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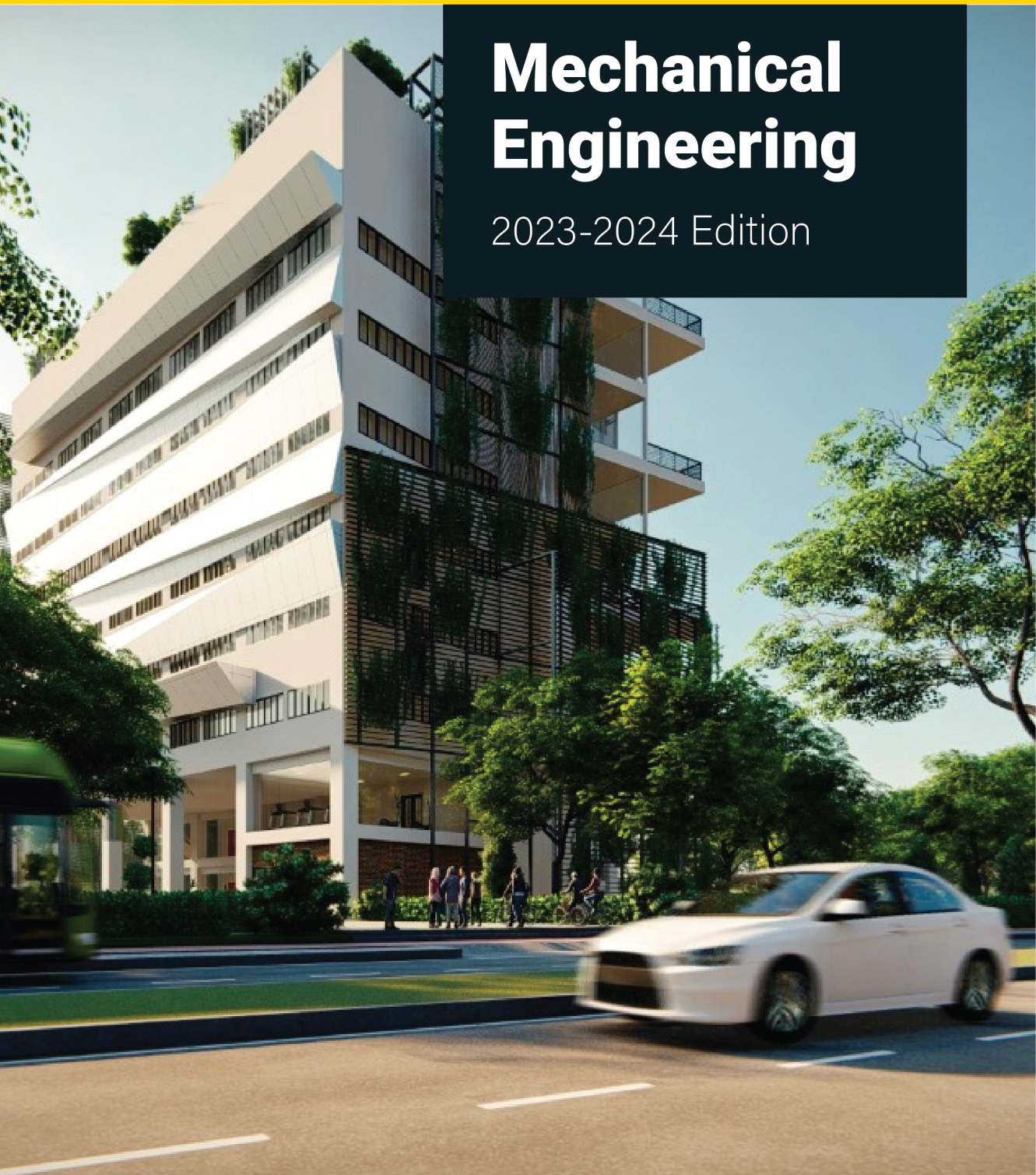
Mechanical Engineering

2023-2024 Edition



FACULTY OF ENGINEERING

UNIVERSITAS INDONESIA

ACADEMIC GUIDEBOOK

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MECHANICAL ENGINEERING GUIDEBOOK

2020 - 2024

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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

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CHAPTER 1

PROFILE OF DEPARTMENT

Profile of Departments

Department of Mechanical Engineering

General

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

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

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

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

of student-centered learning and teaching activities. According to such curriculum, research activities become a major aspect in the Doctoral Degree.

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

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

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Vision

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

Mission

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

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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 : 16 year 2020 on the Implementation of Undergraduate Program in Universitas Indonesia
14. Decree of the Rector of Universitas Indonesia Number : 5 year 2021 on the Implementation of Master Program in Universitas Indonesia
15. Decree of the Rector of Universitas Indonesia Number : 8 year 2021 on the Implementation of Doctoral Program in Universitas Indonesia
16. Decree of the Dean of Faculty of Engineering Universitas Indonesia Number: 622/D/SK/FTUI/ IX/2016 on Academic Sanction for Academic Fraud Perpetrator in Faculty of Engineering Universitas Indonesia.
17. Decree of the Dean of Faculty of Engineering Universitas Indonesia Number: 623/D/SK/ FTUI/IX/2016 on General Regulation on Supplementary Exam for Mid Term and Final Examination in Faculty of Engineering Universitas Indonesia.
18. Decree of the Dean of Faculty of Engineering Universitas Indonesia Number: 624/D/SK/FTUI/ IX/2016 on Academic Sanction for Plagiarism and Act of Fraud in the Completion of Final Project in Faculty of Engineering Universitas Indonesia.
19. Decree of the Dean of Faculty of Engineering Universitas Indonesia Number : 2 year 2022 on the Scientific Publication Assessment Guide for Master Program and Doctoral Program in Faculty of Engineering Universitas Indonesia.
20. Decree of the Dean of Faculty of Engineering Universitas Indonesia Number : 703 year 2016 ont the Credit Transfer

Research

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

CHAPTER 3

FACILITIES AND CAMPUS LIFE

LIST OF NAMES OF HEADS OF LABORATORY AND MECHANICAL ENGINEERING DEPARTMENT YEAR 2023

No	Head of Laboratory	Laboratory	Laboratory Assistant	Subjects Related to Lab
1	Ahmad Syihan Auzani, S.T., M.T., Ph.D.	Thermodynamics	Sarip	Thermal Energy Conversion System
2	Prof. Dr.-Ing. Ir. Nasruddin, M.Eng.	Refrigeration Engineering	Sarip	Performance Evaluation of Energy System
3	Dr-Ing. Ridho Irwansyah, S.T., M.T.	Fluid Mechanics	Aji	Fluid System
4	Dr. Eng. Gerry Liston Putra, S.T., M.T.	Naval Architecture	Feri	Ship Design
5.	Prof. Dr. Ir. R. Danardono A.S., DEA., PE.	Mechanical Technology	Mad Yasin	Material Selection and Manufacturing Process
6.	Agung Shamsuddin Saragih, S.T., M.S.Eng., Ph.D.	Manufacture and Automation Technology	Feri	Mechatronics
7.	Prof. Dr. Ir. Wahyu Nirbito, MSME	Mechanical Design and Biomechanics	Nurul	Strength of Materials
8.	Prof. Dr. Ir. Imansyah Ibnu Hakim, M.Eng.	Heat Transfer	Catur	Heat and Mass Transfer

CHAPTER 4

UNDERGRADUATE PROGRAM

Undergraduate Program in Mechanical Engineering

Program Specification

1.	**Awarding Institution**	Universitas Indonesia Double Degree: Universitas Indonesia and Partner University	
2.	**Teaching Institution**	Universitas Indonesia Double Degree: Universitas Indonesia and Partner University	
3.	**Faculty**	Engineering	
4.	**Study Programme**	Undergraduate Program in Mechanical Engineering	
5.	**Vision and Mission**	VISION As a center of research and education services that excel in mechanical engineering MISSION Carry out research and research-based education for the development of science and technology in the field of mechanical engineering, and conduct research and education that seeks its use to improve the level and quality of people's lives and humanity.	
6.	**Classes**	Regular, Non Reguler and International	
7.	**Final Award**	Sarjana Teknik (S.T) Double Degree: Sarjana Teknik (S.T) and Bachelor of Engineering (B.Eng)	
8.	**Accreditation / Recognition**	Accreditation of BAN-PT (Excellent) Internasional Assesment from Asean University Network-Quality Assurance (AUN-QA) Accreditation of Indonesia Accreditation Board For Engineering Education (IABEE), General Accreditation.	
9.	**Language(s) of Instruction**	Bahasa Indonesia and English	
10.	**Study Scheme (Full Time / Part Time)**	Full Time	
11,	**Entry Requirements**	High school /equivalent, or D3 / Polytechnique / equivalent, AND pass the entrance exam.	
12.	**Duration for Study**	Designed for 4 years	
	Type of Semester	Number of Semester	Number of weeks / semester
	Regular	8	17
	Short (optional)	3	8
13.	**Aims of the programme:** 1. Producing Mechanical Engineering graduates who meet the specified learning outcomes 2. Contribute to the development of scientific and mechanical technology 3. Contribute to improving the quality of society and industry		
14.	**Profile of Graduates:** Bachelor of Mechanical Engineering who is able to analyze and design energy systems, industrial machinery, building facilities, and the transportation industry in contributing to meeting the goals of sustainable development.		

15.	**Expected Learning Outcomes (ELO):** 1. Able to apply basic knowledge of mathematics, numerical methods, statistical analysis and basic science and information technology. 2. Able to design energy systems, industrial machinery, building facilities, and the transportation industry to meet the expected needs within realistic boundaries, as well as to recognize and / or utilize the potential of local and national resources with global insight. 3. Able to carry out experiments, dig up information and analyze data, report the results of experiments by applying statistical rules. 4. Able to think critically, creatively, and innovatively in identifying, formulating, analyzing and solving mechanical engineering problems. 5. Able to apply modern methods, skills and technical tools needed for engineering practices such as the selection of materials and processes, automation systems, and computer-aided mechanical designs. 6. Able to communicate effectively both visually, in writing and verbally. 7. Able to design, plan, complete and evaluate tasks within the existing constraints. 8. Able to work effectively both individually and in teams across disciplines or across cultures 9. Able to take responsibility and adhere to the ethics of the engineering profession and entrepreneurship which is characterized by innovation and independence. 10. Able to carry out lifelong learning processes including access to knowledge related to relevant contemporary issues.
16.	**Composition of Subjects**

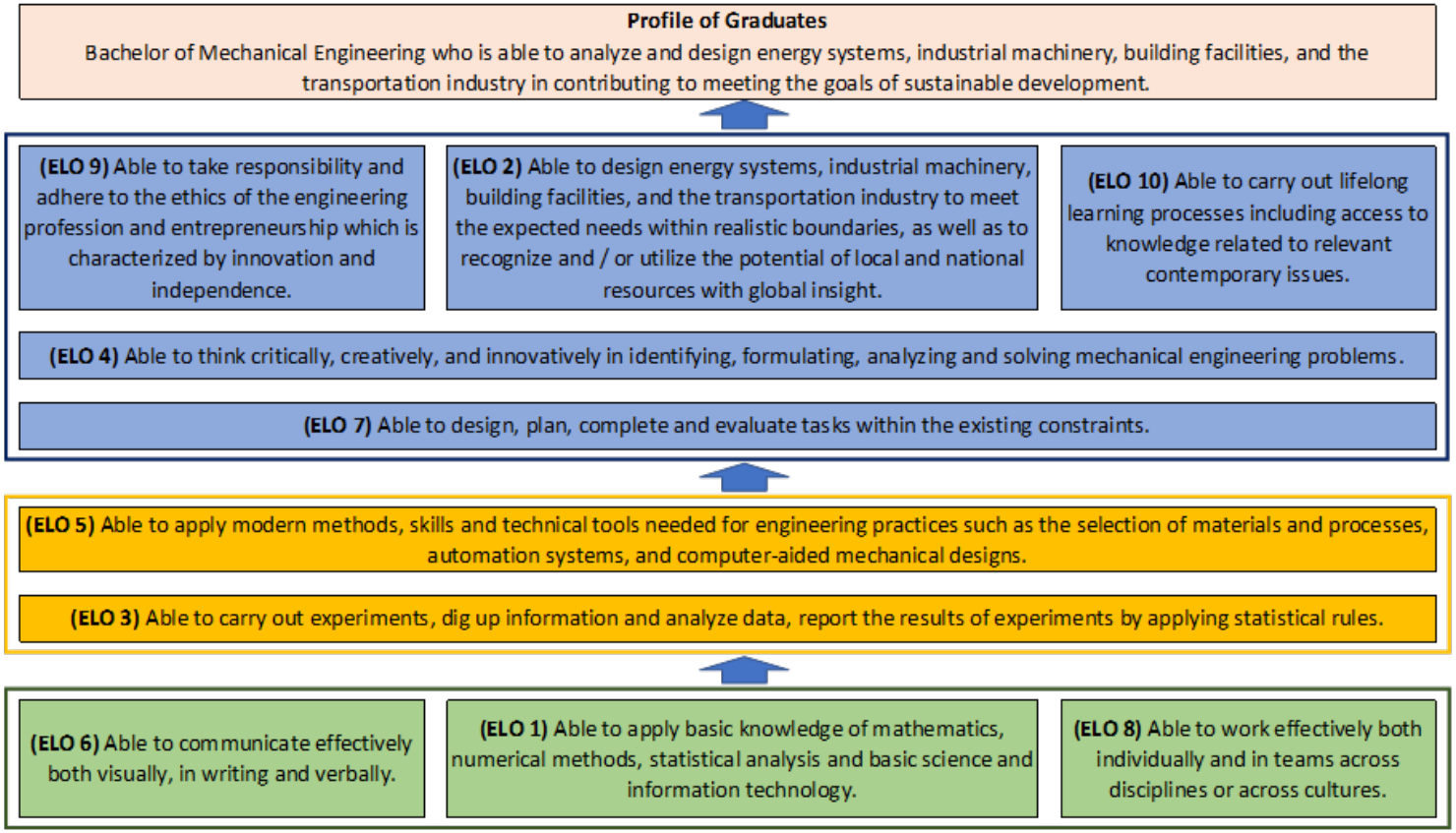
No.	Classification	Credit Hours (SKS)	Percentage
i	University General Subjects	10	6,3 %
ii	Basic Engineering Subjects	20	13,9 %
iii	Core Subjects	81	56,3 %
iv	Specialization Subjects	-	
v	Elective Subjects	26	18,1 %
vi	Internship, Seminar, Undergraduate Thesis,	8	5,6 %
	Total	145	100 %
	Total Credit Hours to Graduate		145 SKS

Career Prospects

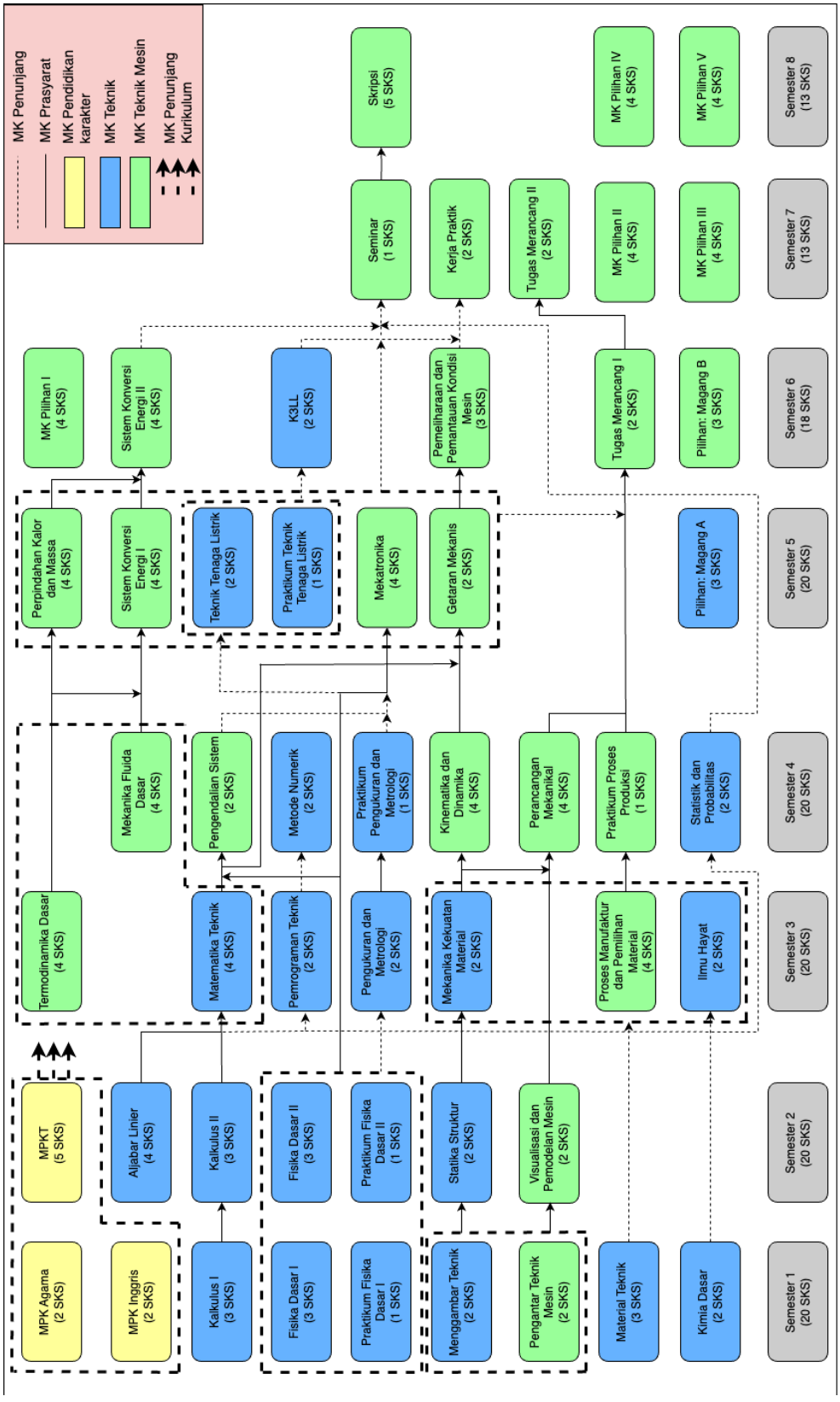
Graduates of this study program can work in various fields such as a) energy systems, b) industrial machinery, c) building facilities, and d) transportation industry, as:

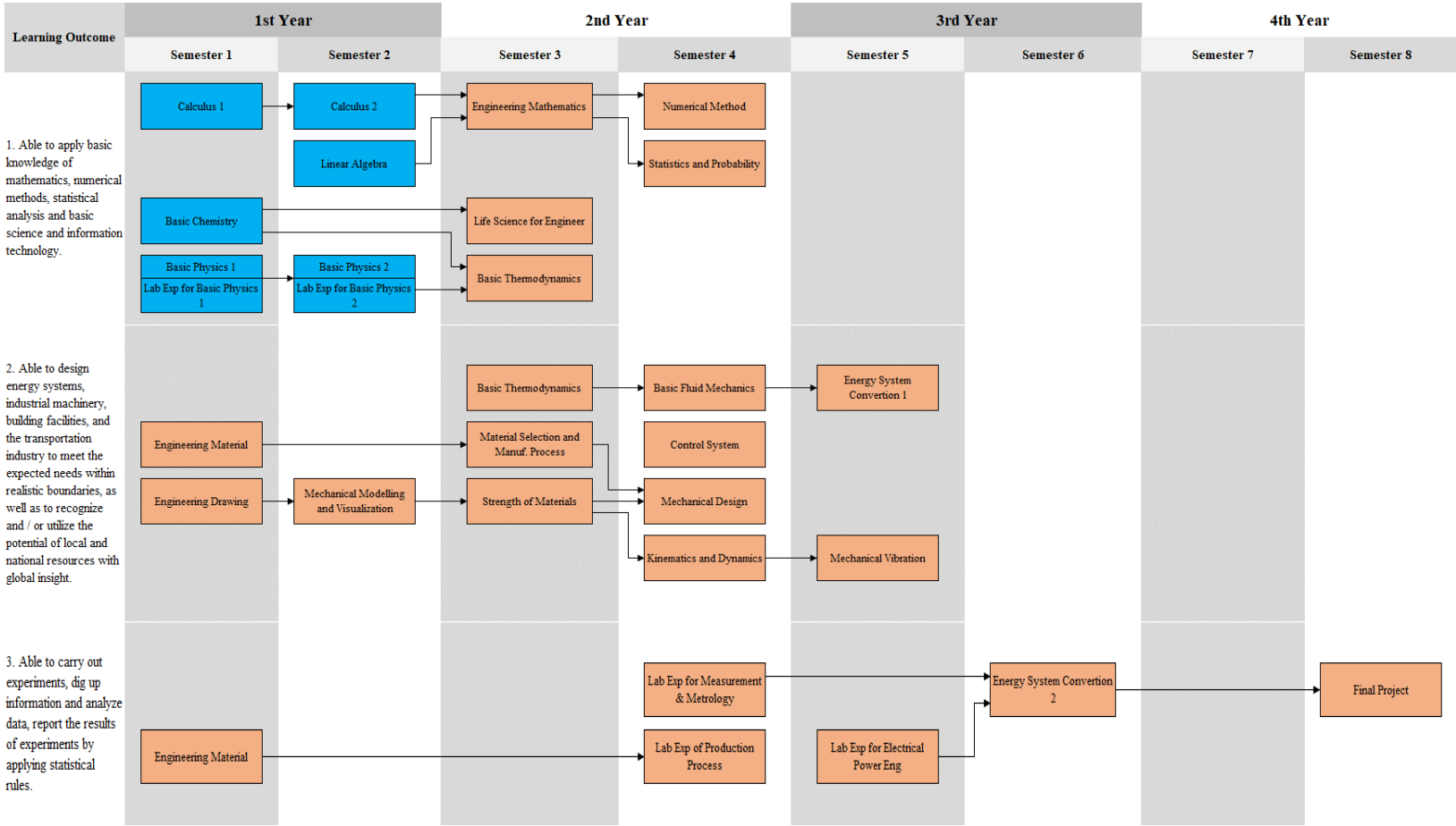
1. Researchers of mechanical elements and systems (mechanical, thermal and fluid systems, materials and production processes)
2. Mechanical systems engineer
3. Managers in the government and private sectors
4. Planners in the process of design, construction, operation and maintenance of machines
5. Civil society motivators and instructors
6. Engineering project inspector
7. Sales & Service Engineers
8. Entrepreneur
9. Adjuster

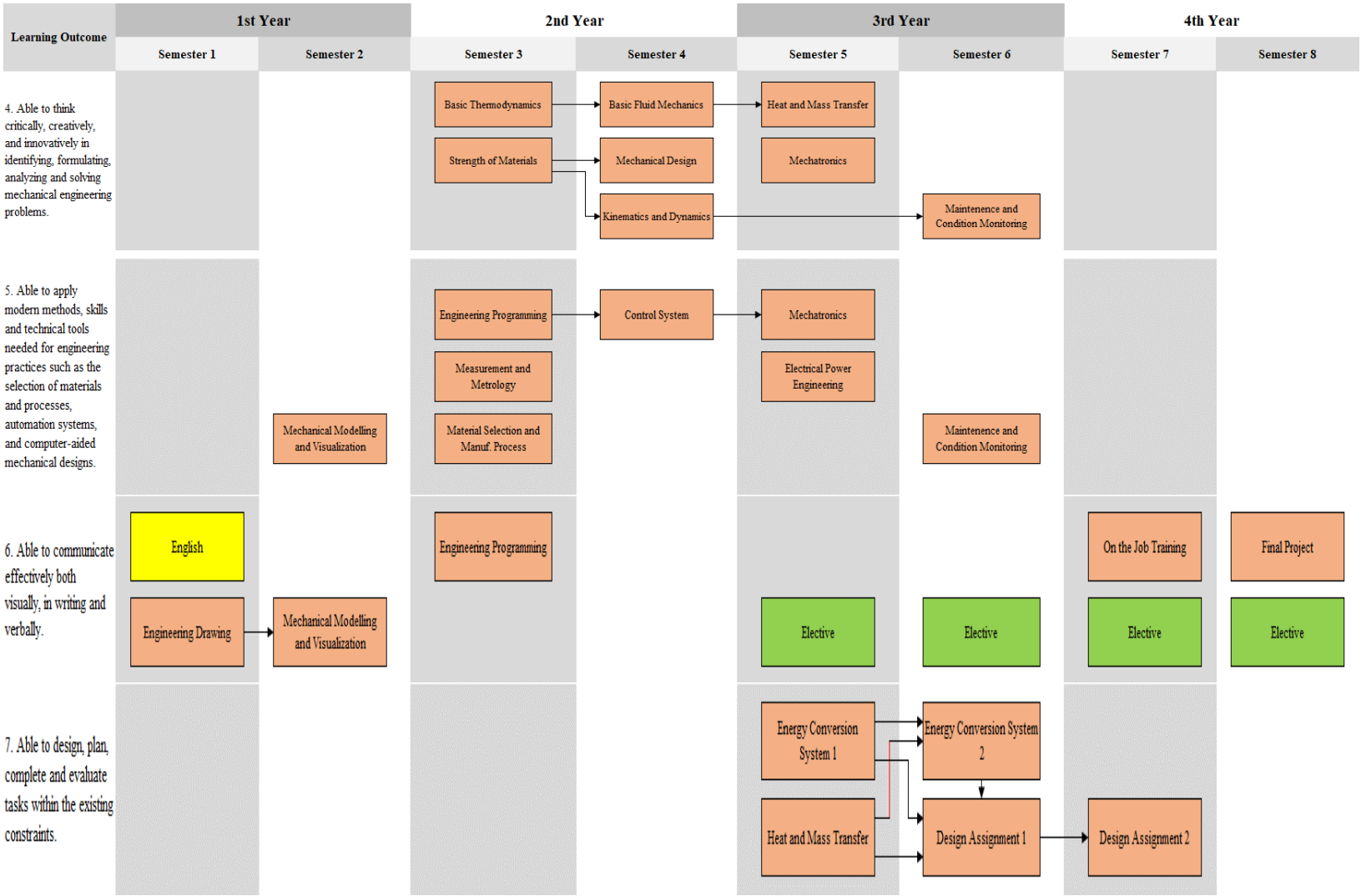
Curriculum Structure Undergraduate Mechanical Engineering Program

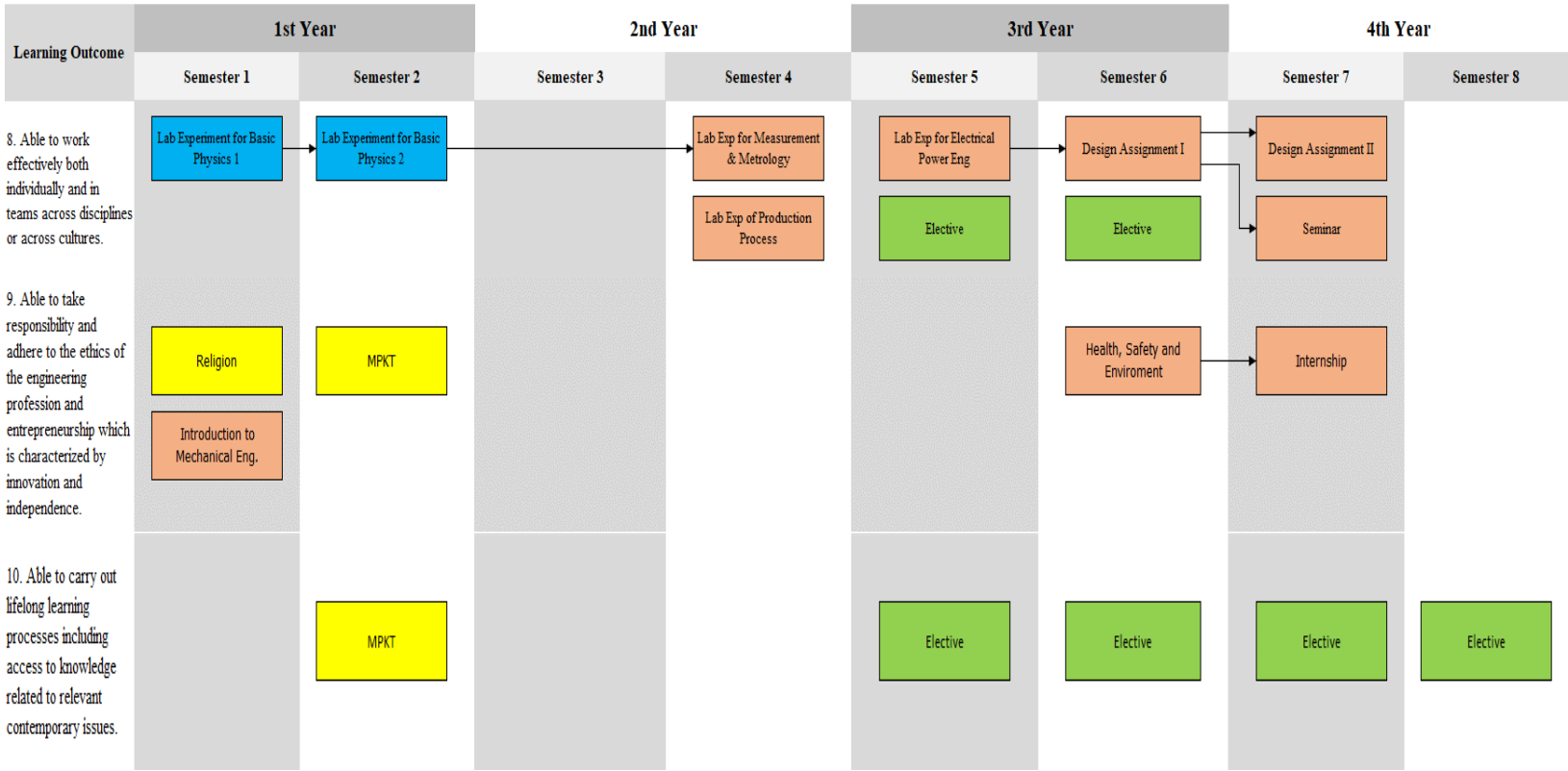


Course Flow Chart to Achieve Learning Outcomes in the Mechanical Engineering Study Program




Learning Outcome
1st Year
2nd Year
3rd Year
4th Year
Semester 1
Semester 2
Semester 3
Semester 4
Semester 5
Semester 6
Semester 7
Semester 8
1. Able to apply basic knowledge of mathematics, numerical methods, statistical analysis and basic science and information technology.
Calculus 1
Calculus 2
Linear Algebra
Engineering Mathematics
Numerical Method
Statistics and Probability
Basic Chemistry
Life Science for Engineer
Basic Physics 1
Lab Exp for Basic Physics 1
Basic Physics 2
Lab Exp for Basic Physics 2
Basic Thermodynamics
2. Able to design energy systems, industrial machinery, building facilities, and the transportation industry to meet the expected needs within realistic boundaries, as well as to recognize and / or utilize the potential of local and national resources with global insight.
Basic Thermodynamics
Basic Fluid Mechanics
Energy System Convertion 1
Engineering Material
Material Selection and Manuf. Process
Control System
Engineering Drawing
Mechanical Modelling and Visualization
Strength of Materials
Mechanical Design
Kinematics and Dynamics
Mechanical Vibration
3. Able to carry out experiments, dig up information and analyze data, report the results of experiments by applying statistical rules.
Lab Exp for Measurement & Metrology
Energy System Convertion 2
Final Project
Engineering Material
Lab Exp of Production Process
Lab Exp for Electrical Power Eng


Learning Outcome
1st Year
2nd Year
3rd Year
4th Year
Semester 1
Semester 2
Semester 3
Semester 4
Semester 5
Semester 6
Semester 7
Semester 8
4. Able to think critically, creatively, and innovatively in identifying, formulating, analyzing and solving mechanical engineering problems.
Basic Thermodynamics
Basic Fluid Mechanics
Heat and Mass Transfer
Strength of Materials
Mechanical Design
Mechatronics
Kinematics and Dynamics
Maintenence and Condition Monitoring
5. Able to apply modern methods, skills and technical tools needed for engineering practices such as the selection of materials and processes, automation systems, and computer-aided mechanical designs.
Engineering Programming
Control System
Mechatronics
Measurement and Metrology
Electrical Power Engineering
Mechanical Modelling and Visualization
Material Selection and Manuf. Process
Maintenence and Condition Monitoring
6. Able to communicate effectively both visually, in writing and verbally.
English
Engineering Programming
On the Job Training
Final Project
Engineering Drawing
Mechanical Modelling and Visualization
Elective
Elective
Elective
Elective
7. Able to design, plan, complete and evaluate tasks within the existing constraints.
Energy Conversion System 1
Energy Conversion System 2
Heat and Mass Transfer
Design Assignment 1
Design Assignment 2


Learning Outcome
1st Year
2nd Year
3rd Year
4th Year
Semester 1
Semester 2
Semester 3
Semester 4
Semester 5
Semester 6
Semester 7
Semester 8
8. Able to work effectively both individually and in teams across disciplines or across cultures.
9. Able to take responsibility and adhere to the ethics of the engineering profession and entrepreneurship which is characterized by innovation and independence.
10. Able to carry out lifelong learning processes including access to knowledge related to relevant contemporary issues.
Lab Experiment for Basic Physics 1
Lab Experiment for Basic Physics 2
Lab Exp for Measurement & Metrology
Lab Exp of Production Process
Lab Exp for Electrical Power Eng
Elective
Design Assignment I
Elective
Design Assignment II
Seminar
Religion
MPKT
Introduction to Mechanical Eng.
Health, Safety and Enviroment
Internship
MPKT
Elective
Elective
Elective
Elective

Curriculum Structure of Mechanical Engineering Study Program

Code	Subject	SKS
	1st Semester	
UIGE600004	Religion	2
UIGE600003	English	2
ENME601001	Introduction to Mechanical Engineering	2
ENGE600001	Calculus 1	3
ENGE600005	Basic Physics 1 (Mechanic & Heat)	3
ENGE600006	Laboratory Experiment for Basic Physics 1	1
ENME601002	Engineering Drawing	2
ENME603005	Engineering Material	3
ENGE600009	Basic chemistry	2
	Sub Total	**20**
	2nd Semester	
UIGE600007	Integrated Character Building Subject	6
ENGE600002	Calculus 2	3
ENGE600007	Basic Physics 2 (Electrical, Magnet, Wave, and Optic)	3
ENGE600008	Laboratory Experiment for Basic Physics 2 (Electrical, Magnet, Wave, and Optic)	1
ENGE600004	Linear Algebra	4
ENME602004	Engineering Statics	2
ENME603006	Mechanical Modelling and Visualization	2
	Sub Total	**21**
	3rd Semester	
ENME605015	Measurement and Metrology	2
ENME600013	Engineering Mathematics	4
ENME604010	Material Selection and Manuf. Process	4
ENME603007	Strength of Materials	2
ENME603008	Basic Thermodynamics	4
ENME606024	Life Science for Engineer	2
ENME600017	Engineering Programming	2
	4th Semester	
ENME604011	Basic Fluid Mechanics	4
ENME604012	Mechanical Design	4
ENME600016	Numerical Method	2
ENGE600010	Statistics and Probability	2
ENME605019	Control System	2
ENME600009	Kinematics and Dynamics	4
ENME600007	Laboratory Experiment of Production Process	1
ENME600008	Laboratory Experiment for Measurement and Metrology	1
	Sub Total	**20**
	5th Semester	
ENME605017	Heat and Mass Transfer	4
ENME605021	Energy Convertion System 1	4
ENME606025	Mechatronics	4
ENME605014	Mechanical Vibration	2
ENME606023	Electrical Power Engineering	2
ENME600010	Laboratory Experiment for Electrical Power Engineering	1
	Elective (Internship A)	3
	Subtotal	**20**
	6th Semester	
ENME600001	Design Assignment 1 (Conceptual Design)	2
ENME606022	Energy Convertion System 2	4
ENGE600012	Health, Safety and Enviroment	2
ENME606020	Maintenance and Condition Monitoring	3
	Elective (Internship B)	3
	Elective	4
	Subtotal	**18**
	7th Semester	
ENME600002	Design Assignment 2	2
ENME600004	Seminar	1
ENME600003	On the Job Training	2
	Elective	4
	Elective	4
	Subtotal	**13**

	8th Semester	
ENME 600 005	Final Project	5
	Elective	4
	Elective	4
	Subtotal	**13**
	Total	**145**

The list of Elective Courses

Code	Electives Courses, Odd Semester	SKS
ENME803105	Internal Combustion Engine	4
ENME803106	Applied Flow Measurement and Visualization	4
ENME803107	CFD Application	4
ENME801113	Ventilation and Air Conditioning System	4
ENME803115	Clean Room	4
ENME803124	Energy Audit	4
ENME803134	Fire Dynamics and Modelling	4
ENME803145	Composite Product Development	4
ENME803147	Toy Production Design	4
ENME803154	Quality and Production Management System	4
ENME803195	Oil and Gas Drilling Equipment	4
ENME803196	Jet and Rocket Propulsion	4
ENME803174	Risk Management	4
ENME601101	Project Management	4
ENME601102	Entrepreneurship	2
ENME601103	Industrial Seminar	2
ENME601108	Internship A (content: Project Management and Entrepreneurship)	3
ENME601104	Special Topic 1	4
ENME601105	Special Topic 2	4
ENME801002	Advanced Engineering Mathematics*	2
ENME802004	Engineering Computation*	2
ENME801101	Advanced Thermodynamics*	4
ENME801102	Advanced Fluid Dynamic and Heat Transfer*	4
ENME802133	Fire and Building Science*	4
ENME801140	Materials and Manufacturing Processes*	4
ENME801141	Product Design and Development Methodolgy*	4
ENME801150	Management of Manufacturing Information System*	4
ENME801151	Manufacturing System and Processes*	4
ENME801163	Vehicle Engineering and Heavy Duty Equipment*	4
ENME801164	Prime Mover and Powertrain System*	4

Code	Electives Courses, Even Semester	SKS
ENME804110	Combustion Engineering	4
ENME804109	Heat and Mass Transfer Engineering	4
ENME804111	Aerodynamics Engineering	4
ENME803108	Refrigeration Engineering	4
ENME804118	Mechanical system for Building	4
ENME802103	Energy System Optimization	4
ENME804138	Fire Safety Analysis	4
ENME804148	Design For Manufacture and Assembly	4
ENME804149	Noise and Vibration Control	4
ENME804155	CAD/CAM	4
ENME804156	Manufacturing Performance Assesment	4
ENME802152	Automation and Robotics	4
ENME804168	Railway Vehicle Engineering	4
ENME804197	Handling and Construction Equipment	4
ENME804198	Aircraft Design and Performance	4
ENME804190	Advanced Welding Engineering	4
ENME804136	Forest and Land Fires	4
ENME803104	Thermal Power Generation	4
ENME803143	Mechanical Failure	4

ENME803153	Machine Vision System	4
ENME601109	Internship B (content: Industrial Seminar and Entrepreneurship)	3
ENME601106	Special Topic 3	4
ENME601107	Special Topic 4	4
ENME802003	Experimental Design*	2
ENME802006	Data Analytics*	2
ENME802131	Fire Protection System*	4
ENME802132	Building Mechanical and Electrical System*	4
ENME802142	Design and Manufacturing Technology Integration*	4
ENME802165	Vehicle Frame and Body Engineering*	4
ENME803166	Vehicle Control System*	4
ENME802181	Maritime Engineering and Management*	4

*For Fast-Track Program Only

Transition Policy from the 2016 to the 2020 Curriculum

1. The 2020 curriculum is implemented starting in the Odd Semester 2020/2021. In principle, after the 2016 Curriculum is implemented, only subjects in the 2020 Curriculum will be opened.
2. Class of 2019 and earlier followed the 2020 curriculum with transitional rules.
3. A transitional period of 1 year is applied, namely in the academic year 2020/2021 for subjects that change the implementation semester (from Even to Odd, or vice versa), if necessary, will be opened in both semesters during the transition period (Academic Year 2020 / 2021).
4. For students who have not passed the compulsory subjects in the 2016 Curriculum, are required to take the same or equivalent subjects in the 2020 Curriculum. (Curriculum 2016 courses that are not listed in the Equivalent Table means that they have not changed, both the name and the Credit.
5. If there is a change in the SKS of the course, the number of SKS taken into account in graduation is the number of the SKS at the time the course was taken. Same or equal subjects with different SKS, if repeated or newly taken will be listed with a new name and calculated with new SKS.
6. If the compulsory subjects in the 2016 Curriculum are removed and there is no equivalence in the 2020 Curriculum then for students who have passed these courses, they will still be counted as compulsory subjects in the calculation of passing 145 SKS. Students who have not passed the course can take new compulsory subjects or elective courses in the 2020 Curriculum to complete 145 credits.

Subject Eqivalent Table Mechanical Engineering Study Program

2016			2020		
CODE	**SUBJECTS**	**CREDIT**	**CODE**	**SUBJECT**	**CREDIT**
UIGE600003	English	3	UIGE600003	English	2
ENME603005	Engineering Material	2	ENME603005	Engineering Material	3
UIGE600001	MPKT A	6	UIGE600007	MPKT	6
UIGE600002	MPKT B	6		Elective	
UIGE600020-48	Sport / Art	1		Elective	
ENME602003	Engineering Drawing	2		Elective	
			ENME600017	Engineering Programming	2
ENME605020	Control System	4	ENME605020	Control System	2
ENME605021	Energy Convertion and Coservation	2	ENME605021	Energy Convertion System 2	4
ENME600019	Lab Exp for Energy Convertion and Coservation	1			
ENME605018	Fluid System	3	ENME605022	Energy Convertion System 1	4
			ENME601108	Elective, Internship A	3
ENME600006	Industrial Seminar	2	ENME601109	Elective, Internship B	3
ENME803134	Fire Dynamics in Room and Modelling	4	ENME803134	Fire Dynamics and Modelling	4
ENME804138	Evaliation and Fire Protection System Maintenance	4	ENME804138	Fire Safety Analysis	4

ENME804149	Noise and Vibration	4	ENME804149	Noise and Vibration Control	4
ENME804198	Aircraft Stability and Control	4	ENME804198	Aircraft Design and Performance	4
			ENME804136	Forest and Land Fires	4
			ENME601104	Special Topic 1	4

Curriculum of International Program In Mechanical Engineering

Code	Subject	SKS
	1st Semester	
ENME611001	Introduction to Mechanical Engineering	2
ENME611002	Engineering Drawing	2
UIGE610002	Academic Writing	2
ENGE610001	Calculus 1	3
ENGE610004	Linear Algebra	4
ENGE610005	Basic Physics 1 (Mechanic & Heat)	3
ENGE610006	Laboratory Experiment for Basic Physics 1	1
ENGE610010	Statistics and Probabilistic	2
	Sub Total	**19**
	2nd Semester	
UIGE610004	Religion	2
ENGE610002	Calculus 2	3
ENGE610007	Basic Physics 2 (Electrical, Magnet, Wave, and Optic)	3
ENGE610008	Laboratory Experiment for Basic Physics 2 (Electrical, Magnet, Wave, and Optic)	1
ENGE610009	Basic chemistry	2
ENME615015	Measurement and Metrology	2
ENME612004	Engineering Statics	2
ENME612005	Engineering Material	3
ENME613006	Mechanical Modelling and Visualization	2
	Sub Total	**20**

	3rd Semester	
ENME610013	Engineering Mathematics	4
ENME613007	Strength of Materials	2
ENME613008	Basic Thermodynamics	4
ENME613010	Material Selection and Manuf. Process	4
ENME606024	Life Science for Engineer	2
ENME610007	Laboratory Experiment of Production Process	1
ENME600008	Laboratory Experiment for Measurement and Metrology	1
ENME600017	Engineering Programming	2
	Sub Total	**20**
	4th Semester	
ENME610016	Numerical Method	2
ENME610009	Kinematics and Dynamics	4
ENME616023	Electrical Power Engineering	2
ENME615017	Heat and Mass Transfer	4
ENME614012	Mechanical Design	4
ENME604011	Basic Fluid Mechanics	4
	Sub Total	**20**

	5th Semester	
UIGE610011	MPKT	6
ENME615014	Mechanical Vibration	2
ENME605021	Energy Convertion System 1	4
ENME616025	Mechatronics	4
ENME605020	Control System	2
	Elective (Internship A)	3
	Sub Total	**21**
	6th Semester	
ENME610001	Design Assignment 1	2
ENME610010	Laboratory Experiment for Electrical Power Engineering	1
ENME606022	Energy Convertion System 2	4
ENGE600012	Health, Safety and Enviroment	2
ENME616020	Maintenence and Condition Monitoring	3
	Elective (Internship B)	3
	Elective	4
	Sub Total	**19**
	7th Semester	
ENME600002	Design Assignment 2	2
ENME600004	Seminar	1
ENME610003	Internship	2
	Elective	4
	Elective	4
	Sub Total	**13**
	8th Semester	
ENME610005	Final Project	5
	Elective	4
	Elective	4
	Sub Total	**13**
	Total	**145**

Course Syllabus of University Subjects

INTEGRATED CHARACTER BUILDING

UIGE600007/UIGE610011
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 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, Construc-

tion, machinery and Noise hazards, Process safety hazard and analysis technique, Fire and explosion hazard, Electrical hazard, Toxicology in the Workplace, Ergonomy Aspect, Hazard communication to employees, Environmental Protection, Case studies, Safety Health and Environment audits.

Prerequisite: none

Textbooks :

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

Syllabus Mechanical Engineering Study Program

RELIGION

ENME600004
2 credits

Learning Outcome(s):

Provide an understanding of the religious values and see the problems from various aspects of life, so that student care about the social realities they face.

Topic:

Meaning and religion that apply in scientific and theological discourse; History and origins of religion; The main dimensions of religion such as divinity, prophethood, scripture, ritual, salvation, social ethics and eschatology; Socio-religious dimension; Religion and state; Inter-religious relations.

Pre-requisite(s): -

References: Guidebook from UI

ENGLISH

ENME600003
2 credits

Learning Outcome(s):

Able to communicate in English orally and in writing with correct English grammar rules.

Topic:

English grammar, writing and conversation.

Pre-requisite(s): -

References: -

INTRODUCTION TO MECHANICAL ENGINEERING

ENME601001
2 credits
Learning Outcome(s):

To give a description of mechanical engineering knowledge by describing scoupe, field and relation to other knowledges. By this course, student can understand the application and the knowldege of mechanical engineering in every sector.

Topic:

Mechanical engineering field, Mechanical engineering sub-field, mechanical engineering professional ethics; mechanical design, manufacturing process; force, structure and machine; material; fluid mechanics, energy and heat

Pre-requisite(s): -

References:

1. Wickert Jonathan, and Kemper Lewis. An introduction to mechanical engineering. Cengage learning, 2012.
2. Avallone, Eugene A., Theodore Baumeister, and Ali Sadegh. Marks' Standard Handbook For Mechanical Engineers (Standard Handbook for Mechanical Engineers). Mcgraw-Hill Professional, 2006.
3. Grote, Karl-Heinrich, and Erik SCPL. Antonsson. Springer handbook of mechanical engineering. Vol. 10. Springer Science & Business Media, 2009.

ENGINEERING DRAWING

ENME601002
2 credits
Learning Outcome(s):

Course participants are able to transfer geometric component by drawing according to standard draw which is recognized by International Standard Organization (ISO). Students understand the theory and procedure of engineering drawing based on ISO standard. Students are able to read, interpret, and transfer 2D/3D geometric draw from component or construction. Students are able to draw the orthogonal projection based on ISO standard.

Topic:

Illustration: Function and benefit of Engineering Drawing; SAP; Measurement and Evaluation; Introduction to drawing equipment; Basic definition of geometric, paper format, draw regulation, line, field,

line configuration, basic geometric form; Visualization geometric: Skew projection and isometric, function and line types, configuration geometric form; Orthogonal Projection: Projection standard, viewing concept, width display principle; Advanced orthogonal projection: Circle region concept, special region concept, trimming concept, display width, refraction.

Pre-requisite(s): -

References:

1. ISO 1101, Technical Drawings, International Organization for Standardization.
2. A.W. Boundy, Engineering Drawing , McGraw-Hill Book Company
3. Colin Simmons & Dennis Maguire, Manual of Engineering Drawing, Edward Arnold
4. Takeshi S. G., Sugiarto Hartanto, Menggambar Mesin, Pradnya Paramita, 1983
5. Warren J. Luzadder, Fundamentals of Engineering Drawing, Prentice-Hall, Inc.
6. Giesecke-Mitchell-Spencer-Hill-Dygdon-Novak, Technical Drawing, Prentice Hall Inc.

ENGINEERING MATERIAL

ENME603005
3 credits
Learning Outcome(s):

Engineering materials are one of the basic knowledge in field of design, especially in mechanical engineering. From the discussion of the behavior of several materials, the students are expected to have the overview about several thing that has to be the concern related to the working process or the specific need. The students are expected to have the basic ability to identify and explain the nature and behavior of materials related to the treatment in working process and specific need.

Topic:

Atomic structure, crystalic material, metal and non metal material, process, phase diagram and solidificatiom, heat treatment process, mechanical behavior of crystalic material, elastic material, plastic deformation, crystal plasticity, method of material mechanical testing, dislocation, strengthening, failure and remaining lifetime of material, introduction to mechanical crack and steel mechanical structure behavior, material structure degradation, corrosion process, corrosion prevention, Oxidation, wear and erotion, concrete material behavior, wood, cement and its structure behavior.

Pre-requisite(s): -

References:

1. Kalpakjian, Manufacturing Engineering and Technology – 6th Ed., Digital Designs- 2006
2. Thomas H. Courtney, Mechanical Behavior of Materials – 2nd Ed, Waveland Press. - 2005
3. R.A. Higgins, Property of Engineering Materials, Edward Arnold - 1994
4. Flinn & Trojan, Engineering Materials and Their Applications, John Wiley & Sons, Inc.- 1995
5. James A. Jacobs & Thomas F. Kilduff, Engineering Material Technology, Prentice- Hall, Inc. - 2004

ENGINEERING STATICS

ENME602004
2 credits
Learning Outcome(s):

To understand the concept of force and force equilibrium in some construction so the student can calculate and analyze the equilibrium of construction by using static equilibrium law.

Topic:

Basic principle of engineering statics/Newton Law. Arrangement and decomposition of force in plane and space. Static equilibrium law. Support and support reaction. Frame construction.

Pre-requisite(s): Introduction to Mechanical Engineering, Engineering Drawing

References:

1. Beer, Ferdinand P, Mechanics for Engineers: STATICS, Mc GrawHill.
2. Hibbeler RC, Mechanics of Materials, 10th ed., Prentice Hall, 2016.
3. Riley, F William, Engineering mechanics: STATICS, John wiley & sons
4. Hamrock, Fundamental of Machine Element, Mc Graw-Hill.
5. Shigley, Joseph Edward, Mechanical Engineering Design, McGrawHill.
6. Kurowski, P.M., Finite Element Analysis for Design Engineers, SAE International, 2004

MECHANICAL VISUALIZATION AND MODELING

ENME603006
2 credits
Learning Outcome(s):

It is expected that students will have the basic ability to effectively describe the information content of a component unit effectively; able to do 2D and 3D modeling and visualization with the help of computers and translate in the form of working drawings that can be used as a guide to the process and can be correctly understood by the parties concerned.

Topic:

Functions and Benefits of Working Drawings in the Design Process and Production Process; Surface Workmanship Quality and Tolerance: Standards & Markings of Workmanship Quality Classification; Standards & Markings of Work Tolerance Classification; Welding Construction, Standards & Marking Types of Camps and Welding Works; Line Chart; 2D and 3D Geometry Representation Methods; Introduction to Modeling Software System Interfaces; 2D and 3D Modeling, Manipulation and Visualization.

Pre-requisite(s):
Engineering Drawing, Introduction of Mechanical Engineering

References:

1. A.W. Boundy, Engineering Drawing, McGraw-Hill Book Company
2. Colin Simmons & Dennis Maguire, Manual of Engineering Drawing – 4th Ed, Elsevier. 2012.
3. ISO 1101, Mechanical Engineering Drawings, International Organization for Standardization.
4. Takeshi S. G., Sugiarto Hartanto, Menggambar Mesin, Pradnya Paramita, 1983
5. Japanese Industrial Standard, Technical Drawing for Mechanical Engineering, Japanese Standards Association.
6. Warren J. Luzadder, Fundamentals of Engineering Drawing, Prentice-Hall, Inc..

MEASUREMENT AND METROLOGY

ENME605015
2 credits
Learning Outcome(s):

Measurment and Metrology course is knowledge to study the concept of metrology and measurement in industry and the applicaton of metrology and its tools. This course is study the relevance of the theory to the engineering application and manufacturing industry. This course will give the ability to the student to understand the theory and application of engineering measurement and metrology in mechanical engineering application

Topic:

The basic concept of measurement and metrology, measurement terminology and systems, industrial measurement and system terminology, temperature measurement, pressure and flow measurement, force, stress, data acquisition, motion measurement : position, velocity, vibration and acceleration, types of sensors/transducer, transfer function, FFT and filtering, uncertainty analysis, geometric and dimension calibration, room dimention, metrology (length measurement), surface texture, roughnes and roundness, flatness and straightness, angle measurement, introduction to CMM.

Pre-requisite(s): -

References:

1. Busch, Ted, Fundamentals of Dimensional Metrology, 4th Ed, Delmar Publishers
2. Fargo F.T., Curtis, M.A., Handbook of Dimensional Measurement, 5th Ed, Industrial Press. 2013.
3. Slocum, A., Precision Machine Design, SME Press, 1992.
4. Raldi Artono Koestoer, Pengukuran Teknik, Departemen Teknik Mesin FTUI.

ENGINEERING MATHEMATICS

ENME600013
4 CREDITS
Learning Outcome(s):

Complete student's anylitical ability. Students understand and able to use the advances mathematical concepts in order to solve the engineering problems.

Topic:

Introduction to differential equation, 1st order differential equation, 2nd order differential equation, higher order differential equation, vector analysis, vector differential, grad operation, divergence and culr, vector integration, laplace transform, laplace transform to solve the differential equation, fourrier transform, convulsion, numerical method, root of equation, numerical differentiation, numerical integral.

Pre-requisite(s): Calculus, Linear Algebra

References:

1. Croft, A, et.al, Mathematics for Engineers, 3rd Edition, 2008, Prentice Hall
2. Chapra S.C., Canale, Numerical Methods for Engineer, 6th Edition, 2010, Mc Graw Hill
3. Kreyszig, E, Advanced Engineering Mathematics 10th Edition, John Wiley and Sons

MATERIAL SELECTION AND MANUFACTURING PROCESS

ENME604010
4 CREDITS
Learning Outcome(s):

To give the knowledge, understanding and competence about the theory, application method and product manufacturing process technology that consist of: characteristic and how the process work, process constraint, force and energy that needed in process, the effect of the process parameter to the product quality and the relation between process and material to the material characterisc that needed in every process.

Topic:

Manufacturing process and production system, materials in manufactur, theory and method in metal casting, theory and method of bulk formation, theory and method of sheet metal forming, theory and method of powder metallurgy, theory and method of machining/metal cutting process, theory and precess of product surface quality improvement, theory and method of joining, theory and method of prototyping process, characteristic of engineering materials, correlation of material and process characteristic, process parameter control of material, Design of material selection and manufacturing process that related to the market needs (assignment).

Pre-requisite(s): Engineering Materials

References:

1. Ashby, Material selection in Mechanical Design, 4th ed., Butterworrth Heinneman, 2010
2. Ashby, Material selection in Mechanical Engineering, 3rd ed., Butterworth Heinneman, 2005
3. John A. Schey, Introduction to Manufacturing Processes, McGraw Hill, 1999
4. Degarmo, E. Paul, Materials and Processes in Manufacturing, Prentice Hall Int. Inc, 10th edition, 2010
5. Kalpakjian, S, Manufacturing Engineering and Technology, McGraw Hill 7th edition, 2013.
6. Buku Panduan Praktikum Proses Produksi, Departemen Teknik Mesin FTUI

STRENGTH OF MATERIALS

ENME603007
4 credits
Learning Outcome(s):

The aim of this subject is student can calculate and analyze the stress in construction. Student able to solve the defelection and indeterminate statics.

Topic:

Moment and internal force diagram. Characteristics of energy. Deformation, stress & strain. Stress due to normal force, shear, bending moment and torsion. Stress distribution, combination of stress. Deflection/ beam deformation. Indeterminate static construction. Column. Energy method. Construction of thin and thick wall, rotating disc.

Pre-requisite(s): Mechanical Drawing, Engineering Statics

References:

1. Timoshenko, Strength of Material, 1965
2. Belyaev, Strength of Material, MIR Publisher, 1979
3. Propov, Mechanic of Material, Prentice Hall, 1976
4. Hibbeler RC, Mechanics of Materials, 10th ed., Prentice Hall, 2016.
5. Riley, F William, Engineering mechanics: STATICS, John wiley & sons
6. Hamrock, Fundamental of Machine Element, Mc Graw-Hill.

BASIC THERMODYNAMICS

ENME603008
4 credits
Learning Outcome(s):

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

Topic:

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

Pre-requisite(s): -

References:

1. Michael J. Moran, Howard N. Shapiro, Fundamentals of Engineering Thermodynamics, 8th Edition, Wiley, 2014.
2. Reynolds W.C., Perkins H.C., Engineering Thermodynamics, Mc. G. Hill .
3. Zemansky , Aboot , van Ness, Basic Engineering Thermodynamics, McGraw Hill
4. Kenneth Wark Jr. Thermodynamics , Mc.Graw Hill
5. H.D. Baehr, Termodynamik , Springer Verlag

LIFE SCIENCE FOR ENGINEERS

ENME606024
2 credits
Learning Outcome(s):

This course will study the basic knowledge and introduction to the aspect of life organism that have close relation to mechanical engineering field. The student will get the broad perspective of life science application in mechanical engineering.

Topic:

Introduction to cell, chemical aspect in biology: acid, carbohidrat, lipid, protein, nucleat acid; bioenergy and metabolism: aerobic and anaerobic respiration, photosynthesis; animal control system, termoregulation and homestasis; biomechanics, animal locomotion, scale effect; food and farm; environmental conservation, air, water, life science consideration in mechanical design

Pre-requisite(s): -

References:

1. Alexander, R. McNeill. Principles of animal locomotion. Princeton University Press, 2003.
2. Karp, G. Cell and Molecular Biology, 5th ed., John Wiley and Sons, Inc.
3. Berger, S. et al. Introduction to Bioengineering, Oxford University Press
4. Cunningham, William P., and Mary Ann Cunningham. Principles of environmental science: inquiry & applications. McGraw-Hill, 2011.
5. Cosentino, Carlo, and Declan Bates. Feedback control in systems biology. CRC Press, 2011.
6. Basic Biomechanics, Susan J. Hall, McGraw Hill, USA
7. Biomechanics, Kreighbaum, Barthels, Burgees Publishing, USA
8. Biomechanics in Ergonomics, Shrawan Kumar, Taylor & Francis INC, USA
9. Biomechanics Circulation, Y.C. Fung, Springer, USA
10. Biomechanics Mechanical Properties, Y.C. Fung, Springer, USA
11. Biomechanics of the Upper Limbs, Andris Freivalds, CRC Press, USA
12. Skeletal Tissue Mechanics, Martin,Burr,Sharkey, Springer, USA
13. Biomedical Engineering Principles, David Cooney, Marcel Dekker INC, USA

ENGINEERING PROGRAMMING

ENME600017
2 credits
Learning Outcome(s):

Understanding the basic knowledge of computational and engineering programming, able to make computational and programming techniques simple, able to solve engineering problems with engineering programming.

Topic:

Introduction to programming languages, Basics of algorithms, Basics of computing, Software for computing and programming techniques, Development of computing and programming with case studies

Pre-requisite(s): -

References:

Computer Programming with MATLAB, J. Michael Fitzpatrick, Ákos Lédeczi, Fitzle, 2013

Introduction to Computation and Programming Using Python: With Application to Understanding Data, John V. Guttag, The MIT Press, 2016

BASIC FLUID MECHANICS

ENME604011
4 credits
Learning Outcome(s):

Fluid meachanic are one of the applied mechanical science branch that will be used to investigate, analyse, and learn the nature and the behavior of fluids. Fluid that will be explored could be a moving or stationary fluid. Fluid Mechanics course intends to complement the ability of a student to be able to apply the basic laws of fluid mechanics in practical engineering calculations of fluid mechanics and be able to analyze the behavior of the fluid and developing knowledge in the field of fluid mechanics.

Topic:

Fluid and its nature, fluid statics, the relative balance, concept and basic equations of fluid flow, dynamic of flow, the equation of fluid motion (Newton, Euler, Navierstokes), Basic Equation of Fluid Dynamics (Continiuty, Energy and momentum), dimentional analysist and hydraulic similarity, ideal fluid flow, viscous flow, viscous flow: transition from laminar into turbulent flow, fully developed turbulent flow, flow around submerged objects, general characteristic of outside flow, concept and characteristic of layer in closed flow, measurement and visualization of flow, pressure measurement concept, flow and capacity, flow measurement devices (Pitot tube, Venturi, orifice, Nozzel, HWA, LDV), Flow visualization method.

Pre-requisite(s): -

References:

1. Munson, B.R., Fundamentals of Fluid Mechanics 7th Ed, John Wiley & Sons, Inc. 2012
2. Smits, A.J., A, Physical Introduction to Fluid Mechanics, John Wiley & Sons, Inc. 2000
3. Kumar, SCPL.L., Engineering Fluid Mechanics, Eurasia Publishing House Ltd., 2010

MECHANICAL DESIGN

ENME604012
4 credits
Learning Outcome(s):

Give the understanding about the application of engineering mechanic science and material strength in machine element. The students have the basic competence to design the machine element.

Topic:

Basic mechanical design review, design of joint : welding, solder, adhesive bonding, rivet, pin, bolt, nut, thread, axel, shaft, hub, roller & lauch bearing, lubrication, wear and friction, spring, break, fixed and unfixed clutch, chain, belt, basic of gear, straight & tilt bearing, Final Assignment : Design process consist of the understanding of purpose, load and calculation of machine element.

Pre-requisite(s): Mechanical Modelling and Visualization; Strength of Materials

References:

1. Hamrock, Fundamental of Machine Element, 3rd ed, CRC Press, 2013
2. Shigley, Joseph Edward, Mechanical Engineering Design, 10th ed, McGraw-Hill., 2014
3. Sularso, Dasar Perencanaan & Pemilihan Elemen Mesin, Pradnya Paramita, 1994
4. Hibbeler RC, Mechanics of Materials, 10th ed., Prentice Hall, 2016.
5. Riley, F William, Engineering Mechanics: STATICS, John wiley & sons

NUMERICAL METHODS

ENME600016
2 credits
Learning Outcome(s):

The objectives of this course is that the student can understand and able to apply the process and method (algorithm) of engineering numerical method in computer-based computation and to understand the parameters that influence the speed and accuracy of calculation.

Topic:

Introduction to numerical method and programming: simple mathematical modeling, programming and software, structural programming, modular programming, iterative method; Function: function and function value, Taylor and Maclaurin series, approximation and error; Root of equation: graphical method, Bisection method, False-Position method, Newton – Raphson method, Secant method, Bairstow method; Linear algebra equation system: Gauss elimination, Gauss-Jordan elimination, Decomposition and transformed matrices; Curve – Fitting: Least – Square regression, Interpolation; Numerical Integral: Trapezoid method, Simpson method, Double Integral; Differential equation: Finite Divided Difference, Euler method, Runge – Kutta method; Ordinary Diffrential Equation System

Pre-requisite(s): -

References:

1. Chapra, Steven C. and Canale, Raymond P. Numerical Methods for Engineers 6th edition. New York: McGraw-Hill, 2010.
2. Kreyszig, Erwin. Advanced Engineering Mathematics 10th edition. Danvers: John Wiley & Sons, 2011.
3. Sedgewick R., Phillippe F, An Introduction to the Analysis of Algorithms, Addison Wesley.
4. Cheney W., Kincaid D., Numerical Mathematics and Computing, Cole Publishing

CONTROL SYSTEM

ENME605019
4 credits
Learning Outcome(s):

System Control is a science that discusses methods for controlling the value of system parameters, so that it is in accordance with what is desired. The system parameters referred to in this subject are physical quantities, which can be in the form of position, velocity, rotation, acceleration of pressure, flow rate, temperature, and other process variables. This subject aims to make students understand the basics, analysis, design techniques and compensation systems of control systems, and be able to choose the right control system (controller) for a mechanical system.

Topic:

Introduction to Full Systems; Laplace transform; Laplace Transformation; Solution of Ordinary Linear Differential Equation (problem of initial value); Mathematical Modeling I-IV; Full Action: PID Controller, Electronic Controller, Pneumatic Controller and Hydraulic Controller; Analysis of Transient Responses I and II; Analysis of the Root Place of the TKA; Control System Design with the help of the TKA Method; Frequency Response Analysis; Stability Analysis; MATLAB Practicum; Control System Design with the help of Frequency Response; Discrete Time and Z-Transformation Systems; PID Control and Robust Control Introduction; State Spatial Analysis I-II; Control System Design in the State Room; Liapunov Stability Analysis and Optimal Quadratic Control.

Pre-requisite(s): Engineering Mathematics, Basic Physics 1, Basic Physics 2

References:

1. Ogata, Katsuhiko., Modern Control Engineering, 5th ed, Prentice-Hall. 2009.
2. Golnaraghi, F and Kuo, B. C., Automatic Control System, 9th Ed, Wiley, 2010.
3. Francis H, Raven., Automatic Control Engineering, 5th ed. McGraw-Hill,1995.
4. Cheng, David SCPL., Analysis of Linear System, Addison–Wesley P. C., Inc.

KINEMATICS AND DYNAMICS

ENME600009

4 credits
Learning Outcome(s):

Students have the ability to understand the key concept of kinematics and dynamics of mechanical system and capable to analyze the movement, velocity, acceleration force and equilibrium.

Topic:

Vector velocity analysis, free body diagram, linier motion, velocity polygon, 2D motion, rectangular coordinates, N-T and pole, relative motioan and velocity of 2 coincide/relate point, Coriolis acceleration and stiff body kinematics, Inertia Force, Statics, particle system, works, energy, impuls, linear-angular momentum, stiff body motion, works and energy, relative motion, rotating mass balancing and back & forth motion, cam dynamics and Gyroscope.

Pre-requisite(s): Engineering Statics

References:
1. Meriam & Kraige, Engineering Mechanics. 7th ed, Wiley New York. 2012.
2. Holowenko, Dynamics of Machinery, John Wiley, 1995.
3. Beer & Johnston, Mechanics for Engineer, Dynamics, 11th ed. Dynamics, Mc Graw-Hill, 2015.

LABORATORY EXPERIMENT OF PRODUCTION PROCESS

ENME600007
1 CREDITS
Learning Outcome(s):

This subject is a complement to the Manufacturing Process and Material Selection, with a focus on practical aspects. With this subject, students are expected to gain practical skills regarding the product manufacturing process, from the technological aspects to the material.

Topic:

Practicum by using manual machining tools for bench work such as lathe, drill, milling, saws, etc .; welding practicum; rapid prototyping practicum

Pre-requisite(s): Material Selection and Manuf. Process

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

LABORATORY EXPERIMENT OF MEASUREMENT AND METROLOGY

ENME600008
1 credits
Learning Outcome(s):

This subject is a complement to Measurement and Metrology, with a focus on aspects of practicum. With this subject, students are expected to get practical knowledge about metrology, various types of sensors and transducers and how to use them in a measurement system.

Topic:

Practicum using metrology measurement tools; practicum use of various types of sensors such as temperature and pressure.

Pre-requisite(s): Measurement and Metrology

References:
1. Busch, Ted, Fundamentals of Dimensional Metrology, 4th Ed, Delmar Publishers
2. Fargo F.T., Curtis, M.A., Handbook of Dimensional Measurement, 3rd Ed, Industrial Press.
3. Slocum, A., Precision Machine Design, SME Press, 1992.
4. Raldi Artono Koestoer, Pengukuran Teknik, Departemen Teknik Mesin FTUI.

HEAT AND MASS TRANSFER

ENME605017

4 CREDITS
Learning Outcome(s):

This course studies about the heat and mass transfer mechanism within a volume control system due to the temperature gradient, this course strictly related to the basic thermodynamics course. The purpose of this course is to develop the understading from the students about several heat and mass transfer mechanism between two systems if the temperature gradient ocure and the students able to calculate the heat transfer rate. The students capable to solve numbers of heat transfer problems using non-dimensional parameter.

Topic:

Fundamental of heat transfer, conduction heat transfer (1 dimentional and 2 dimentional), numerical analysis in conduction heat transfer/unsteady state, forced convection heat transver, free convection heat transfer, boiling and condensation, heat exchanger, radiation, fundamental of mass transfer, steady state molecul diffusion, unsteady state molecul diffusion, convection mass transfer, convection mass transfer correlation, mass transfer apparatus.

Pre-requisite(s): Basic Thermodynamics

References:
1. Frank P Incropere, David P De Witt, Fundamental heat and mass transfer, 7th Ed., Wiley, 2011,

New York
2. Holman JP, Heat Transfer, 10th ed, Mc Graw-Hill, 2009.
3. Koestoer, RA, Perpindahan Kalor untuk Mahasiswa Teknik, Salemba Teknika, 2003.
4. Welty R James, Wicks Charless, Wilson Robert, Fundamentals of Momentum, Heat, and Mass Transfer, 6th Ed. Wiley, 2014.
5. Cengel, Yunus, Heat Transfer a Practical Approach, 2nd Ed. Mc Graw Hill, 2003, Singapore.
6. Kreith Frank, Bohn Mark, Principles of Heat Transfer, 7th Ed. CL Engineering, 2010.

ENERGY CONVERTION SYSTEM 1

ENGE605018
4 credits
Learning Outcome(s):

Energy Convertion System 1 is applied science and engineering of basic fluid science which studies the utilization of characteristic, behavior and properties of fluid and its flow behavior in various fluid machines i.e. rotodynamics, reciprocating, hydraulic and pneumatic system. The course is intended to equip student to understand characteristic of turbo fluid machines, hydraulic and pneumatic system and to be able to calculate and design a fluid system.

Topic:

Basic Thermo fluid in a Fluid System; Energy Transfer from Fluid to Rotor; Lagrangian and Eularian Approach; Energy Transfer Components; Impulse and Reaction; Turbo machinery Analysis with Flow; Operational Aspects of Rotodynamic Machinery; Hydraulic Similarities on Fluid Machinery; Reciprocating Machinery: Classification, Main Component and Operating; Discharge and Coefficient Discharge; Work and Power; Basic Hydraulic Machines; Hydraulic Machines; Hydraulic Accumulator; Hydraulic Intensifier, Hydraulic Press; Hydraulic Crane; Hydraulic lift; Pneumatic System: Basic Laws, Pressure Drop Losses, Basic Control Valve of Pneumatic Circuit.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanics

References:

1. Harinaldi, Sistem Fluida
2. Dixon, S.L, Fluid Mechanics and Thermodynamics of Turbomachinery, 7th Edition, Butterworth-Heinemann, 2013
3. Esposito, A., Fluid Power with Application, 7th Edition, Prentice Hall, 2008
4. Mobley, R.K, Fluid Power Dynamics, Newnes Butterworth-Heinemann, 2000
5. Giles, R.V, Fluid Mechanics and Hydraulics, 4th Edition Schaum's Outline Series, Mc-Graw-Hill, 2013

MECHATRONICS

ENME606022
4 credits
Learning Outcome(s):

This course provides the ability to design electrical-mechanical that properly meet the needs of a process specification and a design that given in a laboratory scale with the mechanical, electrical theory and automation control.

Topic:

Mechatronics concept and theory, electronics analog system, electronis analog components, electronics digital system, analog and digital interface, sensors and actuators (electric motor, pneumatic, hydraulic), principles of microprocessor and microcontroller, microcontroller based control system theory, C/C++ programming for electrical-mechanical for control, programmable logic controller (PLC), Laboratory activity.

Pre-requisite(s): Basic Physics 1, Basic Physics 2

References:

1. Smaili A. dan Mrad F., Applied Mechatronics, Oxford University Press, 2007
2. Sabri Cetinkunt, Mechatronics, Wiley, 2006
3. Histand, M.B., & Alciatore, D.G., Introduction to Mechatronics and Measurement System 4th ed, McGraw-Hill, 2011.
4. Fraser, C. dan Milne, J, Electromechanical Engineering, An Introduction, IEEE Press, McGraw-Hill, New York, 1994.
5. Gandjar K, Hand-out Mekatronika, DTMUI, 2007

MECHANICAL VIBRATION

ENME605014
2 credits
Learning Outcome(s):

The students have an understanding of the key points and concepts of the mechanical vibrations of mechanical systems and have the basic competence to analyze the vibration behavior and what parameters can be controlled in order to vibration damping.

Topic:

Fundamental of mechanical vibration in mechanical system, oscillatory motion, free vibration, harmonic vibration, transient vibration, system with 2 degree of freedom and system witih multi degree freedom, lumped parameters system and continue system, Lagrange equation, random and non-linier vibration.

Pre-requisite(s):

Engineering Mathematics, Kinematics and Dynamics

References:

1. Meriam & Kraige. Engineering Mechanics, Dynamics. Wiley New York. 8th ed.2015.
2. Holowenko. Dynamics of Machinery.John Wiley.1995.
3. William T.Thomson. Theory of Vibration with application, 5th Ed. Prentice Hall India.1997.
4. Beer & Johnston. Mechanics for Engineer-Dynamics, 11th ed. Mc-Graw-Hill. 2015.

ELECTRICAL POWER ENGINEERING

ENME606023
2 CREDITS
Learning Outcome(s):

The objective of this course is to give the understanding of basic concept and practical application on electrical power engineering. Student also studies the general understanding of electrical power engineering terms and can work in team effectively.

Topic:

Linear approach and signal analysis; History of development and basic physics of electrical power generationt Electromechanical energy conversion; Single phase and Triple phase Transformator; Three phase generation..

Pre-requisite(s): -

References:

1. J. David Irwin and David V. Kerns, Jr., Introduction to Electrical Engineering, Prentice Hall, 1995.
2. R.D. Shultz and R.A. Smith, Introduction to Electric Power Engineering, John Wiley &Sons, New York, 1988.
3. Zuhal, Dasar Tenaga Listrik dan Elektronika Daya

LABORATORY EXPERIMENT FOR ELECTRICAL POWER ENGINEERING

ENME600010
1 credits
Learning Outcome(s):

The laboratory is intended to introduce electric power basic concept to electrical engineering students : motor and generator includes DC or AC transformator

Topic:

Watt meter, volt meter, amp meter and transformer. Motor & generators DC. Reading of 3 phase circuit power either with balanced or unbalanced load. One and three phase circuit testing for Y & Δ. Power Transformer, solving by using open loop and closed loop circuit test. Autotransformer.

Pre-requisite(s): Electrical Power Engineering

References:

1. J. David Irwin and David V. Kerns, Jr., Introduction to Electrical Engineering, Prentice Hall, 1995.
2. R.D. Shultz and R.A. Smith, Introduction to Electric Power Engineering, John Wiley &Sons, New York, 1988.
3. Zuhal, Dasar Tenaga Listrik dan Elektronika Daya

DESIGN ASSIGNMENT 1

ENME600001
2 credits
Learning Outcome(s):

Student has the ability to design the system and mechanical product using previous knowledge and skill. From this course, student can work in team, communicate, report, present and defend the final project.

Topic:

Fundamental of mechanical design process; team work in design; process planning, understanding the problem and development of engineering specification; Concept Generation, Evaluation and Selection; Product Design Phase; Engineering Economics

Pre-requisite(s):

Mechanical Design, Material Selection and Manufacturing Process

References:

1. David G.Ullman. The mechanical design process, 4th ed. McGraw-Hill. 2009.
2. George Dieter. Engineering Design: A Material and Processing Approach, 3rd ed. McGraw-Hill. 2000.
3. G.Pahl and W.Beitz. Engineering Design: A Systematic Approach, 3rd ed. Springer. 2007.

ENERGY CONVERTION SYSTEM 2

ENGE606021
4 credits
Learning Outcome(s):

This course discusses about the energy resources, type and classification of energy, energy conversion, energy consumption, basic concept of energy conversion, power resources and classification of energy conversion enginess. The students understand the energy source, type of energy conversion engine, conversion and conservasion of energy system, and also capable to perform a basic calculation of energy conversion engine performance and critical consideration of energy conversion.

Topic:

Definition of energy and energy resources, type and

energy classification, law and equation in energy conversion, energy profile (resources, reserves and the world's and Indonesia's energy needs), basic concept of energy conversion system, power resources and classification of energy conversion engine, fuel in energy conversion, renewable energy, non-renewable energy, classification of combustion engine, calculation for internal combustion engine performance, steam power plant, fluid machinery, cooling engine classification, thermodynamic cycle of cooling engine, energy conversion method in vehicle, industry and building.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanics, Heat and Mass Transfer

References:

1. Kreith, F, Goswami, DY, Energy Conversion (Mechanical Engineering), CNC Press, 2007
2. Kreith, F, Goswami, DY, Energy management and Conservation Handbook, CNC Press, 2007
3. Patrick, D.R., et.al, Energy Conservation Guidebook, 3rd ed. Fairmont Press 2014
4. Dincer, I., Rosen, Thermal Energy Storage: Systems and Applications 2nd ed, Wiley, 2010
5. Panduan Praktikum Prestasi Mesin Konversi energi, Departemen Teknik Mesin versi 2003. Depok 2003.

MAINTENANCE AND CONDITION MONITORING

ENME606020
3 credits
Learning Outcome(s):

This course gives the understanding and the ability to analyze a system and design a system for maintenance and its procedure to improve the efficiency and reliability within a system. To give the understanding and competence to develop and implementation of vibration monitoring and engine condition so that the mechanical system reach the optimum performance.

Topic:

Quality, Reliability and Maintainability, maintenance system strategy, failure analysis, design of maintenance system and scheduling, maintenance system organization, condition monitoring and condition based maintenance, computer based maintenance system, total productive maintenance (TPM) and its implementation, the effectiveness measurement of total productive maintenance, reliability based maintenance system, planning;measurement and standardization of maintenance work, quality of maintenance system, basic theory of vibration and engine condition, basic of engine condition monitoring, vibration monitoring device in several mechanical systems and engine condition analysis.

Pre-requisite(s): Mechanical Vibration

References:

1. Niebel, B.W., Engineering Maintenance Management, Marcel Dekker, Inc. 1994
2. Higgin, L.R., Maintenance Planning and control, Mc Graw Hill Book Company, 1998
3. Mishra, R.C., and SCPL. Pathak, Maintenance Engineering and Management, PHI, 2004
4. Bruel & Kjaer. Handbook of Vibration & Condition Monitoring

DESIGN ASSIGNMENT 2

ENME600002
2 credits
Learning Outcome(s):

Student have ability to produce the prototype from the previous design in Design Assignment 1. Student can work in team, manage the project and present the final project.

Topic:

Product Generation, Evaluation and Performance; Project Management; Product Evaluation or Mechanical System for Cost, Manufacutring, Assembling etc; Technopreneurship consideration.

Pre-requisite(s): Design Assignment 1

References:

1. David G.Ullman. The mechanical design process, 4th ed. McGraw-Hill. 2009.
2. George Dieter. Engineering Design: A Material and Processing Approach.2000.
3. G.Pahl and W.Beitz. Engineering Design: A Systematic Approach. Springer, 3rd ed. Springer. 2007.

Special Subjects Mechanical Engineering Study Program

SEMINAR

ENME600004
1 credits
Learning Outcome(s):

Student can communicate in verbal or written with final project pjroposal; able to formulate the problems and objectives of the research, conduct theoretical review to formulate the hypothesis, design the research method for empirical proof and present the preliminary result to the supervisor

Topic:

Problem description, basic concept of research with

assumption and constraint; making preliminary report, conducting the preparation, literature review and research methodology; present final report with structured report, language, graphical presentation, table etc, reference and clarity.

Pre-requisite(s):

Passed 110 CREDITS and GPA > 2.00 without Grade E

ON THE JOB TRAINING
ENME600003
2 CREDITS
Learning Outcome(s):

The course is intended to provide opportunity for gaining experience in industries and applying mechanical engineering knowledge. Able to perform management tasks and engineering technique according to field of interest.

Topic:

Management and Engineering according to the field of interest. Presentation of internship results and report.

Pre-requisite(s): Passed 95 SKS and GPA > 2.00

FINAL PROJECT
ENME600005
5 CREDITS
Learning Outcome(s):

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

Topic:

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

Pre-requisite(s): Passed 120 Credits and GPA >= 2.00

Elective Subjects Mechanical Engineering Study Program

INTERNAL COMBUSTION ENGINE
ENME803105
4 credits
Learning Outcome(s):

Student is expected to have competency and expertise in the field of his interest of internal combustion engine working principle and theory and is able to design and do construction calculation.

Topic:

Actual Cycle of Internal Combustion Engine; Fuel System; Ignition and Combustion in Spark Ignition Engine and Compressed Ignition Engine; Some Basic Characteristics and Calculations; Basic Engine Design; Determination of Engine's Main Components; Kinematics and Dynamics Analysis of the Motion; Calculation and Planning of Lubrication and Cooling System.

Pre-requisite(s): Basic Thermodynamics

References:

1. Guzela L, Onder, C., Introduction to Modelling and Control of Internal Combustion Engines, 2nd Edition, Springer, 2014
2. Heywood, J., Internal Combustion Engines Fundamental, McGraw Hill, 2011
3. Taylor, C.F., Internal Combustion Engines, in Theory and Practice, M.I.T Press, England, 1985.
4. Khovakh, M., Motor Vehicle Engines, MIR Publisher, Moscow, 1971.

APPLIED FLOW MEASUREMENT AND VISUALIZATION
ENME803106
4 credits
Learning Outcome(s):

Applied flow diagnostic study measurement and visualization techniques which have wide application both in industry and laboratory. The course give basic competency for the student to be bale to understand various measurement and visualization methods and to design appropriate flow diagnostic system in process installation in industry or experimental set up in a scientific research activities which related to fluid flow.

Topic:

Statistics Diagnostic Flow, Calibration in Flow Measurement; Momentum Sensing Meter (orifice plate, venturi, nozzle meters); Positive Displacement Flow Meter (Nutating Disc, Sliding Vane, Gear meters, etc.); Electromagnetic and Ultrasonic Flow Meters; Compressible Flow Meter (Wet Gas and Wind Anemometer); Principles Local Velocity Measurement in Liquid and Gases; Hot Wire Anemometry; Based Laser Velocimetry (LDV, PIV); Principles of Flow Visualization, Flow Visualization conventional; Shadowgraphs and Schliern Technique; Interferometry Technique; Light Sheet Based Technique ; Image Processing and Computer Assitested Method.

Pre-requisite(s): Basic Fluid Mechanics

References:

1. Yang ,W.J, Handbook of Flow Visualization, Taylor and Francis. 2001
2. Baker, R.C., Flow Measurement Handbook: Industrial Designs, Operating Principles, Performance and Applications, Cambridge University Press, 2005

CFD APPLICATION

ENME803107
4 CREDITS
Learning Outcome(s):

Understanding the basic principles of CFD and having the basic knowledge in applying CFD (Computational Fluid Dynamic)

Topic:

Prediction-rule Principles, Numerical Solutions: Advantages and Disadvantages; Mathematical Description of Physical Phenomena; Basic Nature of Coordinates; Discretization Method; Volume-set Application on Heat Conduction Problem; Convection and Diffusion; Two-Dimension Discretization Equations; Three-Dimension Discretization Method; Special Procedure Needs; Some of Constraints Associated with the Representation of Pressure-gradient Factors, Continuity Equations Representation; Stayered Grid; SIMPLE Algorithm; Revision of SIMPLER algorithm; Final Solutions: Basic Properties of Iterative Numerical Procedures; Sourceterm Linearization, Irregular Geometries, Preparation and Testing a Computer Programs.

Pre-requisite(s): Basic Fluid Mechanics, Engineering Programming

References:

1. Suhas V. Patankar, 1980, Numerical Heat Transfer and Fluid Flow, McGraw Hill.
2. C.A.J. Fletcher, 1996, Computational Techniques for Fluid Dynamics, 2nd edition, Springer Verlag
3. A.D. Gosman et al., 1985, Computer Aided Engineering Heat Transfer dan Fluid Flow, John Wiley & Sons.

VENTILATION AND AIR CONDITIONING SYSTEM

ENME801113
4 CREDITS
Learning Outcome(s):

This subject equips students with an understanding and basic competency in designing an air system with an increasing need for good air quality. Considering lately it is necessary to have more knowledge of the air conditioning system such as aspects of air flow velocity problems in the room, noise, odor, all of which are included in Indoor Air Quality (IAQ). This subject will also be given an understanding of the types of ozone friendly refrigerants including the technical implementation of retroophytic air conditioning systems.

Topic:

This subject equips students with an understanding and basic competency in designing an air system with an increasing need for good air quality. Considering lately it is necessary to have more knowledge of the air conditioning system such as aspects of air flow velocity problems in the room, noise, odor, all of which are included in Indoor Air Quality (IAQ). This subject will also be given an understanding of the types of ozone friendly refrigerants including the technical implementation of retroophytic air conditioning systems.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanics

References:

1. Ronald Howell, Harry J.Sauer, Jr and William J.Coad : Principles of HVAC, ASHRAE 1998.
2. Carrier : Handbook of HVAC
3. ASHRAE Standard
4. Overseas Vocational Training Association Employment Promotion Corporation : Fundamentals of refrigeration and Air Conditioning.

CLEAN ROOM

ENME803115
4 CREDITS
Learning Outcome(s):

Provide an understanding of the basic knowledge of clean room systems and its application in buildings, hospital and pharmaceutical industries. Understanding of the concept of air cleanliness, ventilation and fresh air exchange, application of laminar flow, the air pressure in the chamber and measuring systems, validation and its control.

Topic:

Indoor environment: human psychological and physiological aspects, BEAM IAQ assessment; Air quality: air cleanliness, ambient air quality, rationale for standards; Indoor air pollutants: gaseous pollutants, airborne particulate, VOCs, radon, biological contaminants; Indoor air movement: air flow in confined and unconfined spaces, filtration systems; Instrumentation and measurement techniques; Control measures: improved IAQ by HVAC system design, removal of contaminants.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanics

References:

1. ASHRAE : HVAC Design Manual for Hospitals and Clinics Second Edition, 2013
2. W. Whyte, Clean Room Technology Fundamentals of Design, Testing and Operation, John Wiley & Sons Ltd., 2001
3. John D. Spengler, J.M.Samet, J.F McCarthy, Indoor Air Quality Handbook, McGrawHIll, 2001.

ENERGY AUDIT

ENME803124 –

4 credits
Learning Outcome(s):

This course focuses on the theory, techniques and practices of analyzing energy aspects of building operations and correlating a building envelope's interaction with the mechanical systems. Students will perform a detailed energy audit of a state-of-the-art commercial building design using energy modeling simulation software and develop energy conservation strategies, such as thermal stor- age, that can be applied to heating, cooling, and ventilating equipment to reduce utility bills. Students will apply supporting analytical data to develop operations and maintenance changes designed to improve energy efficiency and reduce operating cost.

Topic:

Energy Auditing Basics, Energy Accounting and Analysis, Understanding the Utility Bill, Energy Economics, Survey Instrumentation, The Building Envelope Audit, The Electrical System Audit, The Heating, Ventilating and Air-Conditioning Audit, Upgrading HVAC Systems for Energy Efficiency Verification of System Performance, Maintenance and Energy Audits, Self-Evaluation Checklists, World-class Energy Assessmeents, and Water Conservation.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanics

References:

1. Albert Thumann, William J. Younger, Terry Niehus, Handbook of Energy Audits, Eighth Edition, The Fairmont Press, 2010.
2. Moncef Krarti, Energy Audit of Building Systems: An Engineering Approach, Second Edition, CRC Press, Taylor & Francis Group, 2010.

FIRE DYNAMICS AND MODELLING

ENME803134
4 credits
Learning Outcome(s):

Sudents understand the various stages of fires and provide basic knowledge methods and techniques applied in the analysis of fire development, and develop students' ability to critically analyze the methods of practical application. This course also aims to improve the ability to understand and analyze the fires model.

Topic:

Introduction to the process of combustion, premixed flame and diffusion flame, ignition and spread of fire, classification of fires and the influence of the geometry of the room. Calorimetry fire: heat release rate, mass loss rate and the relationship between time and heat release rate, the growth of fire in the room, as well as testing methods. The dynamics of the flame: fire plume and flame (flame), a high flame, the flame height correlation.

Pre-requisite(s): Basic Thermodynamics

References:

1. Dougal Dysdale, An Introduction to Fire Dynamics, 3rd Edition, John Wiley and Sons, 2011.
2. James G. Quintiere, Fundamentals of Fire Phenomena, John Wiley & Sons, Ltd ISBN: 0-470-09113-4, 2006
3. Bjorn Karlsson, and James G. Quintiere, "Enclosure Fire Dynamics". CRC Press LLC, 2000.
4. SFPE Handbook of Fire Protection Engineering 5th edition, Springer, 2016
5. Thierry POINSOT, Denis VEYNANTE, Theoretical and Numerical Combustion.
6. Jurnal dan standar terkait.

COMPOSITE PRODUCT DEVELOPMENT

ENME803145
4 credits
Learning Outcome(s):

Provide expertise and competence to students in the field of designing and manufacturing of parts / mechanical construction using composite materials. This course provides an understanding of composite materials, including the characteristics, testing, manufacturing process, and special applications in the engineering field.

Topic:

Composite Type, Material, Properties, Mechanics; Knowledge and Characteristics of Fiber Composite, Strength, Hardness, and the composite thermal expansion; Theory of Combination Fiber and Matrix; Matrix Composite Characterization; Laminar Theory On Axis and Off Axis; Composite Product Design, Composite Fabrication Technique ; Testing Method; Future Applications.

Pre-requisite(s): Engineering Materials, Mechanical Design

References:

1. Brent Strong, Fundamentals Of Composites Manufacturing: Materials, Methods and Applications - Technology & Engineering – 2007
2. By Daniel Gay, Suong V . Hoa, Stephen W. TsaiTranslated by Stephen W Tsai Contributor Suong V. Hoa, Stephen W. Tsai, Composite materials: Design and application, 2nd : CRC Press 2007
3. Soemardi,T.P. Diktat Mekanika komposit, Fabrikasi dan Testing. FTUI.2003.
4. Composites ASM handbook No 21

DESIGN AND DEVELOPMENT OF EDUCATIONAL PRODUCTS

ENME803147
4 CREDITS
Learning Outcome(s):

Understand the basics and process of designing and developing educational products in the industry of teaching aids, educational products, and game aids.

Topic:

Brainstorming and expressing ideas and opinions, Innovation and Theme Development, Basics of Toy Product Design, Basic Engineering and Mechanical Design, Basic Theory for Sketching, Sketch Drawing Modeling Process, Design Aesthetics, Manufacturing Theory and Material Selection for Game Props, Basic Theory of Making Prototype, Portfolio Design, Presentation and Idea Pitching.

Pre-requisite(s): Engineering Materials, Mechanical Design

References:

1. Karl Urlich, Steven Eppinger, 2015, Product Design Development Flow, 6th Edition, McGraw Hill.
2. Donald A. Norman, 2005, Emotional Design, 1st Edition, Basic Books.
3. Michael Michalko, 2006, Thinkertoys : A Hanbook of Creative Thinking Techniques, 2nd Edition, Ten Speed Press.

QUALITY AND PRODUCTION MANAGEMENT SYSTEM

ENME803154
4 credits
Learning Outcome(s):

Provide knowledge, understanding and ability to perform management, analysis and improvement of production systems in the manufacturing industry with the principles of efficiency and effectiveness, and able to understand and implement and develop policies and procedures are needed to improve and control the various processes.

Topic :

Introduction to Manufacturing Systems, Manufacturing Principles, Resources, Production Process and Production Organization, Production Lay-Out, Design, Scheduling and Production Process Control; Productive Maintenance, Logistics and Inventory; Engineering Quality, Quality Control, Quality Function Deployment (QFD) , Total Quality Management; Quality Management System (8 Quality Management Principles, International Standard Quality Management System: ISO 9001, ISO 9004, ISO TS 16949, the International Management System Standard: ISO 14001, OHSAS 18001); System And Process Improvement: Cause - Effect Analysis, FMEA (Failure Mode and Effect Analysis), Lean Six Sigma.

Pre-requisite(s): Mechanical Design

References:

1. Hitomi, Katsundo. Manufacturing System Engineering. Taylor & Francis. 2001
2. TQM : A Cross Functional Prespective, Rao, CARR, Dambolena, Kopp, Martin, Rafii, Schlesinger, John Willey, 1996
3. TQM, Text, Cases and Readings, Joel E. Ross, St. Lucie Press 100 E. Linton Blvd Suite 403 B Delray Beach, FL 33483

MICROFABRICATION AND PRECISION MANUFACTURING

ENME803161
4 credits
Learning Outcome(s):

of MEMS (micro Electro mechanical system) at this time that has wide application of the biomedic system, sensors and micro-electronic devices (electronic devices). This course giving understanding of manufacturing techniques and basic structure mechanics in a product and also the micro-characterization of the process fabrication conducted in the laboratory. This course provides a basic competency of the principles in the design techniques which control the movement of the size or dimensions in a very small if compared with the size of the object that is designed and produced the correct design and the development machine and a precision mechanism

Topic:

Introduction to Engineering Micro Fabrication; Lithography: The design aspect, macredits making, etching technique (And Wet Etching Dry Etching); Deposisi Engineering: Chemistry and Chemicals; Electroplating, Micromolding, Beam Processing; Microscaling consideration); Transport Processes and Metrology in the micro-scope; Lab Practice and Applications, Philosophy Precision Manufacturing; kinematic concept; Pro and contra Flexures Design; Materials for Precision Components; Self Calibration Concept; Manufacturing Process which is Important in Precision Manufacturing, Precision Instruments; Basic Concept of Tolerance on Dimensions and geometric.

Pre-requisite(s): Engineering Materials, Mechanical Design, Engineering Programming

References:

1. Madou, M.J. Fundamentals of microfabrication: the science of miniaturization, CRC Press, 2002.
2. McGeough, J (Ed.), Micromachining of Engineering Materials, Marcel Dekker, 2002, ISBN 0-8247-0644-7
3. Mainsah, E., Greenwood J.A. and Chetwynd

D.G. Metrology and properties of engineering surfaces, Kluwer Academic Publ., 2010
4. Gardner J.W. and Hingle H.T. (Ed.) From Instrumentation to Nanotechnology, Gordon and Breach Science Publishers, 1991, ISBN 2-88124-794-.
5. Korvink J.G. and Greiner A. Semiconductors for Micro- and Nanotechnology – An Introduction for Engineers, WILEY-VCH Verlag GmbH, 2002, ISBN 3-527-30257-3.
6. Mark J. Jackson, Microfabrication and nanomanufacturing. Taylor and Francis, 2006

MODERN VEHICLE TECHNOLOGY

ENME803167
4 credits
Learning Outcome(s):

Students understand the concept of manufacturing technology and control systems on the vehicle so as to: • Analyze the condition of current technological advances to make fundamental changes in vehicle design a sustainable future.

- Design process to create an automatic control system that helps in controlling the vehicle.
- Designing vehicles with electronic control systems that can improve vehicle performance.
- Describes the integration of vehicle control systems and mechanicalelectrical interaction possibilities for the design of future vehicles.

Topic:

Knock control, Linear solenoid idle speed control, Sequential fuel injection, Distributorless ignition, Self-diagnosis for fail-safe operation, Crankshaft angular position measurement for ignition timing, Direct mass air flow sensor, Variable valve phasing, Hybrid Electric Vehicles and Electric Vehicle.

Pre-requisite(s): Engineering Materials, Mechanical Design, Engineering Programming

References:

1. Julian Happian-Smith, " An Introduction to Modern Vehicle Design", Butterworth- Heinemann Linacre House, Jordan Hill, Oxford OX2 8DP, ISBN 07506 5044 3.
2. Heinz Hei s ler, "Advance Vehicle Technology", Society of Automotive Engineers, Inc. ISBN 07680 1071 3.
3. Fuhs, Allen E., "Hybrid vehicles and the future of personal transportation", CRC Press, Taylor & Francis Group, ISBN-13: 978-1-4200-7534-2, ISBN-10: 1-4200- 7534-9.
4. Lino Guzzella and Christopher H. Onder, "Introduction to Modeling and Control of Internal Combustion Engine Systems", Springer-Verlag Berlin Heidelberg, ISBN 978-3-642-10774-0 e-ISBN 978-3-642- 10775-7, DOI 10.1007/978-3-642-10775-7, Library of Congress Control Number: 2009940323.
5. Iqbal Husain, "ELECTRIC and HYBRID VEHICLES Design Fundamentals", CRC PRESS Boca Raton London New York Washington, D.C., ISBN 0-203-00939-8 Master e-book ISBN, International Standard Book Number 0-8493-1466-6 (Print Edition), Library of Congress Card Number 2002041120.
6. Ali Emadi, "Handbook of Automotive Power Electronics and Motor Drives", Taylor & Francis Group, CRC Press is an imprint of Taylor & Francis Group, ISBN 0-8247-2361-9.
7. Nicolas Navet and Françoise Simonot- Lion, "Automotive Embedded Systems Handbook", CRC Press Taylor & Francis Group, 6000 Broken Sound Parkway NW, Suite 300, ISBN-13: 978-0-8493-8026-6, ISBN-10: 0-8493-8026-X
8. Paul Nieuwenhuis and Peter Wells, "The automotive industry and the environment A technical, business and social future", Woodhead Publishing ISBN 1 85573 713 2, CRC Press ISBN 0-8493-2072-0, CRC Press order number: WP2072.
9. Simon Tung, Bernard Kinker, and Mathias Woydt," Automotive Lubricant Testing and Advanced Additive Development", ASTM 100 Barr Harbor Drive PO Box C700, West Conshohocken, PA 19428-2959,ISBN: 978- 0-8031-4505-4.
10. James Larminie, John Lowry, "Electric Vehicle Technology Explained", Oxford Brookes University, Oxford, UK, Acenti Designs Ltd.,UK. ISBN 0-470-85163-5.

OIL AND GAS DRILLING EQUIPMENT

ENME803195
4 credits
Learning Outcome(s):

Provide additional insights regarding the implementation of basic knowledge of engineering competence that is at the core of oil and gas drilling techniques. Competencies expected of graduates capable of developing the engine with value added technical knowledge of oil and gas drilling equipment that is ready to be trained and shaped to be easily and immediately adapt to work without the awkwardness of the world's E / P oil and gas fields in general and in particular oil and gas drilling. Thus it has the advantages of graduates and a wider choice in the real world of work later. Objectives and learning outcomes to be achieved:

1. Enabled students to know the basic tools and their functions and how each is needed in an oil

and gas drilling operations.
2. Students capable of explaining the technique of oil and gas drilling operations and its other related aspects such as equipment used, safety issues, safety equipment, emergency and environmental issues.
3. Student s have a pret ty good understanding of the knowledge of drilling equipment and its operation so as to participate in an oil and gas drilling operations with confidence and readiness to increase knowledge and skills later on after graduation.

Topic:

Intro to oil / gas well, oil / gas Exploration, exploitation and production, drilling rig, the terminology, the problem of drilling, drilling fluid, drilling oil and gas in the system, hoisting system equipments, equipments rotating system, circulating system equipments, power system equipments, blowout prevention system equipments, well design, equipments and operations for safety and efficiency, process and equipments for cementing, drilling preparation, drilling operations, drilling and process problems (drill string vibration and whirling, collar failure, etc.) artificial lift methods and equipments, visit to the field of oil and gas drilling.

Pre-requisite(s): Engineering Materials, Mechanical Design

References:

1. Don A. Gorman, Jerry W. Meyer, "Drilling Equipment and Operations", Action Systems Inc., Dallas, Texas – USA.
2. Adam T. Bourgoyne, Martin E. Chenevert, et. al., "Applied Drilling Engineering", Society of Petroleum Engineers, Richarson, Texas – USA.
3. Nguyen J.P., "Drilling-Oil and Gas Field Development Techniques", Institut Français du Pétrole Publication, 1996
4. Kermit E. Brown, "The Technology of Artificial Lift Methods", Volume 2a, Petroleum publishing Co., 1980
5. Amanat U.C., "Oil Well Testing handbook", Elsevier, 2004
6. Amanat U.C., "Gas Well Testing handbook", Elsevier, 2004

JET AND ROCKET PROPULSION

ENME803196
4 CREDITS
Learning Outcome(s):

Students understand the concept of thrust / propulsion related to the resistance of aircraft or flying vehicles. (thrust required); understand the concept and workings of a gas turbine and rocket engine; understand the characteristics of propeller (turboprop), turbofan, and jet (including rocket) propulsion systems on the performance of aircraft or other flying vehicles.

Topics:

The concept of the propulsion system which is influenced by the aerodynamic design of the aircraft (aircraft motion resistance and the 4 main forces of lift, weight, thrust and drag); How gas turbines and rocket engines work; The propulsion characteristics of various types of aircraft propulsion systems, namely, propeller (turboprop), jet and turbofan.

Pre-requisite(s): -

References:

1. J. D. Anderson, Aircraft Performance and Design, McGraw-Hill.
2. Anthony Giampaolo, Gas Turbine Handbook: Principles and Practices, The Fairmont Press.
3. D. P. Mishra, Fundamentals of Rocket Propulsion, CRC Press.
4. Rolls Royce, The Jet Engine, Rolls Royce PLC.

RISK MANAGEMENT

ENME803174
4 credits
Learning Outcome(s):

Fast information flow and the presence of regulatory and supervisory concerns, management requires understanding and measuring risk. Risk management sets standards for combining different information, collecting data, calculating risk measures and creating timely reporting tools for management. This course directs students to understand how complex ricredits on a large scale can be measured and managed.

Topic:

Introduction to risk management, Value at Risk - VaR Risk measures for various asset classes, Monte Carlo Simulation, VaR Validation and Extremes, Regulatory Environment 25 years of risk related regulations, Multifactor models Discussion of multifactor analysis, Review of industry leading risk management systems , Operational Risk and its Basel II requirements.

Pre-requisite(s): -

References:

1. Jorion, Philippe, Value at Risk: The New Benchmark for Managing Financial Risk, 3rd edition, McGraw-Hill, 2007
2. Roger Lowenstein, When Genius Failed, Random House, 2000

PROJECT MANAGEMENT (MK Merdeka)
ENME601101
2 credits
Learning Outcome(s):
Understand project management in engineering in general.

Topic:

Special topics in project management that have not been covered in other subjects.

Pre-requisite(s): -

References: -

ENTREPRENEURSHIP (MK Merdeka)
ENME601102
2 credits
Learning Outcome(s):
Understanding entrepreneurship in general.

Topic:

Special topics in the field of entrepreneurship that have not been covered in other subjects.

Pre-requisite(s): -

References: -

INDUSTRIAL SEMINAR (MK Merdeka)
ENME601103
2 credits
Learning Outcome(s):
Understand the development of the industry and the problems it faces in general.

Topic:
Special topics in the industrial field that have not been covered in other subjects.

Pre-requisite(s): -

References: -

INTERNSHIP A
ENME601108
3 credits
Learning Outcome(s):

Students gain insight and experience activities in industry and the work experiences related to non-engineering aspects.

Topic:

Special topics in the non-engineering industrial sector that have not been covered in other subjects.

Pre-requisite(s): Have undergone a minimum of 4 semesters of lectures, or have obtained a minimum of 72 credits with a GPA> 2.0. Activities carried out by monitoring and evaluation by the Internship Coordinator.

References: -

SPECIAL TOPIC 1
ENME601104
4 credits
Learning Outcome(s):

Students gain insight and experience of activities in national / international competitions, or community, or entrepreneurship, or industry and the work experiences.

Topic:

Special topics in fields that have not been covered in other subjects.

Pre-requisite(s): Have undergone at least 2 semesters of lectures, or have obtained a minimum of 36 credits with a GPA> 2.0. Activities carried out by monitoring and evaluation by the Special Topic Subject Coordinator.

References: -

SPECIAL TOPIC 2
ENME601105
4 credits
Learning Outcome(s):

Students gain insight and experience of activities in national / international competitions, or community, or entrepreneurship, or industry and the work experiences.

Topic:

Special topics in fields that have not been covered in other subjects.

Pre-requisite(s): Have undergone at least 2 semesters of lectures, or have obtained a minimum of 36 credits with a GPA> 2.0. Activities carried out by monitoring and evaluation by the Special Topic Subject Coordinator.

References: -

ADVANCED ENGINEERING MATHEMATICS
ENME802002
2 credits
Learning Outcome(s):

The purpose of this subject is to develop students' analytical skills. Students understand and are able to use advanced engineering mathematical concepts in solving applied engineering problems.

Topic:

Introduction to Differential Equations; Differential Equation Order 1; Differential Equation of Order 2; High Order Differential Equations; Vector Analysis; Differential Vector; Grad, Divergence and Curl Oper-

ations; Vector Integral; Laplace transform; Solving Differential Equations using Laplace Transform; Fourier transform; Convolution

Pre-requisite(s): -

References:

1. Chapra, Steven C. and Canale, Raymond P. Numerical Methods for Engineers 6th edition. New York: McGraw-Hill, 2010.
2. Kreyszig, Erwin. Advanced Engineering Mathematics 10th edition. Danvers: John Wiley & Sons, 2011.
3. Sedgewick R., Phillippe F, An Introduction to the Analysis of Algorithms, Addison Wesley.
4. Cheney W., Kincaid D., Numerical Mathematics and Computing, Cole Publishing

ENGINEERING COMPUTATION

ENME802004
2 credits
Learning Outcome(s):

The purpose of this subject is that students know well and be able to apply the processes and methods (algorithms) of calculation (numerical and analytic) engineering in the real computer-based computing world and parameters that affect the speed and accuracy of the calculation results.

Topic:

Numerical Method: Equation roots, Numerical Diffential, Numerical Integral; Partial Differential Equation Solution. Introduction to Computer Applications: Algorithms and Algorithm Analysis; Computational Complexity; Types of Algorithms; Number Optimization and Representation; Overflow and Underflow; Error and Formula Error in Numerical; Root of Eq. Finite Divided Difference Method in calculating Equation Derivation; Numerical Integration; ODE and ODE systems in Computing Applications; Fast Fourier Transform; PDE in Computational Applications: Solutions of Elliptic, Parabolic, and Hyperbolic Equations with Numerical Methods; Application of Elliptic, Parabolic, and Hyperbolic PDE equation techniques; Monte Carlo in Computing Applications.

Pre-requisite(s): -

References:

1. Chapra, Steven C. and Canale, Raymond P. Numerical Methods for Engineers 6th edition. New York: McGraw-Hill, 2010.
2. Kreyszig, Erwin. Advanced Engineering Mathematics 10th edition. Danvers: John Wiley & Sons, 2011.
3. Sedgewick R., Phillippe F, An Introduction to the Analysis of Algorithms, Addison Wesley.
4. Cheney W., Kincaid D., Numerical Mathematics and Computing, Cole Publishing

ADVANCED THERMODYNAMICS

ENME801101
4 credits
Learning Outcome(s):

Provide further understanding of the science of thermodynamics and its applications so that students are able to design and conduct a basic research mapun able to complete the analysis involves the calculation of the thermodynamic system correctly and systematically in order to find the best solution gentang effectiveness of the use of substances and energy, especially in the 'engineering design' by motto: 'Low entropy production', 'high thermal efficiency' and 'low pollution effect'.

Topic:

Basic Thermodynamics and Gas Dynamics, Equilibrium of Thermodynamics System, Thermodynamics properties of System, Thermodyamics of ideal gas mixture, review of chemical thermodynamics, review of chemical kinetics, conservation equation for multicomponent reaction system, pre-mixed laminar flames, method of measuring flame velocity (bunsen burner), flame quenching, flamability limit of premixed laminar flame, gaseous diffusion flame and combustion of single liquid droplet, combustion in compression ignition engine, combustion in spark ignition engine, combustion research in hydrocarbon oxygen mixture, engine research, combustion-generated emission, experimental method : preseure measurement and recording; temperature measurement and recording; combustion photography and flame speed detection; spectrographic method; chemical analysis technique (NDIR, FID, Gaschromatography).

Pre-requisite(s): -

References:

1. Holmann, J.P., Thermodynamics, Intl. Student Edition, McGraw Hill, 2005.
2. Kenneth Wark Jr. Thermodynamics, McGraw Hill, 2003.
3. Francis F. Huang, Engineering Thermodynamics, MaxWell Macmillan Intl. Edition, 2000.
4. H.D. Baehr, Termodynamik, Springer Verlag
5. K. Stephan, Termodynamik, Grundlagen und technishe Anwendung-en, Band 1, Band Springer Verlag.
6. Bejan, Adrian, Advanced Engineering Thermody-

namics, Wiley – interscience, 2nd Edition, 1997

ADVANCED FLUID DYNAMICS AND HEAT TRANSFER

ENME801102
4 credits
Learning Outcome(s):

Enhance the ability of students in the study of fluid mechanics in more detail so as to conduct research or the application of science in industrial applications. Studying the mechanism of heat transfer in a control volume due to the existence of the temperature difference and concentration as well as the involvement of one, two or three phases at the tim simultaneously.

Topic:

Viscous flow of Newtonian fluid, membrane boundary flow, Non-Newtonian Fluid Flow, Two-Multi Phase Flow, Particle Displacement Flow, Porous Media and Fluidized Beds, Turbulent Flow and Mixing, Jet, Chimney, Energy and Momentum Equatio, one-two-three dimension conduction heat transfer, heat transfer on extended surface.

Pre-requisite(s): -

References:

1. Frank P Incropere, David P De Witt, Fundamental heat and mass transfer, 5th Ed., John Wiley & Sons, 1996, New York
2. Holman JP, Heat Transfer, 9th, Mc Graw Hill, 2003.
3. Koestoer, RA, Perpindahan Kalor untuk Mahasiswa Teknik, Salemba Teknika, 2003.
4. Welty R James, Wicks Charless, Wilson Robert, Fundamentals of Momentum, Heat, and Mass Transfer, 3rd Ed. John Wiley & Sons, 1996, New York
5. Cengel, Yunus, Heat Transfer a Practical Approach, 2nd Ed. Mc Graw Hill, 2003, Singapore.
6. Kreith Frank, Bohn Mark, Principles of Heat Transfer, 6th Ed. Brooks/cole, 2001, USA
7. Abbott I R, Theory of Wing Section, Dover Publications.
8. Bird R B, Transport Phenomena, John Wiley & Sons.

FIRE AND BUILDING SCIENCE

ENME802133
4 credits
Learning Outcome(s):

Students understand the basic and important parameters in the process of fire (fire), the phenomenon of fire dynamics and fire hazards. Students will also learn the science of fire both for indoors and outdoors. To strengthen understanding of fire science in buildings, students will also study building science, which relates to building requirements, which include safety, health, comfort, and ease of access for normal operating conditions and fire emergencies. The basic phenomenon of fires in nature that propagates to buildings or vice versa (wildland-urban interface or WUI fires) will also be studied in this lecture.

Topic:

Basic laws of aerothermochemistry such as combustion thermodynamics, fluid mechanics, heat transfer, combustion chemical reactions, rate of heat release, calculation of fire dynamics, flame and flame propagation indoors and outdoors. Building sciences relating to the fulfillment of safety, health, comfort, and ease of access requirements both under normal operating conditions and fire emergencies. This lecture course is also equipped with experimental activities in the laboratory to understand ignition behavior, premixed and non-premixed flame phenomena, combustion of solids and liquids, plumes formation, smoke production, flame and flame propagation, and fire dynamics in the room to represent fire conditions building.

Pre-requisite(s): -

References:

1. Drysdale, D., An Introduction to Fire Dynamics, John Wiley & Sons Ltd, 1985.
2. James G. Quintiere, Fundamentals of Fire Phenomena, John Wiley & Sons, Ltd ISBN: 0-470-09113-4, 2006
3. SFPE Handbook of Fire Protection Engineering 5th edition, Springer, 2016
4. Turn, S.R., An Introduction to Combustion 2nd Edition, McGraw-Hill, Inc. 2000.
5. Jens Pohl, Building Science: Concept and Application, Wiley-Blackwell, 2011.
6. Samuel Manzello, Encyclopedia of Wildfires and Wildland-Urban Interface (WUI) Fires, Springer, 2020.
7. Undang-Undang Bangunan Gedung Republik Indonesia, Peraturan terkait, dan SNI.

MATERIAL AND MANUFACTURING PROCESSES

ENME801140
4 credits
Learning Outcome(s):

The course provides understanding and basic

competence of theory, application method and product manufacturing processes that covers: working principle, process characteristics, process limitations, work and force due to the process, parameters that affects to the process and the relation of material with the process that needed for certain process.

Topic:

Manufacturing Process and Production Systems; Materials in Manufacturing; Theory and Method of Casting Processes; Theory and Method of Bulk Deformation Processes; Theory and Method of Metal Forming Processes; Theory and Method of Powder Metalurgy Processes; Theory and Method of Material Machining/ Cutting Processes; Theory and Method for Enhancing Manufactured Surface Quality; Theory and Method of Joining Processes; Theory and Method of Prototyping; Engineering Material Characteristics; The Relation between Process Characteristics and Material Characteristics; The Parameter Control of Process for Material; Assignment in Manufacturing Process and Material Selection for Market Needs.

Pre-requisite(s): -

References:

1. Michael Ashby dan Kara Jhonson, Materials and Design: Arts and science in material selection in product design,Butterowrth-Heinemann, 2002
2. Michael Ashby, Material selection in Mechanical Design, Butterworrth Heinneman,2005
3. John A. Schey, Introduction to Manufacturing Processes, McGraw-Hill, 1999
4. Degarmo, E. Paul, Materials and Processes in Manufacturing, Prentice Hall Int. Inc, 8th edition, 2005

PRODUCT DESIGN AND DEVELOPMENT METHODOLOGY

ENME801141
4 credits
Learning Outcome(s):

Provide an understanding and mastery of the theory and methodology of design and product development include: planning, concept development, system design, detailed design, testing and screening, production ramp-up, in a series of factors to consider overall product development.

Topic:

Product Planning: Needs Identification Methods; Product Selection Method (Feasibility Study); Business Specifications: Concept Development and Selection; Aspects of Engineering in Product Development and Manufacturing (Process, Material, Thermal, Durability) Non- Technical Aspects in Product Development and Manufacturing; basic Design for Manufacturing and Assembly; Calculation of Economics of Product Development.

Pre-requisite(s): -

References:

1. Karl T.Ulrich. Product Design and Development, 3rd edition, Mc.Graw Hill 2004.
2. Dieter, G.E., Engineering Design, 3rdedition, Mc.Graw Hill 2000

MANUFACTURING INFORMATION SYSTEM MANAGEMENT

ENME801150
4 credits
Learning Outcome(s):

Provides understanding of the theory, method and application of information technology systems, management, and development of the concept of knowledge-based information systems (Knowledge Management System) and capable to apply in the manufacturing industry.

Topic:

Introduction to Information Systems; State of The Art Utilization Information System; Theory and System Methodology; Database Management Systems; System Design I: Overview functionality, enabling Technology (Automated Solution Assessments Quality, Multi Data Representation, Database Technology and XML); Design System II: (Database Design, Information Input, Output Information); Case Study: Documentation automation and Reporting System for Manufacturing; Introduction Knowledge Base Engineering, Concepts and Methodology in the KBE (System Specialists, Neural Network); KBE application..

Pre-requisite(s): -

References:

1. Raymond McLeod Jr., Strategic information Management: Challenges and Strategies in Managing Information System; 3rd Edition, Butterworth-Heinnemen, 2003.
2. Cortada, James. Total Quality Management, McGraw Hill Book Co.
3. Ake, Kevin et al. Information Technology for Manufacturing: Reducing Costs and Expanding Capabilities, CRC Press, 2003.
4. Cecelja, Franco, Manufacturing Information and Data System: Analysis Design and Practice, Butterworth-Heinnemen, 2001.

MANUFACTURING SYSTEM AND PROCESSES

ENME801151
4 credits
Learning Outcome(s):

Students are expected to know and be able to apply the conventional manufacturing process technology and non-conventional for the manufacture of a product and the parameters which inflence it is devoted to the metal forming processes, machining, rapid prototyping process. In addition, knowing, and understanding the existing production systems in the industry.

Topic:

Materials in Manufacturing: Theory and Method of Casting Process (Metal Casting); Theory and Method of Bulk Formation Processes: Theory and Method of Formation Process Material Sheet (Sheet Metal Forming): Theory and Methods of Powder Metallurgy Process (Powder Metalurgy); Theory and Methods for Machining Processes / Cutting Materials: Theory and Methods of Product Surface Quality Improvement process: Concepts and methods of manufacturing systems.

Pre-requisite(s): -

References:

1. Wagoner R., Chenot J.-L, Fundamentals of Metal Forming, John Wiley & Sons, Inc,2003
2. Degarmo P., Materials and Process in Manufacturing, Prentice Hall, 2004
3. Schey J., Introduction to Manufacturing Process, McGraw-Hill, 2004
4. Thomas E Vollman, Manufacturing Planning and Control, McGraw Hill 1997
5. Stanley B. Gershwin, Manufacturing System Engineering, Prentice Hall, 1993
6. John M. Nicholas, Competitive Manufacturing Management, 1997

VEHICLE ENGINEERING AND HEAVY EQUIPMENT

ENME801163
4 credits
Learning Outcome(s):

This course provides the latest technology from the four-wheeled passenger vehicle, especially with covering all aspects of engineering in a vehicle. Lectures given vehicle engineering with the aim that students have basic competence to do the engineering on the four-wheeled passenger vehicle in particular.

Topic:

Vehicle Kinematics & Dynamics; mover and transmission system; Breaking Systems, Wheel and Suspension; Security System: Active and passive at the time experiencing issues.

Pre-requisite(s): -

References:

1. Bosch Automotive Handbook, Sixth Editions, 2006
2. Gillespie, Thomas D., Fundamentals of Vehicle Dynamics, 2004
3. Hei s ler, Heinz. Advanced Vehicle Technology, 2004
4. Hermann, Hans. SAE Handbook of Automotive Engineering, 2004
5. Miliken, William F., Douglas L. Milliken, Maurice Olley, Chassis Design: Principles and Analysis, 2004
6. Pacejka, Hans B. Tire & Vehicle Dynamics, SAE, 2006

PRIME MOVER AND POWERTRAIN SYSTEM

ENME801164
4 credits
Learning Outcome(s):

Students have the competency and skill in the principles and theory of prime mover including internal combustion motor, electric motor, hybrid motor which are connected to the powertrain system; understand and are able to calculate the construction and design.

Topic:

Combustion motor technology; reciprocating/rotary piston engine; electric motor technology (AC/DC motor); hybrid motor system; serial/Non Reguler hybrid; transmission system: MT, AT, DCT, CVT; battery technology

Pre-requisite(s): -

References:

1. Heywood, J., Internal Combustion Engines Fundamental, McGraw Hill, 1989
2. Khovakh, M., Motor Vehicle Engines, MIR Publisher, Moscow, 1971.
3. Bosch Automotive Handbook, SixthEditions, 2006
4. Gillespie, Thomas D., Fundamentals ofVehicle Dynamics, 2004
5. Heiszler, Heinz. Advanced VehicleTechnology, 2004

6. Hermann, Hans. SAE Handbook ofAutomotive Engineering, 2004

COMBUSTION ENGINEERING

ENME804110
4 CREDITS
Learning Outcome(s):

Combustion Engineering provide basic competency to investigate, analyze and learn about the process of combustion of fuel, and the nature and behavior of flame. The course provides basic understanding to apply the laws of basic aerothermochemistry in the engineering calculation of practical combustion engineering. The student is expected to be able to analyze the combustion behavior of a flame and to develop knowledge in the field of combustion engineering.

Topic:

Important Meaning of Combustion Study; Basic Reaction and Stoikhiometry of Combustion; Gas Fuel (BBG); Liquid Fuel, Solid Fuel; Basic Thermochemistry and Fluid Dynamics of Combustion; Principles of Conservation of Mass and Continuity; Turbulence Premixed Flame Structure; Detonation; Combustion Technology; Fixed-Bed Combustion, Suspension, Fluidized- Bed; Study on Flame and Combustion Technology; Minimum Temperature Self-ignition (Auto/ Self-Ignition); Flammability Limit; Fire spread, Fire Suppression Material, Combustion and the environment.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanic

References:

1. Turn, S.R., An Introduction to Combustion, 3rd Edition, McGraw-Hill, Inc. 2011
2. Borman, G.L., and Ragland, K.W., Combustion Engineering, 2nd Edition, McGraw-Hill, Inc. 2011.
3. Griffi ths, J.F., and Barnard, J.A., Flame and Combustion, 3rd Edition, Blackie Academic and Professional, 1995.
4. Glassman, I., Combustion, 5th Edition, Academic Press, 2014.
5. Warnatz, J., Maas, U., and Dibble R.W., Combustion, 2nd Edition, Springer-Verlag, 1998.

HEAT AND MASS TRANSFER ENGINEERING

ENME804109
4 credits
Learning Outcome(s):

The course objective is to provide understanding of the heat exchangers used in many industrial processes and power plants as the application of heat transfer. This course provides a basic competency to know main heat exchanger types and to understand and able to select suitable heat exchanger type for current applications. Student is also expected to understand basic factors in designing heat exchangers, to estimate size and price and know and choose the type of heat exchanger. Provide basic understanding and various parameters on the drying process so that students can perform calculations and analysis of various drying techniques and their applications. This course also provides the expertise so that students are able to do drying modeling, to design and analyze the system for various materials (solid and solvent) so that the drying process can be suitably selected for particular product.

Topic:

Heat Transfer Review; Type and Application of Heat Exchangers; Practgical Design of Shell and Tube Heat Exchanger (Thermal and Mechanical); Manufacturing Cost Estimation; Heat Exchangers; Operation and Monitoring of Heat Exchangers (Fouling And Vibration); Maintenance of Heat Exchangers; Corrossion on Heat Eschangers; Heat Exchanger Design Software; Presentation and Laboratory Practice of Heat Exchangers. Review Transfer Phenomena (Momentum, Heat and Mass); Drying Principles and Basics; Mathematical Modeling of Drying System; Classification and Selection of Dryer, Post-Harvest Drying and Storage of Grain; Rotary Drying; Vacuum Drying; Fluidized Bed and Spouted Bed Drying; Drum Dryer; Spray Drying, Freeze Drying; Conveyor Drying; Solar Drying; Enrgy Optimization in Drying System; Drying System Design.

Pre-requisite(s):

Heat and Mass Transfer, Basic Fluid Mechanics

References:

1. Frank P Incropere, David P De Witt, Fundamental heat and mass transfer, 7th Ed.,John Wiley & Sons, 2011, New York
2. Holman JP, Heat Transfer, 10th, Mc Graw Hill,2009.
3. Smith Eric, Thermal Design of Heat Exchanger, John Wiley & Sons, 1996, New York
4. Welty R James, Wicks Charless, Wilson Robert, Fundamentals of Momentum, Heat, and Mass Transfer, 6th Ed. John Wiley & Sons, 2014, New York.
5. Cengel, Yunus, Heat Transfer a Practical Approach, 2nd Ed. Mc Graw Hill, 2003,Singapore.
6. Kreith Frank, Bohn Mark, Principles of Heat Transfer, 7th Ed. Brooks/cole, 2010, USA
7. Rohsenow Warren, Hartnett James, Cho Young, Handbooks of Heat Transfer, 3rd Ed., Mc Graw Hill, 1998, New York.

AERODYNAMICS ENGINEERING

ENME804111

4 credits
Learning Outcome(s):

Aerodynamic Engineering is an advanced course of Fluid Mechanics which focusing on aeronautics applications. Through the course students is expected to be able to understand the fundamental principles and basic equations of aerodynamics and to apply them in the process of airfoil design and to understand performance characteristics of the airfoil. Student is able to understand the phenomenon of incompressible flow through the airfoil and finite wings. Student is expected to be able to have an understanding of subsonic and supersonic compressible flow phenomena through aerofoil and other compressible flow phenomena.

Topic:

Introduction on Aerodynamics; Basic and Principle Equations; Incompressible flow; Airfoil Aerodynamics Characteristics; Finite Wings; Incompressible Flow through Airfoil; Incompressible Flow through Finite Wings; Airfoil in Compressible Flow; Wings and Wings-Body Combination in Compressible Flow; Airfoil Design; Double Surface; Vortex Lift; Secondary Flow and Viscous Effect; Other Phenomena in Compressible Flow; Normal Shock Wave; Oblique Shock Wave; Expansion Wave; Supersonic Wave.

Pre-requisite(s):

Basic Thermodynamics, Basic Fluid Mechanics

References:

1. A.M. Kuethe and C.Y. Chow, Foundations of Aerodynamics, 5th Edition, John Wiley & Sons, Inc., 2009.
2. B.W. McCormick, Aerodynamics, Aeronautics, and Flight Mechanics, 6th Edition, John Wiley & Sons,Inc., 2010.
3. J Anderson, Fundamentals of Aerodynamics, 5th Edition, McGraw Hill, 2011.

REFRIGERATION ENGINEERING

ENME803108
4 credits
Learning Outcome(s):

Refrigeration engineering course provides basic competency for the student to be able to do the simulation software to design a cooling system and equipments involved with a very close relationship with the Industrial and engineering users. Hence student will have understanding in design and development of cooling system and ability to evaluate and analyze its performance, especially on clod storage.

Syllabus:

Principles of Refrigeration and Heat Pump, Terminology and Units; Mechanical Vapor Compression Refrigeration Engine; Heat Trasnfer in Refrigeration System; ph Diagram Calculation in Refrigeration Cycle; Refrigeran, Lubricant, Salt and the Environment; Compressors; Condenser and Evaporator; Refrigeration Piping System and Equipments; Automatic Control System and Safety Equipments; Air Properties; Psychrometric and its process; Absorption Refrigeration; Alternative refrigeration Cycles (adsorption, gas compression, and ejector); Display Case, Prefabricated Cold Storage and Cold Storage, Cold Room Calculations.

Pre-requisite(s): Basic Thermodynamics

References:

1. ASHRAE Handbook of Fundamental, ASHRAE Atlanta, 1995.
2. Kuehn, Ramsey and Therkeld, Thermal Environmental Engineering, 3rd Edition, Prentice Hall, 1998.
3. Threkeld,JL., Thermal Environmental Engineering, Prentice Hall.
4. ASHRAE Handbook of Fundamental, ASHRAE Atlanta, 2001
5. ASHRAE Handbook of Refrigeration, ASHRAE, Atlanta, 2002.

MECHANICAL SYSTEM FOR BUILDING

ENME804118
4 credits
Learning Outcome(s):

This subject equips students with basic understanding and competence in designing mechanical systems for buildings that include ventilation and air conditioning systems, plumbing, fire protection, and dirty water treatment.

Topic:

The form of the task of designing the utility system of a multi-storey building.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanics

References:

1. Stein, Benjamin, Reynolds, John S., Grondzik, Walter T., Kwok, Alison G., "Mechanical and Electrical Equipment for Building", John Wiley and Sons, 2006.
2. Gina Barney, "Elevator Traffic Handbook, Theory and Practice", Spon Press, 2003.
3. The American Society of Mechanical Engineers, (ANSI A.17.1-2000), "American National Standard Safety Code for Elevator, Dumbwaiters, Escalators and Moving Walks", ANSI A.17.1-1971

ENERGY SYSTEM OPTIMIZATION

ENME802103
4 credits

Learning Outcome(s):

This course provides an understanding of mathematical modeling, simulation and optimization of energy systems through technical and economical approach. The course is intended to equip student with the ability to understand mathematical model, simulation and optimization of thermal systems.

Topic:

Workable System Design; Economical Evaluation; Determination of Mathematical Equations; Thermal Equipment Modeling; System Simulation; System Optimization: Objective Function, Constraints; Lagrange Multipliers: Lagrange multiplier to complete the optimiza- tion process; Dynamics, Geometric and Linear Programming; Mathematical Model of Thermodynamics Properties; Big System Simulation under Steady Condition; Big Thermal System Simulation; Calculation of Variables in Optimum Conditions.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanics

References:

1. Stoecker, W.F. Design of Thermal System, 3rd Edition, Mc.Graw Hill Book Co, 2011.
2. Boehm,R.F., Design of Analysis of Thermal System, John Wiley&Sons,1987.
3. Yogesh Jaluria, Design and Optimization of Thermal Systems, 2nd Edition, Mc.Graw Hill Book Co, 2007.

FIRE SAFETY ANALYSIS

ENME804138
4 CREDITS
Learning Outcome(s):

Students have comprehensive knowledge of technical analysis related to the design of fire safety systems. These capabilities include the ability to identify and quantify fire ricredits and hazards, provide design options, develop design evaluation concepts, apply fire calculation and modeling methods, determine boundary conditions and constraints in design and analysis. relating to being able to evaluate the performance of a fire protection system and knowing and being able to plan the maintenance of a fire protection system.

Topic:

Development of performance-based fire protection system design, smoke management system design concepts, evacuation time analysis and life-saving facilities, fire safety in buildings, risk management, fire modeling and national and international regulations in the field of Fire Safety Engineering.

Pre-requisite(s): Basic Thermodynamics

References:

1. Dougal Dysdale, An Introduction to Fire Dynamics 3rd Edition, John Wiley and Sons, 2011.
2. SFPE Handbook of Fire Protection Engineering 5th edition, Springer, 2016
3. Rasbach, D.J., et al., Evaluation of Fire Safety, John Wiley and Sons, 2004.
4. A.H. Buchanan, Fire Engineering Design Guide, New Zealand, 2001.
5. SNI, ASTM, NFPA, rules and standards

DESIGN FOR MANUFACTURE AND ASSEMBLY

ENME804148
4 CREDITS
Learning Outcome(s):

Provide knowledge, understanding and competence in the product design process which is considering, including factor and oriented on: material, manufacturing capability and assembling process. Therefore the product is expected to have made ease of manufacture and assembly.

Topic:

Review of the materials selection and processes, product design for manual assembly, design for automated assembly, PCB design for manufacture and assembly, machining process design, injection molding, sheet metal forming processes, die-casting.

Pre-requisite(s): Engineering Materials, Mechanical Design

References:

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

NOISE AND VIBRATION CONTROL

ENME804149
4 credits
Learning Outcome(s):

This course provides competency to students to complete the issue of application of vibration on the mechanical structure of the construction, and plate or vessel (vessel), perform the calculation of vibration reducer system design, system and engine holder enhancing of production equipment. Finally students have to make basic vibration measurements; forecasts predicted the damage engine, the vibration analysis of the data signal and the vibration spectrum and carry out machine performance diagnosis based on data analysis of vibration data and other data related

Topic:

Mechanical vibration with Many Degrees Freedom; Vibration on the Structure Construction; Vibration on plate and body shell (Vibration Plate and Shell); Vibration Isolation; Designing Vibration Absorber;

Engineering Vibration Measurement; Vibration spectrum analysis; Performance Diagnostic Machine.

Pre-requisite(s) : Mechanical Vibration

References:

1. Jerry H.G., "Mechanical and Structural Vibrations", John Wiley, 2004
2. Demeter G.F., "Mechanical and Structural Vibrations", John Wiley, 1995
3. Kenneth G.M., "Vibration Testing: Theory and practice 2nd ed", Wiley, 2008
4. Werner Soedel, "Vibrations of Shells and Plates", 3rd edition – revised and expanded, Marcel Dekker, INC., 2004
5. Randall R.B., "Frequency Analysis", Brüel & Kjær, 1987
6. Jens T.B., "Mechanical Vibration and Shock Measurement", Brüel & Kjær, 1980

CAD/CAM

ENME804155
4 credits
Learning Outcome(s):

This lecture will discussed about technology of CAD, CAM, Integration of CAD / CAM application in the industry and the emphasis on: the principles modeling and surface curve geometry (Geometric modeling), design of 2D and 3D models with computer assisted. The principle of data exchange between CAD/CAM systems also tool path design using computer for prismatic and sculptured model. Lectures CAD / CAM are provided with the aim that students have the understanding and applying technology of CAD / CAM: starting the process from design to production process with the computers assistance.

Topic:

Overview of CAD / CAM System; Hardware & Software System of CAD / CAM; Interactive Tools and Computer Graphics Concepts, Geometric Modeling: Type & Representation of mathematical model Curve, Surface & Solid ; Data Exchange in CAD / CAM system; Manufacturing Processes: Manufacturing Process Review Type and Parameter Calculation machining, Lab. practice of CAD; CNC Technology; Tool Path Generation Method in the CAM system; Control 'quality of machinery' in the CAM system; Computer Aided Process Planning-CAPP; Postprocessing; Lab. practice of CAM.

Pre-requisite(s): Eengineering Programming

References:

1. Kiswanto G., Handout CAD/CAM, Diktat kuliah, 2004.
2. Choi B. K., Jerard R. B., Sculptured Surface Machining,
3. Zeid, I., CAD/CAM Theory and Practice, McGraw-Hill, 2009.
4. Chang, T. -C., Computer Aided Manufacturing, 3rd ed, Prentice-Hall, 2005.
5. Korem, Y., Computer Control of Manufacturing Systems, McGraw-Hill

MANUFACTURING PERFORMANCE ASSESMENT

ENME804156
4 credits
Learning Outcome(s):

Provide knowledge about the basic concepts of performance assessment of manufacturing industry relating to product performance, process, manufacturing system and its relation to manufacturing excellence. At the end of this course, students are expected to understand the methodologies and assessment tools manufacturing performance and are able to identify, assess and analyze the performance of the manufacturing industry increase.

Topic:

Introduction, Traditional Performance Methodology & Tool: Dupont Financial Performance, Basic Performance Measurement process & tools: Data collection techniques, chart, graph & diagram, Process Improvement methodologies & tools: Process Capability, Measurement System Analysis (MSA), QFD, FMEA, six sigma & lean six sigma, Industry specific/ generic standards & best practices, Manufacturing Maturity model concept & measurements, Case study of Industrial performance Measurement (assignment & evaluation)

Pre-requisite(s): Eengineering Materials, Mechanical Design

References:

1. US Departement of Energy, United Sates of America, Performance Based Management, 2005 Oak Ridge Associated Universities,. "How to Measure Performance, A Hand Book of Techniques and Tools"
2. "World Class Manufacturing Performace Measures"
3. Harold T.Amrine, John A.Ritchey, Prentice Hall International Edition, "Manufacturing Organization and Management"
4. Will Kaydos, Productivity Press Portland Oregon, " Measuring, Managing and Maximizing Performance"

AUTOMATION AND ROBOTICS

ENME802152
4 credits
Learning Outcome(s):

Automation and Robotics course discusses tech-

nology and application in the automation industry and the design and control the robot emphasizes: understanding the types of automation systems, particularly in the manufacturing industry and the mechanism, the design and development of automation system that emphasizes the 3 things: reliability, quality and cost and the understanding robot control system. Automation and Robotics Lectures given with the aim that students have an understanding in the implementation of technology Automation and Robotics, especially in the manufacturing industry.

Topic:

Automation System; Classification Type Manufacturing Automation machinery; Actuator; Sensor System; PLC Control System in the Manufacturing Automation machinery; Robot- cs: Definitions and Principles of Robot; Spatial Descriptions: Definitions and Principles, Methods and Applications Spatial descriptions; Forward Kinematics: Definition, Principles and The Forward Kinematics; Jacobians: Speed, explicit shape, definition and principle of inverse Kinematics; Dynamic: The form of explicit, Acceleration and inertia; Control system ronbotic: PID control, the Joint Space Control, Operational Control and Space Force Control; Robot Design Assignment.

Pre-requisite(s): Engineering Programming

References:

1. Craig J., Introduction to Robotics 3rd ed, Prentice Hall, 2004.
2. Heath L., Fundamentals of Robotics, Theory and Applications, Prentice Hall, 1985.
3. Koren Y., Robotics for Engineer, McGraw Hill, Intl Edition, 1985.
4. Lentz K. W. Jr., Design of Automatic Machinery, Van Nostrand Reinhold, 1985.
5. Schilling R. J., Mikell P., Fundamentals of Robotics, Analysis and Control, Prentice Hall, 2000.
6. Kiswanto G., Otomasi dan Robotika, Diktat Kuliah Departemen Teknik Mesin, 2004.

RAILWAY VEHICLE ENGINEERING

ENME804168
4 credits
Learning Outcome(s):
Provide the knowledge and design of rail vehicle.

Topic:

Engineering and economic analysis of rail vehicles; body structures and rail vehicles; structural analysis of flat car; coupler analysis; electrical and pressurized water; analysis and modeling of the bogie; axle; wheel; brake and pivot; suspension system and driving quality; dynamic load analysis; fatigue and cracks in rail vehicles; models of rail vehicles and track geometry; modeling components of rolling stock; response rail vehicle on the track tangent; lateral stability of the rail vehicle on the track tangent; response rail vehicle on a curved trajectory; wheel wear; rail vehicle dynamics.

Pre-requisite(s): Engineering Materials, Mechanical Design

References:

Simon Iwnicki, handbook of railway vehicle dynamics, CRC Press, Taylor & Francis Group, 2006.

HANDLING AND CONSTRUCTION EQUIPMENT

ENME804197
4 credits
Learning Outcome(s):

Provide expertise and competence to students in the field of design and development of lifting equipment and construction equipment

Topic:

Introduction and Scope of Construction Equipment; Tractor, Bulldozer, Dump Truck and shovel; Construction Equipment Mechanical Concept; Heavy equipment system: Pneumatic and Hydraulic; Basic Machine-lifting machinery and materials transporter; Cranes, hoist and conveyor; forklift: Moving Walks, Escalators, and Elevators

Pre-requisite(s): Engineering Materials, Mechanical Design

References:

1. ASME. Handbook of Materials Handling.
2. Mc.Guiness. Mechanical and Electrical Equiment for Building.

AIRCRAFT DESIGN AND PERFORMANCE

ENME804198
4 credits
Learning Outcome(s):

Explain aircraft flying techniques, Explain the design concepts of an aircraft, Explain the design stages of an aircraft, Determine aircraft design requirements, Analyze aircraft performance, Analyze the advantages and disadvantages of an aircraft design

Topic:

The evolution of aircraft design, design requirements of an aircraft, aircraft design concepts, aircraft aerodynamics, aircraft propulsion systems, aircraft performance in steady flight conditions, aircraft performance in accelerated flight conditions, aircraft design which includes aspects of aerodynamics and its components, the technique of flying an airplane.

Pre-requisite(s): Engineering Materials, Mechanical Design

References:

1. J. D. Anderson, Aircraft Performance and Design, McGraw-Hill
2. Daniel Raymer, Aircraft Design, American Institute of Aeronautics and Astronautics.
3. Mohammad H. Sadraey, Aircraft Design: A Systems Engineering Approach, Wiley.
4. John P. Fielding, Introduction to Aircraft Design, Cambridge.
5. Egbert Torenbeek, Advanced Aircraft Design: Conceptual Design, Analysis and Optimization of Subsonic Civil Airplanes, Wiley.

ADVANCED WELDING ENGINEERING

ENME804190
4 credits
Learning Outcome(s):

Provide knowledge, understanding of the theories, principles and design as well as the assessment of the quality of welding and welding applications.

Topic:

Introduction, review of welding term and definition, welding process type, standard power source, Oxy-gas welding, Shield Metal Arc Welding (SMAW), Gas Tungsten Arc Welding (GTAW), Gas Metal Arc Welding (GMAW), Submerged Arc Welding (SAW), Flux Cored Arc Welding (FCAW), Resistance welding, Friction Stir Welding, Other welding process: laser, electron beam, plasma, Cutting and other edge preparation processes, surfacing and spraying, Brazing and soldering, Joining processes for plastics, ceramics and composites, Welding metal: Ferrous-based metal, non-ferrous-based metal, Material behavior during welding process, Testing materials and the weld joint, Non Destructive Examination (NDE), DT (Destructive Test), Heat treatment of base materials and welded joints, Basic of welding design, Residual stresses and distortion, Welding Symbol, Behavior of welded structures under different types of loading, Design of welded structures under static and dynamic loading, welding defects, Design of welded pressure equipment, Welding Performance Qualification Record (WPQR), Welding Procedure Specification (WPS), Welding automation.

Pre-requisite(s): Engineering Materials, Mechanical Design

References:

1. Sindo Kou, Welding Metallurgy, 2nd Edition, Wiley, 2002.
2. ASME Section IX, Welding and Brazing Qualifications
3. AWS D1.1., Structural Welding (Steel)
4. Technical Manual TM 5-805-7. Welding Design, Procedures and Inspection Headquarters, Department of the Army.1985
5. Lloyds Register. Welding Procedures, Inspections and Qualifications.

FOREST AND LAND FIRES

ENME804136
4 credits
Learning Outcome(s):

Students have comprehensive knowledge about the understanding of forest fires, land fires, the basic concepts of forest and land fires, factors related to the occurrence of forest and land fires and their prevention and mitigation efforts. In the learning process students will learn various types of vegetation in tropical forests and peat; identify environmental factors such as the availability of fuel capable, weather, topography, and human activity factors that influence ignition, smoldering, flammability, rate of heat release, rate of fire spread, rate of smoke production, and rate of potential fire hazard rating. Students will also learn various methods of early fire detection, calculation of heat release and emissions from forest and land fires, as well as efforts to prevent and handle forest and land fires.

Topic:

Tropical forests and peat in Indonesia, general understanding, types of forests in Indonesia, climatological conditions, and social environment. Statistics of forest fires in Indonesia and the world. Basic concepts and factors related to forest and land fires. Tropical peat in Indonesia, understanding, types, characteristics and hydrological environment. Weather factors, topography, vegetation types, topography and human activity factors in the process of forest and land fires. Characterization of potential, assessment of ricredits and dangers of forest and land fires: (ignition), flammability, rate of heat release, rate of fire spread, rate of production of hazardous fumes and gases, and fire hazard rating. Early detection techniques for fires by remote sensing (satellite imagery) in the form of hot spots, trace particulates, hazardous gas emissions, and haze. Forest and land fire prevention and prevention strategies. Laboratory scale practicum uses an integrated peat fire analyzer available at the Thermodynamics Laboratory to study peat fires propagation rates and the resulting emissions and extinguishing methods.

Pre-requisite(s): Basic Thermodynamics

References:

1. Laslo Pancel and Michael Kohl, Tropical Forestry Handbook, Second Edition, Springer-Verlag, 2016, ISBN 978-642-54600-6.
2. Mitsuru Osaki, Nobuyuki Tsuji, Tropical Peatland System, Springer – Japan, 2016.
3. National Wildfire Coordinating Group, Guide to

Wildland Fire Origin and Cause Determination, PMS 412, NFES 1874, 2016.
4. SFPE Handbook of Fire Protection Engineering 5th edition, Springer, 2016
5. Jurnal Ilmiah terkait.

THERMAL POWER GENERATION

ENME803104
4 credits
Learning Outcome(s):

The course objective is to provide an understanding of the basic principles of power generation, and basic competency in the design and development of power generation systems.

Topic:

Industrial Power Plant and Steam System: Boiler, Steam Turbine, Gas Turbine; Cogeneration Engineering, Instrumentation and Main Tools; Performance and Reliability Factors; Economical Aspects, Environmental Aspects: Settings and Prevention.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanics

References:

1. Tyler G. Hicks, Power Plant Evaluation and Design Reference Guide, McGraw Hill, 1986.
2. Sill and Zoner, Steam Turbine Generator Process Control and Diagnostics, Wiley Higher Ed., 1996.
3. Saranavamuttoo et.al, Gas Turbine Theory, 6th Edition, Prentice Hall, 2008.
4. Black and Veath-Power plant engineering , Philips Keameh–Power generation handbook
5. Steam Generators by Babcock Willcock
6. Borman, G.L., and Ragland, K.W., Combustion Engineering, 2nd Edition, McGraw-Hill, Inc. 2011.

MECHANICAL FAILURE

ENME803143
4 credits
Learning Outcome(s):

This course provides an understanding and competence about principles and modes of mechanical failure may occur and should be avoided so that should be considered in the design of mechanical, including buckling, Corrosion, fatigue, creep, melting, fracture, thermal, and wear.

Topic:

Theory and Buckling Mode (Torsional-lateral, Plastic, Dynamic), Theory and Corrosion mode (Metal, Non-Metal, Glass); Corrosion Prevention; Theory and Fatigue Failure Mode; Theory and creep mode; Theory and Melting Mode; Theory and Type of Fracture mode, Theory and the thermal failure mode; Theory and Wear mode; Failure Analysis and Prevention to: Buckling, Corrosion, Fatigue, creep, Melting, Fracture, Thermal, and Wear

Pre-requisite(s): Engineering Materials, Mechanical Design

References:

1. Jack A Collins, Materials Failure in Mechanical Design, Wiley - Interscience, 1993
2. S. Suresh, Fatigue of Materials, Cambridge University Press, 1998
3. M Jansenn, J. Zuidema, Fracture Mechanics, VSSD, 2006
4. Arthur J. McEvily, Metal Failures : Mechanisms, Analysis and Prevention, 2013

MACHINE VISION SYSTEM

ENME803153
4 credits
Learning Outcome(s):

Methods and applications monitoring the production process by using visual-based camera technology, image processing, for the purpose of introducing the feature: product identification, selection and product screening, and quality control. With the completion of this course, students have the ability to apply and develop the visual method of monitoring the production process in the industry for the purpose.

Topic:

Basic Machine Vision Method: Binary Image, Binary Morphology and Gray-Scale, Texture analysis; Identification Method feature; image Processing Method Smart / Intelligent, Image Processing System (Prolog); Control Equipment / Instruments Interface (Instruments, Signal, Protocol, PLC) ; Method Introduction Color image; Machine Vision Applications.

Pre-requisite(s): Engineering Programming

References:

1. J.R. Parker, Algorithms for Image Processing and Computer Vision 2nd ed, Wiley, 2010
2. Butchelor B. G., Whelan P. F.,Intelligent Vision System for Industry, Springer, 2012
3. E.R. Davies, Machine Vision : Theory, Algorithm, Practicalities, Morgan Kauffman, 2004
4. Micheul S, Lawrence O'Gorman, Michael J S Practical Algorithms for Image Analysis : Description, Examples and Code, , Cambride Univ. Press, 2000
5. Rafael Gonzales, et.al, Digital Image Processing using Matlab, McGraw Hill, 2010.
6. A.S. Baskoro, Handout Sistem Machine Vision, Diktat kuliah, 2011.

INTERNSHIP B

ENME601109

3 credits
Learning Outcome(s):

Students gain insight and experience activities in industry and the work experiences related to non-engineering aspects.

Topic:

Special topics in the non-engineering industrial sector that have not been covered in other subjects.

Pre-requisite(s): Have undergone a minimum of 4 semesters of lectures, or have obtained a minimum of 72 credits with a GPA> 2.0. Activities carried out by monitoring and evaluation by the Internship Coordinator.

References: -

SPECIAL TOPIC 3
ENME601106
4 credits
Learning Outcome(s):
Students gain insight and experience of activities in national / international competitions, or community, or entrepreneurship, or industry and the work experiences.

Topic:
Special topics in fields that have not been covered in other subjects.

Pre-requisite(s): Have undergone at least 2 semesters of lectures, or have obtained a minimum of 36 credits with a GPA> 2.0. Activities carried out by monitoring and evaluation by the Special Topic Subject Coordinator.

References: -

SPECIAL TOPIC 4
ENME601107
4 credits
Learning Outcome(s):
Students gain insight and experience of activities in national / international competitions, or community, or entrepreneurship, or industry and the work experiences.

Topic:
Special topics in fields that have not been covered in other subjects.

Pre-requisite(s): Have undergone at least 2 semesters of lectures, or have obtained a minimum of 36 credits with a GPA> 2.0. Activities carried out by monitoring and evaluation by the Special Topic Subject Coordinator.

References: -

EXPERIMENTAL DESIGN
ENME802003
4 credits
Learning Outcome(s):

This course provides knowledge about the methods of planning, implementing and reporting research in the field of engineering so that it is able to apply standard scientific principles in the preparation of the final project in particular as well as in a scientific work that results from research in general. Through this subject, students are expected to be able to manage a study that starts from the planning stage, correctly applies the design and construction procedures of the apparatus, and applies instrumentation and measurement systems, executes and analyzes and interprets the data with appropriate statistical rules. In addition, students are also expected to be able to write scientific texts with good techniques, be able to make a bibliography correctly, find the right reference sources.

Topic:

Introduction: Introduction to Research Design; Approaches to Solving Problems (Problem Solving Approaches); Research Project Planning; Design and Application of Measurement Systems: Measuring System Functional Elements, Measurement System Performance Characteristics, System Accuracy (Uncertainty) Analysis; Design and Construction of Research Apparatus; Experimental Planning; Experiment Execution: Apparatus construction, Debugging apparatus, Datasheet and Logbooks; Data Analysis and Interpretation; Communication Engineering: Principles of Communication of Raw Engineering, Reports, Papers, and Research Results Articles. Introduction to Academic Writing; Rhetoric Analysis on Scientific Manuscripts, Critical Behavior and Arguments on Academic Writing, Techniques for Writing Scientific Manuscripts, Writing Scientific Manuscripts, Peer Review and Revision of Scientific Manuscripts, Finding Sources of Scientific References, Synthesis of Scientific Manuscripts, Delivering papers as a result of learning this course.

Pre-requisite(s): -

References:

1. Montgomery, D.C., Design and Analysis of Experiments, (5th ed.), John Wiley and Sons, Inc., New York, 2001
2. Coleman, H.W., Steele, G.W.Jr., Experimentation and Uncertainty Analysis for Engineers, (2nd ed.), John Wiley and Sons, Inc., New York, 1999
3. Doebelin, E.O., Engineering Experimentation: Planning, Execution, Reporting, McGraw-Hill,

Inc., New York, 1995

4. Kirkup, Les., Experimental Method: An Introduction to the Analysis and Presentation of Data, John Wiley and Sons Australia, Ltd., Queensland, 1994
5. Lipson, C, Sheth, N.J., Statistical Design and Analysis of Engineering Experiments, Mc-Graw Hill Kogakusha, Ltd., Tokyo, 1973
6. Ross, V. A Brief Guide to Critical Writing. Philadelphia, PA : Critical Writing Program. 2015.
7. Graff, G., Birkenstein, C. As He Himself Puts It : The Art of Quoting "They Say / I Say" : The Moves That Matter in Academic Writing. New York. 2006
8. Rheingold, H. Net Smart : How To Thrive Online. Cambridge, Mass : MIT Press. 2012.

DATA ANALYTICS

ENME802006
2 credits
Learning Outcome(s):

Know how to identify, collect, and test multivariate data before conducting analysis. Can distinguish statistical analysis techniques available and determine which is most suitable for a particular purpose. Use appropriate techniques in analyzing data and in obtaining statistical summary results to help make management decisions. Verifying the results of the analysis with assumptions that will be considered in the analysis. Apply a variety of techniques to real data sequences using computer applications (eg MS Excel, Origin, Matlab, Tableau) and present the results in appropriate reports that are easily understood by non-statists.

Topic:

Review statistics and probabilities, Factor and Component Design experiments, multiple samples and estimates, Analysis of variance, models and diagnoses, Stepwise and Discriminant Regression, Canonical and Conjoining Analysis, and Non-parametric Statistics.

Pre-requisite(s): -

References:

1. A Modern Introduction to Probability and Statistics: Understanding Why and How by Dekking, Kraaikamp, Lopuhaa, and Meester.
2. Montgomery, D. C., & Runger, G. C. (2010). Applied statistics and probability for engineers. John Wiley & Sons.
3. Härdle, W., A. Werwatz, M. Müller, and S. Sperlich (2004). Nonparametric and Semiparametric Models. Springer.
4. Cox, T. F. (2005). An introduction to multivariate data analysis. London: Hodder Arnold.
5. Hair, Black, Babin, Anderson, and Tatham. Multivariate Data Analysis, 6th Edition. Prentice Hall.

FIRE PROTECTION SYSTEM

ENME802131
4 credits
Learning Outcome(s):

Students are able to understand the fire protection system that is both passive and active.

Topic:

Fire compartmentalization, Passive fire protection strategies, natural ventilation systems for controlling smoke and heat due to fire, fire resistant materials and their installation, integration of automatic fire protection systems for passive fire protection strategies, design of passive fire protection systems, fire modeling for the design of passive protection systems. This course will study various physical and chemical phenomena that are relevant to various hardware and software of a fire protection system such as automatic sprinklers, gas-shaped agents, foam systems and chemical powders. Fire protection installation system complies with applicable standards. Fire resistant material and installation.

Pre-requisite(s): -

References:

1. SFPE Handbook of Fire Protection Engineering 5th edition, Springer, 2016
2. Fire Protection Association, Passive Fire Protection Handbook, 2011
3. Tewarson A, Khan MM (1991) The Role of Active and Passive Fire Protection Techniques in Fire Control,
4. Suppression and Extinguishment. Fire Safety Science 3:1007–1017. doi:10.3801/IAFSS.FSS.3-1007
5. Jurnal dan standar terkait

MECHANICAL AND ELECTRICAL SYSTEM OF BULDING

ENME802131
4 credits
Learning Outcome(s):

Building Mechanical System is a subject that provides specialization and understanding expertise in mechanical systems systems found in modern buildings that are increasingly demanding from the sophistication, efficiency, and use of energy that is more efficient.

Topic:

Building Mechanical Systems in General; Plumbing System: SNI, Calculation, and Dirty Water Treatment; Energy Systems in Buildings; BuildingAutomation System; Fire Fighting Systems: Hydrant and Sprinkler System; Lifts and Escalators: Types of Lifts, Round Trip Time, Handling Capacities, Waiting Time, System Installation and Control; Types of Escalator Types, Applications and Installations.

Pre-requisite(s): Basic Thermodynamics

References:

1. Mechanical System for Building.
2. Handbook of HVAC.
3. ASHRAE Journal
4. NFPA
5. Mechanical Installation in Building.
6. SNI Plambing
7. SNI Hydrant, Sprinkler dan APAR.

DESIGNING AND MANUFACTURING TECHNOLOGY INTEGRATION

ENME802142
4 credits
Learning Outcome(s):

Provide an understanding of competence and capability in designing and manufacturing process by utilizing peracangan / includes latest design and manufacturing system CAD / CAM and reverse engineering and prototype development to improve efficiency and accelerate the production process, reduce errors, improve quality and reduce production costs.

Topic:

System Overview of CAD / CAM; Hardware & Software Systems CAD / CAM: Geometric Modelling: Type a mathematical representation of the model curve, surface and solid 3D modeling methods and manipulation of 3D models; exchange of data within and between sistem-CAD/ CAM; CAD Laboratory Activity; Technology CNC; Tool Path Generation Method-CAM systems;

Control 'quality of machining' (machined surface quality) in the system-CAM: Computer-Aided Process Planning CAPP; postprocessing; Practice CAM: 3D geometry measurements, principles and measurement based Coordinate Measuring Machine (CMM), the method of filtration data, the identification of boundary features, modeling and manipulation of point-based 3D models, 3D models for the modularization of the prototype, prototype and rapidprototyping method, discretization model, principles and application of SLS and SLM.

Pre-requisite(s): -

References:

1. Kunwoo Lee, Principles of CAD / CAM / CAE, Prentice Hall, 2003
2. Gandjar K, Hand out CAD/ CAM, DTMUI, 2007
3. Connie L. Doston, Fundamentals of Dimensional Metrology, Delmar Learning, 2006
4. Ali K. Kamrani. Emad A Nasr, Rapid Prototyping: Theory and Practice, Birkhauser, 2006
5. Patri K. Venivinod, Weyin Ma, Rapid Prototyping: Laser Based and Other Technologies, 2003.

VEHICLE FRAME AND BODY ENGINEERING

ENME802165
4 credits
Learning Outcome(s):

Provides the understanding of several concepts related to design and analysis of vehicle frame such as: A brief understanding in the history of vehicle design development; Understanding the different possible scenarios for vehicle design and interactivity of the process in the design and manufacture of vehicles, as well as various types of vehicle structure and its use.; Understand how the load can be analyzed simply and with the use of computers as well as a simple structural analysis that highlights the processes involved in vehicle structures.; Understanding the basic concepts related to the aerodynamic vehicle body and the basic calculations required in the form of an aerodynamic vehicle design

Topic:

Introduction to Innovation and breakthrough discoveries in the fild of automotive and industrial development of the automotive world today. Understanding the concept of loading on the vehicle structure, various types of chassis, structural analysis with a simple method of surface structure (Simple Structural Surface method) and method of computing the skeletal structure, aerodynamic force, reducing the lift force (drag force reduction), stability and concept of calculation of the vehicle body dynamics computation

Pre-requisite(s): -

References:

1. Heinz Hei s ler, "Advance Vehicle Technology", Society of Automotive Engineers, Inc. ISBN 0 7680 10713.
2. Brian Cantor, Patrick Grant and Colin Johnston, "Automotive Engineering Lightweight, Func-

tional, and Novel Materials", Taylor & Francis Group, 6000 Broken Sound Parkway NW, Suite 300, ISBN 978-0-7503-1001-7.

3. Giancarlo Genta, Lorenzo Morello, "The Automotive Chassis Vol. 1: Components Design", Springer Science+Business Media B.V., ISBN: 978-1-4020-8674-8 e-ISBN: 978-1-4020-8676-2.
4. David A. Crolla, "Automotive Engineering Powertrain, Chassis System and Vehicle Body", Butterworth-Heinemann is an imprint of Elsevier, Linacre House, Jordan Hill, Oxford OX2 8DP, UK ISBN: 978-1-85617-577-7.
5. Nick Tucker and Kevin Lindsey, "An Introduction to Automotive Composite", Rapra Technology Limited, ISBN: 1-85957- 279-0.
6. Jason C. Brown, A. John Robertson, and Stan T. Serpento, "Motor Vehicle Structures: Concepts and Fundamentals", Butterworth-Heinemann Linacre House, Jordan Hill, Oxford OX2 8DP, ISBN 0750651342
7. Liang Yun · Alan Bliault · Johnny Doo, WIG Craft and Ekranoplan, "Ground Effect Craft Technology", ISBN 978-1-4419-0041-8 e-ISBN 978-1-4419-0042-5, DOI 10.1007/978-1-4419-0042-5, Springer New York Dordrecht Heidelberg London.
8. Mat thew Huang, "Vehi c le Crash Mechanics", CRC Press LLC, International Standard Book Number 0-8493-0104-1.
9. Ahmed A. Shabana, Khaled E. Zaazaa and Hiroyuki Sugiyama, "Railroad Vehicle Dynamics a Computational Approach", CRC Press is an imprint of the Taylor & Francis Group, ISBN 978-1-4200-4581-9.

VEHICLE CONTROL SYSTEM

ENME803166
4 credits
Learning Outcome(s):

Students understand the basic features of the vehicle control system that has the ability to: Describes a simple method for the analysis of vehicle suspension systems and components; Describes the vehicle suspension system design requirements and how to achieve it; Analyze the various factors and issues that affect the design of suspension of driving; Understand the mechanics of the vehicle wheel; Describes recent developments in control of the braking system and braking system design and material needs an efficient; Analyze the influence of the steering system characteristics to the vehicle motion

Topic:

Introduction of the role of vehicle suspension systems, factors that affect the design, definitions and terminology in vehicle suspension systems, suspension mobility mechanisms, different types of suspension, kinematics analysis, the analysis center of rotation (roll center analysis), geometric style as well as lateral, suspension components. The basis of the braking system. Regulation, function and terms of use brake system, brake system components and confiurations as well as the kinematics of the braking system. Consideration of adhesion force proportional to the brake system and braking effiiency. Deformation, lateral force and slip angle on the tire when the vehicle is running. Penikungan characteristics (cornering characteristics) according to Fiala theoretical approach to the mathematical model and the effect is due to air pressure in tires.

Pre-requisite(s): -

References:

1. Heinz Heisler, "Advance Vehicle Technology", Society of Automotive Engineers Inc. ISBN 0 7680 1071 3
2. Giancarlo Genta, Lorenzo Morello, "The Automotive Chassis Vol. 1: Components Design", Springer Science+Business Media B.V., ISBN: 978-1-4020-8674-8 e-ISBN: 978- 1-4020-8676-2.
3. Giancarlo Genta, Lorenzo Morello, "The Automotive Chassis Vol. 1: System Design", Springer Science+Business Media B.V., ISBN: 978-1-4020-8673-1 e-ISBN: 978-1- 4020-8675-5.
4. David A. Crolla, "Automotive Engineering Powertrain, Chassis System and Vehicle Body", Butterworth-Heinemann is an imprint of Elsevier, Linacre House, Jordan Hill, Oxford OX2 8DP, UK ISBN: 978-1-85617-577-7.

MARITIME ENGINEERING AND MANAGEMENT

ENME802181
4 credits
Learning Outcome(s):

This course provides knowledge about technologies for ocean transportation and the application of ocean-based energy sources. This course also aims to equip students with understanding of maritime opportunities that can be developed with the use of technology.

Topic:

Classification of ship based on its function, aspects to consider in ship designing, history of development of off-shore structure, ocean environment, typesof off-shore structure: fixed design and floating design, mooring and anchoring system, force calculation of

off-shore structure, FPSO

Pre-requisite(s): -

References:

1. Research Council National Research Council, NEW Mining in the Outer Continental Shelf and in the Deep Ocean, University Press of the Pacific, 2005
2. Arthur H. Johnson, Michael D. Max, William P. Dillon, Natural Gas Hydrate - Arctic Ocean Deepwater Resource Potential, Springer, 2013
3. Khaligh, Alireza and Onar, Omer C., Energy Harvesting: Solar, Wind, and Ocean Energy Conversion Systems, CRC Pr I Llc, 2009

OCEAN ENERGY
ENME803182
4 credits
Learning Outcome(s):

This course provides knowledge about technologies and principles related to the design of renewable ocean energy system

Topic:

Introduction to renewable ocean energy, introduction to wind turbine, tidal system and tidal energy system, OTEC, ocean flows, methods of economic/financial assessment for off-shore renewable energy system, wind energy, momentum theory and the limit of wind power output, tidal flow and its conversion to mechanical energy, description of wave energy sources, instruments of wave energy and instruments for simulation.

Pre-requisite(s): -

References:

1. Twidell, J. and Weir, T., "Renewable Energy Resources. Second Edition", Taylor and Francis Group, 2006.
2. Boyle, G., "Renewable energy power for a sustainable future, Second Edition", Oxford University Press, 2005.
3. Walker J and Jenkins N, "Wind Energy Technology", Wiley Unesco Energy Engineering Series, 1997.
4. Manwell JF, McGowan, JG and Rogers, AL., "Wind Energy explained: Theory, Design and Application", Wiley. 2nd Edition. ISBN0-470-01500-4, 2010
5. Cruz, J., "Ocean Wave Energy: Current Status and Future Perspectives", Springer-Berlin, 2007.
6. Falnes, J., "Ocean Waves and Oscillating Systems: Linear Interactions Including Wave-Energy Extraction", Cambridge University Press, Cambridge, 2002.
7. Baker AC, "Tidal Power", Peter Peregrinus Ltd, 1981.

Curriculum for Fast Track Programme (S1 and S2)

Mechanical Engineering Fast Track Course

Code	Course	
	7th Semester	
ENME600002	Design Assignment II*	2
ENME600004	Seminar*	1
ENME600003	On the Job Training*	2
ENME801001	Applied Engineering Mathematics	2
ENME802004	Engineering Computation	2
	Specialization Course	8
	Sub Total	**17**
	8th Semester	
ENME600005	Final Project*	5
ENME802002	Experiment Design	2
ENME802006	Data Analytics	2
ENME802003	Academic Writing	2
	Specialization Course	8
	Sub Total	**19**
	9th Semester	
ENME800005	Scientific Publication	2
ENME802007	Project Design	2
	Elective Course	4
	Sub Total	**8**
	10th Semester	
ENME800007	Thesis	6
	Elective Course	4
	Sub Total	**10**

*Subjets of S1 program which can not be transfered to S2 program

Bahan Kajian	Code	Subjects	Credits
Energy Convertion and Conservation System	ENME801101	Basic Thermodynamics	4
	ENME801102	Advanced Fluid Dynamics and Heat Transfer	4
	ENME801113	Ventilation and Air Conditioning System	4
	ENME802103	Energy System Optimization	4
	ENME803104	Thermal Power Generation	4
	ENME803105	Internal Combustion Engine	4
	ENME803106	Applied Flow Measurement and Visualization	4
	ENME803107	CFD Application	4
	ENME803108	Refrigeration Engineering	4
	ENME803182	Ocean Energy	4
	ENME803195	Oil and Gas Drilling Equipment	4
	ENME803196	Jet and Rocket Propulsion	4
	ENME804109	Heat and Mass Transfer Engineering	4
	ENME804110	Combustion Engineering	4
	ENME804111	Aerodynamics Engineering	4
	ENME803124	Energy Audit	4
Mechanical System for Building	ENME803124	Energy Audit	4
	ENME801113	Ventilation and Air Conditioning System	4
	ENME802103	Energy System Optimization	4
	ENME802132	Building Mechanical and Electrical System	4
	ENME803107	CFD Application	4
	ENME803115	Clean Room	4
	ENME804118	Mechanical System for Building	4
	ENME803108	Refrigeration Engineering	4
Fire Safety Technology	ENME803134	Fire Dynamics and Modelling	4
	ENME802131	Fire Protection System	4
	ENME801113	Air Conditioning and Ventilation System	4
	ENME804138	Fire Safety Analysis	4
	ENME804137	Fire Investigation Engineering	4
	ENME804136	Forest and Land Fires	4
	ENME803174	Risk Management	4
	ENME804139	Fire Protection in Industrial Process	4
	ENME803135	Fire Fighting Techniques and Strategies	4

Product Design and Manufacrure	ENME801140	Material and Manufacturing Process	4
	ENME801141	Design Methodology and Product Development	4
	ENME802142	Designing and Manufacturing Technology Integration	4
	ENME803143	Mechanical Failure	4
	ENME801150	Manufacture Information System Management	4
	ENME801151	Manufacture System and Process	4
	ENME803144	Mechanical System Dynamics	4
	ENME803145	Composte Product Development	4
	ENME803146	Finite Element and Multiphysics	4
	ENME803147	Educational Product Design and Development	4
	ENME804148	Design for Manufacture and Assemby	4
	ENME804155	CAD/CAM	4
	ENME804156	Manufacturing Performance Assesment	4
	ENME804197	Handling and Construction Equipment	4
Otomation Technology and Microfabrication System	ENME802152	Otomation and Robotics	4
	ENME803153	Machine Vision System	4
	ENME803161	Micro-machining	4
	ENME803154	Quality and Production Management System	4
	ENME804162	Laser Assisted Process	4
	ENME804190	Advanced Welding Engineering	4
Advanced Vehicle Technology	ENME803196	Jet and Rocket Propulsion	4
	ENME803167	Modern Vehicle Technology	4
	ENME801163	Vehicle Engineering and Heavy Duty Equipment	4
	ENME801164	Prime Mover and Powertrain System	4
	ENME802165	Vehicle Frame and Body Engineering	4
	ENME803166	Vehicle Control System	4
	ENME804111	Aerodynamics Engineering	4
	ENME803105	Internal Combustion Engine	4
	ENME804112	Turbomachinery	4
	ENME804119	Accoustics	4
	ENME804149	Noise and Vibration Control	4
	ENME804168	Railway Vehicle Engineering	4

Minor in Mechanical Engineering
Pre-requisite: Mathematics, Physics, Engineering Drawing

Odd Semester			Even Semester		
Code	**Subjects**	**Credits**	**Code**	**Subjects**	**Credits**
Mandatory Subjects, 24 SKS					
ENME603005	Engineering Material	3	ENME602004	Engineering Statics	2
ENME604010	Material Selection and Manuf. Process	4	ENME603006	Mechanical Modelling and Visualization	2
ENME603007	Strength of Materials	2	ENME604011	Basic Fluid Mechanics	4
ENME603008	Basic Thermodynamics	4	ENME606020	Maintenence and Condition Monitoring	3
	Subtotal	13		**Subtotal**	11
Elective, Mechanical Engineering					
ENME605017	Heat and Mass Transfer	4	ENME604012	Perancangan Mekanika	4
ENME605021	Energy System Convertion 1	4	ENME600009	Kinematika dan Dinamika	4
ENME606025	Mechatronics	4	ENME605022	Energy System Convertion 2	4
ENME605014	Mechanical Vibration	2	ENME600001	Design Assignment I (Conceptual design)	2
ENME605015	Measurement and Metrology	2		Elective	4
	Elective	4			
Elective, Fire Safety Engineering					
ENME801113	Air Conditioning and Ventilation System	4	ENME804138	Fire Safety Analysis	4
ENME803134	Fire Dynamics and Modelling	4	ENGE600012	HSE	2
ENME605017	Heat and Mass Transfer	4			

Undergraduate Program in Naval Architecture and Marine Engineering

Program Specification

1.	**Awarding Institution**	Universitas Indonesia	
2.	**Teaching Institution**	Universitas Indonesia	
3.	**Faculty**	Engineering	
4.	**Study Programme**	Undergraduate Program in Naval Architecture and Marine Engineering	
5.	**Vision and Mission**	Vision: To become the center of excellent research and education services in Naval Architecture and Marine Engineering. Mission: To conduct research and research-based education for the development of science and technology in the field of Naval Architecture and Marine Engineering, and to conduct research and education and use it to improve quality life and humanity.	
6.	**Classes**	Regular, Non Reguler, International	
7.	**Final Award**	Sarjana Teknik (S.T)	
8.	**Accreditation / Recognition**	BAN-PT: "A" Accreditated International assessment by Asean University Network-Quality Assurance (AUN-QA)	
9.	**Language(s) of Instruction**	Bahasa Indonesia, English	
10.	**Study Scheme (Full Time / Part Time)**	Full Time	
11,	**Entry Requirements**	High school /equivalent, or D3 / Polytechnique / equivalent, AND pass the entrance exam.	
12.	**Duration for Study**	Designed for 4 years	
	Type of Semester	Number of Semester	Number of weeks / semester
	Regular	8	17
	Short (optional)	3	8
13.	**Aims of the programme:** 1. Provide graduates in Naval Architecture and Marine Engineering with the qualification of expected learning outcomes. 2. Contribute to the development of science and technology in the field of Naval Architecture and Marine Engineering through continuous research. 3. Contribute to improving the quality of society and industry.		
14.	**Profile of Graduates:** Bachelor of Engineering with abilities of analyze and design of ship buildings, marine systems, and marine transportation, with considering an aspect of energy conservation to meet the sustainable development goals.		

15.	**Expected Learning Outcomes (ELO):** 1. Able to apply basic knowledge of mathematics, basic science and information technology needed to achieve competence in the field of Naval Architecture and Marine Engineering. 2. Able to design ship buildings, marine systems, marine transportation, considering the aspect of energy conservation to meet the expected outcomes within realistic boundaries, as well as to recognize and/or utilize local and national potential resources with global insight. 3. Able to carry out experiments, digging information and analyze data, report the results of experiments by applying statistical rules 4. Able to think critically, creatively, and innovatively in identifying, formulating, analyzing and solving shipping technical problems 5. Able to apply modern methods, skills and technical tools needed for engineering practices such as the selection of materials and processes, and the design of computer-aided ships 6. Able communicate effectively both visually, in writing and verbally 7. Able to design, plan, complete and evaluate tasks within the existing constraints 8. Able to work effectively both individually and in teams across disciplines or across cultures 9. Able to take responsibility and adhere to the ethics of the engineering profession and entrepreneurship which is characterized by innovation and independence. 10. Able to carry out the lifelong learning process including access to knowledge related to relevant contemporary issues.
16.	**Composition of Subjects**

No.	Classification	Credit Hours (SKS)	Percentage
i	University General Subjects	10	6 %
ii	Basic Engineering Subjects	20	13,9 %
iii	Core Subjects	81	59,6 %
iv	Elective Subjects	26	18,1 %
v	Special Subjects (On The Job Training, Seminar, Undergraduate Thesis)	8	5,6 %
	Total	145	100 %
	Total Credit Hours to Graduate		145 SKS

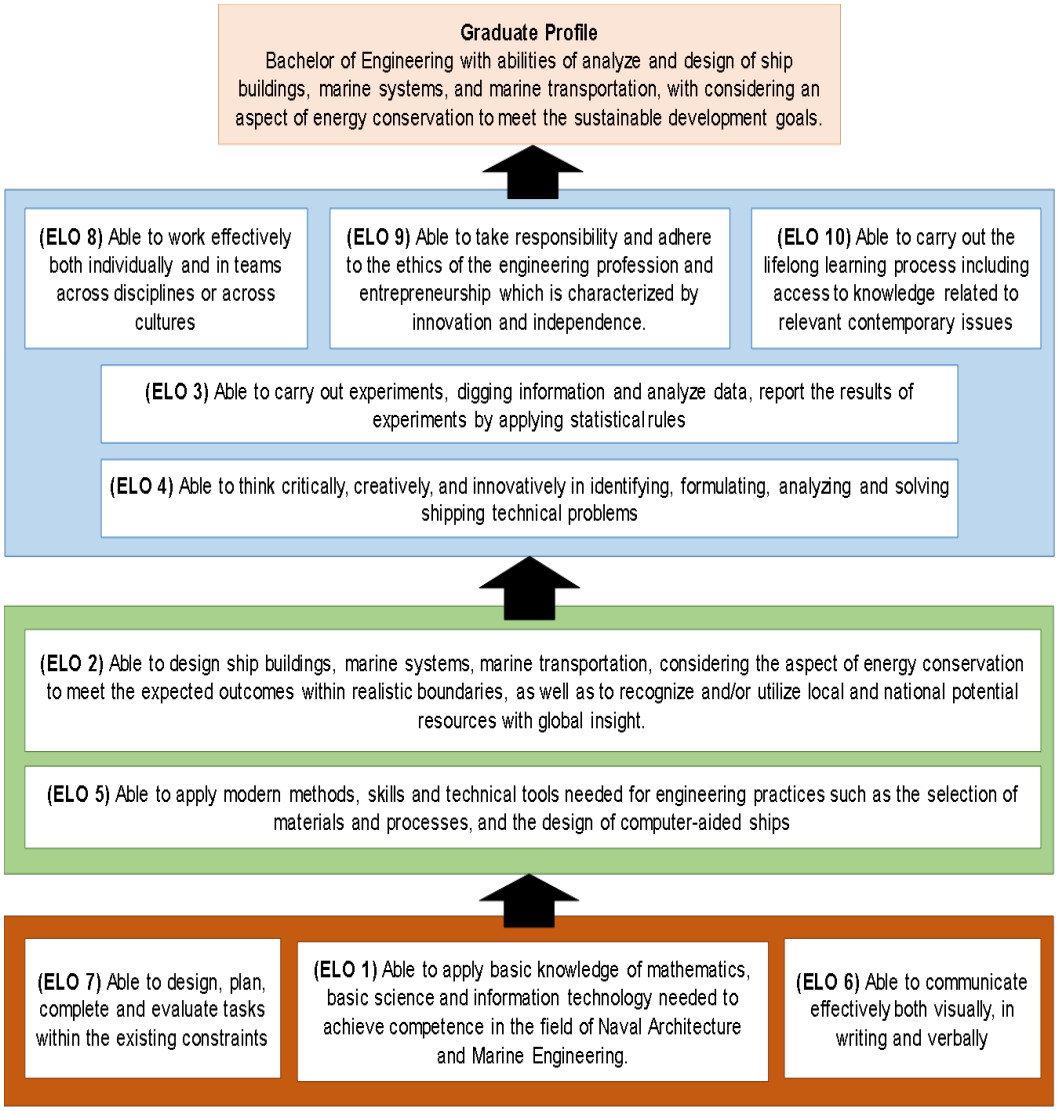
Career Prospects

Graduates of Naval Architecture and Marine Engineering study have devoted themselves to various fields such as:

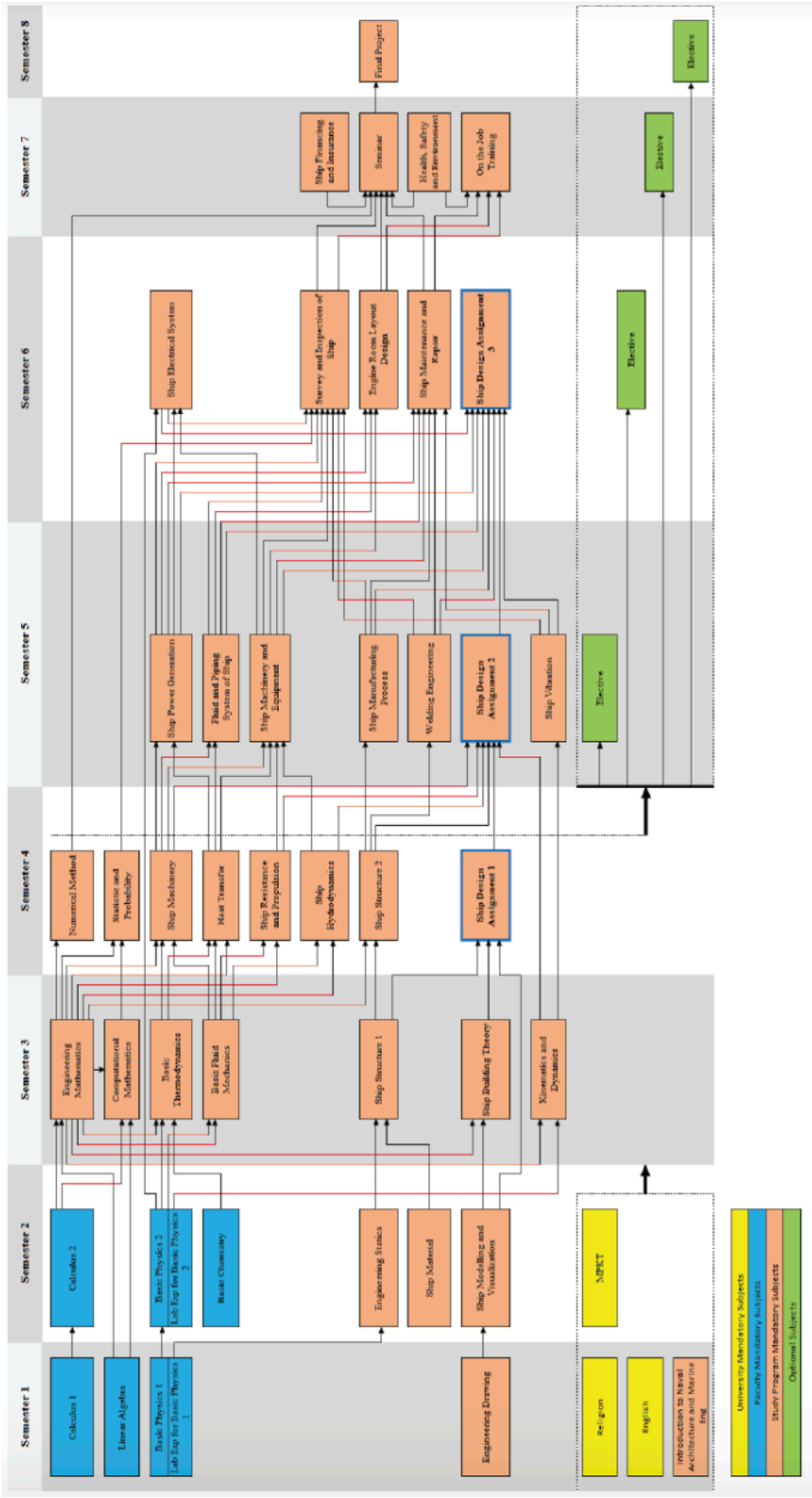
- Engineer at the shipyard
- Superintendent in shipping companies
- Shipping consultant
- Designers in the ship design office
- Appraisers at insurance companies
- Engineers in oil and gas companies
- Analyst at the Ministry of Maritime Affairs and Fisheries
- Analyst at the Ministry of Transportation
- Analysts at the Customs

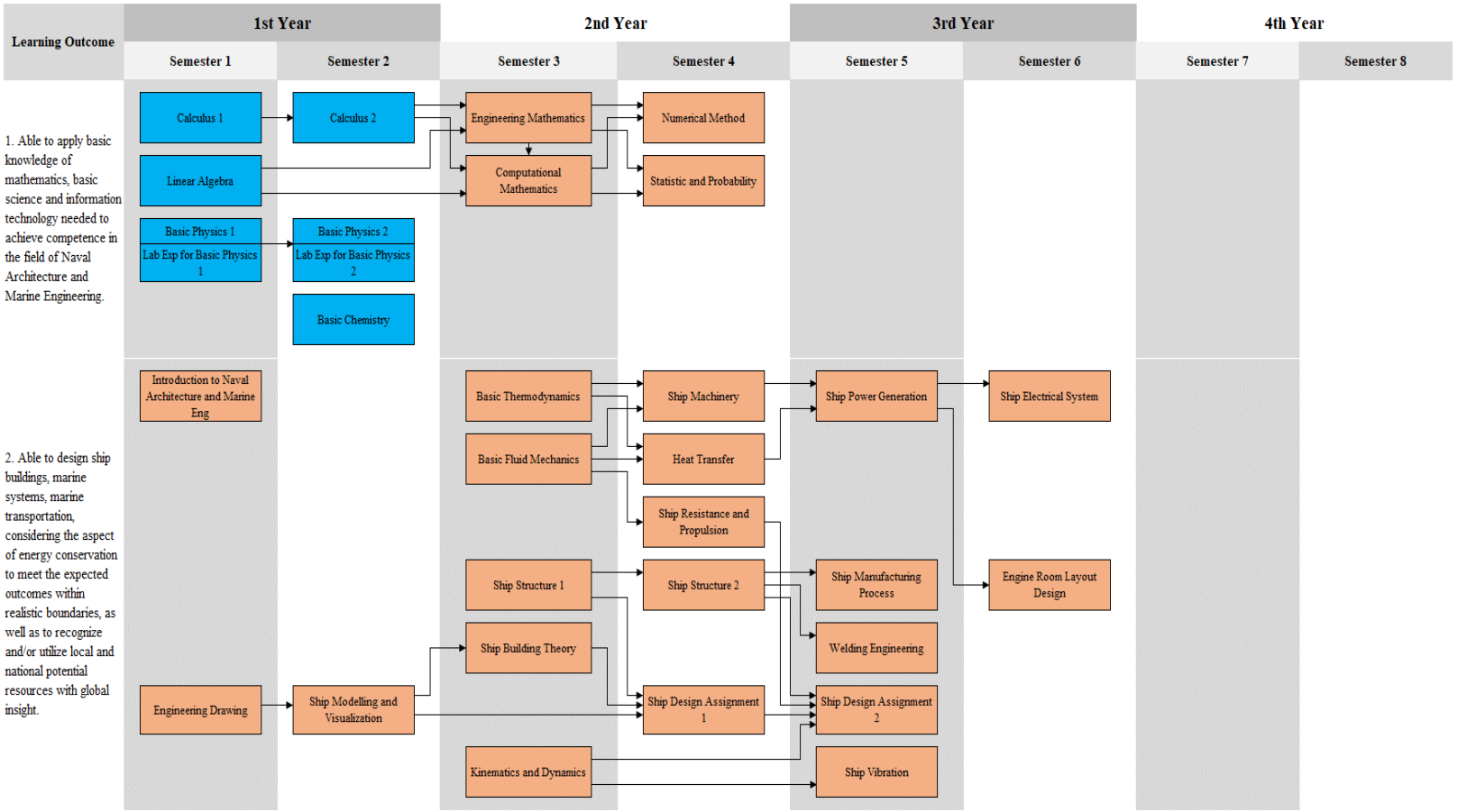
Flow Diagram of Expected Learning Outcomes

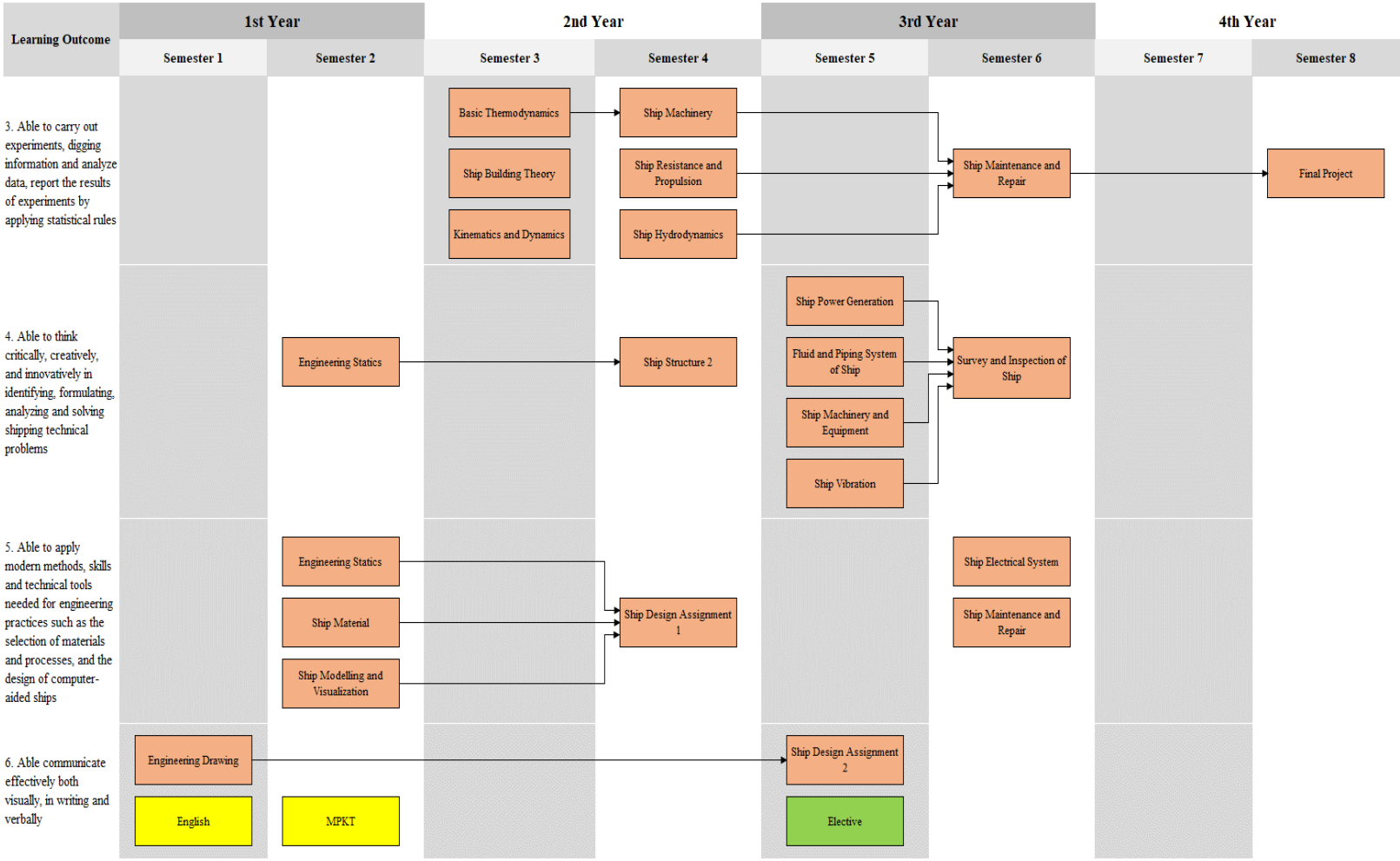
Undergraduate Program in Naval Architecture and Marine Engineering

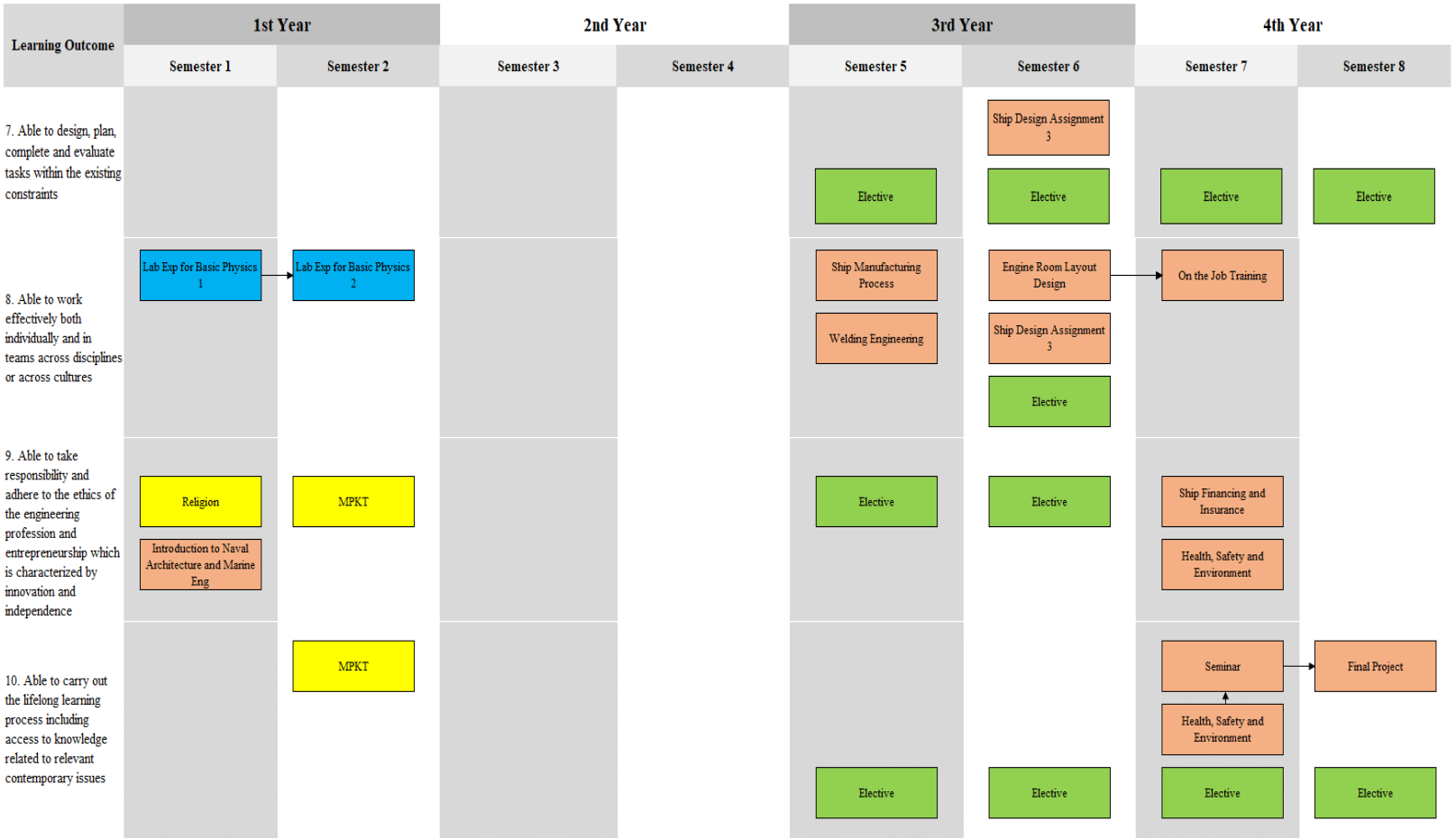


Flow Diagram of Subject Courses Undergraduate Program in Naval Architecture and Marine Engineering




Learning Outcome
1st Year
2nd Year
3rd Year
4th Year
Semester 1
Semester 2
Semester 3
Semester 4
Semester 5
Semester 6
Semester 7
Semester 8
1. Able to apply basic knowledge of mathematics, basic science and information technology needed to achieve competence in the field of Naval Architecture and Marine Engineering.
Calculus 1
Calculus 2
Engineering Mathematics
Numerical Method
Linear Algebra
Computational Mathematics
Statistic and Probability
Basic Physics 1
Lab Exp for Basic Physics 1
Basic Physics 2
Lab Exp for Basic Physics 2
Basic Chemistry
2. Able to design ship buildings, marine systems, marine transportation, considering the aspect of energy conservation to meet the expected outcomes within realistic boundaries, as well as to recognize and/or utilize local and national potential resources with global insight.
Introduction to Naval Architecture and Marine Eng
Basic Thermodynamics
Ship Machinery
Ship Power Generation
Ship Electrical System
Basic Fluid Mechanics
Heat Transfer
Ship Resistance and Propulsion
Ship Structure 1
Ship Structure 2
Ship Manufacturing Process
Engine Room Layout Design
Ship Building Theory
Welding Engineering
Engineering Drawing
Ship Modelling and Visualization
Ship Design Assignment 1
Ship Design Assignment 2
Kinematics and Dynamics
Ship Vibration


Learning Outcome
1st Year
2nd Year
3rd Year
4th Year
Semester 1
Semester 2
Semester 3
Semester 4
Semester 5
Semester 6
Semester 7
Semester 8
3. Able to carry out experiments, digging information and analyze data, report the results of experiments by applying statistical rules
Basic Thermodynamics
Ship Building Theory
Kinematics and Dynamics
Ship Machinery
Ship Resistance and Propulsion
Ship Hydrodynamics
Ship Maintenance and Repair
Final Project
4. Able to think critically, creatively, and innovatively in identifying, formulating, analyzing and solving shipping technical problems
Engineering Statics
Ship Structure 2
Ship Power Generation
Fluid and Piping System of Ship
Ship Machinery and Equipment
Ship Vibration
Survey and Inspection of Ship
5. Able to apply modern methods, skills and technical tools needed for engineering practices such as the selection of materials and processes, and the design of computer-aided ships
Engineering Statics
Ship Material
Ship Modelling and Visualization
Ship Design Assignment 1
Ship Electrical System
Ship Maintenance and Repair
6. Able communicate effectively both visually, in writing and verbally
Engineering Drawing
English
MPKT
Ship Design Assignment 2
Elective


Learning Outcome
1st Year
2nd Year
3rd Year
4th Year
Semester 1
Semester 2
Semester 3
Semester 4
Semester 5
Semester 6
Semester 7
Semester 8
7. Able to design, plan, complete and evaluate tasks within the existing constraints
Ship Design Assignment 3
Elective
Elective
Elective
Elective
8. Able to work effectively both individually and in teams across disciplines or across cultures
Lab Exp for Basic Physics 1
Lab Exp for Basic Physics 2
Ship Manufacturing Process
Engine Room Layout Design
On the Job Training
Welding Engineering
Ship Design Assignment 3
Elective
9. Able to take responsibility and adhere to the ethics of the engineering profession and entrepreneurship which is characterized by innovation and independence
Religion
MPKT
Elective
Elective
Ship Financing and Insurance
Introduction to Naval Architecture and Marine Eng
Health, Safety and Environment
10. Able to carry out the lifelong learning process including access to knowledge related to relevant contemporary issues
MPKT
Seminar
Final Project
Health, Safety and Environment
Elective
Elective
Elective
Elective

Subject Structure Undergraduate Program in Naval Architecture and Marine Engineering

Code	Subject	SKS
	1st Semester	
UIGE600004	Religion	2
UIGE600003	English	2
ENGE600001	Calculus 1	3
ENGE600005	Basic Physics 1 (Mechanic & Heat)	3
ENGE600006	Laboratory Experiment for Basic Physics 1	1
ENMR601001	Introduction to Naval Architecture and Marine Engineering	2
ENME601002	Engineering Drawing	2
ENGE600004	Linier Algebra	4
	Subtotal	**19**
	2nd Semester	
UIGE600007	MPKT	6
ENGE600009	Basic Chemistry	2
ENGE600002	Calculus 2	3
ENGE600007	Basic Physics 2 (Electrical, Magnet, Wave, and Optic)	3
ENGE600008	Laboratory Experiment for Basic Physics 2	1
ENME602004	Engineering Statics	2
ENMR603003	Ship Material	2
ENMR602002	Ship Modelling and Visualization	2
	Subtotal	**21**
	3rd Semester	
ENME600013	Engineering Matematics	4
ENME603008	Basic Thermodynamics	4
ENMR603004	Ship Building Theory	2
ENMR603005	Ship Structure 1	2
ENME600009	Kinematics and Dynamics	4
ENMR604011	Basic Fluid Mechanics	2
ENME600017	Computational Mathe-matics	2
	Subtotal	**20**
	4th Semester	
ENMR604005	Heat Transfer	2
ENMR604007	Ship Machinery	2
ENMR604008	Ship Structure 2	2
ENMR604009	Ship Resistance and Propulsion	4
ENMR604010	Ship Hydrodynamics	2
ENME600016	Numeric Method	2
ENGE600010	Statistic and Probability	2
ENMR600001	Ship Design Assignment 1	3
	Subtotal	**19**
	5th Semester	
ENMR606017	Ship Vibration	2
ENMR600002	Ship Design Assignment 2	4
ENMR605011	Fluid and Piping System of Ship	2
ENMR605013	Ship Manufacturing Process	2
ENMR605014	Welding Engineering	2
ENMR606020	Ship Power Generation	2
ENMR606018	Ship Machinery and Equipment	2
	Elective, Internship A	3
	Subtotal	**19**
	6th Semester	
ENMR600003	Ship Design Assignment 3	3
ENMR607023	Survey and Inspection of Ship	2
ENMR605015	Ship Electrical System	3
ENMR605016	Engine Room Layout Design	2
ENMR606021	Ship Maintenance and Repair	2
	Elective, Internship B	3
	Elective	4
	Subtotal	**19**
	7th Semester	
ENMR600005	Seminar	1
ENMR600004	On the Job Training	2
ENMR605012	Ship Financing and Insurance	2
ENME600009	Health, Safety and Environment	2

	Elective	4
	Elective	4
	Subtotal	**15**
	8th Semester	
ENMR600006	Final Project	5
	Elective	4
	Elective	4
	Subtotal	**13**
	Total	**145**

Elective Subjects Undergraduate Program In Naval Architecture And Marine Engineering

Code	Subject	SKS
	Odd Semester	
ENME803183	Marine and Offshore Structure	4
ENME803185	Maritime Law and regulation	4
ENME804192	Supply Chain Technology	4
ENME804193	Cold Storage Technology	4
ENME803184	Marine Transportation and Port Management	4
ENME601108	Internship A (content: Project Management and Entrepreneurship)	4
ENMR601104	Special Topic 1	4
ENME601105	Special Topic 2	4
ENME801002	Advanced Engineering Mathematics*	4
ENME802004	Engineering Computation*	4
ENME801102	Advanced Fluid Dynamics and Heat Transfer*	4
ENME801140	Materials and Manufacturing Processes*	4
	Even Semester	
ENME804186	Special Ship Project	4
ENME804187	Ship Production Optimization	4
ENME804189	Maritime Safety	4
ENME804190	Advanced Welding Engineering	4
ENME804191	Port Operation and Planning	4
ENME802103	Energy Optimization System	4
ENMR607022	Air Conditioning and Refrigeration System of Ship	4
ENME601109	Internship B (content: Industrial Seminar and Entrepreneurship)	4
ENME601106	Special Topic 3	4
ENME601107	Special Topic 4	4
ENME802003	Experimental Design*	4
ENME802006	Data Analytics*	4
ENME802181	Maritime Engineering and Management*	4
ENME803182	Ocean Energy*	4

*For Fast-Track Program Only

Transition Rules

1. The 2020 curriculum is implemented starting in the Odd Semester 2020/2021. In principle, after the 2016 Curriculum is implemented, only subjects in the 2020 Curriculum will be opened.
2. Class of 2019 and previously followed the 2020 curriculum with transitional rules.
3. A transitional period of 1 year, in the academic year 2020/2021, is implemented for subjects where the semester placement changes (from Even to Odd, or vice versa), if necessary, will be opened in both semesters during the transition period (Academic Year 2020 / 2021).
4. For students who have not passed the compulsory subjects in the 2016 Curriculum, are required to take the same or equivalent subjects in the 2020 Curriculum.)
5. If there is a change in the SKS for the course, the number of SKS taken into account in graduation is the number of the SKS at the time the course was taken. Same or equal subjects with different SKS weights, if repeated or newly taken will be listed with a new name and calculated with new SKS weights.
6. If the compulsory subjects in the 2016 Curriculum are removed and there is no equivalence in the 2020 Curriculum then for students who have passed these courses, they will still be counted as compulsory subjects in the calculation of passing 145 SKS. Students who have not passed the course can take new compulsory subjects or elective courses in the 2020 Curriculum to complete 145 credits.

Curriculum of International Program In Naval Architecture and Marine Engineering

Code	Subject	SKS
	1st Semester	
UIGE610002	Academic Writing	2
UIGE610004	Religion	2
ENGE610004	Linear Algebra	4
ENGE610006	Laboratory Experiment for Basic Physics 1	1
ENGE610001	Calculus 1	3
ENGE610005	Basic Physics 1 (Mechanic and Heat)	3
ENME611002	Engineering Drawing	2
ENMR611001	Intro to Naval Architecture and Marine Eng	2
	Subtotal	**19**
	2nd Semester	
ENGE610007	Basic Physics 2 (Elec, Magnet, Wave & Opt)	3
ENGE610008	Laboratory Experiment for Basic Physics 2	1
ENGE610002	Calculus 2	3
ENMR612002	Ship Modelling and Visualization	2
ENMR613003	Ship Material	2
ENME612004	Engineering Statics	2
ENGE610009	Basic Chemistry	2
ENME610016	Numerical Method	2
ENGE610010	Statistic and Probability	2
	Subtotal	**19**
	3rd Semester	
ENMR613004	Ship Building Theory	2
ENMR614011	Basic Fluid Mechanics	2
ENMR613005	Ship Structure 1	2
ENME610013	Engineering Mathematics	4
ENME610018	Computational Mathematics	2
	4th Semester	
ENMR615013	Ship Manufacturing Process	2
ENMR616020	Ship Power Generation	2
ENMR614010	Ship Hydrodynamics	2
ENMR614009	Ship Resistance and Propulsion	4
ENMR614007	Ship Machinery	2
ENMR615015	Ship Electrical System	3
ENMR614008	Ship Structure 2	2
ENMR614005	Heat Transfer	2
	Sub Total	**19**
	5th Semester	
UIGE610011	Integrated Character Building	6
ENMR610001	Ship Design Assignment 1	3
ENMR616018	Ship Machinery and Equipment	2
ENMR615014	Welding Engineering	2
ENMR615011	Fluid and Piping System of Ship	2
ENMR616017	Ship Vibration	2
	Sub Total	**17**
	6th Semester	
ENGE610012	Health, Safety and Environment	2
ENMR610002	Ship Design Assignment 2	4
ENMR616021	Ship Maintenance and Repair	2
ENMR615016	Engine Room Layout Design	2
ENMR617023	Survey and Inspection of Ship	2
	Sub Total	**12**
	7th Semester	
ENMR600005	Seminar	1
ENMR600004	On the Job Training	2
ENMR605012	Ship Financing and Insurance	2
ENME600003	Ship Design Assignment 3	3
	Elective	4
	Elective	4
	Sub Total	**16**
	7th Semester	
ENMR600006	Final Project	5
	Elective	4
	Elective	4
	Sub Total	**13**

Subject Eqivalent Table Mechanical Engineering Study Program

2016			2020		
CODE	SUBJECTS	CREDIT	CODE	SUBJECT	CREDIT
UIGE600001	MPKT A	6	UIGE600007	MPKT	6
UIGE600002	MPKT B	6		Elective	
UIGE600020-48	Sport / Art	1		Elective	
ENMR606019	Ship Electrical System	2		Elective	
UIGE600003	English	3	UIGE600003	English	2
ENMR602002	Ship Modelling and Visualization	3	ENMR602002	Ship Modelling and Visualization	2
			ENME602004	Engineering Statics	2
			ENME600018	Computational Mathematics	2
ENMR600001	Ship Design Assignment 1	2	ENMR600001	Ship Design Assignment 1	3
ENMR604006	Thermofluids	4	ENMR604011	Basic Fluid Mechanics	2
			ENMR604005	Heat Transfer	2
ENMR605012	Engineering Economic	2	ENMR605012	Ship Financing and Insurance	2
			ENME601108	Internship A	3
ENME600006	Industrial Seminar	2	ENME601109	Internship B	3
ENMR605015	Ship Electrical System	2	ENMR605015	Ship Electrical System	3
ENMR607022	Air Conditioning and Refrigeration System of Ship	4	ENMR607022	Elective, Air Conditioning and Refrigeration System of Ship	4
ENMR604008	Ship Structure 2	4	ENMR604008	Ship Structure 2	2
ENMR606020	Ship Power System	2	ENMR606020	Ship Power Generation	2
ENMR607023	Survey and Inspection of Ship	2	ENMR607023	Survey and Inspection of Ship	4
ENME804187	Ship Production and Management	4	ENME804187	Ship Production Optimization	4

			ENMR601104	Special Topic 1	4
			ENMR601105	Special Topic 2	4
			ENME804192	Supply Chain Technology	4
			ENME804193	Cold Storage Technology	4
			ENME804191	Port Operation and Planning	4

Syllabus Undergraduate Program in Naval Architecture and Marine Engineering

RELIGION
ENME600004
2 credits
Learning Outcome(s) :

Provide an understanding of the religious values and see the problems from various aspects of life, so that student care about the social realities they face.

Topic:

Meaning and religion that apply in scientific and theological discourse; History and origins of religion; The main dimensions of religion such as divinity, prophethood, scripture, ritual, salvation, social ethics and eschatology; Socio-religious dimension; Religion and state; Inter-religious relations.

Pre-requisite(s) : -

References : Guidebook from UI

ENGLISH
ENME600003
2 credits
Learning Outcome(s) :

Able to communicate in English orally and in writing with correct English grammar rules.

Topic:

English grammar, writing and conversation.

Pre-requisite(s) : -

References : -

CALCULUS 1
ENGE600001
3 credits
Learning Outcome(s):

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

Topic :

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

Prerequisite(s): -

References:

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

Additional eferences:

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

BASIC PHYSICS 1 (MECHANIC & HEAT)
ENGE600005
3 credits
Learning Outcome(s) : -

Topic:

Pre-requisite(s) : -

References : -

LAB EXP FOR BASIC PHYSICS
ENGE600006
1 credits
Learning Outcome(s) :

Able to explain the basic concepts of mechanics and thermodynamics, and be able to apply them in an effort to understand natural phenomena and human engineering, including their applications, be able to apply mathematics, science, and basic engineering and civil engineering specialization to be used in solving complex civil engineering problems.

Topic:

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

Pre-requisite(s): -

References:

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

INTRODUCTION TO MARINE ENGINEERING
ENMR601001

2 credits)
Learning Outcome(s):

Provides basic competence of ship building and structure and the approach to ship designing.

Topic:

History of Ship Building; Types of water bulding: the Classification of Society and the International Agency; Ship Building and Construction; main dimension: Ship Motion; Ship Design Process; Stabil- ity: resistance and Propulsion; Tonnage; Ship building method. Historical of ship machinery, main engines, auxiliary engines, the engine room layout.

Pre-requisite(s): -

References:

1. GM Kok, A.C. Nierich., Bangunan Kapa[, MARTECH
2. D A Taylor, Introduction to Marine Engineering.1996

ENGINEERING DRAWING

ENME601002
2 credits
Learning Outcomes :

Course participants are able to transfer geometric component by drawing according to standard draw which is recognized by International Standard Organization (ISO). Students understand the theory and procedure of engineering drawing based on ISO standard. Students are able to read, interpret, and transfer 2DI3D geometric draw from component or construction. Students are able to draw the orthogonal projection based on ISO standard.

Topic:

Introduction to drawing equipment; Basic definition of geometric, paper format, draw regulation, line, field, line configuration, basic geometric form; Visualization geometric: Skew projection and isometric, function and line types, configuration geometric form; Orthogonal Projection: Projection stan- dard, viewing concept, width display principle; Advanced orthogonal projection: Circle region concept, special region concept, trimming concept, display width, refraction.

Pre-requisite(s) : -

References : -

1. ISO 1101, Technical Drawings, International Organization for Standardization.
2. A.W. Boundy, Engineering Drawing , McGraw-Hill Book Company
3. Colin Simmons & Dennis Maguire, Manual of Engineering Drawing, Edward Arnold
4. Takeshi S. G., Sugiarto Hartanto, Menggambar Mesin, Pradnya Paramita, 1983
5. Warren J. Luzadder, Fundamentals of Engineering Drawing, Prentice-Hall, Inc.
6. Giesecke-Mitchell-Spencer-Hill-Dygdon-Novak, Technical Drawing, Prentice Hall Inc.

LINEAR ALGEBRA

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

Topic:

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

Pre-requisite(s): -

Textbooks:

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

MPKT

UIGE600007
6 credits
Learning Outcome(s) :

This course aims to develop student participation to increase awareness of social, national, and environmental issues based on faith, piety, character, and academic ethics in the context of developing science and technology.

Topic:

Logic, Philosophy of Science and Pancasila; Morals and Character; Society and Culture in Indonesia

Pre-requisite(s) : -

References : Guidebook from UI

BASIC CHEMISTRY

ENGE600009
2 credits
Learning Outcome(s) :

Students are able to analyze basic chemical principles for application in engineering, Students are able to explain the classification and state of matter, unit and measurement uncertainty, and dimensional analysis of measurement units.

Topic:

Material and measurements, atoms, molecules and ions, stochiometry, water phase reactions and solution stochiometry, thermochemistry, chemical equi-

librium, acid and base equilibrium, electrochemistry, chemical kinetics, and chemical applications.

Pre-requisite(s) : -

References :

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

CALCULUS 2

ENGE600005
3 credits
Learning Outcome(s) :

Students are able to use the concepts of sequences, series, conic incisional equations and the basic concepts of calculus which involve the function of two or three variables to solve their applied problems, are able to apply mathematics, science, and basic engineering as well as civil engineering specialization to be used in solving civil engineering problems that are complex.

Topic:

Line and series are infinite, Test for convergence of positive series and series of signs, rank series and operations, Taylor and Mc Laurin series, Cone slices, Calculus in polar coordinates, Derivatives, limits and continuity of multi-function functions, Derivative and gradient sequences, Rules chain, tangent plane and surface approximation, Lagrange multiplier method. Double fold integrals in Cartesian coordinates and polar coordinates, Triple fold integrals in Cartesian coordinates, cylindrical coordinates and sphere coordinates, Application double fold and fold integrals 3.

Pre-requisite(s) : Calculus 1

References :

1. D. Varberg, E. J. Purcell, S.E. Rigdon, Calculus, 9th ed., PEARSON, Prentice Hall, 2007.
2. Thomas, Kalkulus Edisi Ketiga Belas Jilid 2 , Erlangga, 2019.

BASIC PHYSICS 2 (ELECTRIC, MAGNET, OPTIC AND WAVE)

ENGE600007
3 credits
Learning Outcome(s) : -

Topic:

Pre-requisite(s) : -

References : -

LAB EXP FOR BASIC PHYSICS 2

ENGE600008
1 credits
Learning Outcome(s) :

Students are able to apply the basic concepts of electrical physics, magnetism, waves, and optics to solve problems in the engineering field, Students are able to explain the classification and state of matter, unit and measurement uncertainty, and dimensional analysis of units of measurement.

Topic:

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

Pre-requisite(s) : -

References :

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

ENGINEERING STATICS

ENME602004
2 credits
Learning Outcome(s) :

Understand the concepts of force and force equilibrium in various constructs so that they are able to calculate and analyze construction equilibrium based on the law of static equilibrium

Topic:

Basic principles of structural statics / Newton's Law. Arrangement and decomposition of style in a field and space. Static equilibrium law. Footsteps and footing reactions. Truss construction.

Pre-requisite(s): - None

References: -

1. Beer, Ferdinand P, Mechanics for Engineers: STATICS, Mc GrawHill.
2. RC Hibbeler, Mechanics of Materials, 10th ed., Prentice Hall, 2016.
3. Riley, F William, Engineering mechanics: STAT-

ICS, John wiley & sons
4. Hamrock, Fundamental of Machine Element, Mc Graw-Hill.
5. Shigley, Joseph Edward, Mechanical Engineering Design, McGrawHill.
6. Kurowski, P.M., Finite Element Analysis for Design Engineers, SAE International, 2004

SHIP MATERIALS

ENMR603003
3 credits
Learning Outcome(s) : -

Students are expected to understand available material options depending on the operation re- quirement of the ships, encompassing both qualitative and quantitative understanding. Qualita- tive understanding includes properties of materials which are used for ship structure. Quantitative understanding includes calculation of properties of materials which may change due to external influences such as elongation that results from a loading.

Topic:

Types of materials and their applications in industry, properties of materials in various industries such as naval industry, heat treatment, diffusion of materials, phase diagram, dislocation and strengthening mechanism, materials failure, corrosion and degradation of materials, stress-strain diagram, elastic-plastic deformation, compressive deformation, shear stress and torsional stress, material hardness, destructive and non-destructive testing.

Pre-requisite(s): -

References:

1. Callister W. D., Introduction to Material Science and Engineering, John Wiley and sons, 2007
2. Hibbeler R. C., Statics and Machanics of Materials, Prentice Hall, 2004
3. Muckle W., Strength of Ship'ss Structure, Edward Arnold Ltd, 1975.
4. Wessel J. K., Handbook of Advanced Material, John Wiley and sons, 2004

SHIPS VISUALIZATION AND MODELING

ENMR602002
3 credits
Learning Outcome(s):

This subject focus on the procedure of preparing a lines plan drawing that represents the shape of the ship's hull. This subject also provide hands on experience to the student on how ship lines plan is prepared and discuss the characteristics of underwater characteristic of the ship hulls.

Topic:

Drawing Lines Plan; Optimizing the main dimensions and coefficients on ship designs with restric- tions on ship type; Method of Nederlandsche Scheepsbouw Proefstatioen (NSP); Data Form Meth- od; Body Plan & Lines Plan. Interpreting the Hydrostatic Curve; HSC calculations use the Simpson method; Read the calculated hydrostatic curve. Interpreting the Bonjen Curve; Calculating the Bonjean curve; Reading the calculated Bonjean curve. Interpreting Cross Curve; Counting Cross Curve; Read Cross Curve that has been calculated.

Pre-requisite(s): -

References:

1. Tupper E.C., Basic Ship Theory, Butterworth Heinemann, 2001
2. David Watson, Practica[Ship Design.Elsevier Science.1998
3. V. Bertram, H.Schneekluth, Ship design for Efficiency and Economy, Butterworth Heinemann, 1998
4. Tupper E.C. dan W. Muckle, Introduction to Nava[Architecture, Butterworth Heinemann, 1996
5. T.C. Gillmer, Modern Ship Design, US Naval Institute, 1975.
6. Manual Autocad dan Maxsurf 12.02

ENGINEERING MATHEMATICS

ENME600013
4 credits
Learning Outcome(s) :

This course aims to complete student's anylitical ability. Students understand and are able to use the advanced mathematical concepts in order to solve engineering problems.

Topic:

Introduction to differential equation, 1st order differential equation, 2nd order differential equa- tion, higher order differential equation, vector analysis, vector differential, grad operation, diver- gence and curl, vector integration, laplace transform, laplace transform to solve the differential equation, fourrier transform, convulsion, numerical method, root of equation, numerical differ- entiation, numerical integral

Pre-requisite(s): Calculus 2

References:

1. Croft, A, et.al, Mathematics for Engineers, 3rd Edition, 2008, Prentice Hall
2. Chapra S.C., Canale, Numerical Methods for Engineer, 6th Edition, 2010, Mc Graw Hill
3. Kreyszig, E, Advanced Engineering Mathematics 10th Edition, John Wiley and Sons

BASIC THERMODYNAMICS

ENME603008
4 credits
Learning Outcome(s):

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

Topic:

Scope and basic understanding of thermodynamics system, temperature concept, pressure, thermodynamics equilibrium, reversibleIirreversible process, zero law of thermodynamics and abso- lute temperature, first law of thermodynamics, second law of thermodynamics, thermodynamics equation, gas power cycle, gas compressor, combustion engine cycle, internal combustion engine, simple gas turbine cycle, brayton's cycle, stirling's cycle, steam power cycle, refrigeration, car- not's cycle, simple rankine's cycle, rankine's cycle with modification, biner cycle, phsycometric chart, cooling tower, real gas, real gas equation, enthalpy and entrophy.

Pre-requisite(s): Physics (Mechanics and Thermal)

References:

1. Michael J. Moran, Howard N. Shapiro, Fundamentals of Engineering Thermodynamics, 8th Edition, Wiley, 2014.
2. Reynolds W.C., Perkins H.C., Engineering Thermodynamics, Mc. G. Hill .
3. Zemansky , Aboot , van Ness, Basic Engineering Thermodynamics, McGraw Hill
4. Kenneth Wark Jr. Thermodynamics , Mc.Graw Hill
5. H.D. Baehr, Termodynamik , Springer Verlag

SHIP BUILDING THEORY

ENMR603004
2 credits
Learning Outcome(s):

Provides an understanding about hydrostatic and dynamic stability calculation

Topic:

Lines Plan calculation and methodology; Bouyancy system; Metasentra, Static Stability: Calcula- tion of hydrostatic curves and cross curves; docking, Ship crashes out, inclining test, ship launch- ing, Wave Theory; Ship Hydrodynamics; Foil shape; Theory of Ship Motion; Plan Steering: Dynamic Stability: Theory of Stationary and Non-Stationary on a Ship Motion; Calculation of Critical Condi- tions Due to shaky ship; Impact loading.

Pre-requisite(s): Ship Visualization and Modelling

References:

1. Bryan Barrass & Dr Derrett, ship stabi[ity for master and mates.2006
2. A.B Brain, Ship hydrostatics and stabi[ity, Butterworth, Heinemann, 2003.
3. Volker Bertram, Practica[ship hydrodynamics, Butterworth, Heinemann, 2000.
4. Dr C B Barrass, Ship stabi[ity notes & examp[e,3rd edition Butterworth, Heinemann, 2001
5. E.C. Tupper & K.J. Rawson, Basic ship Theory, Butterworth, Heinemann, 2001.
6. M.A. Talahatu, Hidrodinamika kapal I & II, FTUI. 1998.

SHIP STRUCTURE 1

ENMR603005
2 credits
Learning Outcome(s):

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

Topic:

Stress and strain torsion (torque) and calculation of moment inertia; axial force, shear force and bending moment; Calculation of reaction cross-beam and diagrams, axial and moment diagrams; Analysis of stress and strain fields; Beams Deflection I; Beams Deflection II: Static; column; energy method; cylinder walls thick and thin; theory of plate; analysis of ship structures; longitudinal and transversal strength of ships; calculation of midship strength; Bending and torsion on the Hull Girder; Calculation of Cross Section, Bending and Buckling on the panels; concept of fatigue.

Pre-requisite(s): -

References:

1. Dr. Yong Bai, Marine Structura[Design. Elsevier Science.2003
2. Tupper E.C., Basic Ship Theory, Butterworth Heinemann, 2001
3. B. Baxter, Naval Architecture Examples and theory, Charles Griffin & Co.
4. Biro Klasifikasi Indonesia
5. Lloyd's Register Rules and Regulations

KINEMATICS AND DYNAMICS

ENME600009
4 credits
Learning Outcome(s):

Students have the ability to understand the key concept of kinematics and dynamics of mechani- cal system and capable to analyze the movement, velocity, acceleration force and equilibrium.

Topic:

Vector velocity analysis, free body diagram, linier motion, velocity polygon, 2D motion, rectan- gular coordinates, N-T and pole, relative motioan and velocity of 2 coincidelrelate point, Coriolis acceleration and stiff body kinematics, Inertia Force, Statics, particle system, works, energy, impuls, linear-angular momentum, stiff body motion, works and energy, relative motion, rotating mass balancing and back & forth motion, cam dynamics and Gyroscope.

Pre-requisite(s): Physics of Mechanics & Heat

Textbooks:

1. Meriam & Kraige, Engineering Mechanics. 7th ed, Wiley New York. 2012.
2. Holowenko, Dynamics of Machinery, John Wiley, 1995.
3. Beer & Johnston, Mechanics for Engineer, Dynamics, 11th ed. Dynamics, Mc Graw-Hill, 2015.

BASIC FLUID MECHANICS

ENMR604011
2 credits
Learning Outcome(s):

Fluid mechanics is a branch of applied mechanics used to investigate, analyze and study the nature and behavior of fluids. The fluid being studied can be a fluid that is moving or stationary.

Topic:

Fluid and its Properties; Fluid Statics; Relative Balance; Basic Concepts and Equations in Fluid Flow; Flow Dynamics: Motion Equations (Newton, Euler, Navierstokes); Basic Equations of Fluid Dynamics (Continuity, Energy and Momentum); Dimensional Analysis and Hydraulic Similarity; Ideal Fluid Flow; Viskos flow; Viskos Flow: Transition from Laminar Flow to Turbulent Flow; Turbulent Flow Full Development; Flow Around Submerged Objects: General Characteristics of Outside Flow.

Pre-requisite(s): -

References:

1. Munson, B.R., Fundamentals of Fluid Mechanics 7th Ed, John Wiley & Sons, Inc. 2012
2. Smits, A.J., A, Physical Introduction to Fluid Mechanics, John Wiley & Sons, Inc. 2000
3. Kumar, SCPL.L., Engineering Fluid Mechanics, Eurasia Publishing House Ltd., 2010

COMPUTATIONAL MATHEMATICS

ENME600017
2 credits
Learning Outcome(s):

Understand the basic knowledge of computational and engineering programming, able to make computational and programming techniques simple, able to solve engineering problems with engineering programming.

Topic:

Introduction to programming languages, Basics of algorithms, Basics of computing, Software for computing and programming techniques, Development of computing and programming with case studies

Pre-requisite(s): -

References:

1. Computer Programming with MATLAB, J. Michael Fitzpatrick, Ákos Lédeczi, Fitzle, 2013
2. Introduction to Computation and Programming Using Python: With Application to Understanding Data, John V. Guttag, The MIT Press, 2016

HEAT TRANSFER

ENME604005
2 credits
Learning Outcome(s):

This subject studies the mechanism of heat and mass transfer in a volume control because of differences in temperature and this subject has a close relationship with basic thermodynamics. The aim of this course is for students to be able to understand the various mechanisms of heat and mass energy transfer between two systems, when there is a temperature difference and be able to calculate the rate of heat transfer. Able to solve various problems of heat transfer and mass using dimensionless parameters.

Topic:

Basics of heat transfer; Conduction Heat Transfer (1 Dimension and 2 Dimension); Numerical Analysis of Conduction / Unsteady State Heat Transfer; Forced Convection Heat Transfer; Free convection heat transfer.

Pre-requisite(s): -

References:

1. Frank P Incropere, David P De Witt, Fundamental heat and mass transfer, 7th Ed., Wiley, 2011, New York
2. Holman JP, Heat Transfer, 10th ed, Mc Graw-Hill, 2009.
3. Koestoer, RA, Perpindahan Kalor untuk Mahasiswa Teknik, Salemba Teknika, 2003.
4. Welty R James, Wicks Charless, Wilson Robert, Fundamentals of Momentum, Heat, and Mass Transfer, 6th Ed. Wiley, 2014.
5. Cengel, Yunus, Heat Transfer a Practical Approach, 2nd Ed. Mc Graw Hill, 2003, Singapore.

6. Kreith Frank, Bohn Mark, Principles of Heat Transfer, 7th Ed. CL Engineering, 2010.

SHIP MACHINERY

ENMR604007
2 credits
Learning Outcome(s):

Understanding of types and concept of the main system, supporting system, lubrication system, and refrigeration system of a ship machinery

Topic:

Basic concept of diesel engine, combustion process, four and two stroke engine theory, types of engine, performance of diesel engine, turbo charger, engine ratings, machinery components, supporting system of machines, starting systems, fuel system, lubrication system, refrigeration system, engine propeller matching, experiment for diesel engine performance testing.

Pre-requisite(s): Basic Thermodynamics

References:

D A Taylor, Introduction to Marine Engineering.1996

SHIP STRUCTURE 2

ENMR604008
4 credits
Learning Outcome(s):

Provides knowledge and understanding of the types of construction on the ship structure and competence to design ship structures

Topic:

Bottom Structure: Ship hull and section system; Bulk head and girder; deck, Coaming and super structure: fore peak and after peak construction: Construction of Tankers; Gas Carrier Ship Con- struction: Doors and Windows; Fire Protection; Cabin Construction: Construction of loading and unloading Equipments; Painting and Corrosion Prevention.

Pre-requisite(s): Ship Structure 1

References:

1. D. J. Eyres, Ship Construction, 5th edition. Butterworth-Heinemann. 2011
2. D. Taylor, Merchant Ship Construction, Prentice Hall
3. Biro Klasifikasi Indonesia
4. Lloyd's Register Rules and Regulations

SHIP RESISTANCE AND PROPULSION

ENMR604009
4 credits
Learning Outcome(s):

Provides an understanding for the calculation of ships resistance and propulsion, both theoreti- cally and by using a model

Topic:

Ship force; Ship Resistance Comparative Law; Frictional resistance: wave resistance; pressure resistance: Air resistance; Effect of Ship Shape; Resistance predictions with Model Test; Wake Fric- tion: Thrust reduction; Ship resistance in Bad Weather: The principle of Hydrofoil Ship; coefficient of propulsion; Calculation of Propeller Design with Form Data and Wageningen Graphs..

Pre-requisite(s): -

References:

1. J. P. Ghose, R. P. Gokarn, Basic Ship Propulsion, 2004
2. Dave Gerr, The Propeller Handbook, McGraw-Hill Professional, 2001
3. Sv. Aa. Harva[d, Resistance and Propu[sion of Ships, 1983
4. C. Gallin, Ships and Their Propulsion System, Lohmann & Stolterfoht

SHIP HYDRODYNAMICS

ENMR604010
2 credits
Learning Outcome(s):

Students are expected to understand basic knowledge on ship hydrodynamics, waves, and viscous flow

Topic:

Basic of fluid, hydrostatic pressure, basic of hydrodynamics, theory of linear wave, Bernoulli equa- tion and dynamic pressure, effect of wave force on the body of ship, mass addition, equation for seakeeping, viscous lift and drag, friction and streamline endurance, buff bodies, and Navier Stoke equation.

Pre-requisite(s): - Ship Building Theory

References:

1. White, F. Fluid Mechanics. 5th ed. New York, NY: McGraw-Hill, 2002. ISBN: 9780072831801.
2. Smits, A. J. A Physical Introduction to Fluid Mechanics. New York, NY: John Wiley & Sons, 1999. ISBN: 9780471253495.
3. Bhattacharyya, F. Dynamics of Marine Vehicles. New York, NY: John Wiley & Sons, 1978. ISBN: 9780471072065

NUMERICAL METHOD

ENME600016
2 credits
Learning Outcome(s):

The objective of this course is so that students can understand and apply the process and method (algo-

rithm) for engineering numerical computation based on computer and parameters that affect speed and accuracy of the results.

Topic:

Introduction to numerical method and programming, simple mathematical modeling, program- ming and software, structured programming, modular programming, iterative method, function, Taylor and Maclaurin series, approximation and error, solutions to system of linear equations, Graphical method, bisection method, false-position method, Newton - Raphson method, Secant method, Bairstow method, linear algebra system of equations: Gaussian elimination, Gauss-Jordan elimination, decomposition, matrix transformation, Curve - Fitting: Least - Square regression, Interpolation; Numerical integral: Trapezoidal method, Simpson method, multiple integral; Dif- ferential equation: Finite Divided Difference, Euler method, Runge - Kutta method; Ordinary dif- ferential equation

Pre-requisite(s): Calculus 1, Calculus 2 and Engineering Mathematics

References:

1. Chapra, Steven C. and Canale, Raymond P. Numerical Methods for Engineers 6th edition. New York: McGraw-Hill, 2010.
2. Kreyszig, Erwin. Advanced Engineering Mathematics 10th edition. Danvers: John Wiley & Sons, 2011.
3. Sedgewick R., Phillippe F, An Introduction to the Analysis of Algorithms, Addison Wesley.
4. Cheney W., Kincaid D., Numerical Mathematics and Computing, Cole Publishing

STATISTICS AND PROBABILISTICS

ENGE600010 / ENGE610010
2 credits
Learning Outcomes:

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

Topic:

Introduction to Statistics for Technical Studies: The role of statistics and their application in engineering, Statistical problem solving methods, Descriptive Statistics, Data collection, data organizing, frequency distribution, graphic presentation, Central tendency measures, dispersion measures, moments, skewness, kurtosis, qualitative data; Probability Theory: Basic concepts and definitions, probabilities, combinations of events, random variables; Probability Distribution: Mathematical model of distribution, continuous and discrete probabilities, probability density functions (PDF), binomial distribution, Poisson distribution, normal distribution (gaussian), chi square distribution; Sampling: The usefulness and advantage of sampling, the distribution of the sampling from the average value, the distribution of the percentage sampling; Estimation: Basic definitions and concepts, Estimating intervals, Estimating average values of populations, Estimating population percentages, Estimating population variances, Determining sample sizes to estimate; Hypothesis testing: General procedures for hypothesis testing; Hypothesis test 1 sample at average value: Hypothesis test 1 sample at variance, Hypothesis test 2 sample at variance, Hypothesis test 2 sample at average value, Hypothesis test 2 sample at percentages, Objectives and procedures ANOVA, sample ANOVA, table ANOVA; Regression: The basic concepts of simple linear regression analysis, Test relations and prediction intervals in linear regression analysis

Pre-requisite(s): none

References:

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

SHIP DESIGN ASSIGNMENT 1

ENMR600001
3 credits
Learning Outcome(s):

Understanding of ship design procedures and monitoring.

Topic:

Design Analysis (owner requirement based); study literature; initial finding: Displacement, main dimension, and shape of ship, finding power driven; linesplan skecth and monitong of calculation CSA (Curve of Sectional Area); general plan sketch (GA); initial assessment payload and unloading space, stability, hull arise, trim; free and unloading space estimates; watertight bulkhead posi- tioning for passenger ships.

Pre-requisite(s): Ship Building Theory

References:

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

SHIP VIBRATION

ENMR606017
2 credits
Learning Outcome(s):

Understanding of engine vibration system and vibration source detection

Topic:

Engine vibration system: free vibration, damping, transient vibrations, forced vibrations, vibrations with two degrees of freedom, torsional vibration, lateral and longitudinal in ship propulsion system; Experimental measurement of vibration

Pre-requisite(s): Kinematics and Dynamics

References:

1. L.C. Burrill, Ship vibration: simp[e methods of estimating critica[frequencies, North East Coast Institution of Engineers and Shipbuilders. 1935
2. Meriam & Kraige. Engineering Mechanics. Vol-2, Dynamics. Wiley New York.4th eds.1998.
3. Holowenko. Dynamics of Machinery.John Wiley.1995.
4. William T.Thomson. Theory of Vibration with application. Prentice Hall India.1972.
5. Beer & Johnston.Mechanics for Engineer-Dynamics.Mc-Graw-Hill.1976.

SHIP DESIGN ASSIGNMENT 2

ENMR600002
4 credits
Learning Outcome(s):

Understanding the calculation and monitoring of supporting system for ships designing

Topic:

Ship displacement methode; determine main dimension and coefficient; determine lines plan, hydrostatic calculation, main section plan, profile and bulkhead plan, design of air condirtioning system, ship maintenance design, communication devices election, navigate devices election, safety plan

Pre-requisite(s): Ship Design Assignment 1

References:

1. B. Baxter, Teach Yourse[f Nava[Architecture, The English Universities Press. Signifi cant Ships, RINA
2. M.A Talahatu, Teori Merancang Kapal. FTUI 1998.

FLUID AND PIPING SYSTEM OF SHIP

ENMR605011
2 credits
Learning Outcome(s):

Understanding types of fluid system, piping system, and practical aspects on the Ship Construction

Topic:

Positive displacement of fluid engines, hydrolic system,pneumatic power systems. Experimental of water piping system, air piping system, pump impeller, Pelton turbine. Piping systems on ships and marine construction, type of pipe material, pipe fittings, valves, tanks, sea-chest, standards and methods of drawing systems, bilga systems, ballast systems, fire extinguish system,supporting sys- tem (auxiliary motor), fuel system, lubrication system, cooling system, compressed air systems, domestic systems, tanker loading and unloading systems.

Pre-requisite(s): Basic Fluid Mechanics

References:

1. A.Keith Escoe. Piping and Pipeline Assesment Guide. Elsevier Inc. 2006
2. Dixon, S.L, Fluid Mechanics and Thermodynamics of Turbomachinery, 4th Edition, Pergamon Press, 2005
3. Esposito, A., Fluid Power with Application, 5th Edition, Prentice Hall, 2003
4. Mobley, R.K, Fluid Power Dynamics, Newnes Butterworth-Heinemann, 1999
5. Giles, R.V, Fluid Mechanics and Hydraulics, 2nd Edition Schaum's Outline Series, Mc- Graw- Hill, 1994

SHIP MANUFACTURING PROCESS

ENMR605013
2 credits
Learning Outcome(s):

This course aims to study the ship manufacturing process in general, the process of forming and shaping, the manufacturing of ship's plate, and the machining process.

Topic:

Ship manufacturing process (ship planning & Mouldloft, Sand Blasting & Primer Coating, Keel Lay- ing, Fabrication, Assembly, Erection, Outfitting, Painting, Leakage Test, Launching, Sea Trial, De- livery), Forming and shaping process (Rolling, Forging, Extrusion, Sheet Metal Forming), Manufac- turing of ship's plate (surface roughness, surface treatment, surface coating, surface cleaning), Machining process (machining fundamentals, turning, milling, broaching, sawing, & filing)

Pre-requisite(s): -

References:

Kalpakjian S., Manufacture Engineering and Technology, Pearson Springer, 2009

WELDING ENGINEERING

ENMR605014

2 credits
Learning Outcome(s):
This course aims to study basic knowledges in welding, joining, cutting. Students are expected to achieve the basic competences of welding engineering.

Topic:
Basic knowledge of welding, joining and cutting (Oxy -gas welding dan SMAW, GTAW dan GMAW, SAW, FCAW and friction welding, types of cutting, Brazing, soldering and joining), terminologies and definitions, welding design and its calculations (Weld joint, non destructive test, and destruc- tive test, Heat treatment of base materials and welded joints)

Pre-requisite(s): -

References:
1. Harsono W., T. Okumura, Teknologi Pengelasan Logam, PT Pradnya Paramita Jakarta Cetakan ke-10, 2008.
2. American Welding Society, AWS D1.1ID1.1M:2004, Structural Welding Code - Steel, 19thedi-

SHIP POWER GENERATION

ENMR606020
2 credits
Learning Outcome(s):

Students can understand the principles of power system of the ship, including the current and the future trends.

Topic:

The need for ship power system, current and future trends (fossil fuel, carbon emission, interna- tional regulations, system and consumption of ship energy, efficiency management of ship energy), conventional power system (diesel and biofuel, LNG and CNG, dual-fuel, gas turbine), non- con- ventional power system (nuclear energy, wind energy, solar energy, Organic Rankine Cycle (ORC)), system of electric ship (principles of electric ship, types of electric ship application, hybrid ship)

Pre-requisite(s): Thermofluids

References:
1. K.C. Weston, Energy Conversion, PWS Publisher
2. D.Y. Goswani, F. Kreith, Energy Conversion, CRC Press
3. A.W. Culp, Principle of Energy Conversion, McGraw-Hill

SHIP MACHINERY AND EQUIPMENT

ENMR606018
2 credits
Learning Outcome(s):

Understanding of theory, system, and working principle of ship equipment

Topic:

Anchoring and mooring equipment supplies; loading and unloading equipment; Water-tight win- dows and doors; Ventilation Equipment: Safety Equipment: Equipment Navigation and Communi- cations; Firefighting Equipment: Equipment Ship Steering; Oil Separator Equipment: Pumps and System Installation.

Pre-requisite(s): -

References:
1. H. McGeorge, Marine Auxiliary Machinery, Butterworth Heinemann, 2001.
2. D.A. Taylor, Introduction to Marine Engineering, Butterworth Heinemann, 1996

SHIP DESIGN ASSIGNMENT 3

ENMR600003
3 credits
Learning Outcome(s):

Understanding of calculation and monitoring of ship engine design

Topic:

Engine and tools selection (auxilary engine); electrical load balance; Detailed drawings; Design of Ship Engine Room Layout; transmission system, reduction gear and shafting; Construction of a propeller and propeller maching; ship piping systems for engine and hull; fire extinguishing sys- tem; steering system; ventilation system; calculation, selection and layout of the marine cable; load analysis and design one-line diagram of electrical & Wiring Diagram instalasi including lighting vessels and equipment. Bilga system design and Engine Room Bilga System (Oily-Water Bilge Sys- tem); Design System Reply: Fire System Design: Design of Fuel System: Engine Lubrication System Design: Design of Engine Cooling System: Air Pressure System Design; Domestic Fresh Water System Design Air & Sea; Sanitary Disposal System Design: the design of loading and unloading systems; Ship Electrical Load Analysis: Calculation and selection of the number and capacity of Genset & Shore Connection: the calculation and selection of battery capacity; List Equipment Code

Pre-requisite(s): Ship Design Assignment 2

References:
1. B. Baxter, Teach Yourse[f Nava[Architecture, The English Universities Press. Signifi cant Ships, RINA
2. M.A Talahatu, Teori Merancang Kapal. FTUI 1998.

SHIP SURVEY AND INSPECTION

ENMR607023
4 credits
Learning Outcome(s):

Understanding of types of class survey, statutory approval and ship operation

Topic:

Statutory survey; Class survey; Hull survey; Loadline survey, Inclining experiment; Damage survey; Machinery Installations survey; Electrical & Genset survey; Seatrial procedure.

Pre-requisite(s): -

References:

1. D. Benkovsky, Technology of ship repairing, MIR Publisher.
2. Piero Caridis, Inspection, Repair, and Maintenance of Ship Structures, Witherby & Co.Ltd, 2001
3. Shields S., et.al, Ship Maintenance : A Quantitative Approach, IMARES, 1996
4. Biro Klasifikasi Indonesia
5. Lloyd's Register Rules and Regulations

SHIP ELECTRICAL SYSTEM

ENMR605015
3 credits
Learning Outcome(s):

Understanding of the principles, operations, and applications of electronic systems of ships

Topic:

Basic of electronics: Passive Components: Semiconductors: Electronic Components; Digital Sys- tems; Digital Combinational circuit; Digital Sequential circuit; PLC; Electronics Simple Plan; basic theory of DC circuit: basic theory of AC electrical circuits, working principle of DC motors, Types of MDC; operation of the MDC, the working principle of AC Motor, Various kinds of MAC, MAC opera- tion: principle of generator, voltage drop generator; generator no-load and under load; Non Reguler generator; Introduction of the application on ship; Electric propulsion and PTO.

Pre-requisite(s): Electrical System of Ships

References:

1. John Bird, Electrical & Electronic Principle and Technology. Jhon Bird.2003
2. John C Payne, The Marine Electronical & Electronics Bible, John Pyne.1993

SHIP MAINTENANCE AND REPAIR

ENMR606021
2 credits
Learning Outcome(s):

Students are able to understand the maintenance and control of ship's engine system.

Topic:

Introduction to reliability system, reliability Fundamental Review of the concept, simple system Network Modelling, Network Modelling System, Introduction to Markov and Monte Carlo Simula- tion, Discrete Markov Chains and Markov Continuous Process. Public Review: Economic and Reli- ability, Maintenance Strategy. Functions of Manual Maintenance; Parts List and Stock; Preparation of Schedule Maintenance: Maintenance Document Preparation; Engine Room Maintenance, Main- tenance of Inventory: The Role of Engine Builders Tips andTools: Spare-Parts.

Pre-requisite(s): -Engine Room Layout Design, Ship Manufacturing Process

References:

1. D. Benkovsky, Technology of ship repairing, MIR Publisher.
2. Piero Caridis, Inspection, Repair, and Maintenance of Ship Structures, Witherby & Co.Ltd, 2001
3. Shields S., et.al, Ship Maintenance : A Quantitative Approach, IMARES, 1996

SHIP FINANCING AND INSURANCE

ENMR605012
2 credits
Learning Outcome(s):

Students are able to understand the concepts of ship investment financing and maritime insurance as one of the ways of controlling risk and the concept of financing and maritime investment feasibility.

Topic:

Pembiayaan investasi maritime; analisis model pembiayaan; kelayakan investasi suatu projek; asuransi dibidang maritim;

Pre-requisite(s): -

References:

The International Handbook of Shipping Finance: Theory and Practice 1st ed. 2016 Edition by Manolis G. Kavussanos (Editor), Ilias D. Visvikis (Editor)

HEALTH, SAFETY AND ENVIRONMENT

ENGE600012
2 credits
Learning Outcome(s):

Understanding the importance of Occupational Health and Safety and Environmental Protection (K3LL), understanding K3LL regulations and legislation, understanding K3LL management systems, understanding the risks and prevention of work acci-

dents, understanding toxic and dangerous objects and materials and their handling, understanding K3LL tools .

Topic: **:**
K3LL introduction, K3LL regulations and legislation, K3LL management system, Occupational risk and accident prevention, Toxic and dangerous substances and their handling and handling, K3LL tools

Prerequisite(s): -

References:

Environmental, Safety, and Health Engineering, Gayle Woodside and Dianna Kocurek, Wiley, 2008

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

Special Subjects

SEMINAR
ENME600004
1 credits
Learning Objective(s):

Student can communicate in verbal or written with final project pjroposal; able to formulate the problems and objectives of the research, conduct theoretical review to formulate the hypothesis, design the research method for empirical proof and present the preliminary result to the supervisor

Topic:

Problem description, basic concept of research with assumption and constraint; making prelimi- nary report, conducting the preparation, literature review and research methodology; present final report with structured report, language, graphical presentation, table etc, reference and clarity.

Pre-requisite(s): Passed 110 CREDITS and GPA > 2.00 without Grade E

References: -

ON THE JOB TRAINING
ENME600003
2 credits
Learning Objective(s):

The course is intended to provide opportunity for gaining experience in industries and applying mechanical engineering knowledge. Able to perform management tacredits and engineering technique according to field of interest.

Topic:
Management and Engineering according to the field of interest. Presentation of internship results and report

Prerequisite(s): Passed 95 CREDITS and GPA > 2.00

FINAL PROJECT
ENME600005
5 credits
Learning Objective(s):

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

Topic:

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

Prerequisite(s): Passed 128 CREDITS and GPA > 2.00 without Grade E

Electives Subjects

MARINE AND OFFSHORE STRUCTURE
ENME803183
4 credits
Learning Objective(s):

Provide the knowledge, understanding of the theory and principles of building offshore include the type, function, and offshore construction technology and techniques in performing design structure.

Topic:

Types of Offshore; Construction and Offshore Structures; Calculation of Style and Power Offshore: Safety Requirements; Construction Semi-submersible; Single Buoy Mooring; FPSO; Offshore Main- tenance and Repair.

Prerequisite(s): -

References:
1. Cliff Gerwick, Construction of Marine and Off-shore Structures, CRC Press 1999
2. Subrata Chakrabarti, Handbook of Offshore Engineering, Elsevier Science, 2005
3. Yong Bai, Marine Structural Design, Elsevier Science, 2003

MARITIME LAW AND REGULATION
ENME803185
4 credits
Learning Objective(s):

Provide knowledge and understanding of the laws and regulations on maritime activities both nationally and

internationally.

Topic:

Introduction of maritime law; Regulation of Marine Pollution Prevention and Control; SOLAS; Pre- vention of Collisions Regulations; ISM Code; Statutory Rules; Passenger Ship Regulations; Tanker Regulations; Offshore Regulations: Accident Rescue Regulations; Other IMO rules. Accident preven- tion regulations; Risk assessment and analysis.

Pre-requisite(s): -

References:

1. International Convention for the Prevention of Pollution From Ships (MARPOL), International Maritime Organisation Publications
2. International Regulations for Preventing Collisions at Sea (COLREG), International Maritime Organisation Publications
3. International Convention for the Safety of Life at Sea (SOLAS), International Maritime Organisation Publications
4. International Safety Management Code (ISM Code) Guide Book, International Maritime Organ- isation Publications
5. Churchil R.R. dan Lowe A.V, The Law of the Sea, MUP 1999

SUPPLY CHAIN TECHNOLOGY

ENME804192
4 credits
Learning Objective(s):

Provides the knowledge and understanding of various management approaches, maritime trans- port and port activities which also include risk factors, safety, and economy.

Topic:

Sea Transport Demand Trend: Marine Transportation Market Research; Inter Mode Transport Sys- tem; System loading and unloading, Types of Sea Transport, Warehousing and Storage Cargo Sys- tems, SystemsAgency, Survey Charge, Corporate Sailing economic calculation, Customs.

Pre-requisite(s): -

References:

1. P. Lorange, Shipping Management, Institution for shipping Research.
2. Patrick Alderton, Reeds Sea Transport : Operation and Management, Adlard Coles, 2008
3. Patrick Alderton, Port Management and Operations,Informa Business Publishing, 2005
4. Svein Kristiansen, Maritime Transportation : Safety management and Risk analysis, Butterworth-Heinemann, 2004
5. M. Stopford, Maritime Economics, Routledge, 1997
6. House, D.J, Cargo Work for Maritime Operation, Butterworth Heinemann, 2005

CARGO COOLING TECHNOLOGY

ENME804193
4 credits
Learning Objective(s):
Providing knowledge and understanding in the use of cooling and air conditioning equipment circulation technology; cold storage and low temperature logistics.

Topic:
Basic principles for estimating cold storage loads, calculation of cooling capacity for various types of cold storage, and other topics of evaporative cooling, principles for designing low-cost refrigeration bases.

Pre-requisite(s): -

References:

Rao, C.G. Engineering for Storage of Fruits and Vegetables: Cold Storage, Controlled Atmosphere Storage, Modified Atmosphere Storage. Academic Press, 2015, ISBN: 0128033657,9780128033654

SEA AND PORT TRANSPORTATION MANAGEMENT

ENME803184
4 credits
Learning Objective(s) :

Provides knowledge and understanding of various management approaches sea transportation and port activities which also include risk factors, safety, and economy.

Topic :

Sea Transportation Demand Trends; Sea Transportation Market Research; Inter Mode Transportation System; Port Loading and Unloading Systems, Determination of Sea Transportation Types, Cargo Storage and Warehousing Systems, Agency Systems, Cargo Surveys, Shipping Company Economic Calculations, Customs.

Pre-requisite(s): -

References:

1. P. Lorange, Shipping Management, Institution for shipping Research.
2. Patrick Alderton, Reeds Sea Transport : Operation and Management, Adlard Coles, 2008
3. Patrick Alderton, Port Management and Operations,Informa Business Publishing, 2005
4. Svein Kristiansen, Maritime Transportation : Safety management and Risk analysis,

5. Butterworth-Heinemann, 2004
6. M. Stopford, Maritime Economics, Routledge, 1997
7. House, D.J, Cargo Work for Maritime Operation, Butterworth Heinemann, 2005

INTERNSHIP A

ENME601108
3 credits
Learning Outcome(s):
Students gain insight and experience activities in industry and the work experiences related to non-engineering aspects.

Topic:
Special topics in the non-engineering industrial sector that have not been covered in other subjects.

Pre-requisite(s): Have undergone a minimum of 4 semesters of lectures, or have obtained a minimum of 72 credits with a GPA> 2.0. Activities carried out by monitoring and evaluation by the Internship Coordinator.

References: -

SPECIAL TOPIC 1

ENME601104
4 credits
Learning Outcome(s):
Students gain insight and experience of activities in national / international competitions, or community, or entrepreneurship, or industry and the work experiences.

Topic:
Special topics in fields that have not been covered in other subjects.

Pre-requisite(s): Have undergone at least 2 semesters of lectures, or have obtained a minimum of 36 credits with a GPA> 2.0. Activities carried out by monitoring and evaluation by the Special Topic Subject Coordinator.

References: -

SPECIAL TOPIC 2

ENME601105
4 credits
Learning Outcome(s):
Students gain insight and experience of activities in national / international competitions, or community, or entrepreneurship, or industry and the work experiences.

Topic:
Special topics in fields that have not been covered in other subjects.

Pre-requisite(s): Have undergone at least 2 semesters of lectures, or have obtained a minimum of 36 credits with a GPA> 2.0. Activities carried out by monitoring and evaluation by the Special Topic Subject Coordinator.

References: -

ADVANCED ENGINEERING MATHEMATICS

ENME802002
2 credits
Learning Outcome(s):

The purpose of this subject is to develop students' analytical skills. Students understand and are able to use advanced engineering mathematical concepts in solving applied engineering problems.

Topic:

Introduction to Differential Equations; Differential Equation Order 1; Differential Equation of Order 2; High Order Differential Equations; Vector Analysis; Differential Vector; Grad, Divergence and Curl Operations; Vector Integral; Laplace transform; Solving Differential Equations using Laplace Transform; Fourier transform; Convolution

Pre-requisite(s): -

References:

1. Chapra, Steven C. and Canale, Raymond P. Numerical Methods for Engineers 6th edition. New York: McGraw-Hill, 2010.
2. Kreyszig, Erwin. Advanced Engineering Mathematics 10th edition. Danvers: John Wiley & Sons, 2011.
3. Sedgewick R., Phillippe F, An Introduction to the Analysis of Algorithms, Addison Wesley.
4. Cheney W., Kincaid D., Numerical Mathematics and Computing, Cole Publishing

ENGINEERING COMPUTATION

ENME802004
2 credits
Learning Outcome(s):

The purpose of this subject is that students know well and be able to apply the processes and methods (algorithms) of calculation (numerical and analytic) engineering in the real computer-based computing world and parameters that affect the speed and accuracy of the calculation results.

Topic:

Numerical Method: Equation roots, Numerical Diffential, Numerical Integral; Partial Differential Equation Solution. Introduction to Computer Applications: Algorithms and Algorithm Analysis; Computational Complexity; Types of Algorithms; Number Optimization and Representation; Overflow and Underflow;

Error and Formula Error in Numerical; Root of Eq. Finite Divided Difference Method in calculating Equation Derivation; Numerical Integration; ODE and ODE systems in Computing Applications; Fast Fourier Transform; PDE in Computational Applications: Solutions of Elliptic, Parabolic, and Hyperbolic Equations with Numerical Methods; Application of Elliptic, Parabolic, and Hyperbolic PDE equation techniques; Monte Carlo in Computing Applications.

Pre-requisite(s): -

References:

1. Chapra, Steven C. and Canale, Raymond P. Numerical Methods for Engineers 6th edition. New York: McGraw-Hill, 2010.
2. Kreyszig, Erwin. Advanced Engineering Mathematics 10th edition. Danvers: John Wiley & Sons, 2011.
3. Sedgewick R., Phillippe F, An Introduction to the Analysis of Algorithms, Addison Wesley.
4. Cheney W., Kincaid D., Numerical Mathematics and Computing, Cole Publishing

ADVANCED FLUID DYNAMICS AND HEAT TRANSFER

ENME801102
4 credits
Learning Outcome(s):

Enhance the ability of students in the study of fluid mechanics in more detail so as to conduct research or the application of science in industrial applications. Studying the mechanism of heat transfer in a control volume due to the existence of the temperature difference and concentration as well as the involvement of one, two or three phases at the tim simultaneously.

Topic:

Viscous flow of Newtonian fluid, membrane boundary flow, Non-Newtonian Fluid Flow, Two-Multi Phase Flow, Particle Displacement Flow, Porous Media and Fluidized Beds, Turbulent Flow and Mixing, Jet, Chimney, Energy and Momentum Equatio, one-two-three dimension conduction heat transfer, heat transfer on extended surface.

Pre-requisite(s): -

References:

1. Frank P Incropere, David P De Witt, Fundamental heat and mass transfer, 5th Ed., John Wiley & Sons, 1996, New York
2. Holman JP, Heat Transfer, 9th, Mc Graw Hill, 2003.
3. Koestoer, RA, Perpindahan Kalor untuk Mahasiswa Teknik, Salemba Teknika, 2003.
4. Welty R James, Wicks Charless, Wilson Robert, Fundamentals of Momentum, Heat, and Mass Transfer, 3rd Ed. John Wiley & Sons, 1996, New York
5. Cengel, Yunus, Heat Transfer a Practical Approach, 2nd Ed. Mc Graw Hill, 2003, Singapore.
6. Kreith Frank, Bohn Mark, Principles of Heat Transfer, 6th Ed. Brooks/cole, 2001, USA
7. Abbott I R, Theory of Wing Section, Dover Publications.
8. Bird R B, Transport Phenomena, John Wiley & Sons.

MATERIAL AND MANUFACTURING PROCESSES

ENME801140
4 credits
Learning Outcome(s):

The course provides understanding and basic competence of theory, application method and product manufacturing processes that covers: working principle, process characteristics, process limitations, work and force due to the process, parameters that affects to the process and the relation of material with the process that needed for certain process.

Topic:

Manufacturing Process and Production Systems; Materials in Manufacturing; Theory and Method of Casting Processes; Theory and Method of Bulk Deformation Processes; Theory and Method of Metal Forming Processes; Theory and Method of Powder Metalurgy Processes; Theory and Method of Material Machining/ Cutting Processes; Theory and Method for Enhancing Manufactured Surface Quality; Theory and Method of Joining Processes; Theory and Method of Prototyping; Engineering Material Characteristics; The Relation between Process Characteristics and Material Characteristics; The Parameter Control of Process for Material; Assignment in Manufacturing Process and Material Selection for Market Needs.

Pre-requisite(s): -

References:

1. Michael Ashby dan Kara Jhonson, Materials and Design: Arts and science in material selection in product design,Butterowrth-Heinemann, 2002
2. Michael Ashby, Material selection in Mechanical Design, Butterworrth Heinneman,2005

3. John A. Schey, Introduction to Manufacturing Processes, McGraw-Hill, 1999

4. Degarmo, E. Paul, Materials and Processes in Manufacturing, Prentice Hall Int. Inc, 8th edition, 2005

SPECIAL SHIP PROJECT

ENME804186
4 credits
Learning Outcome(s):

Provide the knowledge, understanding of ship design for special purposes.

Topic:

Typology and special ship purposes; Material to special Ship, Design Considerations; Calculation of loading; Calculation of Ship Quantities; Computation Structures: Propulsion Systems; Motion System; Safety and Navigation System; Stability Calculation.

Pre-requisite(s): -

References:

1. Lars Larsson dan Rolf Eliasson, Principles of Yacht Design, International MarineIRagged Moun- tain Press, 2007
2. Dave Gerr, The Elements of Boats Strength, International MarineIRagged Mountain Press, 1999
3. Norman L. Skene, dan Marnard Bray, Elements of Yacht Design, Sheridan house, 2001
4. Steve Killing dan Doug Hunter, Yacht Design Explained : A Sailors Guide to the Principles and Practices of Design, W.W Norton and Company, 1998
5. S. Sleight, Modern Boat Building, Conway Maritime Press.

SHIP PRODUCTION OPTIMIZATION

ENME804187
4 credits
Learning Outcome(s):

Provides knowledge and understanding of the various shipyard management and technique.

Topic:

Shipyard Layout; Ship Process Production; Steel Stock Yard Planning; Crane Calculation: Jamo- rang Calculation At Each Stage Production: Make Work Schedule: Work Break Down Structure; Integrated Hull Outfitting and Painting; Advanced Outfiting; Group Technology Methods for Ship Production; Ship launching; Ship trials.

Pre-requisite(s): -

References:

1. D.J. Eyres, Ship Construction, Butterworth-Heinemann, 2007
2. R.Shenoi, Ship Production Technology, Univ. Of Southampton.
3. National Research Council, Shipbuilding Technology and Education, National Academy Press, 1996

MARITIME SAFETY

ENME804189
4 credits

Learning Outcome(s):

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

Topic:

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

Pre-requisite(s): -

References:

1. Jones. S. Maritime Security: A practical Guide, the nautical institute 2012
2. Consolidate Edition, MARPOL, International Maritime Organization, 2006
3. Consolidate Edition, SOLAS, International Maritime Organization, 2004

ADVANCED WELDING ENGINEERING

ENME804190
4 credits
Learning Outcome(s):

Provide knowledge, understanding of the theories, principles and design as well as the assessment of the quality of welding and welding applications.

Topic:

Introduction, review of welding term and definition, welding process type, standard power source, Oxy-gas welding, Shield Metal Arc Welding (SMAW), Gas Tungsten Arc Welding (GTAW), Gas Metal Arc Welding (GMAW), Submerged Arc Welding (SAW), Flux Cored Arc Welding (FCAW), Resistance welding, Friction Stir Welding, Other welding process: laser, electron beam, plasma, Cutting and other edge preparation processes, surfacing and spraying, Brazing and soldering, Joining processes for plastics, ceramics and composites, Welding metal: Ferrous-based metal, non-ferrous-based metal, Material behavior during welding process, Testing materials and the weld joint, Non De- structive Examination (NDE), DT (Destructive Test), Heat treatment of base materials and welded joints, Basic

of welding design, Residual stresses and distortion, Welding Symbol, Behavior of welded structures under different types of loading, Design of welded structures under static and dynamic loading, welding defects, Design of welded pressure equipment, Welding Performance Qualification Record (WPQR), Welding Procedure Specification (WPS), Welding automation.

Pre-requisite(s): -

References:

1. Sindo Kou, Welding Metallurgy, 2nd Edition, Wiley, 2002.
2. ASME Section IX, Welding and Brazing Qualifications
3. AWS D1.1., Structural Welding (Steel)
4. William A. Bowditch, Welding Fundamentals 5th Edition, Goodheart-Willcox, 2011.
5. Technical Manual TM 5-805-7. Welding Design, Procedures and Inspection Headquarters.
6. Lloyds Register. Welding Procedures, Inspections and Qualifications.

PORT PLANNING AND OPERATIONS

ENME804191
4 credits
Learning Outcome(s):

Port Planning and Operations is a lecture that emphasizes the process of planning the layout and operation of ports in accordance with commodities managed based on the principle of green-port development.

Topic:

Sea transportation: Facilities and commodities, Port functions in maritime transportation, types of ports and sea terminals, stages in port planning, principles of integrated port planning, planning and design of port water areas., Conventional general cargo terminals, Container terminals, Oil & liquid gas terminals, Dry bulk cargo terminals, Green port developments, Conventional general cargo terminals, Container terminals, Oil & liquid gas terminals, Dry bulk cargo terminals, Green port developments.

Pre-requisite(s): -

References:

1. Ligteringen, (1999), Ports and Terminals, Faculty of Civil Engineering and Geosciences Department of Hydraulic and Geotechnic Engineering Section Hydraulic Engineering, Technische Universiteit Delft.
2. Velsink, H., (1994), Ports and Terminals: Planning and Functional Design, Faculty of Civil Engineering Hydraulic Engineering Group, Delft University of Technology.
3. Bose, J.W., (2011), Handbook of Terminal Planning, Springer-Verlag New York

ENERGY SYSTEM OPTIMIZATION

ENME802103
4 credits
Learning Outcome(s):

This course provides an understanding of mathematical modeling, simulation and optimization of energy systems through technical and economical approach. The course is intended to equip student with the ability to understand mathematical model, simulation and optimization of thermal systems.

Topic:

Workable System Design; Economical Evaluation; Determination of Mathematical Equations; Thermal Equipment Modeling; System Simulation; System Optimization: Objective Function, Constraints; Lagrange Multipliers: Lagrange multiplier to complete the optimiza- tion process; Dynamics, Geometric and Linear Programming; Mathematical Model of Thermodynamics Properties; Big System Simulation under Steady Condition; Big Thermal System Simulation; Calculation of Variables in Optimum Conditions.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanics

References:

1. Stoecker, W.F. Design of Thermal System, 3rd Edition, Mc.Graw Hill Book Co, 2011.
2. Boehm,R.F., Design of Analysis of Thermal System, John Wiley&Sons,1987.
3. Yogesh Jaluria, Design and Optimization of Thermal Systems, 2nd Edition, Mc.Graw Hill Book Co, 2007.

SHIP AIR CONDITIONING AND REFRIGERATION SYSTEM

ENMR607022
4 credits
Learning Outcome(s):

Students are able to analyze the design of air conditioning and refrigeration system on the ship

Topic:

Basic principles of refrigeration and air conditioning processes. Diagrams Psikrometri, ducting system design, heating system design, ventilation system design, system design of air conditioning and refrigeration, technical specifications and troubleshooting, ISO standards and the Class

Pre-requisite(s): -

References:

1. James Harbach, Marine Refrigeration and Air Conditioning, Cornell Maritime Press, 2005

2. N. Larsen, Marine Air Conditioning Plant, Butterworth-Heinemann, 2001
3. Jones W.P., Air Conditioning Engineering, Butterworth-Heinemann, 2001

INTERNSHIP B
ENME601109
3 credits
Learning Outcome(s):

Students gain insight and experience activities in industry and the work experiences related to non-engineering aspects.

Topic:

Special topics in the non-engineering industrial sector that have not been covered in other subjects.

Pre-requisite(s): Have undergone a minimum of 4 semesters of lectures, or have obtained a minimum of 72 credits with a GPA> 2.0. Activities carried out by monitoring and evaluation by the Internship Coordinator.

References: -

SPECIAL TOPIC 3
ENME601106
4 credits
Learning Outcome(s):

Students gain insight and experience of activities in national / international competitions, or community, or entrepreneurship, or industry and the work experiences.

Topic:

Special topics in fields that have not been covered in other subjects.

Pre-requisite(s): Have undergone at least 2 semesters of lectures, or have obtained a minimum of 36 credits with a GPA> 2.0. Activities carried out by monitoring and evaluation by the Special Topic Subject Coordinator.

References: -

SPECIAL TOPIC 4
ENME601107
4 credits
Learning Outcome(s):

Students gain insight and experience of activities in national / international competitions, or community, or entrepreneurship, or industry and the work experiences.

Topic:

Special topics in fields that have not been covered in other subjects.

Pre-requisite(s): Have undergone at least 2 semesters of lectures, or have obtained a minimum of 36 credits with a GPA> 2.0. Activities carried out by monitoring and evaluation by the Special Topic Subject Coordinator.

References: -

EXPERIMENTAL DESIGN
ENME802003
4 credits
Learning Outcome(s):

This course provides knowledge about the methods of planning, implementing and reporting research in the field of engineering so that it is able to apply standard scientific principles in the preparation of the final project in particular as well as in a scientific work that results from research in general. Through this subject, students are expected to be able to manage a study that starts from the planning stage, correctly applies the design and construction procedures of the apparatus, and applies instrumentation and measurement systems, executes and analyzes and interprets the data with appropriate statistical rules. In addition, students are also expected to be able to write scientific texts with good techniques, be able to make a bibliography correctly, find the right reference sources.

Topic:

Introduction: Introduction to Research Design; Approaches to Solving Problems (Problem Solving Approaches); Research Project Planning; Design and Application of Measurement Systems: Measuring System Functional Elements, Measurement System Performance Characteristics, System Accuracy (Uncertainty) Analysis; Design and Construction of Research Apparatus; Experimental Planning; Experiment Execution: Apparatus construction, Debugging apparatus, Datasheet and Logbooks; Data Analysis and Interpretation; Communication Engineering: Principles of Communication of Raw Engineering, Reports, Papers, and Research Results Articles. Introduction to Academic Writing; Rhetoric Analysis on Scientific Manuscripts, Critical Behavior and Arguments on Academic Writing, Techniques for Writing Scientific Manuscripts, Writing Scientific Manuscripts, Peer Review and Revision of Scientific Manuscripts, Finding Sources of Scientific References, Synthesis of Scientific Manuscripts, Delivering papers as a result of learning this course.

Pre-requisite(s): -

References:

1. Montgomery, D.C., Design and Analysis of Experiments, (5th ed.), John Wiley and Sons,

Inc., New York, 2001

2. Coleman, H.W., Steele, G.W.Jr., Experimentation and Uncertainty Analysis for Engineers, (2nd ed.), John Wiley and Sons, Inc., New York, 1999

3. Doebelin, E.O., Engineering Experimentation: Planning, Execution, Reporting, McGraw-Hill, Inc., New York, 1995

4. Kirkup, Les., Experimental Method: An Introduction to the Analysis and Presentation of Data, John Wiley and Sons Australia, Ltd., Queensland, 1994

5. Lipson, C, Sheth, N.J., Statistical Design and Analysis of Engineering Experiments, Mc-Graw Hill Kogakusha, Ltd., Tokyo, 1973

6. Ross, V. A Brief Guide to Critical Writing. Philadelphia, PA : Critical Writing Program. 2015.

7. Graff, G., Birkenstein, C. As He Himself Puts It : The Art of Quoting "They Say / I Say" : The Moves That Matter in Academic Writing. New York. 2006

8. Rheingold, H. Net Smart : How To Thrive Online. Cambridge, Mass : MIT Press. 2012.

DATA ANALYTICS

ENME802006
2 credits
Learning Outcome(s):

Know how to identify, collect, and test multivariate data before conducting analysis. Can distinguish statistical analysis techniques available and determine which is most suitable for a particular purpose. Use appropriate techniques in analyzing data and in obtaining statistical summary results to help make management decisions. Verifying the results of the analysis with assumptions that will be considered in the analysis. Apply a variety of techniques to real data sequences using computer applications (eg MS Excel, Origin, Matlab, Tableau) and present the results in appropriate reports that are easily understood by non-statists.

Topic:

Review statistics and probabilities, Factor and Component Design experiments, multiple samples and estimates, Analysis of variance, models and diagnoses, Stepwise and Discriminant Regression, Canonical and Conjoining Analysis, and Non-parametric Statistics.

Pre-requisite(s): -

References:

1. A Modern Introduction to Probability and Statistics: Understanding Why and How by Dekking, Kraaikamp, Lopuhaa, and Meester.

2. Montgomery, D. C., & Runger, G. C. (2010). Applied statistics and probability for engineers. John Wiley & Sons.

3. Härdle, W., A. Werwatz, M. Müller, and S. Sperlich (2004). Nonparametric and Semiparametric Models. Springer.

4. Cox, T. F. (2005). An introduction to multivariate data analysis. London: Hodder Arnold.

5. Hair, Black, Babin, Anderson, and Tatham. Multivariate Data Analysis, 6th Edition. Prentice Hall.

MARITIME ENGINEERING AND MANAGEMENT

ENME802181
4 credits
Learning Outcome(s):

This course provides knowledge about technologies for ocean transportation and the application of ocean-based energy sources. This course also aims to equip students with understanding of maritime opportunities that can be developed with the use of technology.

Topic:

Classification of ship based on its function, aspects to consider in ship designing, history of development of off-shore structure, ocean environment, typesof off-shore structure: fixed design and floating design, mooring and anchoring system, force calculation of off-shore structure, FPSO

Pre-requisite(s): -

References:

1. Research Council National Research Council, NEW Mining in the Outer Continental Shelf and in the Deep Ocean, University Press of the Pacific, 2005

2. Arthur H. Johnson, Michael D. Max, William P. Dillon, Natural Gas Hydrate - Arctic Ocean Deepwater Resource Potential, Springer, 2013

3. Khaligh, Alireza and Onar, Omer C., Energy Harvesting: Solar, Wind, and Ocean Energy Conversion Systems, CRC Pr I Llc, 2009

OCEAN ENERGY

ENME803182
4 credits
Learning Outcome(s):

This course provides knowledge about technologies and principles related to the design of renewable ocean energy system

Topic:

Introduction to renewable ocean energy, introduction to wind turbine, tidal system and tidal energy system, OTEC, ocean flows, methods of economic/financial assessment for off-shore renewable energy system, wind energy, momentum theory and the limit of wind power output, tidal flow and its conversion to mechanical energy, description of wave energy sources, instruments of wave energy and instruments for simulation.

Pre-requisite(s): -

References:

1. Twidell, J. and Weir, T., "Renewable Energy Resources. Second Edition", Taylor and Francis Group, 2006.
2. Boyle, G., "Renewable energy power for a sustainable future, Second Edition", Oxford University Press, 2005.
3. Walker J and Jenkins N, "Wind Energy Technology", Wiley Unesco Energy Engineering Series, 1997.
4. Manwell JF, McGowan, JG and Rogers, AL., "Wind Energy explained: Theory, Design and Application", Wiley. 2nd Edition. ISBN0-470-01500-4, 2010
5. Cruz, J., "Ocean Wave Energy: Current Status and Future Perspectives", Springer-Berlin, 2007.
6. Falnes, J., "Ocean Waves and Oscillating Systems: Linear Interactions Including Wave-Energy Extraction", Cambridge University Press, Cambridge, 2002.
7. Baker AC, "Tidal Power", Peter Peregrinus Ltd, 1981.

Bahan Kajian on Naval Architecture And Marine Engineering

Bahan Kajian	Code	Subjects	Credits
Ship Design	ENME803183	Offshore Building	4
	ENME804186	Special Ship	4
	ENME804187	Ship Production Optimization	4
	ENME804190	Advanced Welding Engineering	4
	ENME804189	Marine Safety	4
Ship System	ENME804193	Cargo Cooling Technology	4
	ENMR607022	Ship Air Conditioning and Refrigeration	4
Sea Transportation System	ENME804192	Supply Chain Technology	4
	ENME804191	Port Operational and Planning	4
	ENME803185	Marine Law and Regulation	4

Minor in Naval Architecture and Marine Engineering
Pre-requisite: Mathematics, Physics, Engineering Drawing

Odd Semester			Even Semester		
Code	**Subjects**	**Credits**	**Code**	**Subjects**	**Credits**
Mandatory Subjects, 24 SKS					
ENMR601001	Introduction of Naval Architecture and Marine Engineering	2	ENMR602002	Ship Visualization and Modelling	2
ENMR603004	Ship Building Theory	2	ENMR604009	Ship Resistance and Propulsion	4
ENMR605013	Ship Manufacturing Process	2	ENMR604008	Ship Stucture 2	2
ENMR603005	Ship Stucture 1	2	ENMR604007	Ship Engine	2
ENMR606018	Auxiliary Ship Engine	2	ENMR604010	Ship Hidrodynamics	2
			ENMR607023	Ship Survey and Inspection	2
	Subtotal	10		**Subtotal**	14
Elective (Ship Design and Construction)					
ENME803183	Offshore Building	4	ENME804187	Ship Production Optimization	4
			ENME804186	Special Ship	4
Elective (Ship System)					
ENME804193	Cargo Cooling Technology	4	ENMR607022	Ship Air Conditioning and Refrigeration	4
			ENME803182	Ocean Energy	4
Elective (Ship Transportation)					
ENME803185	Marine Law and Regulation	4	ENME804191	Port Operational and Planning	4
ENME804192	Supply Chain Technology	4			

CHAPTER 5

MASTER PROGRAM

Master Program in Mechanical Engineering

Program Specification

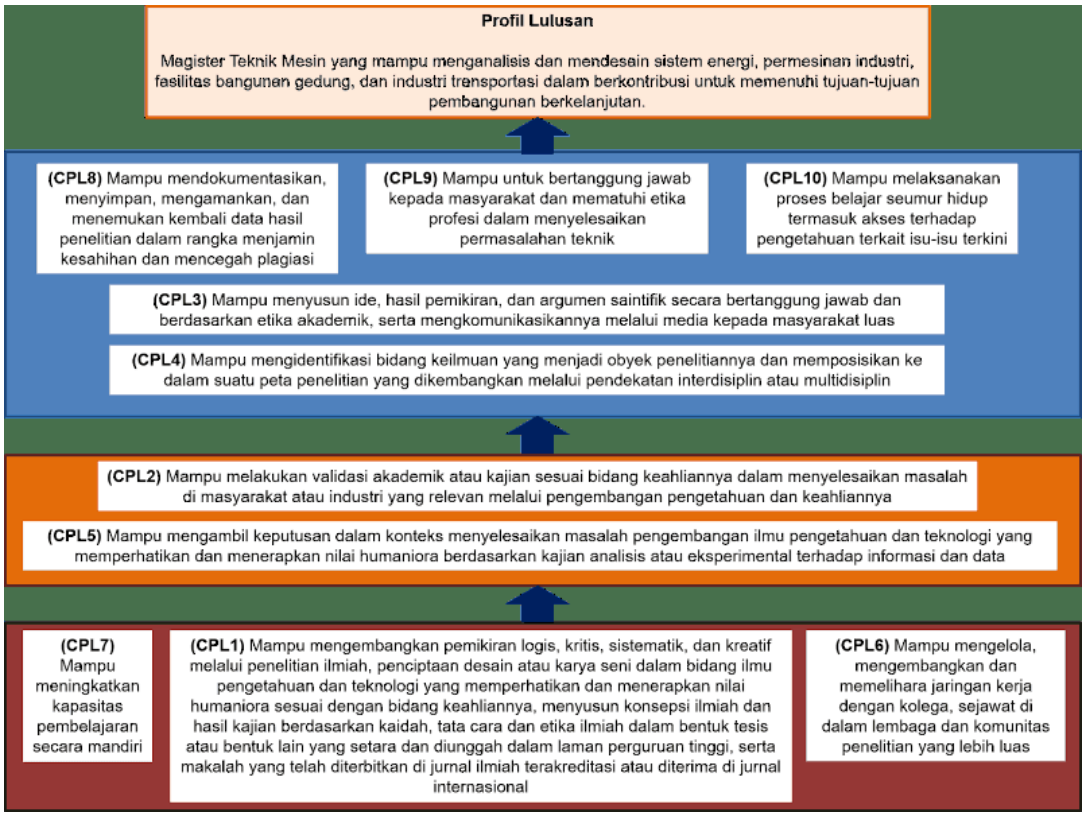
1.	**Awarding Institution**	Universitas Indonesia	
2.	**Organizer Institution**	Universitas Indonesia	
3.	**Faculty**	Engineering	
4.	**Study Programme**	Mechanical Engineering Masters Program	
5.	**Visi dan Misi Prodi**	VISI As a center of research and education services that excel in mechanical engineering MISI Carry out research and research-based education for the development of science and technology in the field of mechanical engineering, and conduct research and education that seeks its use to improve the level and quality of people's lives and humanity.	
6.	**Classes**	Reguler, Research	
7.	**Final Award**	Magister Teknik (MT.)	
8.	**Accreditation / Recognition**	Accreditation of BAN-PT, with status A.	
9.	**Languages**	Bahasa Indonesia and English	
10.	**Study Scheme (Full Time / Part-Time)**	Full Time	
11.	**Entrance Requirements**	Bachelor in Engineering, Mathematics and Physics; and pass the entrance exam	
12.	**Duration of Study**	Designed for 2 years	
	Type of Semester	Number of semester	Number of weeks/semesters
	Reguler	4	17
	Short (opsional)	**1**	**8**
13.	**Aims of the programme:** 1. Producing Mechanical Engineering Masters Program graduates who meet the specified learning outcomes 2. Contribute to the development of scientific and mechanical technology 3. Contribute to improving the quality of society and industry		
14.	**Profile of Graduates:** Masters of Mechanical Engineering who is able to analyze and design energy systems, industrial machinery, building facilities, and the transportation industry in contributing to meeting the goals of sustainable development.		

15.	**Expected Learning Outcomes (ELO) :** 4. Able to develop logical, critical, systematic and creative thinking through scientific research, the creation of designs or works of art in the fields of science and technology that pay attention to and apply humanities in accordance with their fields of expertise, compile scientific conceptions and study results based on rules, procedures and scientific ethics in the form of a thesis or other equivalent form and uploaded on the university website, as well as papers that have been published in accredited scientific journals or accepted in international journals 5. Able to carry out academic validation or study according to their area of expertise in solving problems in the relevant society or industry through developing their knowledge and expertise 6. Able to arrange ideas, results of thought, and scientific arguments responsibly and based on academic ethics, and communicate them through the media to the wider community 7. Able to identify scientific fields that are the object of research and position them into a research map that is developed through an interdisciplinary or multidisciplinary approach 8. Able to take decisions in the context of solving problems in developing science and technology that pay attention to and apply humanities values based on analytical or experimental studies of information and data 9. Able to manage, develop and maintain a network of colleagues, colleagues within the wider research institute and community 10. Able to increase the learning capacity independently 11. Able to document, store, secure, and rediscover research data in order to ensure validity and prevent plagiarism 12. Able to be responsible to the community and to comply with professional ethics in solving technical problems 13. Able to carry out a lifelong learning process including access to knowledge related to current issues

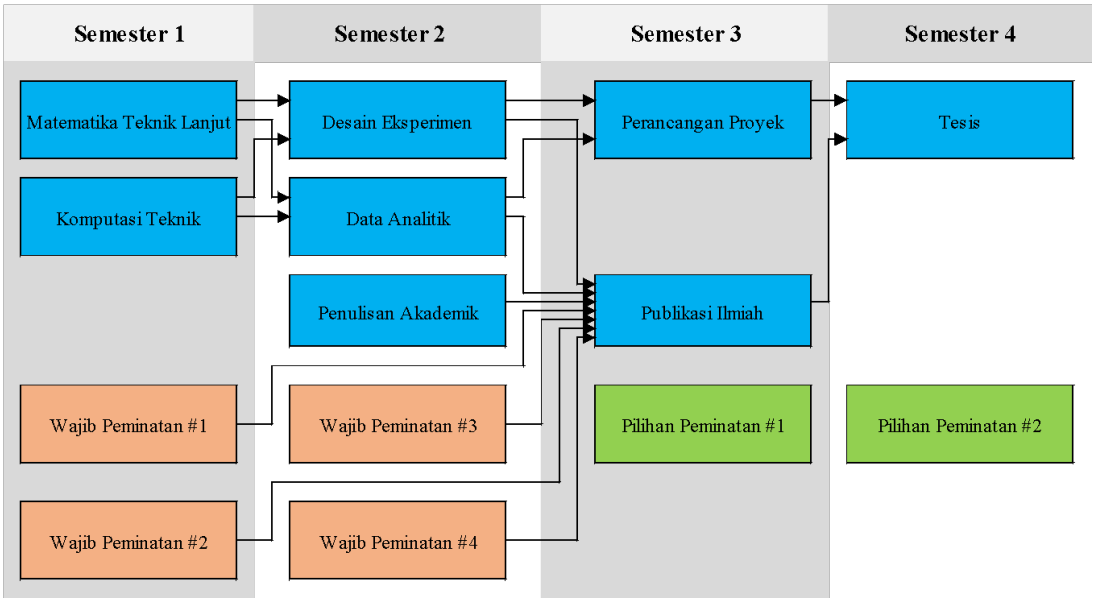
	As a University of Indonesia student, every graduate of the Mechanical Engineering Masters program also has the following competencies: 1. Able to use information communication technology; 2. Able to think critically, creatively, and innovatively and have an intellectual curiosity to solve problems at the individual and group level; 3. Able to use spoken and written languages in Indonesian and English well for academic and non-academic activities; 4. Having integrity and being able to respect others; 5. Able to identify various entrepreneurial efforts characterized by innovation and independence based on ethics In the Mechanical Engineering Masters Program 2020 Curriculum, there are 6 (six) Specialization programs that can be selected by students according to their academic abilities and interests, namely in the Specialization field: 1. Energy Conversion and Conservation 2. Fire and Building Safety Technology 3. Design and Manufacturing 4. Manufacturing and Automation Systems 5. Advanced Vehicle Engineering 6. Maritime Technology and Resources 7. More specifically, in addition to the 10 items of competency as mentioned above, the graduates of the Master of Engineering Program will have competencies in accordance with their fields of specialization as follows: 1. Competence in the field of Energy Conversion and Conservation: Able to analyze, implement and design mechanical systems that utilize laws and current phenomena and technologies related to the field of Energy Conversion and conservation. 2. Competence in the field of Fire and Building Safety Technology: able to analyze, implement and design efficient building utility systems, and performance-based fire safety for buildings and industrial buildings. 3. Competence in the field of Design and Manufacturing: able to analyze, implement and design products and manufacturing processes and their assembly by integrating the latest design and manufacturing technology. 4. Competence in the field of Manufacturing and Automation Systems: able to analyze, implement and design manufacturing and automation systems used for the process of developing and manufacturing manufactured products by utilizing the latest manufacturing and automation technology. 5. Competence in the field of Advanced Vehicle Engineering: able to analyze, and design vehicle systems and heavy equipment for transportation, the construction industry, minerals and energy. 6. Competence in the field of Technology and Maritime Resources: able to analyze, and design systems and apply maritime technology that is appropriate for sustainable utilization of maritime resources.
16.	**Composition of Subjects**

No.	Classification	Credit Hours (SKS)	Percentage
i	**Study Program Mandatory Subjects**	**10**	**25,00**
ii	**Specialization Mandatory Subjects**	**16**	**40,00**
iii	**Elective Specialization Subjects**	**8**	**20,00**
iv	**Publication, Final Projects**	**6**	**15,00**
	Total	**40**	**100 %**

Learning Outcomes, Mechanical Engineering Masters Program



Course Flowchart to Achieve Graduate Learning Outcomes



Capaian Pembelajaran	Tahun ke-1		Tahun ke-2	
	Semester 1	Semester 2	Semester 3	Semester 4
1. Mampu mengembangkan pemikiran logis, kritis, sistematik, dan kreatif melalui penelitian ilmiah, penciptaan desain atau karya seni dalam bidang ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora sesuai dengan bidang keahliannya, menyusun konsepsi ilmiah dan hasil kajian berdasarkan kaidah, tata cara dan etika ilmiah dalam bentuk tesis atau bentuk lain yang setara dan diunggah dalam laman perguruan tinggi, serta makalah yang telah diterbitkan di jurnal ilmiah terakreditasi atau diterima di jurnal internasional	Matematika Teknik Lanjut →	Desain Eksperimen →	Perancangan Proyek →	Tesis

Capaian Pembelajaran	Tahun ke-1		Tahun ke-2	
	Semester 1	Semester 2	Semester 3	Semester 4
2. Mampu melakukan validasi akademik atau kajian sesuai bidang keahliannya dalam menyelesaikan masalah di masyarakat atau industri yang relevan melalui pengembangan pengetahuan dan keahliannya	Matematika Teknik Lanjut Komputasi Teknik →	Data Analitik		

Capaian Pembelajaran	Tahun ke-1		Tahun ke-2	
	Semester 1	Semester 2	Semester 3	Semester 4
3. Mampu menyusun ide, hasil pemikiran, dan argumen saintifik secara bertanggung jawab dan berdasarkan etika akademik, serta mengkomunikasikannya melalui media kepada masyarakat luas	Wajib Peminatan #1 Wajib Peminatan #2	Penulisan Akademik Wajib Peminatan #3 Wajib Peminatan #4	Publikasi Ilmiah	

Capaian Pembelajaran	Tahun ke-1		Tahun ke-2	
	Semester 1	Semester 2	Semester 3	Semester 4
4. Mampu mengidentifikasi bidang keilmuan yang menjadi obyek penelitiannya dan memposisikan ke dalam suatu peta penelitian yang dikembangkan melalui pendekatan interdisiplin atau multidisiplin	Wajib Peminatan #1 Wajib Peminatan #2	Wajib Peminatan #3 Wajib Peminatan #4		

Capaian Pembelajaran	Tahun ke-1		Tahun ke-2	
	Semester 1	Semester 2	Semester 3	Semester 4
5. Mampu mengambil keputusan dalam konteks menyelesaikan masalah pengembangan ilmu pengetahuan dan teknologi yang memperhatikan dan menerapkan nilai humaniora berdasarkan kajian analisis atau eksperimental terhadap informasi dan data	Komputasi Teknik	Data Analitik		Tesis

Capaian Pembelajaran	Tahun ke-1		Tahun ke-2	
	Semester 1	Semester 2	Semester 3	Semester 4
6. Mampu mengelola, mengembangkan dan memelihara jaringan kerja dengan kolega, sejawat di dalam lembaga dan komunitas penelitian yang lebih luas		Penulisan Akademik		

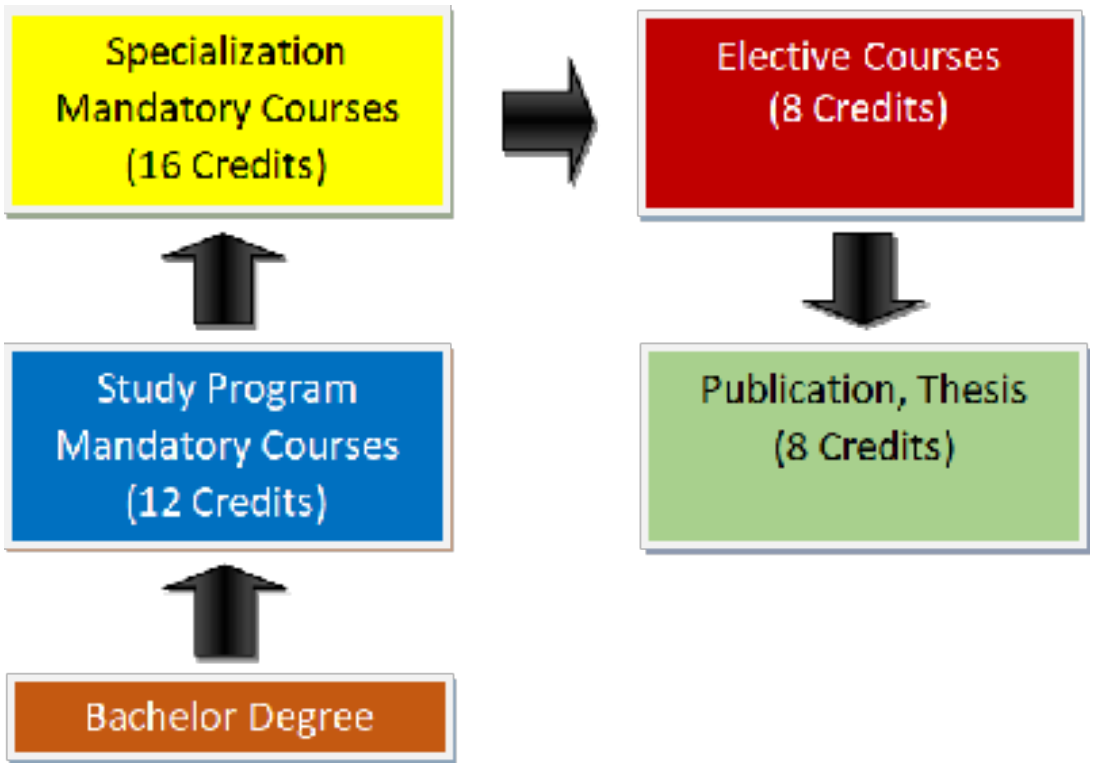
Capaian Pembelajaran	Tahun ke-1		Tahun ke-2	
	Semester 1	Semester 2	Semester 3	Semester 4
7. Mampu meningkatkan kapasitas pembelajaran secara mandiri			Pilihan Peminatan #1	Pilihan Peminatan #2

Capaian Pembelajaran	Tahun ke-1		Tahun ke-2	
	Semester 1	Semester 2	Semester 3	Semester 4
8. Mampu mendokumentasikan, menyimpan, mengamankan, dan menemukan kembali data hasil penelitian dalam rangka menjamin kesahihan dan mencegah plagiasi		Penulisan Akademik →	Publikasi Ilmiah →	Tesis

Capaian Pembelajaran	Tahun ke-1		Tahun ke-2	
	Semester 1	Semester 2	Semester 3	Semester 4
9. Mampu untuk bertanggung jawab kepada masyarakat dan mematuhi etika profesi dalam menyelesaikan permasalahan teknik			Perancangan Proyek	

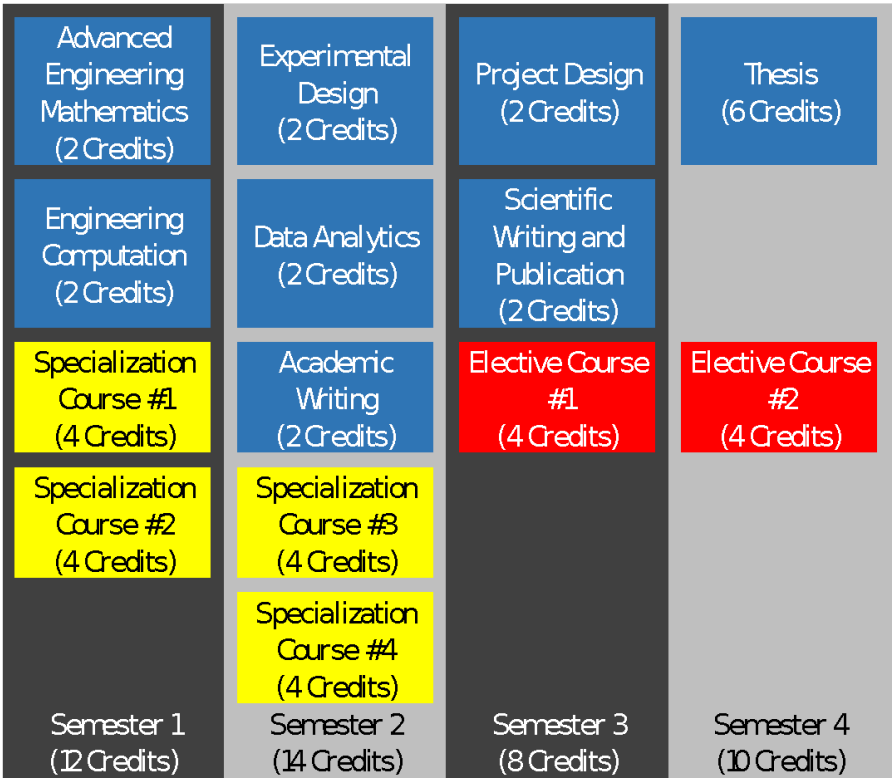
Capaian Pembelajaran	Tahun ke-1		Tahun ke-2	
	Semester 1	Semester 2	Semester 3	Semester 4
10. Mampu melaksanakan proses belajar seumur hidup termasuk akses terhadap pengetahuan terkait isu-isu terkini			Pilihan Peminatan #1	Tesis Pilihan Peminatan #2

Curriculum Structure



Subjects Flowchart

During the study period, students of the Mechanical Engineering Masters program can choose and arrange their courses flexibly according to the amount of credits in each course. The following are general scenarios for the subject flow diagram for the Mechanical Engineering Masters program:



Curriculum Structure of Mechanical Engineering Masters Program

Code	Subject	SKS
	1st Semester	
ENME801002	Advanced Engineering Mathematics	4
ENME802004	Engineering Computation	8
	Specialization Course #1	4
	Specialization Course #2	4
	Subtotal	**12**
	2nd Semester	
ENME802002	Experimental Design	2
ENME802006	Data Analytics	2
ENME802003	Academic Writing	2
	Specialization Course #3	4
	Specialization Course #4	4
	Subtotal	**14**
	3rd Semester	
ENME802007	Project Design	2
ENME800005	Scientific Publication	2
	Elective Course #1	4
	Subtotal	**8**
	4th Semester	
ENME800007	Thesis	6
	Elective Course #2	4
	Subtotal	**10**
	Total	**44**

Specialization in Energy Conversion and Conservation

Code	Subject	SKS
	1st Semester	
ENME801002	Advanced Engineering Mathematics	2
ENME802004	Engineering Computation	2
ENME801101	Advanced Thermodynamics	4
ENME801102	Advanced Fluid Dynamics and Heat Transfer	4
	Subtotal	**12**
	2nd Semester	
ENME802002	Experimental Design	2
ENME802006	Data Analytics	2
ENME802003	Academic Writing	2
ENME802103	Energy Optimization System	4
ENME803104	Thermal Power Generation	4
	Subtotal	**10**
	3rd Semester	
ENME802007	Project Design	2
ENME800005	Scientific Publication	2
	Elective Course #1	4
	Subtotal	**8**
	4th Semester	
ENME800007	Thesis	6
	Elective Course #2	4
	Subtotal	**10**
	Total	**44**

Elective Courses of Specialization in Energy Conversion and

Code	Subject	SKS
	3rd Semester	
ENME803105	Internal Combustion Engine	4
ENME803106	Applied Flow Measurement and Visualization	4
ENME803107	CFD Application	4
ENME803124	Energy Audit	4
ENME803196	Jet and Rocket Propulsion	4
	4th Semester	
ENME804109	Heat and Mass Transfer Engineering	4
ENME804110	Combustion Engineering	4
ENME804111	Aerodynamics Engineering	4
ENME803108	Refrigeration Engineering	4
ENME804112	Turbomachinery	4

Conservation

Specialization in Fire and Building

Code	Subject	SKS
	1st Semester	
ENME801002	Advanced Engineering Mathematics	2
ENME802004	Engineering Computation	2
ENME802133	Fire and Building science	4
ENME801113	Ventilation and Air Conditioning System	4
	Subtotal	**12**
	2nd Semester	
ENME802002	Experimental Design	2
ENME802006	Data Analytics	2
ENME802003	Academic Writing	2
ENME802131	Fire Protection System	4
ENME802132	Building Mechanical and Electrical System	4
	Subtotal	**14**
	3rd Semester	
ENME802007	Project Design	2
ENME800005	Scientific Publication	2
	Elective Course #1	4
	Subtotal	8
	4th Semester	
ENME800007	Thesis	6
	Elective Course #2	4
	Subtotal	**10**
	Total	**44**

Elective Courses of Specialization in Fire and Building Safety Technology

Code	Subject	SKS
	3rd Semester	
ENME803134	Fire Dynamics and Modelling	4
ENME803115	Clean Room	4
ENME803116	Plumbing and Waste Water Treatment System	4
ENME803117	Building Environment Assessment	4
ENME803135	Fire Fighting Engineering and Strategy	4
ENME803136	Fire Safety Management in Building	4
ENME802103	Energy System Optimization	4
ENME804118	Mechanical system for Building	4
ENME804119	Accoustics	4
ENME804137	Fire Investigation Engineering	4
ENME804138	Fire Safety Analysis	4
ENME804133	Forest and Land Fires	4
ENME804139	Fire Protection in Process Industry	4

Specialization in Design and Manufacturing

Code	Subject	SKS
	1st Semester	
ENME801002	Advanced Engineering Mathematics	2
ENME802004	Engineering Computation	2
ENME801140	Materials and Manufacturing Processes	4
ENME801141	Product Design and Development Methodology	4
	Subtotal	**12**
	2nd Semester	
ENME802002	Experimental Design	2
ENME802006	Data Analytics	2
ENME802003	Academic Writing	2
ENME802142	Design and Manufacturing Technology Integration	4
ENME803143	Mechanical Failure	4
	Subtotal	**14**
	3rd Semester	
ENME802007	Project Design	2
ENME800005	Scientific Publication	2
	Elective Course #1	4
	Subtotal	**8**

	4th Semester	
ENME800007	Thesis	6
ENME800008	Elective Course #2	4
	Subtotal	**10**
	Total	**44**

Elective Courses of Specialization in Design and Manufacturing

Code	Subject	SKS
	3rd Semester	
ENME803144	Dynamics of Mechanical System	4
ENME803145	Composite Product Development	4
ENME803146	Finite Element and Multi-physics	4
ENME803147	Toy Production Design	4
ENME803161	Micromachining Process	4
ENME803154	Quality and Production Management System	4
ENME803174	**Risk Management**	**4**
	4th Semester	
ENME804148	Design for Manufacturing and Assembly	4
ENME804149	Noise and Vibration Control	4
ENME804162	Laser Assisted Process	4
ENME804155	**CAD/CAM**	**4**
ENME804156	**Manufacturing Performance Assessment**	**4**

Specialization in Manufacturing and Automation Systems

Code	Subject	SKS
	1st Semester	
ENME801002	Advanced Engineering Mathematics	2
ENME802004	Engineering Computation	2
ENME801150	Management of Manufacturing Information System	4
ENME801151	Manufacturing System and Processes	4
	Subtotal	**12**
	2nd Semester	
ENME802002	Experimental Design	2
ENME802006	Data Analytics	2
ENME802003	Academic Writing	2
ENME802152	Automation and Robotics	4
ENME803153	Machine Vision System	4
	Subtotal	**14**
	3rd Semester	
ENME802007	Project Design	2
ENME800005	Scientific Publication	2
	Elective Course #1	4
	Subtotal	**8**
	4th Semester	
ENME800007	Thesis	6
	Elective Course #2	4
	Subtotal	**10**
	Total	**44**

Elective Courses of Specialization in Manufacturing and Automation Systems

Code	Subject	SKS
	3rd Semester	
ENME803154	Quality and Production Management System	4
ENME803174	Risk Management	4
ENME803144	Dynamics of Mechanical System	4
ENME803145	Composite Product Development	4
ENME803146	Finite Element and Multiphysics	4
ENME803161	Micromachining Process	4
	4th Semester	
ENME804155	CAD/CAM	4
ENME804156	Manufacturing Performance Assessment	4
ENME804148	Design for Manufacturing and Assembly	4
ENME804162	Laser Assisted Process	4

Specialization in Advanced Vehicle Engineering

Code	Subject	SKS
	1st Semester	
ENME801002	Advanced Engineering Mathematics	2
ENME802004	Engineering Computation	2
ENME801163	Vehicle Engineering and Heavy Duty Equipment	4
ENME801164	Prime Mover and Power-train System	4
	Subtotal	**12**
	2nd Semester	
ENME802002	Experimental Design	2
ENME802006	Data Analytics	2
ENME802003	Academic Writing	2
ENME802165	Vehicle Frame and Body Engineering	4
ENME803166	Vehicle Control System	4
	Subtotal	**14**
	3rd Semester	
ENME802007	Project Design	2
ENME800005	Scientific Publication	2
	Elective Course #1	4
	Subtotal	**8**
	4th Semester	
ENME800007	Thesis	6
	Elective Course #2	4
	Subtotal	**10**
	Total	**44**

Elective Courses of Specialization in Advanced Vehicle Engineering

Code	Subject	SKS
	3rd Semester	
ENME803167	Modern Vehicle Technology	4
ENME803195	Oil and Gas Drilling Equipment	4
ENME804168	Railway Vehicle Engineering	4
ENME804197	Handling and Construction Equipment	4
ENME804198	Aircraft Design and Performance	4

Elective Courses of Specialization in Advanced Vehicle Engineering

Code	Subject	SKS
	1st Semester	
ENME801002	Advanced Engineering Mathematics	2
ENME802004	Engineering Computation	2
ENME801102	Advanced Fluid Dynamics and Heat Transfer (Maritime)	4
ENME801140	Materials and Manufacturing Processes (Maritime)	4
	Subtotal	**12**
	2nd Semester	
ENME802002	Experimental Design	2
ENME802006	Data Analytics	2
ENME802003	Academic Writing	2
ENME802181	Maritime Engineering and Management	4
ENME803182	Ocean Energy	4
	Subtotal	**14**
	3rd Semester	
ENME802007	Project Design	2
ENME800005	Scientific Publication	2
	Elective Course #1	4
	Subtotal	**8**
	4th Semester	
ENME800007	Thesis	6
	Elective Course #2	4
	Subtotal	**10**
	Total	**44**

Elective Courses of Specialization in Technology and Maritime Resources

Code	Subject	SKS
	3rd Semester	
ENME803183	Marine and Offshore Structure	4
ENME803184	Sea Transport and Port Management	4
ENME803185	Maritime Law and Regulation	4
ENME804192	**Supply Chain Technology**	**4**
ENME804193	**Cold Storage Technology**	**4**
	4th Semester	
ENME804186	Special Ship	4
ENME804187	Ship Production Management	4
ENME804189	Maritime Safety	4
ENME804190	Advanced Welding Engineering	4
ENME804191	Port Operation and Planning	4

Master By Research

Code	Subject	SKS
	1st Semester	
ENEE800102	Research Proposal Examination	4
ENEE800101	Scientific Seminar	8
	2nd Semester	
ENEE800203	Proceeding Publication	4
ENEE800204	Research Result Examination	6
	3rd Semester	
ENEE800105	Journal Publication	8
	4th Semester	
ENEE800206	Master Thesis	10

Description of Courses

Advanced Engineering Mathematics
ENME801002
2 SKS
Learning Outcomes:

The purpose of this subject is to develop students' analytical skills. Students understand and are able to use advanced engineering mathematical concepts in solving applied engineering problems.

Topic:

Introduction to Differential Equations; Differential Equation Order 1; Differential Equation of Order 2; High Order Differential Equations; Vector Analysis; Differential Vector; Grad, Divergence and Curl Operations; Vector Integral; Laplace transform; Solving Differential Equations using Laplace Transform; Fourier transform; Convolution

Pre-requisite(s): -

References:

1. Chapra, Steven C. and Canale, Raymond P. Numerical Methods for Engineers 6th edition. New York: McGraw-Hill, 2010.
2. Kreyszig, Erwin. Advanced Engineering Mathematics 10th edition. Danvers: John Wiley & Sons, 2011.
3. Sedgewick R., Phillippe F, An Introduction to the Analysis of Algorithms, Addison Wesley.
4. Cheney W., Kincaid D., Numerical Mathematics and Computing, Cole Publishing

Engineering Computation
ENME802004
2 SKS
Learning Outcomes:

The purpose of this subject is that students know well and be able to apply the processes and methods (algorithms) of calculation (numerical and analytic) engineering in the real computer-based computing world and parameters that affect the speed and accuracy of the calculation results.

Syllabus :

Numerical Method: Equation roots, Numerical Differential, Numerical Integral; Partial Differential Equation Solution. Introduction to Computer Applications: Algorithms and Algorithm Analysis; Computational Complexity; Types of Algorithms; Number Optimization and Representation; Overflow and Underflow; Error and Formula Error in Numerical; Root of Eq. Finite Divided Difference Method in calculating Equation Derivation; Numerical Integration; ODE and ODE systems in Computing Applications; Fast Fourier Transform; PDE in Computational Applications: Solu-

tions of Elliptic, Parabolic, and Hyperbolic Equations with Numerical Methods; Application of Elliptic, Parabolic, and Hyperbolic PDE equation techniques; Monte Carlo in Computing Applications.

Pre-requisite(s): -

References:

1. Chapra, Steven C. and Canale, Raymond P. Numerical Methods for Engineers 6th edition. New York: McGraw-Hill, 2010.
2. Kreyszig, Erwin. Advanced Engineering Mathematics 10th edition. Danvers: John Wiley & Sons, 2011.
3. Sedgewick R., Phillippe F, An Introduction to the Analysis of Algorithms, Addison Wesley.
4. Cheney W., Kincaid D., Numerical Mathematics and Computing, Cole Publishing

Experimental Design

ENME802002
2 SKS
Learning Outcomes:

This course provides knowledge about the methods of planning, implementing and reporting research in the field of engineering so that it is able to apply standard scientific principles in the preparation of the final project in particular as well as in a scientific work that results from research in general. Through this subject, students are expected to be able to manage a study that starts from the planning stage, correctly applies the design and construction procedures of the apparatus, and applies instrumentation and measurement systems, executes and analyzes and interprets the data with appropriate statistical rules. In addition, students are also expected to be able to write scientific texts with good techniques, be able to make a bibliography correctly, find the right reference sources.

Syllabus:

Introduction: Introduction to Research Design; Approaches to Solving Problems (Problem Solving Approaches); Research Project Planning; Design and Application of Measurement Systems: Measuring System Functional Elements, Measurement System Performance Characteristics, System Accuracy (Uncertainty) Analysis; Design and Construction of Research Apparatus; Experimental Planning; Experiment Execution: Apparatus construction, Debugging apparatus, Datasheet and Logbooks; Data Analysis and Interpretation; Communication Engineering: Principles of Communication of Raw Engineering, Reports, Papers, and Research Results Articles. Introduction to Academic Writing; Rhetoric Analysis on Scientific Manuscripts, Critical Behavior and Arguments on Academic Writing, Techniques for Writing Scientific Manuscripts, Writing Scientific Manuscripts, Peer Review and Revision of Scientific Manuscripts, Finding Sources of Scientific References, Synthesis of Scientific Manuscripts, Delivering papers as a result of learning this course.

Pre-requisite(s) : -

References:

1. Montgomery, D.C., Design and Analysis of Experiments, (5th ed.), John Wiley and Sons, Inc., New York, 2001
2. Coleman, H.W., Steele, G.W.Jr., Experimentation and Uncertainty Analysis for Engineers, (2nd ed.), John Wiley and Sons, Inc., New York, 1999
3. Doebelin, E.O., Engineering Experimentation: Planning, Execution, Reporting, McGraw-Hill, Inc., New York, 1995
4. Kirkup, Les., Experimental Method: An Introduction to the Analysis and Presentation of Data, John Wiley and Sons Australia, Ltd., Queensland, 1994
5. Lipson, C, Sheth, N.J., Statistical Design and Analysis of Engineering Experiments, Mc-Graw Hill Kogakusha, Ltd., Tokyo, 1973
6. Ross, V. A Brief Guide to Critical Writing. Philadelphia, PA : Critical Writing Program. 2015.
7. Graff, G., Birkenstein, C. As He Himself Puts It : The Art of Quoting "They Say / I Say" : The Moves That Matter in Academic Writing. New York. 2006
8. Rheingold, H. Net Smart : How To Thrive Online. Cambridge, Mass : MIT Press. 2012.

Data Analytics

ENME802006
2 SKS
Learning Outcomes:

Know how to identify, collect, and test multivariate data before conducting analysis. Can distinguish statistical analysis techniques available and determine which is most suitable for a particular purpose. Use appropriate techniques in analyzing data and in obtaining statistical summary results to help make management decisions. Verifying the results of the analysis with assumptions that will be considered in the analysis. Apply a variety of techniques to real data sequences using computer applications (eg MS Excel, Origin, Matlab, Tableau) and present the results in appropriate reports that are easily understood by non-statists.

Topic:

Review statistics and probabilities, Factor and Component Design experiments, multiple samples and estimates, Analysis of variance, models and diagnoses, Stepwise and Discriminant Regression,

Canonical and Conjoining Analysis, and Non-parametric Statistics.

Pre-requisite(s): -

References:

1. A Modern Introduction to Probability and Statistics: Understanding Why and How by Dekking, Kraaikamp, Lopuhaa, and Meester.
2. Montgomery, D. C., & Runger, G. C. (2010). Applied statistics and probability for engineers. John Wiley & Sons.
3. Härdle, W., A. Werwatz, M. Müller, and S. Sperlich (2004). Nonparametric and Semiparametric Models. Springer.
4. Cox, T. F. (2005). An introduction to multivariate data analysis. London: Hodder Arnold.
5. Hair, Black, Babin, Anderson, and Tatham. Multivariate Data Analysis, 6th Edition. Prentice Hall.

Academic Writing

ENME802003
2 SKS
Learning Outcomes:

Student able to understand the basic academic writing to improve the capability of reading the scientific paper, reference and to write argumentation accurately with the proper and proficient language effectively. This course also study the critical thinking, propose the argumentation, formulate basic reasoning and how to deliver the idea with correct language. Student will study how to write the scientific paper with good technique, able to find and to make proper list of reference.

Syllabus:

Introductoin to academic writing, rhetoric analysis in scientific paper, act critically and argumentation in academic writing, academic writing techniques, draft scientific paper, peer review and scientific paper revision, find scientific resources, synthesis scientific paper, present the paper as a result from this course

Pre-requisite(s) : -

References:

1. Ross, V. *A Brief Guide to Critical Writing.* Philadelphia, PA : Critical Writing Program. 2015.
2. Graff, G., Birkenstein, C. As He Himself Puts It : *The Art of Quoting "They Say / I Say" : The Moves That Matter in Academic Writing.* New York. 2006
3. Rheingold, H. *Net Smart : How To Thrive Online*. Cambridge, Mass : MIT Press. 2012.

Project Design

ENME802007
2 SKS
Learning Outcomes:

Students are able to practice the design process of products, systems or services based on performance. Performance-based design is an approach in the design of energy systems, manufacturing systems, building systems and so on, which can be applied throughout the life cycle (life cyle) process by considering the fulfillment of physical, functional, environmental, financial, economic and psychological, social and psychological performance criteria. energy and so on. Students understand the performance-based design approach that allows the participation of stakeholders in various stages of design and development of products, services, systems or buildings. Thus it is expected to define the formulation of performance criteria that will be met by the results of the design during the service period. With the performance criteria that must be met, it is possible for alternative solutions to emerge in the design process so that the best solutions that can meet performance criteria such as cost / benefit analysis, life cycle assessment, optimization, assembly ease, compliance with safety criteria, ease of manufacture and so on. Students understand Performance Based Design to strengthen Final Project / Thesis work and scientific publications.

Topic:

Introduction to the process of thinking design, understanding problems, the process of formulating performance criteria with stakeholders, developing technical specifications for products / services, developing conceptual design, process calculations and simulations, material selection, dimensional analysis, cost and benefit analysis), life cycle assessment and optimization, manufacturing processes / construction processes, assembly, and performance testing.

Pre-requisite(s): -

References:

1. David G Ulman, the Mechanical Engineering Design Process 6th Edition, McGraw Hill, 2017.
2. Karl Ulrich and Steven Eppinger and Maria C. Yang, Product Design and Development 7th Edition, McGraw Hill, 2020.
3. Dejan Mumovic, Mat Santamouris, A Handbook of Sustainable Building Design and Engineering an Integrated Approach to Energy, Health and Operational Performance, 2nd Edition, 2018, Routledge, London
4. Brian J. Meacham (Editor), Performance-Based Building Regulatory Systems Principles and

Experiences, the Interjurisdictional Regulatory Collab oration Committee, 2010
5. Standar dan Jurnal Ilmiah terkait.

Scientific Publication
ENME800005
2 SKS
Learning Outcomes:

Students are able to develop logical, critical, systematic and creative thinking that has been carried out through scientific research and / or the creation of designs in the field of science and technology that pay attention to and apply the value of humanities in accordance with their fields of expertise, based on scientific conceptions and study results in accordance with the rules , scientific procedures and ethics written in papers published in accredited scientific journals or accepted in international journals under the guidance of one or more supervisors.

Syllabus: -

Pre-requisite(s): Experimental Design

References: International Journal

Thesis
ENME800007
6 SKS
Learning Outcomes:

Students are guided to apply the knowledge and knowledge they have previously learned to carry out the final project under the guidance of one or more supervisors. After attending this lecture, students are expected to be able to conceptualize the final project by applying existing theories. With guidance from the supervisor, students are expected to be able to design, integrate, implement, and analyze concepts and write research findings systematically and scientifically in the form of a final project book. Students are also expected to be present and defend their concepts and work in front of the examiners in the final project examination forum.

Syllabus: -

Pre-requisite(s): Has taken min 32 credits

References: Guidebook for thesis

Advanced Thermodynamics
ENME801101
4 SKS
Learning Outcomes:

Provide further understanding of the science of thermodynamics and its applications so that students are able to design and conduct a basic research mapun able to complete the analysis involves the calculation of the thermodynamic system correctly and systematically in order to find the best solution gentang effectiveness of the use of substances and energy, especially in the 'engineering design' by motto: 'Low entropy production', 'high thermal efficiency' and 'low pollution effect'.

Syllabus :

Basic Thermodynamics and Gas Dynamics, Equilibrium of Thermodynamics System, Thermodynamics properties of System, Thermodyamics of ideal gas mixture, review of chemical thermodynamics, review of chemical kinetics, conservation equation for multicomponent reaction system, pre-mixed laminar flames, method of measuring flame velocity (bunsen burner), flame quenching, flamability limit of premixed laminar flame, gaseous diffusion flame and combustion of single liquid droplet, combustion in compression ignition engine, combustion in spark ignition engine, combustion research in hydrocarbon oxygen mixture, engine research, combustion-generated emission, experimental method : preseure measurement and recording; temperature measurement and recording; combustion photography and flame speed detection; spectrographic method; chemical analysis technique (NDIR, FID, Gaschromatography).

Pre-requisite(s): -

References:
1. Holmann, J.P., Thermodynamics, Intl. Student Edition, McGraw Hill, 2005.
2. Kenneth Wark Jr. Thermodynamics, McGraw Hill, 2003.
3. Francis F. Huang, Engineering Thermodynamics, MaxWell Macmillan Intl. Edition, 2000.
4. H.D. Baehr, Termodynamik , Springer Verlag
5. K. Stephan, Termodynamik, Grundlagen und technishe Anwendung-en, Band 1, Band Springer Verlag.
6. Bejan, Adrian, Advanced Engineering Thermodynamics, Wiley – interscience, 2nd Edition, 1997

Advanced Fluid Dynamics and Heat Transfer
ENME801102
4 SKS
Learning Outcomes:

Enhance the ability of students in the study of fluid mechanics in more detail so as to conduct research or the application of science in industrial applications. Studying the mechanism of heat transfer in a control volume due to the existence of the temperature difference and concentration as well as the involvement of one, two or three phases at the time simultaneously.

Syllabus :

Viscous flow of Newtonian fluid, membrane boundary flow, Non-Newtonian Fluid Flow, Two- Multi Phase Flow, Particle Displacement Flow, Porous Media and Fluidized Beds, Turbulent Flow and Mixing, Jet, Chimney, Energy and Momentum Equatio, one-two-three dimension conduction heat transfer, heat transfer on extended surface.

Pre-requisite(s): -

References:

1. Frank P Incropere, David P De Witt, Fundamental heat and mass transfer, 5th Ed., John Wiley & Sons, 1996, New York
2. Holman JP, Heat Transfer, 9th, Mc Graw Hill, 2003.
3. Koestoer, RA, Perpindahan Kalor untuk Mahasiswa Teknik, Salemba Teknika, 2003.
4. Welty R James, Wicks Charless, Wilson Robert, Fundamentals of Momentum, Heat, and Mass Transfer, 3rd Ed. John Wiley & Sons, 1996, New York
5. Cengel, Yunus, Heat Transfer a Practical Approach, 2nd Ed. Mc Graw Hill, 2003, Singapore.
6. Kreith Frank, Bohn Mark, Principles of Heat Transfer, 6th Ed. Brooks/cole, 2001, USA
7. Abbott I R, Theory of Wing Section, Dover Publications.
8. Bird R B, Transport Phenomena, John Wiley & Sons.

Energy System Optimization

ENME802103
4 SKS
Learning Outcomes:

This course provides an understanding of mathematical modeling, simulation and optimization of energy systems through technical and economical approach. The course is intended to equip student with the ability to understand mathematical model, simulation and optimization of thermal systems.

Syllabus:

Workable System Design; Economical Evaluation; Determination of Mathematical Equations; Thermal Equipment Modeling; System Simulation; System Optimization: Objective Function, Constraints; Lagrange Multipliers: Lagrange multiplier to complete the optimiza- tion process; Dynamics, Geometric and Linear Programming; Mathematical Model of Thermodynamics Properties; Big System Simulation under Steady Condition; Big Thermal System Simulation; Calculation of Variables in Optimum Conditions.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanics

References:

1. Stoecker, W.F. Design of Thermal System, 3rd Edition, Mc.Graw Hill Book Co, 2011.
2. Boehm,R.F., Design of Analysis of Thermal System, John Wiley&Sons,1987.
3. Yogesh Jaluria, Design and Optimization of Thermal Systems, 2nd Edition, Mc.Graw Hill Book Co, 2007.

Thermal Power Generation

ENME803104
4 SKS
Learning Outcomes:

The course objective is to provide an understanding of the basic principles of power generation, and basic competency in the design and development of power generation systems.

Syllabus:

Industrial Power Plant and Steam System: Boiler, Steam Turbine, Gas Turbine; Cogeneration Engineering, Instrumentation and Main Tools; Performance and Reliability Factors; Economical Aspects, Environmental Aspects: Settings and Prevention.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanics

References:

1. Tyler G. Hicks, Power Plant Evaluation and Design Reference Guide, McGraw Hill, 1986.
2. Sill and Zoner, Steam Turbine Generator Process Control and Diagnostics, Wiley Higher Ed., 1996.
3. Saranavamuttoo et.al, Gas Turbine Theory, 6th Edition, Prentice Hall, 2008.
4. Black and Veath-Power plant engineering , Philips Keameh–Power generation handbook
5. Steam Generators by Babcock Willcock
6. Borman, G.L., and Ragland, K.W., Combustion Engineering, 2nd Edition, McGraw-Hill, Inc. 2011.

Internal Combustion Engine

ENME803105
4 SKS
Learning Outcomes:

Student is expected to have competency and expertise in the field of his interest of internal combustion engine working principle and theory and is able to design and do construction calculation.

Syllabus:

Actual Cycle of Internal Combustion Engine; Fuel System; Ignition and Combustion in Spark Ignition Engine and Compressed Ignition Engine; Some Basic Characteristics and Calculations; Basic Engine

Design; Determination of Engine's Main Components; Kinematics and Dynamics Analysis of the Motion; Calculation and Planning of Lubrication and Cooling System.

Pre-requisite(s): Basic Thermodynamics

References:

1. Guzela L, Onder, C., Introduction to Modelling and Control of Internal Combustion Engines, 2nd Edition, Springer, 2014
2. Heywood, J., Internal Combustion Engines Fundamental, McGraw Hill, 2011
3. Taylor, C.F., Internal Combustion Engines, in Theory and Practice, M.I.T Press, England, 1985.
4. Khovakh, M., Motor Vehicle Engines, MIR Publisher, Moscow, 1971.

Applied Flow Measurement and Visualization

ENME803106
4 SKS
Learning Outcomes:

Applied flow diagnostic study measurement and visualization techniques which have wide application both in industry and laboratory. The course give basic competency for the student to be bale to understand various measurement and visualization methods and to design appropriate flow diagnostic system in process installation in industry or experimental set up in a scientific research activities which related to fluid flow.

Syllabus :

Statistics Diagnostic Flow, Calibration in Flow Measurement; Momentum Sensing Meter (orifice plate, venturi, nozzle meters); Positive Displacement Flow Meter (Nutating Disc, Sliding Vane, Gear meters, etc.); Electromagnetic and Ultrasonic Flow Meters; Compressible Flow Meter (Wet Gas and Wind Anemometer); Principles Local Velocity Measurement in Liquid and Gases; Hot Wire Anemometry; Based Laser Velocimetry (LDV, PIV); Principles of Flow Visualization, Flow Visualization conventional; Shadowgraphs and Schliern Technique; Interferometry Technique; Light Sheet Based Technique ; Image Processing and Computer Assisted Method.

Pre-requisite(s): Basic Fluid Mechanics

References:

1. Yang ,W.J, Handbook of Flow Visualization, Taylor and Francis. 2001
2. Baker, R.C., Flow Measurement Handbook: Industrial Designs, Operating Principles, Performance and Applications, Cambridge University Press, 2005

CFD Applications

ENME803107
4 SKS
Learning Outcomes:

Understanding the basic principles of CFD and having the basic knowledge in applying CFD (Computational Fluid Dynamic)

Syllabus:

Prediction-rule Principles, Numerical Solutions: Advantages and Disadvantages; Mathematical Description of Physical Phenomena; Basic Nature of Coordinates; Discretization Method; Volume-set Application on Heat Conduction Problem; Convection and Diffusion; Two-Dimension Discretization Equations; Three-Dimension Discretization Method; Special Procedure Needs; Some of Constraints Associated with the Representation of Pressure-gradient Factors, Continuity Equations Representation; Stayered Grid; SIMPLE Algorithm; Revision of SIMPLER algorithm; Final Solutions: Basic Properties of Iterative Numerical Procedures; Sourceterm Linearization, Irregular Geometries, Preparation and Testing a Computer Programs.

Pre-requisite(s): Basic Fluid Mechanics, Engineering Programming

References:

1. Suhas V. Patankar, 1980, Numerical Heat Transfer and Fluid Flow, McGraw Hill.
2. C.A.J. Fletcher, 1996, Computational Techniques for Fluid Dynamics, 2nd edition, Springer Verlag
3. A.D. Gosman et al., 1985, COMPUTER AIDED ENGINEERING Heat Transfer dan Fluid Flow, John Wiley & Sons.

Energy Audit

ENME803124
4 SKS
Learning Outcomes:

This course focuses on the theory, techniques and practices of analyzing energy aspects of building operations and correlating a building envelope's interaction with the mechanical systems. Students will perform a detailed energy audit of a state-of-the-art commercial building design using energy modeling simulation software and develop energy conservation strategies, such as thermal stor- age, that can be applied to heating, cooling, and ventilating equipment to reduce utility bills. Students will apply supporting analytical data to develop operations and maintenance changes designed to improve energy efficiency and reduce operating cost.

Syllabus:

Energy Auditing Basics, Energy Accounting and Anal-

ysis, Understanding the Utility Bill, Energy Economics, Survey Instrumentation, The Building Envelope Audit, The Electrical System Audit, The Heating, Ventilating and Air-Conditioning Audit, Upgrading HVAC Systems for Energy Efficiency Verification of System Performance, Maintenance and Energy Audits, Self-Evaluation Checklists, World-class Energy Assessmeents, and Water Conservation.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanics

References:

1. Albert Thumann, William J. Younger, Terry Niehus, Handbook of Energy Audits, Eighth Edition, The Fairmont Press, 2010.
2. Moncef Krarti, Energy Audit of Building Systems: An Engineering Approach, Second Edition, CRC Press, Taylor & Francis Group, 2010.

Jet Propulsion and Rocket

ENME803196
4 SKS
Learning Outcomes:

Students understand the concept of thrust/propulsion related to the resistance to motion of aircraft or flying vehicles. (thrust required); understand the concepts and workings of gas turbine and rocket engines; understand the characteristics of the propulsion system of propellers (turboprop), turbofans, and jets (including rockets) on the performance of aircraft or other flying vehicles.

Syllabus :

The concept of the propulsion system which is influenced by the aerodynamic design of the aircraft (aircraft resistance and the 4 main forces of lift, weight, thrust and drag); How gas turbine and rocket engines work; Thrust characteristics of various types of aircraft propulsion systems, namely, propeller (turboprop), jet and turbofan.

References:

1. J. D. Anderson, Aircraft Performance and Design, McGraw-Hill.
2. Anthony Giampaolo, Gas Turbine Handbook: Principles and Practices, The Fairmont Press.
3. D. P. Mishra, Fundamentals of Rocket Propulsion, CRC Press.
4. Rolls Royce, The Jet Engine, Rolls Royce PLC.

Heat and Mass Transfer Engineering

ENME804109
4 SKS
Learning Outcomes:

The course objective is to provide understanding of the heat exchangers used in many industrial processes and power plants as the application of heat transfer. This course provides a basic competency to know main heat exchanger types and to understand and able to select suitable heat exchanger type for current applications. Student is also expected to understand basic factors in designing heat exchangers, to estimate size and price and know and choose the type of heat exchanger. Provide basic understanding and various parameters on the drying process so that students can perform calculations and analysis of various drying techniques and their applications. This course also provides the expertise so that students are able to do drying modeling, to design and analyze the system for various materials (solid and solvent) so that the drying process can be suitably selected for particular product.

Syllabus:

Heat Transfer Review; Type and Application of Heat Exchangers; Practgical Design of Shell and Tube Heat Exchanger (Thermal and Mechanical); Manufacturing Cost Estimation; Heat Exchangers; Operation and Monitoring of Heat Exchangers (Fouling And Vibration); Maintenance of Heat Exchangers; Corrossion on Heat Eschangers; Heat Exchanger Design Software; Presentation and Laboratory Practice of Heat Exchangers. Review Transfer Phenomena (Momentum, Heat and Mass); Drying Principles and Basics; Mathematical Modeling of Drying System; Classification and Selection of Dryer, Post-Harvest Drying and Storage of Grain; Rotary Drying; Vacuum Drying; Fluidized Bed and Spouted Bed Drying; Drum Dryer; Spray Drying, Freeze Drying; Conveyor Drying; Solar Drying; Enrgy Optimization in Drying System; Drying System Design.

Pre-requisite(s): Heat and Mass Transfer, Basic Fluid Mechanics

References:

1. Frank P Incropere, David P De Witt, Fundamental heat and mass transfer, 7th Ed.,John Wiley & Sons, 2011, New York
2. Holman JP, Heat Transfer, 10th, Mc Graw Hill,2009.
3. Smith Eric, Thermal Design of Heat Exchanger, John Wiley & Sons, 1996, New York
4. Welty R James, Wicks Charless, Wilson Robert, Fundamentals of Momentum, Heat, and Mass Transfer, 6th Ed. John Wiley & Sons, 2014, New York.

5. Cengel, Yunus, Heat Transfer a Practical Approach, 2nd Ed. Mc Graw Hill, 2003,Singapore.
6. Kreith Frank, Bohn Mark, Principles of Heat Transfer, 7th Ed. Brooks/cole, 2010, USA
7. Rohsenow Warren, Hartnett James, Cho Young, Handbooks of Heat Transfer, 3rd Ed., Mc Graw Hill, 1998, New York.

Combustion Engineering

ENME804110
4 SKS
Learning Outcomes:

Combustion Engineering provide basic competency to investigate, analyze and learn about the process of combustion of fuel, and the nature and behavior of flame. The course provides basic understanding to apply the laws of basic aerothermochemistry in the engineering calculation of practical combustion engineering. The student is expected to be able to analyze the combustion behavior of a flame and to develop knowledge in the field of combustion engineering.

Syllabus:

Important Meaning of Combustion Study; Basic Reaction and Stoikhiometry of Combustion; Gas Fuel (BBG); Liquid Fuel, Solid Fuel; Basic Thermochemistry and Fluid Dynamics of Combustion; Principles of Conservation of Mass and Continuity; Turbulence Premixed Flame Structure; Detonation; Combustion Technology; Fixed-Bed Combustion, Suspension, Fluidized- Bed; Study on Flame and Combustion Technology; Minimum Temperature Self-ignition (Auto/ Self-Ignition); Flammability Limit; Fire spread, Fire Suppression Material, Combustion and the environment.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanic

Pre-requisite(s): -

References:

1. Turn, S.R., An Introduction to Combustion, 3rd Edition, McGraw-Hill, Inc. 2011
2. Borman, G.L., and Ragland, K.W., Combustion Engineering, 2nd Edition, McGraw-Hill, Inc. 2011.
3. Griffi ths, J.F., and Barnard, J.A., Flame and Combustion, 3rd Edition, Blackie Academic and Professional, 1995.
4. Glassman, I., Combustion, 5th Edition, Academic Press, 2014.
5. Warnatz, J., Maas, U., and Dibble R.W., Combustion, 2nd Edition, Springer-Verlag, 1998.

Aerodynamics Engineering

ENME804111
4 SKS
Learning Outcomes:

Aerodynamic Engineering is an advanced course of Fluid Mechanics which focusing on aeronautics applications. Through the course students is expected to be able to understand the fundamental principles and basic equations of aerodynamics and to apply them in the process of airfoil design and to understand performance characteristics of the airfoil. Student is able to understand the phenomenon of incompressible flow through the airfoil and finite wings. Student is expected to be able to have an understanding of subsonic and supersonic compressible flow phenomena through aerofoil and other compressible flow phenomena.

Syllabus:

Introduction on Aerodynamics; Basic and Principle Equations; Incompressible flow; Airfoil Aerodynamics Characteristics; Finite Wings; Incompressible Flow through Airfoil; Incompressible Flow through Finite Wings; Airfoil in Compressible Flow; Wings and Wings-Body Combination in Compressible Flow; Airfoil Design; Double Surface; Vortex Lift; Secondary Flow and Viscous Effect; Other Phenomena in Compressible Flow; Normal Shock Wave; Oblique Shock Wave; Expansion Wave; Supersonic Wave.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanics

References:

1. A.M. Kuethe and C.Y. Chow, Foundations of Aerodynamics, 5th Edition, John Wiley & Sons, Inc., 2009.
2. B.W. McCormick, Aerodynamics, Aeronautics, and Flight Mechanics, 6th Edition, John Wiley & Sons,Inc., 2010.
3. J Anderson, Fundamentals of Aerodynamics, 5th Edition, McGraw Hill, 2011.

Refrigeration Engineering

ENME803108
4 SKS
Learning Outcomes:

Refrigeration engineering course provides basic competency for the student to be able to do the simulation software to design a cooling system and equipments involved with a very close relationship with the Industrial and engineering users. Hence student will have understanding in design and development of cooling system and ability to evaluate and analyze its performance, especially on cold storage.

Syllabus:

Principles of Refrigeration and Heat Pump, Terminology and Units; Mechanical Vapor Compression Refrigeration Engine; Heat Trasnfer in Refrigeration System; ph Diagram Calculation in Refrigeration Cycle; Refrigeran, Lubricant, Salt and the Environment; Compressors; Condenser and Evaporator; Refrigeration Piping System and Equipments; Automatic Control System and Safety Equipments; Air Properties; Psychrometric and its process; Absorption Refrigeration; Alternative refrigeration Cycles (adsorption, gas compression, and ejector); Display Case, Prefabricated Cold Storage and Cold Storage, Cold Room Calculations.

Pre-requisite(s): Basic Thermodynamics

References:

1. ASHRAE Handbook of Fundamental, ASHRAE Atlanta, 1995.
2. Kuehn, Ramsey and Therkeld, Thermal Environmental Engineering, 3rd Edition, Prentice Hall, 1998.
3. Threkeld,JL., Thermal Environmental Engineering, Prentice Hall.
4. ASHRAE Handbook of Fundamental, ASHRAE Atlanta, 2001
5. ASHRAE Handbook of Refrigeration, ASHRAE, Atlanta, 2002.

Turbomachinery

ENME804112
4 SKS
Learning Outcomes:

Students understand the different types of construction of gas and steam turbines, and their characteristics and performance, including support equipment.

Syllabus :

Characteristics and types of steam and gas turbines to the generated power output, the calculation of its performance, power improvement, condenser performance, combined cycle plant, system vibrations in turbine construction.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanics

References: Thermische Stroomung Machine by Traupel

FIRE AND BUILDING SCIENCE

ENME802133
4 SKS
Learning Outcomes:

Students understand the basic and important parameters in the process of fire (fire), the phenomenon of fire dynamics and fire hazards. Students will also learn the science of fire both for indoors and outdoors. To strengthen understanding of fire science in buildings, students will also study building science, which relates to building requirements, which include safety, health, comfort, and ease of access for normal operating conditions and fire emergencies. The basic phenomenon of fires in nature that propagates to buildings or vice versa (wildland-urban interface or WUI fires) will also be studied in this lecture.

Syllabus :

Basic laws of aerothermochemistry such as combustion thermodynamics, fluid mechanics, heat transfer, combustion chemical reactions, rate of heat release, calculation of fire dynamics, flame and flame propagation indoors and outdoors. Building sciences relating to the fulfillment of safety, health, comfort, and ease of access requirements both under normal operating conditions and fire emergencies. This lecture course is also equipped with experimental activities in the laboratory to understand ignition behavior, premixed and non-premixed flame phenomena, combustion of solids and liquids, plumes formation, smoke production, flame and flame propagation, and fire dynamics in the room to represent fire conditions building.

Pre-requisite(s): -

References:

1. Drysdale, D., An Introduction to Fire Dynamics, John Wiley & Sons Ltd, 1985.
2. James G. Quintiere, Fundamentals of Fire Phenomena, John Wiley & Sons, Ltd ISBN: 0-470-09113-4, 2006
3. SFPE Handbook of Fire Protection Engineering 5th edition, Springer, 2016
4. Turn, S.R., An Introduction to Combustion 2nd Edition, McGraw-Hill, Inc. 2000.
5. Jens Pohl, Building Science: Concept and Application, Wiley-Blackwell, 2011.
6. Samuel Manzello, Encyclopedia of Wildfires and Wildland-Urban Interface (WUI) Fires, Springer, 2020.
7. Undang-Undang Bangunan Gedung Republik Indonesia, Peraturan terkait, dan SNI.

Ventilation and Air Conditioning System

ENME801113
4 SKS
Learning Outcomes:

This subject equips students with an understanding and basic competency in designing an air system with an increasing need for good air quality. Considering lately it is necessary to have more knowledge of the air conditioning system such as aspects of air flow velocity problems in the room, noise, odor, all

of which are included in Indoor Air Quality (IAQ). This subject will also be given an understanding of the types of ozone friendly refrigerants including the technical implementation of retroophytic air conditioning systems.

Syllabus :

This subject equips students with an understanding and basic competency in designing an air system with an increasing need for good air quality. Considering lately it is necessary to have more knowledge of the air conditioning system such as aspects of air flow velocity problems in the room, noise, odor, all of which are included in Indoor Air Quality (IAQ). This subject will also be given an understanding of the types of ozone friendly refrigerants including the technical implementation of retroophytic air conditioning systems.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanics

References:

1. Ronald Howell, Harry J.Sauer, Jr and William J.Coad : Principles of HVAC, ASHRAE 1998.
2. Carrier : Handbook of HVAC
3. ASHRAE Standard
4. Overseas Vocational Training Association Employment Promotion Corporation : Fundamentals of refrigeration and Air Conditioning.

Fire Protection System

ENME802131
2 SKS
Learning Outcomes:

Students are able to understand the fire protection system both passive and active.

Syllabus :

Fire compartmentalization, Passive fire protection strategies, natural ventilation systems for controlling smoke and heat due to fire, fire resistant materials and their installation, integration of automatic fire protection systems for passive fire protection strategies, design of passive fire protection systems, fire modeling for the design of passive protection systems. This course will study various physical and chemical phenomena that are relevant to various hardware and software of a fire protection system such as automatic sprinklers, gas-shaped agents, foam systems and chemical powders. Fire protection installation system complies with applicable standards. Fire resistant material and installation.

Pre-requisite(s): -

References:

1. SFPE Handbook of Fire Protection Engineering 5th edition, Springer, 2016
2. Fire Protection Association, Passive Fire Protection Handbook, 2011
3. Tewarson A, Khan MM (1991) The Role of Active and Passive Fire Protection Techniques in Fire Control,
4. Suppression and Extinguishment. Fire Safety Science 3:1007–1017. doi:10.3801/IAFSS.FSS.3-1007
5. Jurnal dan standar terkait

Building Mechanical and Electrical System

ENME802132
4 SKS
Learning Outcomes:

Building Mechanical System is a subject that provides specialization and understanding expertise in mechanical systems systems found in modern buildings that are increasingly demanding from the sophistication, efficiency, and use of energy that is more efficient.

Syllabus:

Building Mechanical Systems in General; Plumbing System: SNI, Calculation, and Dirty Water Treatment; Energy Systems in Buildings; BuildingAutomation System; Fire Fighting Systems: Hydrant and Sprinkler System; Lifts and Escalators: Types of Lifts, Round Trip Time, Handling Capacities, Waiting Time, System Installation and Control; Types of Escalator Types, Applications and Installations.

Pre-requisite(s): Basic Thermodynamics

References:

1. Mechanical System for Building.
2. Handbook of HVAC.
3. ASHRAE Journal
4. NFPA
5. Mechanical Installation in Building.
6. SNI Plambing
7. SNI Hydrant, Sprinkler dan APAR.

Fire Dynamics and Modelling

ENME803134
4 SKS
Learning Outcomes:

Sudents understand the various stages of fires and provide basic knowledge methods and techniques applied in the analysis of fire development, and develop students' ability to critically analyze the methods of practical application. This course also aims to improve the ability to understand and analyze the fires model.

Syllabus:

Introduction to the process of combustion, premixed

flame and diffusion flame, ignition and spread of fire, classification of fires and the influence of the geometry of the room. Calorimetry fire: heat release rate, mass loss rate and the relationship between time and heat release rate, the growth of fire in the room, as well as testing methods. The dynamics of the flame: fire plume and flame (flame), a high flame, the flame height correlation.

Pre-requisite(s): Basic Thermodynamics

References:

1. Dougal Dysdale, An Introduction to Fire Dynamics, 3rd Edition, John Wiley and Sons, 2011.
2. James G. Quintiere, Fundamentals of Fire Phenomena, John Wiley & Sons, Ltd ISBN: 0-470-09113-4, 2006
3. SFPE Handbook of Fire Protection Engineering 5th edition, Springer, 2016
4. Thierry POINSOT, Denis VEYNANTE, Theoretical and Numerical Combustion.
5. Jurnal dan standar terkait.

Clean Room

ENME803115
4 SKS
Learning Outcomes:

Provide an understanding of the basic knowledge of clean room systems and its application in buildings, hospital and pharmaceutical industries. Understanding of the concept of air cleanliness, ventilation and fresh air exchange, application of laminar flow, the air pressure in the chamber and measuring systems, validation and its control.

Syllabus:

Indoor environment: human psychological and physiological aspects, BEAM IAQ assessment; Air quality: air cleanliness, ambient air quality, rationale for standards; Indoor air pollutants: gaseous pollutants, airborne particulate, VOCs, radon, biological contaminants; Indoor air movement: air flow in confined and unconfined spaces, filtration systems; Instrumentation and measurement techniques; Control measures: improved IAQ by HVAC system design, removal of contaminants.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanics

References:

1. ASHRAE : HVAC Design Manual for Hospitals and Clinics Second Edition, 2013
2. W. Whyte, Clean Room Technology Fundamentals of Design, Testing and Operation, John Wiley & Sons Ltd., 2001
3. John D. Spengler, J.M.Samet, J.F McCarthy, Indoor Air Quality Handbook, McGrawHIll, 2001.

Plumbing and Waste Water Treatment System

ENME803116
4 SKS
Learning Outcomes:

Plumbing system is a subject that provides specialization expertise and understanding of plumbing systems found in modern buildings that are increasingly demanding in terms of sophistication, efficiency, and more efficient use of energy.

Syllabus :

Plumbing system in general, calculation of the need for clean water and hot water, water tanks, plumbing equipment units, pumps, water hammer applications, sewage treatment systems. A water treatment plumbing system for multi-storey buildings and dirty and sewage removal systems and foam pressure effects will be provided.

Pre-requisite(s): -

References:

1. Soufyan M. Noerbambang, Takeo Morimura, “Perancangan dan Pemeliharaan Sistem Plambing”, Pradnya Paramita, 2009.
2. Louis S.Nielsen, “Standard Plumbing Engineering Design”, McGraw-Hill, 1982,
3. IPC, “International Plumbing Code”, International Code Council, 2009.
4. ASPE, “Plumbing Engineering Design Handbook-Volume 1 & 2”, ASPE, 2004.
5. B.B. Sharp & D.B Sharp, “Water Hammer – Practical Solutions”, Butterworth Heinemann, 2003.
6. Metcalf & Eddy, “Wastewater Engineering – Treatment and Reuse”, McGraw-Hill Co.,2003.
7. Shun Dar Lin, “Water and Wastewater Calculation Manual”, McGraw-Hill, 2007.
8. Michael Frankel, CPD, “Facility Piping Systems Handbook - For Industrial, Commercial, and Healthcare Facilities”, McGraw-Hill, 2010.
9. 2012 Uniform Plumbing Code, IIAPMO 2012

Building Environment Assesment

ENME803117
4 SKS
Learning Outcomes:

Students are provided with an understanding to increase the awareness of environmental issues and the impact of buildings on the environment and be able to evaluate the ability of new and existing buildings to meet a wide range of environmental performance criteria.

Syllabus :

Global issues: electrical loading and equivalent CO2

production, ozone depletion and global warming, abusive use of natural resources; Local issues: demand of electricity, use of water, wastewater discharge, recycled material, local environmental impact; Building environmental assessment methods; Assessment of energy use; Energy audit; Indoor issues: indoor environmental quality factors, current legislation and standards; Pollutants in buildings; Indoor air quality; Health and safety; Safety audit; Health audit.

Pre-requisite(s): -

References:

1. Energy-Efficient Building Systems Green Strategies for Operation and Maintenance, Dr. Lal Jayamaha, McGraw-Hill, 2006.
2. Bradon, S.P., and Lombardi, P., (2005) Evaluating Sustainable Development in the Built Environment, Blackwell Science Ltd., Oxford.
3. An Environmental Assessment for Existing Building Developments. Version 5/03, May 2003
4. An Environmental Assessment for New Building Developments. Version 4/03, May 2003
5. Energy audit of building systems : An engineering approach, Moncef Krarti, 2nd edition,CRC Press Taylor & Francis Group, 2011

Fire Fighting Engineering and Strategy

ENME803135
4 SKS
Learning Outcomes:

This course will provide scientific and practical knowledge on all aspects of the techniques and strategies to effectively extinguish the fire source.

Syllabus :

Forcible Entry, Fire Extinguishing Technique (covers the types of extinguishing material), Fire Fighting of High Rise Building, Safe Work at Heights, Compartment Fires and Tactical Ventilation and Fire Communication and Mobilization Officer.

Pre-requisite(s): -

References:

1. Delmar Cengage Learning, Firefighter's Handbook: Essentials of Firefighting and Emergency Response 2nd edition, ISBN-13: 978-1401835750, Delmar Thomson Learning, 2004
2. SFPE Handbook of Fire Protection Engineering 5th edition, Springer, 2016
3. Jurnal dan standar terkait

Fire Safety Management in Building

ENME803136
4 SKS
Learning Outcomes:

This course will provide scientific knowledge concerning all aspects of Safety Management in Buildings.

Syllabus :

Fire Safety Management, Fire Hazard Identification, Making Plans Activity, Organizational Structure and Development of Human Resources, and Fire Control and Prevention in the building.

Pre-requisite(s): -

References:

1. Daniel E. Della-Giustina, Fire Safety Management Handbook, CRC Press, 2014
2. SFPE Handbook of Fire Protection Engineering 5th edition, Springer, 2016
3. Jurnal dan standar terkait

Mechanical System for Building

ENME804118
4 SKS
Learning Outcomes:

This subject equips students with basic understanding and competence in designing mechanical systems for buildings that include ventilation and air conditioning systems, plumbing, fire protection, and dirty water treatment.

Syllabus :

The form of the task of designing the utility system of a multi-storey building.

Pre-requisite(s): Basic Thermodynamics, Basic Fluid Mechanics

References:

1. Stein, Benjamin, Reynolds, John S., Grondzik, Walter T., Kwok, Alison G., "Mechanical and Electrical Equipment for Building", John Wiley and Sons, 2006.
2. Gina Barney, "Elevator Traffic Handbook, Theory and Practice", Spon Press, 2003.
3. The American Society of Mechanical Engineers, (ANSI A.17.1-2000), "American National Standard Safety Code for Elevator, Dumbwaiters, Escalators and Moving Walks", ANSI A.17.1-1971

Acoustic

ENME804119
4 SKS
Learning Outcomes:

Provide a basic understanding of the concept of

acoustic, acoustic systems in buildings as well as the concept of controlling the propagation of sound in the ventilation system and ventilation.

Syllabus :

Acoustic fundamentals: fundamental properties of sound and waves, sound propagation and transmission inside buildings and in air ducts; Acoustic design and planning: requirements for auditoria, lecture theatres, plant rooms and etc., directional and spacial impression, reverberation, echo, silencers, active noise control; Environment impact and local legislation; Vibration: acoustically driven vibration, control and transmission; Problem investigations: noise and vibration measurement, data analysis techniques, software packages.

Pre-requisite(s): -

References:

1. Acoustic Noise Measurement. J. R. Hassall (1979).
2. An Environmental Assessment for Existing Office Buildings. BRE (1993).
3. CIBSE Guide B12 Sound Control (1976).
4. Concert Halls and Theatres: How they sound. L. L. Beranek (1996).
5. Engineering Principles of Acoustics. D. D. Reynolds (1981).
6. Fundamentals of Acoustics. L. E. Kinsler, A. R. Frey, A. B. Coppens and J. V. Sanders (1982).
7. Handbook of Acoustics, M.J. Crocker, Wiley (1998).
8. ASHRAE HVAC System and Equioment, ASHRAE Atlanta, 2012
9. Noise Control in Building Services. A. Fry (1988).

Fire Investigation Engineering

ENME804137
4 SKS
Learning Outcomes:

This course will provide an understanding and scientific knowledge of fire investigation within the scope of the legislature regarding fire safety regulations.

Syllabus :

Compartment Fires, Flame Spread, Forensic Science, Laboratory Analytical Techniques, Modelling for helping the investigation, and case studies on fire.

Pre-requisite(s): -

References:

1. Drysdale, D., An Introduction to Fire Dynamics, John Wiley & Sons Ltd, 1985.
2. James G. Quintiere, Fundamentals of Fire Phenomena, John Wiley & Sons, Ltd ISBN: 0-470-09113-4, 2006
3. SFPE Handbook of Fire Protection Engineering 5th edition, Springer, 2016
4. Jurnal dan standar terkait

Fire Safety Analysis

ENME804138
4 SKS
Learning Outcomes:

Students have comprehensive knowledge of technical analysis related to the design of fire safety systems. These capabilities include the ability to identify and quantify fire risks and hazards, provide design options, develop design evaluation concepts, apply fire calculation and modeling methods, determine boundary conditions and constraints in design and analysis. relating to being able to evaluate the performance of a fire protection system and knowing and being able to plan the maintenance of a fire protection system.

Syllabus :

Development of performance-based fire protection system design, smoke management system design concepts, evacuation time analysis and life-saving facilities, fire safety in buildings, risk management, fire modeling and national and international regulations in the field of Fire Safety Engineering.

Pre-requisite(s): Basic Thermodynamics

References:

1. Dougal Dysdale, An Introduction to Fire Dynamics 3rd Edition, John Wiley and Sons, 2011.
2. SFPE Handbook of Fire Protection Engineering 5th edition, Springer, 2016
3. Rasbach, D.J., et al., Evaluation of Fire Safety, John Wiley and Sons, 2004.
4. A.H. Buchanan, Fire Engineering Design Guide, New Zealand, 2001.
5. SNI, ASTM, NFPA, rules and standards

Forest And Land Fire

ENME804133
4 SKS
Learning Outcomes:

Students have comprehensive knowledge about the understanding of forest fires, land fires, the basic concepts of forest and land fires, factors related to the occurrence of forest and land fires and their prevention and mitigation efforts. In the learning process students will learn various types of vegetation in tropical forests and peat; identify environmental factors such as availability of fuel capable, weather, topography, and human activity factors that influence ignition, smoldering, flammability, rate of heat release, rate of fire spread, rate of smoke production, and rate of potential fire hazard rating.

Students will also learn various methods of early fire detection, calculation of heat release and emissions from forest and land fires, and efforts to prevent and handle forest and land fires.

Syllabus :

Tropical forests and peat in Indonesia, general understanding, types of forests in Indonesia, climatological conditions, and social environment. Statistics of forest fires in Indonesia and the world. Basic concepts and factors related to forest and land fires. Tropical peat in Indonesia, understanding, types, characteristics and hydrological environment. Weather factors, topography, vegetation types, topography and human activity factors in the process of forest and land fires. Characterization of potential, assessment of risks and dangers of forest and land fires: (ignition), flammability, rate of heat release, rate of fire spread, rate of production of hazardous fumes and gases, and fire hazard rating. Early detection techniques for fires by remote sensing (satellite imagery) in the form of hot spots, trace particulates, hazardous gas emissions, and haze. Forest and land fire prevention and prevention strategies. Laboratory scale practicum uses an integrated peat fire analyzer available at the Thermodynamics Laboratory to study peat fires propagation rates and the resulting emissions and extinguishing methods.

Pre-requisite(s): Basic Thermodynamics

References:

1. Laslo Pancel and Michael Kohl, Tropical Forestry Handbook, Second Edition, Springer-Verlag, 2016, ISBN 978-642-54600-6.
2. Mitsuru Osaki, Nobuyuki Tsuji, Tropical Peatland System, Springer – Japan, 2016.
3. National Wildfire Coordinating Group, Guide to Wildland Fire Origin and Cause Determination, PMS 412, NFES 1874, 2016.
4. SFPE Handbook of Fire Protection Engineering 5th edition, Springer, 2016
5. Jurnal Ilmiah terkait.

Fire Protection in Process Industry

ENME804139
4 SKS
Learning Outcomes:

This course will provide an understanding and scientific knowledge of fire protection systems in the process industry.

Syllabus :

Fire Hazard identification on Industry, Standard and applicable Law, Fire Protection in Industrial Processes, Evacuation Planning and Mitigation, and Modeling for Fire Hazard Prediction in Process Industries.

Pre-requisite(s): -

References:

1. A.H. Buchanan, Fire Engineering Design Guide, New Zealand, 2001.
2. SFPE Handbook of Fire Protection Engineering 5th edition, Springer, 2016
3. Jurnal dan standar terkait

Material and Manufacturing Processes

ENME801140
4 SKS
Learning Outcomes:

The course provides understanding and basic competence of theory, application method and product manufacturing processes that covers: working principle, process characteristics, process limitations, work and force due to the process, parameters that affects to the process and the relation of material with the process that needed for certain process.

Syllabus :

Manufacturing Process and Production Systems; Materials in Manufacturing; Theory and Method of Casting Processes; Theory and Method of Bulk Deformation Processes; Theory and Method of Metal Forming Processes; Theory and Method of Powder Metalurgy Processes; Theory and Method of Material Machining/ Cutting Processes; Theory and Method for Enhancing Manufactured Surface Quality; Theory and Method of Joining Processes; Theory and Method of Prototyping; Engineering Material Characteristics; The Relation between Process Characteristics and Material Characteristics; The Parameter Control of Process for Material; Assignment in Manufacturing Process and Material Selection for Market Needs.

Pre-requisite(s): -

References:

1. Michael Ashby dan Kara Jhonson, Materials and Design : Arts and science in material selection in product design,Butterowrth-Heinemann, 2002
2. Michael Ashby, Material selection in Mechanical Design, Butterworrth Heinneman,2005
3. John A. Schey, Introduction to Manufacturing Processes, McGraw-Hill, 1999
4. Degarmo, E. Paul, Materials and Processes in Manufacturing, Prentice Hall Int. Inc, 8th edition, 2005

Product Design and Development Methodology

ENME801141
4 SKS

Learning Outcomes: Provide an understanding and mastery of the theory and methodology of design and product development include: planning, concept development, system design, detailed design, testing and screening, production ramp-up, in a series of factors to consider overall product development.

Syllabus :

Product Planning: Needs Identification Methods; Product Selection Method (Feasibility Study); Business Specifications: Concept Development and Selection; Aspects of Engineering in Product Development and Manufacturing (Process, Material, Thermal, Durability) Non- Technical Aspects in Product Development and Manufacturing; basic Design for Manufacturing and Assembly; Calculation of Economics of Product Development.

Pre-requisite(s): -

References:

1. Karl T.Ulrich. Product Design and Development, 3rd edition, Mc.Graw Hill 2004.
2. Dieter, G.E., Engineering Design, 3rdedition, Mc.Graw Hill 2000

Designing and Manufacturing Technology Integration

ENME802142
4 SKS
Learning Outcomes:

Provide an understanding of competence and capability in designing and manufacturing process by utilizing peracangan / includes latest design and manufacturing system CAD / CAM and reverse engineering and prototype development to improve efficiency and accelerate the production process, reduce errors, improve quality and reduce production costs.

Syllabus :

System Overview of CAD / CAM; Hardware & Software Systems CAD / CAM: Geometric Modelling: Type a mathematical representation of the model curve, surface and solid 3D modeling methods and manipulation of 3D models; exchange of data within and between sistem-CAD/CAM; CAD Laboratory Activity; Technology CNC; Tool Path Generation Method-CAM systems; Control 'quality of machining' (machined surface quality) in the system-CAM: Computer-Aided Process Planning CAPP; postprocessing; Practice CAM: 3D geometry measurements, principles and measurement based Coordinate Measuring Machine (CMM), the method of filtration data, the identification of boundary features, modeling and manipulation of point-based 3D models, 3D models for the modularization of the prototype, prototype and rapidprototyping method, discretization model, principles and application of SLS and SLM.

Pre-requisite(s): -

References:

1. Kunwoo Lee, *Principles of CAD / CAM / CAE,* Prentice Hall, 2003
2. Gandjar K, *Hand out CAD/ CAM*, DTMUI, 2007
3. Connie L. Doston, *Fundamentals of Dimensional Metrology,* Delmar Learning, 2006
4. Ali K. Kamrani. Emad A Nasr, *Rapid Prototyping : Theory And Practice,* Birkhauser, 2006
5. Patri K. Venivinod, Weyin Ma, *Rapid Prototyping : Laser Based and Other Technologies,* 2003.

Mechanical Failure

ENME803143
4 SKS
Learning Outcomes:

This course provides an understanding and competence about principles and modes of mechanical failure may occur and should be avoided so that should be considered in the design of mechanical, including buckling, Corrosion, fatigue, creep, melting, fracture, thermal, and wear.

Syllabus:

Theory and Buckling Mode (Torsional-lateral, Plastic, Dynamic), Theory and Corrosion mode (Metal, Non-Metal, Glass); Corrosion Prevention; Theory and Fatigue Failure Mode; Theory and creep mode; Theory and Melting Mode; Theory and Type of Fracture mode, Theory and the thermal failure mode; Theory and Wear mode; Failure Analysis and Prevention to: Buckling, Corrosion, Fatigue, creep, Melting, Fracture, Thermal, and Wear

Pre-requisite(s): Engineering Materials, Mechanical Design

References:

1. Jack A Collins, Materials Failure in Mechanical Design, Wiley - Interscience, 1993
2. S. Suresh, Fatigue of Materials, Cambridge University Press, 1998
3. M Jansenn, J. Zuidema, Fracture Mechanics, VSSD, 2006
4. Arthur J. McEvily, Metal Failures : Mechanisms, Analysis and Prevention, 2013

Dynamics of Mechanical System

ENME803144

4 SKS
Learning Outcomes:

Provide an understanding and competence in the principles and methods of dynamic analysis of mechanical systems as an important input in the design process to produce a mechanical system that has a better dynamic resistance and also know the effects they impose on other systems that interact.

Syllabus :

Kinematic Systems: Theory and Principles of Dynamic Systems: Dynamic Modeling Method: Block Diagrams and State-Variable Model: Analysis on Time-Domain System: Analysis of the Frequency-Domain System; Vibration; Stability: Dynamic Balance: Dynamic Analysis of Mechanical Components; Modeling and Analysis control system.

Pre-requisite(s): -

References:

1. Palm, Modelling, Analysis, and Controlof Dynamic Systems, Wiley, 2006
2. Harold Joseph dan Ronald Huston, Dynamicof Mechanical System, CRC, 2002
3. Palm, System Dynamics, McGraw-Hill,2007
4. Chapman, Stephen J., Essentials of Matlab Programming, Thomson Nelson, 2006

Composite Product Development

ENME803145
4 SKS
Learning Outcomes:

Provide expertise and competence to students in the field of designing and manufacturing of parts / mechanical construction using composite materials. This course provides an understanding of composite materials, including the characteristics, testing, manufacturing process, and special applications in the engineering field.

Syllabus:

Composite Type, Material, Properties, Mechanics; Knowledge and Characteristics of Fiber Composite, Strength, Hardness, and the composite thermal expansion; Theory of Combination Fiber and Matrix; Matrix Composite Characterization; Laminar Theory On Axis and Off Axis; Composite Product Design, Composite Fabrication Technique ; Testing Method; Future Applications.

Pre-requisite(s): Engineering Materials, Mechanical Design

References:

1. Brent Strong, Fundamentals Of Composites Manufacturing: Materials, Methods and Applications - Technology & Engineering – 2007
2. By Daniel Gay, Suong V . Hoa, Stephen W. TsaiTranslated by Stephen W Tsai Contributor Suong V. Hoa, Stephen W. Tsai, Composite materials: Design and application, 2nd : CRC Press 2007
3. Soemardi,T.P. Diktat Mekanika komposit, Fabrikasi dan Testing. FTUI.2003.
4. Composites ASM handbook No 21

Finite Element and Multiphysics

ENME803146
4 SKS
Learning Outcomes:

Provide a basic understanding and skills regarding the principles of modeling, solution techniques such as 'finite element method' and its application in cases of design and engineering analysis. The models studied included physical aspects of the problem in Thermal, elasticity (plates and shells), acoustic, and electromagnetic.

Syllabus :

The introduction of FEA (Finite Element Analysis); Fundamental FEA I (basic concepts and formulations FEA FEA) FEA Fundamentals II (failure modes, Dynamic Analysis, FEA Capabilities and limitations); Basic Finite Element Modeling: Modeling CAD for FEA; Building a Finite Element Model: Model simulation and interpretation of results; Thermal-Structural; Pressure-Structural; Electromagnetic-Thermal- Structural; Analysis of Thermal Actuator; Coating process: Key elements of Successful Implementation of Technology multiphysics; Introduction to CFD and Its Application.

Pre-requisite(s): -

References:

1. William B J Zimmerman, Multiphysics Modeling with Finite Element Methods, World Scientific Publishing, 2006
2. Barry H V Topping, A. Bittner, Engineering Computational Technology, Civil Comp Press, Edinburgh, UK, 2002.
3. Indra Siswantara, Catatan Kuliah Teknologi Multihysics, 2008

Design And Development Of Educational Products

ENME803147
4 SKS
Learning Outcomes:

Understand the basics and process of designing and developing educational products in the industry of teaching aids, educational products, and game aids.

Syllabus:

Brainstorming and expressing ideas and opinions,

Innovation and Theme Development, Basics of Toy Product Design, Basic Engineering and Mechanical Design, Basic Theory for Sketching, Sketch Drawing Modeling Process, Design Aesthetics, Manufacturing Theory and Material Selection for Game Props, Basic Theory of Making Prototype, Portfolio Design, Presentation and Idea Pitching.

Pre-requisite(s): Engineering Materials, Mechanical Design

References:

1. Karl Urlich, Steven Eppinger, 2015, Product Design Development Flow, 6th Edition, McGraw Hill.
2. Donald A. Norman, 2005, Emotional Design, 1st Edition, Basic Books.
3. Michael Michalko, 2006, Thinkertoys : A Hanbook of Creative Thinking Techniques, 2nd Edition, Ten Speed Press.

Microfabrication and Precision Manufacturing

ENME803161

4 SKS

Learning Outcomes:

This course provides specialization expertise on micro fabrication processes that are widely used in the manufacture of MEMS (micro Electro mechanical system) at this time that has wide application of the biomedic system, sensors and micro-electronic devices (electronic devices). This course giving understanding of manufacturing techniques and basic structure mechanics in a product and also the micro-characterization of the process fabrication conducted in the laboratory. This course provides a basic competency of the principles in the design techniques which control the movement of the size or dimensions in a very small if compared with the size of the object that is designed and produced the correct design and the development machine and a precision mechanism

Syllabus:

Introduction to Engineering Micro Fabrication; Lithography: The design aspect, masks making, etching technique (And Wet Etching Dry Etching); Deposisi Engineering: Chemistry and Chemicals; Electroplating, Micromolding, Beam Processing; Microscaling consideration); Transport Processes and Metrology in the micro-scope; Lab Practice and Applications, Philosophy Precision Manufacturing; kinematic concept; Pro and contra Flexures Design; Materials for Precision Components; Self Calibration Concept; Manufacturing Process which is Important in Precision Manufacturing, Precision Instruments; Basic Concept of Tolerance on Dimensions and geometric.

Pre-requisite(s): Engineering Materials, Mechanical Design, Engineering Programming

References:

1. Madou, M.J. Fundamentals of microfabrication: the science of miniaturization, CRC Press, 2002.
2. McGeough, J (Ed.), Micromachining of Engineering Materials, Marcel Dekker, 2002, ISBN 0-8247-0644-7
3. Mainsah, E., Greenwood J.A. and Chetwynd D.G. Metrology and properties of engineering surfaces, Kluwer Academic Publ., 2010
4. Gardner J.W. and Hingle H.T. (Ed.) From Instrumentation to Nanotechnology, Gordon and Breach Science Publishers, 1991, ISBN 2-88124-794-.
5. Korvink J.G. and Greiner A. Semiconductors for Micro- and Nanotechnology – An Introduction for Engineers, WILEY-VCH Verlag GmbH, 2002, ISBN 3-527-30257-3.
6. Mark J. Jackson, Microfabrication and nanomanufacturing. Taylor and Francis, 2006

Quality and Production Management System

ENME803154

4 SKS

Learning Outcomes:

Provides knowledge, understanding and ability to perform management, analysis and improvement of production systems in the manufacturing industry with the principles of efficiency and effectiveness, and able to understand and implement and develop policies and procedures are needed to improve and control the various processes.

Syllabus :

Introduction to Manufacturing Systems, Manufacturing Principles, Resources, Production Process and Production Organization, Production Lay-Out, Design, Scheduling and Production Process Control; Productive Maintenance, Logistics and Inventory; Engineering Quality, Quality Control, Quality Function Deployment (QFD) , Total Quality Management; Quality Management System (8 Quality Management Principles, International Standard Quality Management System: ISO 9001, ISO 9004, ISO TS 16949, the International Management System Standard: ISO 14001, OHSAS 18001); System And Process Improvement: Cause - Effect Analysis, FMEA (Failure Mode and Effect Analysis), Lean Six Sigma.

Pre-requisite(s): Mechanical Design

References:

1. Hitomi, Katsundo. Manufacturing System Engineering. Taylor & Francis. 2001
2. TQM : A Cross Functional Prespective, Rao, CARR, Dambolena, Kopp, Martin, Rafii,

Schlesinger, John Willey, 1996
3. TQM, Text, Cases and Readings, Joel E. Ross, St. Lucie Press 100 E. Linton Blvd Suite 403 B Delray Beach, FL 33483

Risk Management

ENME803174
4 SKS
Learning Outcomes:

Fast information flow and the presence of regulatory and supervisory concerns, management requires understanding and measuring risk. Risk management sets standards for combining different information, collecting data, calculating risk measures and creating timely reporting tools for management. This course directs students to understand how complex risks on a large scale can be measured and managed.

Syllabus:

Introduction to risk management, Value at Risk - VaR Risk measures for various asset classes, Monte Carlo Simulation, VaR Validation and Extremes, Regulatory Environment 25 years of risk related regulations, Multifactor models Discussion of multifactor analysis, Review of industry leading risk management systems, Operational Risk and its Basel II requirements.

Pre-requisite(s): -

References:

1. Jorion, Philippe, Value at Risk: The New Benchmark for Managing Financial Risk, 3rd edition, McGraw-Hill, 2007
2. Roger Lowenstein, When Genius Failed, Random House, 2000

Design for Manufacture and Assembly

ENME804148
4 SKS
Learning Outcomes:

Provide knowledge, understanding and competence in the product design process which is considering, including factor and oriented on: material, manufacturing capability and assembling process. Therefore the product is expected to have made ease of manufacture and assembly.

Syllabus:

Review of the materials selection and processes, product design for manual assembly, design for automated assembly, PCB design for manufacture and assembly, machining process design, injection molding, sheet metal forming processes, die-casting.

Pre-requisite(s): Engineering Materials, Mechanical Design

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

Noise and Vibration Control

ENME804149
4 SKS
Learning Outcomes:

This course provides competency to students to complete the issue of application of vibration on the mechanical structure of the construction, and plate or vessel (vessel), perform the calculation of vibration reducer system design, system and engine holder enhancing of production equipment. Finally students have to make basic vibration measurements; forecasts predicted the damage engine, the vibration analysis of the data signal and the vibration spectrum and carry out machine performance diagnosis based on data analysis of vibration data and other data related

Syllabus :

Mechanical vibration with Many Degrees Freedom; Vibration on the Structure Construction; Vibration on plate and body shell (Vibration Plate and Shell); Vibration Isolation; Designing Vibration Absorber; Engineering Vibration Measurement; Vibration spectrum analysis; Performance Diagnostic Machine.

Pre-requisite(s): Mechanical Vibration

References:

1. Jerry H.G., "Mechanical and Structural Vibrations", John Wiley, 2004
2. Demeter G.F., "Mechanical and Structural Vibrations", John Wiley, 1995
3. Kenneth G.M., "Vibration Testing: Theory and practice 2nd ed", Wiley, 2008
4. Werner Soedel, "Vibrations of Shells and Plates", 3rd edition – revised and expanded, Marcel Dekker, INC., 2004
5. Randall R.B., "Frequency Analysis", Brüel & Kjær, 1987
6. Jens T.B., "Mechanical Vibration and Shock Measurement", Brüel & Kjær, 1980

Laser Assisted Process

ENME804162
4 SKS
Learning Outcomes:

Students are expected to understand knowledges related to fabrication process assisted by laser, and its direct application. Students can understand the science associated with the fabrication process that is assisted with laser technology, and the application and direct application of the fabrication process assisted by laser technology.

Syllabus :

Basics of Laser-based Manufacturing Technology; Laser-assisted Formation Process; the joining process with the help of laser technology; Laser Assisted Surface Engineering; Types of Lasers, Application of Laser Technology, Basics of laser interactions with materials and Classification of Material Processes with Laser Technology.

Pre-requisite(s): -

References:

1. A.M. Hasofer, V.R. Beck, I.D. Bennetts, Risk Analysis in Building Fire Safety Engineering, Elsevier Butterworth-Heinemann, 2007.
2. Ralph W King and John Magid, Industrial Hazard and Safety Handbook, ISBN: 978-0-408-00304-9
3. SFPE Handbook of Fire Protection Engineering 5th edition, Springer, 2016
4. Jurnal dan standar terkait

CAD/CAM

ENME804155
4 SKS
Learning Outcomes:

This lecture will discuss about technology of CAD, CAM, Integration of CAD / CAM application in the industry and the emphasis on: the principles modeling and surface curve geometry (Geometric modeling), design of 2D and 3D models with computer assisted. The principle of data exchange between CAD/CAM systems also tool path design using computer for prismatic and sculptured model. Lectures CAD / CAM are provided with the aim that students have the understanding and applying technology of CAD / CAM: starting the process from design to production process with the computers assistance.

Syllabus:

Overview of CAD / CAM System; Hardware & Software System of CAD / CAM; Interactive Tools and Computer Graphics Concepts, Geometric Modeling: Type & Representation of mathematical model Curve, Surface & Solid ; Data Exchange in CAD / CAM system; Manufacturing Processes: Manufacturing Process Review Type and Parameter Calculation machining, Lab. practice of CAD; CNC Technology; Tool Path Generation Method in the CAM system; Control 'quality of machinery' in the CAM system; Computer Aided Process Planning-CAPP; Postprocessing; Lab. practice of CAM.

Pre-requisite(s): Engineering Programming

References:

1. Kiswanto G., Handout CAD/CAM, Diktat kuliah, 2004.
2. Choi B. K., Jerard R. B., Sculptured Surface Machining,
3. Zeid, I., CAD/CAM Theory and Practice, McGraw-Hill, 2009.
4. Chang, T. -C., Computer Aided Manufacturing, 3rd ed, Prentice-Hall, 2005.
5. Korem, Y., Computer Control of Manufacturing Systems, McGraw-Hill

Manufacturing Performance Assessment

ENME804156
4 SKS
Learning Outcomes:

Provides knowledge about the basic concepts of performance assessment of manufacturing industry relating to product performance, process, manufacturing system and its relation to manufacturing excellence. At the end of this course, students are expected to understand the methodologies and assessment tools manufacturing performance and are able to identify, assess and analyze the performance of the manufacturing industry increase.

Syllabus:

Introduction, Traditional Performance Methodology & Tool: Dupont Financial Performance, Basic Performance Measurement process & tools: Data collection techniques, chart, graph & diagram, Process Improvement methodologies & tools: Process Capability, Measurement System Analysis (MSA), QFD, FMEA, six sigma & lean six sigma, Industry specific/ generic standards & best practices, Manufacturing Maturity model concept & measurements, Case study of Industrial performance Measurement (assignment & evaluation)

Pre-requisite(s): Engineering Materials, Mechanical Design

References:

1. US Departement of Energy, United Sates of America, Performance Based Management, 2005 Oak Ridge Associated Universities,. "How to Measure Performance, A Hand Book of Techniques and Tools"
2. "World Class Manufacturing Performace Measures"
3. Harold T.Amrine, John A.Ritchey, Prentice Hall International Edition, "Manufacturing Organization and Management"
4. Will Kaydos, Productivity Press Portland Oregon, " Measuring, Managing and Maximizing Performance"

Manufacturing Information System Management

ENME801150
4 SKS
Learning Outcomes:

Provides understanding of the theory, method and application of information technology systems, management, and development of the concept of knowledge-based information systems (Knowledge Management System) and capable to apply in the manufacturing industry.

Syllabus :

Introduction to Information Systems; State of The Art Utilization Information System; Theory and System Methodology; Database Management Systems; System Design I: Overview functionality, enabling Technology (Automated Solution Assessments Quality, Multi Data Representation, Database Technology and XML); Design System II: (Database Design, Information Input, Output Information); Case Study: Documentation automation and Reporting System for Manufacturing; Introduction Knowledge Base Engineering, Concepts and Methodology in the KBE (System Specialists, Neural Network); KBE application.

Pre-requisite(s): -

References:

1. Raymond McLeod Jr., *Strategic information Management : Challenges and Strategies in Managing Information System;* 3rd Edition, Butterworth-Heinnemen, 2003.
2. Cortada, James. *Total Quality Management,* McGraw Hill Book Co.
3. Ake, Kevin et al. *Information Technology for Manufacturing : Reducing Costs and Expanding Capabilities,* CRC Press, 2003.
4. Cecelja, Franco, *Manufacturing Information and Data System : Analysis Design and Practice,* Butterworth-Heinnemen, 2001.

Manufacturing System and Processes

ENME801151
4 SKS
Learning Outcomes:

Students are expected to know and be able to apply the conventional manufacturing process technology and non-conventional for the manufacture of a product and the parameters which inflence it are devoted to the metal forming processes, machining, rapid prototyping process. In addition, knowing, and understanding the existing production systems in the industry.

Syllabus :

Materials in Manufacturing: Theory and Method of Casting Process (Metal Casting); Theory and Method of Bulk Formation Processes: Theory and Method of Formation Process Material Sheet (Sheet Metal Forming): Theory and Methods of Powder Metallurgy Process (Powder Metalurgy); Theory and Methods for Machining Processes / Cutting Materials: Theory and Methods of Product Surface Quality Improvement process: Concepts and methods of manufacturing systems.

Pre-requisite(s): -

References:

1. Wagoner R., Chenot J.-L, *Fundamentals of Metal Forming*, John Wiley & Sons, Inc,2003
2. Degarmo P., *Materials and Process in Manufacturing*, Prentice Hall, 2004
3. Schey J., *Introduction to Manufacturing Process*, McGraw-Hill, 2004
4. Thomas E Vollman, *Manufacturing Planning and Control*, McGraw Hill 1997
5. Stanley B. Gershwin, *Manufacturing System Engineering*, Prentice Hall, 1993
6. John M. Nicholas, *Competitive Manufacturing Management*, 1997

Automation and Robotics

ENME802152
4 SKS
Learning Outcomes:

Automation and Robotics course discusses technology and application in the automation industry and the design and control the robot emphasizes: understanding the types of automation systems, particularly in the manufacturing industry and the mechanism, the design and development of automation system that emphasizes the 3 things: reliability, quality and cost and the understanding robot control system. Automation and Robotics Lectures given with the aim that students have an understanding in the implementation of technology Automation and Robotics, especially in the manufacturing industry.

Syllabus:

Automation System; Classification Type Manufacturing Automation machinery; Actuator; Sensor System; PLC Control System in the Manufacturing Automation machinery; Robot- cs: Definitions and Principles of Robot; Spatial Descriptions: Definitions and Principles, Methods and Applications Spatial descriptions; Forward Kinematics: Definition, Principles and The Forward Kinematics; Jacobians: Speed, explicit shape, definition and principle of inverse Kinematics; Dynamic: The form of explicit, Acceleration and inertia; Control system ronbotic: PID control, the Joint Space Control, Operational Control

and Space Force Control; Robot Design Assignment.

Pre-requisite(s): Engineering Programming

References:

1. Craig J., Introduction to Robotics 3rd ed, Prentice Hall, 2004.
2. Heath L., Fundamentals of Robotics, Theory and Applications, Prentice Hall, 1985.
3. Koren Y., Robotics for Engineer, McGraw Hill, Intl Edition, 1985.
4. Lentz K. W. Jr., Design of Automatic Machinery, Van Nostrand Reinhold, 1985.
5. Schilling R. J., Mikell P., Fundamentals of Robotics, Analysis and Control, Prentice Hall, 2000.
6. Kiswanto G., Otomasi dan Robotika, Diktat Kuliah Departemen Teknik Mesin, 2004.

Machine Vision System

ENME803153
4 SKS
Learning Outcomes:

Machine Vision Industry Subjects provides the understanding and competency of the principles, methods and applications monitoring the production process by using visual-based camera technology, image processing, for the purpose of introducing the feature: product identification, selection and product screening, and quality control. With the completion of this course, students have the ability to apply and develop the visual method of monitoring the production process in the industry for the purpose.

Syllabus:

Basic Machine Vision Method: Binary Image, Binary Morphology and Gray-Scale, Texture analysis; Identification Method feature; image Processing Method Smart / Intelligent, Image Processing System (Prolog); Control Equipment / Instruments Interface (Instruments, Signal, Protocol, PLC) ; Method Introduction Color image; Machine Vision Applications.

Pre-requisite(s): Engineering Programming

References:

1. J.R. Parker, Algorithms for Image Processing and Computer Vision 2nd ed, Wiley, 2010
2. Butchelor B. G., Whelan P. F.,Intelligent Vision System for Industry, Springer, 2012
3. E.R. Davies, Machine Vision : Theory, Algorithm, Practicalities, Morgan Kauffman, 2004
4. Micheul S, Lawrence O'Gorman, Michael J S Practical Algorithms for Image Analysis : Description, Examples and Code, , Cambride Univ. Press, 2000
5. Rafael Gonzales, et.al, Digital Image Processing using Matlab, McGraw Hill, 2010.
6. A.S. Baskoro, Handout Sistem Machine Vision, Diktat kuliah, 2011.

Vehicle Engineering and Heavy Duty Equipment

ENME801163
4 SKS
Learning Outcomes:

This course provides the latest technology from the four-wheeled passenger vehicle, especially with covering all aspects of engineering in a vehicle. Lectures given vehicle engineering with the aim that students have basic competence to do the engineering on the four-wheeled passenger vehicle in particular.

Syllabus :

Vehicle Kinematics & Dynamics; mover and transmission system; Breaking Systems, Wheel and Suspension; Security System: Active and passive at the time experiencing issues.

Pre-requisite(s): -

References:

1. Bosch Automotive Handbook, Sixth Editions, 2006
2. Gillespie, Thomas D., Fundamentals of Vehicle Dynamics, 2004
3. Hei s ler, Heinz. Advanced Vehicle Technology, 2004
4. Hermann, Hans. SAE Handbook of Automotive Engineering, 2004
5. Miliken, William F., Douglas L. Milliken, Maurice Olley, Chassis Design : Principles and Analysis, 2004
6. Pacejka, Hans B. Tire & Vehicle Dynamics, SAE, 2006

Prime Mover and Power Train System

ENME801164
4 SKS
Learning Outcomes:

Students have the competency and skill in the principles and theory of prime mover including internal combustion motor, electric motor, hybrid motor which are connected to the powertrain system; understand and are able to calculate the construction and design.

Syllabus :

Combustion motor technology; reciprocating/rotary piston engine; electric motor technology (AC/DC motor); hybrid motor system; serial/Non Reguler hybrid; transmission system: MT, AT, DCT, CVT; battery technology

Pre-requisite(s): -

References:

1. Heywood, J., Internal Combustion Engines Fundamental, McGraw Hill, 1989
2. Khovakh, M., Motor Vehicle Engines, MIR Publisher, Moscow, 1971.
3. Bosch Automotive Handbook, SixthEditions, 2006
4. Gillespie, Thomas D., Fundamentals ofVehicle Dynamics, 2004
5. Heiszler, Heinz. Advanced VehicleTechnology, 2004
6. Hermann, Hans. SAE Handbook ofAutomotive Engineering, 2004

Vehicle Frame and Body Engineering

ENME802165
4 SKS
Learning Outcomes:

Prrovide an understanding of various concepts related to vehicle frame design and analysis, such as: A brief understanding of the history of vehicle design development; Understanding of vehicle design and interactivity in the vehicle design and manufacturing process, including various types of vehicle structures and their uses; Understanding how loads can be analyzed simply and using a computer includes simple structural analysis that focuses on the processes involved in vehicle structure; Understanding of basic concepts related to vehicle body aerodynamics and the basic calculations needed to design vehicle body aerodynamics.

Syllabus :

The introduction of the latest innovations and breakthroughs in the automotive field and the development of the automotive industry. Understanding the concept of loading on vehicle structures, various types of vehicle frames, structural analysis using the Simple Structural Surface method and the method of computing the skeletal structure. Aerodynamic force, reduction of lift (reduction of drag). Stability and the concept of calculating vehicle body dynamics.

Pre-requisite(s): -

References:

1. Heinz Hei s ler, “Advance Vehicle Technology”, Society of Automotive Engineers, Inc. ISBN 0 7680 10713.
2. Brian Cantor, Patrick Grant and Colin Johnston, “Automotive Engineering Lightweight, Functional, and Novel Materials”, Taylor & Francis Group, 6000 Broken Sound Parkway NW, Suite 300, ISBN 978-0-7503-1001-7.
3. Giancarlo Genta, Lorenzo Morello, “The Automotive Chassis Vol. 1: Components Design”, Springer Science+Business Media B.V., ISBN: 978-1-4020-8674-8 e-ISBN: 978-1-4020-8676-2.
4. David A. Crolla, “Automotive Engineering Powertrain, Chassis System and Vehicle Body”, Butterworth-Heinemann is an imprint of Elsevier, Linacre House, Jordan Hill, Oxford OX2 8DP, UK ISBN: 978-1-85617-577-7.
5. Nick Tucker and Kevin Lindsey, “An Introduction to Automotive Composite”, Rapra Technology Limited, ISBN: 1-85957- 279-0.
6. Jason C. Brown, A. John Robertson, and Stan T. Serpento, “Motor Vehicle Structures: Concepts and Fundamentals”, Butterworth-Heinemann Linacre House, Jordan Hill, Oxford OX2 8DP, ISBN 0750651342
7. Liang Yun · Alan Bliault · Johnny Doo, WIG Craft and Ekranoplan, “Ground Effect Craft Technology”, ISBN 978-1-4419-0041-8 e-ISBN 978-1-4419-0042-5, DOI 10.1007/978-1-4419-0042-5, Springer New York Dordrecht Heidelberg London.
8. Mat thew Huang , “Vehi c le Crash Mechanics”, CRC Press LLC, International Standard Book Number 0-8493-0104-1.
9. Ahmed A. Shabana, Khaled E. Zaazaa and Hiroyuki Sugiyama, “Railroad Vehicle Dynamics a Computational Approach”, CRC Press is an imprint of the Taylor & Francis Group, ISBN 978-1-4200-4581-9.

Vehicle Control System

ENME803166
4 SKS
Learning Outcomes:

Students understand the basic features of the vehicle control system that has the ability to;

- Describes a simple method for the analysis of vehicle suspension systems and components;
- Describes the vehicle suspension system design requirements and how to achieve it;
- Analyze the various factors and issues that affect the design of suspension of driving;
- Understand the mechanics of the vehicle wheel;
- Describes recent developments in control of the braking system and braking system design and material needs an efficient;
- Analyze the influence of the steering system characteristics to the vehicle motion

Syllabus :

Introduction of the role of vehicle suspension systems, factors that affect the design, definitions and terminology in vehicle suspension systems, suspension mobility mechanisms, different types of suspension, kinematics analysis, the analysis center of rotation (roll center analysis), geometric style as

well as lateral, suspension components. The basis of the braking system. Regulation, function and terms of use brake system, brake system components and confiurations as well as the kinematics of the braking system. Consideration of adhesion force proportional to the brake system and braking effiiency. Deformation, lateral force and slip angle on the tire when the vehicle is running. Penikungan characteristics (cornering characteristics) according to Fiala theoretical approach to the mathematical model and the effect is due to air pressure in tires.

Pre-requisite(s): -

References:

1. Heinz Heisler, "Advance Vehicle Technology", Society of Automotive Engineers Inc. ISBN 0 7680 1071 3
2. Giancarlo Genta, Lorenzo Morello, "The Automotive Chassis Vol. 1: Components Design", Springer Science+Business Media B.V., ISBN: 978-1-4020-8674-8 e-ISBN: 978- 1-4020-8676-2.
3. Giancarlo Genta, Lorenzo Morello, "The Automotive Chassis Vol. 1: System Design", Springer Science+Business Media B.V., ISBN: 978-1-4020-8673-1 e-ISBN: 978-1- 4020-8675-5.
4. David A. Crolla, "Automotive Engineering Powertrain, Chassis System and Vehicle Body", Butterworth-Heinemann is an imprint of Elsevier, Linacre House, Jordan Hill, Oxford OX2 8DP, UK ISBN: 978-1-85617-577-7.

Modern Vehicle Technology

ENME803167
4 SKS
Learning Outcomes:

SStudents understand the concepts of manufacturing technology and vehicle control systems to: Analyze the current state of technological advances so that they can make fundamental changes in the design of sustainable vehicles; Designing processes to create automated control systems that assist vehicle control; Designing vehicles with electronic control systems that can improve vehicle performance; Describe the integration in vehicle control systems and the interaction of mechanical and electrical systems that can support the design and development of future vehicles

Syllabus:

Knock control, Linear solenoid idle speed control, Sequential fuel injection, Distributorless ignition, Self-diagnosis for fail-safe operation, Crankshaft angular position measurement for ignition timing, Direct mass air flow sensor, Variable valve phasing,teknologi kendaraan Hybrid Electric Vehicles and Electric Vehicle.

Pre-requisite(s): Engineering Programming

References:

1. Julian Happian-Smith, " An Introduction to Modern Vehicle Design", Butterworth- Heinemann Linacre House, Jordan Hill, Oxford OX2 8DP, ISBN 07506 5044 3.
2. Heinz Hei s ler, "Advance Vehicle Technology", Society of Automotive Engineers, Inc. ISBN 07680 1071 3.
3. Fuhs, Allen E., "Hybrid vehicles and the future of personal transportation", CRC Press, Taylor & Francis Group, ISBN-13: 978-1-4200-7534-2, ISBN-10: 1-4200- 7534-9.
4. Lino Guzzella and Christopher H. Onder, "Introduction to Modeling and Control of Internal Combustion Engine Systems", Springer-Verlag Berlin Heidelberg, ISBN 978-3-642-10774-0 e-ISBN 978-3-642- 10775-7, DOI 10.1007/978-3-642-10775-7, Library of Congress Control Number: 2009940323.
5. Iqbal Husain, "ELECTRIC and HYBRID VEHICLES Design Fundamentals", CRC PRESS Boca Raton London New York Washington, D.C., ISBN 0-203-00939-8 Master e-book ISBN, International Standard Book Number 0-8493-1466-6 (Print Edition), Library of Congress Card Number 2002041120.
6. Ali Emadi, "Handbook of Automotive Power Electronics and Motor Drives", Taylor & Francis Group, CRC Press is an imprint of Taylor & Francis Group, ISBN 0-8247-2361-9.
7. Nicolas Navet and Françoise Simonot- Lion, "Automotive Embedded Systems Handbook", CRC Press Taylor & Francis Group, 6000 Broken Sound Parkway NW, Suite 300, ISBN-13: 978-0-8493-8026-6, ISBN-10: 0-8493-8026-X
8. Paul Nieuwenhuis and Peter Wells, "The automotive industry and the environment A technical, business and social future", Woodhead Publishing ISBN 1 85573 713 2, CRC Press ISBN 0-8493-2072-0, CRC Press order number: WP2072.
9. Simon Tung, Bernard Kinker, and Mathias Woydt," Automotive Lubricant Testing and Advanced Additive Development", ASTM 100 Barr Harbor Drive PO Box C700, West Conshohocken, PA 19428-2959,ISBN: 978- 0-8031-4505-4.
10. James Larminie, John Lowry, "Electric Vehicle Technology Explained", Oxford Brookes University, Oxford, UK, Acenti Designs Ltd.,UK. ISBN 0-470-85163-5.

Oil and Gas Drilling Equipment

ENME803195
4 SKS
Learning Outcomes:

Provide an understanding of the implementation of basic knowledge of technical competence which is the core technology of oil and gas drilling equipment. The competencies expected of students who have taken this course are graduates who have added value related to technical knowledge of oil and gas drilling equipment and are ready and able to adapt easily in the world of the oil and gas industry in general and oil and gas drilling in particular. The expected learning objectives and outcomes are as follows: Students know the basic equipment and its functions and how each of these equipment is needed in oil and gas drilling operations; Students are able to explain oil and gas drilling operation techniques as well as various related aspects such as equipment used, safety issues, safety equipment, environmental issues, and emergency conditions; Students have a good understanding of drilling equipment and operations so that they can participate in oil and gas drilling operations in the world of work and are ready to improve their knowledge and skills while working

Syllabus:

Introduction to oil/gas wells, Oil/gas exploration, production and exploitation, drilling rigs, terminology and drilling problems of drilling, drilling fluids, oil and gas drilling systems, hoisting system equipment, rotating system equipment, circulatin system equipment, power system equipment, blowout prevention systems, well design, equipment and operations for safety and efficiency, processes and equipment for cementing, drilling preparation, drilling operations, problems in the drilling process (drill string vibration and whirling, collar failure, etc.) artificial lift methods and equipment, visits to the oil and gas drilling industry

Pre-requisite(s): Engineering Materials, Mechanical Design

References:

1. Don A. Gorman, Jerry W. Meyer, “Drilling Equipment and Operations”, Action Systems Inc., Dallas, Texas – USA.
2. Adam T. Bourgoyne, Martin E. Chenevert, et. al., “Applied Drilling Engineering”, Society of Petroleum Engineers, Richarson, Texas – USA.
3. Nguyen J.P., “Drilling-Oil and Gas Field Development Techniques”, Institut Français du Pétrole Publication, 1996
4. Kermit E. Brown, “The Technology of Artificial Lift Methods”, Volume 2a, Petroleum publishing Co., 1980
5. Amanat U.C., “Oil Well Testing handbook”, Elsevier, 2004
6. Amanat U.C., “Gas Well Testing handbook”, Elsevier, 2004

Railway Vehicle Engineering

ENME804168
4 SKS
Learning Outcomes:

Provides the knowledge and design of rail vehicle.

Syllabus:

Engineering and economic analysis of rail vehicles; body structures and rail vehicles; structural analysis of flat car; coupler analysis; electrical and pressurized water; analysis and modeling of the bogie; axle; wheel; brake and pivot; suspension system and driving quality; dynamic load analysis; fatigue and cracks in rail vehicles; models of rail vehicles and track geometry; modeling components of rolling stock; response rail vehicle on the track tangent; lateral stability of the rail vehicle on the track tangent; response rail vehicle on a curved trajectory; wheel wear; rail vehicle dynamics.

Pre-requisite(s): Engineering Materials, Mechanical Design

References:: Simon Iwnicki, handbook of railway vehicle dynamics, CRC Press, Taylor & Francis Group, 2006.

Material Handling Equipment

ENME804197
4 SKS
Learning Outcomes:

Provides expertise and competence to students in the field of design and development of lifting equipment and construction equipment

Syllabus:

Introduction and Scope of Construction Equipment; Tractor, Bulldozer, Dump Truck and shovel; Construction Equipment Mechanical Concept; Heavy equipment system: Pneumatic and Hydraulic; Basic Machine-lifting machinery and materials transporter; Cranes, hoist and conveyor; forklift: Moving Walks, Escalators, and Elevators

Pre-requisite(s): Engineering Materials, Mechanical Design

References:

1. ASME. Handbook of Materials Handling.
2. Mc.Guiness. Mechanical and Electrical Equiment for Building.

Aircraft Design And Performance

ENME804198
4 SKS
Learning Outcomes:

Explain aircraft flying techniques, Explain the design concepts of an aircraft, Explain the design stages of an aircraft, Determine aircraft design requirements, Analyze aircraft performance, Analyze the advantages and disadvantages of an aircraft design.

Syllabus:

The evolution of aircraft design, design requirements of an aircraft, aircraft design concepts, aircraft aerodynamics, aircraft propulsion systems, aircraft performance in steady flight conditions, aircraft performance in accelerated flight conditions, aircraft design which includes aspects of aerodynamics and its components, the technique of flying an airplane.

Pre-requisite(s): Engineering Materials, Mechanical Design

References:

1. J. D. Anderson, Aircraft Performance and Design, McGraw-Hill
2. Daniel Raymer, Aircraft Design, American Institute of Aeronautics and Astronautics.
3. Mohammad H. Sadraey, Aircraft Design: A Systems Engineering Approach, Wiley.
4. John P. Fielding, Introduction to Aircraft Design, Cambridge.
5. Egbert Torenbeek, Advanced Aircraft Design: Conceptual Design, Analysis and Optimization of Subsonic Civil Airplanes, Wiley.

Maritime Engineering and Management

ENME802181
4 SKS
Learning Outcomes:

This course provides knowledge about technologies for ocean transportation and the application of ocean-based energy sources. This course also aims to equip students with understanding of maritime opportunities that can be developed with the use of technology.

Syllabus :

Classification of ship based on its function, aspects to consider in ship designing, history of development of off-shore structure, ocean environment, typesof off-shore structure: fixed design and floating design, mooring and anchoring system, force calculation of off-shore structure, FPSO

Pre-requisite(s): -

References:

1. Research Council National Research Council, NEW Mining in the Outer Continental Shelf and in the Deep Ocean, University Press of the Pacific, 2005
2. Arthur H. Johnson, Michael D. Max, William P. Dillon, Natural Gas Hydrate - Arctic Ocean Deepwater Resource Potential, Springer, 2013
3. Khaligh, Alireza and Onar, Omer C., Energy Harvesting: Solar, Wind, and Ocean Energy Conversion Systems, CRC Pr I Llc, 2009

Ocean Energy

ENME803182
4 SKS
Learning Outcomes:

This course provides knowledge about technologies and principles related to the design of renewable ocean energy system

Syllabus :

Introduction to renewable ocean energy, introduction to wind turbine, tidal system and tidal energy system, OTEC, ocean flows, methods of economic/ financial assessment for off-shore renewable energy system,wind energy, momentum theory and the limit of wind power output, tidal flow and its conversion to mechanical energy, description of wave energy sources, instruments of wave energy and instruments for simulation.

Pre-requisite : -

References:

1. Twidell, J. and Weir, T., "Renewable Energy Resources. Second Edition", Taylor and Francis Group, 2006.
2. Boyle, G., "Renewable energy power for a sustainable future, Second Edition", Oxford University Press, 2005.
3. Walker J and Jenkins N, "Wind Energy Technology", Wiley Unesco Energy Engineering Series, 1997.
4. Manwell JF, McGowan, JG and Rogers, AL., "Wind Energy explained: Theory, Design and Application", Wiley. 2nd Edition. ISBN0-470-01500-4, 2010
5. Cruz, J., "Ocean Wave Energy: Current Status and Future Perspectives", Springer-Berlin, 2007.
6. Falnes, J., "Ocean Waves and Oscillating Systems: Linear Interactions Including Wave-Energy Extraction", Cambridge University Press, Cambridge, 2002.
7. Baker AC, "Tidal Power", Peter Peregrinus Ltd, 1981.

Marine and Offshore Structure

ENME803183
4 SKS
Learning Outcomes:

Provides the knowledge, understanding of the theory and principles of building offshore include the type, function, and offshore construction technology and techniques in performing design structure.

Syllabus :

Types of Offshore; Construction and Offshore Structures; Calculation of Style and Power Offshore: Safety Requirements; Construction Semi-submersible; Single Buoy Mooring; FPSO; Offshore Maintenance and Repair.

Pre-requisite : -

References :

1. Cliff Gerwick, Construction of Marine and Off-shore Structures, CRC Press 1999
2. Subrata Chakrabarti, Handbook of Offshore Engineering, Elsevier Science, 2005
3. Yong Bai, Marine Structural Design, Elsevier Science, 2003

Sea Transport and Port Management

ENME803184
4 SKS
Learning Objective(s):

Provides the knowledge and understanding of various management approaches, maritime transport and port activities which also include risk factors, safety, and economy.

Syllabus :

Sea Transport Demand Trend: Marine Transportation Market Research; Inter Mode Transport System; System loading and unloading, Types of Sea Transport, Warehousing and Storage Cargo Systems, SystemsAgency, Survey Charge, Corporate Sailing economic calculation, Customs.

Pre-requisite : -

References :

1. P. Lorange, Shipping Management, Institution for shipping Research.
2. Patrick Alderton, Reeds Sea Transport : Operation and Management, Adlard Coles, 2008
3. Patrick Alderton, Port Management and Operations,Informa Business Publishing, 2005
4. Svein Kristiansen, Maritime Transportation : Safety management and Risk analysis, Butterworth-Heinemann, 2004
5. M. Stopford, Maritime Economics, Routledge, 1997
6. House, D.J, Cargo Work for Maritime Operation, Butterworth Heinemann, 2005

Maritime Law and Regulation

ENME803185
4 SKS
Learning Outcomes:

Provides knowledge and understanding of the laws and regulations on maritime activities both nationally and internationally.

Syllabus :

Introduction of maritime law; Regulation of Marine Pollution Prevention and Control; SOLAS; Prevention of Collisions Regulations; ISM Code; Statutory Rules; Passenger Ship Regulations; Tanker Regulations; Offshore Regulations: Accident Rescue Regulations; Other IMO rules. Accident prevention regulations; Risk assessment and analysis.

Pre-requisite : -

References:

1. International Convention for the Prevention of Pollution From Ships (MARPOL), International Maritime Organisation Publications
2. International Regulations for Preventing Collisions at Sea (COLREG), International Maritime Organisation Publications
3. International Convention for the *Safety of Life at Sea* (SOLAS), International Maritime Organisation Publications
4. International Safety Management Code (ISM Code) Guide Book, International Maritime Organisation Publications
5. Churchil R.R. dan Lowe A.V, The Law of the Sea, MUP 1999

Supply Chain Technology

ENME804192
4 SKS
Learning Outcomes:

Providing knowledge and understanding in the use of technology in managing the flow of goods with a focus on the transportation system and managing the flow of information between organizations in a supply chain.

Syllabus :

Introduction and introduction to supply chains, the role and function of transportation in supply chains, intermodal transportation, variability in transport lead time in supply chains, use of technology in supply chains (Artificial Intelligence, Advanced Analytics, Internet of Things, Intelligent Things, Conversational Systems)

Pre-requisite : -

References:

1. Ek Peng Chew. Advances in Maritime Logistics and Supply Chain Systems, World Scientific Publishing Company, 2011
2. Robert A. Novack. Transportation: A Global Supply Chain Perspective, South Western Educational Publishing, 2018
3. Geunes, J. Supply Chain Optimization, Springer, 2005.
4. Lehmacher. W. The Global Supply Chain: How Technology and Circular Thinking Transform Our Future, Springer International Publishing, 2017

Cargo Cooling Technology

ENME804193
4 SKS
Learning Outcomes:

Providing knowledge and understanding in the use of cooling and air conditioning equipment circulation technology; cold storage and low temperature logistics.

Syllabus :

Basic principles for estimating cold storage loads, calculation of cooling capacity for various types of cold storage, and other topics of evaporative cooling, principles for designing low-cost refrigeration bases.

Pre-requisite : -

References:

1. ERao, C.G. Engineering for Storage of Fruits and Vegetables: Cold Storage, Controlled Atmosphere Storage, Modifie Atmosphere Storage. Academic Press, 2015, ISBN: 0128033657,9780128033654

Special Ship Project

ENME804186
4 SKS
Learning Outcomes:

Provides the knowledge, understanding of ship design for special purposes.

Syllabus :

Typology and special ship purposes; Material to special Ship, Design Considerations; Calculation of loading; Calculation of Ship Quantities; Computation Structures: Propulsion Systems; Motion System; Safety and Navigation System; Stability Calculation.

Pre-requisite : -

References :

1. Lars Larsson dan Rolf Eliasson, Principles of Yacht Design, International Marine/Ragged Mountain Press, 2007
2. Dave Gerr, The Elements of Boats Strength, International Marine/Ragged Mountain Press, 1999
3. Norman L. Skene, dan Marnard Bray, Elements of Yacht Design, Sheridan house, 2001
4. Steve Killing dan Doug Hunter, Yacht Design Explained : A Sailors Guide to the Principles and Practices of Design, W.W Norton and Company, 1998
5. S. Sleight, Modern Boat Building, Conway Maritime Press.

Ship Production Optimization

ENME804187
4 SKS
Learning Outcomes:

Provides knowledge and understanding of the various shipyard management and technique.

Syllabus :

Shipyard Layout; Ship Process Production; Steel Stock Yard Planning; Crane Calculation: Jamorang Calculation At Each Stage Production: Make Work Schedule: Work Break Down Structure; Integrated Hull Outfitting and Painting; Advanced Outfiting; Group Technology Methods for Ship Production; Ship launching; Ship trials.

Pre-requisite : -

References :

1. D.J. Eyres, Ship Construction, Butterworth-Heinemann, 2007
2. R.Shenoi, Ship Production Technology, Univ. Of Southampton.
3. National Research Council, Shipbuilding Technology and Education, National Academy Press, 1996

Maritime Safety

ENME804189
4 SKS
Learning Outcomes:

Provides knowledge and understanding related to the safety via regulations, management, and development of any forms of maritime transportation technology.

Syllabus :

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

Pre-requisite(s): -

References:

1. Jones. S. Maritime Security: A practical Guide, the nautical institute 2012
2. Consolidate Edition, MARPOL, International Maritime Organization, 2006
3. Consolidate Edition, SOLAS, International Maritime Organization, 2004

Advanced Welding Engineering
ENME804190
4 SKS
Learning Outcomes:

Provide knowledge, understanding of the theories, principles and design as well as the assessment of the quality of welding and welding applications.

Syllabus:

Introduction, review of welding term and definition, welding process type, standard power source, Oxy-gas welding, Shield Metal Arc Welding (SMAW), Gas Tungsten Arc Welding (GTAW), Gas Metal Arc Welding (GMAW), Submerged Arc Welding (SAW), Flux Cored Arc Welding (FCAW), Resistance welding, Friction Stir Welding, Other welding process: laser, electron beam, plasma, Cutting and other edge preparation processes, surfacing and spraying, Brazing and soldering, Joining processes for plastics, ceramics and composites, Welding metal: Ferrous-based metal, non-ferrous-based metal, Material behavior during welding process, Testing materials and the weld joint, Non Destructive Examination (NDE), DT (Destructive Test), Heat treatment of base materials and welded joints, Basic of welding design, Residual stresses and distortion, Welding Symbol, Behavior of welded structures under different types of loading, Design of welded structures under static and dynamic loading, welding defects, Design of welded pressure equipment, Welding Performance Qualification Record (WPQR), Welding Procedure Specification (WPS), Welding automation.

Pre-requisite(s): -

References:

1. Sindo Kou, Welding Metallurgy, 2nd Edition, Wiley, 2002.
2. ASME Section IX, Welding and Brazing Qualifications
3. AWS D1.1., Structural Welding (Steel)
4. William A. Bowditch, Welding Fundamentals 5th Edition, Goodheart-Willcox, 2011.
5. Technical Manual TM 5-805-7. Welding Design, Procedures and Inspection Headquarters, Department of the Army.1985
6. Lloyds Register. Welding Procedures, Inspections and Qualifications.

Planning And Operational Port
ENME804191
4 SKS
Learning Outcomes:

Port Planning and Operations is a lecture that emphasizes the process of planning the layout and operation of ports in accordance with commodities managed based on the principle of green-port development. This course is Shipping Engineering Elective Courses, which are expected to provide a complete understanding for students in planning ports in the realm of sea transportation. After completing this lecture, students plan the layout and operation of the port in accordance with the principles of green-port development technology.

Syllabus :

Sea transportation: Facilities and commodities, Port functions in maritime transportation, types of ports and sea terminals, stages in port planning, integrated port planning principles, planning and design of port water areas., Conventional general cargo terminals, Container terminals, Oil & liquid gas terminals, Dry bulk cargo terminals, Green port developments, Conventional general cargo terminals, Container terminals, Oil & liquid gas terminals, Dry bulk cargo terminals, Green port developments.

Pre-requisite : Welding Engineering

References:

1. Ligteringen, (1999), Ports and Terminals, Faculty of Civil Engineering and Geosciences Department of Hydraulic and Geotechnic Engineering Section Hydraulic Engineering, Technische Universiteit Delft.
2. Velsink, H., (1994), Ports and Terminals: Planning and Functional Design, Faculty of Civil Engineering Hydraulic Engineering Group, Delft University ofTechnology.
3. Bose, J.W., (2011), Handbook of Terminal Planning, Springer-Verlag New York

Engineering Magister Through Fast Track Program

For students who wish and are able to continue their education program to the Masters level in Engineering through the Fast track program, a credit transfer can be made up to a maximum of 22 credits. The number of credits that can be transferred is 14 credits from the mandatory subjects and 8 credits from the 2 elective subjects @ 4 credits.

Specialization subjects and optional specialization subjects, so that credit can be transferred if the subject is in accordance with the subject in the

choice of Specialization in Mechanical Engineering Masters Program.

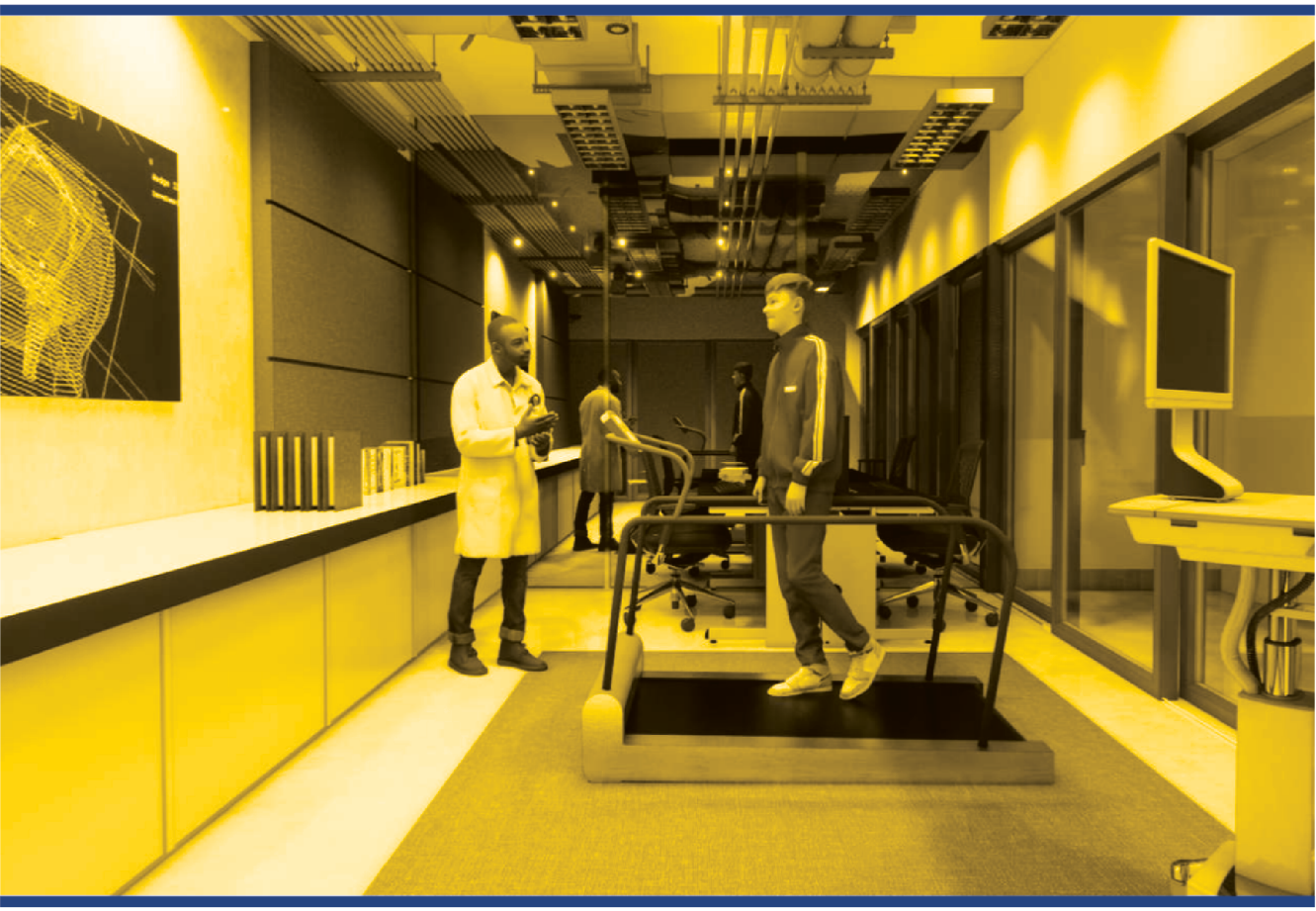
Requirements for students to take part in the Fast Track program are as follows:

1. Expressing his intention to take part in the Fast Track Program, by writing an Application Letter to the Chairperson of the Department of Mechanical Engineering by including a Study Plan in the form of a lesson plan in Semester 6 to 8 (Undergraduate Engineering Program) and Semester 1 s.d. 4 (in the Master of Engineering Program) in accordance with the Specialization in the Master of Engineering Program, no later than at the end of Semester 5 of the Bachelor of Mechanical Engineering or Naval Architecture and Marine Engineering programs.
2. Have excellent academic grades, with a Grade Point Average (GPA) up to Semester 5, minimum 3.2, and have graduated from all Basic Subjects.
3. Has a person in charge and or a scholarship to complete his Bachelor of Engineering and Masters of Engineering with the Fast Track Scheme.
4. Students who take part in the Fast Track Program express their willingness to attend the Academic Program on a Full-Time basis.
5. If the Application for Fast Track Scheme can be approved by the Head of Department / Study Program, the student concerned will discuss together with the Academic Advisor for finalization of the Bachelor of Engineering (S1) and Masters of Engineering (S2) Study Plans.

Students of Engineering Undergraduate Program (S1) who have been approved with plans to continue their studies to the Masters Degree in Engineering (S2) by the Chair of the Department of Mechanical Engineering, need to immediately adjust their study plans in Semesters 7 and 8, especially in taking their S1 Elective Subjects by adjusting themselves with Obligatory and Elective Subjects at the Masters level in Engineering according to their specialization.

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.

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