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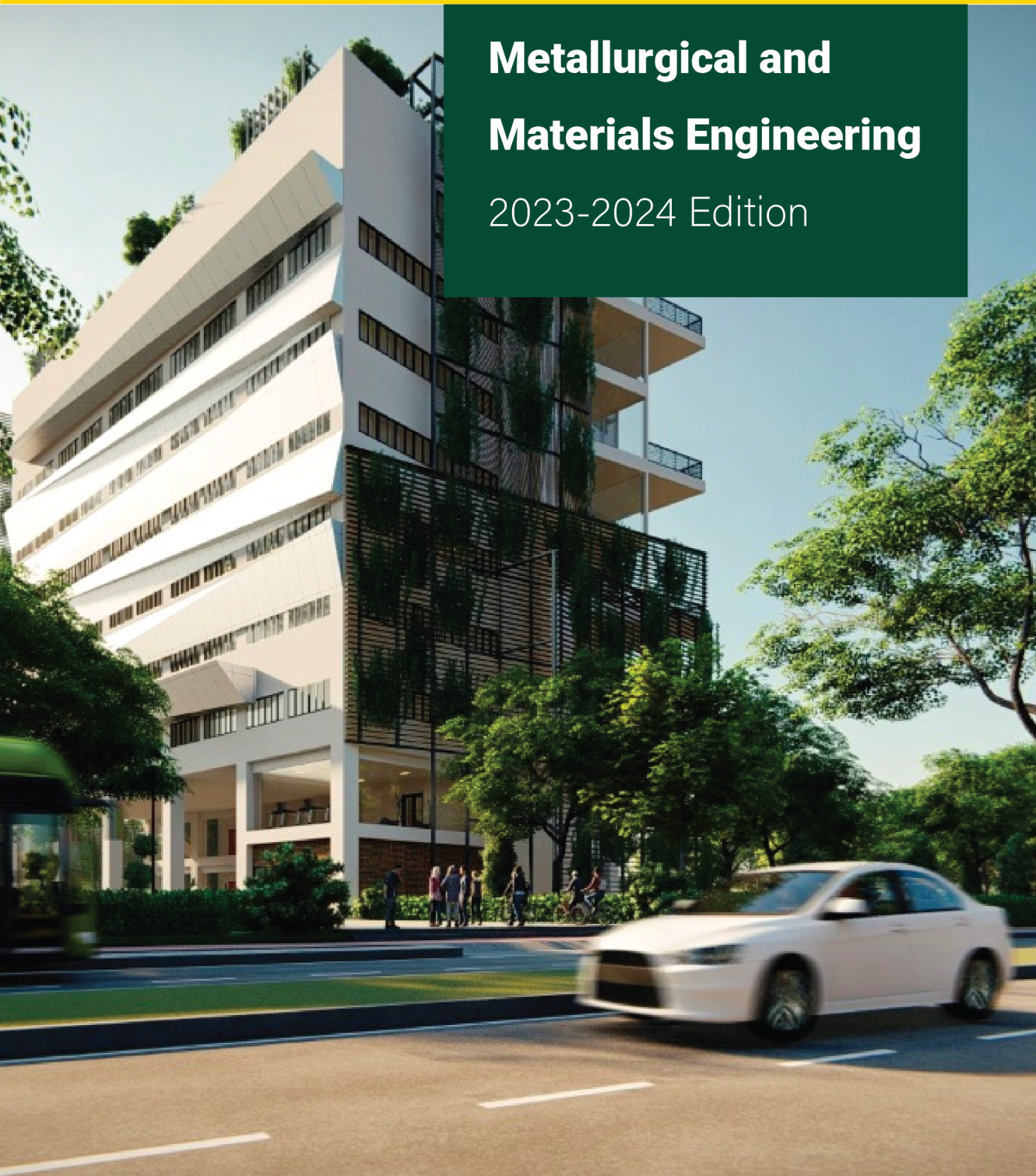
FAKULTAS TEKNIK

Metallurgical and Materials Engineering

2023-2024 Edition



FACULTY OF ENGINEERING

UNIVERSITAS INDONESIA

ACADEMIC GUIDEBOOK

2020 - 2024

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METALLURGICAL AND MATERIALS ENGINEERING GUIDEBOOK

2020 - 2024

2023 Edition

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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 Metallurgical and Materials Engineering

General

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

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

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

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

- Grade A Accreditation for Undergraduate Program from National Accreditation Board, Ministry of National Education (Year 2018 – 2023).
- Establishment of master (1995) and doctoral (2008) programs.
- Grade A Accreditation for Master Program from National Accreditation Board, Ministry of National Education (Year 2019 - 2024)
- Grade A Accreditation for Doctoral Program from National Accreditation Board, Ministry of National Education (Year 2017 - 2022)
- Establishment of "Dual-degree" International Program with Monash University (2003); Queensland University of Technology, Australia; and Duisburg Essen, Germany
- Grant awards from the Government of Republic Indonesia for:
    - Internal Improvement for non-metallic field competence - PHK-A4 (2004)
    - Improvement for external and regional competence – PHK-A2 (2004-2006)
    - Internationalization of academic and research activities in information technology, energy and nonmaterial – PHKI (2010-2013)
- Establishment of Center for Materials Processings and Failure Analysis (CMPFA), a special task unit to support the materials engineering community and industry (2001).
- Intensive academic and research collabora-

tions with international institutions, such as Monash University (Australia), Kagoshima University (Japan), Nanyang Technological University (Singapore), Yeungnam University and KITECH (Korea) (since 2006).

- Materials Testing Laboratory in CMPFA was accredited SNI-ISO 17025 (accredited since 2011, renewed until 2024)

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Vision

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

Mission

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

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

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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 with a copy to the Head of the Department.

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

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

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

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

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

Academic Leave

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

Procedures of Academic Leave

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

Faculty and Department Judiciums

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

Semester Grade Transcript, Diploma and Academic Transcripts

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

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

level.

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

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

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

Offenses and Sanctions

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

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

Academic Sanction for Perpetrators of Academic Cheating In Exams

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

offence in the examination process for planning and carrying out the plan to help any other examinee;

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

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

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

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

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

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

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

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

Academic Regulation Of The Universitas Indonesia

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

General:

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

Number: 005/SK/ MWA-UI/2004 on the Code of conduct on Campus Life in Universitas Indonesia

Education

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

Research

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

CHAPTER 3

FACILITIES AND CAMPUS LIFE

LIST OF HEADS' NAMES FOR THE LABORATORY AND METALLURGY & MATERIALS

ENGINEERING DEPARTMENTS

No	Head of Laboratory	Laboratory	Laboratory Assistant	Equipment in the Lab	Subjects Related to Lab
1	Dr. Sotya Astituningsih	Metalurgi Fisik	Bagas Aji Rotama	Tensile testing equipment; impact test equipment; hardness test equipment	Failure analysis ; Materials Physics
2	Prof. Dr. Ir. Donanta Dhaneswara, M.Si	Metalurgi Proses	Adimas Jati Gusti Sukmajaya	Sieving test machine; universal testing machine; rammar, dryer; crucible kitchen	Testing of molding sand and metal casting
3	Prof. Dr. Mochamad Chalid, S.Si., M.Sc.Eng.	Metalurgi Kimia	Ary Yanuar Tri Amalia	Analytical balances; centrifuge; hotplates; pH meter	Basic chemistry
4	Prof. Dr. Ir. Myrna Ariati Mochtar, M.S.	Metalografi dan Perlakuan Panas	Paramitha Vidya	sanding machine; polishing machine; microscope; furnaces; oil baths; sample cutting machine; Vickers hardness	Material Characterization
5	Prof. Dr. Ir. Rini Riastuti, M.Sc.	Korosi	Dewi kurnia suci	Potentiostat; Salt spray tester; Neraca Analitik; Furnace; Froth Flotation; Software Nova Autolab	Metal Corrosion and Protection; Extraction Metallurgy
6	Dr. Rahmat Saptono	Metalurgi Mekanik	Muhammad Syamhusein Finsyah	Pilot rolling machine; Universal Sheet Metal Testing Machine;	Sheet Metal Forming

CHAPTER 4

UNDERGRADUATE PROGRAM

Undergraduate Program in Metallurgical & Materials Engineering

Program Specification

1.	**Awarding Institution**	Universitas Indonesia Double Degree: Universitas Indonesia & Partner Universities	
2.	**Teaching Institution**	Universitas Indonesia Double Degree: Universitas Indonesia & Partner Universities	
3.	**Faculty**	Engineering	
4.	**Name of Study Program**	Undergraduate Program in Metallurgy and Materials Engineering	
5.	**Vission and Mission**	**Vision:** To be a research-based center of excellence, as well as referral center and solution provider for problems in the field of metallurgical and materials engineering in national and global levels **Mission:** • To provide broad access to education and research for the public and industry • To produce high quality graduates with strong academic background and comprehensive skills in process technology, material engineering and design, who are capable of undertaking active and dynamic role in national, regional and international arenas • To perform quality Tridharma (three duties) relevant to the national and global challanges. • To create conducive academic environment to support the vision of the Department of Metallurgical and Materials Engineering	
6.	**Type of Class**	Reguler, Non Reguler, International	
7.	**Awarding Degree**	Sarjana Teknik (S.T.) Double Degree: Sarjana Teknik (S.T.) and Bachelor of Engineering (B.Eng.)	
9.	**Accreditation / Recognition**	BAN-PT: Excellent AUN-QA: Accredited IABEE: Accredited	
10.	**Language Course**	Bahasa (Indonesia) and English	
11.	**Learning Scheme (Full Time / Part Time)**	Full Time	
12.	**Entry Requirements**	High school graduate/equivalent, or Vocational/Polytechnique/Community College	
11.	**Term of Study**	Programmed for 4 years	
	Type of Semester	Number of Semester	Number of weeks / semester
	Regular	8	16
	Short (optional)	3	8
13.	**Aims of the programme** 1. To produce high quality graduates with a strong academic foundation 2. To produce graduates who are comprehensively capable in process technology and material engineering 3. To produce graduates who are able to contribute an active and dynamic role in the national, regional and international community.		

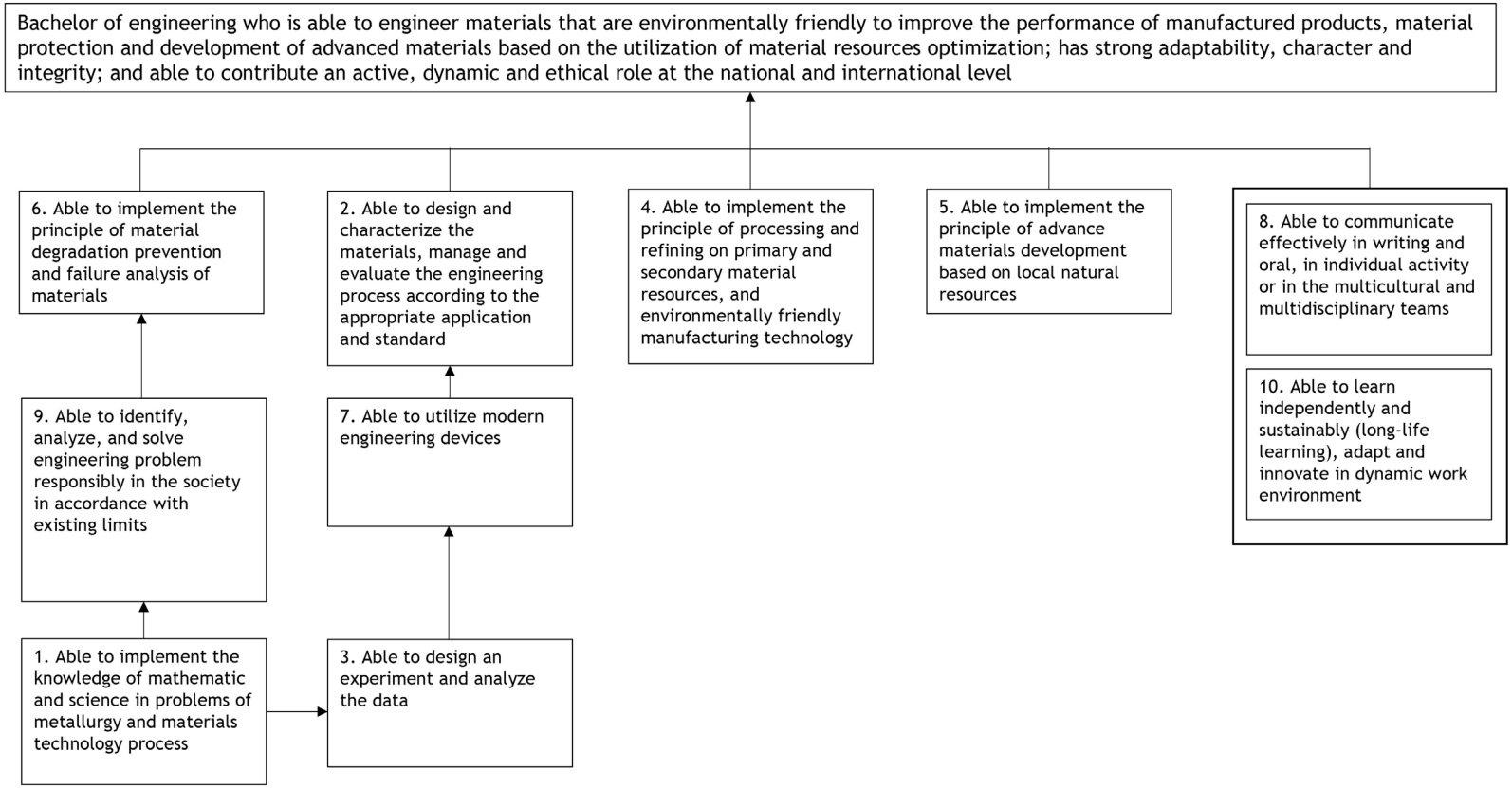
14.	**Profile of Graduates** Bachelor of Engineering who is able to engineer materials that are environmentally friendly to improve the performance of manufactured products, material protection and development of advanced materials based on the utilization of material resources optimization; has strong adaptability, character and integrity; and able to contribute an active, dynamic and ethical role at the national and international level
15.	**Expected Learning Outcomes:** The graduates of Metallurgical and Materials Engineering will have the following outcomes: 1. Able to implement the knowledge of mathematic and science in problems of metallurgy and materials technology process 2. Able to design and characterize the materials, manage and evaluate the engineering process according to the appropriate application and standard 3. Able to design an experiment and analyze the data 4. Able to implement the principle of processing and refining on primary and secondary material resources, and environmentally friendly manufacturing technology 5. Able to implement the principle of advance materials development based on local natural resources 6. Able to implement the principle of material degradation prevention and failure analysis of materials 7. Able to utilize modern engineering devices 8. Able to communicate effectively in writing and oral, in individual activity or in the multicultural and multidisciplinary teams 9. Able to identify, analyze, and solve engineering problem responsibly in the society in accordance with existing limits 10. Able to learn independently and sustainably (long-life learning), adapt and innovate in dynamic work environment

No.	Type of Courses	Credits	Percentage
i	**Basic University Courses**	10	6,25 %
ii	**Basic Engineering Courses**	22	15,28 %
iii	**Metallurgical and Materials Engineering Courses**	77	53,47%
iv	**Elective Courses**	28	19,44%
v	**Internship, Seminar, Final Year Projects**	8	5,56 %
	Total	145	100 %
	Total Credit Hours to Graduate		145 credits

Job Prospects

Graduates of this study program can work in various sectors both private, state-owned and government such as in the automotive industry, manufacturing, heavy equipment, mining, oil and gas, research and development fields such as Pertamina, LIPI, BATAN, BPPT, LAPAN, Ministry of Industry, and Ministry of Energy and Mineral Resources.

Expected Learning Outcomes Matrix



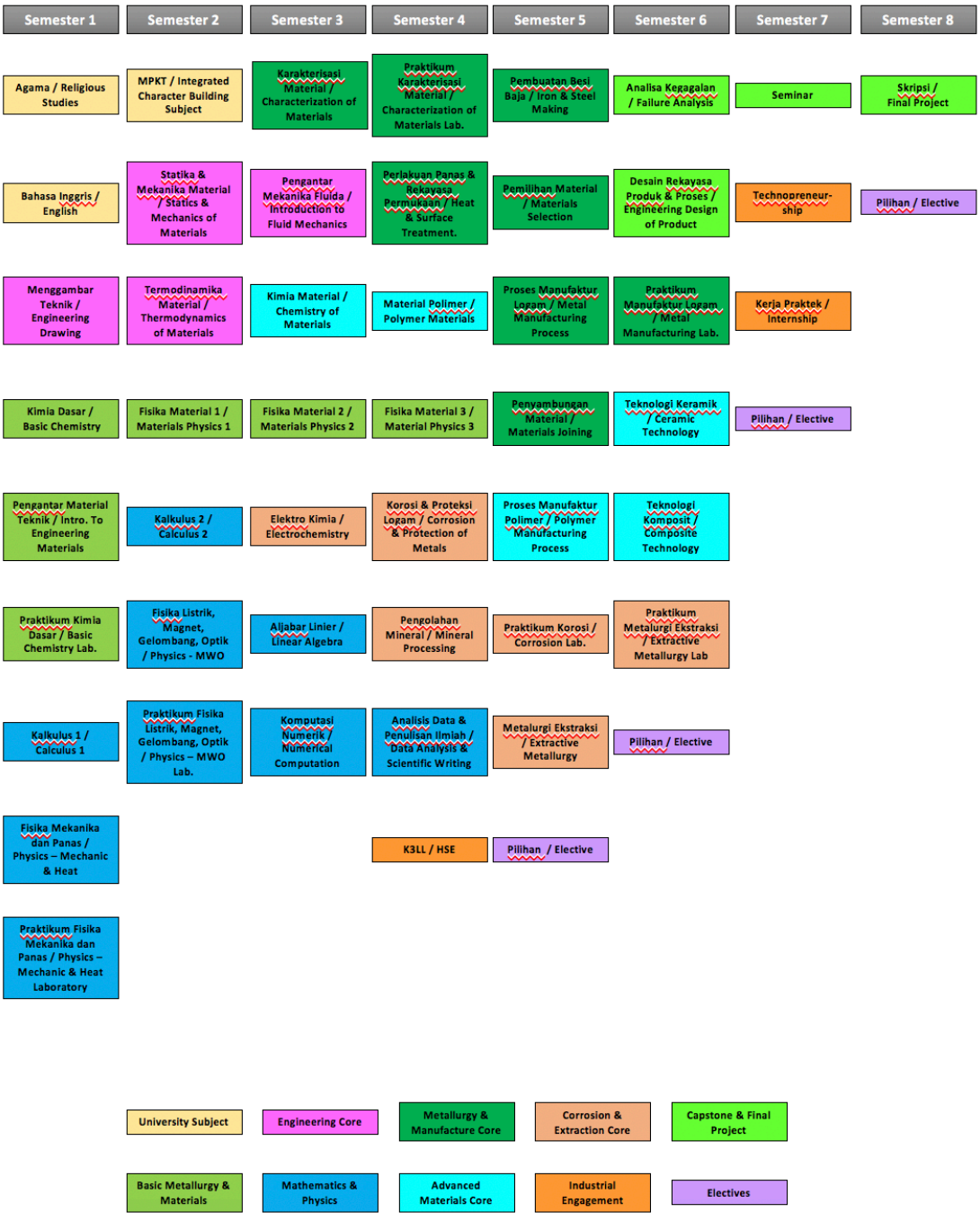
Course Flowchart for Learning Outcome Achievement
Bachelor Program Metallurgical & Materials Engineering

Learning Outcome	Year 1		Year 2		Year 3		Year 4	
	Semester 1	Semester 2	Semester 3	Semester 4	Semester 5	Semester 6	Semester 7	Semester 8
1. Able to implement the knowledge of mathematic and science in problems of metallurgy and materials technology process	Calculus 1	Calculus 2	Numerical Computation					
	Basic Chemistry	Materials Physic 1	Characterization of Materials					
	Basic Chemistry Laboratory	Static & Mechanic of Materials	Materials Physic 2					
	Introduction to Engineering Materials	Physics - Electricity, MWO	Electrochemistry					
	Physics - Mechanics and Heat	Physics - Electricity, MWO Laboratory	Linear Algebra					
		Thermodynamics of Materials	Introduction to Fluids Mechanics					
2. Able to design and characterize the materials, manage and evaluate the engineering process according to the appropriate application and standard			Characterization of Materials		Materials Selection	Engineering Design of Products		
3. Able to design an experiment and analyze the data				Data Analysis & Scientific Writing			Seminar	Final Project

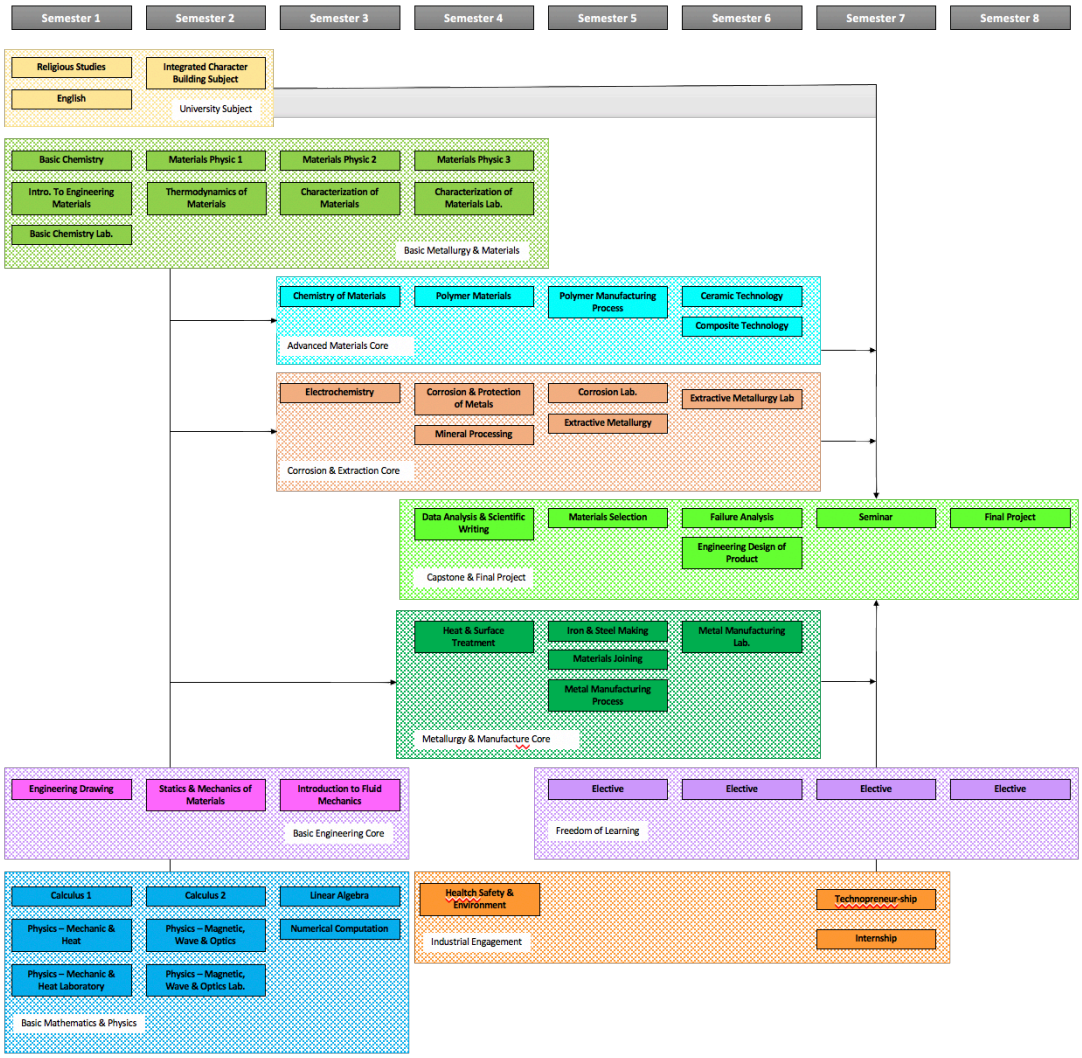
4. Able to implement the principle of processing and refining on primary and secondary material resources, and environmentally friendly manufacturing technology				Mineral Processing	Extractive Metallurgy			
				Heat Treatment & Surface Engineering	Iron & Steel Making			
					Materials Joining			
					Metal Manufacturing			
5. Able to implement the principle of advance materials development based on local natural			Materials Physic 2	Materials Physic 3	Polymer Manufacturing Process	Ceramic Technology		
				Polymer Materials		Composite Technology		
6. Able to implement the principle of material degradation prevention and failure analysis of materials				Corrosion & Protection of Metals		Failure Analysis		
7. Able to utilize modern engineering devices	Basic Chemistry Laboratory	Physics - Electricity, MWO Laboratory		Materials Characterization Laboratory	Corrosion Laboratory	Extractive Metallurgy Laboratory		
	Engineering Drawing					Metals Manufacturing Laboratory		
	Physics - Mechanics and Heat Laboratory							

8. Able to communicate effectively in writing and oral, in individual activity or in the multicultural and multidisciplinary teams	English	Integrated Character Building Subject	Numerical Computation	HSE Protection	Extractive Metallurgy	Metals Manufacturing Laboratory	Technopreneurship	
	Engineering Drawing			Data Analysis & Scientific Writing	Iron & Steel Making	Extractive Metallurgy Laboratory	Internship	
				Materials Characterization Laboratory	Materials Selection		Seminar	
					Corrosion Laboratory			
9. Able to identify, analyze, and solve engineering problem responsibly in the society in accordance with existing limits			Materials Physic 2	Materials Physic 3		Failure Analysis	Internship	Final Project
			Characterization of Materials	Corrosion & Protection of Metals		Engineering Design of Products		
				Polymer Materials				
				Mineral Processing				
10. Able to learn independently and sustainably (long-life learning), adapt and innovate in dynamic work environment	Religious Studies	Integrated Character Building Subject	Electrochemistry	Heat Treatment & Surface Engineering	Materials Joining	Ceramic Technology	Technopreneurship	
	Introduction to Engineering Materials	Materials Physic 1	Chemistry of Materials		Metal Manufacturing Process	Composite Technology		
		Static & Mechanic of Materials	Introduction to Fluids Mechanics		Polymer Manufacturing Process			
		Thermodynamics of Materials						

Course Type Distribution in Curriculum 2020



Course Correlation in Curriculum 2020



Course Structure for Undergraduate Metallurgical & Materials Engineering Program (Regular & Non Reguler Class)

Code	Subject	SKS
	1st Semester	
UIGE600004	Religious Studies	2
UIGE600003	English for Academic Writing	2
ENGE600001	Calculus 1	3
ENGE600005	Physics - Mechanics and Heat	3
ENGE600006	Physics - Mechanics and Heat Laboratory	1
ENGE600009	Basic Chemistry	2
ENMT601001	Engineering Drawing	**2**
ENMT601002	Introduction to Engineering Materials	**2**
ENMT601003	Basic Chemistry Laboratory	1
	Sub Total	**18**
	2nd Semester	
UIGE600007	Integrated Character Building Subject	6
ENGE600002	Calculus 2	3
ENGE600007	Physics - Electricity, MWO	3
ENGE600008	Physics - Electricity, MWO Laboratory	1
ENMT602004	Materials Physic 1	2
ENMT602005	Static & Mechanic of Materials	3
ENMT602006	Thermodynamics of Materials	2
	Sub Total	**20**
	3rd Semester	
ENGE600004	Linear Algebra	4
ENMT603007	Electrochemistry	3
ENMT603008	Materials Physic 2	3
ENMT603009	Characterization of Materials	3
ENMT603010	Chemical Characterization of Materials	2
ENMT603011	Numerical Computation	2
ENMT603012	Introduction to Fluids Mechanics and Heat Transfer	2
	Sub Total	**19**
	4th Semester	
ENGE600012	HSE Protection	2
ENMT604013	Data Analysis and Scientific Writing	3
ENMT604014	Materials Physics 3	2
ENMT604015	Corrosion & Protection of Metals	3
ENMT604016	Polymer Materials	3
ENMT604017	Mineral Processing	3
ENMT604018	Heat Treatment and Surface Engineering	1
ENMT604019	Materials Characterization Laboratory	1
	Sub Total	**18**
	5th Semester	
ENMT605020	Extractive Metallurgy	3
ENMT605021	Iron & Steel Making	2
ENMT605022	Materials Selection	2
ENMT605023	Materials Joining	3
ENMT605024	Metal Manufacturing Process	4
ENMT605025	Polymer Manufacturing Process	3
ENMT606026	Corrosion Laboratory	**1**
ENMT607937-51	Elective	3
	Sub Total	**20**
	6th Semester	
ENMT606027	Failure Analysis	3
ENMT606028	Engineering Design of Products and Process	3
ENMT606029	Ceramics Technology	3
ENMT606030	Composite Technology	3
ENMT606031	Metal Manufacturing Laboratory	1
ENMT606032	Extractive Metallurgy Laboratory	1
ENMT608952-60	Elective	5
	Sub Total	**19**

	7th Semester	
ENMT607033	Technopreneurship	2
ENMT607034	Internship	2
ENMT607035	Seminar	2
ENMT607939-49	Elective	14
	Sub Total	**20**
	8th Semester	
ENMT600036	Final Project	4
ENMT608950-60	Elective	7
	Sub Total	**11**
	Total	**145**

Resume

Semester	Course	Prerequisite
4	HSE Protection	Minimum 50 credits
4	Materials Physic 3	Termodynamics of Materials, Introduction to Fluid Mechanics
4	Capita Selecta, Technology, and Society	Minimum 50 credits
4	Corrosion & Protection of Metals	Electrochemistry
4	Polymer Materials	
4	Mineral Processing	Materials Physics 1
4	Materials Characterization Laboratory	Characterization of Materials
4	Chemical Characterization of Materials Laboratory	Materials Characterization Laboratory
5	Extractive Metallurgy	Mineral Processing
5	Iron & Steel Making	Mineral Processing
5	Heat Treatment and Surface Engineering	Materials Physic 3
5	Metal Manufacturing Process	Materials Physic 3
5	Polymer Manufacturing Process	Polymer Materials
5	Corrosion Laboratory	Corrosion & Protection of Metals
6	Data Analysis and Scientific Writing	Minimum 90 credits
6	Materials Selection	Characterization of Materials, Materials Physics 2, Materials Physics 3
6	Materials Joining	Characterization of Materials, Materials Physics 3
6	Ceramics Technology	Materials Physics 3
6	Composite Technology	Polymer Materials
6	Metals Manufacturing Laboratory	Metal Manufacturing Process
6	Extractive Metallurgy Laboratory	Extractive Metallurgy
7	Failure Analysis	Materials Selection
7	Engineering Design of Products	Metal Manufacturing Process, Polymer Manufacturing Process, Ceramics Technology, Composite Technology, Materials Selection
7	Technopreneurship	Minimum 100 credits
7	Internship	Minimum 100 credits
7	Seminar	Minimum 105 credits
8	Final Project	Minimum 125 credits

Prerequisite List For Curriculum 2020 Courses

Code	Subject	SKS
	1st Semester	
ENMT607939	Special Alloyed Steels	2
ENMT607940	Biomaterial	2
ENMT607941	Engineering Ethics	2
ENMT607942	Computational Materials	2
ENMT607943	High Temperature Corrosion	2
ENMT607944	Electron Microscopy	2
ENMT607945	Polymer Compounding	2
ENMT607946	Quality Management Systems	2
ENMT607947	Advanced Solidification	2
ENMT607948	Special Processing and Assembly Technologies	2
ENMT607949	1st Term Advanced Internship	3
ENMT803918	Risk Based-Inspection and Integrity	3
ENMT803919	Advanced Polymer Manufacturing	3
ENMT803920	Electronic Materials	3
ENMT803921	Nanotechnology	3
	2nd Semester	
ENMT608950	Industrial Ecology	2
ENMT608951	Concrete Corrosion	2
ENMT608952	Energy Materials	2
ENMT608953	Refractory Materials	2
ENMT608954	Mechanics of Material Forming	2
ENMT608955	Industrial Mechanic Equipment	2
ENMT608956	Material Standardization	2
ENMT608957	Polymer Recycling Technology	2
ENMT608958	Rubber Technology	2
ENMT608959	Quenching Technology	2
ENMT608960	2nd Term Adv. Internship	3
ENMT804922	Advanced Manufacture	3
ENMT804923	Smart Materials	3
ENMT804924	Advanced Extractive Metallurgy	3
ENMT804925	Advanced Surface Engineering	3

Prerequisite for Elective Courses

Semester	Course	Prerequisite	Recommended Semester
1st Term	Special Alloyed Steels	Iron & Steel Making	7
1st Term	Biomaterial	Corrosion & Protection of Metals	5 or 7
1st Term	Engineering Ethics		5 or 7
1st Term	Computational Materials	Numerical Computation	5 or 7
1st Term	High Temperature Corrosion	Corrosion & Protection of Metals	5 or 7
1st Term	Electron Microscopy	Characterization of Materials	5 or 7
1st Term	Polymer Compounding	Polymer Materials	5 or 7
1st Term	Quality Management Systems	Data Analysis and Scientific Writing	7
1st Term	Advanced Solidification	Materials Physic 3	5 or 7
1st Term	Special Processing and Assembly Technologies	Materials Selection	7
1st Term	1st Term Advanced Internship	Minimum 125 credits	

1st Term	Risk Based-Inspection and Integrity	Characterization of Materials, Corrosion & Protection of Metals	(for fast-track / by department approval)
1st Term	Advanced Polymer Manufacturing	Polymer Manufacturing Process	(for fast-track / by department approval)
1st Term	Electronic Materials	Metal Manufacturing Process, Polymer Manufacturing Process, Ceramics Technology, Composite Technology	(for fast-track / by department approval)
1st Term	Nanotechnology	Metal Manufacturing Process, Polymer Manufacturing Process, Ceramics Technology, Composite Technology	(for fast-track / by department approval)
2nd Term	Industrial Ecology	Mineral Processing	6 or 8
2nd Term	Concrete Corrosion	Corrosion & Protection of Metals	8
2nd Term	Energy Materials		6 or 8
2nd Term	Refractory Materials	Ceramics Technology	8
2nd Term	Mechanics of Material Forming	Metal Manufacturing Process	6 or 8
2nd Term	Industrial Mechanic Equipment	Metal Manufacturing Process	6 or 8
2nd Term	Material Standardization	Characterization of Materials	6 or 8
2nd Term	Polymer Recycling Technology	Polymer Manufacturing Process	8
2nd Term	Rubber Technology	Polymer Manufacturing Process	8
2nd Term	Quenching Technology	Heat Treatment and Surface Engineering	6 or 8
2nd Term	2nd Term Advanced Internship	Minimum 125 credits	
2nd Term	Advanced Manufacture	Metal Manufacturing Process, Polymer Manufacturing Process, Ceramics Technology, Composite Technology	(for fast-track / by department approval)

2nd Term	Smart Materials	Metal Manufacturing Process, Polymer Manufacturing Process, Ceramics Technology, Composite Technology	(for fast-track / by department approval)

Course Structure for Undergraduate Metallurgical & Materials Engineering Program (International Class)

Code	Subject	SKS
	1st Semester	
UIGE610003	Religious Studies	2
UIGE610002	English for Academic Writing	2
ENGE610001	Calculus 1	3
ENGE100005	Physics - Mechanics and Heat	3
ENGE610006	Physics - Mechanics and Heat Laboratory	1
ENGE610009	Basic Chemistry	2
ENMT611001	Engineering Drawing	**2**
ENMT611002	Introduction to Engineering Materials	**2**
ENMT611003	Basic Chemistry Laboratory	1
	Sub Total	**18**
	2nd Semester	
UIGE610011	Integrated Character Building Subject	6
ENGE610002	Calculus 2	3
ENGE610007	Physics - Electricity, MWO	3
ENGE610008	Physics - Electricity, MWO Laboratory	1
ENMT612004	Materials Physic 1	2
ENMT612005	Static & Mechanic of Materials	3
ENMT612006	Thermodynamics of Materials	2
	Sub Total	**20**
	3rd Semester	
ENGE610004	Linear Algebra	4
ENMT613007	Electrochemistry	3
ENMT613008	Materials Physic 2	3
ENMT613009	Characterization of Materials	3
ENMT613010	Chemical Characterization of Materials	2
ENMT613011	Numerical Computation	2
ENMT613012	Introduction to Fluids Mechanics and Heat Transfer	2
	Sub Total	**19**
	4th Semester	
ENGE610012	HSE Protection	2
ENMT614013	Data Analysis and Scientific Writing	3
ENMT614014	Materials Physics 3	2
ENMT614015	Corrosion & Protection of Metals	3
ENMT614016	Polymer Materials	3
ENMT614017	Mineral Processing	3
ENMT614018	Heat Treatment and Surface Engineering	1
ENMT614019	Materials Characterization Laboratory	1
	Sub Total	**18**
	5th Semester	
ENMT615020	Extractive Metallurgy	3
ENMT615021	Iron & Steel Making	2
ENMT615022	Materials Selection	2
ENMT615023	Materials Joining	3
ENMT615024	Metal Manufacturing Process	4
ENMT615025	Polymer Manufacturing Process	3
ENMT616026	Corrosion Laboratory	**1**
ENMT607937-51	Elective	3
	Sub Total	**20**
	6th Semester	
ENMT616027	Failure Analysis	3
ENMT616028	Engineering Design of Products and Process	3
ENMT616029	Ceramics Technology	3
ENMT616030	Composite Technology	3
ENMT616031	Metal Manufacturing Laboratory	1
ENMT616032	Extractive Metallurgy Laboratory	1
ENMT608952-66	Elective	5
	Sub Total	**19**

	7th Semester	
ENMT617033	Technopreneurship	2
ENMT610034	Internship	2
ENMT610035	Seminar	2
ENMT607939-51	Elective	14
	Sub Total	**20**
	8th Semester	
ENMT610036	Final Project	4
ENMT608950-66	Elective	7
	Sub Total	**11**
	Total	**145**

Resume

Semester	Course	Prerequisite
4	HSE	Minimum 50 credits
4	Data Analysis and Scientific Writing	Minimum 50 credits
4	Material Physics 3	Materials Physics 1, Materials Physics 2, Thermodynamics of Materials, Introduction to Fluids Mechanics and Heat Transfer
4	Corrosion and Protection of Metals	Electrochemistry
4	Polymer Materials	-
4	Mineral Processing	Materials Physics 1
4	Heat Treatment and Surface Engineering	Materials Physics 1, Materials Physics 2
4	Materials Characterization Laboratory	Characterization of Materials
5	Extractive Metallurgy	Mineral Processing
5	Iron & Steel Making	Mineral Processing
5	Metal Manufacturing Process	Materials Physics 1, Materials Physics 2, Materials Physics 3
5	Polymer Manufacturing Process	Polymer Materials
5	Corrosion Laboratory	Corrosion and Protection of Metals
5	Materials Selection	Characterization of Materials, Materials Physics 1, Materials Physics 2, Materials Physics 3
5	Materials Joining	Characterization of Materials, Materials Physics 2, Materials Physics 3
6	Ceramics Technology	Materials Physics 3
6	Composite Technology	Polymer Materials
6	Metal Manufacturing Laboratoy	Metal Manufacturing Process
6	Extractive Metallurgy Laboratory	Extractive Metallurgy
6	Failure Analysis	Materials Selection
6	Engineering Design of Products and Process	Metal Manufacturing Process, Polymer Manufacturing Process, Ceramic Technology, Composite Technology, Materials Selection
7	Technopreneurship	Minimum 100 credits
7	Internship	Minimum 100 credits
7	Seminar	Minimum 105 credits
8	Final Project	Minimum 125 credits
8	Final Project	Minimum 125 credits

Prerequisite List For Curriculum 2020 Courses

Code	Subject	SKS
	1st Semester	
ENMT617937	Special Alloyed Steels	2
ENMT617938	Biomaterial	2
ENMT617939	Engineering Ethics	2
ENMT617940	High Temperature Corrosion	2
ENMT617941	Polymer Compounding	2
ENMT617942	Quality Management Systems	2
ENMT617943	Rubber Technology	2
ENMT617944	Special Processing and Assembly Technologies	2
ENMT617945	General Apprenticeship	6
ENMT817946	Risk Based-Inspection and Integrity	3
ENMT817947	Computational Materials	2
ENMT817948	Electronic Materials	3
ENMT817949	Electron Microscopy	2
ENMT817950	Advanced Solidification	2
ENMT817951	Nanotechnology	3
	2nd Semester	
ENMT618952	Industrial Ecology	2
ENMT618953	Concrete Corrosion	2
ENMT618954	Refractory Materials	2
ENMT618954	Mechanics of Material Forming	2
ENMT618956	Industrial Mechanic Equipment	2
ENMT618957	Material Standardization	2
ENMT618958	Polymer Recycling Technology	2
ENMT618959	Quenching Technology	2
ENMT618960	Industrial Apprenticeship	6
ENMT818961	Advanced Manufacture	3
ENMT818962	Advanced Polymer Manufacture	2
ENMT818963	Smart Materials	3
ENMT818964	Energy Materials	2
ENMT819865	Advanced Extractive Metallurgy	3
ENMT818966	Advanced Surface Engineering	3

Prerequisite for Elective Courses

Semester	Course	Prerequisite	Recommended Semester
1st Term	Special Alloyed Steels	Iron & Steel Making	7
1st Term	Biomaterial	Corrosion & Protection of Metals	5 or 7
1st Term	Engineering Ethics	-	5 or 7
1st Term	Computational Materials	Numerical Computation	5 or 7
1st Term	High Temperature Corrosion	Corrosion & Protection of Metals	5 or 7
1st Term	Electron Microscopy	Characterization of Materials	5 or 7
1st Term	Polymer	Polymer Materials	5 or 7
1st Term	Quality Management Systems	Data Analysis & Scientific Writing	7
1st Term	Advanced Solidification	Materials Physic 3	5 or 7
1st Term	Special Processing and Assembly Technologies	Materials Selection	7
1st Term	General Apprenticeship	Minimum110 credits	
1st Term	Risk Based-Inspection and Integrity	Characterization fo Materials, Corrosion & Protection of Metals	for fast-track / by department approval

1st Term	Advanced Polymer Manufacturing	Polymer Manufacturing Process	for fast-track / by department approval
1st Term	Electronic Materials	Metal Manufacturing Process, Polymer Manufacturing Process, Ceramic Technology, Composite Technology	for fast-track / by department approval
1st Term	Nanotechnology	Metal Manufacturing Process, Polymer Manufacturing Process, Ceramic Technology, Composite Technology	for fast-track / by department approval
2nd Term	Industrial Ecology	Mineral Processing	6 or 8
2nd Term	Concrete Corrosion	Corrosion & Protection of Metals	8
2nd Term	Energy Materials	-	6 or 8
2nd Term	Refractory Materials	Ceramic Technology	8
2nd Term	Mechanics of Material Forming	Metal Manufacturing Process	6 or 8
2nd Term	Industrial Mechanic Equipment	Metal Manufacturing Process	6 or 8
2nd Term	Material Standardization	Characterization of Materials	6 or 8
2nd Term	Polymer Recycling Technology	Polymer Manufacturing Process	8
2nd Term	Rubber Technology	Polymer Manufacturing Process	8
2nd Term	Quenching Technology	Heat Treatment & Surface Engineering	6 or 8
2nd Term	Industrial Apprenticeship	Minimum 110 credits	
2nd Term	Advanced Manufacture	Metal Manufacturing Process, Polymer Manufacturing Process, Ceramic Technology, Composite Technology	for fast-track / by department approval
2nd Term	Smart Materials	Metal Manufacturing Process, Polymer Manufacturing Process, Ceramic Technology, Composite Technology	for fast-track / by department approval
2nd Term	Advanced Extractive Metallurgy	Extratcive Metallurgy	for fast-track / by department approval
2nd Term	Advanced Surface Engineering	Heat Treatment & Surface Engineering	for fast-track / by department approval

Transition Policy from Curriculum 2016 to Curriculum 2020

1. The Curriculum 2020 takes effect from the Second Term 2020/2021. After this curriculum is implemented, only the subjects in the Curriculum 2020 will be counted for the graduation: any subject in the Curriculum 2016 follows the transition rules.
2. Transition rules will be valid for 1 (one) year, starting from the Second Term of 2020/2021 until the First Term 2021/2022 for any subject changing in its place (from the first term to second term or vice versa). If it is necessary, the subject will be opened in both semesters.
3. Students who have not passed the compulsory subjects in the Curriculum 2016 are required to take the same or equivalent subjects in the Curriculum 2020.
4. If there is a change in the credit hours, the credits at the first time the subject taken will be considerred. The same or equivalent subjects with different credit hours, if repeated or newly taken, will be counted with the new name and credit hours.
5. The equivalence subjects for Curriculum 2016 and Curriculum 2020 can be seen in the Equivalency Table. Any unlisted subject in the Curriculum 2016 has been removed and is no longer offered.
6. If the compulsory subjects in the Curriculum 2016 are removed and there are no equivalencies in the Curriculum 2020:
   a. For students who have passed the subjects, the subjects will be counted as compulsory credits with the same name and credit hours.
   b. For students who have not passed the subjects, students can take new compulsory subjects or elective subjects with the new name and credit hours.
7. If a subject has a reduction in the credit hours while the student has already taken the subject required for the graduation, then the student is still allowed to graduate even though the total number of credits is less than the required one.

Equivalency of Curriculum 2016 and 2020

No	Course Name in Curriculum 2016	Credits	Course Name in Curriculum 2020	Credits
1	Academic Writing	3	Academic Writing	2
2	Integrated Character Building A	6	Integrated Character Building	6
3	Integrated Character Building B	6		
4	Statistics & Probability	2	Data Analysis and Scientific Writing	2
5	Physical Metallurgy 1	4	Materials Physics 1	2
6			Materials Physics 2	3
7	Testing of Materials	2	Characterization of Materials	3
8	Tech. of Microstructural Analysis	2		
9	Chemical Characterizations of Materials	2	Chemistry of Materials	2
10	Polymer Chemistry	4	Polymer Materials	3
11	Physical Metallurgy 2	3	Materials Physics 3	3
12	Mineral Processing	4	Mineral Processing	3
13	Transport Phenomenon	3	Introduction to Fluids Mechanic	2
14	Industrial Management	2	Technopreneurship	2
15	Polymer Technology	3	Polymer Manufacturing Process	3

16	Tech. of Microstructural Analysis Laboratory	1	Characterizations of Materials Laboratory	1
17	Testing of Materials Laboratory	1		
18	Chemical Characterization Laboratory	1		
19	Metal Manufacturing Process Laboratory	2	Metal Manufacturing Process Laboratory	1
20	Engineering Design of Products	3	Engineering Design of Products & Process	3
21	Capita Selecta	2	Technopreneurship	2
22	Fracture Mechanics & Failure Analysis	4	Failure Analysis	3

Other subjects that are not listed in this table do not change except for the subject code and curriculum code (full list is given in the SIAK-NG website)

Course Syllabus of University Subjects

INTEGRATED CHARACTER BUILDING

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.

Graduates Learning Outcomes:

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

Course Learning Outcomes:

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

Prerequisite: None

CALCULUS 2

ENGE600002/ENGE610002
3 SKS
Course Learning Outcomes:

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

Graduates Learning Outcomes:

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

Syllabus :

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

Prerequisite: Calculus 1

Academic Writing

UIGE610002

3 SKS

The objectives of the English component of the MPK program are :

1. To activate students, English so that they will be able to communicate effectively in English;
2. To enable students to develop the learning strategies and study skills needed to finish their study successfully and o continue learning on their own after taking the MPK program (to develop independent learners)

Main Competencies :

By the end of the course, students should be able to:

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

Learning Method :

Active learning, Contextual language learning, small group discussion.

Prerequisite :

- Students Learning Orientation/Orientasi Belajar Mahasiswa (OBM)
- UI English Proficiency Test

English

UIGE600003

3 SKS

Learning Objectives :

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

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

ISLAMIC STUDIES

UIGE600010/UIGE610005

2 SKS

General instructional objectives : The cultivation of students who have concern for social, na-tional and countrys issues based on Islamic values which is applied in the development of science through intellectual skills. **Learning Objectives :** Course participants are expected to do the following when faced with a problem or issue which they must solve :

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

Syllabus :

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

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

CATHOLIC STUDIES

UIGE600011/UIGE610006
2 SKS

General instructional objectives :

1. To help deliver students as intellectual capital in implementing a lifelong learning process to become scientists with mature personalities who uphold humanity and life.
2. Be scholars who believe in God according to the teachings of Jesus Christ by continuing to be responsible for his faith in life in church and society.

Syllabus :

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

CHRISTIAN STUDIES

UIGE600012/UIGE610007
2 SKS

General instructional objectives :

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

Learning Objectives:

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

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

Syllabus :

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

HINDU STUDIES

UIGE600013/UIGE610008
2 SKS

Syllabus :

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

BUDDHIST STUDIES

UIGE600014/UIGE610009
2 SKS

Syllabus :

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

work hard and fair), Politics (Religion contribution in the political life of nation and country), Law (Raise awareness to obey and follow God's law, the role of religion in the formulation and enforcement of law, the function of religion in the legal profession).

KONG HU CU STUDIES
UIGE600015/UIGE610010
2 SKS

Syllabus :

Course Syllabus of Faculty Subjects

CALCULUS 1
ENGE600001/ENGE610001
3 credits
Course Learning Outcomes:

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

Graduates Learning Outcomes:

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

Syllabus :

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

Prerequisite: None

Textbooks:

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

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

CALCULUS 2
ENGE600002/ENGE610002
3 SKS
Course Learning Outcomes:

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

Graduates Learning Outcomes:

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

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

Prerequisite: Calculus 1

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

CALCULUS
ENGE600003/ENGE610003
4 SKS
Course Learning Outcomes:

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

Graduates Learning Outcomes:

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

Syllabus :

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

Prerequisite: None

Textbooks:

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

Additional:

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

LINEAR ALGEBRA

ENGE600004/ENGE610004
4 SKS
Course Learning Outcomes:

Students are able to calculate linear system problems to solve engineering problems.

Graduates Learning Outcomes:

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

Syllabus :

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

Prerequisite: None

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

MECHANICAL AND HEAT PHYSICS

ENGE600005 / ENGE610005
3 credits
Course Learning Outcomes:

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

Graduate Learning Outcomes:

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

Syllabus:

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

Prerequisite: none

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

ELECTRICAL MAGNETIC, OPTICAL AND WAVE PHYSICS

ENGE600007 / ENGE610007
3 credits
Course Learning Outcomes:

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

Graduate Learning Outcomes:

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

Syllabus:

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

Prerequisite: none

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

BASIC CHEMISTRY

ENGE600009 / ENGE610009
2 credits
Course Learning Outcomes:

Students are able to analyze the principe of basic chemistry for application in engineering.

Graduates' Learning Outcomes:

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

Syllabus:

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

librium, 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 regu-

latory framework and standard related to the stages of life cycle of machine, building structure, construction, and process.
4. Students are able to design and propose an effective hazard communication, management and engineering control, and risk mitigation through an engineering assignment project.
5. Students are able to identify the knowledge required to perform risk assesment, investigation and design improvement through a multidisiplinary case of incident and accident.

Syllabus:

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

Prerequisite: none

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

Course Syllabus of Metallurgical and Material Engineering Subjects

Engineering Drawing
ENMT601001
2 credits
Syllabus:

Illustration: Function and beneft of Engineering Drawing; Measurement and Evaluation; Introduction to drawing equipment; Basic definition of geometric, paper format, draw regulation, line, feld, line confguration, basic geometric form; Visualization geometric: Skew projection and isometric, function and line types, confguration geometric form; Orthogonal Projection: Projection standard, viewing concept, width display principle; Advanced orthogonal projection: Circle region concept, special region concecpt, trimming concept, display width, refraction

Prerequisite: -

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

Introduction to Engineering Materials
ENMT601002
2 credits
Syllabus:

(1) Types of engineering materials and their applications; (2) Structures of engineering materials; (3) Properties of material; (4) Manufacturing and Processing of Metallic Materials; (5) Steel and iron: production and properties; (6) Aluminium: production and properties;(7) Other non-ferrous alloys: production and properties; (8) Polymer: processing and properties; (9) Ceramic: processing and properties; (10) Composite: processing and properties

Prerequisite: -

References:
1. Bondan T. Sofyan, Pengantar Material Teknik, Penerbit Salemba Teknika, 2010
2. W.D. Callister, Materials Science and Engineering: An Introduction, 6th ed., John Wiley & Sons, 2003
3. William F. Smith, Introduction to Materials Science and Engineering

Basic Chemistry Laboratory
ENMT601003
1 credits
Syllabus:

Physical and chemical properties; Separation and purification of substances; Identification of alkaline metal ions, alkaline earth, ammonium, sulfate, iodide, bromide and nitrate; Acid-base titration; Metal and acid reactions; Crystal water.

Prerequisite: Basic Chemistry

References:
Basic Chemistry Laboratory Module

Materials Physics
ENMT602004 1
2 credits
Syllabus:

Introduction to crystal, crystal lattice, Bravais lattice, Miller index, crystal projections / stereography, Wulff Net, crystal symmetry, crystal defects

Prerequisite: -

References:

1. Borchardt-Ott, W.; Crystallography; Springer; 1995
2. McKie, D. and McKie, C.; Essential of Crystallography; Blackwek Scientific; 1986
3. William D Callister; Materials Science and Engineering, an Introduction; john Wiley and Sons; 2004
4. Robert W Cahn and Peter Haasen; Physical Metallurgy; 1996

Statics and Mechanics of Materials

ENMT602005
3 credits
Syllabus:

Basic principle in statics and mechanis of materials, basic procedures, scalar and vectors, addition and operations, vector products, force vector, moment, cross product. Equivalent system, moment couple. Equilibrium mechanics, equilibrium conditions, free-body diagram. Simple trusses, joint method, zero-force member, section methods, frame and machine. Center of mass and gravitations, inertia moment, Non Reguler axis theorem, Center of mass and inertia moment of composite. Internal loading of a structure member, moment and shear diagram, relation of distributed loading, shear and moment. Stress concept, Normal stress, allowes stress, simple connection, deformation and strain. Stress and strain diagram, stress strain behvavior in ductile and brittle materials. Hooke law, strain energi and Poisson ratio. Saint Vernon principle, elastic deformation. Superposition principe. Thermal stress, crcluar shaft torsion deformation. Power transmission. Twist angle. Bending deformation in straight member, flexure formula, assymetrical bending, shear formula, stress shear for column, pressure in thin walled vessel. Stress plane transformation, Mohr cycle. Column and Buckling design. Critical loading. Inelastic Buckling.

Prerequisite: -

References:

1. Hibbeler, Russel C., Engineering mechanics,statics, 8th Ed., Macmillan Publishing Company,Inc.
2. Hibbeler, Russel C., Mechanical of Materials,-Prentice Hall International Inc., 1997
3. Ferdinant L. Singer, Ilmu Kekuatan Bahan, Penerbit Erlangga, 1981
4. Beer, F.P. and Johston, E.R., Mechanics of Materials, McGraw-Hill, 1983

Thermodynamics of Materials

ENMT602006
2 credits
Syllabus:

Equilibrium of reaction in component systems .Basic principle in thermodynamics of materials, zeroth law of thermodynamics, first law of thermodynamics, second law of thermodynamics and third law of thermodynamics. Enthalpy, entropy and free energy concepts. Thermodynamics balance and materials balance. Heat balance. Thermodynamics phase equilibrium, phase equilibrium in one component system. Free energy as a function of temperature and pressure. Equilibrium of vapor phase and condensation phase. Gas behavior and gases reactions. Solvent phenomena, Raoul't law, Henry law, Gibb-Duhem equation, solvent free energy, regular solvent. Equilibrium of reaction in component systems, condensated solvent, equilibrium reaction in component system with condensated solvent. Phase diagrams.

Prerequisite: -

References:

1. David . R. Gaskell, Introduction to Metallurgcal Thermodynamics, 4td. ed., CRC. Taylor and Francis Groups , 2008.
2. D, V. Ragone , "Thermodynamics of Materials " Vol 1 and 2 , John Wiley &Sons New York, 1995.

Electro-Chemistry

ENMT603007
3 credits
Syllabus:

Basic concepts and applications of electrochemistry, and conductivity solution, Faraday's law, and their application.Elektrode electrochemical cell (definition, potential, equation Nerst, electrical double layer, the polarization, the measurement of potential, free energy and electrode potential, equilibrium potential), the reference electrode,Construction Pourbaix diagram and its application. Electrochemical kinetics, electrode reaction speed, mixed potential theory, Evans-diagram, the mixed-potential diagram

Prerequisite: -

References:

1. J.O.M. Bockris and A.K.N. Reddy; Modern Electrochemistry vol 1 & 2; Penum Rosetta Edition; 1997
2. Bard Faulkner and Larry R; Electrochemical Methods Fundamental and Application; Willey; 1980
3. Piron; The Electrochemistry of Corrosion; NACE; 1991

Materials Physics 2

ENMT603008

3 credits
Syllabus:

Dislocation theory: screw and edge, solid solution: substitution and interstition (impurities and alloys), plastic and elastic deformation theories, mechanical and physical properties of metals: strength, hardness, toughness, wear , fatigue, creep, basic of fracture mechanics. Case study.

Prerequisite: -

References:

1. Robert W Cahn and Peter Haasen; Physical Metallurgy; 1996
2. D. Hull and D.J. Bacon; Introduction to Disclocation 4th Ed.; Butterworth-Heinman; 2001
3. Smallman R.E. and Bishop R.J.; Metal and Materials; Butterworth-Heinmann; 1995

Characterization of Materials

ENMT603009
3 credits
Syllabus:

Introduction to material testing, Review of mechanical behavior of materials, Data analysis and presentation of test results, Testing procedures, Testing machine and instruments, Standardization of materials testing, Destructive testing (tensile, compression, shear, fatigue, stress relaxation, and wear), Non-destructive (visual, penetrant, ultrasonic, radiography, eddy current and magnetic particle). Techniques of microstructure analysis, Phase formation and general characteristic of material structures, Microstructure of steel; stable and metastable phases and the formation and mechanism, Microstructure of non-ferrous alloys; aluminum, copper, titanium, Macrostructure, Sampling techniques, Samples preparation, Observation techniques with optical and electron microscopes, Special measurements; micro-hardness, coating thickness, roughness, Quantitative metallography; grain size, volume fraction of phases and precipitates, electron interaction with samples, advanced microstructural analysis: SEM, TEM, FIB, EBSD, XRD, XRF, OES.

Prerequisite: -

References:

1. Davis H.E., G.E. Troxell, G.F.W. Hauck; The Testing of Engineering Materials; Mc Graw-Hill; 1982
2. ASM; Mechanical Testing of Metal; 1983
3. Lous Cartz, Non Destructive Testing; ASM International; 1995
4. Vernon john; Testing of Materials; 1992
5. Andreas Ohsner and Holm Altenbach; Properties and Characterization of Modern Materials; 2017
6. Callister, William D. 2007. Materials Science and Engineering, John Wiley & Sons.
7. Der Voort, Van. 1984. Metallography Principles and Practice, McGraw-Hill Book Company.
8. Goodnew, Peter J; Humphrey, John. 2000. Electron Microscopy and Analysis, CRC Press
9. Petzow, Gunter. 1991. Metallographic Etching, University Microfilms.
10. ASM Handbook Vol 9 – Metallography and Microstructures, ASM International
11. Zhang, Sam; Li, Lin; Kumar, Ashok. 2008. Materials Characterization Techniques, CRC Press.
12. Schwartz, A.J.; Kumar, M.; Adams, B.L.; Field, D.P. 2009. Electron Backscatter Diffraction in Materials Science, Springer US

Chemistry Materials

ENMT603010
2 credits
Syllabus:

Basic principles of atomic and molecular bonding, material classification, solid structure: crystalline, amorphous. Introduction to the chemistry of metals, polymers, ceramics, composites, semiconductors and advanced materials. Classification and nomenclature of organic compounds; type of organic reaction; polymer structure, polymerization, and molecular weight; polymer type. Overview of the structure and physiochemical properties of materials, concept of material analysis (qualitative and qualitative), principles of instrumentation analysis (theory, principles of tools and work, interpretation of outputs and their use); methods of separation using chromatography; spectroscopy (mass, UV / VIS, infrared-FTIR, emissions, XRF and spark emission, and some other sophisticated equipments; thermal (TGA, DTA / DSC, MFI and Vicat), and strategy in characterizing materials.

Prerequisite: -

References:

1. Ralph J. Fessenden and Joan S. Fessenden. Organic Chemistry, 5th edition, 1994, Brooks Cole: Pacific Grove. CA
2. G. Challa, Polymer Chemistry – An Introduction, 1993, Ellis Horwood Limited series in Polymer Science, UK

Numerical Computation

ENMT603011
3 credits
Syllabus:

Introduction to numerical methods, type of number, type of data, basic principles of computing, mathematical models. Type of errors, accuracy, propagation of errors, precision. Non linear equation problems, Bisection method, Regula-False method, Newton Raphson method and Secant method. Linear equation systems, Gauss method, Gauss-Jordan method and

Gauss Seidel method. Ordinary differential equations, Euler Methods, Eigen systems, Runge Kutta method. Numerical integration methods, Trapezoid methods, Simpson 1/3, Simpson 3/8. Advanced computational methods, Stochastic methods, Dynamic Particle Methods. Nano Scale Computations. Application of numerical methods in metallurgical and materials engineering problems: Fluid motions, Heat Transfers, Grain Boundaries, Solidification, Band Gap Calculation, Strenght of materials, Partcile Dynamics.

Prerequisite: -

References:

1. Applied Numerical Methods with Matlab for Engineers and Scientists, Steven C. Chapra, Third Edition, McGraw-Hill, 2012.
2. Numerical and Analytical Methods with MATLAB® for Engineers and Scientists, William Bober, CRC Press, 2014.
3. Numerical Methods in Engineering with MATLAB, Jaan Kiusalaas, Cambrideg University Press, 2005.

Introduction to Fluid Mechanics and Heat Transfer

ENMT603012
2 credits
Syllabus:

Fluid flow concept, laminar flow, momentum conservation, turbulent flow, energy balance, fluid flow application, transient heat flow & heat transfer: conduction, convection, and radiation heat transfer.

Prerequisite: -

References:

1. Porer D.R. and Geiger G.H.; Transport Phenomena in Material Processing; Addison Wesley; 1998
2. Sindo Kou; transport Phenomena and Material Processing; John Wiley; 1996

Data Analysis and Scientific Writing

ENMT604013 /ENMT614013
2 credits
Syllabus:

Scientific understanding, research methodology, problem formulation, hypothesis, literature review, data collection and processing, preparation of research proposals and presentation of scientific papers. Descriptive statistics, probability, probability distribution, random variable, descrete probability distribution, continuous probability distribution, sampling distribution, estimation, one and two sample test of hypothesis, simple linear regression, applied statistics in engineering.

Prerequisite: -

References:

1. Devore, J.L., Probability and Statistics for Engineering and The Sciences (5th Ed.), Duxbury, 2000
2. Barnes J.W, Statistical Analysis for Engineers and Scientists, a Computer- Based Approach, McGraw-Hill, 1994
3. Donald H.S, Statistics, A First Course (6thEd), McGraw-Hill, 2001
4. Walpole, Ronald E, Probability & Statistics for Engineers & Scientist, 8th Ed, Pearson Prentice Hall, 2007.
5. Kothari, C.R., Research Methodology, Methods and Techniques, New Age International (P) Ltd., Publishers, New Delhi, 2004
6. Cargill, M. and O'Connor, P., Writing Scientific Research Articles, Strategy and Steps, Wiley-Blackwell, Hoboken, 2009

Materials Physics 3

ENMT604013
3 credits
Syllabus:

Phase rules, binary phase diagram, free energy diagram, introduction to ternary phase diagram, introduction to phase transformation and interface, solidification process, homogen and heterogen nucleation, nucleation rate, alloy solidification process, diffusional transformation, age hardening, eutectic transformation, non-diffusional transformation, martensitic transformation.

Prerequisite: Termodynamics of Materials, Introduction to Fluid Mechanics

References:

1. Porter, D. A and Easterling, K.E, Phase Transformation in Metals and Alloys, 3rd. ed., CRC Press, 2009.
2. ASM, ASM Handbook Vol. 3, Alloy Phase Diagram, Ohio, 2010
3. R.W. Cahn and P. Haasen (eds), Physical Metallurgy, North-Holland, 1996
4. M. Flemings, Solidification Processing, McGraw Hill, New York, 1974

Corrosion & Protection of Metals

ENMT604015
3 credits
Syllabus:

Principles of corrosion, kinetics of corrosion, polarization, passivation, measurement of corrosion rate, metallurgical aspects, corrosion tests, forms of corrosion, high temperature corrosion, cathodic protection, anodic protection, coating, inhibition, materials selection and design, monitoring and inspection, analysis of corrosion driven-damage, standards related to corrosion

Prerequisite: Electrochemistry

References:

1. Jones DA; Principles & Prevention of Corrosion; Mc Milan Pubs; 1992
2. Fontana; Corrosion Engineerng 3rd Ed; 1992
3. Roberge Pierre R; Handbook of Corrosion Engineerin; Mc Graw-Hill; 1999

Polymer Materials

ENMT604016
3 credits
Syllabus:

Chemical bonding, reactive species in organic chemistry. The classification of organic compounds. Organic compunds nomeclature. Isomer and assymmetric configuration in organic chemistry, conjugation in organic chemistry. Nucleophilic SN1 and SN2 substitution reaction. Electropile and Nucleophile addition reaction. Other reactions in organic chemistry. Introductory of polymer materials. Polymer chain configuration and type of polymers. Relation between polymer chain structure and its properties. Reactivity of polymer chains. Polymerization reaction of substitution and condensation.

Prerequisite: -

References:

1. G. Challa, Polymer Chemistry – An Introduction, 1993, Ellis Horwood Limited series in Polymer Science, UK
2. Young R.J. and Lovell P.A., Introduction to Polymers, 2nd edition, 1997, Chapman & Hall, Cambridge, UK
3. Cheremisinoff N.P., Polymer Characterization – Laboratory Techniques and Analysis, 1996, Noyes Publication, New Jersey, USA
4. Morton-Jones D.H., Polymer Processing, 1994, Chapman & Hall, UK

Mineral Processing

ENMT604017
3 credits
Syllabus:

Understanding mineralogy, classifcation of minerals, mineral properties, mineral that has economic value. Terminology and basic concepts of processing mineral / ore, potential sources of mineral / ore that can be processed in a technically and economically, the processes of size reduction (comminution): The process of crushing, screening, grinding, the classifcation process, process of separation / concentration: Gravity concentration: Concentration Heavy Jigging Flowing Film, Media Separation, Flotation process, Magnetic Separation, High Tension Separation, Dewatering and Thickening process

Prerequisite: Materials Physics 1

References:

1. Sorell. The Rocks and Minerals of the World, Collins, 1982
2. Hulburt, Jr. Manual of Mineralogy, John Willey and Sons, 1979
3. B.A. Wills, Mineral Processing Technology, 4th ed., Pergamon Press, 1988
4. Gilchrist J.D., Extraction Metallurgy, Pergamon Press, London, 1980
5. Gill C.B., Non Ferrous Extractive Metallurgy, John Wiley and Sons Inc., 1980

Heat Treatment & Surface Engineering

ENMT605022
3 credits
Syllabus:

Definition of heat treatment, phase transformation and microstructure, TTT and CCT diagram, the influence of heating and cooling rate, stable and metastable microstructure, hardenability, the influence of alloying element, hardening, softening, temper brittleness, distortion and its prevention, carburization, nitro-carburizing, nitriding, boronizing, non-ferrous heat treatment, surface hardening, surface deposition, various heat-treating furnace and its atmosphere, deviation in heat treatment process, special heat treatment, case study of heat treatment and surface engineering

Prerequisite: Materials Physic 3

References:

1. Bill Bryson; Heat Treatment Selection and Application of Tool Steel; Hanser Gardner Publication; 1997
2. ASM Practical Heat treatting; ASM International; 2006
3. ASM Handbook Vol. 4; ASM International; 1991

Materials Characterization Laboratory

ENMT604018
1 credits
Syllabus:

Tensile, hardness, wear and impact testing for some technical materials, non-destructive testing (penetrant and magnetic particles), metallographic sample preparation (cutting, sanding, polishing and etching techniques), microstructure analysis of metal structures (ferrous and non-ferrous) with optical microscope

Prerequisite: Characterization of Materials

References:
Materials Characterization Laboratory Module

Extractive Metallurgy

ENMT605020
4 credits
Syllabus:

Basic principles of extractive metallurgy (pyrometallurgy, hydrometallurgy and electrometallurgy). Process/treatment process of ore to be extracted. Leaching method of oxide and sulfide ores, Bayer process, Al, Au leaching by cyanidation (Leaching; precipitation techniques; ion exchange; solvent extraction; reverse osmosis). Electrometallurgy (Electro winning and electro refining). Molten salt electro winning. Hall process. Electro winning of Mg, Ti. Secondary metals. Obtaining metals from scrap and secondary sources by using pyro-, hydro-, and electrometallurgy. Pyrometallurgy, mineral separation, slag, blast furnace, raw materials, reactions, material balance, iron ore, roasting, smelting, refining of Sn, Ni, Cu, Zn, Pb.

Prerequisite: Mineral Processing

References:

1. Pehlke, Robert D., Unit Processes in Extractive Metallurgy, Elsevier Pub., New York, 1973
2. J. J. Moore., Chemical Metallurgy, Butterworth-Heinemann, London, 1981
3. J. D. Gilchrist., Extractive Metallurgy, Pergamon., 2nd ed., Oxford, Pergamon Press, 1980

Iron & Steel Making

ENMT605021
2 credits
Syllabus:

Kinetics and thermodynamics, blast furnace, direct reduction, desulphurization and dephosporization process, deoxidation, degassig, BOF steel making, EAF steel making, secondary metallurgy, continuous casting

Prerequisite: Mineral Processing

References:

1. John Peacey and Bill Davenport, The Iron Blast Furnace, Pergamon, 1979
2. Geerdes et al, Modern Blast furnace Ironmaking, an Introduction, 2009
3. A.Biswas, Principles of Blast Furnace Ironmaking, Theory and Practice, 1981
4. Babich et al, iron Making, RWTH Aachen, 2008
5. W.R. Irving: Continous Casting of Steels, Institute of Metals, 1993

Materials Selection

ENMT605022/ENMT605122
2 credits
Syllabus:

Classification of technical materials, factors and systematics of design and material selection, material selection criteria, material property chart and performance index, design for corrosion resistance, design for the use of high temperature materials and design for wear and fatigue resistant materials, design for plastics and composites as well as the selection of various types of carbon steel, cast iron and alloy steels (tool steels, stainless steels, heat resistant steels, wear-resistant steels, selection of super alloys (super alloys), and case studies on material selection.

Prerequisite: Materials Characterization, Materials Physic 2, Materials Physic 3

References:

1. Ashby, M. F, Materials Selection in Mechanical Design, 2nd ed., Cambridge Uni. Press., Oxford, 1999

Materials Joining

ENMT606028
3 credits
Syllabus:

Arc welding methods: SMAW, FCAW, SAW, ESW, GMAW, PAW. Electric resistance methods: spot welding, Seam welding, Projection welding, Flash welding. Pressure welding methods: Cold butt welding, Explosive welding, Diffusion welding, Forge welding, Ultrasonic welding, Friction welding. Other welding methods: Oxy-Acetylene welding, Thermite welding, Electron Beam welding, Laser Beam welding, Underwater welding, Soldering, Brazing. Welding design, standard and calculation (WPS) AWS, ASME, EN. Welding metallurgy for carbon steel, alloy steel, cast iron, non ferrous materials. Welding defects. Polymer joining: thermal bonding, cementing, adhesive bonding and mechanical fastening.

Prerequisite: Characterization of Materials, Materials Physics 3

References:

1. Larry F. Jeffus; Welding Principles and Applications
2. Kou; Welding Metallurgy 2nd Edition; John Wiley and Sons; 2005
3. Easterling; Introduction to Physical Metallurgy of Welding; Butterworth and Co; 1992
4. David A. Grewell; Plastics and Composites Welding Handbook
5. Alphonsus V.V. pocius; Adhesion and Adhesive Technology
6. Winarto & Anis; Lecture notes; 2007

Metal Manufacturing Process

ENMT605023
4 credits
Syllabus:

The forming of metals as a part of design process and

manufacture; fundamentals of metal casting (mould, molten metal, solidification), mould (sand, ceramic, metal), pouring system (pattern, riser, pressure and unpressure, chill) and its simulation, solidification of cast iron and aluminum, liquid treatment for ferrous metals (inoculation, Mg treatment) and nonferrous (modifier, grain refiner), various methods of casting, casting defect; common principle of solid forming of a metal, techniques of metal forming through: pressing, forging, rolling, extrusion, wire drawing, sheet metal forming; thermo-mechanical processing (TMP). General principle of powder metallurgy, powder fabrication and mechanism of powder forming, powder characteristics and characterization, mechanical alloying, pre-compaction process, compaction, precursor characteristic, sintering and powder consolidation, full density processing, sintering equipment and related aspects, application of powder metallurgy products. Laboratory: (1) Sand particle size distribution, water content calculation, additive substance (bentonite) content in mould, sand flowablity, relation of water and additive content in sand with permeability, shear and compressive strength of sand, (2) utilization of simulation software in calculation and design of casting, (3) Design of inlet and riser, mould making from patterns, making of the core of the mould, melting and pouring of molten metal to the mould, analysis of casting defect, analysis of casting product related to the alloying element and casting process.

Prerequisite: Materials Physic 3

References:

1. Heine, R. W. et.al., Principles of Metal Casting, McGraw-Hill Pub., New Delhi, 1986
2. Surdia, T. Teknologi Pengecoran Logam, P. Paramita, 1985
3. John Campbell, Castings, Second Edition, Elsevier Butterworth-Heinemann, 2004

Polymer Manufacturing Process

ENMT605024
3 credits
Syllabus:

Basic principle and characteristics of polymer materials, as well as the fabrication methods of polymer raw materials into ready-to-use products, relationship between structure and behavior of polymer molecules; thermal, chemical, optical, and electrical properties of polymer materials; polymer rheology; fabrication process (formulation, continuous and discontinuous formation, and product finalization) of thermoplastic, thermoset, and rubber; and study case of polymer product technology on packaging (rigid and flexible), automotive, electronics, and construction applications.

Prerequisite: Polymer Materials

References:

1. G. Challa, Polymer Chemistry – An Introduction, 1993, Ellis Horwood Limited series in Polymer Science, UK
2. Young R.J. and Lovell P.A., Introduction to Polymers, 2nd edition, 1997, Chapman & Hall, Cambridge, UK
3. Cheremisinoff N.P., Polymer Characterization – Laboratory Techniques and Analysis, 1996, Noyes Publication, New Jersey, USA
4. Morton-Jones D.H., Polymer Processing, 1994, Chapman & Hall, UK

Corrosion Laboratory

ENMT605025
1 credits
Syllabus:

Corrosion cells, Measurement of the Corrosion Potential of Several Metals, Stainless steel Polarization, Cathodic Protection, Surface Engineering.

Prerequisite: Corrosion & Protection of Metals

References:

Corrosion Laboratory Module

Failure Analysis

ENMT606027 /ENMT616027
1 credits
Syllabus:

Aspects of failure engineering and its analysis, sources/factors contributing the material's failure, explanation of failure factors, types of fractures, stress system and residual stress, theories of fracture mechanics and introduction to the risk-based inspection, failure due to: fatigue, creep, wear, brittleness, heat treatment, residual stress, corrosion and environment, case study.

Prerequisite: Materials Selection

References:

1. Wulpi, D. J., Understanding How Components Fail, ASM, 1998
2. Charlie, R. B and Ashok, C., Metallurgical Failure Analysis, McGraw-Hill Inc., 1993
3. French, D. N., Metallurgical Failure in Fossil Fired Boilers, John Wiley & Sons, 1983

Engineering Design of Products

ENMT607034
4 credits
Syllabus:

Introduction to Engineering Design, total design activity, group dynamics and design management, problem identifcation and design specifcation, creativity and the conception of design, modeling, optimallisation, materials and process selection, design communica-

tion and presentation.

Prerequisite:

Metal Manufacturing Process, Polymer Manufacturing Process, Ceramics Technology, Composite Technology, Materials Selection

References:

1. Saptono, Rahmat. First Lecture on Engineering Design. Universitas Indonesia, 2006
2. Hurst, Kenneth S., Engineering Design Principles, 1st Ed., Arnold, New York, 1999
3. Pugh, Stuart, Total Design, Integrated Methods for Successful Product Engineering., Addison-Wesley Publisher Ltd., Edinburgh 1991
4. Dym, Clive L and Patrick Little, Engineering Design, A-Project-Based Introduction, John Wiley and Sons, Inc., 2000
5. Dieter, G. E., Engineering Design, A Material and Processing Approach, 2nd ed., McGraw Hill., 1991
6. Ashby, M. F, Materials Selection in Mechanical Design, 2nd ed., Cambridge Uni. Press., Oxford, 1999

Ceramics Technology

ENMT606029
3 credits
Syllabus:

Introduction to ceramics (general), crystal structure, glass structure, phase diagrams, phase transformations. Properties of ceramics: thermal, optical, mechanical, electrical and magnetic fields, as well as the dielectric nature. Manufacture of ceramic technology and applications: conventional ceramic (aluminum-silicate; clay, glaze); cement and concrete; glass and advanced ceramics (advanced ceramics). The processes for modern ceramics, ceramic thin film, ceramic for field application of mechanical, electronic, optical and magnetic. -Based ceramic matrix composites. Refractory ceramics. Refractory raw materials, types of refractories: refractory system Alumininum - silica, silica refractories, refractory magnesite, chromite refractories, refractory carbon, special refractories. Manufacture of refractories, the use of refractory metals in the industry and others, as well as the failure mechanism of refractory.

Prerequisite: Materials Physics 3

References:

1. Kingery et al, Introduction to Ceramics, 2nd ed., John Wiley & Sons., 1976
2. Hummel AF, Phase Equilibria in Ceramic Systems, Marcel Dekker Inc, 1984

Composite Technology

ENMT606030
3 credits
Syllabus:

The concept, definition and clarification of the composite, matrix and reinforcement type for composites, metal matrix composite, polymer matrix composite, ceramic matrix composite, fiber composite nature. Reinforced fibers and Whiskers, the rule of mixtures, the interface in composite materials, interfacial area, interfacial wettability, interfacial bonding.

Prerequisite: Polymer Materials

References:

1. Hull, D., An Introdution to composite Materials, Cambridge Uni. Press, 1981
2. Mattew, F.L. and R.D. Rawlings, Composite Materials: Engineering and Science, Chapman Hall, 1993
3. Bryan Harris, Engineering Composites Materials, 2nd Eddtion, Institute of Materials Communication Ltd, 1999

Metals Manufacturing Laboratory

ENMT606031
1 credits
Syllabus:

Sand size distribution, calculation of water content, content of additives (bentonite) in molds, sand flowability, relationship between water content and additives in sand with permaebility, shear strength and strength of sand pressure, use of simulation software for calculation and casting design, design making inlet systems and enhancers, making sand molds from patterns, making core molds, the process of melting and pouring molten metal into molds, analysis of casting defects, analysis of casting products related to alloying elements and casting processes. Metal Transformation Module: Solid cylindrical metal stressing, Sheet metal rolling, Sheet metal formation includes non-simulative sheet testing (tensile testing for n and r values) and sheet simulative testing (sheet stretching and pulling, dome height limit (LDH) and ratio limits withdrawal (LDR).

Prerequisite: Metal Manufacturing Process

References:
Metals Manufacturing Laboratory Module

Extractive Metallurgy Laboratory

ENMT606032
1 credits
Syllabus:

Metal extraction testing and electrometallurgical (e.g. Electroplating, froth flotation)

Prerequisite: Extractive Metallurgy

References:

Extractive Metallurgy Laboratory Module

Technopreneurship
ENMT607035
2 credits
Syllabus:

Introduction to technopreneurship and business, business idea and opportunity identification, business idea feasibility, development of effective business model, writing of business plan, management of marketing, operational, human resources and finance.

Prerequisite: Minimum of 100 credits obtained

References:

1. Simmons, J. & Spinelli, S. (2012). "New Venture Creation: Entrepreneurship for the 21st Century", (9th ed.). New York: McGraw-Hill Irwin
2. Barringer, B. R., & Ireland, R. D. (2010). Entrepreneurship: Successfully launching new ventures. Upper Saddle River, N.J: Prentice Hall.
3. Osterwalder, A., Pigneur, Y., & Clark, T. (2010). Business model generation: A handbook for visionaries, game changers, and challengers. Hoboken, NJ: Wiley.
4. William, B. K., Sawyer, S. C., Berston, S., (2013). Business: A Practical Introduction. Upper Saddle River, N.J: Prentice Hall

Internship
ENMT607036
2 credits
Syllabus:

A minimum of one month of in the job training. The result of internship is submitted as written report and presented before the job training assembly

Prerequisite: Minimum of 100 credits obtained

References:

Seminar
ENMT607037
1 credits
Syllabus:

Final assignment writing guide including initial research, abstract writing guide, research methodology, type of references, discussion, also conclusion. To make scientifc paper from existing fnal report which then be presented according to certain journal term or final assignment proposal presentation.

Prerequisite: Minimum of 105 credits obtained

References: -

Final Project
ENMT607038
4 credits
Syllabus:

Implementation/application of various lectures taken by students on integration in a research to solve a problem in metallurgy and material engineering feld. The research result is presented in a form of scientifc report and presented in front of the judging lecturers.

Prerequisite: Minimum of 125 credits obtained

References: -

Elective Courses

Special Alloyed Steels
ENMT607939
2 credits
Syllabus:

Classifcation and utilisation of special steels and super alloys, alloying element and microstructure of alloy steels and super alloys, stainless steels (ferritic, austenitic, duplex, martensitic, precipitation-hardening stainelss steels), heat resistant steels, wear resistant steels, tool steels, other alloy steels, super alloys (Co- and Ni- based alloys)

Prerequisite: Iron & Steel Making

References:

1. J.R. Davis, Stainless Steel, ASM Specialty Hand Book, 1994
2. J.R. Davis, Heat Resistant Materials, ASM Specialty HandBook, 1997
3. Tool Steel Handbook, Fifth Edition, Geoge Roberts, ASM, 1998
4. E.F. Bradley, Super Alloy A Technical Guide, ASM International, 1998

Biomaterial
ENMT607940
2 credits
Syllabus:

Overview of Biomaterials and Their Use in Medical Devices, Physical and Mechanical Requirements for Medical Device Materials, Metallic Materials, Corrosion of Metallic Implants and Prosthetic Devices, Failure Analysis of Metallic Orthopedic Implants, Ceramic Materials, Polymeric Materials, Adhesives, Coatings, Biomaterials for Dental Applications, Tarnish and Corrosion of Dental Alloys, Friction and Wear of Dental Materials

Prerequisite: Corrosion & Protection of Metals

References:

1. J. Park R.S. Lakes, Biomaterials: An Introduction 3rd Edition, Springer, NY, 2007
2. J.R. Davis, Handbook of Materials for Medical Devices, ASM International , Metal Park OH, 2003
3. S. Shang, L. Woo, Selecting Materials for Medi-

cal Product in Handbook of Materials Selection Edited by Myer Kutz, John Wiley and Sons, NY, 2002.

Engineering Ethics

ENMT607941
2 credits
Syllabus:

Ethical theories and tools: basic ethical theories such as consequentialism, deontology, and virtue ethics, but also more modern theories such as discourse ethics, feminist ethics as well as theories about justice and equal opportunities. Decision-making models and frameworks within engineering ethics.

Case Study: Analysis of examples of situations which engineers may encounter in their professional life with the help of the studied ethical theory. Interview with professionally active engineers on ethical issues they have encountered during their career

Prerequisite: -

References:

1. Seebauer, E.G. and Barry, R.L. Fundamental of Ethics for Scientists and Engineers (New York: Oxford University Press, 2001).
2. Martin, M.W. and R. Schinzinger. Ethics in Engineering. 4 th Edition. (McGrawHill, Inc., 2005).
3. Harris Jr., C.E., Pritchard, M.S., Rabins, M.J., Engineering Ethics, Concepts, and Cases: 4th edition (California: Wadsworth Learning, 2009).
4. Whitbeck, Caroline. Ethics in Engineering – Practice and Research: 2nd edition (Cambridge: Cambridge University Press, 2011).

High Temperature Corrosion

ENMT607943
2 credits
Syllabus:

Thermodynamics of metal oxidation reactions, Ellingham Diagram, Structure oxide (corrosion products) and non-stoichiometri stoichiometri, oxide-type and n-type p, PillingBedworth ratio, oxide growth mechanisms: diffusion and migration, the kinetics of oxide growth rate: Wagner-parabolic, logarithmic, linear, aspects of the morphology of the oxide layer (corrosion products), high temperature corrosion in specifc environments: salt melt (hot corrosion), boiler, carburizing / metal dusting, sulfdisasi and thermal cycling, high temperature corrosion protection method: material selection, high temperature resistant alloys, coating / surface treatment

Prerequisite: Corrosion & Protection of Metals

References:

1. N. Birks and G.H. Meier, "Introduction to High Temperature Oxidation of Metals", Cambridge University Press, 2006
2. D.John Young, "High Temperature Oxidation and Corrosion of Metals", Publisher: Elsevier Science, 2008.
3. Per Kofstad, "High Temperature Corrosion", Elsevier Applied Science, 1988

Polimer Compounding

ENMT607945
2 credits
Syllabus:

Introduction to polymers and their products. Processing-related polymer properties. Polymer rheological theory. Stages and types of machine processes of polymer products. Injection molding. Extrusion (blown film, callendering, blow molding and thermoforming). Composite (Reinforcing process. Laminating process)

Prerequisite: Polymer Materials

References:

1. Edward.A.Muccio, Plastic Processing Technology, ASM International, ISBN:9780871704948

Quality Management System

ENMT607946
2 credits
Syllabus:

General, process approach, relation to ISO 9004, adaptation with other system such health safety and environment management. The terms on quality management system are including; scope of implementation, regulating model, term and defnition, terms of documentation, management responsibility, resources management, product realization, performance measurement, analysis and monitoring and also enhancement of sustainable system including internal audit, prevention and correction action.

Prerequisite: Data Analysis and Scientific Writing

References:

1. ISO Standard 9000:2000 series including ISO 9000, 9001 and ISO 9004, ISO 19011

Rubber Technology

ENMT608958
2 credits
Syllabus:

Introduction to rubber, type and characteristics on raw materials and rubber prodcut, additives in rubber product, equipment and manufacturing process for rubber product, testing method for raw materials and rubber product, application and development of rubber product

Prerequisite: Polymer Manufacturing Process

References:

M.Morton, Rubber Technology, Springer, 1999

Special Processing and Assembly Technologies

ENMT607948
2 credits
Syllabus: Materials Selection

The importance of economy and technology in assembly manufacturing. Production technology and economic prerequisites for automatic as wellas manualassembly. Design technical issues related to assembly. Equipment and techniques used for different part operations in assembly. Production philosophy and assembly systems. Industrial robot technology related to flexible automatic assembly. Dissassembly.**Prerequisite:**

References:

Fundamentals of Modern Manufacturing: Materials, Processes, and Systems By Mikell P. Groove

General Apprenticeship

ENMT607949
2 credits
Syllabus:

Apprenticeship at an institution for at least 3 months. The results of the internship are presented in the form of a report and presented before the internship examination

Prerequisite: Minimum of 110 credits hours during the break

References: -

Risk Based-Inspection and Integritiy

ENMT807946/ENMT817946
3 credits
Syllabus:

Definition & Definition: Asset Integrity & Risk Based Inspection. Policy: Production Level Policy and Health, Safety & Environment (HSE) Considerations. Strategy / Prioritization: Based on Priority Scale. Program Planning: Program Planning. Hazard / Threat Identification: Identification of Potential Threats. Damage Mechanism: Damage Mechanism. Probability of Failure: Failure Opportunity. Consequence of Failure: Consequences of Failure. Asset Register: Naming Facilities / Equipment. Risk Assessment: Risk Assessment. Program Implementation: Program Implementation. Data Compilation-Evaluation-Interpretation: Compilation, Evaluation & Interpretation of Data. Corrective Actions & Recommendations: Corrective actions & Recommendations. Inspection Interval: Inspection time period. Inspection Methods: Inspection Methods. Inspection Scope: Inspection Scope. Inspection Work package: Inspection Work Details.

Prerequisite: -

References:

1. Chapter 008, Risk-Based Inspection Technique by Mohamed El-Reedy (Author) Publisher: Gulf Professional Publishing (17 July 2012) ASIN: B00DGSWO4S

Computational Materials

ENMT607942
2 credits
Syllabus:

Basic computational techniques: methods of solving linear equations, methods of solving differential equations and other methods, Other advanced computational methods: Monte carlo method, stochastic, metropolis. Computational domains in material engineering: the macro domain (FEM), the meso domain (coarse graining), molecular dynamics, the nanoscale domain (quantum mechanics approximation), the macro domain, finite element computing (FEM). Weak formulation: finite element node, mesh element, procedure. Linear interpolation function: parameter function and interpolation function. One-dimensional analysis. FEM continued. Two-dimensional analysis Three-dimensional problem Isoparametric element Solution and finite element equation, Galerkin Method. FEM examples on ABAQUS. Meso computation (phase field method). Phase field method, spinodal decomposition using the Cahn Hillard method. Thermodynamics and Thermodynamics are irreversible processes. Meso computation uses molecular dynamics. Nano Computing (Density Functional Theory) I & II

Prerequisite: Numerical Computation

References:

1. Olukeke Oluwole, Finite Element Modelling for Materials Engineers Using MATLAB, Springer, London 2011 .
2. LAMMPS Tutorials, https://icme.hpc.msstate.edu
3. Toulouse, Julien, Introduction to density-functional theory. " (2015)

Electronic Materials

ENMT807948/ENMT817948
3 credits
Syllabus:

The basic principles of semiconductor devices such as thermoelectric, piezoelectric, LED, solar cells. Basic integrated circuit process.

Prerequisite: -

References:

1. Gordon McComb, Electronics for Dummies
2. C. Hamaguchi, Basic Semiconductor Physics
3. B.G. Yacobi, Semiconductor Materials – An

Introduction to Basic Principles
4. Stephen W. Fardo & Dale R. Patrick, Electricity and Electronic Fundamentals
5. William J. Greig, Integrated Circuit Packaging, Assembly and Interconnections
6. Vasilis F. Pavlidis and Eby G. Friedman, Three-Dimensional integrated Circuit Design

Electron Microscopy

ENMT607944
2 credits
Syllabus:

Introduction to optics, principles of image formation, light microscopy techniques, principles of fluorescence, digital imaging, confocal microscopy, TIRF, STORM/PALM, STED, FRET-FLIM, and FRAP techniques, structured illumination, two-photon fluorescence, second harmonic generation, vibrational imaging, scanning probe microscopy (SPM) techniques, atomic force microscopy (AFM), electron microscopy (SEM, TEM and STEM), and X-ray microscopy/microCT.

Prerequisite: Characterization of Materials

References:

1. "Fundamentals of Light Microscopy and Electronic Imaging" by Douglas B. Murphy and Michael W. Davidson (ISBN: 047169214X)
2. "Transmission Electron Microscopy: A Textbook for Materials Science (4 Vol. set)" by David B. Williams and C. Barry Carter (ISBN: 0387765026)
3. "Atomic Force Microscopy" by Peter Eaton and Paul West (ISBN: 0199570450)
4. "Physical Principles of Electron Microscopy: An Introduction to TEM, SEM, and AEM" by Ray F. Egerton (ISBN: 1441938370)
5. "Low Voltage Electron Microscopy: Principles and Applications" by David C. Bell and Natasha Erdman (ISBN: 111997111X)
6. "MicroComputed Tomography: Methodology and Applications" by Stuart R. Stock (ISBN: 1420058762)

Advanced Solidification

ENMT607947
2 credits
Syllabus:

Solidification processes thermodynamics, kinetics and morphology of alloy solidification, Redistribution of the Solute and Scheil equation, solidification path, cooling curve analysis, competitive growth, columnar and equiaxed transition, eutectic growth, coupled zone and eutectic structure modification, Micro-macro segregation, Solidification simulation.

Prerequisite: Materials Physic 3

References:

1. M. Flemings, Solidification Processing, McGraw Hill, New York, 1974
2. Metals Handbook, 9th Edition, Vol. 15, Casting, ASM International, Materials Park, Ohio, 1988.
3. W. Kurz & D. J. Fisher, Fundamentals of Solidification, Trans Tech Publications, Aedermannsdorf, Switzerland, 1992.
4. J.A. Dantzig and M. Rappaz, Solidification, CRC Press, 2017
5. D.M. Stefanescu, Science and Engineering of Casting Solidification, Springer US, 2015

Nanotechnology

ENMT607947
3 credits
Syllabus:

Definition and scope, solid surface physical chemistry, nanostructures (zero, one and two-dimensional: 0D, 1D, 2D), special nano materials, fabrication processes (lithography, nanolithography, soft-lithography, assembly), characterization (structural, physical and chemical) and applications (chemical sensors, biosensors, MEMS / Microelectromechanical systems, DNA chips, photonic crystals).

Prerequisite: -

References:

1. Drexler, K. Eric (1986). Engines of Creation: The Coming Era of Nanotechnology. Doubleday. ISBN 978-0-385-19973-5.
2. Drexler, K. Eric (1992). Nanosystems: Molecular Machinery, Manufacturing, and Computation. New York: John Wiley & Sons. ISBN 978-0-471-57547-4.
3. Prasad, S. K. (2008). Modern Concepts in Nanotechnology. Discovery Publishing House. pp. 31–32. ISBN 978-81-8356-296-6.

Industrial Ecology

ENMT608950
2 credits
Syllabus:

Views on Industrial Ecology, Life-Cycle Assessment: Method Basics, Environmental Evaluation and Advanced Methods, Aggregate Materials Flows, Environmental Policy Strategies

Prerequisite: Mineral Processing

References:

1. T.E. Graedel and B.R. Allenby, "Industrial Ecology", AT&T, Prentice Hall, New Jersey 1995.
2. T.E. Graedel and B.R. Allenby, "Design for Environment", AT&T, Prentice Hall, New Jersey 1996.
3. UNEP, Life Cycle Assessment: What it is and how to do it, UN Publication, Paris 1996.
4. MIT Open course

5. Yale University https://environment.yale.edu/courses/2015-2016/detail/884/

Concrete Corrosion

ENMT608951
2 credits

Syllabus:

Cement characteristics: type of cement, water/cement ratio, porosity, permeability; transfer process on cement: porosity and water composition; transfer mechanism, water diffusion and migration; cement degradation: acid attack, sea water attack; corrosion mechanism inside cement: electrochemistry aspect, carbonate induced corrosion, chloride induced corrosion, stray-current induced corrosion, stress corrosion cracking, hydrogen induced cracking; corrosion prevention: inhibitor, surface engineering, material selection, cathodic protection, inspection and monitoring, repair.

Prerequisite: Corrosion & Protection of Metals

References:

1. Luca Bertolini, Bernhard Elsener Pietro Pedeferri, Rob Polder. Corrosion of Steel in Concrete, Prevention,Diagnosis, Repair, Willey-VCH, 2004
2. P.M. Chess, Cathodic Protection of teel in Concrete, E&FN spon, Great Britain, 1998

Refractory Materials

ENMT608953
2 credits
Syllabus:

Introduction, acid refractory, basic refractory, neutral refractory, bricks refractory, monolithic refractories, fused cast refractories, insulating refractories, refractory application in ferrous, non-ferrous, heat treatment, ceramics, glass, and other industries

Prerequisite: Ceramics Technology

References:

1. Kingery et al, Introduction to Ceramics, 2nd ed., John Wiley & Sons., 1976
2. Hummel AF, Phase Equilibria in Ceramic Systems, Marcel Dekker Inc, 1984

Mechanics of Material Forming

ENMT608954
Syllabus:

Review of Stress and Strain, Energy-Balance Analysis, Force-Balance Analysis, Upper Bound Analysis, Slip Line Field Analysis, Finite Element Analysis, Circle Grid Analysis, Distortion and Deformations Analysis.

Prerequisite: Metal Manufacturing Process

References:

1. W. Hosford and R.M. Caddel, Metal Forming: Mechanics and Metallurgy 4th Edition, Cambridge University Press, Cambridge, 2011.
2. Z. Marciniak, J.L. Duncan, S.J. Hu, Mechanics of Sheet Metal Forming 2nd Edition, Butterworth-Heinemann, Oxford, 2002.
3. S. Kobayashi, S. Oh, T. Altan, Metal Forming and the Finite Element Method, Oxford University Press, Oxford, 1989.
4. R.J. Shipley and D.A. Moore, "Analysis of Distortion and Deformation" in ASM Metals Handbook Volume 11: Failure Analysis and Prevention, ASM Internationals, Metal Parks OH, 2002.

Industrial Mechanic Equipment

ENMT608955
2 credits
Syllabus:

Code and Standard, Pipes and Pipe Fittings, Special Items, Valves, Pipe Connection to Process Equipments (Tanks, Pressure Vessels, Heat Exchangers, Columns, Pumps, Compressors), Piping System for Oil, Gas, LNG, Geothermal, Water, Chemical, Piping System for Instrumentation, Piping and Instrument Diagram (P & ID), Plot Plan, Isometric, Cross Section, Pipe Fabrication Drawings, Process Pipes, Utility Pipes, Onshore and Offshore

Prerequisite: Metal Manufacturing Process

References:

1. Peter Smith, Piping Materials Selection & Applications, Gulf Professional Publishing, Elsevier, 2005
2. Mohinder Nayyar, "Piping Handbook", 7th Ed., McGraw-Hill Professional; 1999, ISBN: 0070471061
3. Tyler G. Hicks, Power Plant Evaluation & Design Reference Guide, McGraw Hill, 1986
4. Saranavamutto et. al., Gas Turbine Theory, 5th Ed., Prentice Hall, 2001
5. Smith Eric, Thermal Design of Heat Exchanger, Jon Willey & Son, 1996, New York.

Materials Standardization

ENMT608956
2 credits
Syllabus:

Introduction, characteristics of standards, organization for standards, ISO structure and development, metal classification, ASTM, JIS, BS, DIN, NACE, AWS, and API standards

Prerequisite: Characterization of Materials

References:

1. Peter Smith, Piping Materials Selection & Applications, Gulf Professional Publishing, Elsevier,

2005
2. Mohinder Nayyar, "Piping Handbook", 7th Ed., McGraw-Hill Professional; 1999, ISBN: 0070471061

Polymer Recycling Technology

ENMT608957
2 credits
Syllabus:

National and international regulations on polymer recycling. Polymer material cycle. The polymer industry classification in Indonesia. Polymeric and ecological products. The basic principle of recycling. Stages and types of processes / machinery for recycling polymer products. The choice of the method for recycling the polymer product. Chemical and physical engineering of polymer recycled products. Case study of recycling of polymer products (polyethylentereptate-PET, PE & PP, polystyrene-styrofoam, PVC, polyacrylate, thermoplastic enjineering-ABS, rubber and thermoset)

Prerequisite: Polymer Manufacturing Process

References:

Edward.A.Muccio, Plastic Processing Technology, ASM International, ISBN:9780871704948

Polymer Recycling Technology

ENMT608958/ENMT618958
2 credits
Syllabus:

National and international regulations on polymer recycling. Polymer material cycle. The polymer industry classification in Indonesia. Polymeric and ecological products. The basic principle of recycling. Stages and types of processes / machinery for recycling polymer products. The choice of the method for recycling the polymer product. Chemical and physical engineering of polymer recycled products. Case study of recycling of polymer products (polyethylentereptate-PET, PE & PP, polystyrene-styrofoam, PVC, polyacrylate, thermoplastic enjineering-ABS, rubber and thermoset)

Prerequisite: -

References:

1. Edward.A.Muccio, Plastic Processing Technology, ASM International, ISBN:9780871704948

Quenching Technology

ENMT608959
2 credits
Syllabus:

Introduction, comparison of conventional and advanced cooling processes, types of advanced cooling media

Prerequisite: Heat Treatment and Surface Engineering

References:

1. Handbook of Quenchatnts and Quenching Technology
2. Quenching technology: a selected overview of the current state-of-the-art. Mat. Res. vol.8 no.4 São Carlos Oct./Dec. 2005

Industrial Apprenticeship

ENMT608060
6 credits
Syllabus:

Apprenticeship in an industry for at least 3 months. The results of the apprenticeship are submitted in the form of a report and presented before the apprenticeship examination committee

Prerequisite: Minimum of 110 credit hours during the break

References: -

Advanced Manufacturer

ENMT808061/ENMT818061
3 credits

Syllabus:

Metal forming as part of the design and manufacturing process; general principles, phenomena and mechanisms related to metal casting; molds (sand, ceramics, metals), gating systems and simulations, freezing of cast iron and aluminum processes, liquid treatment for ferrous metals (inoculation, Mg treatment) and non-ferrous (modifiers, grain refiner), various casting methods cast defects (casting defects); general principles, phenomena and mechanisms for the formation of solid phase metals, through the processes of forging, rolling, extrusion, withdrawal, sheet metal forming, and thermo-mechanical treatment. Phenomenon and mechanism in powder metallurgy, metal powder fabrication and powder forming mechanism, powder characteristics and characterization, mechanical alloying, pre-compacting process, compacting, feed characteristics, sintering process and powder consolidation, full density processing, sintered equipment type and related aspects, application and use of powder metallurgical products. Case study of process selection and evaluation of manufacturing processes.

Prerequisite: -

References:

1. Heine, R. W. et.al., Principles of Metal Casting, McGraw-Hill Pub., New Delhi, 1986
2. Surdia, T. Teknologi Pengecoran Logam, P. Paramita, 1985
3. John Campbell, Castings, Second Edition, Elsevier Butterworth-Heinemann, 2004

Advanced Polymer Manufacturing

ENMT808062/ENMT808z062
2 credits

Syllabus:

Polymer production fabrication process (formulation, shaping and finalization). Purpose and finalization process for polymer product types (deflashing, smoothing and polishing, sawing and cutting, drilling, grinding and sanding, routing, milling & turning, tapping & threading, cleaning, annealing, assembling, and decoration). Types of assembly processes (mechanical joining, welding and adhesive bonding). Type of decoration process (painting, plating, thermal spray coating, vacuum metalizing, hotstamping, coloring). Machinery and process construction mechanisms. The process of finalizing the manufacture of polymer products. Case studies on the fabrication process for product packaging (rigid and flexible), automotive, electronics and construction equipment.

Prerequisite: -

References:

1. G. Challa, Polymer Chemistry – An Introduction, 1993, Ellis Horwood Limited series in Polymer Science, UK
2. Young R.J. and Lovell P.A., Introduction to Polymers, 2nd edition, 1997, Chapman & Hall, Cambridge, UK
3. Cheremisinoff N.P., Polymer Characterization – Laboratory Techniques and Analysis, 1996, Noyes Publication, New Jersey, USA
4. Morton-Jones D.H., Polymer Processing, 1994, Chapman & Hall, UK

Advanced Polymer Manufacturing

ENMT808062 /ENMT808062
2 credits
Syllabus:

Polymer production fabrication process (formulation, shaping and finalization). Purpose and finalization process for polymer product types (deflashing, smoothing and polishing, sawing and cutting, drilling, grinding and sanding, routing, milling & turning, tapping & threading, cleaning, annealing, assembling, and decoration). Types of assembly processes (mechanical joining, welding and adhesive bonding). Type of decoration process (painting, plating, thermal spray coating, vacuum metalizing, hotstamping, coloring). Machinery and process construction mechanisms. The process of finalizing the manufacture of polymer products. Case studies on the fabrication process for product packaging (rigid and flexible), automotive, electronics and construction equipment.

Prerequisite: -

References:

1. G. Challa, Polymer Chemistry – An Introduction, 1993, Ellis Horwood Limited series in Polymer Science, UK
2. Young R.J. and Lovell P.A., Introduction to Polymers, 2nd edition, 1997, Chapman & Hall, Cambridge, UK
3. Cheremisinoff N.P., Polymer Characterization – Laboratory Techniques and Analysis, 1996, Noyes Publication, New Jersey, USA
4. Morton-Jones D.H., Polymer Processing, 1994, Chapman & Hall, UK

ENMT808963/ENMT818963

Syllabus:

Introduction and definition of smart materials, properties of materials, current developments in materials and technology, applications in various fields and functionalities: multiferoic and magnetoelectric materials for spintronics, concept of smart materials for photovoltaic, piezo and electro-active materials, shape-remember materials (shape memory alloys and polymers), and smart coatings.

Prerequisite: -

References:

Igor A. Luk'yanchuk and Daoud Mezzane, Smart Materials for Energy, Communications and Security, Springer Science + Business Media B.V. Dordrecht, 2007.

Energy Materials

ENMT808964/ENMT818964
2 credits

Syllabus:

Overview of materials and materials related energy: society's present needs and future energy demands on conventional energy sources and systems, including fossil fuels and then focus on alternate renewable energy. Synthesis of materials: Solid state, sol-gel, gas phase (CVD/ALD). Synthesis of bulk and nanomaterials, chemical properties of energy-relevant materials at the nanoscale. Crystal field theory for solid-state materials. Semiconductors and their use in energy relevant applications. Materials related energy with applications in energy storage, batteries and related areas. Advanced concept in fuel cells, supercapacitors, thermoelectrics, solar cells, solar heat, batteries and other renewable energy sources and possible future hydrogen storage and nanotechnology in energy.

Prerequisite: -

References:

1. Bent Sørensen: Renewable Energy, Physics, Engineering, Environmental Impacts, Economics & Planning, 4th Ed., Elsevier, Burlington, MA (2011).
2. Radu D. Rugescu: Solar Energy, Intech, Vukovar, Croatia (2010)
3. Zekai Şen: Solar Energy Fundamentals and Modeling Techniques, Springer-Verlag London Limited (2008)
4. Aldo Vieira da Rosa: Fundamentals of Renewable Energy Processes, ElsevierAcademic Press, Burlington, MA (2005)

Advanced Extractive Metallurgy

ENMT808965/ENMT818965
3 credits

Syllabus:

Waste characterization for process raw materials. Innovation of wet metallurgical processes (hydrometallurgy) and hot metallurgy (pyrometallurgy) for low-grade raw materials and energy efficiency: reaction mechanisms and applications, such as metal extraction with plasma, microwaves. Metal recycling process. Processing slag, dust and metallurgical ash particles. Processing and utilization of by-products (by product): slag utilization, cross processing, fly ash processing. Acquisition of metals from process wastes (such as tailings, residues, sludges): mineral processing from tailings, recovery of metals from red mud, recovery of metals from waste sludges. New technology for metal recycling.

Prerequisite: -

References:

S. Ramachandra Rao, Resources Recovery and Recycling from Metallurgical Waste, waste Management Series vol. 7, Oxford, 2006.

Related publications in journals e.g. Metallurgical and Materials Transaction, B; Journal of Metals, Hydrometallurgy, etc.

Advanced Surface Engineering

ENMT808966/ENMT818966

3 credits

Syllabus:

Basic surface engineering, conventional surface engineering, advanced surface engineering, surface coating, surface modification, thin film characterization.

Prerequisite: -

References:

1. Chattopadhyay et al, Green Tribology, ASM International, 2014.
2. H.O. Pierson, Handbook of Chemical Vapor Deposition, Noyes Publication, 2000
3. D.M. Mattox, Handbook of Physical Vapor Deposition, Elsevier, 2010
4. J.P. Davim, Materials and Surface Engineering, Woodhead Publishing, 2012
5. A.S. Hamdy, Handbook of Smart Coating for Materials Protection, Woodhead Publ, 2014

CHAPTER 5

MASTER PROGRAM

Master Program in Metallurgy and Materials Engineering

Program Specification

1.	**Awarding Institution**	Universtas Indonesia Double Degree: Universitas Indonesia & partner universities	
2.	**Teaching Institution**	Universtas Indonesia Double Degree: Universitas Indonesia & partner universities	
3.	**Faculty**	Engineering	
4.	**Name of Study Program**	Graduate Program (Master) in Metallurgical and Materials Engineering	
5.	**Study Programme Vision and Mission**	Vision: To be a research-based center of excellence, as well as referral center for master level education and research in the field of metallurgical and materials engineering in national and global levels Mission: - Providing a master's education in metallurgy and material engineering. - Producing high quality master graduates with a strong academic background in process technology and material engineering. - Producing master graduates who are able to play an active and dynamic role in their community.	
6.	**Type of Class**	Reguler, Special, Research	
7.	**Awarding Degree**	Magister Teknik (M.T.) Double Degree: Magister Teknik (M.T.) dan Master of Engineering (M.Eng.)	
8.	**Accreditation Status**	BAN-PT : A	
9.	**Language Course**	Bahasa (Indonesia) and English	
10.	**Study Scheme (Full Time / Part-Time)**	Full Time	
11.	**Entry Requirements**	Bachelor (S1) from the same degree, mechanical, chemical, or electrical engineerings, physics, chemistry or equivalent degree via matriculation	
12.	**Term of Study**	2 years	
	Type of Semester	Number of semester	Number of weeks/semesters
	Reguler	4	16
	Short (opsional)	**1**	**8**
13.	**Aims of the programme:** 1. Producing high quality master graduates characterized by having an in-depth analytical skills 2. Producing master graduates who are able to design complex products, processes and systems in the fields of metallurgical and material engineering 3. Producing master graduates who are able to play an active role and contribute to meet the goals of sustainable development		
14.	**Profile of Graduates:** Master of Engineering who has the ability to analyze in depth, designs products, processes, and complex systems in the field of Metallurgical and Material Engineering and contribute to meeting the goals of sustainable development		

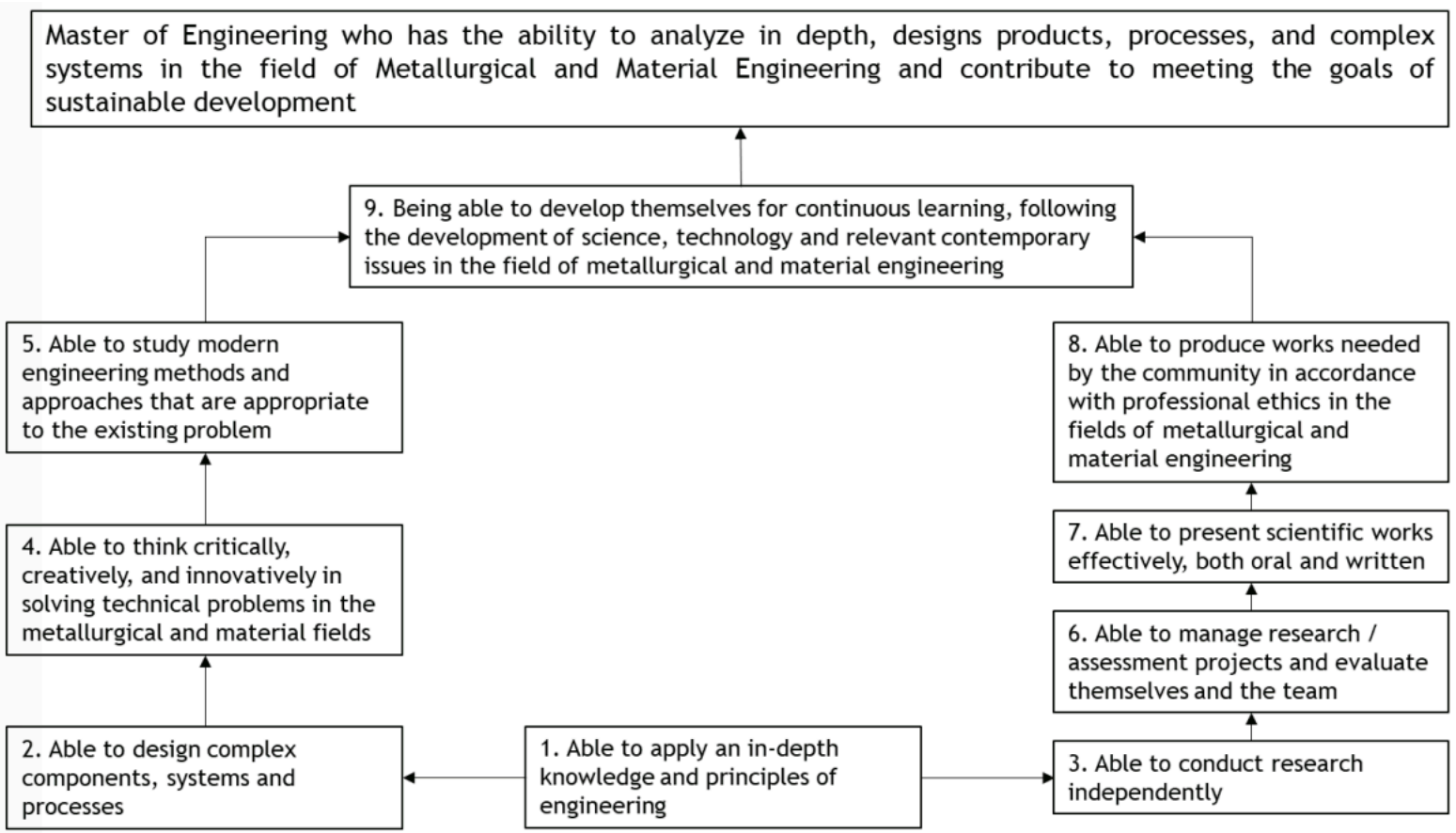
15	**Expected Learning Outcomes (ELO):** The Master of Metallurgy and Materials Engineering has the following learning outcomes: 1. Able to apply an in-depth knowledge and principles of engineering 2. Able to design complex components, systems and processes 3. Able to conduct research independently 4. Able to think critically, creatively, and innovatively in solving technical problems in the metallurgical and material fields 5. Able to study modern engineering methods and approaches that are appropriate to the existing problem 6. Able to manage research / assessment projects and evaluate themselves and the team 7. Able to present scientific works effectively, both oral and written 8. Able to produce works needed by the community in accordance with professional ethics in the fields of metallurgical and material engineering 9. Being able to develop themselves for continuous learning, following the development of science, technology and relevant contemporary issues in the field of metallurgical and material engineering
16.	**Composition of Subjects**

No.	Type of Courses	Credit Hours (SKS)	Percentage
I	**Compulsory / Expertise Courses**	**20**	**45,45%**
II	**Specialization Courses**	**12**	**27,27%**
III	**Elective Courses**	**3**	**6,82%**
IV	**Seminar, Scientific Publication & Thesis**	**9**	**20,46%**
	Total	**44**	**100 %**

Job Prospects

Graduates of this study program can work in various sectors both private, state-owned and government such as in the automotive industry, manufacturing, heavy equipment, mining, oil and gas, research and development fields such as Pertamina, LIPI, BATAN, BPPT, LAPAN, Ministry of Industry, and Ministry of Energy and Mineral Resources.

Expected Learning Outcome Matrix



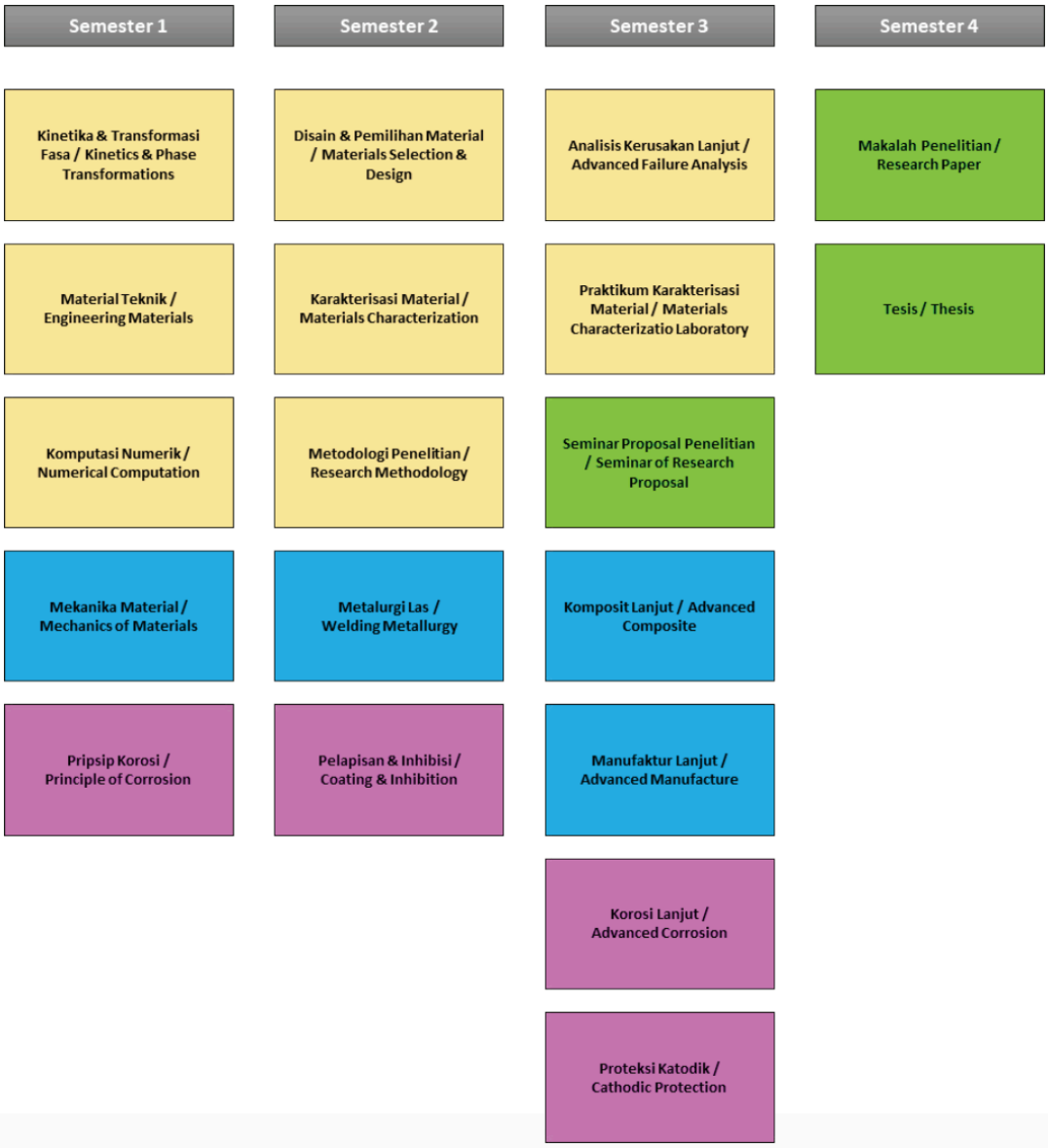
Flowchart for Learning Outcome Achievement
Master Program in Metallurgical & Materials Engineering

Learning Outcome	Year 1		Year 2	
	Semester 1	Semester 2	Semester 3	Semester 4
1. Able to apply an in-depth knowledge and principles of engineering	Kinetics & Phase Transformations			
	Engineering Materials			
	Numerical Computation			
	Mechanics of Materials			
	Principle of Corrosion			
		Welding Metallurgy		
		Coating & Inhibition		
			Advanced Composites	
			Advanced Manufacture	
			Advanced Corrosion	
			Cathodic Protection	
2. Able to design complex components, systems and processes		Materials Selection & Design		
		Material Characterizations		
3. Able to conduct research independently		Research Methodology		

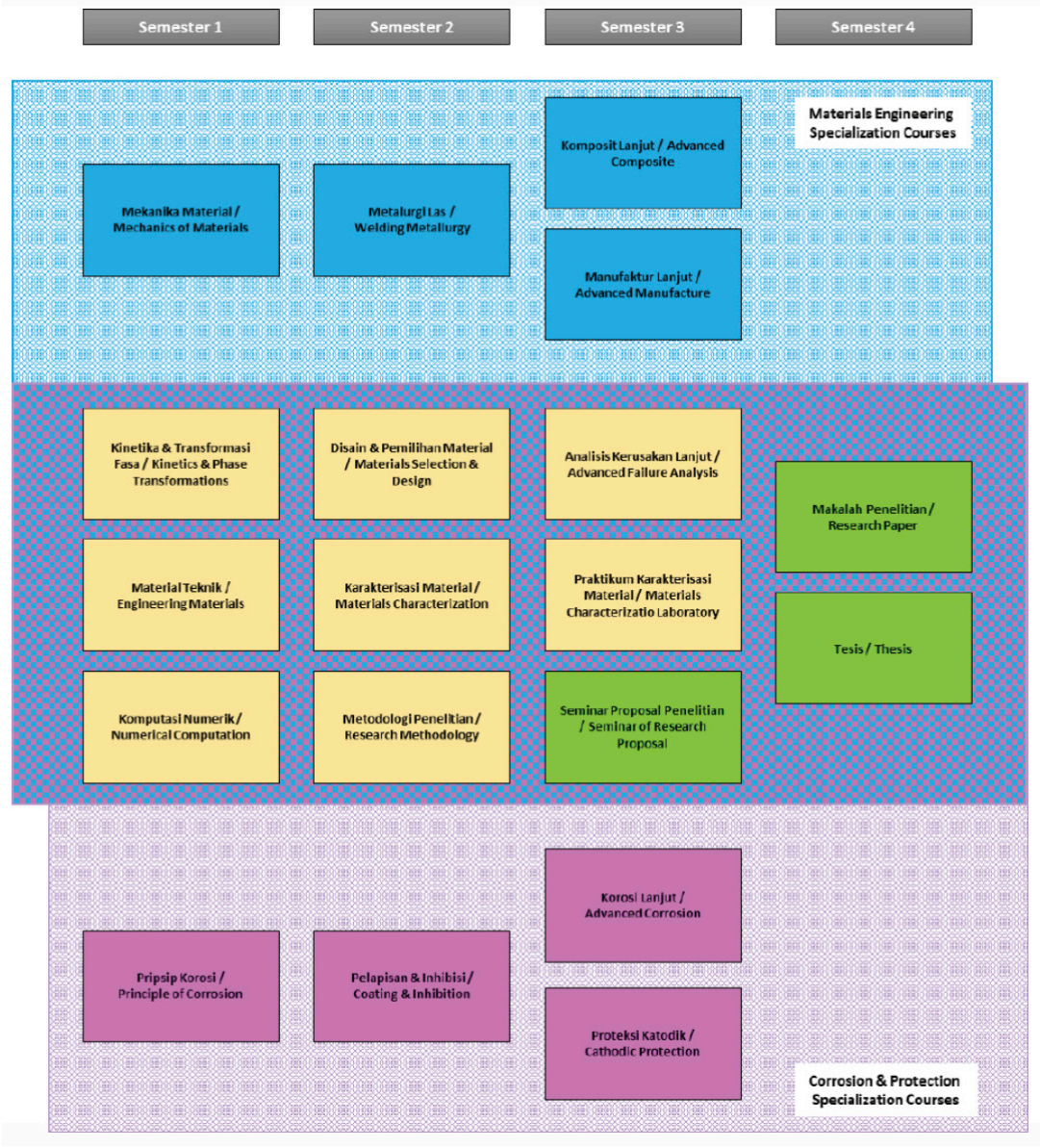
4. Able to think critically, creatively, and innovatively in solving technical problems in the metallurgical and material fields			Advanced Failure Analysis	
5. Able to study modern engineering methods and approaches that are appropriate to the existing problem		Research Methodology		
6. Able to manage research / assessment projects and evaluate themselves and the team				Scientific Publication
			Seminar of Research Proposal	Thesis
7. Able to present scientific works effectively, both oral and written				Scientific Publication
			Seminar of Research Proposal	Thesis
8. Able to produce works needed by the community in accordance with professional ethics in the fields of metallurgical and material engineering				Scientific publication
			Seminar of Research Proposal	Thesis
9. Being able to develop themselves for continuous learning, following the development of science, technology and relevant contemporary issues in the field of metallurgical and material engineering				Scientific publication
			Seminar of Research Proposal	Thesis

Curriculum Course Structure

Subject Distribution in Curriculum 2020



Subject Correlation in Curriculum 2020



Course Structure for Master Program Metallurgical & Materials Engineering

Compulsory / Expertise Courses

Code	Subject	SKS
	1st Semester	
ENMT801001	Kinetics & Phase Transformation	3
ENMT801002	Engineering Materials	2
ENMT801003	Numerical Computation	3
	Sub Total	**8**
	2nd Semester	
ENMT802006	Materials Selection & Design	3
ENMT802007	Material Characterization	3
ENMT802008	Research Methodology	3
	Sub Total	**9**
	3rd Semester	
ENMT803011	Advanced Failure Analysis	3
ENMT800013	Seminar of Research Proposal	1
	Sub Total	5
	4th Semester	
ENMT800018	Scientific publication	2
ENMT800019	Thesis	6

Materials Engineering Specialization Courses

Code	Subject	
	1st Semester	
ENMT801104	Mechanics of Materials	3
	Sub Total	**3**
	2nd Semester	
ENMT802109	Welding Metallurgy	3
	Sub Total	**3**
	3rd Semester	
ENMT803114	Advanced Composites	3
ENMT803115	Advanced Manufacture	3
	Sub Total	**6**
	4th Semester	
	Elective	3
	Sub Total	**3**
	Total	**15**

Corrosion & Protection Specialization Courses

Code	Subject	SKS
	1st Semester	
ENMT801205	Principle of Corrosion	3
	Sub Total	**3**
	2nd Semester	
ENMT802210	Coating & Inhibition	3
	Sub Total	**3**
	3rd Semester	
ENMT803216	Advanced Corrosion	3
ENMT803217	Cathodic Protection	3
	Sub Total	**6**
	4th Semester	
	Elective	3
	Sub Total	**3**
	Total	**15**

Electives Courses

Code	Electives	SKS
	1st Semester	
ENMT803920	Nano Technology	3
ENMT803921	Electronic Materials	3
ENMT803922	Polymer Products Manufacturing	3
ENMT803923	RBI & Integrity	3
	2nd Semester	
ENMT804924	Polymer Materials and Derivatives	3
ENMT804925	Advanced Extractive Metallurgy	3

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

Transition Policy from Curriculum 2016 to Curriculum 2020

1. The Curriculum 2020 takes effect from the Second Term 2020/2021. After this curriculum is implemented, only the subjects in the Curriculum 2020 will be counted for the graduation: any subject in the Curriculum 2016 follows the transition rules.
2. Transition rules will be valid for 1 (one) year, starting from the Second Term of 2020/2021 until the First Term 2021/2022 for any subject changing in its place (from the first term to second term or vice versa). If it is necessary, the subject will be opened in both semesters.
3. Students who have not passed the compulsory subjects in the Curriculum 2016 are required to take the same or equivalent subjects in the Curriculum 2020.
4. If there is a change in the credit hours, the credits at the first time the subject taken will be considerred. The same or equivalent subjects with different credit hours, if repeated or newly taken, will be counted with the new name and credit hours.
5. The equivalence subjects for Curriculum 2016 and Curriculum 2020 can be seen in the Equivalency Table. Any unlisted subject in the Curriculum 2016 has been removed and is no longer offered.
6. If the compulsory subjects in the Curriculum 2016 are removed and there are no equivalencies in the Curriculum 2020:

a. For students who have passed the subjects, the subjects will be counted as compulsory credits with the same name and credit hours.

b. For students who have not passed the subjects, students can take new compulsory subjects or elective subjects with the new name and credit hours.

7. If the credit hour of a subject has been reduced while the student has already taken the subject required for the graduation, then the student is still allowed to graduate even though the total number of credits is less than the required one.

Equivalency of Curriculum 2016 and 2020

No	Curriculum 2019			Curriculum 2020		
	Code	Subject	Credit	Code	Subject	Credit
1	ENMT800016	Research Paper	2	ENMT800018	Scientific Publication	2
2	ENMT800019	Thesis	8	ENMT800019	Thesis	6
3	ENMT801001	Kinetics and Phase Transformation	3	ENMT801001	Kinetics and Phase Transformation	3
4	ENMT801002	Engineering Materials	2	ENMT801002	Engineering Materials	2
5	ENMT801003	Research Methodology and Computation	3	ENMT802008	Research Methodology	3
6	ENMT801104	Mechanics of Material	3	ENMT801104	Mechanics of Material	3
7	ENMT801205	Principle of Corrosion	3	ENMT801205	Principle of Corrosion	3
8	ENMT802006	Design and Material Selection	3	ENMT802006	Design and Material Selection	3
9	ENMT802007	Material Characterization	3	ENMT802007	Material Characterization	3
10	ENMT802109	Advanced Manufacture	3	ENMT803115	Advanced Manufacture	3
11	ENMT802210	Advanced Corrosion	3	ENMT803216	Advanced Corrosion	3
12	ENMT802211	Coating and Inhibition of Materials	3	ENMT802210	Coating and Inhibition of Materials	3
13	ENMT803012	Advanced Failure Analysis	3	ENMT803011	Advanced Failure Analysis	3
14	ENMT803113	Advanced Composite	3	ENMT803114	Advanced Composite	3
15	ENMT803114	Welding Metallurgy	3	ENMT802109	Welding Metallurgy	3
16	ENMT803115	Cathodic Protection	3	ENMT803217	Cathodic Protection	3
17	ENMT803919	Project Management	3	ENMT804927	Project Management	3
18	ENMT803920	Electronic Materials	3	ENMT803921	Electronic Materials	3
19	ENMT803921	Polymer Derivatives	3	ENMT804924	Polymer Materials and Derivatives	3
20	ENMT803922	Risk Based Inspection and Integrity	3	ENMT803923	Risk Based Inspection and Integrity	3
21	ENMT804923	Advanced Polymer Manufacturing	3	ENMT803922	Polymer Products Manufacturing	3
22	ENMT804924	Advanced Extractive Metallurgy	3	ENMT804925	Advanced Extractive Metallurgy	3
23	ENMT804925	Advanced Surface Engineering	3	ENMT804926	Advanced Surface Engineering	3
24	ENMT804927	Nanotechnology	3	ENMT803920	Nanotechnology	3

Note:
Other subjects that are not listed in this table do not change except for the subject code and curriculum code (full list is given in the SIAK-NG website)

Course Syllabus Master Program in Metallurgical and Materials Engineering

Compulsory / Expertise Courses

Kinetics & Phase Transformation

ENMT801001
3 SKS
Syllabus:

Introduction to thermodynamics, Thomson effects, diffusion, interface and energy / surface tension, grain growth kinetics, grain boundary movements, homogeneous and heterogeneous nucleation, continuous and lateral growth, alloy freezing, equilibrium freezing, non-equilibrium freezing, cellular freeze and dendritic freeze, constitutional super-cooling, eutectic freezing, eutectic structure, eutectic growth, rod and lamellar formation, impurity effects, interphase interfaces, coherent, semi-coherent and non-coherent, interface migration, sediment growth, kinetic transformation, recrystallization, grain formation, grain growth, age hardening, ferrite and austenite precipitation, pearlite reaction, bainite transformation, martensite transformation, spinodal transformation, tempering martensite, case studies.

Prerequisite: -

References:

- Porter, D. A and Easterling, K.E, Phase Transformation in Metals and Alloys, 3rd. ed., CRC Press, 2009.
- ASM, ASM Handbook Vol. 3, Alloy Phase Diagram, Ohio, 2010
- R.W. Cahn and P. Haasen (eds), Physical Metallurgy, North-Holland, 1996
- M. Flemings, Solidification Processing, McGraw Hill, New York, 1974

Engineering Materials

ENMT801002
2 SKS
Syllabus:

Atomic theory, atomic bonding, bonding system, crystal structure, structure and material properties. Iron material selection, classification of markings and specifications of steel, low alloy steel, heat treatable cabon steel and low alloy steel, tool steel selection, stainless steel selection, cast iron, non ferrous material selection. Smart materials, materials in organic: ceramics and glass, mechanical behavior of ceramics, polymer materials, plastic selection, polymerization and composite materials

Prerequisite: -

References:

- Bondan T. Sofyan, Pengantar Material Teknik, Penerbit Salemba Teknika, 2010
- W.D. Callister, Materials Science and Engineering: An Introduction, 6th ed., John Wiley & Sons, 2003
- William F. Smith, Introduction to Materials Science and Engineering

Numerical Computation

ENMT801003
3 SKS
Syllabus:

Introduction to computing, basic matlab, logical expressions, vectorization, controlling flow with if and while, loops in matlab, functions and m-files, test output, matlab programming, binary numbers, floating point numbers, precision of machines, linear equations , curve fitting, ordinary differential equations, statistical and data analysis processes

Prerequisite: -

References:

- Applied Numerical Methods with Matlab for Engineers and Scientists, Steven C. Chapra, Third Edition, McGraw-Hill, 2012.
- Numerical and Analytical Methods with MATLAB® for Engineers and Scientists, William Bober, CRC Press, 2014.
- Numerical Methods in Engineering with MATLAB, Jaan Kiusalaas, Cambridge University Press, 2005.

Materials Selection & Design

ENMT802006
3 SKS
Syllabus:

Classification of engineering materials, factors and systematic design and selection of materials, material selection criteria, material property charts and performance indexes, designs for corrosion resistance, designs for the use of high temperature materials and designs for wear and fatigue resistant materials , designs for plastics and composites and the selection of various types of steel.

Prerequisite: -

References:

- Hurst, Kenneth S., Engineering Design Princi-

ples, 1st Ed., Arnold, New York, 1999

- Pugh, Stuart, Total Design, Integrated Methods for Successful Product Engineering., Addison-Wesley Publisher Ltd., Edinburgh 1991
- Dym, Clive L and Patrick Little, Engineering Design, A-Project-Based Introduction, John Wiley and Sons, Inc., 2000
- Dieter, G. E., Engineering Design, A Material and Processing Approach, 2nd ed., McGraw Hill., 1991
- Ashby, M. F, Materials Selection in Mechanical Design, 2nd ed., Cambridge Uni. Press., Oxford, 1999

Material Characterizations

ENMT802007
3 SKS
Syllabus:

Introduction, testing procedures and standards, principles and advanced analysis methods for the chemical composition of engineering materials (AAS, OES, EDS, XPS), identification of crystal structures (X-ray diffraction), advanced metallography (SEM, EPMA, TEM), and thermal analysis (DTA, TGA, DSC and TMA).

Prerequisite: -

References:

- Davis H.E., G.E. Troxell, G.F.W. Hauck; The Testing of Engineering Materials; Mc Graw-Hill; 1982
- ASM; Mechanical Testing of Metal; 1983
- Lous Cartz, Non Destructive Testing; ASM International; 1995
- Vernon john; Testing of Materials; 1992
- Andreas Ohsner and Holm Altenbach; Properties and Characterization of Modern Materials; 2017
- Callister, William D. 2007. Materials Science and Engineering, John Wiley & Sons.
- Der Voort, Van. 1984. Metallography Principles and Practice, McGraw-Hill Book Company.
- Goodnew, Peter J; Humphrey, John. 2000. Electron Microscopy and Analysis, CRC Press
- Petzow, Gunter. 1991. Metallographic Etching, University Microfilms.
- ASM Handbook Vol 9 – Metallography and Microstructures, ASM International
- Zhang, Sam; Li, Lin; Kumar, Ashok. 2008. Materials Characterization Techniques, CRC Press.
- Schwartz, A.J.; Kumar, M.; Adams, B.L.; Field, D.P. 2009. Electron Backscatter Diffraction in Materials Science, Springer US

Research Methodology

ENMT802008
3 SKS
Syllabus:

Scientific understanding, research methodology, problem formulation, hypotheses, literature review, data collection and processing, preparation of research proposals and presentation of scientific papers;

Prerequisite: -

References:

- Willie Tan, “Practical Research Methods”, Prentice Hall, 2002.
- R. Kumar, Research Methodology, A Stepby-step Guide for Beginner, 3rd ed., SagePub, 2012

Advanced Failure Analysis

ENMT803011
3 SKS
Syllabus:

Definition & purpose of failure analysis, general material failure factors, general procedures in failure analysis techniques, classification of sources of failure, characteristics & mechanism of material failure, ductile fracture, brittle fracture, fatigue fracture, as well as failure.

Prerequisite: -

References:

- Wulpi, D. J., Understanding How Components Fail, ASM, 1998
- Charlie, R. B and Ashok, C., Metallurgical Failure Analysis, McGraw-Hill Inc., 1993
- French, D. N., Metallurgical Failure in Fossil Fired Boilers, John Wiley & Sons, 1983

Seminar of Research Proposal

ENMT800013
1 SKS

Syllabus:

Research proposal presented at the seminar in accordance with the proposals submitted in the thesis. The paper includes: Problems and hypotheses, methodology and discussion

Prerequisite: -

References: -

Scientific publication
ENMT800018
2 SKS
Syllabus:

The research results are written in a journal format and are published minimum in a national journals or in international proceedings.

Prerequisite: -

References: -

Thesis
ENMT800019
6 SKS
Syllabus:

The application / implementation of various courses that are followed in an integrated manner in a study in order to solve a problem in the field of metallurgical and material engineering. Research results are presented in the form of scientific reports and presented in front of a team of examiners.

Prerequisite: -

References: -

Materials Engineering Specialization Courses

Mechanics of Materials
ENMT801104
3 SKS
Syllabus:

Introduction to material mechanics, types of material failure, material engineering and selection, elastic deformation and strength theory, in-elastic deformation, metal and alloy processes, composites, ceramics and glass, polymers, stress and strain concepts, rheological models, plastic deformations, creep deformation, anisotropic material, material mechanical test theory, stress-strain properties, tensile behavior tendencies, interpretation of actual stress-strain, compression test, hardness, impact, bending and torque test, plane stress, plane strain, three-dimensional stress state, stress in the octahedral plane, complex strain states, general forms of failure criteria, criteria, fracture mechanics concepts, fracture toughness values, application of K values in design and analysis, stress based fatigue, load cycles, stress-time curves, average stresses, multiaxial stresses , fatigue crack growth, fatigue based on strain, strain vs. age, average stress effect, estimated age for structural components chtur and creep.

Prerequisite: -

References:

- Hibbeler, Russel C., Engineering mechanics,statics, 8th Ed., Macmillan Publishing Company,Inc.
- Hibbeler, Russel C., Mechanical of Materials,-Prentice Hall International Inc., 1997
- Ferdinant L. Singer, Ilmu Kekuatan Bahan, Penerbit Erlangga, 1981
- Beer, F.P. and Johston, E.R., Mechanics of Materials, McGraw-Hill, 1983

Welding Metallurgy
ENMT802109
3 SKS
Syllabus:

Introduction to material joining, classification, basic principles and characteristics of electric arc welding processes, their advantages and limitations, classification & characteristics of welding machines and welding wires, fluxes and gases, welding parameters and heat input, basic principles of metallurgical welding, metal transfer in electric arc welding, welded joint microstructure, alloying effect, temperature changes in welds (HAZ), factors affecting the cooling rate of weld metal, weldability of ferrous metals (steel and its alloys, steel) stainless and cast iron & non-ferrous (Al, Cu, Mg, Ni, and alloys), welding defects and prevention, preheating & PWHT, and quality control of welds. Welding case studies.

Prerequisite: -

References:

- Larry F. Jeffus; Welding Principles and Applications
- Kou; Welding Metallurgy 2nd Edition; John Wiley and Sons; 2005
- Easterling; Introduction to Physical Metallurgy of Welding; Butterworth and Co; 1992
- David A. Grewell; Plastics and Composites Welding Handbook
- Alphonsus V.V. pocius; Adhesion and Adhesive Technology
- Winarto & Anis; Lecture notes; 2007

Advanced Composites
ENMT803114
3 SKS
Syllabus:

Concepts, definitions and classifications of composites, matrices and reinforcement, composite fabrication, mixed laws, interface and wetting theory, nano composites, composite mechanics, geomet-

rical aspects in composites, laminae and laminates, elastic behavior, fiber edge effects, theory laminate, one-way lamina strength, laminate strength, short fiber composite strength, composite fracture energy and composite case studies.

Prerequisite: -

References:

- Hull, D., An Introdution to composite Materials, Cambridge Uni. Press, 1981
- Mattew, F.L. and R.D. Rawlings, Composite Materials: Engineering and Science, Chapman Hall, 1993
- Bryan Harris, Engineering Composites Materials, 2nd Eddtion, Institute of Materials Communication Ltd, 1999

Advanced Manufacture

ENMT803115
3 SKS
Syllabus:

Metal forming as part of the design and manufacturing process; general principles, phenomena and mechanisms related to metal casting; molds (sand, ceramics, metals), gating systems and simulations, freezing of cast iron and aluminum processes, liquid treatment for ferrous metals (inoculation, Mg treatment) and non-ferrous (modifiers, grain refiner), various casting methods cast defects (casting defects); general principles, phenomena and mechanisms for the formation of solid phase metals, through the processes of forging, rolling, extrusion, withdrawal, sheet metal forming, and thermo-mechanical treatment. Phenomenon and mechanism in powder metallurgy, metal powder fabrication and powder forming mechanism, powder characteristics and characterization, mechanical alloying, pre-compacting process, compacting, feed characteristics, sintering process and powder consolidation, full density processing, sintered equipment type and related aspects, application and use of powder metallurgical products. Case study of process selection and evaluation of manufacturing processes.

Prerequisite: -

References:

- Heine, R. W. et.al., Principles of Metal Casting, McGraw-Hill Pub., New Delhi, 1986
- Surdia, T. Teknologi Pengecoran Logam, P. Paramita, 1985
- John Campbell, Castings, Second Edition, Elsevier Butterworth-Heinemann, 2004

Principle of Corrosion

ENMT801205
3 SKS
Syllabus:

Electrochemical concepts: basis and application, definition of corrosion, form of corrosion, cost of corrosion, electrical concepts relevant to corrosion, relevant chemical and electrochemical concepts, prediction of corrosion trends thermodynamically, electrolytes, corrosion kinetics, over-potential (polarization), passivation , corrosion velocity measurements, metallurgical aspects, forms of corrosion, and combined potential theory, corrosion testing (weight loss coupon method, electrochemistry).

Prerequisite: -

References:

- Jones DA; Principles & Prevention of Corrosion; Mc Milan Pubs; 1992
- Fontana; Corrosion Engineering 3rd Ed; 1992
- Roberge Pierre R; Handbook of Corrosion Engineering; Mc Graw-Hill; 1999

Coating & Inhibition

ENMT802210
3 SKS
Syllabus:

Coatings: metallic coatings, metallic coatings' types and classifications, protection mechanisms, electroplating and electroless plating, anodizing, phosphating, chromatting, hot-dip galvanizing, service lie prediction, Organic Coating (paints), organic coating properties, classification and 'paints' formulations, protection mechanisms, surface preparation standards, application methods, coating defects and 'painting' failures. Inhibition; Types, classifications and mechanisms of inhibition (anodic, cathodic, and mixture inhibitors), corrosion inhibitor formulations in general, applications and limitations (for automotive, water cooling, systems)

Prerequisite: -

References:

- Jones DA; Principles & Prevention of Corrosion; Mc Milan Pubs; 1992
- Fontana; Corrosion Engineerng 3rd Ed; 1992
- Roberge Pierre R; Handbook of Corrosion Engineerin; Mc Graw-Hill; 1999

Advanced Corrosion

ENMT803216
3 SKS
Syllabus:

Introduction, dilute solutions and water, thermodynamic aspects of aqueous corrosion, corrosion kinetics, aqueous corrosion applications in the field (seawater corrosion, underground corrosion, corrosion in the soil environment), corrosion applications for metals other than iron, atmospheric corrosion, high temperature oxidation reactions, oxidation thermodynamics, oxide layer growth, oxide properties and characteristics, pilling-bedworth ratio, oxidation reaction rate, influence of oxygen corrosion pressure in specific environments, high temperature carburization, decarburization, metal dusting, hot corrosion, high temperature corrosion testing, material protection at temperatures high, high temperature resistant material, coating (aluminizing, chromizing, siliconizing). Case study of corrosion.

Prerequisite: -

References:

- Jones DA; Principles & Prevention of Corrosion; Mc Milan Pubs; 1992
- Fontana; Corrosion Engineerng 3rd Ed; 1992
- Roberge Pierre R; Handbook of Corrosion Engineerin; Mc Graw-Hill; 1999

Cathodic Protection

ENMT803217
3 SKS
Syllabus:

Basic theory of cathodic protection, protection criteria, cathodic protection system with sacrificial anode, material properties of sacrificial anode and its selection, cathodic protection application of sacrificial anode, cathodic protection system impressed current (ICCP), instrument for corrosion protection, cathodic protection in sea water environment, soil , and structure in concrete (cement), material classification, specific material and environmental relationships, design instructions for corrosion prevention, SS stainless steel and super duplex stainless steel resistance properties, corrosion resistance of commonly used engineering materials (cast steel, carbon steel, low alloy steel, nickel, aluminum, copper, zinc, titanium and its alloys, corrosion resistance of non-metal materials (rubber, plastic, composite, ceramic).

Prerequisite: -

References:

- Jones DA; Principles & Prevention of Corrosion; Mc Milan Pubs; 1992
- Fontana; Corrosion Engineering 3rd Ed; 1992
- Roberge Pierre R; Handbook of Corrosion Engineering; Mc Graw-Hill; 1999

Elective Courses

Nanotechnology

ENMT803920
3 SKS
Syllabus:

Definition and scope, solid surface physical chemistry, nanostructures (zero, one and two-dimensional: 0D, 1D, 2D), special nano materials, fabrication processes (lithography, nanolithography, soft-lithography, assembly), characterization (structural, physical and chemical) and applications (chemical sensors, biosensors, MEMS / Microelectromechanical systems, DNA chips, photonic crystals).

Prerequisite: -

References:

- Drexler, K. Eric (1986). Engines of Creation: The Coming Era of Nanotechnology. Doubleday. ISBN 978-0-385-19973-5.
- Drexler, K. Eric (1992). Nanosystems: Molecular Machinery, Manufacturing, and Computation. New York: John Wiley & Sons. ISBN 978-0-471-57547-4.
- Prasad, S. K. (2008). Modern Concepts in Nanotechnology. Discovery Publishing House. pp. 31–32. ISBN 978-81-8356-296-6.

Electronic Materials

ENMT803921
3 SKS
Syllabus:

The basic principles of semiconductor devices such as thermoelectric, piezoelectric, LED, solar cells. Basic integrated circuit process.

Prerequisite: -

References:

- Gordon McComb, Electronics for Dummies
- C. Hamaguchi, Basic Semiconductor Physics
- B.G. Yacobi, Semiconductor Materials – An Introduction to Basic Principles
- Stephen W. Fardo & Dale R. Patrick, Electricity and Electronic Fundamentals
- William J. Greig, Integrated Circuit Packaging, Assembly and Interconnections
- Vasilis F. Pavlidis and Eby G. Friedman, Three-Dimensional integrated Circuit Design

Polymer Product Manufacturing

ENMT803922
3 SKS
Syllabus:

Polymer production fabrication process (formulation, formation and finalization). The purpose and process of finalizing the types of polymer products (deflashing, smoothing and polishing, sawing and cutting, drilling, grinding and sanding, routing, milling & turning, tapping & threading, cleaning, annealing, assembling, and decoration). Types of assembly processes (mechanical joining, welding and adhesive bonding). Types of decoration processes (painting, plating, thermal spray coating, vacuum metalizing, hotstamping, coloring). Machine and process construction mechanism. Finalization process of making polymer products. Case studies on the fabrication process of product packaging (rigid and flexible), automotive, electronics and construction equipment.

Prerequisite: -

References:

- G. Challa, Polymer Chemistry – An Introduction, 1993, Ellis Horwood Limited series in Polymer Science, UK
- Young R.J. and Lovell P.A., Introduction to Polymers, 2nd edition, 1997, Chapman & Hall, Cambridge, UK
- Cheremisinoff N.P., Polymer Characterization – Laboratory Techniques and Analysis, 1996, Noyes Publication, New Jersey, USA
- Morton-Jones D.H., Polymer Processing, 1994, Chapman & Hall, UK

Risk Based-Inspection and Integrity

ENMT803923
3 SKS
Syllabus:

Definition & Definition: Asset Integrity & Risk Based Inspection. Policy: Production Level Policy and Health, Safety & Environment (HSE) Considerations. Strategy / Prioritization: Based on Priority Scale. Program Planning: Program Planning. Hazard / Threat Identification: Identification of Potential Threats. Damage Mechanism: Damage Mechanism. Probability of Failure: Failure Opportunity. Consequence of Failure: Consequences of Failure. Asset Register: Naming Facilities / Equipment. Risk Assessment: Risk Assessment. Program Implementation: Program Implementation. Data Compilation-Evaluation-Interpretation: Compilation, Evaluation & Interpretation of Data. Corrective Actions & Recommendations: Corrective actions & Recommendations. Inspection Interval: Inspection time period. Inspection Methods: Inspection Methods. Inspection Scope: Inspection Scope. Inspection Work package: Inspection Work Details.

Prerequisite: -

References:

- Chapter 008, Risk-Based Inspection Technique by Mohamed El-Reedy (Author) Publisher: Gulf Professional Publishing (17 July 2012) ASIN: B00DGSWO4S

Polymer Materials and Derivatives

ENMT803216
3 SKS
Syllabus:

Industrial strategic approaches in polymer derivatives material. General introduction in polymer derivaties (polyblends, polyalloys, thermoplastic elastomer, polymer matrix composites, liquid crystal polymer, conductive polymers, pyro and piezo polymers, shape memory polymers. Biodegradable polymer (definition, types, manufacturing process). Polymer material selection for polyblends and polyalloys synthesis. Process method selection (physics and chemical) for polymer alloying. Testing and evaluation of polymer alloying. Case studies.

Prerequisite: -

References: -

Advanced Extractive Metallurg

ENMT804925
3 SKS
Syllabus:

Waste characterization for process raw materials. Innovation of wet metallurgical processes (hydrometallurgy) and hot metallurgy (pyrometallurgy) for low-grade raw materials and energy efficiency: reaction mechanisms and applications, such as metal extraction with plasma, microwaves. Metal recycling process. Processing slag, dust and metallurgical ash particles. Processing and utilization of by-products (by product): slag utilization, cross processing, fly ash processing. Acquisition of metals from process wastes (such as tailings, residues, sludges): mineral processing from tailings, recovery of metals from red mud, recovery of metals from waste sludges. New technology for metal recycling.

Prerequisite: -

References:

- S. Ramachandra Rao, Resources Recovery and Recycling from Metallurgical Waste, waste Management Series vol. 7, Oxford, 2006.

- Related publications in journals e.g. Metallurgical and Materials Transaction, B; Journal of Metals, Hydrometallurgy, etc.

Advanced Surface Engineering

ENMT804926
3 SKS
Syllabus:

Basic surface engineering, conventional surface engineering, advanced surface engineering, surface coating, surface modification, thin film characterization

Prerequisite: -

References:

- Chattopadhyay et al, Green Tribology, ASM International, 2014.
- H.O. Pierson, Handbook of Chemical Vapor Deposition, Noyes Publication, 2000
- D.M. Mattox, Handbook of Physical Vapor Deposition, Elsevier, 2010
- J.P. Davim, Materials and Surface Engineering, Woodhead Publishing, 2012
- A.S. Hamdy, Handbook of Smart Coating for Materials Protection, Woodhead Publ, 2014

Project Management

ENMT804927
3 SKS
Syllabus:

The concept of project management system and system approach, engineering systems and procedures, basic planning,cost estimation and budgeting, project quality management, execution and project control,project organization, and context of project management, project communication, and project risk management.

Prerequisite: -

References: -

Master Program in Materials Integrity Management

Program Specification

1.	**Awarding Institution**	Universtas Indonesia Double Degree: Universitas Indonesia & partner universities	
2.	**Teaching Institution**	Universtas Indonesia Double Degree: Universitas Indonesia & partner universities	
3.	**Faculty**	Engineering	
4.	**Name of Study Program**	Graduate Program (Master) in Metallurgical and Materials Engineering	
5.	**Study Programme Vision and Mission**	Vision: As a center of excellence for research-based education as well as a center for reference and problem solutions in the field of material integrity management on a national and regional level in Southeast Asia Mission: • Providing access to education and research in the field of material integrity management for the public and industry. • Producing high-quality graduates with strong engineering skills with comprehensive capabilities in the field of material integrity management techniques and able to play an active and dynamic role in the national, regional, and international community. • Organizing quality tridharma activities that are relevant to national and global challenges. • Creating an academic climate that is able to support the realization of the vision of the study program.	
6.	**Type of Class**	Special, Research	
7.	**Awarding Degree**	Magister Teknik (M.T.) Double Degree: Magister Teknik (M.T.) dan Master of Engineering (M.Eng.)	
8.	**Accreditation Status**	BAN-PT : Good	
9.	**Language Course**	Bahasa (Indonesia) and English	
10.	**Study Scheme (Full Time / Part-Time)**	Full Time	
11.	**Entry Requirements**	• Meet University Requirements (bachelor's degree graduate, register online and pass the screening exam) • Undergraduate Diplomas from foreign tertiary institutions must obtain equivalence from the Higher Education, Ministry of National Education • Able to read and write in English • Color blindness is free to entry.	
12.	**Term of Study**	2 years	
	Type of Semester	Number of semester	Number of weeks/semesters
	Reguler	4	16
	Short (opsional)	**1**	**8**

13.	**Aims of the programme:** 1. Produce graduates who can develop the science of material integrity management through research, professional practice to produce innovative and tested designs. 2. Produce graduates who are able to design, implement, evaluate and maintain a material integrity management system in a professional manner. 3. Produce graduates who are able to apply knowledge in the engineering field in the material integrity management system. 4. Produce graduates who are able to provide alternative solutions to various problems that arise in industrial societies, the nation and the state.
14.	**Profile of Graduates:** Master of Engineering Management who has the ability to design, implement, evaluate and maintain an international quality material integrity management system and uphold professional values.
15	**Expected Learning Outcomes (ELO):** 1. Able to develop the science of material integrity management through research, professional practice to produce innovative and tested designs. 2. Able to design, implement, evaluate and maintain a material integrity management system in a professional manner. 3. Able to apply engineering knowledge in material integrity management. 4. Able to identify, formulate and solve contemporary problems in the field of material integrity management. 5. Able to solve problems in the field of material integrity management through an interdisciplinary approach with other engineering fields. 6. Able to manage research in the field of material integrity management which has received national and international recognition. 7. Able to provide alternative solutions to various problems that arise in the industrial society, nation and state.
16.	**Composition of Subjects**

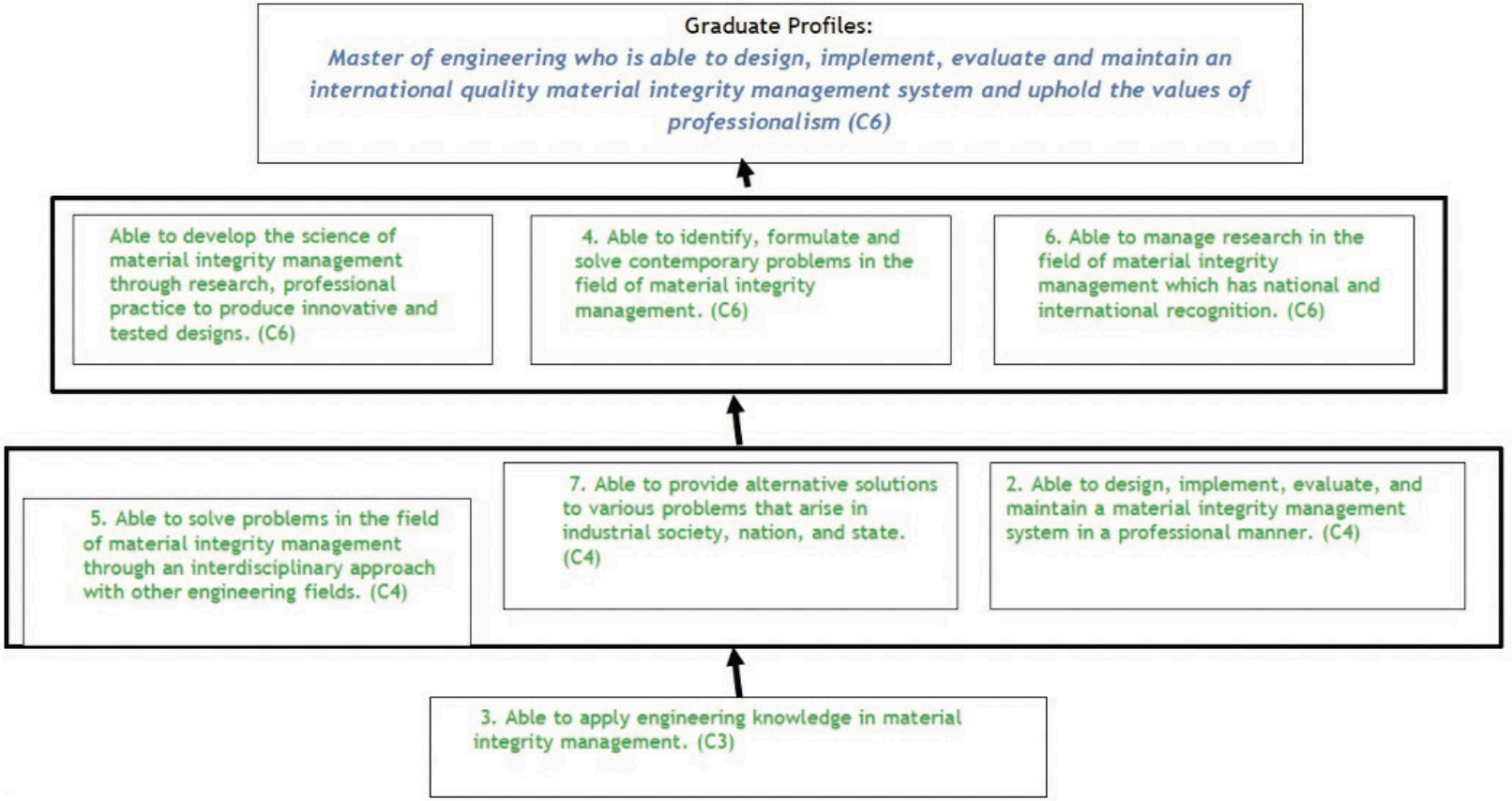
No.	Type of Courses	Credit Hours (SKS)	Percentage
I	Compulsory / Expertise Courses	31	70,45%
II	Specialization Courses	0	0%
III	Elective Courses	4	9,09%
IV	Seminar, Scientific Publication & Thesis	9	20,46%
	Total	44	100 %
	Total Credit Hours to Graduate		44 Credits

Job Prospects

Graduates of the Masters in Material Integrity Management can have careers as consultants / experts in RBI (Risk Based Inspection) and AIMS (Asset Integrity Management Systems), consultants in government agencies, consultants for the oil and gas industry, energy, petrochemical, manufacturing and related industries, Inspection managers, Control managers Quality, Safety manager and other related fields.

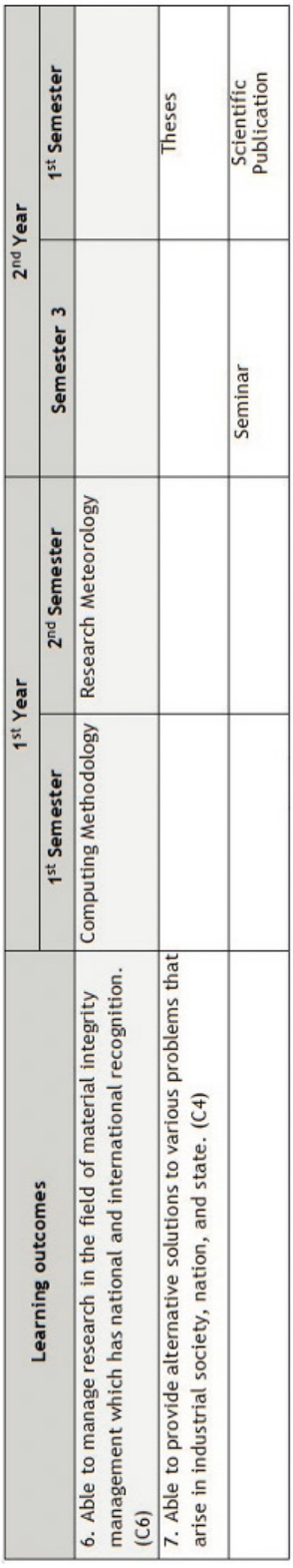
Expected Learning Outcome Matrix

Expected Learning Outcome Matrix



Flowchart for Learning Outcome Achievement
Master Program in Materials Integrity Management

Learning outcomes	1st Year		2nd Year	
	1st Semester	2nd Semester	3rd Semester	4th Semester
1. Able to develop the science of material integrity management through research, professional practice to produce innovative and tested designs. (C6)		Asset Integrity Elements	Risk Based Inspection	
		Inspection Methods and Materials Testings		
2. Able to design, implement, evaluate, and maintain a material integrity management system in a professional manner. (C4)	Integrity System Engineering		Reliability Engineering	
3. Able to apply engineering knowledge in material integrity management. (C3)	Risk Management		Failure Analyses	
4. Able to identify, formulate and solve contemporary problems in the field of material integrity management. (C6)	Integrated Materials Engineering	Corrosion and Protections		
5. Able to solve problems in the field of material integrity management through an interdisciplinary approach with other engineering fields. (C4)			Piping and Mechanical Engineering	Theses
			Case Study I	Case Study II
			Precision Maintenance	Advanced HSE
				Stochastic Models for Risk Management
				Advanced of Life Cycles Assets



Learning outcomes	1st Year		2nd Year	
	1st Semester	2nd Semester	Semester 3	1st Semester
6. Able to manage research in the field of material integrity management which has national and international recognition. (C6)	Computing Methodology	Research Meteorology		
7. Able to provide alternative solutions to various problems that arise in industrial society, nation, and state. (C4)				Theses
			Seminar	Scientific Publication

Course Structure for Master Program Materials Integrity Management

Compulsory / Expertise Courses

Code	Subject	SKS
	1st Semester	
ENMI801001	Integrated Materials Engineering	3
ENMI801002	Integrity System Engineering	2
ENMI801003	Risk Management	3
ENMI801004	Computational Methods	3
	Sub Total	**12**
	2nd Semester	
ENMI802005	Corrosion and Protections	3
ENMI802006	Asset Integrity Elements	4
ENMI802007	Inspection Methods and Materials Testing	3
ENMI802008	Research Methodology	3
	Sub Total	**13**
	3rd Semester	
ENMI803009	Failure Analysis	3
ENMI803010	Risk Based Inspection	3
ENMI803011	Seminar Proposal	1
ENMI803012 - ENMI803015	Electives I	2
	Sub Total	9
	4th Semester	
ENMI800020	Scientific publication	2
ENMI800021	Thesis	6
ENMI804916 - ENMI804919	Electives II	2
	Sub Total	8
	Total	**44**

Electives Courses

Code	Electives	SKS
	1st Semester	
ENMI803912	Study Case I	2
ENMI803913	Reliability Engineering	2
ENMI803914	Precision Maintenance	2
ENMI803915	Mechanical and Piping Engineering	2
	2nd Semester	
ENMI804916	Study Case II	2
ENMI804917	Advanced Health, Safety and Environment	2
ENMI804918	Stochastic Model for Risk Management	2
ENMI804919	Advanced Life Cycle Asset Analysis	2

Master By Research

Code	Subject	SKS
	1st Semester	
ENMI800102	Research Proposal Examination	4
ENMI800101	Scientific Seminar	8
	2nd Semester	
ENMI800203	Proceeding Publication	4
ENMI800204	Research Result Examination	6
	3rd Semester	
ENMI800105	Journal Publication	8
	4th Semester	
ENMI800206	Master Thesis	10
	Total	40

Course Syllabus Master Program in Materials Integrity Management

Compulsory / Expertise Courses

Integrated Materials Engineering

ENMI801001

3 Credits

CLO:

Students are able to apply material technology in engineering applications starting from the introduction of material structure and properties, material product selection and design, processing and quality assurance.

Syllabus:

Introduction to materials, material types and characteristics, material applications, crystallography, phase diagrams and material kinetics. Introduction to material manufacturing processes, heat treatment of materials, material treatment and splicing techniques as well as material design and selection.

Pre-requsites:

References:

- William D. Callister, Jr., David G. Rethwisch., Materials science and engineering: an introduction /–8th ed.
- William F. Smith, Introduction to Materials Science and Engineering

Integrity System Engineering

ENMI801002

3 Credits

CLO:

Students are able to synthesize the preliminary concept of Asset Integrity Management in the project.

Syllabus:

Introduction, Management responsibility, AIM Cycle, Failure mechanisms and modes, Asset selection and critical determination, inspection, testing and preventive maintenance.

Pre-requsites:

References:

- Guidelines for Asset Integrity Management, the American Institute of Chemical Engineers, 2017

Asset Integrity Element

ENMI802006

3 Credits

CLO:

Students are able to synthesize advanced concept of Asset Integrity Management in a project-based activity.

Syllabus:

Training in asset integrity and quality assurance, procedure, quality management, deficiency management, specific integrity management, implementation, metrics, audit and sustainable development, and tools.

Pre-requsites:

References:

- Guidelines for Asset Integrity Management, the American Institute of Chemical Engineers, 2017

Computing Methods

ENMI801004

3 Credits

CLO:

Students are able to apply model making in solving problems in the Materials Integrity Management field by using software.

Syllabus:

Introduction to computation, matlab basics, logical expressions, vectorization, flow control with if and while, loops in matlab, functions and m-files, test output, matlab programming, binary numbers, floating point numbers, machine precision, linear equations, curve fitting, ordinary differential equations, statistics and process data analysis.

Pre-requsites:

References:

- Applied Numerical Methods with Matlab for Engineers and Scientists, Steven C. Chapra, Third Edition, McGrawHill, 2012.
- Numerical and Analytical Methods with MATLAB® for Engineers and Scientists, William Bober, CRC Press, 2014.
- Numerical Methods in Engineering with MATLAB, Jaan Kiusalaas, Cambridge University Press, 2005.

Risk Management

ENMI801003

3 Credits

CLO:

Students are able to design an asset integrity and safety management communication system and be able to design a risk and safety management system implementation in an organization.

Syllabus:

Risk communication, rick communication report planning, case study and evaluation, risk management, standard and compliance, risk management components, analysis techniques and managerial systems.

Pre-requsites:

References:

- Lundgren, Regina E._ McMakin, Andrea H - Risk communication_ a handbook for communicating environmental, safety, and health risks-Wiley (2018) WileyIEEE Press
- (Process safety guidelines and concept books) Center for Chemical Process Safety (CCPS) - Bow ties in risk management _ a concept book for process safety-John Wiley & Sons (2018)
- Ian Sutton - Process risk and reliability management-Gulf Professional Publishing, Elsevier Inc (2015)

Inspection Methods and Materials Testing

ENMI802007

3 Credits

CLO:

Students are able to design inspection methods to analyze materials from their properties and be able to carry out characterization and testing of materials independently.

Syllabus:

Methods of material inspection in Integrity standards. Broken Testing. Introduction, testing procedures and standards, principles and

advanced analysis methods for the chemical composition of engineering materials (AAS, OES, EDS, XPS), identification of crystal structures (X-ray diffraction), advanced metallography (SEM, EPMA, TEM), and thermal analysis (DTA, TGA, DSC and TMA).

Pre-requsites:

References:

- Davis H.E., G.E. Troxell, G.F.W. Hauck; The Testing of Engineering Materials; Mc Graw-Hill; 1982
- ASM; Mechanical Testing of Metal; 1983
- Lous Cartz, Non Destructive Testing; ASM International;
  - 1995
- Vernon john; Testing of Materials; 1992
- Andreas Ohsner and Holm Altenbach; Properties and Characterization of Modern Materials; 2017
- Callister, William D. 2007. Materials Science and Engineering, John Wiley & Sons.
- Der Voort, Van. 1984. Metallography Principles and Practice, McGraw-Hill Book Company.
- Goodnew, Peter J; Humphrey, John. 2000. Electron Microscopy and Analysis, CRC Press
- Petzow, Gunter. 1991. Metallographic Etching, University Microfilms.
- ASM Handbook Vol 9 – Metallography and Microstructures, ASM International
- Zhang, Sam; Li, Lin; Kumar, Ashok. 2008. Materials Characterization Techniques, CRC Press.
- Schwartz, A.J.; Kumar, M.; Adams, B.L.; Field, D.P. 2009. Electron Backscatter Diffraction in Materials Science, Springer US

Research Methodology

ENMI802008

3 Credits

CLO:

Students are able to design independent research, analyze data, formulate methodologies and disseminate research results by following international research principles.

Syllabus:

Scientific understanding, research methodology, problem formulation, hypotheses, literature review, data collection and processing, preparation of research proposals and presentation of scientific papers.

Pre-requsites:

References:

- Willie Tan, “Practical Research Methods”, Prentice Hall, 2002.
- R. Kumar, Research Methodology, A Step-by-step Guide for Beginner, 3rd ed., SagePub, 2012

Failure Analyses

ENMI802009

3 Credits

CLO:

Students able to analyze the failure of a material and prevent material failure with the principle of fracture mechanics.

Syllabus:

Definition & purpose of damage analysis, general material damage factors, general procedures in damage analysis techniques, classification of sources of failure, characteristics & mechanisms of material failure, ductile fracture, brittle fracture, fatigue fracture, and consequent failure and embrittlement.

Pre-requsites:

References:

- Wulpi, D. J., Understanding How Components Fail, ASM, 1998
- Charlie, R. B and Ashok, C., Metallurgical Failure Analysis, McGraw-Hill Inc., 1993
- French, D. N., Metallurgical Failure in Fossil Fired Boilers, John Wiley & Sons, 1983

Seminar

ENMI800011

1 Credits

CLO:

Students are able to express a problem and their opinions in the form of working papers / short papers / scientific papers and discuss in a scientific forum / seminar systematically, clearly, orderly and correctly.

Syllabus:

Working papers / papers submitted in the seminar are in accordance with the proposals submitted in the thesis. Papers include: Problems and hypotheses, methodology and discussion.

Pre-requsites:

References:

Scientific Publication

ENMI800020

2 Credits

CLO:

Students are able to disseminate their research results to seminars or leading scientific meetings.

Syllabus:

The research results are written in journal format and published at least in national journals or international proceedings.

Pre-requsites:

References:

Thesis

ENMI800021

6 Credits

CLO:

Students are able to write independent research results into a written work that follows applicable academic principles.

Syllabus:

Application / implementation of various courses that are followed in an integrated manner in a research to solve a problem in the field of Materials Integrity Management. The research results are presented in the form of scientific reports and presented in front of a team of examiners.

Pre-requsites:

References:

Corrosion and Protections

ENMI802005

3 Credits

CLO:

Students are able to identify the corrosion phenomenon and apply it in material engineering preventive measures and be able to design coating engineering on materials to improve the performance of the material. Students can analyze or synthesize cathodic protection methods as a way of controlling corrosion in aqueous (aqueous) environments. Students can also perform calculations and design a cathodic protection system that can be applied in practice. Apart from the Cathodic Protection method, also the method of design and material selection. Basic theory of cathodic protection, protection criteria, cathodic protection systems with sacrificial anodes, material properties of sacrificial anodes and their selection, application of sacrificial anode cathodic protection, impressed current cathodic protection systems (ICCP), instruments for corrosion protection, cathodic protection in marine, soil environments , and structures in concrete (cement), material classification, specific material and environmental relationships, design instructions for corrosion prevention, resistance properties of stainless steel and super duplex SS materials, corrosion resistance of commonly used engineering materials (cast steel, carbon steel, low alloy steel, nickel, aluminum, copper, zinc, titanium and their alloys, non-metal material corrosion resistance (rubber, plastic, composite, ceramic).

Syllabus:

The concept of electrochemistry: the basis and its application, definition of corrosion, form of corrosion, cost of corrosion, electrical concepts relevant to corrosion, relevant chemical and electrochemical concepts, prediction of the trend of corrosion by thermodynamics, electrolytes, corrosion kinetics, over-potential (polarization), passivation , measurement of corrosion velocity, metallurgical aspects, forms of corrosion, and combined potential theory, corrosion testing (weight loss coupon method, electrochemistry). Coating: metallic coating, metallic coating type and classification, protection mechanism, electroplating and electroless plating, anodizing, phosphating, chroming, hot-dip galvanizing, service lie prediction, Organic Coating (paints), organic coating properties, classification and formulations of 'paints', their protection mechanisms, standard of surface preparation, method of application, coating defects and 'painting' failures. Inhibition; Types, classification, and mechanism of inhibition (anodic, cathodic and mixed inhibitors), general corrosion inhibitor formulations, applications and limitations (for automotive, water cooling, systems).

Pre-requsites:

References:

- Jones DA; Principles & Prevention of Corrosion; Mc Milan Pubs; 1992
- Fontana; Corrosion Engineering 3rd Ed; 1992
- Roberge Pierre R; Handbook of Corrosion Engineering; Mc Graw-Hill; 1999

- Jones DA; Principles & Prevention of Corrosion; Mc Milan Pubs; 1992
- Fontana; Corrosion Engineering 3rd Ed; 1992
- Roberge Pierre R; Handbook of Corrosion Engineering; Mc Graw-Hill; 1999

Risk Based Inspection

ENMI803010

3 Credits

CLO:

Students are able to apply risk-based inspection methods.

Syllabus:

Definition & Definition: Asset Integrity & Risk Based Inspection. Policy: Policy on Production Level and Health, Safety & Environment (HSE) Considerations. Strategy / Prioritization: Based on Priority Scale. Program Planning: Program Planning. Hazard / Threat Identification: Identification of Potential Threats. Damage Mechanism: Damage Mechanism. Probability of Failure: Chance of Failure. Consequence of Failure: Consequence of Failure. Asset Register: Naming of Facilities / Equipment. Risk Assessment: Risk Assessment. Program Implementation: Program Implementation. Data Compilation-Evaluation-Interpretation: Compilation, Evaluation & Interpretation of Data. Corrective Actions & Recommendations: Corrective Actions & Recommendations. Inspection Interval: Inspection period. Inspection Methods: Inspection Methods. Inspection Scope: Scope of Inspection.

Inspection Work package: Details of Inspection Work.

Pre-requsites:

References:

- Chapter 008, Risk-Based Inspection Technique by Mohamed El-Reedy (Author) Publisher: Gulf

Elective Courses

Case Study I

ENMI803912

2 Credits

CLO:

Students are able to build an Asset Integrity Management system in real cases.

Syllabus:

Students select a case study in their area of interest: the oil and gas industry which includes planning, commissioning, document preparation, maintenance, and reporting. Students choose a case study in their area of interest: The Petrochemical industry which includes planning, commissioning, document preparation, maintenance and reporting.

Pre-reuisites:
References:

Case Study II

ENMI803912

2 Credits

CLO:

Students are able to build an Asset Integrity Management system in real cases.

Syllabus:

Students select a case study in their area of interest: the oil and gas industry which includes planning, commissioning, document preparation, maintenance, and reporting. Students choose a case study in their area of interest: The Petrochemical industry which includes planning, commissioning, document preparation, maintenance and reporting.

Pre-requsites:

References:

Reliability Engineering

ENMI803913

2 Credits

CLO:

Students are able to build an Asset Integrity Management system based on the Analysis of Reliability Techniques.

Syllabus:

Methods in Reliability Techniques, Statistics, Implementation.

Pre-requisites:

References:

- Ian Sutton - Process risk and reliability management-Gulf Professional Publishing, Elsevier Inc (2015)

Piping and Mechanical Engineering

ENMI803915

2 Credits

CLO:

Students are able to analyze mechanical and piping systems. **Syllabus:**

Introduction to mechanical engineering and design. Introduction to mechanical engineering, principles of kinematics and kinetics of machines, friction and vibration, introduction to fluid mechanics, heat transfer, basic concepts of stress and strain analysis, principles of mechanical engineering problem solving. Introduction to piping engineering, components, piping instrumentation and equipment, piping flow diagrams, piping materials, piping design and engineering.

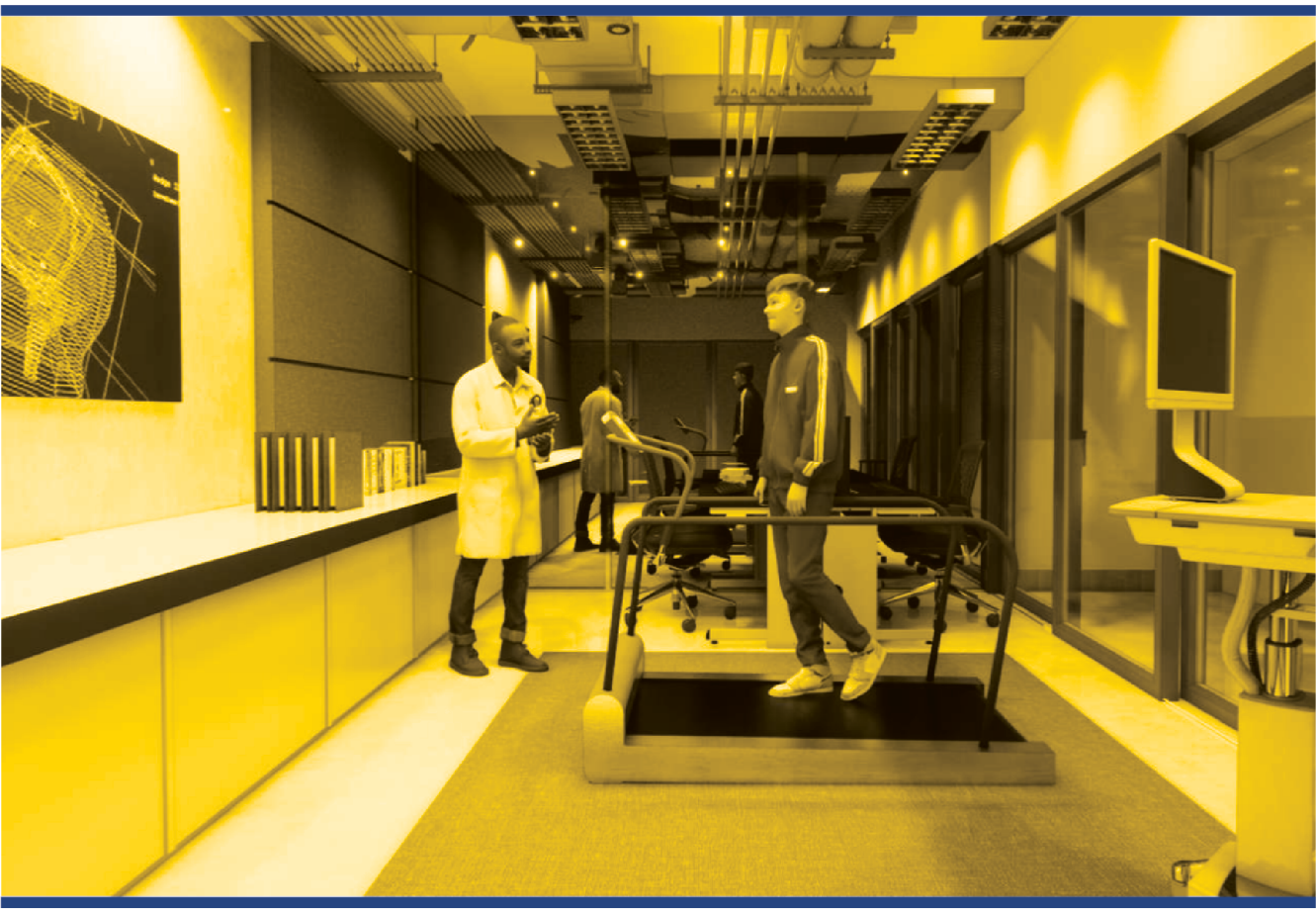
Pre-requsites:

References:

- Jonathan Wickert, Kemper Lewis, Introduction to Mechanical Engineering, 4th edition, Cengage Learning, 2016.
- Sanjay Kumar Gupta, Perfect knowledge of piping engineering, CreateSpace Independent Pub, 2015.

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

Engineering Universitas Indonesia or courses from other faculties in UI as stated in the Guidance Book or the Master/Doctoral Program Catalog.

3. Students are allowed to take classes in other Master Program in the Faculty of Engineering Universitas Indonesia or other faculties within the Universitas Indonesia as deemed necessary by their Academic Advisor
4. In the event where neither conditions is viable for the students, the Academic Advisor is allowed to conduct a class of said course.

Research Group Periodic Seminar
ENXX900003
6 SKS

Research Group Periodic Seminar is an early activity of research in the Doctoral Program in Research where students conduct literature study in relation to the materials for their research. This literature study must be done intensively by mapping out the research results from the latest international journals in related field. The final aim was so that students have a state-of-the-art understanding of their research topic, and can determine the knowledge gap previously unexplored in the international level for further research in their Doctoral Program. The result of this literature study is compiled in a literature study report presented in the Research Group Periodic Seminar to be examined by a panel comprises of future Promoter/ Academic Advisor and Examiners from related field of study. Students will passed this Research Group Periodic Seminar if they received a minimum grade of B.

Research Proposal
ENXX900005
6 SKS

Research Proposal is the continuous activity of the literature study, where after gaining a state-of-the-art knowledge of their research topic, students can formulize the scope of their Doctoral research and determine which research method will be use. The result of this activity is a comprehensive research proposal which include: goals, background and data analysis from early study or experiments done. Included in this research proposal is plan of work for each semester and its publication goals. At this level, it is expected for students to begin experiment activity or early study which can show the direction of their research is feasible and recent in his field. The early experiment or study result, the literature study and the whole research plan is then compiled in a Research Proposal Report to be presented and examined in a Research Proposal Examination. Students will passed this Research Proposal if they received a minimum grade of B.

Research Result Examination
ENXX900008
10 SKS

At this stage, students are expected to have a research output with a minimum of 75% from their research plan. Doctorate candidate are expected to have reach a research outcome which is the main part of the originally planned contribution. The outcome of this research is measured through the Research Output Examination. The examination committee is appointed through the Dean's Decree based on the Head of Department's proposal. These examiners consist of experts related in the field of study of the Doctorate candidate with at least one examiner from an institution outside of Universitas Indonesia. Doctor Candidate will passed this Research Output Examination if they received a minimum grade of B. At this stage, a Doctor Candidate are allowed to design a scientific article framework to be published in an indexed International Journal and determine which International Journal they will send the article to.

Publication – International Conference
ENXX900006
4 SKS

Publication I – International Conference
ENXX900007
6 SKS

At this stage, students are expected to have an experiment result or study to focused on in their research topic and clarify their research direction. The result of the experiment must also show innovation or breakthrough, mastery of knowledge on their stream in relation to their research topic, the depth of their research materials, and the mastery of the state of the art development in their field or research interest, originality, and the contribution towards science and/or its implementation. Once presented in front of their promoter and co-promoter, the whole research result at this stage will be deemed worthy for international conference publication.

Publication II – International Journal
ENXX900009
8 SKS

Publication III – National Journal
ENXX900011
8 SKS

The scientific publication is an integral part of research activity and a prerequisite in participating in a Promotion Examination. International Journal meant here is an English language journal which its

editorial board consists of member from at least three different countries or more. A mandatory publication must have an "Accepted" status before the Promotion Examination. FTUI itself publish their own international journal, the International Journal of Technology (IJTech), which students can utilize as one of the international journal to publish their Doctoral research.

Promotion Examination

ENXX900012
6 SKS

Before deemed fit to participate in a Promotion Examination. Doctor Candidate are required to conduct additional research as a follow up from the Research Output Examination. The inputs and revisions given during the Research Output Examination must be completed and revised through a series of final research. At this stage, the Doctor Candidate must prove the authencity and originality of their research as new contribution to the scientific world. Thus, at this stage, the Doctor Candidate is required to have an "Accepted" for their international Journal, they are also required to complete their dissertation paper ready to be tested during the Promotion Examination.

Dissertation is an academic scientific paper study output and/or in depth research done independently and contained new contribution to issues that are temporary already known the answer or new questions ask on issues that are seen to have been established in the field of science and technology by the Doctor Candidate under the guidance of his Academic Advisor. A Doctor Candidate that has completed the revision of their dissertation are required to submit a completed version of their dissertation in five hard cover books and original approval form that has been signed by their advisors and submitted to PAF FTUI signifying the end of their study. The format for writing and binding the Dissertation should follow the writing and binding guidelines in the Technical Guidelines of Final Project Writing for Students of Universitas Indonesia that can be downloaded at http://www.ui.ac.id/download.

Promotion Examination is a scheduled academic activity as a medium of evaluation for the Doctor Candidate Dissertation as a requirement to obtain the highest academic title, Doctor. The requirements and provision for Promotion Examination are as follow:

- Promotion Examination can be done if all the scientific publication requirements are completed by the Doctor Candidate: a minimum of one publication in an International Scientific Journal (in "Accepted" status) in relation to their dissertation research. The Publication is required to state Faculty of Engineering Universitas Indonesia as one of the affiliation institution.
- Promoter and Co-Promoter gave a written approval on the dissertation as a sign that the dissertation can move forward to the Promotion Examination.
- The Promotion Examination is carried out by the Committee of Promotion Examination which is appointed with a Rector's Decree based on a proposal from the Head of Department and the Dean of the Faculty of Engineering Universitas Indonesia.
- The Committee of the Promotion Examination comprises of: (a) Promoter and Co-Promoter, (b) The Examiners, (c) a minimum of one examiner from outside of Universitas Indonesia.
- Examiners consist of experts from related field of study. In a special circumstances, an expert that is not from the academic community can be invited as part of the examiners team.
- The Promotion Examination is led by the Head of the Examiners Committee that is also a member of the committee outside of the Promoter/ Co-Promoter and outside examiner. If the Head of the Examiners Committee is unavailable, his/her position can be replaced by one of the member of the examiner team.
- The Promotion Examination is held as an open session for a period of maximum three hours divided into two stages: the dissertation presentation given by the Doctor Candidate for 15-30 minutes and a question and answer session for 120-165 minutes.
- The Doctor Candidate will pass the Promotion Examination if they received a minimum grade of B with GPA 3.00.

Facilities for Doctoral Program Students

To make sure that student of FTUI Doctoral Program are able to conduct full time research and produce excellent publications as required, FTUI provides the following facilities:

Doctoral Program Students' Workstation

Compact cubicles in comfortable rooms are available as Doctoral program students' workstation. The locations for these workstations are located on the 2nd and 3rd floor of the Engineering Center Building. Access to these workstations requires a swipe card to guarantee security. A round the clock wi-fi service is also available. To procure a workstation and access card, students are requested to register to the Associate Dean for General Affairs in the Dean's building, 2nd floor, FTUI Depok.

International Journal Article Writing Training

These free of charge trainings for the FTUI Doctoral program students are held several times each year. The information regarding these trainings are communicated through an announcement in SIAK-NG, posters at each Department, Doctoral program mailing list and FTUI website (www.eng.ui.ac.id).

Research Proposal Writing Training

These free of charge trainings for the FTUI Doctoral program students are held several times each year. The information regarding these trainings are communicated through an announcement in SIAK-NG, posters at each Department, Doctoral program mailing list and FTUI website (www.eng.ui.ac.id).

Line Editing Draft for International Journal Article

FTUI provides funds for line editing drafts for International Journal Articles. Requirement for applying for this funds are: the article must include the promoter name as part of the writing team and state FTUI as the main affiliation. To be grant this facility, students only needs to send a draft of their article through email to the FTUI Associate Dean of Academic and Research (risetft@eng.ui.ac.id). The time required for line editing is 2-4 weeks.

Doctoral Program Mailing-List

The Doctoral Program mailing list is used as a communication tool between the Dean's Faculty Heads, the Faculty Center Administration staff and all Doctoral program students in FTUI. Information regarding trainings, seminars, grants or other academic matters is announced through this mailing list. Complaints and suggestions are also accommodated by this mailing list. The mailing list address is: programdoktorft@group.eng.ui.ac.id

Research and Incentive Grants for Master and Doctoral Program

Research funds including consumables and tests for research as part of the thesis and dissertation writing is the responsibility of the student. There are a number of competitive research grants, incentive research grant schemes available from which Master and Doctoral program students may propose to finance his/her research. Complete guidance and research proposal examples are available at the Associate Dean for Research and Community Development secretary at the Dean's Building, 2nd floor or through http://research.eng.ui.ac.id.

International Journal Writing Incentive

This incentives are given to lecturer of State of Private Universities that have published an article in an international journal. Each proposer must be the first writer of the article and include an institution affiliation in Indonesia.

UNIVERSITAS INDONESIA
Veritas, Perfektas, Iustitia

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