biomaterials, T. A. Horbert, R. A. Latour.

BASIC BIOMEDICAL AUTOMATION SYSTEM

ENBE605021
3 CREDITS
Learning outcomes:

After finishing this course, students are able to:

1. Analyze stability, transient response, and steady-state error in a control system
2. Choose a control system design method according to the control problem
3. Designing a controller on an example of a biomedical system

Topics:

Introduction, discusses the definition of control systems, configurations, main components of the system, theoretical history and examples of control applications; Mathematical models of systems in the biomedical field that can be designed automated control systems and the creation of simulations using MATLAB/Simulink or SCILAB/Xcos; The decline of mathematical models of continuous and discrete linear systems by using linearization methods, Laplace and z transformations; Decrease in the time domain model; Pole-zero, system block diagrams and their simplification; Transient response, stability and steady state error (error in the steady-state condition); Frequency response analysis; The technique of the seat of the roots; Design of PID controllers; Designing controllers and observers with a state space model; Design of controllers for biomedical field applications.

Prerequisites: None

Textbook:
1. Automatic Control Systems in Biomedical Engineering, Springer Verlag, 2018
2. Control Systems Engineering 6th ed, John Wiley & Sons, 2011
3. Feedback Control of Dynamic Systems 7th, Pearson, 2015
4. Control Engineering: MATLAB Exercises, Springer Verlag, 2019
5. Control Theory in Biomedical Engineering: Applications in Physiology and Medical Robotics, Academic Pres, 2020.

NUMERICAL COMPUTATION

ENEE604020
3 CREDITS
Learning Outcomes:

Students are able to complete it both individually and in groups by applying numerical methods with the help of computational tools in a critical, creative, and innovative way of thinking.

Topics:

Introduction to numerical and computational methods, Error analysis in numerical calculations, Excel-based programming, Closed methods for finding the roots of non-linear equations, Open methods for finding the roots of non-linear equations, Direct methods for solving systems of linear equations, Iterative methods for solving systems of linear equations, Methods of iteration of fixed points for solving systems of non-linear equations, Newton and Secant methods for solving systems of equations non-linear, Trapezoidal rule to perform numerical integration, Simpson rule to perform numerical integration, Installation of curves to perform data regression.

Prerequisites: None

Textbook:
1. Chapra, SC dan Canale, Metode Numerik RP untuk Insinyur, Ed 6, McGraw-Hill Education, New York
2. Konstantinides, A. dan Mostoufi, N. Metode Numerik untuk Insinyur Kimia dengan Aplikasi MATLAB, Seri Internasional Prentice Hall, New Jersey
3. Joseph E. Billo, Unggul untuk Ilmuwan dan Insinyur: Metode Numerik, Wiley Interscience, 2007
4. Victor J. Law, Metode Numerik untuk Insinyur Kimia Menggunakan Excel, VBA, dan MATLAB, CRC Press, Taylor&Francis Group, Boca Raton

Additional:
1. Lecture notes (power point files)
2. Screencast of lectures (video files).

MEDICAL SIGNAL PROCESSING

ENBE606022
3 CREDITS
Learning Outcomes:

After completing this course, students are expected to:

1. Able to analyze medical signal processing methods
2. Able to analyze medical image processing methods
3. Able to apply medical signal and image processing methods using MATLAB software
4. Able to use correct Indonesian language in presenting ideas/opinions.

Topics:

Introduction to medical image and signal processing, Fourier transform application, Image Filtering, Enhancement, and Restoration, edge detection and image segmentation, Wavelet transform, artificial neural network recognition, deep learning recognition, basic signal processing EEG, ECG, PET, CT, X -Ray, MRI, Ultrasound and SEM.

Prerequisites: Signal and System

Textbook:
1. Kayvan Najarian and Robert Splinter, "Biomedical Signal and Image Processing, 2nd Ed", Taylor & Francis, 2012
2. E. S. Gopi "Digital Signal Processing for Medical Imaging Using Matlab", Springer, 2013.

DESIGN OF BIOMEDICAL SENSORS

ENBE606023
3 CREDITS
Learning Outcomes:

After completing this course, students will be able to design biosensors for medical applications.

Topics:

The basis of the sensor which includes sensor characteristics, sensor calculation technology, and biocompatibility of the sensor, Physical sensor which includes resistance sensor, inductive sensor, capacitive sensor, piezoelectric sensor, magnetoelectric sensor, photoelectric, and thermoelectric sensor, optical sensor, Chemical sensor includes ion sensor , gas sensors, humidity sensors, sensor arrays, and sensor networks, and biosensors including catalytic biosensors, affinity biosensors, cell and tissue biosensors, biochips, and nano-biosensors.

Prerequisites: None

Textbook:
1. Enderle J., Bronzino J. - Introduction to biomedical engineering-AP (2011).
2. Wang, P. Q. Liu. Biomedical Sensor and Measurement. Springer (2011).

RF MEDICAL SYSTEM DEVICE AND MICROWAVE

ENBE606024
3 CREDITS
Learning Outcomes:
After completing this course, students are expected to design the necessary hardware and software parts in the field of biomedical engineering.

Topics:

Maxwell equation review, review of electromagnetic wave equations in materials, Introduction to microwave engineering, Transmission lines, Waveguide, coaxial, microstrips, Microwave network and impedance matching techniques, Microwave resonators and antennas, Passive device coupler, hybrid and filter, Noise, active components and active device.

Prerequisites: Electromagnetic Field Theory

Textbook:
1. David M. Pozar, "Microwave Engineering," 4th Ed, JohnWiley & Sons, Inc.

Additional:
2. Advanced Design System 2011 Guide, Agilent Technologies, Santa Clara, CA 95052 USA
3. R.J. Weber: "Introduction to Microwave Circuits: Radio Frequency and Design Applications", IEEE Press: 2001

BIOMEDICAL ENGINEERING PROJECT DESIGN 1

ENBE606025
2 CREDITS
Learning outomes:

After completing this course, students are expected to be:

1. Able to formulate problems in the field of engineering that are relevant to real conditions
2. Able to understand and consider realistic boundaries and engineering standards in project planning
3. Able to understand and consider professional ethics in project planning
4. Able to convey project planning effectively in the form of writing (proposal)
5. Able to show the role of creative, innovative and mutual cooperation with each other in project planning.

Topics:

Engineering design concepts, engineering design processes, selection of required objects/devices, selection and decision making, Engineering standards, Realistic boundaries, Socioeconomic impacts, Research Methodology: Problem formulation, Objectives and problem limitations, methodology design and device selection. Project understanding

and project management, organizational structure, function management, leadership in the project environment, cooperative management, investment analysis, control analysis for infrastructure development, cost and wealth allocation, risk management and quality management, work breakdown structure, scheduling, budgeting resources, controlling (S-curve), Engineering Economics (NPV, IRR, BEP), TOR technical proposals, and project proposals.

Prerequisites: None

Textbook:

1. Harvey F. Hoffman, The Engineering Capstone Course : Fundamental for Students and Instructors, Springer, 2014
2. David V. Thiel, Research Methods for Engineers, Cambridge University Press, 2014
3. Code Etik PII – Persatuan Insinyur Indonesia

BIOMEDICAL ENGINEERING STANDARD AND REGULATION

ENBE606026
2 CREDITS
Learning Outcomes:

After completing this course, students are expected to correlate various aspects related to the standards and regulations that apply when activities in the field of biomedical engineering.

Topics:

Introduction to clinical engineering, Management and information systems of Health technology, Standards and regulations related to the clinical environment, Standards and regulations related to the development of medical devices.

Prerequisites: None

Textbook:
1. Dyro JF. 2004. Clinical Engineering Book. Elsevier Academic Press.
2. International Organization for Standardization (ISO). IEC 60601 Series.

BIOMEDICAL ENGINEERING PROJECT DESIGN 2

ENBE607027
3 CREDITS
Learning outcomes:

After completing this course, students are expected to be able to:

1. Formulate problems in the field of engineering that are relevant to real conditions
2. Able to design components, systems or processes to meet the needs of solutions to a problem Engineering within realistic limits, considering aspects, including, law, economy, environment, social, political, health and safety, as well as its sustainability potential
3. Able to deliver project planning effectively in the form of writing (proposals) and demonstrating the achievement of solutions in oral form (presentation)
4. Able to show the role of creative, innovative and mutual cooperation with each other in achieving common goals in project planning and implementation
5. Able to understand and consider professional ethics in project planning and implementation

Topics:

Review & discussion of proposals by ensuring the exact formulation of problems and their solutions, the content of realistic boundaries, engineering standards and socioeconomic impacts, the effectiveness and accuracy of the selection of concepts, components, devices, techniques, and systems used, well-planned project management content, professionalism of team members in carrying out planning, functional testing of supporting systems, implementation of solutions in solving problems, and testing problem solving.

Prerequisite: Biomedical Engineering Project Design 1

Textbook:
1. Harvey F. Hoffman, The Engineering Capstone Course: Fundamental for Students and Instructors, Springer, 2014
2. David V. Thiel, Research Methods for Engineers, Cambridge University Press, 2014
3. Code Etik PII – Persatuan Insinyur Indonesia

Special Subjects

PRE-THESIS

ENBE607028
2 CREDITS
Learning Outcomes:

After finishing this course, students are expected to be able to:

1. Students are able to recognize problems in the field of biomedical engineering and identify the feasibility of solving these problems
2. Students are able to present several possible solutions to the biomedical engineering problems they face supported by good arguments

3. Students are able to recognize the benefits of solving the biomedical engineering problems they face for society, either in the short or long term.

Topics:

Determination of research topics, literature studies, deepening of problem backgrounds, identification and formulation of problems, determination of research objectives, determination of research boundaries and assumptions, formulation of research methodology, formulation of research implementation schedules, writing thesis proposals, seminar.

Prerequisites: Earns more than 114 credits.

Textbook:
1. Day, R. A., & Gastel, B. (n.d.). How to write and publish a scientific paper. Cambridge University Press
2. Gustafsson, B., Hermerén, G., Petersson, B., & Vetenskapsrådet. (2006). Good Research Practice - what is It?: Views, Guidelines and Examples
3. References related to research topics

INTERNSHIP

ENBE607029
2 CREDITS
Learning Outcomes:

In this course, students are be expected to:

1. Able to use spoken and written language well in communication and in practical work reports
2. Able to show a critical, creative, and innovative attitude and respect others in Practical Work
3. Able to qualify good work ethics.

Topics: Adjusted to the assignments given and agreed upon during the implementation of the internship.

Prerequisites:

Earn 90 credits. Internship locations are industries, institutions, and laboratories connected to biomedical engineering with appointed supervisors and person in charge that can guide the students daily. The choice of companies or laboratories will start with an administrative process in the Biomedical Engineering Study Program.

Textbook: Adjusted to the assignments given and agreed upon during the implementation of the internship

UNDERGRADUATE THESIS

ENBE608030
4 CREDITS
Learning Outcomes:

After completing the study, students are expected to be able to:

1. Recommend alternative solutions to the latest biomedical engineering problems by referring to the right research methods.
2. Use spoken and written language well in communication and in thesis book..

Syllabus:

Introduction and research background, Literature study, Research Objectives, Research Design, Procedures for writing a thesis following a predetermined format or guidelines, Chaptering function, indexing images and tables, Styling IEEE references or others, Experimental variables and set up, Statistical analysis tools, Use of Indonesian and good English in thesis and scientific publications, Utilization of online references, Library utilization, Implementation of system design, Data analysis, Conclusion.

Prerequisites: Earns more than 120 credits

Textbook:
1. Keputusan Rektor Universitas Indonesia Nomor 2143/SK/R/UI/2017 tentang Pedoman Teknis Penulisan Tugas Akhir Mahasiswa Universitas Indonesia
2. IEEE Citation Reference.
3. Day, R.A., Gastel, B., (n.d). How to write and publish a scientific paper. Cambridge University Press
4. Gustafsso, B., Hermeren, G., Petersson., B., Vetenskapsardet. (2006). Good Research Practice.

Elective Courses for Biomedical Engineering

MEDICAL COMMUNICATION SYSTEM

ENBE605031
3 CREDITS
Learning Outcomes:
After completing this course, students are expected to be able to:
1. Designing communication systems for applications in the field of health
2. Analyze to solve critically and creatively at the individual and group level in the health sector.

Topics:

Communication system technology for health applications, analyzing the nature of electromagnetic waves and propagation in body-centric wireless communication (BWCS) technology and the effects of electromagnetic compatibility and interference (EMC / EMI), analyzing wearable devices and implant

models for communication as well as the concept of body area network (BAN), telemedicine, e-health, hospital information system (HIS) and wireless power transfer (WPT); and in the end students can design a communication application for the health sector simply through the development of hardware and software.

Prerequisites: None

Textbook:

1. Joseph D. Bronzino, The Biomedical Engineering Handbook, Third Edition, "Medical Devices and Systems," CRC Press: 2006, Section II.
2. Mohamed K. Watfa, "E-Healthcare Systems and Wireless Communications: Current and Future Challenges," Publisher: IGI Global, 2012.
3. P.S. Hall, "Antennas and Propagation for Body Centric Wireless Communications," Publisher: Artech House, 2006.
4. H.W. Ott, "Electromagnetic Compatibility Engineering," John Wiley & Sons, New Jersey, 2009.
5. N. Shinohara, Wireless Power Transfer via Radiowaves, Publisher: John Wiley & Sons, New Jersey, 2014
6. Hebda T. & Czar P. (2013). Handbook of Informatics for Nurses & Healthcare Professionals (5th Edition). Pearson

Additional:

7. M. Kato, Electromagnetics in Biology, Publisher: Springer, Tokyo, 2006.
8. J. Y. Khan, and M. R. Yuce, "Wireless Body Area Network (WBAN) for Medical Applications", in New Developments in Biomedical Engineering. London, United Kingdom
9. Gartee R. (2016).Electronic Health Records (3rd Edition). Pearson.

HEALTH, SAFETY & ENVIRONMENT (HSE) FOR HOSPITAL

ENBE605032
2 CREDITS
Learning Outcomes:
After completing this course, students are expected to:

1. Apply the principles of occupational safety and health in the hospital environment.
2. Express the concept of the application of policies related to occupational safety and health in the health care facility environment.

Syllabus:

Patient safety and the biomedical engineer; Risk management; Patient safety best practices model; Hospital safety program; System approach to medical device safety; Electromagnetic interference in the hospital; Electrical safety in the hospital; Accident investigation; Medical devices Failure modes, accidents and liability

Prerequisites: None

Textbook:

1. Kemenkes RI, Pedoman manajemen Risiko di Fasilitas Pelayanan Kesehatan, 2013.
2. Joseph Dyro (ed.), Clinical Engineering Handbook, Elsevier Academic Press, 2004.
3. Keputusan Menteri Kesehatan Republik Indonesia Nomor: 1087/Menkes/Sk/Viii/2010 Tentang Standar Kesehatan Dan Keselamatan Kerja Di Rumah Sakit
4. Myer Kutz, Biomedical Engineering and Design Handbook (Volume 2: Applications), McGraw Hill, New York, 2nd edition, 2009.
5. Improving Patient safety: Insights from American, Australian and British Healthcare, ECRI Europe, 2012.
6. Elizabeth Mattox, Medical Devices and Patient Safety, AACN Journals Vol. 32, No.4 Agust 2014.

BIOMEDICAL SPECIAL TOPIC 1

ENBE607033
3 CREDITS
Learning Outcomes:

After completion this course, students are expected to be able:

1. To study the latest developments in biomedical engineering including technological, business and regulatory aspects.
2. To reference the latest biomedical engineering developments including technological, business and regulatory aspects.

Topics:

Current issues on aspects of technology, applications, business and regulation in the health sector.

Prerequisites: None

Textbook: None

IMMUNE ENGINEERING

ENBE607034
3 CREDITS
Learning outcomes:

After completing this course, students are able to make basic application concepts in the field of biomedical technology using the principles of immunology.

Topics:

The principles in immunity, includes innate and adaptive immunity; antibody and antigen interaction; hipersensitivity; autoimmune and host defense; vaccine; immune regulation; immune response

against microbiological infection; diagnostic methods of infection; synthetic biology; biomimetic; personalized medicine; in vitro diagnostic.

Prerequisite: Engineering Biology and Laboratory

Textbook:
1. Abbas AK, et al, 2017, Cellular and Molecular Immunology, 9th ed., Elsevier
2. Delves PJ, et al, 2017, Roitt's Essential Immunology, Wiley Blackwell.
3. Silvestre R and Torrado e, 2018, Metabolic Interaction in Infection, Springer.

BASIC THERMODYNAMICS

ENBE607035
3 CREDITS
Learning outcomes:

After completing this course, students are expected to:

1. Apply the laws and basic concepts of thermodynamics, thermodynamic processes, and equations of state.
2. Design thermodynamic systems and information technology needed to achieve competence in the discipline of Biomedical Engineering.

Topics:

Scope and basic understanding of thermodynamics system, temperature concept, pressure, thermodynamics equilibrium, reversible/irreversible process, zero law of thermodynamics and absolute temperature, first law of thermodynamics, second law of thermodynamics, thermodynamics equation, gas power cycle, gas compressor, combustion engine cycle, internal combustion engine, simple gas turbine cycle, brayton's cycle, stirling's cycle, steam power cycle, refrigeration, carnot's cycle, simple rankine's cycle, rankine's cycle with modification, biner cycle, phsycometrich chart, cooling tower, real gas, real gas equation, enthalpy and entrophy.

Prerequisite: Basic Chemistry

Textbook:
1. Moran, Michael J. and Shapiro, Howard N. Fundamentals of Engineering Thermodynamics 5th edition. Danvers: John Wiley & Sons, 2006.
2. Cengel, Yunus A. and Boles, Michael A. Thermodynamic: an Engineering Approach 5th edition. Boston: McGraw-Hill, 2006g.

ARTIFICIAL INTELLIGENCE

ENBE607036
3 CREDITS
Learning outcomes:
At the end of the course, students are expected to:
1. Able to design machine learning-based medical decision support system software
2. Able to evaluate machine learning technology that processes medical information / data
3. Able to use Python programming language to implement machine learrning algorithms

Topics:

Introduction to machine learning and artificial intelligence, Data in machine learning, Regression, Clustering, Classification, Artificial neural networks, Deep Learning, Dimensional reduction with Principal Component Analysis, Designing recognition systems.

Prerequisite:

Engineering Mathematics 2, Biomedical Statistics and Probability, Numeric Computation, Basic Computer and Programming

Textbook:
1. Oliver Theobald, Machine Learning for Absolute Beginners: A Plain English Introduction, Independently published, 2018
2. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2011
3. Joel Gruss, Data Science from Scratch, O'Reilly, 2015
4. Other reading materials: Andrew Ng, Machine Learning, Online Course at Coursera.

BIOMEDICAL EMBEDDED SYSTEM

ENBE606037
4 CREDITS
Learning Outcomes:

After completing this course, students are able to design, program and create complex m-based embedded systems.

Topics:

The 8051 Microcontrollers; 8051 Assembly Language Programming; Jump, Loop, And Call Instructions; I/O Port Programming; 8051 Addressing Modes; Arithmetic, Logic Instructions, And Programs; 8051 Hardware Connection And Intel Hex File; 8051 Timer Programming In Assembly; 8051 Serial Port Programming In Assembly; Interrupts Programming In Assembly; LCD Programming in Assembly; Microcontroller project based on common microcontroller, like Arduino Uno etc.

Prerequisites: Analog Electronics

Textbook:

1. The 8051 Microcontroller and Embedded Systems Using Assembly and C, Second Edition, Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, USA, 2006.
2. Introduction to Embedded Systems Using ANSI

C and the Arduino Development Environment, David J. Russell, Morgan & Claypool Publishers, 2010.

BIOMEDICAL EMBEDDED SYSTEM LABORATORY

ENBE606038
1 CREDITS
Learning Outcomes:

Students have capability to:

1. Design complex microcontroller-based embedded systems
2. Apply modern engineering devices to complex engineering practices.

Topics: Biomedical Embedded System Laboratory.

Prerequisites: Biomedical Embedded System Laboratory.

Textbook:

1. Biomedical Embedded System Laboratory Module

BIOMEDICAL SPECIAL TOPIC 2

ENBE600039
3 CREDITS
Learning Outcomes:

After completion this course, students are expected to be able:

1. To study the latest developments in biomedical engineering including technological, business and regulatory aspects.
2. To reference the latest biomedical engineering developments including technological, business and regulatory aspects.

Syllabus:

Current issues on aspects of technology, applications, business and regulation in the health sector.

Prerequisites: None

Textbook: None

BIOINFORMATICS AND GENOMICS

ENBE600040
3 CREDITS
Learning outcomes:

After completing this course, students are expected to be able to conclude the results of genomic data analysis through the bioinformatics approach (C4).

Topics: Fundamental information of genome along with its database and software; sequencing technology; nucleotide analysis; DNA marker analysis; RNA analysis; wet lab application related to bioinformatics; pathway and GO annotation system; molecular analysis of protein; biological system.

Prerequisite: Engineering Biology and Laboratory.

Textbook:

1. Ibrahim KS, et al, 2017, Bioinformatics-A Student's Companion. Springer. Singapore.
2. Keith JM. 2017. Bioinformatics Volume II: Structure, Function, and Application. Humana Press. New York.
3. Li X, et al. 2018. Non-Coding RNAs in complex diseases. Springer. Singapore.

MEDICAL THERAPY TECHNOLOGY

ENBE600041
3 CREDITS
Learning Outcomes:

After completing this course, students are expected to be able to:

1. Able to correlate various aspects related to problems in oncology cases related to human physiological conditions.
2. Able to connect oncology case studies with treatment methods that are in accordance with health standards and regulations.

Topics:

Introduction to the basic principles of oncology, Oncology case approach with precision medicine, Handling oncology cases with radiation therapy, Handling oncology cases with thermal therapy, Handling oncology cases with immunotherapy.

Prerequisites: None

Textbook:

1. Symonds P, Mills J, Duxbury A. Walter and Miller's Textbook of Radiotherapy: Radiation Physics, Therapy and Oncology. 8th ed: Elsevier; 2019.
2. Moros E. Physics of Thermal Therapy: Fundamentals and Clinical Applications. 1st ed: CRC/Taylor & Francis; 2013.
3. Cooper LJN, Mittendorf EA, Moyes J, Prabhakaran S. Immunotherapy in Translational Cancer Research. 1st ed: Wiley-Blackwell; 2018.

Transition Rules

1. The 2020 curriculum is implemented starting from the Odd Semester of 2020/2021. In principle, after the 2020 Curriculum is implemented, only the subjects in the 2020 Curriculum will be opened.
2. The class of 2019 and previously followed the 2020 curriculum with transition rules.
3. A transition period of 1 year is applied, namely

in the 2020/2021 academic year for subjects that have changed the location of the organizing semester (from Even to Odd, or vice versa), if necessary, will be opened in both semesters during the transition period (Academic Year 2020/2021).

4. For students who have not passed the compulsory course in the 2018 Curriculum, they are required to take the same or equivalent course in the 2020 Curriculum. (The 2018 Curriculum subject, which is not listed in the Equality Table, means that it has not changed, both the name and the size of the credits.)
5. If there is a change in the credits of the subjects, then the number of credits that are taken into account in graduation is the number of credits at the time the course is taken. The same or equivalent subjects with different credit weights, if repeated or just taken, will be listed with a new name and calculated with the weight of the new credits.
6. If the compulsory subjects in the 2018 Curriculum are removed and there is no equality in the 2020 Curriculum, then for students who have passed the subject, it is still counted as compulsory course credits in the calculation of graduation of 144 credits. For students who have not passed the course, they can take a new compulsory course or elective course in the 2020 Curriculum to complete 144 credits.
7. Lack of credits due to differences in the weight of credits, can be obtained from elective courses.

CHAPTER 5

MASTER PROGRAM

Master Program in Electrical Engineering

Program Specification

1.	**Awarding Institution**	Universitas Indonesia	
2.	**Teaching Institution**	Universitas Indonesia	
3.	**Faculty**	Engineering	
4.	**Programme Title**	Master Program in Electrical Engineering	
5.	**Study Programme Vision and Mission**	**Vision** To become an institution which can give solutions to both national and global problems and challenges as well as being independent and excellent in South-East Asia **Mission** a. Organizing education based on good university governance concept in order to produce graduates who are knowledgeable, international minded, and have entrepreneurship skills b. Increasing facility, research funding, and participation in applied research and new findings which can give solutions to national and global problems c. Applying science and appropriate technology to support community services based on people and industrial needs	
6.	**Class**	Reguler, Special, Research	
7.	**Final Award**	Magister Teknik (MT.)	
8.	**Accreditation / Recognition**	BAN-PT: A- accredited	
9.	**Language (s) of Instruction**	Bahasa Indonesia dan English (for International class)	
10.	**Study Scheme (Full Time / Part-Time)**	Full Time	
11.	**Entry Requirements**	Pass the entrance exam, and pass S1/d IV from electrical engineering study program, mechanical engineering, computer science, informatic engineering, mathematic, physics, and equivalent program	
12.	**Study Duration**	Designed for 2 years	
	Type of Semester	Number of semester	Number of weeks/semesters
	Reguler	4	16
	Short (opsional)	**1**	**8**
13.	**Aims of the programme:** "Producing master in electrical engineering graduates who can analyse problems, give solutions logically, systematically and practically supported by the use of appropriate method. The graduates also are wished to design and develop both software and hardware, and always being up-to-date to the development of technology"		
14.	**Profile of Graduates:** Magister of engineering who is able to analyze and design in-depth on products, process and technology system in complex electrical engineering based on professional ethics in contributing to sustainable development goals		

15. Expected Learning Outcomes (ELO) :

General Outcomes :

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

Majoring in Power and Smart System

1. Able to specify technical and non-technical aspects in the formulation and utilization of the intelligent network-based electricity industry.
2. Able to recommend strategies to improve efficiency, quality, and power quality in electricity systems based on intelligent networks.
3. Able to integrate new and renewable energy power plants with smart electricity grid systems.
4. Able to assess strategies and risk mitigation in the development of power systems that are reliable, safe, and environmentally friendly.

Majoring in Telecommunication and Smart Wireless System

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

Majoring in Electronic and Intelligent Embedded System

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

Majoring in Cyber Security and Future Internet

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

Majoring in Automation and Data Analytic Engineering

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

Majoring in Data Engineering and Business Intelligence

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

Majoring in Telecommunication Management

1. Able to develop policy recommendation and industrial telecommunication strategy and ICT that support the digital economy
2. Able to develop innovative and visionary traits in the telecommunications and ICT industries in the digital economy era
3. Able to evaluate technical aspects that support the telecommunications and ICT business infrastructure in the industrial era 4.0 and digital economy era

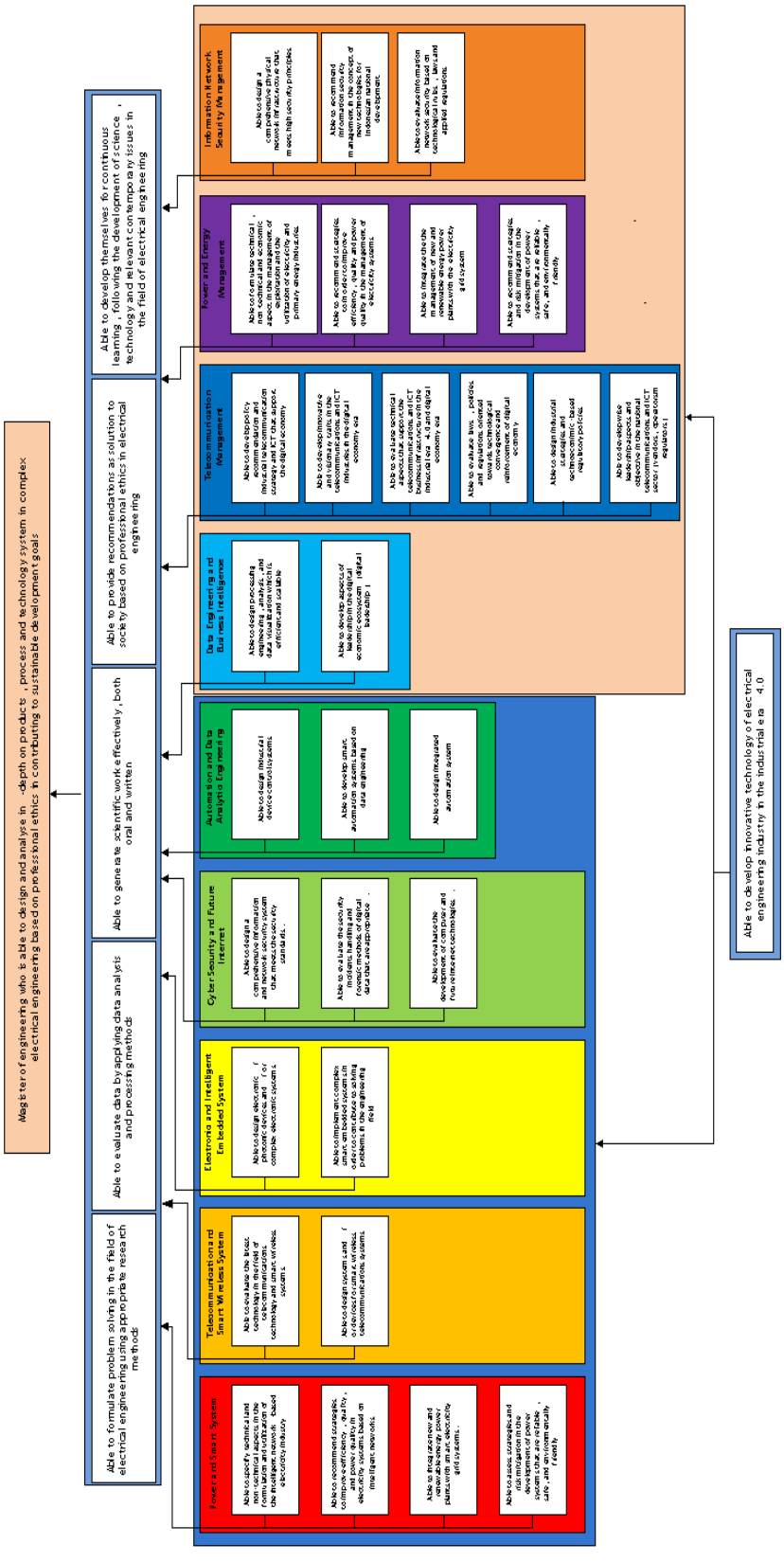
	4. Able to evaluate information network security based on technological rules, laws and applied regulations 5. Able to design industrial strategies and technoeconimic-based regulatory policies 6. Able to develop wise leadership aspects and objective in the national telecommunications and ICT sector (vendors, operatorsm regulators) Majoring in Power and Energy Management 1. Able to formulate technical, non-technical and economic aspect in the management of exploitation and the utilization of electricity and primary energy industries 2. Able to recommend strategies to in order to improve efficiency, quality and power quality in the management of electricity systems 3. Able to integrate the the management of new and renewable energy power plants with the electricity grid system 4. Able to recommend strategies and risk mitigation in the development of power systems that are reliable, safe, and environmentally friendly. Majoring in Information Network Security Management 1. Able to design a comprehensive physical network infrastructure that meets high security principles 2. Able to recommend information security management in the concept of new technologies for Indonesian national development

16.	**Composition of Subjects**		
No.	**Classification**	**Credit Hours (SKS)**	**Percentage**
i	**Core Subjects**	**21**	**47,7%**
ii	**Majoring Course**	**19**	**43,2%**
iii	**Optional Course**	**4**	**9,1%**
	Total	**44**	**100 %**
	Total Credit Hours to Graduate		**44 SKS**

Career Prospects

The graduates of this program have been employed in various industrial companies such as power engineering, IT, electronic, oil & gas, telecommunication and other related inductries. Some of graduates who have been employed before have opportunity to get promotion of career path to a higher level. Some occupation or job titles that are suitable for this program are electrical engineer, software engineer telecommunication engineer, process engineer, control engineer, instrumentation engineer, program manager, project manager, technical manager, regulator, professional lecturers and researchers.

Learning Outcomes Flow Diagram



FLOW DIAGRAM OF SUBJECTS

No.	Learning Outcomes	Semester 1	Semester 2	Semester 3	Semester 4
1	Able to evaluate data by applying data analysis and processing methods	Processing and data analysis			
2	Able to formulate problem solving in the field of electrical engineering with appropriate research methods	Research methodology			
3	Able to develop innovative capabilities in the electrical engineering industry in the industrial era 4.0			Entrepreneurship and Technology Innovation	
4	Able to produce scientific works effectively, both oral and written				Thesis Scientific Publications
5	Able to provide solutions to the community based on the professional ethics in the electrical engineering field				Thesis Scientific Publications
6	Able to improve self-development skill to study continuously, keep update with the latest developments in science, technology and relevant contemporary issues in the field of electrical engineering				Scientific Publications
7	Able to specify technical and non-technical aspects in the utilization of the intelligent network-based electricity industry	Electric Generation Operation and Control Electric Power and Environment	Dynamic Systems and Modeling Advanced Power Electronics Economics Energy and management		
8	Able to recommend strategies to improve efficiency, quality, and power quality in electricity systems based on intelligent networks	Electrical power system quality			
9	Able to integrate new and renewable energy power plants with smart electricity grid systems		Renewable energy and energy storage	Smart Energy System	
10	Able to assess strategies and risk mitigation on the development of power systems that are reliable, safe, and eco-friendly			Power System Planning	

MAJORING IN TELECOMMUNICATION AND SMART WIRELESS SYSTEM

No.	Learning Outcomes	Semester 1	Semester 2	Semester 3	Semester 4
1	Able to evaluate data by applying data analysis and processing methods	Processing and data analysis			
2	Able to formulate problem solving in the field of electrical engineering with appropriate research methods	Research methodology			
3	Able to develop innovative capabilities in the electrical engineering industry in the industrial era 4.0			Technological Innovation and Entrepreneurship	
4	Able to produce scientific works effectively, both oral and written				Thesis Scientific Publications
5	Able to provide solutions to the community in accordance with professional ethics in the electrical engineering field				Thesis Scientific Publications
6	Able to improve self-development skill to study continuously, keep update with the latest developments in science, technology and relevant contemporary issues in the field of electrical engineering				Scientific Publications
7	Able to evaluate the latest technology in the field of telecommunications technology and smart wireless systems	Signal Processing and Applications Modern Telecommunications System Modern Radar System	Terahertz and optic Systems	Technological quality of services and experience Computational Intelligence for communication engineering	
8	Able to design systems and / or devices for smart wireless telecommunications systems		Sensor Communication System smart RF design Modern Antenna Techniques		

MAJORING IN ELECTRONIC AND INTELLIGENT EMBEDDED SYSTEM

No.	Learning Outcomes	Semester 1	Semester 2	Semester 3	Semester 4
1	Able to evaluate data by applying data analysis and processing methods	Processing and data analysis			
2	Able to formulate problem solving in the field of electrical engineering with appropriate research methods	Research methodology			
3	Able to develop innovative capabilities in the electrical engineering industry in the industrial era 4.0			Technological Innovation and Entrepreneurship	
4	Able to produce scientific works effectively, both oral and written				Thesis Scientific Publications
5	Able to provide solutions to the community in accordance with professional ethics in the electrical engineering field				Thesis Scientific Publications
6	Able to improve self-development skill to study continuously, keep update with the latest developments in science, technology and relevant contemporary issues in the field of electrical engineering				Scientific Publications
6	Able to design electronic / photonic devices and / or complex electronic systems	Digital Microelectronic circuit design photonic device Green electronic devices	Nanoelectronic Sensor dan Actuator Advanced analog electronic circuits Opto-electronics instrumentation		
7	Able to implement complex smart embedded systems to contribute to solving problems in the engineering field			IoT and smart Electronic system System on Chip	

MAJORING IN CYBER SECURITY AND FUTURE INTERNET

No.	Learning Outcomes	Semester 1	Semester 2	Semester 3	Semester 4
1	Able to evaluate data by applying data analysis and processing methods	Processing and data analysis			
2	Able to formulate problem solving in the field of electrical engineering with appropriate research methods	Research methodology			
3	Able to develop innovative capabilities in the electrical engineering industry in the industrial era 4.0			Technological Innovation and Entrepreneurship	
4	Able to produce scientific works effectively, both oral and written				Thesis Scientific Publications
5	Able to provide solutions to the community in accordance with professional ethics in the field of electrical engineering				Thesis Scientific Publications
6	Able to develop own-self through lifelong learning, keep updated with the latest advancement in science, technology and relevant contemporary issues in the field of electrical engineering				Scientific Publications
7	Able to design a comprehensive information and network security system that meets the applicable security standard rules.	Network security and reliability Network security and data protection	Applied Cryptography and Blockchain Technology		
8	Able to evaluate the security incidents handling and forensic methods of digital data that are appropriate.		Security operation and Incident Handling Network and Digital Forensics	Security Risk Assesment and Analysis	
9	Able to evaluate the development of computer and future Internet technologies.	Advanced network computer systems	Convergence Information Network NG	Cyber Threat Intelligence and Incident Analysis	

MAJORING IN AUTOMATION AND DATA ANALYTIC ENGINEERING

No.	Learning Outcomes	Semester 1	Semester 2	Semester 3	Semester 4
1	Able to evaluate data by applying data analysis and processing methods	Processing and data analysis			
2	Able to formulate problem solving in the field of electrical engineering with appropriate research methods	Research methodology			
3	Able to develop innovative capabilities in the electrical engineering industry in the industrial era 4.0			Technological Innovation and Entrepreneurship	
4	Able to produce scientific works effectively, both oral and written				Thesis Scientific Publications
5	Able to provide solutions to the community based on the professional ethics in the electrical engineering field				Thesis Scientific Publications
6	Able to improve self-development skill to study continuously, keep update with the latest developments in science, technology and relevant contemporary issues in the field of electrical engineering				Scientific Publications
7	Able to recommend industrial device control systems	Industrial Electric Drive System Mechatronicsystem modeling and control			
8	Able to develop smart automation systems based on data engineering		Advanced smart data computation smart system monitoring and data engineering	Advanced Machine Learning for the Autonomous System	
9	Able to design an integrated automation system	System optimization and optimal control	Coordinated and networked control system special topics on automation data engineering	Industrial Cyber Automation and Security	

MAJORING IN DATA ENGINEERING AND BUSINESS INTELLIGENCE

No.	Learning Outcomes	Semester 1	Semester 2	Semester 3	Semester 4
1	Able to evaluate data by applying data analysis and processing methods	Processing and data analysis			
2	Able to formulate problem solving in the field of electrical engineering with appropriate research methods	Research methodology			
3	Able to develop innovative capabilities in the electrical engineering industry in the industrial era 4.0			Technological Innovation and Entrepreneurship	
4	Able to produce scientific works effectively, both oral and written				Thesis Scientific Publications
5	Able to provide solutions to the community based on the professional ethics in the electrical engineering field				Thesis Scientific Publications
6	Able to improve self-development skill to study continuously, keep update with the latest developments in science, technology and relevant contemporary issues in the field of electrical engineering				Scientific Publications
7	Able to design efficient, scalable data processing, analysis and visualization techniques	Business analytic and visualization Imaging Technology and Computer Vision	Big Data Technology and Architechture Advanced Artificial Intelligence Applied Data Engineering	Enterprise Cyber Threat Analysis	
8	Able to develop aspects of leadership in the digital economic ecosystem (digital leadership)	Digital Enterprise Software Architechture	Ethics and Professionalism	Advanced IT Project Management	

MAJORING IN TELECOMMUNICATION MANAGEMENT

No.	Learning Outcomes	Semester 1	Semester 2	Semester 3	Semester 4
1	Able to evaluate data by applying data analysis and processing methods	Processing and data analysis			
2	Able to formulate problem solving in the field of electrical engineering with appropriate research methods	Research methodology			
3	Able to develop innovative capabilities in the electrical engineering industry in the industrial era 4.0			Technological Innovation and Entrepreneurship	
4	Able to produce scientific works effectively, both oral and written				Thesis Scientific Publications
5	Able to provide solutions to the community in accordance with professional ethics in the electrical engineering field				Thesis Scientific Publications
6	Able to improve self-development skill to study continuously, keep update with the latest developments in science, technology and relevant contemporary issues in the field of electrical engineering				Scientific Publications
7	Able to evaluate the latest technology in the field of telecommunications technology and smart wireless systems	Signal Processing and Applications Modern Telecommunications System Modern Radar System	Terahertz and optic Systems	Technological quality of services and experience Computational Intelligence for communication engineering	
8	Able to design systems and / or devices for smart wireless telecommunications systems		Sensor Communication System smart RF design Modern Antenna Techniques		

MAJORING IN POWER AND ENERGY MANAGEMENT

No.	Learning Outcomes	Semester 1	Semester 2	Semester 3	Semester 4
1	Able to evaluate data by applying data analysis and processing methods	Processing and data analysis			
2	Able to formulate problem solving in the field of electrical engineering with appropriate research methods	Research methodology			
3	Able to develop innovative capabilities in the electrical engineering industry in the industrial era 4.0			Technological Innovation and Entrepreneurship	
4	Able to produce scientific works effectively, both oral and written				Thesis Scientific Publications
5	Able to provide solutions to the community in accordance with professional ethics in the electrical engineering field				Thesis Scientific Publications
6	Able to improve self-development skill to study continuously, keep update with the latest developments in science, technology and relevant contemporary issues in the field of electrical engineering				Scientific Publications
7	Able to formulate technical, non-technical, management and economic aspects in the business, utilization and electricity industry including energy issues	Economic of Electric Utility Power Generation Control and Operation of Power Generation Plant	Dynamic system and modeling Strategic management Economics Energy and Management	Energy and Environment	
7	Able to recommend strategies to improve efficiency, quality and power quality in the electricity system			Electric power system planning	
8	Able to integrate new and Renewable Energy power plants with the electricity grid system			Electric Power System Planning	
9	Able to recommend strategies and risk mitigation in the development of power systems and energy that is reliable, safe and eco-friendly		Strategic management		

MAJORING IN INFORMATION NETWORK SECURITY MANAGEMENT

No.	Learning Outcomes	Semester 1	Semester 2	Semester 3	Semester 4
1	Able to evaluate data by applying data analysis and processing methods	Processing and data analysis			
2	Able to formulate problem solving in the field of electrical engineering with appropriate research methods	Research methodology			
3	Able to develop innovative capabilities in the electrical engineering industry in the industrial era 4.0			Technological Innovation and Entrepreneurship	
4	Able to produce scientific works effectively, both oral and written				Thesis Scientific Publications
5	Able to provide solutions to the community in accordance with professional ethics in the electrical engineering field				Thesis Scientific Publications
6	Able to improve self-development skill to study continuously, keep update with the latest developments in science, technology and relevant contemporary issues in the field of electrical engineering				Scientific Publications
7	Able to design a comprehensive physical network infrastructure that meets high security principles	Information Network Infrastructure Computer Based Network Simulation Information Network Security			
7	Able to recommend information security management on the concept of new technologies for national development in Indonesia		Cyber Forensics Network and Application Security		
8	Able to evaluate information network security based on technological rules, laws and applicable regulations		Operations Security and Incident Management Security Assessment and Analysis	Security Risk Management and Regulation Cyber Threat Intelligence Analysis	

Core Subjects

Code	Subject	SKS
ENEE801001	Data Processing and Analytic	4
ENEE801002	Research Methodology	4
ENEE803003	Technology Innovation and Entrepreneurship	3

Majoring Course

Code	Subject	SKS
Majoring in Power and Smart System		
ENEE801101	Electric Generation Operation and Control	2
ENEE801102	Electric Power System Quality	2
ENEE801103	Electric Power and Environment	2
ENEE802104	Dynamic System and Modeling	2
ENEE802105	Economics Energy and Management	3
ENEE802106	Advanced Power Electronics	2
ENEE802107	Renewable Energy and Energy Storages	2
ENEE803108	Power System Planning	2
ENEE803109	Smart Energy System	2
Majoring in Telecommunication and Smart Wireless System		
ENEE801201	Signal Processing and applications	3
ENEE801202	Modern Telecommunication System	2
ENEE801203	Modern Radar System	2
ENEE802204	Modern Antenna Engineering	2
ENEE802205	Smart RF Design	2
ENEE802206	Terahertz and Optics System	2
ENEE802207	Sensor Communications System	2
ENEE803208	Technological Quality of Service and Experience	2
ENEE803209	Computational Intelligence for Communication Engineering	2
Majoring in Electronic and Intelligent Embedded System		
ENEE801301	Photonic Device	2
ENEE801302	Green Electronic Devices	2
ENEE801303	Digital Microelectronic Circuit Design	2
ENEE802304	Sensor and Actuators	2
ENEE802305	Nanoelectronic	2
ENEE802306	Advanced Analog Electronic Circuits	2
ENEE802307	Opto-Electronics Instrumentation	2
ENEE803308	System on Chip	2
ENEE803309	IoT and Smart Electronic System	3
Majoring in Cyber Security and Future Internet		
ENEE801401	Network Security and Reliability	2
ENEE801402	Advanced Network Computer Systems	2
ENEE801403	Network Security and Data Protection	2
ENEE802404	Applied Cryptography & Blockchain Technology	3
ENEE802405	Security Operation and Incident Handling	2
ENEE802406	Network & Digital Forensics	2
ENEE802407	Convergence Information Network NG	2
ENEE803408	Cyber Threat Intelligence and Incident Analysis	2
ENEE803409	Security Risk Assessment and Analysis	2
Majoring in Automation and Data Analytic Engineering		
ENEE801501	Mechatronic System Modeling and Control	2
ENEE801502	Industrial Electric Drive System	2

ENEE801503	System Optimization and Optimal Control	2
ENEE802504	Advanced Smart Data Computation	2
ENEE802505	Smart System Monitoring and Data Engineering	2
ENEE802506	Coordinated and Networked Control System	2
ENEE802507	Special Topics on Automation and Data Engineering	2
ENEE803508	Industrial Automation System and Security	3
ENEE803509	Advanced Machine Learning for Autonomous System	2
Majoring in Data Engineering and Business Intelligence		
ENEE801601	Digital Enterprise Software Architecture	2
ENEE801602	Business Analytic and Visualization	2
ENEE801603	Imaging Technology and Computer Vision	2
ENEE802604	Big Data Technology and Architecture	3
ENEE802605	Advanced Artificial Intelligence	2
ENEE802606	Applied Data Engineering	2
ENEE802607	Ethics and Professionalism	2
ENEE803608	Enterprise Cyber Threat Analysis	2
ENEE803609	Advanced IT Project Management	2
Majoring in Telecommunication Management		
ENEE801701	Management of Telecommunications System and Digital Business	3
ENEE801702	Trend of Digital Technology	3
ENEE802703	Law, Regulation and Telecommunications Policy	3
ENEE802704	Strategic Management and Technoeconomic	3
ENEE802705	Telecommunications Convergence Service and Infrastructure	2
ENEE802706	Ecosystem and Digital Economic	2
ENEE802707	Special Topic of Technology and Innovation	2
ENEE803708	Internet of Things (IoT) and Future Network Technology	3
ENEE803709	Capita Selecta	2
Majoring in Power and Energy Management		
ENEE801801	Control and Operation of Power Generation Plant	3
ENEE801802	Economic of Electric Utility Power Generation	3
ENEE802803	Dynamic Systems and Modeling	3
ENEE802804	Economics Energy and Management	3
ENEE802805	Strategic Managemen	3
ENEE803806	Electrical Power System Quality	2
ENEE803807	Electric Power System Planning	3
ENEE803808	Energy and Environment	3
Majoring in Information Network Security Management		
ENEE802901	Information Network Security	2
ENEE802902	Information Network Infrastructure	2
ENEE802903	Computer Based Network Simulation	2
ENEE803904	Network and Application Security	3

Special Subjects

Code	Subject	SKS
ENEE804004	Publication	2
ENEE804005	Thesis	8

Course Structure Master Program in Electrical Engineering

Majoring in Power and Smart System

Code	Subject	SKS
	1st Semester	
ENEE801001	Data Processing and Analytic	4
ENEE801002	Research Methodology	4
ENEE801101	Electric Generation Operation and Control	2
ENEE801102	Electric Power System Quality	2
ENEE801103	Electric Power and Environment	2
	Sub Total	**14**
	2nd Semester	
ENEE802104	Dynamic System and Modeling	2
ENEE802105	Economics Energy and Management	3
ENEE802106	Advanced Power Electronics	2
ENEE802107	Renewable Energy and Energy Storages	2
	Elective Course	2
	Sub Total	**11**
	3rd Semester	
ENEE803003	Technology Innovation and Entrepreneurship	3
ENEE803108	Power System Planning	2
ENEE803109	Smart Energy System	2
	Elective Course	2
	Sub Total	**9**
	4th Semester	
ENEE804004	Thesis	8
ENEE804005	Scientific Publication	2
	Subtotal	**10**
	Total	**44**

Majoring in Telecommunication and Smart Wireless System

Code	Subject	SKS
	1st Semester	
ENEE801001	Data Processing and Analytic	4
ENEE801002	Research Methodology	4
ENEE801201	Signal Processing and applications	3
ENEE801202	Modern Telecommunication System	2
ENEE801203	Modern Radar System	2
	Sub Total	**15**
	2nd Semester	
ENEE802204	Modern Antenna Engineering	2
ENEE802205	Smart RF Design	2
ENEE802206	Terahertz and Optics System	2
ENEE802207	Sensor Communications System	2
	Elective Course	**2**
	Sub Total	**10**
	3rd Semester	
ENEE803003	Technology Innovation and Entrepreneurship	3
ENEE803208	Technological Quality of Service and Experience	2
ENEE803209	Computational Intelligence for Communication Engineering	2
	Elective Course	**2**
	Sub Total	**9**
	4th Semester	
ENEE804004	Thesis	8
ENEE804005	Scientific Publication	2
	Sub Total	**10**
	Total	**44**

Majoring in Electronic and Intelligent Embedded System

Code	Subject	SKS
	1st Semester	
ENEE801001	Data Processing and Analytic	4
ENEE801002	Research Methodology	4
ENEE801301	Photonic Device	2
ENEE801302	Green Electronic Devices	2
ENEE801303	Digital Microelectronic Circuit Design	2
	Sub Total	**14**
	2nd Semester	
ENEE802304	Sensor and Actuators	2
ENEE802305	Nanoelectronic	2
ENEE802306	Advanced Analog Electronic Circuits	2
ENEE802307	Opto-Electronics Instru-mentation	2
	Elective Course	2
	Sub Total	**10**
	3rd Semester	
ENEE803003	Technology Innovation and Entrepreneurship	3
ENEE803308	System on Chip	2
ENEE803309	IoT and Smart Electronic System	3
	Elective Course	2
	Sub Total	**10**
	4th Semester	
ENEE804004	Thesis	8
ENEE804005	Scientific Publication	2
	Sub Total	**10**
	Total	**44**

Majoring in Cyber Security and Future Internet

Code	Subject	SKS
	1st Semester	
ENEE801001	Data Processing and Analytic	4
ENEE801002	Research Methodology	4
ENEE801401	Network Security and Reliability	2
ENEE801402	Advanced Network Computer Systems	2
ENEE801403	Network Security and Data Protection	2
	Sub Total	**14**
	2nd Semester	
ENEE802404	Applied Cryptography & Blockchain Technology	3
ENEE802405	Security Operation and Incident Handling	2
ENEE802406	Network & Digital Forensics	2
ENEE802407	Convergence Information Network NG	2
	Elective Course	2
	Sub Total	**11**
	3rd Semester	
ENEE803003	Technology Innovation and Entrepreneurship	3
ENEE803408	Cyber Threat Intelligence and Incident Analysis	2
ENEE803409	Security Risk Assessment and Analysis	2
	Elective Course	2
	Sub Total	**9**
	4th Semester	
ENEE804004	Thesis	8
ENEE804005	Scientific Publication	2
	Sub Total	**10**
	Total	**44**

Majoring in Automation and Data Analytic Engineering

Code	Subject	SKS
	1st Semester	
ENEE801001	Data Processing and Analytic	4
ENEE801002	Research Methodology	4
ENEE801501	Mechatronic System Modeling and Control	2
ENEE801502	Industrial Electric Drive System	2

ENEE801503	System Optimization and Optimal Control	2
	Sub Total	**14**
	2nd Semester	
ENEE802504	Advanced Smart Data Computation	2
ENEE802505	Smart System Monitoring and Data Engineering	2
ENEE802506	Coordinated and Networked Control System	2
ENEE802507	Special Topics on Automation and Data Engineering	2
	Elective Course	2
	Sub Total	**10**
	3rd Semester	
ENEE803003	Technology Innovation and Entrepreneurship	3
ENEE803508	Industrial Automation System and Security	3
ENEE803509	Advanced Machine Learning for Autonomous System	2
	Elective Course	2
	Sub Total	**10**
	4th Semester	
ENEE804004	Thesis	8
ENEE804005	Scientific Publication	2
	Subtotal	**10**
	Total	**44**

Curriculum of Electrical Engineering Department Special Class in Salemba

Code	Subject	SKS
	1st Semester	
ENEE801002	Data Processing and Analytic	4
ENEE801003	Research Methodology	4
ENEE801601	Digital Enterprise Software Architecture	2
ENEE801602	Business Analytic and Visualization	2
ENEE801603	Imaging Technology and Computer Vision	2
	Sub Total	**14**
	2nd Semester	
ENEE802604	Big Data Technology and Architecture	3
ENEE802605	Advanced Artificial Intelligence	2
ENEE802606	Applied Data Engineering	2
ENEE802607	Ethics and Professionalism	2
	Elective Course	2
	Sub Total	**11**
	3rd Semester	
ENEE803003	Technology Innovation and Entrepreneurship	3
ENEE803608	Enterprise Cyber Threat Analysis	2
ENEE803609	Advanced IT Project Managemen	2
	Elective Course	2
	Sub Total	**9**
	4th Semester	
ENEE804004	Thesis	8
ENEE804005	Scientific Publication	2
	Sub Total	**10**
	Total	**44**

Majoring in Telecommunication Management

Code	Subject	SKS
	1st Semester	
ENEE801001	Data Processing and Analytic	4
ENEE801002	Research Methodology	4
ENEE801701	Management of Telecommunications System and Digital Busines	3
ENEE801702	Trend of Digital Technology	3
	Sub Total	**14**
	2nd Semester	
ENEE802703	Law, Regulation and Telecommunications Policy	3
ENEE802704	Strategic Management and Technoeconomic	3

ENEE802705	Telecommunications Convergence Service and Infrastructure	2
ENEE802706	Ecosystem and Digital Economic	2
ENEE802707	Special Topic of Technology and Innovation	2
	Sub Total	**12**
	3rd Semester	
ENEE803003	Technology Innovation and Entrepreneurship	3
ENEE803708	Internet of Things (IoT) and Future Network Technology	3
ENEE803709	Capita Selecta	2
	Sub Total	**8**
	4th Semester	
ENEE804004	Thesis	8
ENEE804005	Scientific Publication	2
	Sub Total	**10**
	Total	**44**

Majoring in Power and Energy Management

Code	Subject	SKS
	1st Semester	
ENEE801001	Data Processing and Analytic	4
ENEE801002	Research Methodology	4
ENEE801801	Control and Operation of Power Generation Plant	3
ENEE801802	Economic of Electric Utility Power Generation	3
	Sub Total	**14**
	2nd Semester	
ENEE802803	Dynamic System and Modeling	3
ENEE802804	Economics Energy and Management	3
ENEE802805	Strategic Management	3
	Sub Total	**9**
	3rd Semester	
ENEE803003	Technology Innovation and Entrepreneurship	3
ENEE803806	Electrical Power System Quality	2
ENEE803807	Power System Planning	3
ENEE803808	Energy and Environment	3
	Sub Total	**11**
	4th Semester	
ENEE804004	Thesis	8
ENEE804005	Scientific Publication	2
	Sub Total	**6**
	Total	**40**

Majoring in Information Network Security Management

Code	Subject	SKS
	1st Semester	
ENEE801001	Data Processing and Analytic	4
ENEE801002	Research Methodology	4
ENEE801901	Information Network Security	2
ENEE801902	Information Network Infrastructure	2
ENEE801903	Computer Based Network Simulation	2
	Sub Total	**14**
	2nd Semester	
ENEE802904	Network and Application Security	3
ENEE802905	Security Operations and Incident Management	3
ENEE802906	Cyber Forensic	3
ENEE802907	Security Assessment and Analysis	3
	Sub Total	**12**
	3rd Semester	
ENEE803003	Technology Innovation and Entrepreneurship	3
ENEE803508	Cyber Threat Intelligence Analysis	2
ENEE803509	Security Risk Management & Regulation	3
	Sub Total	**12**

	4th Semester	
ENEE804004	Thesis	8
ENEE804005	Scientific Publication	2
	Sub Total	**10**
	Total	**44**

ENEE800204	Research Result Examination	6
	3rd Semester	
ENEE800105	Journal Publication	8
	4th Semester	
ENEE800206	Master Thesis	10

Master By Research

Code	Subject	SKS
	1st Semester	
ENEE800102	Research Proposal Examination	4
ENEE800101	Scientific Seminar	8
	2nd Semester	
ENEE800203	Proceeding Publication	4

Transition Rules

1. The curriculum 2020 is implemented starting in the odd semester 2020/2021. In principle, after curriculum 2020 is implemented, only subjects in the curriculum 2020 will be opened.
2. The curriculum 2020 will be implemented from class of 2020 onwards. Class of 2019 and earlier will folloe curriculum 2020 with transitional rules.
3. An applied transitional period of 1 year, is in the academic year 2020/2021 for subjects that change the academic semester (from even to odd, or vice versa), if necessary, will be opened in both semester during the transition period (academic year 2020/201)
4. Students who have not passed the compulsory subjects in the curriculum 2016 are required to take the similar or quivalent subjects in the curriculum 2020. (Se the equality table of curriculum 2020 and 2016. ; courses in the curriculum 2016 which are not listed in the equality table mean that there is no changes, both in name and in the credits).
5. If there is a change in the credits course, the number of credits taken into graduation is that the the number of credits at the time the course was taken. Similar or equivalent courses will be counted in different credits, If repeated or newly taken will be listed with the new name and calculated with new credits.
6. If the compulsory subjects in the curriculum 2016 are removed and there is no equivalency in curriculum 2020, for the students who passed these courses, then they are still counted as compulsory credit courses for graduation. For students who have not passed the course, they can take take the new compulsory subjects.

The equality table Master Program in Electrical Engineering

Curriculum 2016			Curriculum 2020			Information
Courses	Credit	SMT	Courses	Credit	SMT	
Applied Mathematics	3	1	Processing and data analysis	4	1	Equivalent
Research Method	3	2	Metodologi Penelitian	4	1	Equivalent
Engineering Project Management and Economics	3	3	Technological Innovation and Entrepreneurship	3	3	Equivalent

Syllabus of Master Program in Electrical Engineering

Data Processing and Analytic

ENEE801001
4 Credits
Learning Outcomes:

Be able to evaluate data by applying AI/Big data analysis methods and able to create mathematical models to design optimum systems in the field of electrical engineering

Topic:

AI/Big data & methods: Hypothesis testing (ANOVA), regression, classification (KNN & Weighted KNN, SOM, LVQ, BPNN, SVM), Modeling & Design and optimization

Prerequisite:

Textbooks:

1. Laurene Fausett, "Fundamental of Neural Network", Prentice-Hall, 1994.
2. Douglas C. Montgomery, Design and Analysis of Experiments, 9th ed. Wiley, 2019
3. John D. Kelleher, Brian Mac Namee, and Aoife D'Arcy, Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, and Case Studies, The MIT Press, 2015.

Research Methodology

ENEE801002
4 Credits
Learning Outcomes:

Be able to explain research problems and the background, be able to explain research designs and the application, be able to apply standard scientific writing techniques in scientific publications, be able to examine important aspects in the research process such as literature studies, communication, be able to write the current research trend proposals in the field of electrical engineering

Topic:

Research Problem; Literature Review and Technical Reading; Attributions and Citations; Intellectual Property Rights; Ethics in Engineering Research; Technical Writing and Publishing; Research Management and Planning; Research Proposal

Prerequisite:

Textbooks:

1. Dipankar Deb, Rajeeb Dey, Valentina E. Balas, "Engineering Research Methodology: A Practical Insight for Researchers", Springer 2019.
2. C.R. Kothari, "Research Methodology: Methods and Techniques", New Age International, 2004
3. Pedoman Teknis Penulisan Tugas Akhir Mahasiswa UI

Technology Innovation And Entrepreneurship

ENEE803003
3 Credits
Learning Outcomes:

Students are able to develop innovative and visionary character in various industrial sectors in the digital economy era

Topic:

National and Sectoral Innovation Systems; Evolutionary Theory; R&D management; Technology Diffusion; Innovation in Service era 4.0; Globalization, national competitiveness and economic development; Science Technology and Innovation Policy; Intellectual Property and Standardization; Policies and Markets in the New Knowledge Economy era; Kano Model; Product and service design; Product and Service valuation; Entrepreneurship

Prerequisite:

Textbooks:

1. J. Fagerberg, D.C. Mowery, R.R. Nelson, "The Oxford Handbook of Innovation", Oxford University Press, 2006.
2. M.R. Milson, D. Wilemon, "The Strategy of Managing Innovation and Technology", Prentice Hall, 2007. 3. R. Mansell, C. Avgerou, D. Quah, R. Silverstone, "The Oxford Handbook of Information and Communication Technologies", Oxford University Press, 2007.

Majoring in Power and Smart System

Electric Generation Operation and Control

ENEE801101
2 Credits
Learning Outcomes:

After completing courses, students are able to operate geothermal and hydro power plants, distribution and power control systems.

Topic:

Commitment; Generation with limited energy supply; Hydrothermal Coordination; Production cost model; Control of generation; Power and energy exchange.

Prerequisite:

Textbooks:

1. A.J. Wood and B.F. Wollenberg, "Power Generation, Operation and Control", 2nd Edition, John Wiley & Sons Inc., 1996.

Electrical Power System Quality

ENEE801102
2 Credits
Learning Outcomes:

Be able to analyze the operating conditions of the electrical power system, under the steady-state condition and disruption due to swell voltage/sag voltage and harmonic distortion.

Topic:

Transient; Overvoltage; Undervoltage; Interruptions; Sags; Swells; Voltage Imbalance; Voltage fluctuations; Waveform distortion; Power frequency variations; Harmonic Distortion; Voltage Distortion vs Current; Harmonic vs Transient; Harmonic Control; Filter Design; Benchmarking power quality; Power distribution and power quality; Wiring and grounding; Power quality check.

Prerequisite:

Textbooks:

1. R.C. Dugan, M.F. Mc.Granaghan, S.Santoso, H.W. Beaty, "Electrical Power Sistem Quality", 2nd Edition, Mc.Graw Hill, 2002.

Electric Power and Environment

ENEE801103
2 Credits
Learning Outcomes:

At the end of the course, students will be able to analyze the effects of using green energy sources

Topic:

Global warming is caused by the use of fossil and non-fossil energy; Solving environmental problems nationally and globally; Implementation of the Kyoto Protocol in the form of a Clean Development Mechanism; CO2 trading.

Prerequisite:

Textbooks:

1. W.W. Nazaroff, L.A. Cohen, "Environment Engineering Science", John Wiley and Sons Inc., 2001.
2. R.A. Ristineu, J.J. Kroushaar, "Energi and Environment", John Wiley and Sons Inc., 2006.

Dynamic System and Modeling

ENEE802104
2 Credits
Learning Outcomes:

Be able to formulate the factors that influence the latest developments in the electricity system both technical and non-technical aspects

Topic:

Introduction to dynamic systems, feedback cycles, multivariable and multi-objective complex models, modeling and simulation, model design, change development, urban dynamics

Prerequisite: -

Textbooks:

Economics Energy And Management

ENEE802105
2 Credits
Learning Outcomes:

Be able to design an energy management system by applying supply/demand from the management side related to sources, both fossilized and non-fossilized

Topic:

Sources of Fossils and Non-Fossils; Power system management: including the generation, transmission and distribution of electricity; Supply management and supply management are known as Integrated Resource Planning.

Prerequisite: -

Textbooks:

1. J.M. Griffin, H.B. Steele, "Energi Economics and Policy", Academic Press New York, 1980.
2. Zuhal, "Ketenagalistrikan Indonesia", PT. Ganesha Prima, April 1995.

Advanced Power Electronics

ENEE802106
2 Credits
Learning Outcomes:

Be able to design applications in the field of high-power semiconductor devices in the industrial and military fields.

Topic:

Introduction to electric power systems and Power Semiconductor Switches; Rectifier Diode; Controlled rectifier; Inverters; Resonant Converters and Switching D.C. for power supply; Power Conditioners and Uninterruptible Power Supplies; Introduction to Motor Drives; D.C. Motor Drives; Synchronous Motor Drives; Residential; Electric utility industry and applications; Optimization of utility interface systems with electric power systems.

Prerequisite: -

Textbooks:

N. Mohan, T.M. Undeland, W.P. Robbins, "Power Electronics", 3rd Edition, John Wiley and Sons, 2003.

Renewable Energy and Energy Storages
ENEE802107
2 Credits
Learning Outcomes:

Be able to analyze the appropriate renewable energy system and design an optimal energy storage system both in terms of capacity and type of plant based on the condition of resource availability and changing load demands.

Topic:

Renewable energy is becoming increasingly important as a method of reducing environmental impacts that are far lower than conventional energy technologies. Topics to be discussed will focus on power system issues related to the integration of renewable energy resources into the electricity grid, including Photovoltaic Systems, Wind Power Systems, Heat and Combined Power (CHP), Solar Concentrates (CSP), Biomass, Hydropower, Fuel cells / fuel cells, as well as chemical energy storage systems in the form of batteries and mechanics such as flywheels

Prerequisite: -

Textbooks:

1. Gilbert M. Masters, "Renewable and Efficient Electric Power Systems", Wiley-Interscience, 1st Edition, 2004 Handout

Power System Planning
ENEE803108
2 Credits
Learning Outcomes:

Be able to analyze the demand identity of the estimated changes in economic variables and be able to estimate the reliability of the system in changing economic conditions.

Topic:

Estimated demand for increased electric power; Long-term electricity supply; Electricity generation (production) planning; Scheduling maintenance of power system generators; Strategic factors of Indonesia's electricity development; Prospects for electricity development in Indonesia; Electric power system development model; Optimization method.

Prerequisite: -

Textbooks:

1. X. Wang, J.R. McDonald, "Modern Power Sistem Planning", McGraw Hill Book Co., 1994.
2. Zuhal, "Ketenagalistrikan Indonesia", PT. Ganesha Prima, April 1995

SMART ENERGY SYSTEM
ENEE803109
2 Credits
Learning Outcomes:

Be able to make a holistic/integrated model of energy management system which includes electricity, heating, cooling, industry, buildings and transportation

Topic:

Introduction to Smart Energy Systems; The Impact of Energy Storage Technology and Renewable Energy Sources on an Energy Hub System; Storage of Solar Thermal Energy for the Housing Sector; Optimal Short-Term Scheduling of Photovoltaic-Powered Multi-Chiller Generators in the Presence of Demand Response Programs; cooling and heating systems in buildings, electric vehicles integrated with electricity networks, dynamic pricing

Prerequisite: -

Textbooks:

Behnam Mohammadi-Ivatloo, Farkhondeh Jabari, "Operation, Planning, and Analysis of Energy Storage Systems in Smart Energy Hubs", Springer; 1st edition, April 2018

Majoring in Telecommunication and Smart Wireless System

Signal Processing and Applications
ENEE801201
2 Credits
Learning Outcomes:

Be able to evaluate algorithms from signal processing platforms and use certain smart technology applications

Topic:

Signal Analysis; Frequency and Transient Response; Discrete FT - FFT, Z Transform, Correlation & Convolution; Digital Filter: FIR & IIR; Multi rate signal processing; Advanced transforms: DCT, WHT, Wavelet; Its Applications in signal Processing; Projects: Object Detection & Recognition; Wireless Communication; Radar System; Compression: Audio, Image and Video

Prerequisite: -

Textbooks:

1. Emmanuel C. Ifeachor & Barrie W Jervis, "Digital Signal Processing: A Practical Approach",

Second Edition, Prentice Hall, 2002.

2. John G Proakis and Dimitris G. Manolakis, "Digital Signal Processing: Principles, Algorithms, and Applications", 3rd Edition, Prentice Hall, 2005.
3. Dadang Gunawan & Filbert Hilman Yuwono, "Pengolahan Sinyal Digital dengan Pengolahan MATLAB", Graha Ilmu, 2012.

Modern Telecommunication System

ENEE801202
2 Credits
Learning Outcomes:

Be able to evaluate the technical aspects of the radio communication technology platform system

Topic:

Trends in Telecommunications System, Deterministic Signal Analysis, Random Signal Analysis, Information Theory and Channel Coding, Digital Modulation and Demodulation, Spread Spectrum, Intersymbol Interference and Equalization, Fading Channel Analysis, Channel Modeling and Mobility Modeling, FFH, OFDM, MIMO and Channel Capacity , Traffic Modeling, Digital Satellite Communication Systems, Artificial Intelligence / Expert in Telecommunication Systems, Telecommunications Software Development and Process Modeling, 5G Mobile Technology (uRLLC, mMTC, eMBB). LTE Rail 15. Fiber Technology (FTTH, Radio over Fiber). The vision towards 6G. Internet Tactile. Terahertz and VLC (Visible Light Communications). HAPS (High Altitude Platforms). Fundamentals of Internet of Things (IoT). IoT management planning. LoRA, NB-IoT, Future Network Technology.

Prerequisite: -

Textbooks:

1. "Telecommunications Breakdown: Concepts of Communication Transmitted via Software-Defined Radio,"C. Richard Johnson Jr. and William A. Sethares, Pearson Prentice Hall, 2004, ISBN 0-13-143047-5
2. Software Engineering by Ian Sommer Ville 7th Edition
3. DigitalCommunications ,. Simon Haykin John Wiley & Sons
4. Modern Telecommunications: Basic Principles and Practices 1st Edition Martin J N Sibley, 2018

Modern Radar System

ENEE801203
2 Credits
Learning Outcomes:

Be able to evaluate the performance of modern radar systems

Topic:

Introduction and overview; Radar equations; Propagation effect and mechanism; Radar clutter; Target reflectivity and fluctuation models; Doppler phenomenon; Radar antenna, transmitter and receiver; Radar Processor; Radar signal processing: detection, false alarm, Doppler processing, radar measurement, tracking and imaging.

Prerequisite: -

Textbooks:

1. M.A. Richards, J. A. Sheer and W. A. Holm: "Principles of Modern Radar," Scitech Publishing, 2010
2. M. Skolnik: "Radar Handbook," Mc Graw-Hill, 2008

Modern Antenna Engineering

ENEE802204
2 Credits
Learning Outcomes:

Able to design modern antenna applications in support of the quality of modern society

Topic:

Introduction and review Maxwell's eqs in differential and integral form. Wave solution; Ideal dipole antenna and basic antena parameters. Microstrip antenna: basic properties, design consideration, widebanding, circular polarization, Microstrip Antenna miniaturization: fundamental limit, several techniques. Analysis of Array Antenna: linear, planar dan circular, Synthesis of Array Antenna. Microstrip antenna Array, Different type of planar antenna, applications of microstrip antenna.

Prerequisite: -

Textbooks:

1. Microstrip Antenna Design Handbook, Ramesh Garg et.al.
2. Microstrip and Printed Antennas: New Trends, Techniques and Applications, Debatosh Guha et.al., Wiley and Son 2011.
3. Practical Microstrip and Printed Antenna Design, Anil Pandey, Artech House, 2019

Smart RF Design

ENEE802205
2 Credits
Learning Outcomes:

Be able to design RF components for smart endur-

ance systems

Topic:

Modern Wireless Telecommunication Technology, Single Radio Access Network Technology, Multiband RF Transceiver, Design of Transmitter, Design of Receiver, Smart RF Project Design

Prerequisite: -

Textbooks:

1. Matthew M. Radmanesh, "Advanced Rf & Microwave Circuit Design: The Ultimate Guide to Superior Design,"Artech House, 2003.
2. Ulrich L. Rohde and David P. Newkirk, "RF/ Microwave Circuit Design for Wireless Applications," John Wiley and Sons, 2000
3. Qizheng Gu, "RF System Design of Transceivers for Wireless Communications," Springers, 2005

Terahertz And Optics System

ENEE802206
2 Credits
Learning Outcomes:

Able to evaluate the optical network communication components and the Terahertz system

Topic:

Introduction: networks and telecommunication; Types of fiber; Physical impairment, Overview of optical communication technology; Design of optical networks, THz Wireless Communications, Case Study

Prerequisite: -

Textbooks:

1. G. Keiser, Optical Fiber Communications, McGraw-Hill, 3rd ed., 2000.
2. R. Ramaswami, Sivarajan, k. and g. Sasaki, "Optical Networks: A Practical Perspective", 3rd Edition, Morgan Kaufman Publishers 2008, 2009, 2010.
3. B. Mukherjee, "Optical WDM Networks (Optical Networks)," Springer, 2006. ISBN: 0387290559.
4. D Saeedkia, Handbook of Terahertz Technology for Imaging, Sensing and Communications, Elsevier, 16 Jan 2013

Sensor Communication System

ENEE802207
2 Credits
Learning Outcomes:

Be able to design wireless sensor communication that will be applied in a variety of relevant services

Topic:

Introduction to Sensor, Sensor Network Architecture, Information Collection Technique, Radio Communication Technique, Network management technique, Multi-hop communication, Localization Techniques, Sensing/Observation Technique, Energy Management Engineering, Network and Information Security, Operating Systems, Programming, Design and experiment of sensor communication system applications

Prerequisite: -

Textbooks:

1. Building Wireless Sensor Networks: Theoretical and Practical Perspectives, karya Nandini Mukherjee, Sarmistha Neogy, Sarbani Roy.
2. Introduction to Wireless Sensor Networks, karya Anna Forster

Technological Quality Of Service And Experience

ENEE803208
2 Credits
Learning Outcomes:

Be able to evaluate QoE and QoS from technology applications

Topic:

Fundamental Concept of Service Quality. Technical and Non-Technical aspects in Quality measurements. Methods to measure QoE, QoS. Quality of Experience in 4G and 5G. Quality of Physical Experience (QoPE). Innovation Service towards 6G. Kano Model to improve Service quality. Case study.

Prerequisite: -

Textbooks:

1. Quality of Experience: Advanced Concepts, Applications and Methods, Sebastian Möller, Alexander Raake, Springer, 2014.
2. Quality of Service Mechanisms in Next Generation Heterogeneous Networks, ed. Abdelhamid Mellouk, John Wiley & Sons, 2013.

Computational Intelligence for Communication Engineering

ENEE803208
2 Credits
Learning Outcomes:

Be able to evaluate telecommunications systems that apply signal processing computational intelligence

Topic:

Intro to Biomedical Systems; Bioelectric Signals and Electrode Theory; Biomedical Signal Processing (Signals system, Signal Transforms, Spectral Analysis and Estimation, Filters) and Feature Extraction; Computational Intelligence Techniques (Artificial Neural Networks, Support Vector Machines, Hidden Markov Models, Fuzzy Systems); Applications in Cardiology and Heart Disease Diagnosis, Electromyography Signals, Electroencephalogram Analysis, Gait and Movement Pattern Analysis.

Prerequisite: -

Textbooks:

1. Rezaul Begg, Daniel T.H. Lai, Marimuthu Palaniswami, "Computational Intelligence in Biomedical Engineering," Boca Raton, FL, USA: CRC Press (Taylor & Francis Group), 2008, ISBN 978-0-8493-4080-2.
2. Tavares, João Manuel R.S., Dey, Nilanjan, Joshi, Amit (Editors.), "Biomedical Engineering and Computational Intelligence," Proceedings of The World Thematic Conference—Biomedical Engineering and Computational Intelligence, 2018.
3. Charles S. Lessard, "Signal Processing of Random Physiological Signals," Morgan & Claypoo, 2006: 1 st Ed.
4. Klaus D. Toennies, "Advances in Computer Vision and Pattern Recognition: Guide to Medical Image Analysis," Springer-Verlag London, 2012, ISBN 978-1-4471-2750-5.

Majoring in Electronic and Intelligent Embedded System

Photonic Device

ENEE801301
2 Credits
Learning Outcomes:

Be able to design and analyze systems and optical devices

Topic:

Passive and active optical device designs for sensor and communication applications using software; Optical system design for a variety of telecommunications, biomedical and light sensor applications; Ray optics analysis, wave optics and quantum optics for various optical devices; Performance analysis of optical system applications: telecommunications, and several sensors.

Prerequisite: -

Textbooks:

1. Bahaa E. A. Saleh, Malvin Carl Teich, "Fundamentals of Photonics," A Wiley-Interscience publication Vol. 32, Wiley Series in Pure and Applied Optics, ISSN 0277-2493.

Green Electronic Devices

ENEE801302
2 Credits
Learning Outcomes:

Able to design organic LED devices and organic solar cell

Topic:

Introduction of lighting systems from time to time; Introduction of OLED technology; Types of OLEDs; OLED characterization; OLED fabrication techniques; Introduction of lighting systems from time to time; Introduction of Organic solar cell technology; Types of Organic solar cells; Characterization of Organic solar cells; Organic solar cell fabrication techniques

Prerequisite: -

Textbooks:

1. Cristian Ravariu, Dan Mihaiescu, "Green Elctronics," IntechOpen, ISBN 978-1-78923-304-9.

Digital Microelectronics Circuit Design

ENEE801303
2 Credits
Learning Outcomes:

Be able to design and analyze microelectronic circuits

Topic:

Digital circuit basic logic gates, Formation of logic functions, VLSI fabrication theory: coding. Optimization of logic functions, validation, Baseband system functions

Prerequisite: -

Textbooks:

1. Richard Jaeger, Travis Blalock, "Microelectronic Circuit Design," McGraw-Hill Higher Education, 2015, ISBN 978-1-25922-714-1

Sensors and Actuators

ENEE802303
2 Credits
Learning Outcomes:

Be able to apply sensors and actuators to an integrated system**Topic:**

Instrumentation of an engineering system, component interconnection and signal conditioning, performance specification and instrument rating

parameters, estimation from measurements, analog sensor and transducers, digital and innovative sensing, mechanical transmission components, stepper motors, continuous drive actuators.

Prerequisite: -

Textbooks:

1. Clarence W. de Silva, Sensors and Actuators, CRC Press, 2016

Nanoelectronic

ENEE802305
2 Credits
Learning Outcomes:

Be able to design transistor devices based on tunneling phenomena and able to follow the latest developments in the electronics field

Topic:

Introduction to nanoscience and technology; Development of electronics from micro to nano; Device miniaturization effect; Extended traditional CMOS technology; Beyond traditional CMOS technology; Introduction to nanoscience and technology; Development of electronics from micro to nano; Device miniaturization effect; Extended traditional CMOS technology; Beyond traditional CMOS technology; Single electron transistor; Tunnel FET

Prerequisite: -

Textbooks:

1. Robert Puers, Livio Baldi, Marcel Van de Voorde, Sebastiaan E. van Nooten, "Nanoelectronics: Materials, Devices, Applications," John Wiley & Sons, 2017, ISBN 978-3-52734-053-8

Advanced Analog Electronics Circuits

ENEE802306
2 Credits
Learning Outcomes:

Be able to design advanced electronic circuits

Topic:

Operational Amplifiers; Oscillators; Phase Locked Loops; Short Channel Effects and Device Models; CMOS Processing Technology

Prerequisite: -

Textbooks:

1. Richard Jaeger, Travis Blalock, "Microelectronic Circuit Design, " McGraw-Hill Higher Education, 2015, ISBN 978-1-25922-714-1

Opto-Electronic Instrumentation

ENEE802307
2 Credits
Learning Outcomes:

Be able to design opto-electronic instrumentation systems for the measurement of various physical quantities

Topic:

The characteristic and phenomena of light, opto-electronic instrumentation systems, basic and various types of interferometers, fiber optic sensors, integration of various opto-electronic components to build instrumentation systems.

Prerequisite: -

Textbooks:

1. Measurement and Instrumentation Principles, Alan Morris
2. Fibre Optic Sensor, Francis T. Yu

System On Chip

ENEE803308
2 Credits
Learning Outcomes:

Be able to design an on-chip system by considering design methodology, design requirements, systems and supporting components, handoff procedures, and design infrastructure requirements.

Topic:

Introduction, system on chip (SOC, logic design and HDL on SoC, SOC synthesis, DFT design for SoC, SOC design verification, SOC physical design and verification, static time analysis, reference design.

Prerequisite: -

Textbooks:

1. Veena S. Chakravarthi , A Practical Approach to VLSI System on Chip (SoC) Design: A Comprehensive Guide, Springer International Publishing 2020.

IoT and Smart Electronic Systems

ENEE803309
2 Credits
Learning Outcomes:

Be able to design smart electronic systems for IoT applications

Topic:

IoT, Arm Mbed, IoT Enabling Technologies, Arm Mbed Development

Prerequisite: Sensor and Actuator

Textbooks:

1. Perry Xiao, Designing Embedded Systems and the Internet of Things (IoT) with the ARM Mbed, IEEE, 2018.

Majoring in Cyber Security and Future Internet

Network Security and Reliability

ENEE801401
2 Credits
Learning Outcomes:

In this course students learn security standards of creating a reliable network. After taking this course, students are able to design security standards for data storage and data communication in the network.

Topic:

Introduction to Security and Privacy, Classical Cryptosystems, Cryptanalysis, Stream and Block Ciphers, Modern Symmetric Key Crypto Systems, Public Key Cryptography, Public Key Cryptography, RSA and ElGamal, Diffie-Hellman, Hash functions, Digital Signatures, Key Management and Distribution, Web Security (SSL / TLS), Emerging Technologies, Ethics.

Prerequisite: None

Textbooks:

1. W. Stallings, "Cryptography and Network Security: Principles and Practice", 3rd Edition, Prentice Hall, 2003.
2. O. Goldreich, "Foundations of Cryptography: Basic Tools", Cambridge University Press, 2001.

Advanced Network Computer Systems

ENEE801402
2 Credits
Learning Outcomes:

In this course students learn the latest computer network systems and architecture. After taking this course, students are able to evaluate the performance of a computer architecture design, and are able to analyze the Internet of Things technology.

Topic:

Introduction to Computer Design, Instruction Set, Advanced Microarchitecture, Memory-Hierarchy Design, Thread-Level Non Regulerism, Data-Level Non Regulerism, Performance-tuning and Analysis of Modern Applications, Architecture Implementation Issues and Analysis, Data Communication Traffic, Lan Transport and Standards, Internet and Routing Protocols, Internetworking of Things (IoT).

Prerequisite: None

Textbooks:

1. Hennessy and Patterson, "Computer Architecture - A Quantitative Approach", 6th Edition, 2018.
2. Andrew Minteer, "Analytics for the Internet of Things (IoT)", Packt Publishing, 2017

Network Security and Data Protection

ENEE801403
2 Credits
Learning Outcomes:

In this course students learn security standards for various types and categories of data on the network. After taking this course, students are able to evaluate the security system of a particular data type, and are able to implement a data security system that is appropriate to the data type.

Topic:

Information Systems Security and Protection Objectives, Control at the Level of Management, Software Control, Access Control, Legal Aspects of the Security of Information Systems. Information Systems Security Planning, Network Security Threats, Defining a Security Policy, Protecting the Network and Operating System Services. Secure Data Storage. Monitoring the Performance of the System, Intrusion Detection Systems, Reestablishment of Network Systems.

Prerequisite: None

Textbooks:

1. Sébastien Ziegler, "Internet of Things Security and Data Protection", Springer, 2019

Applied Cryptography & Blockchain Technology

ENEE802404
2 Credits
Learning Outcomes:

In this course students learn cryptographic and blockchain technology and their applications. After taking this course, students are able to apply the cryptographic method and are able to evaluate the blockchain transaction system.

Topic:

Digital Trust, Assets, Transactions, Distributed Ledger Technology, Types of Network, Components of Blockchain or DLT, Ledger, Blocks, Blockchain, PKI and Cryptography, Private keys, Public keys, Digital Signature, Consensus, Byzantine Fault, Proof of Work, Poof of Stake, Security, Cryptocurrency, Digital Tokens.

Prerequisite: None

Textbooks:

1. Alan T. Norman, "Blockchain Technology Explained", 2017

Security Operation And Incident Handling

ENEE802405
2 Credits
Learning Outcomes:

After taking this course, students are able to handle risks and evaluate vulnerabilities, threats, and network security alerts, and are able to compare the objectives and common reasons for using various cybersecurity tools and technologies.

Topic:

Threat Management; Vulnerability Management; Cyber Incident Responses; Security Architecture and Tool Sets

Prerequisite: None

Textbooks:

1. CISCO CCNA Cyber Operation (CyberOps)
2. CompTIA Cybersecurity Analyst (CySA +)

Network and Digital Forensics

ENEE802406
2 Credits
Learning Outcomes:

In this course students learn digital forensics and networking. After attending this course, students are able to identify digital traces on the computers and the network, are able to recognize forms of attack from digital traces, are able to analyze digital traces and are able to collect legal evidence.

Topic:

Introduction to Digital Forensics and Networks; Windows-Based Computer Forensics; Linux Based Computer Forensics; Forensics in Computer Networks; Forensics on Mobile Devices.

Prerequisite: None

Textbooks:

1. E. Casey, "Digital Evidence and Computer Crime: Forensic Science, Computers, and the Internet", 3rd Edition, Academic Press, 2011.
2. J. Marcella Jr. and F. Guillossou, "Cyber Forensics: From Data to Digital Evidence", Wiley, 2012.

Convergence Information Network NG

ENEE802407
2 Credits
Learning Outcomes:

In this course students learn the 5G network architecture system along with the division of functions. After attending this course, students are able to analyze the 5G network architecture in the future network, and are able to analyze the functions on the network slices.

Topic:

Introduction to SDN and NFV, 5G, Software Defined Networking, Network Functions Virtualization, C-RAN, Network Slicing, Fronthaul and Backhaul Networks in 5G.

Prerequisite: None

Textbooks:

1. Kazmi, et. al., "Network Slicing for 5G and Beyond Networks", Springer, 2019
2. James M. Anderson, Patricia A. Morreale, "Software Defined Networking", CRC Press, 2014

Cyber Threat Intelligence And Incident Analysis

ENEE803408
2 Credits
Learning Outcomes:

After taking this course, students are able to deduce accurate perceptions about the company's security attitudes and threats, able to analyze the status of future risks by applying artificial intelligence.

Topic:

Introduction to Threat Intelligence, Cyber Threats and Kill Chain Methodology, Requirements, Planning, Direction, and Review, Data Collection and Processing, Data Analysis, Dissemination and Reporting of Intelligence

Prerequisite: None

Textbooks:

1. EC-Council Certified Threat Intelligence Analyst (C | TIA)

Security Risk Assessment and Analysis

ENEE803409
2 Credits
Learning Outcomes:

After taking this course, students are able to exploit vulnerabilities in networks, web applications, wireless, cloud, and databases, and are able to compile reports and recommendations on prevention strategies for discovered vulnerabilities

Topic:

Planning and Scoping, Information Gathering, Vulnerability Identification, Attacks and Exploits, Penetration Testing Tools, Reporting and Communication.

Prerequisite: None

Textbooks:

1. EC-Council Security Analyst (ECSA)
2. CompTIA PenTest +

Majoring in Automation and Data Analytic Engineering

Mechatronic System Modeling And Control

ENEE801501
2 Credits
Learning Outcomes:

Be able to describe the components and working principles of mechatronic systems, be able to describe the mathematical models of mechatronic systems, be able to apply the concept of mechatronic system modeling in simulations, be able to analyze the performance of mechatronic systems with controllers, able to recommend the design of mechatronic systems

Topic:

Mechatronic system design, mechatronic components, sensors, actuators, mechatronic system block diagrams, mathematical models (transfer function/ state space), PID control design, control system simulation, system evaluation

Prerequisite: -

Textbooks:

1. Devdas Shetty, Ph.D., P.E., Richard A. Kolk, "Mechatronics System Design", Cangage Learning, 2011.
2. "Dynamics Of Mechatronics Systems: Modeling, Simulation, Control, Optimization and Experimental Investigations", World Scientific Publishing, 2017.

Industrial Electric Drive System

ENEE801502
2 Credits
Learning Outcomes:

Be able to explain the components in the electric drive system, able to explain the working principle of the drive system with various types of electric machines, able to apply the simulation method with MATLAB/Simulink on the electric drive system, able to analyze the performance of the electric drive system, able to recommend controllers on the electric drive system

Topic:

Basics of electric engine, AC engine, DC engine, electrical engine mathematical models, system simulation, power electronics for actuator systems, electric actuator control designs

Prerequisite: -

Textbooks:

1. Shaahin Filizadeh, "Electric Machines and Drives: Principles, Control, Modeling, and Simulation", CRC Press, 2013.
2. Muhammed Fazlur Rahman, Sanjeet K. Dwivedi, "Modeling, Simulation and Control of Electrical Drives", The Institute of Engineering and Technology, 2019.

System Optimization and Optimal Control

ENEE801503
2 Credits
Learning Outcomes:

Be able to state optimization problems in mathematical equations, able to apply optimization methods in the design of optimization systems.

Topic:

Various optimization problems and their application, optimization mathematical models, optimization mathematical methods (unconstrained, constrained, linear programming), optimal control problems, optimal control simulation design, optimal control system analysis

Prerequisite: -

Textbooks:

1. Hassan Bevrani, Mohammad Fathi, "Optimization in Electrical Engineering", Springer-Verlag, 2019.
2. Mark Levi, "Classical Mechanics With Calculus Of Variations And Optimal Control: An Intuitive Introduction", Orient Blackswan, 2016.
3. Aschepkov, L.T., Dolgy, D.V., Kim, T., Agarwal, R.P., "Optimal Control", Springer-Verlag, 2016.

Advanced Smart Data Computation

ENEE802504
2 Credits
Learning Outcomes:

Be able to explain the data engineering process, able to apply data analysis methods with ML and Deep Learning by using software, able to analyze the performance of various data analysis methods, able

to choose the right data analysis method

Topic:

Machine learning (supervised, unsupervised), neural networks, training of multi layer neural network, classification, deep learning, convolution neural network

Prerequisite: -

Textbooks:

1. HIan Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2017

Smart System Monitoring And Data Engineering

ENEE802505
2 Credits
Learning Outcomes:

Be able to define the design requirements,able to implement the design of monitoring software, able to use a web application programming language in a monitoring system, able to do the analysis of the design results, able to recommend methods for developing a monitoring system

Topic:

Computer and network, client-server, internet protocol, data communication, design methodology, database, GUI, web application programming, database

Prerequisite: -

Textbooks:

1. Olayinka Omole,"Server Side development with Node.js and Koa.js Quick Start Guide", Packt, 2018.
2. Manuel Amunategui, Mehdi Roopaei, "Monetizing Machine Learning: Quickly Turn Python ML Ideas into Web Applications on the Serverless Cloud", Apress, 2018.

Advanced Smart Data Computation

ENEE802506
2 Credits
Learning Outcomes:

Be able to describe the concept of Networked and Coordinated Control System, able to formulate Networked and Coordinated Control System problems, able to implement Networked and Coordinated Control System simulation methods using MATLAB/Simulink, able to analyze the performance of Networked and Coordinated Control Systems via simulations, able to design Networked and Coordinated Control Systems System in certain applications

Topic:

Elements and concepts of Networked and Coordinated Control Systems, wireless control systems, system models, model analysis, controlling formulas in networks and coordination, stability and performance to control systems, simulations

Prerequisite: -

Textbooks:

1. Eduardo Paciencia Godoy, "Networked Control Systems", Nova, 2018.
2. Keyou You, Nan Xiao, Lihua Xie, "Analysis and Design of Networked Control Systems", Springer-Verlag, 2016.
3. Zhong-Kui Li, Zhisheng Duan, "Cooperative Control of Multi-Agent Systems: A Consensus Region Approach", CRC Press, 2014.

Special Topic on Automation and Data Engineering

ENEE802507
2 Credits
Learning Outcomes:

Be able to explain the needs of automation and data engineering applications in support of technological advancements, be able to analyze the impacts of automation and engineering technologies, be able to sort out automation and data engineering technologies according to application needs.

Topic:

Paper-based explanation and discussion, explanation from the automation and data engineering industry professionals, exploration of automation and data engineering technology issues

Prerequisite: -

Textbooks:

1. Journals

Industrial Automation System and Security

ENEE803508
3 Credits
Learning Outcomes:

Be able to describe SCADA systems (hardware and software), be able to identify the need for SCADA system development, be able to identify cyber security issues in system design, be able to identify current issues in industrial automation systems

Topic:

Process control, industry control, application integration control, SCADA, SCADA protocol, cyber security control system

Prerequisite: -

Textbooks:

1. Robert Radvanovsky, Jacob Brodsky, " Handbook of SCADA/Control Systems Security, Second Edition", CRC Press, 2016.
2. Tyson Macaulay, Bryan L. Singer, "Cybersecurity for Industrial Control Systems", CRC Press, 2012.

Advanced Machine Learning for Autonomous System

ENEE803509
3 Credits
Learning Outcomes:

Be able to portray autonomous systems, be able to analyze the performance of autonomous systems based on data, be able to recommend data analysis methods in autonomous system applications

Topic:

Autonomous system (definition, application), autonomous system components, data acquisition systems, data processing, data analysis

Prerequisite: -

Textbooks:

1. Prof. Hong Cheng, "Autonomous Intelligent Vehicles: Theory, Algorithms, and Implementation", Springer-Verlag, 2011.
2. Nilanjan Dey, Sanjeev Wagh, Parikshit N. Mahalle, Mohd. Shafi Pathan, "Applied Machine Learning for Smart Data Analysis", CRC Press, 2019.

Majoring in Data Engineering and Business Intelligence

Digital Enterprise Software Architecture

ENEE801601
2 Credits
Learning Outcomes:

Be able to design the most appropriate mitigation model according to the level of risk impact and the results of the analysis of the company's architecture

Topic:

Software engineering, Risk Management, Introduction to Enterprise Software Architecture (EA), EA structuring and modelling, enterprise engineering, Service orientation in Enterprise Engineering (SOA, SoEA): Technological infrastructure for Big Data handling in EA, Cloud computing opportunities for EA, Flexible (agile) business and information architectures (SoEA).

Prerequisite: -

Textbooks:

1. Boris Shishkov, "Designing Enterprise Information Systems: Merging Enterprise Modeling And Software Specification", The Enterprise Engineering Series, Springer, 2020.
2. 2. N Zarvić, R Wieringa., "Designing Enterprise Architecture Frameworks: Integrating Business Processes with IT Infrastructure", Apple Academic Press. 2016.
3. 3. Dominic Duggan, "Enterprise Software Architecture and Design: Entities, Services, and Resources cover", Quantitative Software Engineering Series,Wiley-IEEE Computer Society Pr, Year: 2012

Business Analysis and Visualization

ENEE801602
2 Credits
Learning Outcomes:

Be able to design an appropriate digital business model

Topic:

The S curve and the determinants of industry evolution, tools for exploring new markets, capturing value: uniqueness and complementary assets, Core concepts in network externalities, Respond to discontinuous technological change.

Prerequisite: -

Textbooks:

1. Ramesh Sharda, Dursun Delen, and Efraim Turban. "Business Intelligence: A Managerial Perspective on Analytics (3rd Edition) (3rd. ed.)". Prentice Hall Press, USA, 2013.

Image Technology and Computer Vision

ENEE801603
2 Credits
Learning Outcomes:

Be able to evaluate image processing methods for certain applications

Topic:

Image transformation, morphological operation, image filtering, feature characterization, edge detection, template matching, advanced topics in image processing, remote sensing, medical imaging

Prerequisite: -

Textbooks:

1. R.Szeliski, "Computer Vision: Algorithms and

Applications", Springer, 2010.

2. J.E. Solem, "Programming Computer Vision with Python: Tools and Algorithms For Analyzing Images", 1st Edition, O'Reilly, 2012.

Big Data Technology and Architecture

ENEE802604
3 Credits
Learning Outcomes:

Be able to evaluate Big Data processing systems

Topic:

Introduction, Evolution of Big Data Technologies, Data-driven Paradigm, Big Data Use Case, RDBMS – NoSQL, Data Warehouse-Lake-Virtualization, Data Analytics Life Cycle, Big Data Processing Architecture, Hadoop and its ecosystem, Apache Spark, Cloud Computing, Visualization

Prerequisite: -

Textbooks:

1. Arshdeep Bahga and Vijay Madisetti. "Big Data Science & Analytics: A Hands-On Approach (1st. ed.)", VPT, 2016.

2. 2. Somani, A. (Ed.), Deka, G. (Ed.). "Big Data Analytics". New York: Chapman and Hall/CRC, 2017.

Advanced Artificial Intelligence

ENEE802605
2 Credits
Learning Outcomes:

Be able to design a detection system for certain problems based on machine learning algorithms

Topic:

Basic of machine learning. Supervised learning: regression and classification. Unsupervised learning: clustering. Feature extraction for image and signals. Dimension reduction. Performance analysis

Prerequisite: -

Textbooks:

1. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow", O'Reilly, 2017

2. John D. Kelleher, Brian Mac Namee, and Aoife D'Arcy, "Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, and Case Studies", The MIT Press, 2015.

Applied Data Engineering

ENEE802606
2 Credits
Learning Outcomes:

Be able to evaluate Big Data processing systems

Topic:

Natural Language and Formal Language, N-grams and Language Models, POS Tagging, HMMs, Context-Free Grammars, Parsing, Representing Meaning, Semantic Analysis, Machine Learning Approaches to NLP, Summarization. Language Processing, Accessing Text Corpora and Lexical Resources, Processing Raw Text, Writing Structured Programs, Categorizing and Tagging Words, Learning to Classify Text, Extracting Information, Analyzing Sentence Structure, Building Featured-based Grammar, Analyzing the Meaning of Sentences

Prerequisite: -

Textbooks:

1. Steven Bird, Ewan Klein, and Edward Loper, "Natural Language Processing with Python", O'Reilly Media, Inc., 2009.

2. 2. Nitin Indurkhya and Fred J. Damerau, "Handbook of Natural Language Processing (2nd. ed.)". Chapman & Hall/CRC, 2010.

Ethics and Professionalism

ENEE802607
2 Credits
Learning Outcomes:

Be able to analyze the concepts of professionalism and ethics in the field of computer engineering

Topic:

Ethics; Job, profession and professional; Profession in information technology; Organization and code of Ethics of IT experts; cyber ethics; intellectual copyright; Internet crime

Prerequisite: -

Textbooks:

1. ACM Code of Ethics and Professional Conduct, https://www.acm.org/about-acm/acm-codeof-ethics-and-professional-conduct

2. Tavani, Herman t., "Ethics & Technology: Ethical Issues in an Age of Information and CommunicationTechnology", John Wiley & Sons, 2004

Enterprise Cyber Threat Analysis

ENEE803608
2 Credits
Learning Outcomes:

Be able to analyze the data and threat landscape of IT and cyber by applying artificial intelligence

Topic:

Introduction to Threat Intelligence, Cyber Threats and Kill Chain Methodology, Requirements, Planning, Direction, and Review Data Collection and Processing, Data Analysis, Intelligence Reporting and Dissemination.

Prerequisite: -

Textbooks:

1. Ali Dehghantanha, Mauro Conti, Tooska Dargahi, "Advances in Information Security Vol. 70: Cyber Threat Intelligence", Springer, 2018.
2. CyberEdge Group, "The Threat Intelligence Handbook", CyberEdge Group, LLC 1997

Advanced IT Project Management

ENEE803609
2 Credits
Learning Outcomes:

Be able to design integrated systems based on computer engineering expertise

Topic:

Introduction; Fundamental of IT Project Management; IT Project Management; Building Great Software Development Teams; Tools for Great Software Development Teams

Prerequisite: -

Textbooks:

1. K. Schwalbe, "Information Technology Project Management", 7th Edition, Course Technology, 2013.
2. 2. W. S Humphrey, "Introduction to the Team Software Process, Addison Wesley, 2000.

Majoring in Telecommunication Management

Management of Telecommunications System and Digital Business

ENEE801701
3 Credits
Learning Outcomes:

Students are able to understand the basics of management and develop strategies in the digital industry by using Strategic Management theories

Topic:

Digital Economy paradigm. Big Data paradigm. ICT Trade Issue. Cretivity and Innovation in ICT. Technological management aspect for FINTECH industry. E-commerce. Social media platform. Strategic Management. HRD Management. Financial Management. Risk Management. Strategic choice. Canvas Model. Business Ethics. Case study in Telco industry. Key Management model (Porter Model, BSC, Benchmarking)

Prerequisite: -

Textbooks:

1. International Journals, White paper, Report with the topic of "Telco strategy" FR. David, "Strategic Management : Concepts", Prentice Hall.

Trend Of Digital Technology

ENEE801701
3 Credits
Learning Outcomes:

Students are able to understand the basic principles of telecommunications network technology and the latest technological developments that are relevant to the digital business ecosystem

Topic:

Fundamental digital communications system. Evolution Mobile Technology 1G-2G-3G-4G. The concept of 5G Mobile Technology (uRLLC, mMTC, eMBB). LTE Rel 15. Fiber Technology (FTTH, Radio over Fiber). NGN Next Generation Network. The vision towards 6G. Tactile Internet. Terahertz and VLC (Visible Light Communications). Satellite and HAPS (High Altitude Platforms). Human-centric Technology. Big Data Engineering. Cryptocurrency. Blockchain. Cybersecurity.

Prerequisite: -

Textbooks:

1. IEEE Transactions, Journals and Magazine, Accessed in IEEEXPlore, topic relevant to "Digital Communications Technology"
2. IEEE Conference Proceeding, Accessed in IEEEXPlore, topic relevant to "Digital Communications Technology"

Law, Regulation And Telecommunication Policy

ENEE802703
3 Credits
Learning Outcomes:

The competence built in this course is the ability of students to understand aspects of international and national law, telecommunications regulations and policies, and the standardization process in the Telecommunications industry.

Topic:

Fundamental theories for Policy making. Management of Technology. Managing Regulation. Traditional telco regulatory issues. Contemporary Converged Telco ICT Regulatory issues. International telecommunications organization. Indonesian telecommunications regulations and laws. The standardization process at ITU. International standardization body for the telecommunications industry. Case studies of telecommunications policies and regulations in Indonesia and the world.

Prerequisite: -

Textbooks:

1. ICT Regulation Toolkit, www.ictregulationtoolkit.org
2. C. Blackman, L.Srivastava, "Telecommunications Regulation Handbook: 10th Anniversary Edition", World Bank, 2011. https:// openknowledge.worldbank.org

Strategic Management and Technoeconomics

ENEE802704
3 Credits
Learning Outcomes:

Students are able to develop strategies based on technoeconomic and financial management concepts that are relevant in the telecommunications and digital industries

Topic:

Macroeconomic overview. Industrial revolution. Strategic Management. The importance of Vision and Mission. External Factor and Internal Factor evaluation. Strategy Analysis and Choice. Grand Strategy. SWOT Analysis. QSPM Method. Technoeconomic in telecommunications and digital industry. Financial and accounting for engineering. Understanding Financial Report. Feasibility Analysis. Technological forecasting; Engineering Economics. Corporate level strategy. Strategic leadership. Case study of Technoeconomic strategy in Industrial case and Government Policies. Cost analysis of the technological deployment.

Prerequisite: -

Textbooks:

1. FR. David, "Strategic Management:Concepts", Prentice Hall,
1. Leland T Blank, Anthony J Tarquin, "Basics of Engineering Economy", McGraw-Hill, 2014.
1. IEEE Conference Proceeding, Accessed in IEEEXPlore, topic relevant to "Technoeconomic"

Telecommunications Convergence Services and Infrastructure

ENEE802705
2 Credits
Learning Outcomes:

Students are able to develop strategies based on techno-economic concepts and Students are able to understand the principles of wireless and multimedia technology that shape the infrastructure and services of smart city convergence

Topic:

Wireless Communications Practice. Fundamental of Smart City. Mobile Technology for Smart City. Multimedia for smart city. Compression Technique and Applications. Quality of Service (QoS) and Quality of Experience (QoE). Quality of Perception (QoP). Multimedia Design. Interactive Multimedia System. Quality of Experience in 4G and 5G. Quality of Physical Experience (QoPE).

Prerequisite: -

Textbooks:

1. T. Rapaport, "Wireless Communications: Principles and Practice", Prentice Hall, 2009.
2. Smart City Emergence: Cases from Around the World, ed. L. Anthopolous, Elsevier, 2019

Ecosystem and Digital Economic

ENEE802706
2 Credits
Learning Outcomes:

Students are able to understand the changing paradigm of technology in the era of the digital economy and be able to explain the technical and non-technical aspects that shape the digital economic ecosystem

Topic:

ICT ecosystem. Telecommunications economics. Telecommunications Policy. Governance and State Organization in The Digital Era. Spectrum Pricing. Economic Valuation of Technology. ICT business models, policy impact, assessment, scenarios, socio-economic aspects of user adoption of new communication technologies. ICT productivity paradox ICT and telecom technology overviews, new economy, traditional telecommunication economics, ICT and sustainability and the importance of the intellectual property.

Prerequisite: -

Textbooks:

1. Handout

Special Topic of Technology and Innovation
ENEE802707
2 Credits
Learning Outcomes:

The competence built in this course is the ability of students to understand aspects of international and national law, telecommunications regulations and policies, and the standardization process in the Telecommunications industry.

Topic: -

Prerequisite: -

Textbooks:

1. Handout

Internet of Things (IoT) and Future Network Technology
ENEE803708
3 Credits
Learning Outcomes:

Students are able to design and analyze the performance of IoT technology and future networks in the industrial era 4.0.

Topic:

TMN Generic Model. eTOM. Traffic Management. Mobile Network Design. Frequency Planning. Fundamentals of Internet of Things (IoT). IoT management planning. LoRA, NB-IoT, Future Network Technology.

Prerequisite: -

Textbooks:

1. T. Plevyak, V. Sahin, "Next Generation Telecommunications Networks, Services and Management", Wiley-IEEE Press, 2010.
2. M. Guizaini, HH Chen, C.Wang, "The Future of Wireless Networks: Architectures, Protocols, and Services", CRC Press 2016

Capita Selecta
ENEE803709
2 Credits
Learning Outcomes:

Students are able to develop a vision of leadership and holistic insights for students by sharing knowledge with stakeholders in the telecommunications industry (operators,vendors) and government, including in the fields of convergence, macroeconomics, and microeconomics.

Topic: -

Prerequisite: -

Textbooks:

1. Handout

Majoring in Power and Energy Management

Control and Operation of Power Generation Plant
ENEE801801
3 Credits
Learning Outcomes:

After completing this course, students are able to operate geothermal and hydro power plants, distribution and power control systems and build a model of electricity production costs.

Topic:

Commitment; Generation with limited energy supply; Hydrothermal Coordination; Production cost model; Control of generation; Power and energy exchange.

Prerequisite: -

Textbooks:

1. A.J. Wood and B.F. Wollenberg, "Power Generation, Operation and Control", 2nd Edition, John Wiley & Sons Inc., 1996.

Economic of Electric Utility Power Generation
ENEE801802
3 Credits
Learning Outcomes:

At the end of the course, students are able to describe the operating methods of utility power generation efficiently without compromising business development.

Topic:

Introduction; Organizational Utility; Target accounting principles; Time and money value; Revenue requirements: fixed charge rate; Economic analysis methods; Electric utility system loads; Operating system; System stability: reserves, economic characteristics of generating units; Problems with total system analysis; Analysis of renewable energy and storage; Direct unit comparison; Future development.

Prerequisite: -

Textbooks:

1. W.D. Marsh, "Economics of Electric Utility Power Generation", Oxford University Press, 1980. ISBN-10: 019856130X, ISBN-13: 978-0198561309
2. W.G. Sullivan, E.M. Wicks, J.T. Luxhoj, "Engineer-

ing Economy", 13th Edition, Pearson Education Ltd., 2006.

Dynamic System and Modeling

ENEE802803
3 Credits
Learning Outcomes:

Be able to formulate the factors that influence the latest developments in the electricity system both technical and non-technical aspects

Topic:

Introduction to dynamic systems, feedback cycles, multivariable and multi-objective complex models, modeling and simulation, model design, change development, urban dynamics

Prerequisite: -

Textbooks: -

Economics Energy And Management

ENEE802804
3 Credits
Learning Outcomes:

Be able to design an energy management system by applying supply/demand from the management side related to sources, both fossilized and non-fossilized

Topic:

Sources of Fossils and Non-Fossils; Power system management: including the generation, transmission and distribution of electricity; Supply management and supply management are known as Integrated Resource Planning.

Prerequisite: -

Textbooks:

1. J.M. Griffin, H.B. Steele, "Energy Economics and Policy", Academic Press New York, 1980.
2. Zuhal, "Ketenagalistrikan Indonesia", PT. Ganesha Prima, April 1995.

Strategic Management

ENEE802805
3 Credits
Learning Outcomes:

This course aims to embed the concept of strategic management to produce business excellence and industrial competitiveness. Students are expected to be able to understand applied theories and develop strategies relevant to the technology industry.

Topic:

The characteristics of strategy management; Strategy in practice; Evaluation of external factors; Internal factor analysis; Strategy and choice analysis; Evaluation and control strategies; Quality management; Global Strategy Strategy Management; Risk management; Business ethics; Strategy at the corporate level; Leadership strategy.

Prerequisite: -

Textbooks:

1. F.R. David, "Concepts of Strategic Management," 13th Edition, Prentice Hall, 2010.
2. M.A. Hitt, R.D. Ireland, R.E. Hoskisson, "Strategic Management: Concepts and Cases: Competitiveness and Globalization", 9th Edition, South-Western College Pub., 2010

Electrical Power System Quality

ENEE803806
2 Credits
Learning Outcomes:

Be able to analyze the operating conditions of the electrical power system, under the steady-state condition and disruption due to swell voltage/sag voltage and harmonic distortion.

Topic:

Transient; Overvoltage; Undervoltage; Interruptions; Sags; Swells; Voltage Imbalance; Voltage fluctuations; Waveform distortion; Power frequency variations; Harmonic Distortion; Voltage Distortion vs Current; Harmonic vs Transient; Harmonic Control; Filter Design; Benchmarking power quality; Power distribution and power quality; Wiring and grounding; Power quality check.

Prerequisite: -

Textbooks:

1. R.C. Dugan, M.F. Mc.Granaghan, S.Santoso, H.W. Beaty, "Electrical Power System Quality", 2nd Edition, Mc.Graw Hill, 2002.

Electric Power System Planning

ENEE803807
3 Credits
Learning Outcomes:

Be able to analyze the identity of the demand forecast of changes in economic variables and be able to estimate the reliability of the system in changing economic conditions.

Topic:

Estimated demand for increased electric power; Long-term electricity supply; Electricity generation (production) planning; Scheduling maintenance of power system generators; Strategic factors of Indonesia's electricity development; Prospects for

electricity development in Indonesia; Electric power system development model; Optimization method.

Prerequisite: -

Textbooks:

1. X. Wang, J.R. McDonald, "Modern Power System Planning", McGraw Hill Book Co., 1994.
2. Zuhal, "Ketenagalistrikan Indonesia", PT. Ganesha Prima, April 1995.

Energy and Environment

ENEE803808
2 Credits
Learning Outcomes:

At the end of the course, students will be able to analyze the effects of using green energy source.

Topic:

Global warming is caused by the use of fossil and non-fossil energy; Solving environmental problems nationally and globally; Implementation of the Kyoto Protocol in the form of a Clean Development Mechanism; CO2 trading.

Prerequisite: -

Textbooks:

1. W.W. Nazaroff, L.A. Cohen, "Environment Engineering Science", John Wiley and Sons Inc., 2001.
2. R.A. Ristineu, J.J. Kroushaar, "Energy and Environment", John Wiley and Sons Inc., 2006.

Majoring in Information Network Security Management

Information Network Security

ENEE801901
2 Credits
Learning Outcomes:

In this course students will learn about the latest issues on privacy and security related to information systems. After completing this course, students are able to describe the protocols and models of a security system in communication. Students are also able to analyze network vulnerabilities and apply security systems on the network and the web. In addition, students will be able to carry out techniques of proof in cryptography.

Topic:

Introduction to Security and Privacy Issues Related to Information Systems; Principles of Confidentiality, Integrity, Availability, Identity and Authentication; Data Protocols and Integrity; Access Control; Safety Model; Cryptographic Systems and Protocols for Privacy; Network & Web Security; Intrusion Detection and Prevention; Vulnerability and Attack; Security Risk Analysis; Disaster Recovery Planning; Safety Regulations; Safety and ISO17799 Audit; Introduction to Cryptography; Encryption; Classic Encryption Techniques; Data Encryption and Block Password Standards; Advanced Encryption Standards; Pseudo-Random Generation; Digital Signatures; Two-Party Protocols and Zero-Knowledge.

Prerequisite: -

Textbooks:

1. R.R. Panko, "Corporate Computer and Network Security", Prentice Hall, 2004.
2. W. Stallings, "Cryptography and Network Security: Principles and Practice", 3rd Edition, Prentice Hall, 2003.
3. O. Goldreich, "Foundations of Cryptography: Basic Tools", Cambridge University Press, 2001.

Information Network Infrastructure

ENEE801902
2 Credits
Learning Outcomes:

This course introduces students to the basic concepts behind the design and scale of server farms using data centers and content switching technology. This course will discuss the principles and concepts that necessary to face the most common challenges faced during the planning, procurement, implementation and management of Internet and IP-based intranet server farms. In-depth analysis of data center technology with real scenarios will also be discussed. After completing this course, students will be able to design, implement and analyze server farm designs. Students will also be able to manage server farms.

Topic:

Introduction To Server Farms; Server Farm Protocols; Infrastructure Protocols; Security and Server Load Balancing; Data Center Design: Designing The Data Center Infrastructure; Integrating Security Into The Infrastructure; Performance Metrics of Data Center Devices; Data Center Administration and Management; State of the Art Data Center, Procurement.

Prerequisite: -

Textbooks:

1. M. Arregoces, M. Portolani, "Data Center Fundamentals", Cisco Press. 2004.
2. D. McCabe, "Network Analysis, Architecture

and Design", 3rd Edition, Morgan Kaufman, 2007.

3. M. Lankhorst, "Enterprise Architecture at Work: Modeling, Communication and Analysis", 2nd Edition, Springer, 2009.

4. M. Liotine, "Mission-Critical Network Planning", Artech House, 2003.

Computer Based Network Simulation

ENEE801903
2 Credits
Learning Outcomes:

After completing this course, students are able to describe the role of network simulation in new protocol research on the internet and are able to implement and analyze network simulations by using NS (Network Simulator) to conduct research in networks.

Topic:

Introduction; Basic network simulation; NS Basics: OTCL, simple simulation examples (topology, events, marking flows, monitoring a queue), architecture (nodes, links, applications, protocols, packets, loss modules, math support); Event Scheduler; Network Components; Packet; Post Simulation: analyzing tracefile, queue monitor (examples); Best Practice in Network Performance Evaluation Techniques; Ns topology generation, OTCL and C ++, routing (unicast, multicast, network dynamics), multicast transport; NAM network animator; Further features (abstraction, multicast, RTP / RTCP, SRM, QoS, Scenario generation, test suites); Developing NS: Ns structure, OTCL linkage, adding new applications and agents, queue; New protocol for NS: Header file, C ++ code, necessary changes, the TCL code; Introduction to NS-3

Prerequisite: -

Textbooks:

1. J. F. Kurose and K. W. Ross, "Computer Networking, A Top-Down Approach Featuring the Internet", Addison Wesley, 2003

2. A. Law and W. Kelton, "Simulation Modeling and Analysis", McGraw-Hill, 2001.

3. R. Jain. "The Art of Computer Systems Performance Analysis: Techniques for Experimental Design, Measurement, Simulation, and Modeling", John Wiley and Sons, New York, 1991.

Network and Application Security

ENEE802904
3 Credits
Learning Outcomes:

In this course students will learn and practice securing applications and computer networks. After completing this course, students are able to describe the forms of security attacks on applications and computer networks, are able to analyze security problems in applications both desktop-based and web-based applications, and are able to implement security concepts on applications and computer networks.

Topic:

Introduction to Computer Application and Network Security; Network Penetration Detection; Web-based Application Penetration Detection; Penetration Detection on Wireless Networks; Safe Encoding in Java; Safe coding in PHP; Building a Secure Database.

Prerequisite: -

Textbooks:

1. G. McGraw, "Software Security: Building Security In", Pearson Education, Inc., 2006.

2. M. Zalewski, "The Tangled Web: A Guide to Securing Modern Web Applications", No Starch Press, 2011.

Security Operations and Incident Management

ENEE802905
3 Credits
Learning Outcomes:

After taking this course, students are able to handle risks and evaluate vulnerabilities, threats, and network security warnings, and are able to compare the objectives and common reasons for using various cybersecurity tools and technologies.

Topic:

Threat Management; Vulnerability Management; Cyber Incident Responses; Security Architecture and Tool Sets

Prerequisite: -

Textbooks:

1. CISCO CCNA Cyber Operation (CyberOps)

2. CompTIA Cybersecurity Analyst (CySA+)

Cyber Forensic

ENEE802906
3 Credits
Learning Outcomes:

In this course students will learn digital forensics and networking. After attending this course, students are able to identify digital traces on computers and on

the network, able to recognize forms of attack from digital traces, able to analyze digital traces and able to collect legal evidence.

Topic:

Introduction to Digital Forensics and Networks; Windows-Based Computer Forensics; Linux Based Computer Forensics; Forensics in Computer Networks; Forensics on Mobile Devices.

Prerequisite: -

Textbooks:

1. E. Casey, "Digital Evidence and Computer Crime: Forensic Science, Computers, and the Internet", 3rd Edition, Academic Press, 2011.
2. A. J. Marcella Jr. and F. Guillossou, "Cyber Forensics: From Data to Digital Evidence", Wiley, 2012.

Security Assessment and Analysis

ENEE802904
3 Credits
Learning Outcomes:

After taking this course, students are able to exploit vulnerabilities inside the networks, web applications, wireless, cloud, and databases, and are able to write reports and recommendations on prevention strategies for discovered vulnerabilities

Topic:

Planning and Scoping; Information Gathering; Vulnerability Identification; Attacks and Exploits; Penetration Testing Tools; Reporting and Communication

Prerequisite: -

Textbooks:

1. EC-Council Security Analyst (ECSA)
2. CompTIA PenTest+

Cyber Threat Intelligence Analysis

ENEE803908
2 Credits
Learning Outcomes:

After taking this course, students are able to conclude accurate perceptions about the company's security attitudes and threats, able to analyze the status of future risks by applying artificial intelligence.

Topic:

Introduction to Threat Intelligence, Cyber Threats and Kill Chain Methodology, Requirements, Planning, Direction, and Review, Data Collection and Processing, Data Analysis, Dissemination and Reporting of Intelligence

Prerequisite: -

Textbooks:

1. EC-Council Certified Threat Intelligence Analyst (C|TIA)

Security Risk Management and Regulation

ENEE803909
2 Credits
Learning Outcomes:

This course introduces and explores the aspects of management, information network security standards and regulations. At the end of this course, students are expected to comprehend the principles of information security and be able to apply these principles to design solutions to manage information security risks effectively. Students are also expected to understand how to apply the principles of information network security management in a broad and contemporary context. Finally, students are able to manage information networks in accordance with professional standards, ethics, rules and regulations.

Topic:

Information Security Policy and Management; Management of Threats and Weaknesses in Information Networks; Incident and Risk Management; Crisis Management and Business Sustainability; Information Security Awareness and Culture and Information Network; Implementation Aspects of Information Network Security; Legal and Regulatory Aspects of Information Security; Information Security and Information Network Certification; SNI ISO/IEC 27001: 2009 Standard.

Prerequisite: -

Textbooks:

1. C.P. Pfleeger, and S.L. Pfleeger, "Security in Computing", 4th Edition, Prentice Hall, 2008.
2. M. Subramanian, "Network Management Principles & Practices", Pearson, 2010.

Master Program in Biomedical Technology

Program Specification

1.	**Awarding Institution**	Universitas Indonesia	
2.	**Teaching Institution**	Universitas Indonesia	
3.	**Faculty**	Engineering	
4.	**Programme Title**	Master Program in Biomedical Technology	
5.	**Program Vision and Mission**	To become a higher level study program in education, research and community service in the field of Biomedical Technology and be able to contribute to the development of Indonesian and Global society.	
6.	**Class**	Reguler	
7.	**Final Award**	Magister Teknik (M.T.)	
8.	**Accreditation / Recognition**	BAN-PT: Accreditation B	
9.	**Language (s) of Instruction**	Bahasa / English	
10.	**Study Scheme (Full Time / Part-Time)**	Full Time	
11.	**Entry Requirements**	Pass the entrance exam, graduate from Bachelor/Diploma 4 in Biomedical Engineering, Medical, Engineering, Science, Computer, Pharmacy, and other subjects of equal.	
12.	**Study Duration**	Designed for 2 years	
	Type of Semester	Number of semester	Number of weeks/semesters
	Reguler	4	16
	Short (opsional)	**1**	**8**
13.	**Aims of the programme:** Producing Masters who are able to design systems, components, or processes in the field of Biomedical Technology through the design, analysis, development and application of the latest technological concepts in dealing with problems in the field of biomedical technology.		
14.	**Profile of Graduates:** Master in Engineering that has ability to formulate and solve a complex problem in biomedical engineering field through research based on innovative technology with inter or multi discipline approach in accordance to professional ethics.		

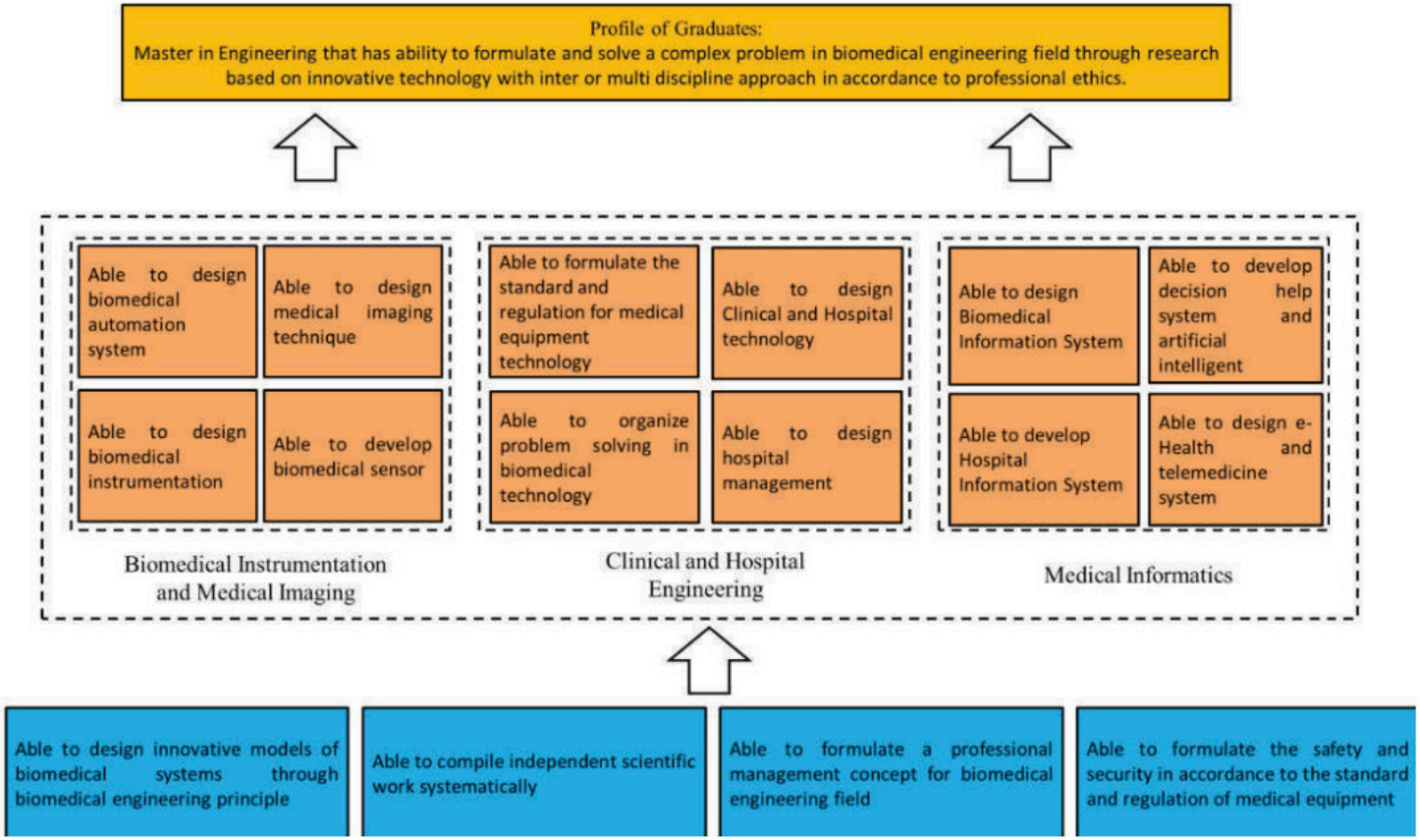
15.	**Expected Learning Outcomes /Expected Learning Outcomes (ELO) :** Master in Biomedical Technology graduates are expected to have the following competence: 1. Able to design innovative models of biomedical systems through biomedical engineering principle (C6) 2. Able to compile independent scientific work systematically (C6) 3. Able to formulate a professional management concept for biomedical engineering field (C6) 4. Able to formulate the safety and security in accordance to the standard and regulation of medical equipment (C6) Beside the above competence, a Master in Biomedical Engineering should also have the following specialized competence: Specialization in Biomedical Instrumentation and Medical Imaging: 1. Able to design biomedical instrumentation (C6) 2. Able to develop biomedical sensor (C6) 3. Able to design biomedical automation system (C6) 4. Able to design medical imaging technique (C6) Specialization in Medical Informatics: 1. Able to develop Hospital Information System (C6) 2. Able to design e-Health and telemedicine system (C6) 3. Able to design Biomedical Information System (C6) 4. Able to develop decision help system and artificial intelligent (C6) Specialization in Clinical and Hospital Engineering: 1. Able to organize problem solving in biomedical technology (C6) 2. Able to design hospital management (C6) 3. Able to formulate the standard and regulation for medical equipment technology (C6) 4. Able to design Clinical and Hospital technology (C6)
16.	**Composition of Subjects**

No.	Classification	Credit Hours (SKS)	Percentage
I	**Core Subjects**	16	36,36%
II	**Majoring Subject**	12	27,27%
III	**Special Subject**	10	22,73%
IV	**Elective Subject**	6	13,64%
	Total	44	100 %

Career Prospects

Graduates from Biomedical Engineering Study Program can work in various types of companies and health industries, information technology, education, government or regulator, and other industries related to health facilities, such as hospitals and health clinics.

Learning Outcomes



Course Flowchart for Master Program in Program Study of Biomedical Technology

Biomedical Instrumentation and Medical Imaging Specialization

No.	Learning Outcomes	Semester 1	Semester 2	Semester 3	Semester 4
1	Able to design innovative models of biomedical systems through biomedical engineering principle	Anatomy and Modelling in Physiology Design and Prototyping Biomedical System			Scientific Publication Thesis
2	Able to compile independent scientific work systematically	Research Methodology 1	Research Methodology 2		Scientific Publication Thesis
3	Able to formulate a professional management concept for biomedical engineering field	Project Management for Biomedical Engineering			
4	Able to formulate the safety and security in accordance to the standard and regulation of medical equipment	Patient Safety Standards and Regulations			
5	Able to design biomedical instrumentation		Biomedical Instrumentation		
6	Able to develop biomedical sensor		Biomedical Sensor		
7	Able to design biomedical automation system		Biomedical System Automation		
8	Able to design medical imaging technique		Medical Imaging and Image Processing		

Medical Informatics Specialization

No.	Learning Outcomes	Semester 1	Semester 2	Semester 3	Semester 4
1	Able to design innovative models of biomedical systems through biomedical engineering principle	Anatomy and Modelling in Physiology Design and Prototyping Biomedical System			Scientific Publication Thesis
2	Able to compile independent scientific work systematically	Research Methodology 1	Research Methodology 2		Scientific Publication Thesis
3	Able to formulate a professional management concept for biomedical engineering field	Project Management for Biomedical Engineering			
4	Able to formulate the safety and security in accordance to the standard and regulation of medical equipment	Patient Safety Standards and Regulations			
5	Able to develop Hospital Information System		Hospital Information System		
6	Able to design e-Health and telemedicine system		*e-Health* and Telemedicine		
7	Able to design Biomedical Information System		Computational Biology and Bioinformatics		
8	Able to develop decision help system and artificial intelligent		Decision Making System and Artificial		

Clinical and Hospital Engineering Specialization

No.	Learning Outcomes	Semester 1	Semester 2	Semester 3	Semester 4
1	Able to design innovative models of biomedical systems through biomedical engineering principle	Anatomy and Modelling in Physiology Design and Prototyping Biomedical System			Scientific Publication Thesis
2	Able to compile independent scientific work systematically	Research Methodology 1	Research Methodology 2		Scientific Publication Thesis
3	Able to formulate a professional management concept for biomedical engineering field	Project Management for Biomedical Engineering			
4	Able to formulate the safety and security in accordance to the standard and regulation of medical equipment	Patient Safety Standards and Regulations			
5	Able to organize problem solving in biomedical technology		Hospital Medical Equipment		
6	Able to design hospital management		Clinical Asset and Equipment Management System		
7	Able to formulate the standard and regulation for medical equipment technology		Hospital Engineering		
8	Able to design Clinical and Hospital technology		Design of Hospital and Healthcare Facilities		

Curriculum Structure

Majoring in Biomedical Instrumentation and Medical

Code	Subject	SKS
	1st Semester	
ENBE801001	Anatomy and Modelling in Physiology	3
ENBE801002	Research Methodology 1	2
ENBE801003	Patient Safety Standards and Regulations	3
ENBE801104	Design and Prototyping Biomedical System	3
ENBE801005	Project Management for Biomedical Engineering	**3**
	Subtotal	**14**
	2nd Semester	
ENBE802006	Research Methodology 2	2
ENBE802101	Biomedical Instrumentation	3
ENBE802102	Biomedical Sensors	3
ENBE802103	Medical Imaging and Image Processing	3
ENBE802104	Biomedical System Automation	**3**
	Subtotal	**14**
	3rd Semester	
	Elective Course	3
	Elective Course	3
	Subtotal	**6**
	4th Semester	
ENBE804007	Scientific Publication	2
ENBE804008	Final Project	8
	Sub Total	**10**
	Total	**44**

Majoring in Medical Informatics

Code	Subject	SKS
	1st Semester	
ENBE801001	Anatomy and Modelling in Physiology	3
ENBE801002	Research Methodology 1	2
ENBE801003	Patient Safety Standards and Regulations	3
ENBE801104	Design and Prototyping Biomedical System	3
ENBE801005	Project Management for Biomedical Engineering	**3**
	Subtotal	**14**
	2nd Semester	
ENBE802006	Research Methodology 2	2
ENBE802201	Hospital Information System	3
ENBE802202	Decision Making System and Artificial Intelligent	3
ENBE802203	e-Health and Telemedicine	3
ENBE802204	Computational Biology and Bioinformatics	**3**
	Subtotal	**14**
	3rd Semester	
	Elective Course	3
	Elective Course	3
	Subtotal	**6**
	4th Semester	
ENBE804007	Scientific Publication	2
ENBE804008	Final Project	8
	Sub Total	**10**
	Total	**44**

Majoring in Clinical and Hospital Engineering

Code	Subject	SKS
	1st Semester	
ENBE801001	Anatomy and Modelling in Physiology	3
ENBE801002	Research Methodology 1	2
ENBE801003	Patient Safety Standards and Regulations	3
ENBE801004	Design and Prototyping Biomedical System	3
ENBE801005	Project Management for Biomedical Engineering	**3**
	Subtotal	**14**

	2nd Semester	
ENBE802006	Research Methodology 2	2
ENBE802301	Hospital Medical Equipment	3
ENBE802302	Hospital Engineering	3
ENBE802303	Design of Hospital and Healthcare Facilities	3
ENBE802304	Clinical Asset and Equipment Management System	**3**
	Subtotal	**14**
	3rd Semester	
	Elective Course	3
	Elective Course	3
	Subtotal	**6**
	4th Semester	
ENBE804007	Scientific Publication	2
ENBE804008	Final Project	8
	Sub Total	**10**
	Total	**44**

Transition Rules

1. Curriculum of 2020 is implemented starting in the Odd Semester 2020/2021. After Curriculum of 2020 is implemented, only subjects in Curriculum of 2020 will be opened.
2. Class of 2019 and previous class followed the Curriculum of 2020 with transitional rules.
3. A transitional period of 1 year, in the academic year 2020/2021, is implemented for subjects where the semester changes (from Even to Odd, or vice versa), if necessary, the class will be opened in both semesters during the transition period (Academic Year 2020 / 2021).
4. For students who have not passed the compulsory subjects in Curriculum of 2018 are required to take the same or equivalent subjects in the 2020 Curriculum.
5. If there is a change in the credit (SKS) for the course, the number of credit (SKS) taken in graduation is the number of the SKS at the time the course was taken. If students are repeated or newly taken same or equal subjects with different credit (SKS), will be listed with a new name and calculated with new credit (SKS).
6. If the compulsory subjects in Curriculum of 2018 are removed and there is no equivalence in Curriculum of 2020, students who have passed these courses, it will still be counted as compulsory subjects in the graduation calculation of 44 credits. For students who have not passed the course, they can take new compulsory subjects or elective courses in Curriculum of 2020 to complete 44 credits.

Equivalence Course in Masters in Biomedical Technology

No	Name of courses in the curriculum 2018	SKS 2018	Name of courses in the curriculum 2020	SKS 2020
1	Human Body Physiological System Modelling	3	Anatomy and Modelling in Physiology	3
2	Research Methodology	2	Research Methodology 1	2
3			Research Methodology 2	2
Required Specialization Courses				
4	Biomedical Instrumentation 1	3	Biomedical Instrumentation	3
5	Medical Imaging	3	Medical Imaging and Image Processing	3
6	Biomedical Instrumentation 2	3	-	
7	Special Topic on Biomedical Instrumentation	3	-	
8	Hospital Medical Equipment I	3	Hospital Medical Equipment	3
9	Hospital Medical Equipment II	3	Hospital Engineering	
10	Regulation and Policy of Clinical Technology	3	-	
11	Planning and Design of Health Service Building	3	Design of Hospital and Healthcare Facilities	3
12	Clinical Engineering Management System	3	Clinical Asset and Equipment Management System	3
13	Planning and Design of Health Service Utility	3	Healthcare Technology Management System	3
14	Hospital Information System and Medical Record	3	Hospital Information System	3
15	Medical Automation	3	-	
16	Telemedicine	3	e-Health and Telemedicine	3

17	Information System-Based Management Skill	3	Hospital Information Management	3
18	Medical Informatics Consultancy	3		
19			Computational Biology and Bioinformatics	3

Subject Syllabus

Study Program Obligatory Subject

Anatomy and Modelling in Physiology
ENBE801001
3 CREDITS
Learning Outcome:

After completing this course, students are able to:

1. Analyze the results of molecular computing related to the physiology of the human body (C4)
2. Design biomedical system models based on engineering principles in accordance with the anatomy and physiology of the human body (C6).

Syllabus:

Complexity of physiology, central dogma of molecular biology, introduction to bioinformatics, molecular docking, principles of data modeling and modeling, neural systems, bioelectric phenomena, system modeling, introduction to MATLAB simulink, and case studies.

Prerequisite: None

Reference Books:
1. Cobelli C and Carson ER, Introduction to Modeling in Physiology and Medicine. 1st ed. A volume in Biomedical Engineering. 2008
2. Thieman, W. J., M. A. Palladino, Introduction to Biotechnology, Pearson 2012
3. Ibrahim, K. S., G. Gurusubramanian, Zothansanga, R. P. Yadav, N. S. Kumar, S. K. Pandian, P. Borah, S. Mohan, Bioinformatics – A Student's Companion, Springer 2017
4. Tortora, G. J., Derrickson, B., Principles of Anatomy and Physiology, Wiley 2017
5. Enderle, J. D., Bioelectric Phenomena, Elsevier 2012
6. https://www.mathworks.com/support/learn-with-matlab-tutorials.html

Research Methodology 1
ENBE801002
2 CREDITS
Learning Outcome:

After completing this course, students will be able to formulate a research proposal (C6)

Syllabus:

Writing the formulation of the research problem and its background, SotA and Hypotheses, Data collection methods, abstracts, conclusions, and research proposals.

Prerequisite: None

Reference Book:
1. N1.ovikov, A. M. and D. A. Novikov. Research methodology from philosophy of science to research design. CRC Press. 2013
2. Deb, D., R. Dey, V. E. Balas. Engineering Research Methodology A Practical Insight for Researchers. Springer. 2019
3. John D. Enderle, David C. Farden, And Daniel J. Krause; Advanced Probability Theory for Biomedical Engineers; Morgan&Claypool; 2006
4. Kristina M. Ropella, Introduction to Statistics for Biomedical Engineers, Morgan&Claypool; 2007

Patient Safety Standards and Regulations
ENBE801003
3 CREDITS
Learning Outcome:

After completing this course, students will be able to formulate standards and regulations for medical devices that will be made for the needs of national, regional and international markets (C6).

Syllabus:

Overview Medical Device Standard & Regulation, WHO Global Model Regulatory Framework for Medical Devices including in vitro diagnostic medical devices, International Electrical Comission (IEC), Standar Nasional Indonesia (SNI), Intenasional Standard Organisation (ISO) Standard, Medical Device Directive (MDD) European Union, Food and Drug Agency (FDA) Medical Devices Regulation, Global Health Task Force (GHTF), Asean Medical Device Directive (AMDD), Good Manufacturing Product (CPAKB), Good Distribution Product (CDAKB), Preparing FDA Submission, Preparing CE Submission, Filing Marketing License for Medical Devices in Indonesia.

Prerequisite: None

Reference Book:

1. Fries, RC (editor) (2001). Handbook of Medical Device Design. New York, Bassel: Marcel Dekker Inc.
2. GHTF. International Medical Device Regulators Forum. https://www.imdrf.org/ghtf
3. SNI (2016). SNI ISO 13485:2016. Peralatan kesehatan – Sistem manajemen mutu – Persyaratan untuk tujuan regulasi
4. SNI. Alat Kesehatan. http://sispk.bsn.go.id/SNI/DaftarList#
5. WHO (2003). MEDICAL DEVICE REGULATIONS Global overview and guiding principles. Geneva: WORLD HEALTH ORGANIZATION.
6. WHO (2017). WHO Global Model Regulatory Framework for Medical Devices including in vitro diagnostic medical devices. Printed by the WHO Document Production Services, Geneva, Switzerland.

Design and Prototyping Biomedical System

ENBE801004
3 CREDITS
Learning Outcome:

After completing this course, students will be able to:

- Design a structured selection of design concepts (C4).
- Synthesize prototypes of selected design concepts (C5).

Syllabus:

Product development, Opportunity identification; Identify customer needs; Concept generation; Concept Screening; Concept Testing; Product Architecture; Industrial Design; Design for Manufacturing; Prototyping Development; Workshop Prototyping.

Prerequisite: None

Reference Book:

1. Karl T. Ulrich, Steven D. Eppinger, Maria Yang; 7th Edition, Irwin McGraw-Hill, 2019.
2. Product Prototyping: From Concept to Reality in a Weekend, David Feinleib, 2014, Appress Publishing
3. Prototyping and Modelmaking for Product Design, Bjarki Hallgrimsson, 2012, Laurence King Publishing, London, UK.

Project Management of Biomedical Engineering

ENBE802005
3 CREDITS
Learning Outcome:

- Students will able to design a professional management for biomedical engineering field
- Students will able to design project economics aspect, so students are expected to understand the basic theories to support feasibility analysis for investment and service development/application for biomedical technology.

Syllabus:

Organization in project management, characteristics of the project cycle and project phases, project management processes including project management during planning, execution (monitoring), and control, project scope (WBS), time management, cost management, Gant Chart, S curve, and analysis economy.

Prerequisite: None

Reference Book:

1. Project management institute. A Guide to the project management body of knowledge fifth edition. 2013
2. Kerzner, H. Project management A System Approach to Planning, Scheduling, and Controlling. Willey Ohio 2002
3. Newnan, D. G., T. G. Eschenbach, J. P. Lavelle. Engineering Economic Analysis. Oxford University Press: Oxford. 2004

Research Methodology 2

ENBE801006
2 CREDITS
Learning Outcome:

After completing this course, students will be able to compile scientific papers from research results (C6)

Syllabus:

How to get research topics (digging information), appropriateness of research topics, looking for references, mapping references and sota), how to do our research, simulation and experiment-based research, continuity of research objects with realization, research data processing, research proposal writing methods, and methods scientific writing.

Prerequisite: None

Reference Book:

1. Novikov, A. M. and D. A. Novikov. Research methodology from philosophy of science to research design. CRC Press. 2013
2. Deb, D., R. Dey, V. E. Balas. Engineering Research Methodology A Practical Insight for Researchers. Springer. 2019
3. John D. Enderle, David C. Farden, And Daniel J. Krause; Advanced Probability Theory for

Biomedical Engineers; Morgan&Claypool; 2006
4. Kristina M. Ropella, Introduction to Statistics for Biomedical Engineers, Morgan&Claypool; 2007

Majoring Subject

Majoring in Biomedical Instrumentation And Medical Imaging

Biomedical Intrumentation

ENBE802101
3 CREDITS
Learning Outcome:

After completing this course, students will be able to design medium and high technology biomedical instrumentation designs in diagnostic and therapeutic services from patients in health care facilities (C6).

Syllabus:

Compression therapy, cryosurgery, auto spirometry device, test stress cardiopulmonary, LabVIEW, clinical chemistry analyzer, hematology analyzer, EEG, EMG, ECG, dan cardiac defibrillators.

Prerequisite: None

Reference Book:
1. Carr, J. J., & Brown, J. M. (2001). Introduction to Biomedical Technology (4th edition). New Jersey: Prentice Hall.
2. Enderle, J., Blanchard, S., & Bronzino, J. (2000). Introduction to Biomedical Engineering. San Diego, CA: Academic Press.
3. Wang, P., & Liu, Q. (2011). Biomedical Sensors and Measurement. Hangzhou, Heidelberg: Springer Berlin Heidelberg.
4. Webster, J. G. (2010). Medical Instrumentation: Application and Design (4th edition). New Jersey: John Wiley & Sons, Inc.

Biomedical Sensor

ENBE802102
3 CREDITS
Learning Outcome:

After completing this course, students will be able to design biosensors for medical applications (C6).

Syllabus:

The basis of the sensor which includes sensor characteristics, sensor calculation technology, and biocompatibility of the sensor, Physical sensor which includes resistance sensor, inductive sensor, capacitive sensor, piezoelectric sensor, magnetoelectric sensor, photoelectric, and thermoelectric sensor, optical sensor, Chemical sensor includes ion sensor , gas sensors, humidity sensors, sensor arrays, and sensor networks, and biosensors including catalytic biosensors, affinity biosensors, cell and tissue biosensors, biochips, and nano-biosensors.

Prerequisite: None

Reference Book:
1. Enderle J., Bronzino J. - Introduction to biomedical engineering-AP (2011).
2. Wang, P. Q. Liu. Biomedical Sensor and Measurement. Springer (2011)

Medical Imaging and Image Processing

ENBE802103
3 CREDITS
Learning Outcome:

After completing this course, students will be able to:

- Design (C6) medical imaging techniques for applications in the field of medicine.
- Recommend (C5) medical image processing techniques for applications in the field of medicine.

Syllabus:

Introduction to Medical Imaging Technologies (X-Ray and CT, MRI, Ultrasound, PET and SPECT, Electrical Impedance Tomography), Image formation and Reconstruction (Acquisition, Digitization, Image Reconstruction Methods), Image Enhancement (Fundamentals of enhancement techniques, Image enhancement with linear, nonlinear, fixed, adaptive, and pixel-based methods), Image Segmentation and Analysis (Fundamentals of Medical Image Segmentation, Image preprocessing and acquisition artifacts, Thresholding, Edge-based techniques, Region-based segmentation, Classification, Morphological Methods for Biomedical Image Analysis), Image Visualization (2-dimensional visualization, 3-dimensional visualization methods: surface rendering, volume rendering, Algorithm for 3-D visualization), Image Management (Fundamentals of Standards Compression Storage and Communication, Image archive and retrieval, three-dimensional compression), citra visual dan digital, transformasi citra, representasi warna, image enhancement (domain spatial), image enhancement (frequency domain), konvolusi dan korelasi, segmentasi citra, sifat fitur objek, image compression, pattern recognition, image restoration, image morphology.

Prerequisite: None

Reference Book:

Mandatory:

1. Joseph D. Bronzino, The Biomedical Engineering Handbook, Third Edition, "Medical Devices and Systems," CRC Press: 2006, Section II.
2. Avinash C. Kak and M. Slaney, "Principle of Computerized Tomographic Imaging," IEEE Press: 1999.
3. Isaac Bankman, "Handbook of Medical Imaging: Processing and Analysis Management," Academic Press: 2000, CA, USA.
4. E. S. Gopi, "Digital Signal Processing for Medical Imaging Using Matlab," Springer:2013, New York.
5. Medical Image Processing, Reconstruction and Restoration: Concepts and Methods, Jirí Jan, CRC Press: Taylor & Francis Group 2006, Boca Raton, FL, USA.

Addition:

6. Handbook of Medical Imaging, Vol. 2: Medical Image Processing and Analysis, M. Sonka & J.M. Fitzpatrick, SPIE Press, 2009, Washington, USA
7. Biomedical Image Processing, Thomas M. Deserno, Springer-Verlag Berlin Heidelberg, 2011
8. Biomedical Signal and Image Processing, Kayvan Najarian and Robert Splinter, CRC Press: Taylor & Francis Group 2012, Boca Raton, FL, USA.

Biomedical System Automation
ENBE803105
3 CREDITS
Learning Outcome:

After completing this course, students are able to:

1. Analyze stability, transient response and steady-state error in a control system (C4).
2. Recommend a control system design method (C5)
3. Design controllers in a biomedical system (C6)

Syllabus:

Introduction, discusses the definition of control systems, configurations, theoretical history and application examples; Mathematical models of systems in the biomedical field that can be designed for automated control systems; Mathematical model simulation using MATLAB/Simulink or SCILAB/Xcos; Derivation of mathematical models of continuous and discrete linear systems using linearization, laplace transform and z methods; Transient response, stability and steady state error (error at steady state); Frequency response analysis; Root positioning technique; PID controller design; Design of controllers for biomedical applications.

Prerequisite: None

Reference Book:

1. Automatic Control Systems in Biomedical Engineering, Springer Verlag, 2018
2. Control Systems Engineering 6th ed, John Wiley & Sons, 2011
3. Feedback Control of Dynamic Systems 7th, Pearson, 2015
4. Control Engineering: MATLAB Exercises, Springer Verlag, 2019
5. Control Theory In Biomedical Engineering: Applications in Physiology and Medical Robotics, Academic Pres, 2020.

Majoring in Medical Informatics

Hospital Information System
ENBE802201
3 CREDITS
Learning Outcome:

After completing this course, students will be able to develop hospital information systems (C6).

Syllabus:

Introduction to Health Care Information, Health Care Data Quality, Health Care Information Regulations, Laws, and Standards, Clinical Information Systems, Quality of Patient Care through the Use of Health Information Technology and System Acquisition, Technologies That Support Health Care Information Systems, Security of Health Care Information Systems, e-Security: Frameworks for Privacy and Security in E-Health Data Integration and Aggregation, Organizing Information Technology Services, IT Governance and Management, Management's Role in Major IT Initiatives, Assessing and Achieving Value in Health Care Information Systems.

Prerequisite: None

Reference Books:

1. K.A. Wager et al.. (2013). Health Care Information Systems: A Practical Approach for Health Care Management. Publisher: John Wiley & Sons.
2. J. Tan. (2005). E-Health Care Information Systems Jossey-Bass,.
3. J. Carnicero and A. Fernandes. (2012). eHealth Handbook for Managers of Healthcare Services and Systems, United Nations Publication ISBN: 978-84-695-4145-6

Decision Making System and Artificial Intelligence
ENBE802202
3 CREDITS
Learning Outcome:

After completing this course, students will be able to:

- Assess the results of intelligent decision support (C5).
- Design intelligent decision support based on the knowledge they have gained (C5).

Syllabus:

Intelligent Systems and Intelligent Decision Support Systems (IDSS) in Healthcare; Medical Diagnosis Applications with Deep Learning; IDDS in Medical Research; Data Mining-Based Intelligent Decision Support Systems.

Prerequisite: None

Reference Book:

1. Belciug S, Gorunescu F. Intelligent Decision Support Systems—A Journey to Smarter Healthcare. 1st ed: Springer; 2020. [https://link.springer.com/book/10.1007/978-3-030-14354-1]
2. Berner ES. Clinical Decision Support Systems: Theory and Practice. 3rd ed: Springer; 2016. [https://link.springer.com/book/10.1007/978-0-387-38319-4]
3. Kose U, Deperlioglu O, Alzubi J, Patrut B. Deep Learning for Medical Decision Support Systems. 1st ed: Springer; 2021. [https://link.springer.com/book/10.1007/978-981-15-6325-6]
4. Sharda R, Delen D, Turban E. Analytics, Data Science, and Artificial Intelligence: Systems for Decision Support. 11th ed: Pearson; 2020. [https://www.pearson.com/us/higher-education/program/Sharda-Analytics-Data-Science-Artificial-Intelligence-Systems-for-Decision-Support-11th-Edition/PGM2067063.html]

Addition:

1. Hashizume M. Multidisciplinary Computational Anatomy: Toward Integration of Artificial Intelligence with MCA-based Medicine. 1st ed: Springer; 2022. [https://link.springer.com/book/10.1007/978-981-16-4325-5]
2. Kaklauskas A. Biometric and Intelligent Decision Making Support. 1st ed: Springer; 2015. [https://link.springer.com/book/10.1007/978-3-319-13659-2]
3. Suzuki K, Chen Y. Artificial Intelligence in Decision Support Systems for Diagnosis in Medical Imaging. 1st ed: Springer; 2018. [https://link.springer.com/book/10.1007/978-3-319-68843-5]

e-Health and Telemedicine

ENBE802203
3 CREDITS
Learning Outcome:

After completing this course, students will be able to:

1. Designing (C6) e-health and telemedicine systems.
2. Analyze to solve (C4) critically and creatively at the individual and group level in the health sector.

Syllabus:

Students will identify communication system technology for health applications, analyze the nature of electromagnetic waves and propagation in body-centric wireless communication (BWCS) technology and the effects of electromagnetic compatibility and interference (EMC / EMI), analyze wearable devices and implant models for communication as well as the concept of body area network (BAN), telemedicine, e-health, hospital information system (HIS) and wireless power transfer (WPT); and in the end students can design a communication application for the health sector simply through the development of hardware and software.

Prerequisite: None

Reference Books:

Mandatory:

1. H. Eren and J.G. Webster. (2016). Telehealth and Mobile Health, The e-Medicine, E-Health, M-Health, Telemedicine, and Telehealth Handbook Vol. II. CRC Press, Boca Raton, FL.
2. Mohamed K. Watfa. (2012). E-Healthcare Systems and Wireless Communications: Current and Future Challenges. Publisher: IGI Global.
3. Hebda T. & Czar P. (2013). Handbook of Informatics for Nurses & Healthcare Professionals (5th Edition). Pearson

Addition:

4. Gartee R. (2016).Electronic Health Records (3rd Edition). Pearson

Computational Biology and Bioinformatics

ENBE802204
3 CREDITS
Learning Outcome:

After completing this course, students will be able to design prototypes of computational biology and bioinformatics programs (C6).

Syllabus:

Computational concepts of biology and bioinformatics; Molecular central dogma; Genomics, transcriptomics, proteomics, as well as their relation to bioinformatics analysis; R and python languages for bioinformatics.

Prerequisite: None

Reference Books:

1. Claverie, J. M. & Notredame, C. 2011. Bioinformatics for Dummies. Wiley Publishing.
2. Wong KC. 2016. Computational Biology and Bioinformatics: Gene Regulation. CRC Press.
3. Judith Hurwitz, Alan Nugent, Fern Halper, Marcia Kaufman. 2013. Big Data for Dummies. John Wiley & Sons.
4. Lutz, M. 2013. Learning Python. O'Reilly Media.
5. Adler J. 2010. R in a nutshell: A desktop quick reference. O'Reilly Media.

Majoring in Clinical and Hospital Engineering

Hospital Medical Equipment

ENBE802301
3 CREDITS
Learning Outcome:

After completing this course, students will be able to organize general medical equipment technology for hospital needs.

Syllabus:

Major equipment used by health professional in Hospital. This study includes physiology principles for each clinical technology equipment, operation principles, main features, method for testing and evaluation for work display and equipment security, a review on the equipment population currently available in market. The clinical technology equipment that will be discussed in this session are as follow fundamental of medical instrumentation system; Vital sign monitoring; External defibrillator; Cardiac Defibrillator; Ventilator system; Anesthesia machine; Clinical laboratory equipment.

Prerequisite: None

Reference Books:

1. John G. Webster (ed.), Encyclopedia of Medical Devices and Instrumentation, A John Wiley & Sons, 2nd edition, 2006.
2. Myer Kutz, Biomedical Engineering and Design Handbook (Volume 1: Fundamentals), McGraw Hill, New York, 2nd edition, 2009.
3. Myer Kutz, Biomedical Engineering and Design Handbook (Volume 2: Applications), McGraw Hill, New York, 2nd edition, 2009.
4. Yadin David (ed.), Clinical Engineering, CRC Press, Washington DC, 2005.

Hospital Engineering

ENBE802302
3 CREDITS
Learning Outcome:

After completing this course, students will be able to make a design of technology / hospital infrastructure based on national and international bibliography (C6).

Syllabus:

Overview of Planning and Design of Hospital Utilities; Standards for Hospital Technology/Infrastructure; Regulations for Hospital Technology/Infrastructure; Hospital Electrical Installation System; Hospital Air Conditioning System; Hospital Active Fire Protection System; Hospital Building Automation System; Medical Gas and Vacuum Medical Installation System; Hospital Elevator/Elevator System; Hospital Clean Water System; Hospital Liquid Waste Treatment System; Hospital Solid Waste Treatment System; Telemedicine, Communication and Health Information Systems; Examples of Hospital Technology/Infrastructure Design; Planning and Design of Hospital Technology / Infrastructure.

Prerequisite: None

Reference Books:

1. ASHRAE. (2013). HVAC Design Manual for Hospitals and Clinics. 2 nd Edition. Atalanta: The American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc
2. FGI & AIA. (2006). Guidelines for Design and Construction of Health Care Facilities.
3. G.D. Kunders. (2010). Hospitals Facilities Planning and Management. New-Delhi: Tata McGraw-Hill Publishing Company Limited.
4. IHFG. (2017). Part B – Health Facility Briefing & Design: including Functional Planning Units. International Health Facility Guidelines
5. J.C.I (2015 Planning, Design, and Construction of Health Care Facilities. Joint Comission International. Printed in USA.
6. J.M. Currie. (2004). Book Section. An Overview of Healthcare Facilities Planning. New York: McGraw-Hill Digital Engineering Library.
7. KLHK. (2019). Pedoman Kriteria Teknologi Pengelolaan Limbah Medis Ramah Lingkungan. Jakarta: Tim Kementerian Lingkungan Hidup
8. NFPA. (2019). Health Care Facilities Code Handbook. 11 th Edition. Massachusetts: National Fire Protection Association

Design of Hospital and Healthcare Facilities

ENBE802303
3 CREDITS
Learning Outcome:

After completing this course, students will be able to design health service buildings and utilities based on national and international bibliography (C6).

Syllabus:

Planning, Design and Construction of Healthcare Facilities; Standards for Health Care Buildings and Utilities; Regulations for Health Care Buildings and Utilities; Planning and Design: Emergency Room; Planning and Design: Operating Room; Planning and Design: Intensive Care Room; Planning and Design: Inpatient Room; Planning and Design: Diagnostic Radiology Room; Example of Hospital Building Design: General & Typical Hospital; Technical Requirements for Hospital Electrical Installations; Medical Gas and Vacuum Medical Installation System; Hospital Active Fire Protection System; Hospital Clean Water System; Hospital Sewage Treatment System; Telemedicine, Communication and Health Information Systems.

Prerequisite: None

Reference Books:

1. FGI & AIA. (2006). Guidelines for Design and Construction of Health Care Facilities.
2. G.D. Kunders. (2010). Hospitals Facilities Planning and Management. New-Delhi: Tata McGraw-Hill Publishing Company Limited.
3. J.C.I (2015) Planning, Design, and Construction of Health Care Facilities. Joint Comission International. Printed in USA.
4. J.M. Currie. (2004). Book Section. An Overview of Healthcare Facilities Planning. New York: McGraw-Hill Digital Engineering Library.

Clinical Asset And Equipment Management System

ENBE802304
3 CREDITS
Learning Outcome:

After completing this course, students will be able to design management of asset safety and hospital equipment (C6).

Syllabus:

Hospital management and health services, medical equipment, public and outpatient hospital facilities, and other medical facilities. Hospital facilities generally such as emergency services, clinical laboratories, radiology services, diagnosis services, surgery services, childbirth services, as well as other medical services such as radiation therapy services, nuclear medicine, rehabilitation, therapy, and cardiac characterization laboratories.

Prerequisite: None

Reference Books:

1. Kunders, G.D., 2004, Hospitals: Facilities Planning and Management, Tata McGraw-Hill Education.
2. AIA, 2006, Guidelines for Design and Construction of Health Care and Facilities.

Special Course

Scientific Publication

ENBE804007
2 CREDITS
Learning Outcome:

After completing this course, students will be able to:

- Design scientific works with innovations from biomedical systems (C6).
- Present ideas / research results in the form of scientific papers in Indonesian or English properly and correctly following the writing rules of the intended journal (C6).

Syllabus:

Scientific writing systematics, the use of good and proper language in scientific writing, proofread, paper submission system, review process and scientific paper publishing.

Prerequisite: None

Reference Books:

1. Peraturan Dekan FTUI No. 2 Tahun 2022 tentang Panduan Penilaian Publikasi Ilmiah Bagi Mahasiswa Program Magister (S2) dan Program Doktor (S3) di Lingkungan Fakultas Teknik Universitas Indonesia.
2. How to Write & Publish a Scientific Paper, Robert A. Day, Publisher: Oryx Press 5th Ed., 1998.
3. Technical Guidance for Universitas Indonesia Students' Final Project
4. IEEE - Publish a Paper with IEEE (www.ieee.org)

Thesis

ENBE804008
8 CREDITS
Learning Outcome:

After completing this course, students will be able to recommend alternative solutions to current problems in the field of biomedical technology through a research process (C5).

Syllabus: None

Prerequisite: Have taken and passed a minimum of 24 credits

Reference:

1. Pedoman Teknis Penulisan Tugas Akhir Mahasiswa Universitas Indonesia
2. IEEE Citation Reference
3. IEEE Transactions on Non Reguler and Distributed Systems, Vol. 21, No. 2, February 2010, "How To Write Research Articles in Computing

and Engineering Disciplines"

Elective Course

Cell and Tissue Engineering

ENB803009
3 CREDITS
Learning Outcome:

After completing this course, students will be able to:

- Correlate (C4) various aspects related to cells, tissue engineering, and regenerative medicine related to human physiological conditions.
- Link (C6) case studies of degenerative and other diseases to regenerative medicine-principled cell and tissue engineering technologies that comply with health standards and regulations.

Syllabus:

Basic principles of cell technology and tissue engineering for regenerative medicine, cell physiology and body tissues, material types and properties, material degradation, biomaterial characterization and biocompatibility assays, in vitro cell and surface principles, scaffolding type and design, the latest technology of cells and tissue engineering for regenerative medicine, applications of tissue engineering and regenerative medicine in stem cell therapy, applications of tissue engineering and regenerative medicine for organ transplantation, as well as regulation, commercialization and ethics related to cell technology and tissue engineering for regenerative medicine.

Prerequisite: None

Reference:
Mandatory:

1. Lanza R, Langer R, Vacanti JP, Atala A. Principles of Tissue Engineering. 5th ed: Elsevier Academic Press; 2020. [https://www.sciencedirect.com/book/9780128184226/principles-of-tissue-engineering]
2. Wagner W, Elbert SS, Zhang G, Yaszemski M. Biomaterials Science: An Introduction to Materials in Medicine. 4th ed: Elsevier Academic Press; 2020. [https://www.sciencedirect.com/book/9780128161371/biomaterials-science]
3. Lanza R, Atala A. Essentials of Stem Cell Biology. 2nd ed: Elsevier Academic Press; 2014. [https://www.sciencedirect.com/book/9780124095038/essentials-of-stem-cell-biology]
4. Atala A, Lanza R, Mikos AG, Nerem R. Principles of Regenerative Medicine. 3rd ed: Elsevier Academic Press; 2019. [https://www.sciencedirect.com/book/9780128098806/principles-of-regenerative-medicine]
5. Orlando G, Keshavjee S. Organ Repair and Regeneration: Preserving Organs in the Regenerative Medicine Era. 1st ed: Elsevier Academic Press; 2021. [https://www.sciencedirect.com/book/9780128194515/organ-repair-and-regeneration]
6. Holnthoner W, Banfi A, Kirkpatrick J, Redl H. Vascularization for Tissue Engineering and Regenerative Medicine. 1st ed: Springer; 2021. [https://link.springer.com/referencework/10.1007/978-3-319-54586-8]

Addition:

1. Vishwakarma A, Karp J. Biology and Engineering of Stem Cell Niches. 1st ed: Elsevier Academic Press; 2017.[https://www.sciencedirect.com/book/9780128027349/biology-and-engineering-of-stem-cell-niches]
2. Fernandes TG, Diogo MM, Cabral JS. Engineering Strategies for Regenerative Medicine. 1st ed: Elsevier Academic Press; 2020. [https://www.sciencedirect.com/book/9780128162217/engineering-strategies-for-regenerative-medicine]
3. Eberli D, Lee SJ, Traweger A. Organ Tissue Engineering. 1st ed: Springer; 2021. [https://link.springer.com/referencework/10.1007/978-3-030-44211-8]
4. Gimble JM, Marolt Presen D, Oreffo ROC, Wolbank S, Redl H. Cell Engineering and Regeneration. 1st ed: Springer; 2020. [https://link.springer.com/referencework/10.1007/978-3-319-08831-0]
5. Ovsianikov A, Yoo J, Mironov V. 3D Printing and Biofabrication. 1st ed: Springer; 2018. [https://link.springer.com/referencework/10.1007/978-3-319-45444-3]

Hospital Information Management

ENB803010
3 CREDITS
Learning Outcome:

After completing this course, students will be able to develop a hospitalization information management system (C6).

Syllabus:

Health Care Delivery Systems, Health information management professionals, health care arrangements, electronic health records, content of patient records, numbering & filling system and record storage and circulation, indexes, registers, and data collections, legal aspects of health information management, and introduction to coding and reimbursement.

Prerequisite: None

Reference:

1. Green, M. A., Bowie, M. J. Essential of health Information Management. Principles and Practices 2nd edition. 2011. Delmar Cengage Learning

Healthcare Technology Management System

ENB803011
3 CREDITS
Learning Outcome:

After completing this course, students will be able to:

- Correlate (C4) various aspects related to health service management related to hospitalization.
- Design (C6) hospitalization management in accordance with health standards and regulations.

Syllabus:

The material to be studied includes the following topics: Clinical engineering: evolution of a discipline; Overview of engineering & engineering services; Introduction to Medical Technology Management Practices; Strategic planning; Quality & safety management in clinical engineering department; Risk factors, safety, and managemet of medical equipment; Inventory & asset management; Contract & vendor management; Technology needs assessment of medical technology; Technology acquisition; System maintenance management & technical support; Financial Management of Clinical Engineering Services; Personal Management;Cost-Effectiveness and Productivity; Clinical engineering program indicators.

Prerequisite: None

Reference:

1. Iadanza E. Clinical Engineering Handbook. 2nd ed: Elsevier Academic Press; 2020. [https://www.sciencedirect.com/book/9780128134672/clinical-engineering-handbook]
2. Jacques S, Christe BL. Introduction to Clinical Engineering. 1st ed: Elsevier Academic Press; 2020. [https://www.sciencedirect.com/book/9780128181034/introduction-to-clinical-engineering]
3. Miniati R, Iadanza E, Dori F. Clinical Engineering: from Devices to Systems. 1st ed: Elsevier Academic Press; 2016.[https://www.sciencedirect.com/book/9780128037676/clinical-engineering]

Medical Information Consultation Technique

ENB803012
2 CREDITS
Learning Outcome:

After completing this course, students will be able to design biomedical information systems (C6).

Syllabus:

Tools and techniques to learn and improve consulting skills, supervision systems, quality, and practical management, assess and manage risks according to special organ systems or populations, postoperative care and management according to the type of operation, postoperative general condition.

Prerequisite: None

Reference:

1. Moulton, Liz. 2016. The Naked Consultation. A Practical Guide to Primary Care Consultation second edition. CRC Press.
2. Jaffer, A. K., Grant, P. J. 2012. Perioperative Medicine. Willey-Blackwell

Biostatistic Intermediate

ENBE802013
2 CREDITS
Learning Outcome:

After completing this course, students will be able to analyze quantitative data and information, starting from the descriptive stage, which includes collecting, organizing, and presenting data by the scientific method, to the inductive or inferential stage, which includes the process of estimating and drawing conclusions based on available data and relationships between variables (C4).

Syllabus:

Descriptive statistical methods, probability and probability distribution, discrete probability distribution, continuous probability distribution, estimation theory, hypothesis test, regression and correlation method, design and analysis of techniques for epidemological studies, hypothesis test: person-time data, Planning Experiments partitioning variation and construction a model, ANOVA, interpretation analysis: from hypothesis tests to biology, category data, and nonparametric methods.

Prerequisite: None

Reference:

1. Budiarto, Eko. 2001. Biostatistika Untuk Kedokteran dan Kesehatan Masyarakat. Jakarta: EGC
2. Forthofer R. N., Lee E. S., Hernandez, M. 2007. Biostatistics. A Guide to Design, Analysis, and Discovery 2nd Edition. Elsevier. Academic Press
3. McCleery, R.H., T.A. Watt, T. Hart. 2007. Introduction to Statistics for Biology 3rd Edition. CRC Press
4. Rosner, B. 2015. Fundamentals of Biostatistics 8th Edition. Cengage Learning

5. Walpole, R.E., R.H. Myers, S.L. Myers., K. Ye. 2016. Probability & Statistics for Engineers & Scientists 9th Edition. Pearson

Intelligent Medical Systems Engineering

ENB803014
3 CREDITS
Learning Outcome:

After completing this course, students will be able to:

- Design machine learning-based medical decision support system software (C6)
- Evaluate machine learning technologies that process medical information/data (C5)
- Use Python programming language to implement machine learrning algorithms (C3)

Syllabus:

The basis of Artificial Intelligence (AI) with further emphasis on machine learning and applying it to medicine, health services, and medical equipment. This includes clinical risk stratification, phenotype and biomarker discovery, time series analysis of physiological data, disease progression modeling, and patient outcome prediction.

Prerequisite: None

Reference:

1. Oliver Theobald, Machine Learning for Absolute Beginners: A Plain English Introduction, Independently published, 2018
2. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2011
3. Joel Gruss, Data Science from Scratch, O'Reilly, 2015

Health Economic Management

ENB803015
2 CREDITS
Learning Outcome:

After completing this course, students will be able to:

- Understand the basic concepts, theories and methods of economics and their application in the health sector.
- Develop critical thinking on the application of health economics as a basis for determining policies / operations (evidence-based policies / practices).
- Live and commit to inherent values in health economics as part of welfare economics.
- Understand the basic concepts of theory and application of economics.
- Apply the science and methods of health economics in policy, planning, implementation, monitoring and evaluation of health programs / services and solving various kinds of health problems.

Syllabus:

Introduction to macro and microeconomic sciences; Introduction to health economics; Demand and Supply of health services; Public goods and Private goods (Health service commodities); Unique Characteristics of the Healthcare Industry; The basic concept of equality measures in the health sector; Health funding; Prepayment system as an alternative to health financing; The concept of costs and classification of costs and health services; Principles of program and health care cost analysis; Economic Evaluation in the Health Sector; Benchmarking the Development of Health Economics in islamic countries.

Prerequisite: None

Reference:

1. Culyer, T. (2012). The Humble Economist. York: York Publishing Services.
2. Drummond, M. (1992). Methods for the Economic Evaluation.
3. Mankiw, N. G. (2009). Macroeconomics: Seventh Edtion. New York: Worth Publishers.
4. Pyndick, R., & Rubinfeld, D. (2001). Microeconomics: Fifth Edition. New Jersey: Pearson Education, Inc.
5. Rahardja, P., & Manurung, M. (2016). Pengantar Ilmu Ekonomi (Mikroekonomi dan Makroekonomi). Depok: Fakultas Ekonomi Universitas Indonesia.
6. Weimer, D., & Vining, A. (2011). Policy Analysis. Canada: Person Education.

Biomedical Signal Processing

ENB803016
3 CREDITS
Learning Outcome:

After completing this course, students will be able to:

- Design medical signal processing methods.
- Design medical image processing methods.
- Applying signal and medical image processing methods using MATLAB software.

Syllabus:

Signal recognition, visual and digital imaging, image transformation, color representation, image enhancement (spatial domain), image enhancement (frequency domain), convolution and correlation, image segmentation, object feature properties, image compression, pattern recognition, image

restoration, image morphology , Wavelet transformation.

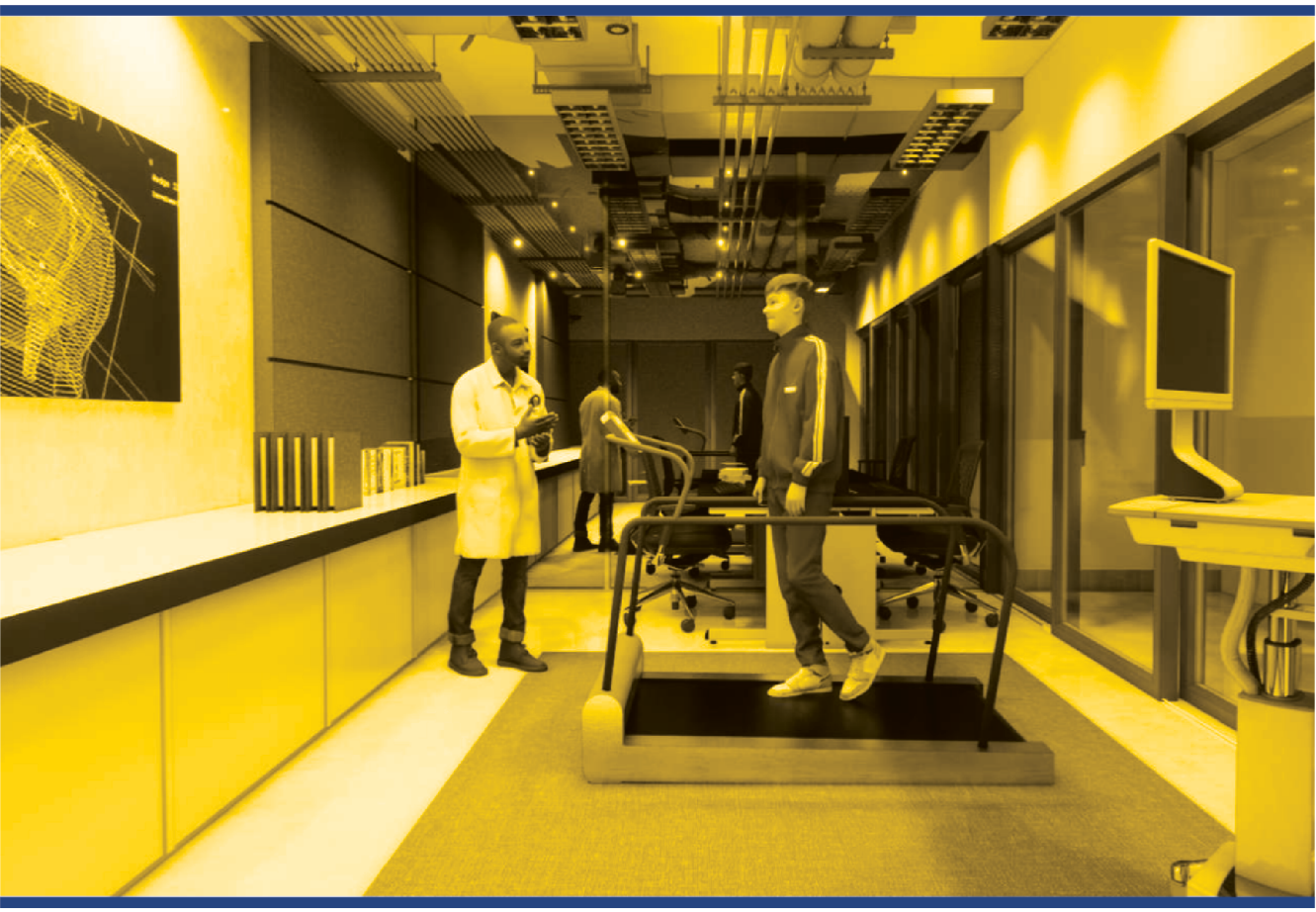
Prerequisite: None

Reference:

1. Kayvan Najarian and Robert Splinter, “Biomedical Signal and Image Processing, 2nd Ed”, Taylor & Francis, 2012
2. Varun Bajaj, G. R. Sinha, Chinmay Chakraborty, “Emerging Trends in Biomedical Technologies and Health Informatics“,Taylor & Francis, 2022
3. Sridhar Krishnan, “Biomedical Signal Analysis for Connected Healthcare,” Academic Press, Elsevier, 2021.

CHAPTER 6

DOCTORAL PROGRAM



Doctoral Program

FTUI holds Doctoral Program for the seven following study programs:

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

FTUI Doctoral program was officially opened in 2000 with the opening of the Civil Engineering and Electrical Engineering Doctoral program followed by the emersion of the Opto-electrotechnique and Laser Application study program into the Postgraduate Program of FTUI. The Mechanical Engineering study program was officially opened in 2006 while the Metallurgy & Material Engineering and Chemical Engineering followed in 2007. And In 2009, respectively Department of Architecture opened the Architecture Doctoral Program. In 2001, the Opto-electrotechnique and Laser Application was closed and was emerged into the Electrical Engineering study program. Each Doctoral study program is headed by the Head of Study Program which is held ex-officio by the Head of Department in the Faculty of Engineering UI. The Doctoral study programs have one or more focus subjects to give a more specific knowledge on engineering field to all students of the program.

Currently, the Doctoral Program is held in two ways: Lecture & Research; and Research.

New Students Selection

Selection process for new students for the FTUI Doctoral Program is as follow:

1. Pre-admission stage: future student is encouraged to informally contact their prospective Promotor or the Head of Department to further discuss his/her desired dissertation topic. This is important to make sure the availability of Promotor in accordance to said research topic. Communication may be done through email or face to face. The Head of Department and future Promotor then would discuss the student's proposal internally.
2. Future student should register online via http://penerimaan.ui.ac.id and complete the required documents and prerequisites.
3. Future student will then take the entrance examination (SIMAK UI) which consists of: (i) Academic Potential Examination and (ii) English Proficiency Test.
4. The results of the Entrance Examination will then be sent to FTUI by the UI Entrance Examination Committee. These results will then be discussed in a Department Committee Meeting headed by the Head of Department to determine which students accepted, and the proposed research topic approved, and the availability of future Promotor. An interview have to be arrange with the future student to determine the suitability of research topic, with previous study field, and the student's commitment to participate in the Doctoral program full time. Interview may be done directly or through email or messanger application.
5. The outcome of the Department Committee Meeting will then be submitted to the UI Entrance Examination Committee to be announced.

Academic Counseling

Since the day a student is registered as student for the Doctoral program until the time that he/she passes qualification examination, the student will be under the guidance of an academic advisor who the student expected to be their Promotor or Co-Promotor. Head of Department accepts a proposal of future Promotor/Academic Advisor from a committee in the Department. Once the student pass the qualification examination, the student will earn status as Doctor Candidate and the Academic Advisor's status will revert to Promotor/Co-Promotor.

Promotor and Co-Promotor

Promotor and Co-Promotor for Doctoral Program are lecturers or experts from related field and are assigned by Head of Department based on a Rector's Decree to guide and advise a Doctor candidate in conducting research and dissertation writing. Academic Advisor consist of 1 Promotor and a maximum of 2 (two) Co-Promotors. Promotor is a first chair Advisor who holds an academic degree of Professor or Doctor and a minimum of Senior Lecture academic position; has a relevant expertise in the field which the student's dissertation topic is; and is acknowledge as a full time faculty at the Universitas Indonesia, and for the last five years has produced at the latest: one scientific paper in an accredited national journal or a reputable international journal; or one other form of scientific product which is acknowledge by a group of experts set up by the Academic Senate of Universitas Indonesia.

Co-Promotors are the Promotor's companions who act as second and/or third chair advisor who hold academic degree of Doctor or Senior Lecturer, and has a relevant expertise in the field with the student's dissertation topic. Co-Promotor from outside of the Faculty of Engineering UI must have the approval from the Promotor. Promotor and Co-Promotors are appointed by the Rector based on the proposal submitted by the Dean which are also based on suggestions from the Head of Department after the student has pass the qualification examination. The appointment must be done at the latest 1 (one) semester after the qualification examination. A change of Promotor/Co-Promotor must be proposed by the Dean to the Rector based on a proposal from the Head of Department.

Program Specifications

1.	**Awarding Institution**	Universitas Indonesia	
2.	**Teaching Institution**	Universitas Indonesia	
3.	**Programme Title**	Doctoral Program in Civil Engineering Doctoral Program in Mechanical Engineering Doctoral Program in Electrical Engineering Doctoral Program in Metallurgy & Material Engineering Doctoral Program in Architecture Doctoral Program in Chemical Engineering Doctoral Program in Industrial Engineering	
4.	**Class**	Regular	
5.	**Final Award**	Doctor (Dr.)	
6 .	**Accreditation / Recognition**	Civil Engineering Doctoral Program: Accreditation A from BAN-PT Mechanical Engineering Doctoral Program: Accreditation A from BAN-PT Electrical Engineering Doctoral Program: Accreditation A from BAN-PT Metallurgy & Material Engineering Doctoral Program: Accreditation A from BAN-PT Chemical Engineering Engineering Doctoral Program: Accreditation A from BAN-PT Architecture Doctoral Program: Accreditation A from BAN-PT Industrial Engineering Doctoral Program: Accreditation A from BAN-PT	
7.	**Language(s) of Instruction**	Bahasa Indonesia	
8.	**Study Scheme (Full Time / Part Time)**	Full Time	
9.	**Entry Requirements**	Master graduate from study programs in line with study program chosen and pass the entrance examination	
10.	**Study Duration**	Programmed for 3 years	
	Type of Semester	Number of Semester	Number of weeks / semester
	Regular	6	14-17
	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 several research focus areas: 1. Manufacturing Systems Engineering • Industrial Policy and Analysis • Value Chain and Logistics • Quality and Reliability • Product/Process Design and Innovation 2. Service Systems Engineering • Product - Service - System • Service Design • Service Quality & Improvement • Decisions, Uncertainty & Risk 3. Optimization and Data Analytics • Operations Research • Data analytics and Forecasting • Real-time optimization
11..	**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.

12..	**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.

13.	**Course Composition (Course & Research)**		
No.	**Classification**	**Credit Hours (SKS)**	**Percentage**
i	**Course Component**	**16**	**32%**
ii	**Research Component**	**34**	**68%**
	Total	**50**	**100%**

14.	**Classification of Subjects. (Research)**		
No.	**Classification**	**Credit Hours (SKS)**	**Percentage**
i	**Course Component**	**0**	**0 %**
ii	**Research Component**	**50**	**100 %**
	Total	**50**	**100%**
	Total Credit Hours to Graduate	**50 CP**	

Curriculum Structure for FTUI Doctoral Program

The curriculum structure for the Doctoral Program in all study programs are the same, they are only differentiated by their codes for the research component. The code "xx" for each study programs are as follow:

ENCV for Civil Engineering, ENME for Mechanical Engineering, ENEE for Electrical Engineering, ENMT for Metallurgy & Material Engineering, ENAR for Architecture, and ENCH for Chemical Engineering, ENIE for Industrial Engineering

The FTUI Doctoral Program is held in two program: Course and Research and Research.

Doctoral Program (Course & Research)

The following is the curriculum structure for Course & Research Doctoral Program in Table 1.

Table 1. The Curriculum Structure – Doctoral Program in Course and Research

Code	Subject	SKS
	1st Semester	
ENGE901001	Advanced Research Method	6
ENXX900001	Special Subject I	3
	Sub Total	**9**
	2nd Semester	
ENGE902002	Qualitative & Quantitative Analysis	4
ENXX900002	Special Subject II	3
ENXX900004	Research Proposal	6
	Sub Total	**13**
	3rd Semester	
ENXX900006	Publication – International Conference	4
	Sub Total	**4**
	4th Semester	
ENXX900008	Research Result Examination	10
	Sub Total	**10**
	5th Semester	
ENXX900010	Publication International Journal	8
	Sub Total	**8**
	6th Semester	
ENXX900012	Promotion Examination	6
	Sub Total	**6**
	Total	**50**

The Lecture Component includes four subjects:

a. Advanced Research Method, 6 sks
b. Qualitative and Quantitative Analysis, 4 sks
c. Special Subject I, 3 SKS.
d. Special Subject II, 3 SKS.

The Research Component includes:

1. Research Proposal, 6 SKS
2. Publication – International Conference, 4 SKS
3. Research Result Examination, 10 SKS
4. Publication – International Journal, 8 SKS
5. Promotion Exam, 6 SKS

Doctoral Program (Research)

The following is the curriculum structure for Research Doctoral Program in Table 2.

Table 2. The Curriculum Structure – Doctoral Program in Research

Code	Subject	SKS
	1st Semester	
ENXX900003	Research Group Periodic Seminar	6
	Sub Total	**6**
	2nd Semester	
ENXX900005	Research Proposal	6
	Sub Total	**6**
	3rd Semester	
ENXX900007	Publication I – International Conference	6
	Sub Total	**6**
	4th Semester	
ENXX900008	Research Result Examination	10
	Sub Total	**10**
	5th Semester	
ENXX900009	Publication II – National Journal	8
	Sub Total	**8**

	6th Semester	
ENXX900011	Publication III – International Journal	8
ENXX900012	Promotion Examination	6
	Sub Total	**14**
	Total	**50**

Description of Subjects

Advanced Research Method

ENGE901001
6 SKS

Learning Objective(s): Course participants are expected to: (a) master the scientific work process based on science philosophy, which is the scientific justification aspects, innovative aspects and scientific ethics aspects, (b) able to write a research proposal and or draft of scientific writing related to the student's doctoral topic, (c) can map research result from the latest international journal in their field and understand the state-of-the-art from their research topic, and can determine the knowledge gap yet explored in the international level for further research in their Doctoral Program.

Syllabus: (1) Relationship between philosophy and engineering science; (2) Science Philosophy; (3) Epystemology in Engineering Science; (4) Research Method; (5) Problem formulation and hypothesis; (6) Research and state of the art; (7) Research Evaluation; (8) Design Evaluation and research Stages; (9) Introduction to the analysis of the data processing method; (10) Benchmark on research output and conclusion formulation; (11) Various citation method; (12) Finalization of research proposal draft and /or scientific article draft.

Prerequisite(s): None

Textbooks:

1. Haryono Imam R dan C. Verhaak, Filsafat Ilmu Pengetahuan, Gramedia, Jakarta, 1995
2. Willie Tan, "Practical Research Methods", Prentice Hall, 2002.
3. R. Kumar, *Research Methodology, A Step-by-step Guide for Beginner,* 3rd ed., Sage Pub, 2012

Qualitative and Quantitative Analysis

ENGE902002
4 SKS

Learning Objective(s): Discuss the qualitative and quantitative in data analysis and exploring specific data analysis areas. After participating in this subject which discuss the qualitative and quantitative approach in data analysis in exploring specific areas of data analysis. Students are expected to be able to build the following learning outcome: (1) awareness to situations requiring qualitative data analysis in the inductive paradigm; (2) awareness to situations requiring quantitative data analysis in the deductive paradigm; (3) appreciation toward various approaches; (4) possessing skills in giving critical appraisal; (5) possessing skills in performing qualitative and quantitative data analysis.

Syllabus: Introduction; Qualitative Analysis; Quantitative Analysis; Non-Parametric Analysis; Uncertainty Analysis; Critical Appraisal; Design of Experiment; ANOVA revisit; Multivariate Techniques.

Prerequisite(s): None

Textbooks:

1. Miles M & Huberman M, Qualitative Data Analysis, London Sage Publications, (1994)
2. Montgomery, D.C., & Runger, G.C, Applied Statistics and Probability for Engineers 3rd Ed., John Wiley and Sons, Inc., New York, (2003)
3. Kirkup, L, Experimental Method: An Introduction to the Analysis and Presentation, John Wiley and Sons, Australia, Ltd., Queensland, (1994)
4. Montgomery, D.C, Design and Analysis of Experiments 6th Ed., John Wiley and Sons, Inc., New York, (2005)
5. Hair, J.F., B.Black, B.Babin and R.E Anderson, Multivariate Data Analysis 6th Ed., Pearson Education Inc., New Jersey, (2006)

Special Subject 1

ENXX900001
4 SKS

Special Subject 2

ENXX900002
4 SKS

Special Subject 1 in the 1st first semester (4 SKS) and Special Subject 2 in the 2nd semester (4 SKS) are determined together with the student's Academic Advisor to support the student's research and/or to develop the student's knowledge with information and knowledge from unrelated field. Academic Advisor is also allowed to propose a special content for the student to Head of Department.

The following are the requirements for the implementation of Special Subject 1 and 2:

1. For students who do not have in line Master degree educational background from the Faculty of Engineering Universitas Indonesia, they are allowed to take the similar courses of the related field of study available at the Master Program in FTUI during the running semester.
2. Students are also allowed to take courses from other study programs within the Faculty of

1. Engineering Universitas Indonesia or courses from other faculties in UI as stated in the Guidance Book or the Master/Doctoral Program Catalog.
2. 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
3. In the event where neither conditions is viable for the students, the Academic Advisor is allowed to conduct a class of said course.

Research Group Periodic Seminar
ENXX900003
6 SKS

Research Group Periodic Seminar is an early activity of research in the Doctoral Program in Research where students conduct literature study in relation to the materials for their research. This literature study must be done intensively by mapping out the research results from the latest international journals in related field. The final aim was so that students have a state-of-the-art understanding of their research topic, and can determine the knowledge gap previously unexplored in the international level for further research in their Doctoral Program. The result of this literature study is compiled in a literature study report presented in the Research Group Periodic Seminar to be examined by a panel comprises of future Promoter/ Academic Advisor and Examiners from related field of study. Students will passed this Research Group Periodic Seminar if they received a minimum grade of B.

Research Proposal
ENXX900005
6 SKS

Research Proposal is the continuous activity of the literature study, where after gaining a state-of-the-art knowledge of their research topic, students can formulize the scope of their Doctoral research and determine which research method will be use. The result of this activity is a comprehensive research proposal which include: goals, background and data analysis from early study or experiments done. Included in this research proposal is plan of work for each semester and its publication goals. At this level, it is expected for students to begin experiment activity or early study which can show the direction of their research is feasible and recent in his field. The early experiment or study result, the literature study and the whole research plan is then compiled in a Research Proposal Report to be presented and examined in a Research Proposal Examination. Students will passed this Research Proposal if they received a minimum grade of B.

Research Result Examination
ENXX900008
10 SKS

At this stage, students are expected to have a research output with a minimum of 75% from their research plan. Doctorate candidate are expected to have reach a research outcome which is the main part of the originally planned contribution. The outcome of this research is measured through the Research Output Examination. The examination committee is appointed through the Dean's Decree based on the Head of Department's proposal. These examiners consist of experts related in the field of study of the Doctorate candidate with at least one examiner from an institution outside of Universitas Indonesia. Doctor Candidate will passed this Research Output Examination if they received a minimum grade of B. At this stage, a Doctor Candidate are allowed to design a scientific article framework to be published in an indexed International Journal and determine which International Journal they will send the article to.

Publication – International Conference
ENXX900006
4 SKS

Publication I – International Conference
ENXX900007
6 SKS

At this stage, students are expected to have an experiment result or study to focused on in their research topic and clarify their research direction. The result of the experiment must also show innovation or breakthrough, mastery of knowledge on their stream in relation to their research topic, the depth of their research materials, and the mastery of the state of the art development in their field or research interest, originality, and the contribution towards science and/or its implementation. Once presented in front of their promoter and co-promoter, the whole research result at this stage will be deemed worthy for international conference publication.

Publication II – International Journal
ENXX900009
8 SKS

Publication III – National Journal
ENXX900011
8 SKS

The scientific publication is an integral part of research activity and a prerequisite in participating in a Promotion Examination. International Journal meant here is an English language journal which its

editorial board consists of member from at least three different countries or more. A mandatory publication must have an "Accepted" status before the Promotion Examination. FTUI itself publish their own international journal, the International Journal of Technology (IJTech), which students can utilize as one of the international journal to publish their Doctoral research.

Promotion Examination

ENXX900012
6 SKS

Before deemed fit to participate in a Promotion Examination. Doctor Candidate are required to conduct additional research as a follow up from the Research Output Examination. The inputs and revisions given during the Research Output Examination must be completed and revised through a series of final research. At this stage, the Doctor Candidate must prove the authencity and originality of their research as new contribution to the scientific world. Thus, at this stage, the Doctor Candidate is required to have an "Accepted" for their international Journal, they are also required to complete their dissertation paper ready to be tested during the Promotion Examination.

Dissertation is an academic scientific paper study output and/or in depth research done independently and contained new contribution to issues that are temporary already known the answer or new questions ask on issues that are seen to have been established in the field of science and technology by the Doctor Candidate under the guidance of his Academic Advisor. A Doctor Candidate that has completed the revision of their dissertation are required to submit a completed version of their dissertation in five hard cover books and original approval form that has been signed by their advisors and submitted to PAF FTUI signifying the end of their study. The format for writing and binding the Dissertation should follow the writing and binding guidelines in the Technical Guidelines of Final Project Writing for Students of Universitas Indonesia that can be downloaded at http://www.ui.ac.id/download.

Promotion Examination is a scheduled academic activity as a medium of evaluation for the Doctor Candidate Dissertation as a requirement to obtain the highest academic title, Doctor. The requirements and provision for Promotion Examination are as follow:

- Promotion Examination can be done if all the scientific publication requirements are completed by the Doctor Candidate: a minimum of one publication in an International Scientific Journal (in "Accepted" status) in relation to their dissertation research. The Publication is required to state Faculty of Engineering Universitas Indonesia as one of the affiliation institution.
- Promoter and Co-Promoter gave a written approval on the dissertation as a sign that the dissertation can move forward to the Promotion Examination.
- The Promotion Examination is carried out by the Committee of Promotion Examination which is appointed with a Rector's Decree based on a proposal from the Head of Department and the Dean of the Faculty of Engineering Universitas Indonesia.
- The Committee of the Promotion Examination comprises of: (a) Promoter and Co-Promoter, (b) The Examiners, (c) a minimum of one examiner from outside of Universitas Indonesia.
- Examiners consist of experts from related field of study. In a special circumstances, an expert that is not from the academic community can be invited as part of the examiners team.
- The Promotion Examination is led by the Head of the Examiners Committee that is also a member of the committee outside of the Promoter/ Co-Promoter and outside examiner. If the Head of the Examiners Committee is unavailable, his/her position can be replaced by one of the member of the examiner team.
- The Promotion Examination is held as an open session for a period of maximum three hours divided into two stages: the dissertation presentation given by the Doctor Candidate for 15-30 minutes and a question and answer session for 120-165 minutes.
- The Doctor Candidate will pass the Promotion Examination if they received a minimum grade of B with GPA 3.00.

Facilities for Doctoral Program Students

To make sure that student of FTUI Doctoral Program are able to conduct full time research and produce excellent publications as required, FTUI provides the following facilities:

Doctoral Program Students' Workstation

Compact cubicles in comfortable rooms are available as Doctoral program students' workstation. The locations for these workstations are located on the 2nd and 3rd floor of the Engineering Center Building. Access to these workstations requires a swipe card to guarantee security. A round the clock wi-fi service is also available. To procure a workstation and access card, students are requested to register to the Associate Dean for General Affairs in the Dean's building, 2nd floor, FTUI Depok.

International Journal Article Writing Training

These free of charge trainings for the FTUI Doctoral program students are held several times each year. The information regarding these trainings are communicated through an announcement in SIAK-NG, posters at each Department, Doctoral program mailing list and FTUI website (www.eng.ui.ac.id).

Research Proposal Writing Training

These free of charge trainings for the FTUI Doctoral program students are held several times each year. The information regarding these trainings are communicated through an announcement in SIAK-NG, posters at each Department, Doctoral program mailing list and FTUI website (www.eng.ui.ac.id).

Line Editing Draft for International Journal Article

FTUI provides funds for line editing drafts for International Journal Articles. Requirement for applying for this funds are: the article must include the promoter name as part of the writing team and state FTUI as the main affiliation. To be grant this facility, students only needs to send a draft of their article through email to the FTUI Associate Dean of Academic and Research (risetft@eng.ui.ac.id). The time required for line editing is 2-4 weeks.

Doctoral Program Mailing-List

The Doctoral Program mailing list is used as a communication tool between the Dean's Faculty Heads, the Faculty Center Administration staff and all Doctoral program students in FTUI. Information regarding trainings, seminars, grants or other academic matters is announced through this mailing list. Complaints and suggestions are also accommodated by this mailing list. The mailing list address is: programdoktorft@group.eng.ui.ac.id

Research and Incentive Grants for Master and Doctoral Program

Research funds including consumables and tests for research as part of the thesis and dissertation writing is the responsibility of the student. There are a number of competitive research grants, incentive research grant schemes available from which Master and Doctoral program students may propose to finance his/her research. Complete guidance and research proposal examples are available at the Associate Dean for Research and Community Development secretary at the Dean's Building, 2nd floor or through http://research.eng.ui.ac.id.

International Journal Writing Incentive

This incentives are given to lecturer of State of Private Universities that have published an article in an international journal. Each proposer must be the first writer of the article and include an institution affiliation in Indonesia.

UNIVERSITAS INDONESIA

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