UNIVERSITAS INDONESIA

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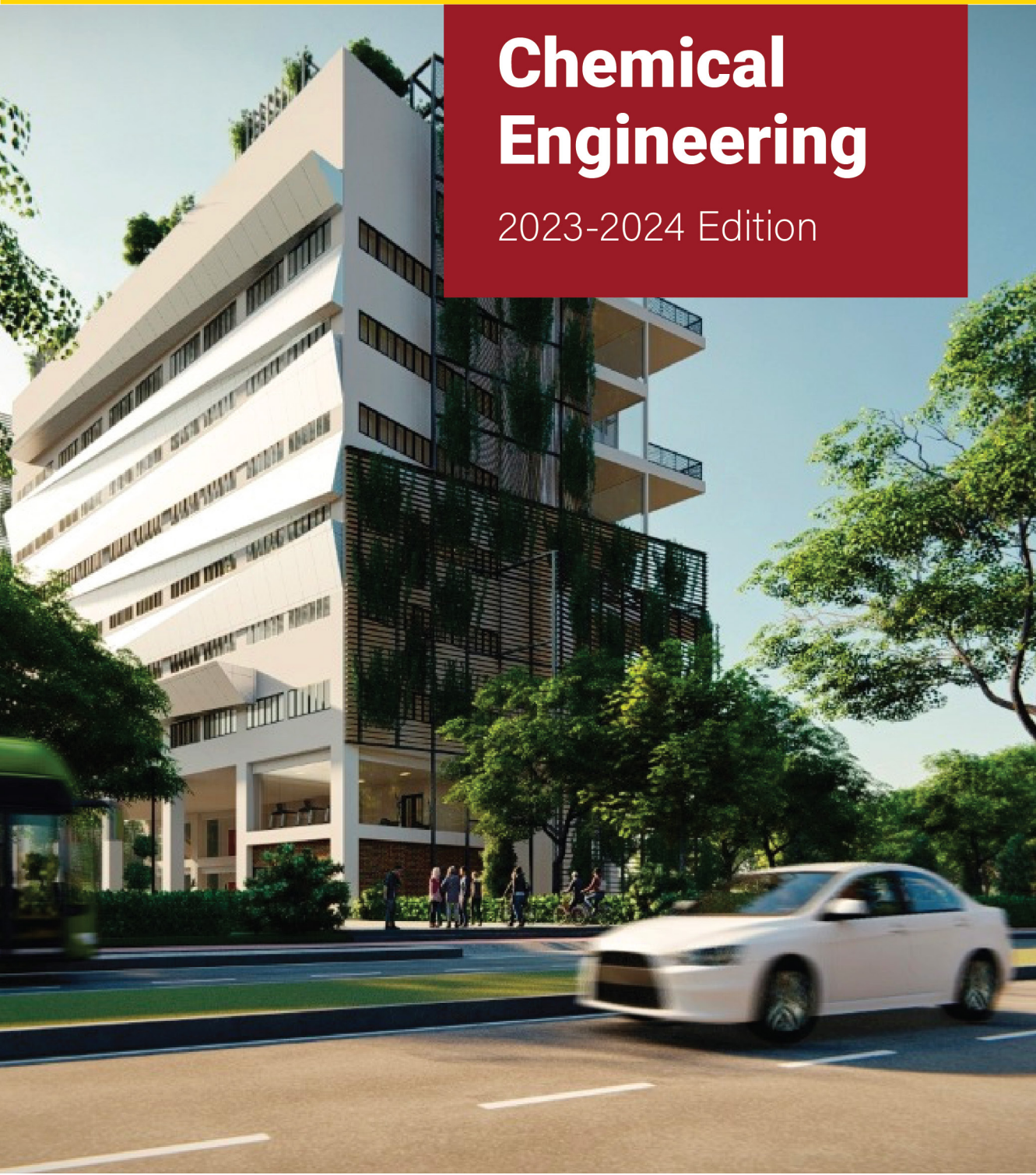
Chemical Engineering

2023-2024 Edition



FACULTY OF ENGINEERING

UNIVERSITAS INDONESIA

ACADEMIC GUIDEBOOK

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CHEMICAL 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 Chemical Engineering

General

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

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

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

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

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

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

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

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

The 2020 curriculum has been more streamlined and integrated, allowing students to take elective courses previously only available for particular study programs (PSTK or PSTB) or available for

a particular academic level (undergraduate or graduate). This means that students could choose the courses that are more suitable to their interests. For those who qualify, there is a fast-track program that allows undergraduate students to obtain both Bachelor's and Master's degrees in ten semesters instead of the regular twelve semesters.

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

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

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Vision

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

Mission

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

Chemical Engineering Staffs

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

Head of Department

Dr. Dianursanti, S.T., M.T.

Vice Head of Department

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

Head of Chemical Engineering Study program

Dr. Tania Surya Utami, S.T., M.T.

Head of Bioprocess Engineering Study program

Dr. Ir. Yuliusman, M.Eng

Coordinator of Special Subjects (Internship, Undergraduate Thesis, Master Thesis)

Ir. Riezqa Andhika, S.T., Ph.D.

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Rahma Muthia, Ph.D.

Assistant to the Head of Academic Affairs

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Health, Safety, Security and Environment Coordinator

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Dr. Eva Fathul Karamah, ST, MT

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Dr. Ir. Sukirno, M.Eng

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CHAPTER 2

ACADEMICS SYSTEM AND REGULATION

Academic System and Regulation

General

Teaching and Learning Activities

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

Semester Credits Units (SKS)

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

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

Subjects

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

Grade Point Average

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

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

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

Semester Grade Point Average (SGPA)

Grade Point Average (GPA/IPK)

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

Academic Performance Evaluation

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

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

Grades

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

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

grade within one month; otherwise, it will automatically change to 'E' grade. The 'T' mark is given for no attendance in the exam. The 'BS' mark is given for special lecture (such as internship, seminar, and final project) that has not been completed. These 'BS' courses are not taken into account in the calculation of Semester Study Unit, SGPA, and CGPA.

Table 2.1. Grade Value and Point

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

Length of Study and Academic Load

Undergraduate Program

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

As for the second semester, these following rules apply:

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

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

Master Program

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

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

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

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

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

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

Matriculation for Master

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

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

Fast Track (Master – Doctoral Program)

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

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

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

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

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

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

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

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

Doctoral Program

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

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

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

Undergraduate Final Project (Skripsi)

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

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

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

Thesis (Master Program)

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

Requirements for a student to start writing a Thesis are:

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

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

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

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

Dissertation

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

Internship for Undergraduate Student

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

Supplementary Exam

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

Credit Transfer

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

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

Credit Transfer for Non Reguler Class Students of Diploma Graduates

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

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

Study Abroad

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

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

Fast Track (Undergraduate – Master Program)

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

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

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

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

Requirements and Procedure for Fast Track Registration

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

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

Procedure for Fast Track Program:

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

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

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

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

Fast Track (Undergraduate – Doctoral Program)

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

Merdeka Belajar Kampus Merdeka Program

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

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

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

The student may apply for the following elective courses scheme:

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

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

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

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

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

Administrative and Academic Registration

Academic Calendar

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

Term 1

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

Term 2

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

Short Semester

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

Note:

*) Schedules are subject to change

Note:

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

Registration and Course Guidelines

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

Administrative Registration

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

Academic Registration

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

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

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

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

Sanctions

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

Exception Administrative Registration

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

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

Prerequisite Courses

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

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

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

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

required.

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

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

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

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

English Language Requirements for Undergraduate International Program Single Degree

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

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

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

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

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

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

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

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

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

7. Student sends their application documents to Partnery University.

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

9. Student makes payment and signed the Letter of Offer

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

11. Departure to Partner University

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

Graduate Predicate

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

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

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

Academic Performance Evaluation and Dropout Criteria

Undergraduate Program

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

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

Or:

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

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

Master's Program

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

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

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

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

Doctoral Program

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

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

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

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

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

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

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

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

Academic Leave

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

Procedures of Academic Leave

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

Faculty and Department Judiciums

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

Semester Grade Transcript, Diploma and Academic Transcripts

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

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

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

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

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

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

Offenses and Sanctions

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

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

Academic Sanction for Perpetrators of Academic Cheating In Exams

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

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

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

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

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

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

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

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

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

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

Academic Regulation Of The Universitas Indonesia

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

General:

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

conduct on Campus Life in Universitas Indonesia

Education

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

Research

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

CHAPTER 3

LABORATORY FACILITIES

LIST OF NAMES OF HEADS OF LABORATORY AND CHEMICAL ENGINEERING DEPARTMENT

YEAR 2023

No	Head of Laboratory	Laboratory	Laboratory Assistant	Equipment in the Lab	Subjects Related to Lab
1	Prof. Ir. Kamarza Mulia, MSc, Ph.D	Chemical Product Engineering	Jajat Sudrajat & Albi Waladika	Reaktor pirolisis, reaktor, fotokatalitik, GC, HPLC, Ultrasonikator, Inkubator, Furnace	
2	Dr. Sukirno, M.Eng	Process Operations Unit	Wanizal	Icell Lab Equipment	Process Operation Unit Practicum
3	Dr. Eva Fathul Karamah, S.T, M.T	Process Intensification Technology	Reni Warni	Reaktor Plasma Ozon Nanobubble, Reaktor sel permeasi, Reaktor DBD Plasma, Reaktor Airborne terminator, Reaktor Kavitasi, Reaktor AOP, Ozonator, Autoclave, Spectrophotometer UV-Vis, TDS meter, Konduktometer, pH meter, Colorimeter, Oven, Pompa vakum, DRB 200 reactor, BSC Class II, Jartest, GC TCD, Ozon meter	
4	Ir. Rita Arbianti, M.Si	Basic Chemical Processes	Muhamad Saeful Anwar & Ahdha Nurdianzah	Icell Lab Equipment	1. Basic Chemistry and Organic Chemistry Practicum 2. Physical Chemistry and Analytical Chemistry Practicum 3. Biochemistry Practicum (Specifically for TB Study Program)

5	Prof. Dr. Ir. Praswasti PDK Wulan, M.T	Sustainable Energy and Process Engineering	Novi Widya	UV-Vis Spectrophotometer, Sieve Shaker, Muffle Furnace, Furnace gas, Oven, Ultrasonic, Timbangan digital analitik, Reaktor Hidrogenasi, Reaktor Pirolisis lambat	
6	Apriliana Cahaya Khayrani, STP, M.Eng, Ph.D	Bioprocess Engineering	Dini Kista Riyanti	Autoclave, Centrifuge, Refrigerated centrifuge, Ultrasonicator, Portable ultrasonic cell disruptor, waterbath, Shaker-waterbath, UV-Vis Spectrophotometer, Fermentor, pH meter, Incubator, Shaker-inkubator, Evaporator, HPLC, mesin Water purification, refractometer, hotplate stirrer, Laminar air flow, BSC class II	
7	Dr. Kenny Lischer, S.T, M.T	Test	Eko Anjang Budi P & Ikhwanul Muslimin	FTIR, GC-FID, Viscometer, Pycnometer, UV-Vis Spectrometer	
8	Prof. Dr. Ir. Abdul Wahid , M.T	Process Systems Engineering	Masturo	PC dan Software (Unisim, Stella Architect, dll)	

CHAPTER 4

UNDERGRADUATE PROGRAM

Undergraduate Program in Chemical Engineering

Program Specification

1.	**Awarding Institution**	a. Regular and Non Reguler: Universitas Indonesia b. International Program: - Double Degree: Universitas Indonesia and Partner University - Single Degree: Universitas Indonesia	
2.	**Host Institution**	a. Regular and Non Reguler: Universitas Indonesia b. International Program: - Double Degree: Universitas Indonesia and Partner University - Single Degree: Universitas Indonesia	
3.	**Faculty**	Engineering	
4.	**Program Tittle**	Undergraduate Program in Chemical Engineering	
5.	**Vision and Mission**	**Vision** Becoming a superior and competitive Chemical Engineering Study Program, through efforts to educate the nation's life to improve people's welfare, thus contributing to the development of Indonesian and world society **Missions** • Providing broad and fair access, as well as quality education and teaching in Chemical Engineering; • Organizing quality Tridharma activities that are relevant to national and global challenges; • Creating graduates of Chemical Engineering who are of high quality, noble character, and able to compete globally; • Creating an academic climate that can support the realization of the vision of the Department	
6.	**Class**	Regular, Parale, International Program	
7.	**Final Award**	a. Regular and Non Reguler: Sarjana Teknik (ST) b. International Program: - Double Degree: Sarjana Teknik (S.T) And Bachelor of Engineering (B.ENG) - Single Degree: Sarjana Teknik (ST)	
8.	**Accreditation / Recognition**	Accredited: BAN-PT (Excellent), JABEE and IABEE Assessment: AUN QA	
9.	**Language(s) of Instruction**	• Regular and Non Reguler: Bahasa Indonesia • International Program: English	
10.	**Study Scheme (Full Time / Part Time)**	Full Time	
11.	**Entry Requirements**	• Regular and International Program: High Shool / equivalent • Non Reguler: High School /Equivalent, or D3 / Polytechnique / Equivalent, and Pass The Entrance Exam.	
12.	**Study Duration**	8 (eight) Semesters or 4 (Four) years	
	Type of Semester	Number of Semester	Number of weeks / semester
	Regular	8	16
	Short (optional)	3	8

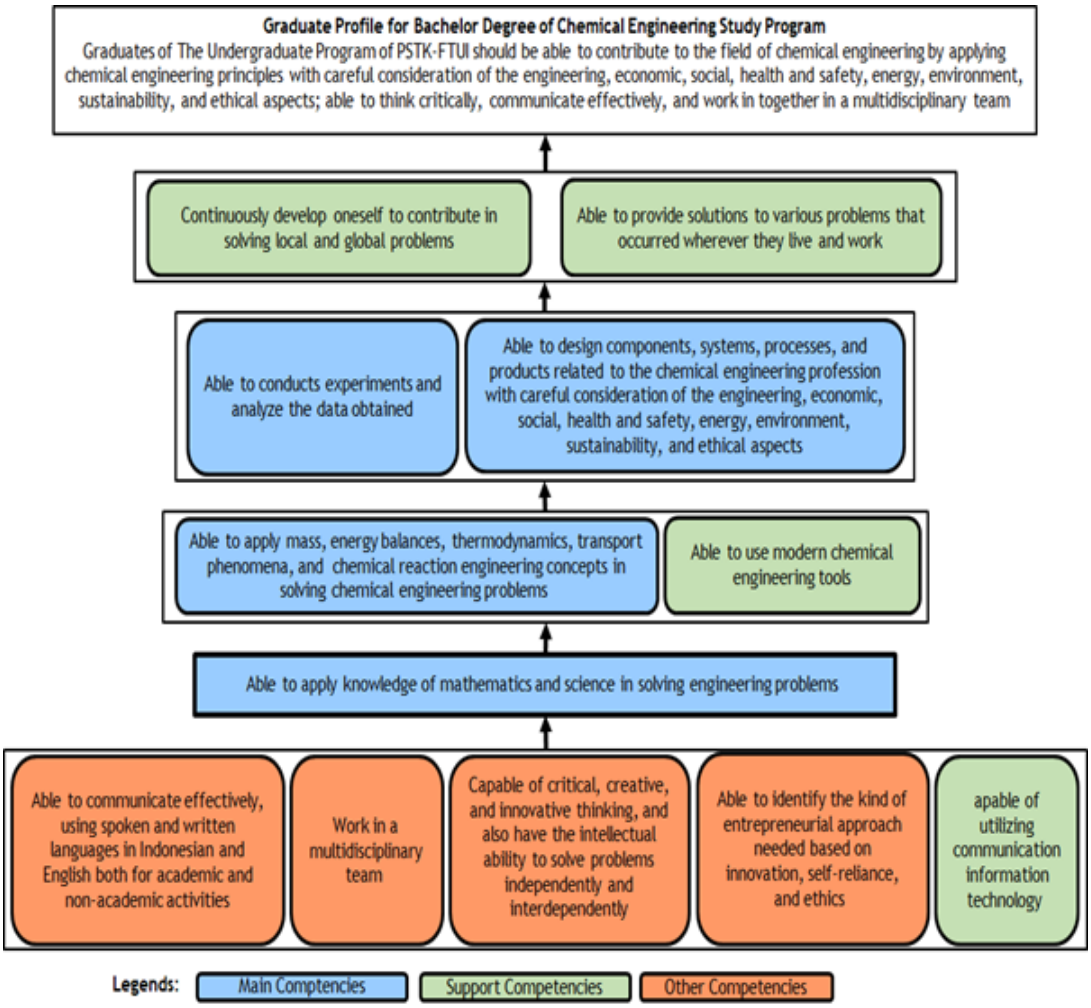
13.	**Aims of the program is to provide the highest quality education so that graduates have:** 1. Able to apply their knowledge in working in the field of chemical process technology 2. Able to develop themselves as industrial planners and managers 3. Able to contribute to science and technology
14.	**Graduate Profile:** Graduates of The Undergraduate Program of PSTK-FTUI should be able to contribute to the field of chemical engineering by applying chemical engineering principles with careful consideration of the engineering, economic, social, health and safety, energy, environment, sustainability, and ethical aspects; able to think critically, communicate effectively, and work in together in a multidisciplinary team.
15.	**Expected Learning Outcomes:** 1. Able to communicate effectively, using spoken and written languages in Indonesian and English both for academic and non-academic activities 2. Able to work in a multidisciplinary team. 3. Capable of critical, creative, and innovative thinking, and also have the intellectual ability to solve problems independently and interdependently. 4. Capable of utilizing communication information technology 5. Able to apply knowledge of mathematics and science in solving engineering problems. 6. Able to apply mass and energy balances, thermodynamics, transport phenomena, and chemical reaction engineering concepts in solving chemical engineering problems. 7. Able to use modern chemical engineering tools. 8. Able to conducts experiments and analyze the data obtained. 9. Able to design components, systems, processes, and products related to the chemical engineering profession with careful consideration of the engineering, economic, social, health and safety, energy, environment, sustainability, and ethical aspects. 10. Able to provide solutions to various problems that occurred wherever they live and work. 11. Able to identify the kind of entrepreneurial approach needed based on innovation, self-reliance, and ethics. 12. Continuously develop oneself to contribute in solving local and global problems.

No.	Classification	Credit Hours (SKS)	Percentage
i	**University General Subjects**	**10**	**6,25%**
ii	**Basic Engineering Subjects**	**25**	**17,36%**
iii	**Core Subjects**	**75**	**52,08%**
iv	**Elective Subjects**	**26**	**18,06%**
v	**Special Subject (Internship, Seminar, Undergraduate Thesis or Skripsi)**	**9**	**6,25%**
	Total	**145**	**100 %**
	Total Credit Hours to Graduate		**145 SKS**

Employment Prospects

A graduate of the Chemical Engineering Study Program at UI can be described as a "Universal Engineer" as they learn the basics of engineering such as thermodynamics, reaction kinetics, reactor design, separation processes, as well as transport phenomena (momentum, energy, and mass). Graduates of the Chemical Engineering Department at UI have contributed in the following areas: energy (oil and gas industry), engineering contractor companies (engineering, procurement, construction, and trial operation), chemical industry (petrochemicals, bulk, and specialty chemicals), research and development of process and/or chemical products, and processing and synthesis of food products and pharmaceuticals.

The Network of Expected Learning Outcome (ELO)



Expected Learning Outcome (ELO)	Name of Course							
	1st Semester	2nd Semester	3rd Semester	4th Semester	5th Semester	6th Semester	7th Semester	8th Semester
Able to communicate effectively, using spoken and written languages in Indonesian and English both for academic and non-academic activities	Communication Skills English	Integrated Character Building	Instrumental Analytical Chemistry Physical Chemistry	Heat Transfer Chemical Engineering Thermodynamics		Chemical Product Design	Plant Design	
Able to work in a multidisciplinary team	Communication Skill Religion	Integrated Character Building				Chemical Product Design	Plant Design	
Capable of critical, creative, and innovative thinking, and also have the intellectual ability to solve problems independently and interdependently			Instrumental Analytical Chemistry Physical Chemistry	Heat Transfer Chemical Engineering Thermodynamics				
Capable of utilizing communication information technology			Numerical Computation	Chemical Engineering Modelling	Chemical Process Simulation			
Able to apply knowledge of mathematics and science in solving engineering problems	Basic Chemistry Calculus Physics (Electricity, MWO)	Linear Algebra Physics (Mechanics and Thermal) Statistic and Probability Organic Chemistry Organic and Basic Chemistry Lab	Biochemistry Numerical Computation Instrumental Analytical Chemistry Physical Chemistry Phys. & Anal. Chem. Lab	Material Science & Corrosion Chemical Engineering Modelling	Engineering Economics			
Able to apply mass, energy balances, thermodynamics, transport phenomena, and chemical reaction engineering concepts in solving chemical engineering problems	Introduction to chemical engineering		Transport Phenomena Mass and Energy Balance	Fluid and Particle Mechanics Heat Transfer	Chemical Reaction Engineering 1 Mass Transfer	Chemical Reaction Engineering 2 Process Control		

Expected Learning Outcome (ELO)	Name of Course							
	1st Semester	2nd Semester	3rd Semester	4th Semester	5th Semester	6th Semester	7th Semester	8th Semester
				Chemical Engineering Thermodynamics				
Able to use modern chemical engineering tools			Numerical Computation	Process Engineering Drawing Chemical Engineering Modelling	Chemical Process Simulation	Process Equipment Design Chemical Product Design Process Control	Plant Design	
Able to conduct experiments and analyze the data obtained	Physics (Electricity, MWO) Lab	Organic and Basic Chemistry Lab Physics (Mechanics and Thermal) Lab	Phys. & Anal. Chem. Lab		Unit Operation Process Lab I	Unit Operation Process Lab II	Research Methodology & Seminar	Undergraduat Thesis
Able to design components, systems, processes, and products related to the chemical engineering profession with careful consideration of the engineering, economic, social, health and safety, energy, environment, sustainability, and ethical aspects					HSE Protection Engineering Economics	Process Equipment Design Chemical Product Design Process Control	Industrial Project Management Plant Design Research Methodology & Seminar	Undergraduat Thesis
Able to provide solutions to various problems that occurred wherever they live and work					HSE Protection	Chemical Product Design	Plant Design	Undergraduat Thesis
Able to identify the kind of entrepreneurial approach needed based on innovation, self-reliance, and ethics.						Chemical Product Design	Plant Design	Undergraduat Thesis Capita Select
Continuously develop oneself to contribute to solving local and global problems						Chemical Product Design	Plant Design	Undergraduat Thesis

List of Course

Code	Name of Course	Credit
University Courses (9 Credits)		
UIGE600007	MPK Terintegrasi / Integrated Character Building	6
UIGE600003	MPK Bahasa Inggris / English	2
UIGE600004	MPK Agama / Religion	2
Faculty Courses (25 Credits)		
ENGE600003	Kalkulus / Calculus	4
ENGE600004	Aljabar Linear / Linear Algebra	4
ENGE600005	Fisika Mekanik dan Panas / Physics (Mechanics and Thermal)	3
ENGE600006	Praktikum Fisika Mekanik dan Panas / Physics (Mechanics and Thermal) Lab	1
ENGE600007	Fisika Listrik, Magnet, Gelombang dan Optik / Physics [Electricity, Magnetic, Wave, Ophtics (MWO)]	3
ENGE600008	Praktikum Fisika Listrik, Magnet, Gelombang dan Optik / Physics (Electricity, MWO) Lab	1
ENGE600009	Kimia Dasar / Basic Chemistry	2
ENGE600010	Statistik dan Probablitas / Statistic and Probability	2
ENGE600011	Ekonomi Teknik / Engineering Economics	3
ENGE600012	Kesehatan, Keselamatan Kerja & Lindung Lingkungan / HSE Protection	2
Special Courses (9 Credits)		
ENCH600028/ENCH610031	Kerja Praktek / On The job Training (Internship)	2
ENCH600029/ENCH610032	Metodologi Penelitian dan Seminar / Research Methodology & Seminar	2
ENCH600033/ENCH610033	Skripsi / Undergraduate Thesis	5
Chemical Engineering Courses (75 Credits)		
ENCH600001/ENCH610001	Pengantar Teknik Kimia / Introduction to chemical engineering	3
ENCH600002/ENCH610002	Kecakapan Komunikasi / Communication Skills	2
ENCH600003/ENCH610003	Kimia Organik / Organic Chemistry	3
ENCH600004/ENCH610004	Praktikum Kimia Dasar dan Kimia Organik / Basic and Organic Chemistry Lab	1
ENCH600005/ENCH610007	Komputasi Numerik / Numerical Computation	3
ENCH600006/ENCH610008	Kimia Nalaitik Intrumental / Instrumental Analytical Chemistry	3
ENCH600007/ENCH610005	Kimia Fisika / Physical Chemistry	3
ENCH600008/ENCH610009	Praktikum Kimia Fisika dan Kimia Analitik / Phys. & Anal. Chem. Lab	1
ENCH600009/ENCH610006	Neraca Massa dan Energi / Mass and Energy Balance	3
ENCH600010/ENCH610010	Peristiwa Perpindahan / Transport Phenomena	3
ENCH600011/ENCH610014	Pemodelan Teknik Kimia / Chemical Engineering Modelling	3

ENCH600012/ENCH610011	Mekanika Fluida dan Partikel / Fluid and Particle Mechanics	3
ENCH600013/ENCH610012	Termodinamika Teknik Kimia / Chemical Engineering Thermodynamics	4
ENCH600014/ENCH610015	Perpindahan Kalor / Heat Transfer	3
ENCH600015/ENCH610017	Menggambar Teknik Proses / Process Engineering Drawing	3
ENCH600016/ENCH610013	lmu Bahan dan Korosi / Material Science & Corrosion	2
ENCH600017/ENCH610016	Perpindahan Massa / Mass Transfer	3
ENCH600018/ENCH610020	Praktikum UOP 1 / Unit Operation Process Lab I	1
ENCH600019/ENCH610021	Chemical Reaction Engineering 1	3
ENCH600020/ENCH610018	Chemical Process Simulation	3
ENCH600021/ENCH610023	Process Control	3
ENCH600022/ENCH610024	Unit Operation Process Lab II	1
ENCH600023/ENCH610025	Chemical Reaction Engineering 2	3
ENCH600024/ENCH610026	Process Equipment Design	3
ENCH600025/ENCH610027	Chemical Product Design	4
ENCH600026/ENCH610028	Industrial Project Management	2
ENCH600027/ENCH610029	Plant Design	4
ENCH600030/ENCH610030	Capita Selecta	2
Elective Courses (26 Credits)		
	Mata Kuliah Pilihan 1 / Elective 1	3
	Mata Kuliah Pilihan 2 / Elective 2	3
	Mata Kuliah Pilihan 3 / Elective 3	3
	Mata Kuliah Pilihan 4 / Elective 4	3
	Mata Kuliah Pilihan 5 / Elective 5	3
	Mata Kuliah Pilihan 6 / Elective 6	3
	Mata Kuliah Pilihan 7 / Elective 7	3
	Mata Kuliah Pilihan 8 / Elective 8	3
	Mata Kuliah Pilihan 9 / Elective 9	2

Courses Structure of Undergraduate Program in Chemical Engineering for Regular and Non Reguler Class Program

Code	Subject	SKS
	1st Semester	
UIGE600004	Religion	2
UIGE600003	English	2
ENGE600003	Calculus	4
ENGE600007	Physics (Electricity, MWO)	3
ENGE600008	Physics (Electricity, MWO) Lab	1
ENGE600009	Basic Chemistry	2
ENCH600001	Introduction to chemical engineering	2
ENCH600002	Communication Skills	2
	Sub Total	**18**
	2nd Semester	
UIGE600007	Integrated Character Building	6
ENGE600004	Linear Algebra	4
ENGE600005	Physics (Mechanics and Thermal)	3
ENGE600006	Physics (Mechanics and Thermal) Lab	1
ENGE600010	Statistic and Probability	2
ENCH600003	Organic Chemistry	3
ENCH600004	Organic and Basic Chemistry Lab	1
	Sub Total	**20**
	3rd Semester	
ENCH600005	Numerical Computation	3
ENCH600006	Instrumental Analytical Chemistry	3
ENCH600007	Physical Chemistry	3
ENCH600008	Phys. & Anal. Chem. Lab	1
ENCH600009	Mass and Energy Balance	3
ENCH600010	Transport Phenomena	3
	Elective 1	3
	Sub Total	**19**
	4th Semester	
ENCH600011	Chemical Engineering Modelling	3
ENCH600012	Fluid and Particle Mechanics	3
ENCH600013	Chemical Engineering Thermodynamics	4
ENCH600014	Heat Transfer	3
ENCH600015	Process Engineering Drawing	2
ENCH605016	Material Science & Corrosion	3
	Elective 2	3
	Sub Total	**21**
	5th Semester	
ENGE600011	Engineering Economics	3
ENGE600012	HSE Protection	2
ENCH600017	Mass Transfer	4
ENCH600018	Unit Operation Process Lab I	1
ENCH600019	Chemical Reaction Engineering 1	3
ENCH600020	Chemical Process Simulation	3
	Elective 3	3
	Sub Total	**19**
	6th Semester	
ENCH600021	Process Control	3
ENCH600022	Unit Operation Process Lab II	1
ENCH600023	Chemical Reaction Engineering 2	3
ENCH600024	Process Equipment Design	3
ENCH600025	Chemical Product Design	4
	Elective 4	3
	Elective 5	3
	Sub Total	**20**
	7th Semester	
ENCH600026	Industrial Project Management	2
ENCH600027	Plant Design	4
ENCH600028	On The Job Training (Internship)	2
ENCH600029	Research Methodology & Seminar	2
	Elective 6	3
	Elective 7	3
	Elective 8	3
	Elective 9	2
	Sub Total	**21**

	8th Semester	
ENCH600030	Capita Selecta	2
ENCH600031	Undergraduate Thesis	5
	Sub Total	**7**
	Total	**145**

List of Elective Courses in Odd Semester

Code	Subject	SKS
	Odd Semester	
ENCH800014	Oleochemical Industry	3
ENCH800015	Food Technology	3
ENCH800016	Protein Engineering	3
ENCH800017	Herbal Technology	3
ENCH800018	Composite Material	3
ENCH800019	Applied Thermodynamics	3
ENCH800020	Dynamic System	3
ENCH800021	Thermodynamic Properties of Hydrocarbon	3
ENCH800022	Lubricant Technology	3
ENCH800023	Cryogenic Technology	3
ENCH800024	Combustion Technology	3
ENCH800025	Plasma and Ozone Technology	3
ENCH800026	Heterogeneous Catalytic	3
ENCH800027	Sustainable Energy	3
ENCH800028	Risk Management	3
ENCH800029	Electrochemical Technology	3
ENCH800030	Extraction Technology & Isolation for Natural Products	3
ENCH800031	Special Topic 1	3
ENCH800032	Biochemistry	3
ENCH800033	Natural Gas Processing	3

List of Elective Courses in Even Semester

Code	Subject	SKS
	Even Semester	
ENCH800034	Storage and Packing Technology	3
ENCH800035	Bioinformatics	3
ENCH800036	Drugs and Cosmetics Technology	3
ENCH800037	Petroleum Processing	3
ENCH800038	Petrochemical Processing	3
ENCH800039	Photocatalytic Technology	3
ENCH800040	Hydrocarbon Exploration and Production	3
ENCH800041	Waste Management and Prevention	3
ENCH800042	Microalgae Cultivation and Development Technology	3
ENCH800043	Plant Utility and Maintenance	3
ENCH800044	Transportation and Utilization of Natural Gas	3
ENCH800045	Mixing Technology	3
ENCH800046	Problem Solving Skills	3
ENCH800047	Polymer Technology	3
ENCH800048	Genetically Modified Organism	3
ENCH800049	Controlled Drug Release Technology	3
ENCH800050	Special Topic 2	3
ENCH800051	Biomass Thermochemical Conversion	3
ENCH800052	Basic Computer Programming	3

Curriculum 2020 for Fast-Track Undergraduate to Master in Chemical Engineering Study Program

Courses Placement of Fast Track Undergraduate to Master Courses in Chemical Engineering Study Program from Chemical Engineering Undergraduate Program

Code	Subject	SKS
	7th Semester	
ENCH800033	Natural Gas Processing	3
ENCH600028	Industrial Project Management	2
ENCH600027	Plant Design	4
ENCH600028	Internship	2

ENCH600029	Research Methodology & Seminar	2
ENCH800001	Advanced Chemical Engineering Termodynamics	3
ENCH800027	Sustainable Energy	3
	Elective 6	3
	Total	**22**
	8th Semester	
ENCH600033	Undergraduate Thesis	5
ENCH600030	Capita Selecta	2
ENCH800003	Advanced Transport Phenomenon	3
ENCH800004	Advanced Chemical Reaction Engineering	3
ENCH800005	Advanced Chemical Engineering Modelling	3
	Elective 7	3
	Elective 8	3
	Total	**22**
	9th Semester	
ENCH800006	Research Methodology	3
ENCH800007	Pre-Thesis	2
	Elective 9	3
	Elective 10	3
	Elective 11	3
	Elective 12	2
	Total	**16**
	10th Semester	
ENCH800008	Thesis	6
ENCH800055	Research Publication	2
	Total	**8**

Curriculum 2020 for Fast-Track Undergraduate to Doctor in Chemical Engineering Study Program

Courses Placement of Fast Track Undergraduate to Doctor Courses in Chemical Engineering Study Program from Chemical Engineering Undergraduate Program

Code	Subject	SKS
	7th Semester	
ENCH600027	Natural Gas Processing	3
ENCH600028	Industrial Project Management	2
ENCH600027	Plant Design	4
ENCH600028	Internship	2
ENCH600029	Research Methodology & Seminar	2
ENCH800001	Advanced Chemical Engineering Termodynamics	3
ENCH800027	Sustainable Energy	3
	Elective 6	3
	Total	**22**
	8th Semester	
ENCH600033	Undergraduate Thesis	5
ENCH600030	Capita Selecta	2
ENCH800003	Advanced Transport Phenomenon	3
ENCH800004	Advanced Chemical Reaction Engineering	3
ENCH800006	Advanced Chemical Engineering Modelling	3
	Elective 7	3
	Elective 8	3
	Total	**22**
	9th Semester	
ENCH800006	Research Methodology	3
ENCH800007	Pre-Thesis	2
	Elective 9	3
	Elective 10	3
	Elective 11	3
ENCH900003	Research Group Periodic Seminar	8
	Total	**22**
	10th Semester	
ENCH800008	Thesis	4
ENCH800055	Research Publication	2
	Elective 12	2
ENCH900005	Research Proposal	6
	Total	**14**
	11th Semester	
ENCH900007	Publication 1 – International Conference	6
	Total	**6**
	12th Semester	
ENCH900008	Research Defense	10
	Total	**10**

	13th Semester	
ENCH900010	Publication 2 – International Journal	8
	Total	**8**
	14th Semester	
ENCH900011	Publication 3 – International Journal	8
ENCH900012	Doctoral Promotion	6
	Total	**14**

Transition Guidance from Curriculum 2016 to 2020 for Regular and Non Reguler Undergraduate Class

1. New curriculum 2020 will be applied effectively from Odd Semester 2020/2021. In principle, after curriculum 2020 is implemented, then only courses from this new curriculum will be opened.
2. For class 2019 and above will follow these transition rules.
3. The enforcement of the transitional period is one year. During this transition period, if a course in curriculum 2020 is in odd Semester while in the previous curriculum in even Semester (vice versa), then this course can be held (if necessary) in both semesters.
4. For students who have not passed the compulsory courses in curriculum 2016, are required to take the same course or equivalent in curriculum 2020. Equivalence courses can be seen in the table below. All courses in the curriculum 2016 that are not listed in the equivalence table have not changed, both in names and credits.

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

No	Name of Courses in Curriculum 2016	Semester	Credits 2016	Name of Courses in Curriculum 2020	Semester	Credits 2020
1	MPKT A (Integrated Character Building A)	2	6	MPKT Terintegrasi (Integrated Character Building)	2	6
2	MPKT B (Integrated Character Building B)	1	6			
3	MPK Bahasa Inggris (English)	3	3	MPK Bahasa Inggris (English)	1	2
4	Pengantar Teknik Kimia (Introduction to Chemical Engineering	2	3	Pengantar Teknik Kimia (Introduction to Chemical Engineering)	1	2
5	Biologi Molekular (Molecular Biology)	4	3	Biokimia (Biochemistry)	Elective (Odd)	3
6	Pengolahan Gas Bumi (Natural Gas Processing)	7	3	Pengolahan Gas Bumi (Natural Gas Processing)	Elective (Odd)	3
7	MPK Olah raga/seni (Sport/ Art)	1	1	MPK Olah raga/seni (Sport/ Art)	-	-
8	Skripsi (Undergraduate Thesis)	8	4	Skripsi (Undergraduate Thesis)	8	5
9	Statistik & Probabilistik (Statistic and Probability)	4	2	Statistik & Probabilistik (Statistic and Probability)	2	2

5. When there is a change in the course credits, then the number of graduation credits counted in is the number of credits when it was taken. The same or equivalent courses, when are equated with different credits, if retaken, or just taken, will be acknowledged under a new name and credits.
6. When a compulsory subject in the curriculum 2016 is deleted, and there is no equivalence in the curriculum 2020 then:
   a. For students who have passed these subjects, the credits that are achieved will be counted in the calculation of graduation 145 credits.
   b. For students who did not pass these courses, they can take new compulsory courses or choose elective subjects in the curriculum 2020 to complete 145 credits.
7. In addition to changes in curriculum structure from 2016 to 2020, there are also the addition of several elective courses: Teknologi Elektrokimia), Teknologi Pencampuran (Mixing Technology), Teknologi Pengembangan dan Pemanfaatan Mikroalga (Microalgae Cultivation and Development Technology), Teknologi Ekstraksi dan Isolasi Bahan Alam (Extraction & Isolation Technology for Natural Products), Konversi Termokimia Biomassa (Biomass Termochemical Conversion Technology), Modifikasi Genetik Makhluk Hidup (Genetically Modified Organism), and Dasar Pemrograman Computer (Basic Computer Programming)

Course Structure of Undergraduate Program in Chemical Engineering for International Class

Code	Subject	SKS
	1st Semester	
UIGE600004	Religion Studies	2
ENGE610003	Calculus	4
ENGE610007	Physics (Electric, Magnet, Wave & Optic)	3
ENGE610008	Physics (Electric, Magnet, Wave & Optic) Laboratory	1
ENGE610009	Basic Chemistry	2
ENCH610001	Introduction to Chemical Engineering	2
ENCH610002	Communication Skills	2
ENCH610006	Mass and Energy Balances	3
	Total	**19**
	2nd Semester	
UIGE600002	Academic Writing	2
ENGE610004	Linear Algebra	4
ENGE610005	Physics (Mechanics and Thermal)	3
ENGE610006	Physics(Mechanics and Thermal) Laboratory	1
ENCH610003	Organic Chemistry	3
ENCH610004	Basic Chem. and Org. Chem. Lab.	1
ENCH610005	Physical Chemistry	3
ENGE610010	Statistics and Probabilistic	2
	Sub Total	**19**
	3rd Semester	
ENCH610007	Numerical Computation	3
ENCH610008	Instrumental Analytical Chemistry	3
ENCH610009	Phys. Chem. and Anal. Chem. Lab.	1
ENCH610010	Transport Phenomena	3
ENCH610011	Fluid and Particle Mechanics	3
ENCH610012	Chemical Engineering Thermodynamics	4
ENCH610013	Material Science and Corrosion	3
	Sub Total	**20**
	4th Semester	
ENGE610012	Health, Safety and Environmental Protection	2
ENCH610014	Chemical Engineering Modeling	3
ENCH610015	Heat Transfer	3
ENCH610016	Mass Transfer	4
ENCH610017	Process Engineering Drawing	2
ENCH610018	Chemical Process Simulation	3
	Elective 1	3
	Sub Total	**20**
	5th Semester	
ENGE610011	Engineering Economics	3
ENCH610020	Unit Operation Laboratory 1	1
ENCH610021	Chemical Reaction Engineering 1	3

	Elective 2	3
	Elective 3	3
	Elective 4	3
	Elective 5	3
	Sub Total	**19**
	6th Semester	
UIGE610011	Integrated Character Building	6
ENCH610023	Process Control	3
ENCH610024	Unit Operation Laboratory 2	1
ENCH610025	Chemical Reaction Engineering 2	3
ENCH610026	Process Equipment Design	3
ENCH610027	Chemical Product Design	4
	Sub Total	**20**
	7th Semester	
ENCH610028	Industrial Project Management	2
ENCH610029	Plant Design	4
ENCH610030	Capita Selecta	2
ENCH610031	On the Job Training (Internship)	2
ENCH610032	Research Methodology and Seminar	2
	Elective 6	3
	Elective 7	3
	Sub Total	**18**
	8th Semester	
ENCH610033	Undergraduate Thesis	5
	Elective 8	3
	Elective 9	2
	Sub Total	**10**
	Total	**145**

List of Elective Courses in Odd Semester

Code	Subject	SKS
	Odd Semester	
ENCH800014	Oleochemical Industry	3
ENCH800015	Food Technology	3
ENCH800016	Protein Engineering	3
ENCH800017	Herbal Technology	3
ENCH800018	Composite Material	3
ENCH800019	Applied Thermodynamics	3
ENCH800020	Dynamic System	3
ENCH800021	Thermodynamic Properties of Hydrocarbon	3
ENCH800022	Lubricant Technology	3
ENCH800023	Cryogenic Technology	3
ENCH800024	Combustion Technology	3
ENCH800025	Plasma and Ozone Technology	3
ENCH800026	Heterogeneous Catalytic	3
ENCH800027	Sustainable Energy	3
ENCH800028	Risk Management	3
ENCH800029	Electrochemical Technology	3
ENCH800030	Extraction Technology & Isolation for Natural Products	3
ENCH800031	Special Topic 1	3
ENCH800032	Biochemistry	3
ENCH800033	Natural Gas Processing	3

List of Elective Courses in Even Semester

Code	Subject	SKS
	Even Semester	
ENCH800034	Storage and Packing Technology	3
ENCH800035	Bioinformatics	3
ENCH800036	Drugs and Cosmetics Technology	3
ENCH800037	Petroleum Processing	3
ENCH800038	Petrochemical Processing	3
ENCH800039	Photocatalytic Technology	3
ENCH800040	Hydrocarbon Exploration and Production	3
ENCH800041	Waste Management and Prevention	3
ENCH800042	Microalgae Cultivation and Development Technology	3
ENCH800043	Plant Utility and Maintenance	3
ENCH800044	Transportation and Utilization of Natural Gas	3
ENCH800045	Mixing Technology	3
ENCH800046	Problem Solving Skills	3

ENCH800047	Polymer Technology	3
ENCH800048	Genetically Modified Organism	3
ENCH800049	Controlled Drug Release Technology	3
ENCH800050	Special Topic 2	3
ENCH800051	Biomass Thermochemical Conversion	3
ENCH800052	Basic Computer Programming	3

Courses Structure of Undergraduate Program in Chemical Engineering at Partner Universities

Couse Structure in Chemical Engineering at Monash University

3rd Year	Courses	
Code	Semester 5 (in July)	Credits
CHE3162	Process control	6
CHE3164	Reaction engineering	6
CHE3166	Process design	6
	Choose one stream	6
	Subtotal	24
Code	**Semester 6 (in February)**	**Credits**
CHE3162	Chemistry and chemical thermodynamics	6
CHE3164	Sustainable processing I	6
CHE3166	Separation processes	6
	Transport phenomena and numerical methods	6
	Subtotal	24
4th Year	**Courses**	
Code	**Semester 7 (in July)**	**Credits**
CHE4162	Particle technology	6
CHE4170	Design project	12
	Choose one stream	6
	Subtotal	24
Code	**Semester 8 (in February)**	**Credits**
CHE4161	Engineers in society	6
CHE4180	Chemical engineering project	12
	Choose one stream	6
	Subtotal	24

Elective Courses

3rd Year		
Code	Courses	Credits
Biotechnology Stream		
CHE3171	Bioprocess technology	6
Nanotechnology and Materials Stream		
CHE3172	Nanotechnology and materials I	6
Sustainable Processing Stream		
CHE3175	Process engineering	6
4th Year		
Code	Courses	Credits
Biotechnology Stream		
BCH2011	Structure and function of cellular biomolecules	6
CHE4171	Biochemical engineering	6
Nanotechnology and Materials Stream		
CHE4172	Nanotechnology and materials II	6
MTE2541	Nanostructure of materials	6
Sustainable Processing Stream		
CHE4173	Sustainable processing II	6
ENE3608	Environmental impact and management systems	6

Couse Structure in Chemical Engineering at Curtin University

3rd Year	Courses	
Code	Semester 5 (in July)	Credits
CHE 223	Thermodynamics	25
CHE 324	Fluid & Particle Processes	25
CHE 325	Reaction Engineering	25
CHE 328	Process Instrumentation & Control	25
	Subtotal	100
Code	**Semester 6 (in February)**	**Credits**
ChE 322	Process Plant Engineering	25
ChE 312	Proc Syn & Design 1	12.5
ChE 479	Advanced Special Topics	12.5
CHE	Mass Transfer Operations	25
ChE 421	Risk Management	25
	Subtotal	100
4th Year	**Courses**	
Code	**Semester 7 (in July)**	**Credits**
ChE 423	Process Economics & Management	25
ChE 422	Advanced Separation Processes	25
ChE 499	Design Project (Lectures/Feasibility Studies)	50
	Subtotal	100
Code	**Semester 8 (in February)**	**Credits**
ChE 481	Process Laboratory Projects	25
ChE 414	Proc Syn & Design II	12.5
ChE 411	Advanced Process Control	12.5
CHE 491	Research Project	12.5
CHE 493	Research Project	12.5
	Optional Unit	12.5
	Optional Unit	12.5
	Subtotal	100

Elective Courses

Code	Courses	Credits
CHE374	Mineral processing	12.5
CHE475	Petroleum processing	12.5
CHE39	Special topics (biochemical engineering	12.5
CHE493	Research project	12.5
CHE477	Computational fluid dynamics	12.5
CHE313	Fundamentals of air pollution control	12.5

Couse Structure in Chemical Engineering at University of Queensland

3rd Year	Courses	
Code	Semester 5 (in July)	Credits
CHEE3004	Unit operations	2
CHEE3005	Reaction engineering	2
CHEE3006	Process and control system synthesis	2
CHEE3007	Process modeling and dynamics	2
	Subtotal	8
Code	**Semester 6 (in February)**	**Credits**
CHEE4002	Environmental risk assessment	2
CHEE4009	Transport phenomena	2
CHEE1001	Principles of biological engineering	2
	Part B2 Advanced Elective	2
	Subtotal	8
4th Year	**Courses**	
Code	**Semester 7 (in July)**	**Credits**
CHEE4001	Process engineering design project	4

	Part B2 Advanced Elective	2
	Part B2 Advanced Elective	2
	Subtotal	8
Code	**Semester 8 (in February)**	**Credits**
	Part B2 Advanced Elective	2
	Part B2 Advanced Elective	2
	Part B2 Advanced Elective	2
	Subtotal	6

Elective Courses

Code	Courses	Credits
Part B2 Advanced Electives		
CHEE4003	Special Topics A	2
CHEE4005	Polymer rheology & processing	2
CHEE4006	Individual inquiry A	2
CHEE4007	Individual inquiry B	2
CHEE4012	Industrial wastewater & solid waste management	2
CHEE4015	Special Topics VII	2
CHEE4020	Biomolecular engineering	2
CHEE4021	Particle design & processing	2
CHEE4022	Principles of adsorption	2
CHEE4024	Energy systems in sustainable development	2
CHEE4028	Metabolic engineering	2
CHEE4301	Cell & tissue engineering	2
CHEE4302	Nanomaterials and their characterization	2
CHEE4101	Electrochemistry and corrosion	2
CHEE4102	Systems engineering & design management	2
CHEE4103	Advanced product design method	2
Part B3 Process Engineering Electives		
CHEE2005	Chemical product design	2
CHEE3008	Special Topics C	12.5
CHEE3301	Polymer engineering	12.5
CHEE3305	Biomaterials: Materials in Medicine	12.5
CHEM2002	Biophysical chemistry	
CIVL3150	Modeling of environmental systems	
MINE2201	Physical & chemical processing of minerals	

1. New curriculum 2020 will be applied effectively from Odd Semester 2020/2021. In principle, after curriculum 2020 is implemented, then only courses from this new curriculum will be opened.
2. For class 2019 and above will follow these transition rules.
3. The enforcement of the transitional period is one year. During this transition period, if a course in curriculum 2020 is in odd Semester while in the previous curriculum in even Semester (vice versa), then this course can be held (if necessary) in both semesters.
4. For students who have not passed the compulsory courses in curriculum 2016, are required to take the same course or equivalent in curriculum 2020. Equivalence courses can be seen in the table below. All courses in the curriculum 2016 that are not listed in the equivalence table have not changed, both in names and credits.
5. When there is a change in the course credits, then the number of graduation credits counted in is the number of credits when it was taken. The same or equivalent courses, when are equated with different credits, if retaken, or just taken will be acknowledged under a new name and credits.
6. When a compulsory subject in the curriculum 2016 is deleted, and there is no equivalence in the curriculum

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

No	Name of Courses in Curriculum 2016	Semester	Credits 2016	Name of Courses in Curriculum 2020	Semester	Credits 2020
1	MPKT A (Integrated Character Building A)	2	6	MPKT Terintegrasi (Integrated Character Building)	2	6
2	MPKT B (Integrated Character Building B)	1	6			
3	Academic Writing	3	3	MPK Bahasa Inggris (English)	1	2
4	Introduction to Chemical Engineering	2	3	Introduction to Chemical Engineering	1	2
5	Biologi Molekular (Molecular Biology)	4	3	Biokimia (Biochemistry)	Elective (Odd)	3
6	Pengolahan Gas Bumi (Natural Gas Processing)	7	3	Pengolahan Gas Bumi (Natural Gas Processing)	Elective (Odd)	3
7	Sport/Art	1	1	Sport/Art	-	-
8	Undergraduate Thesis	8	4	Undergraduate Thesis	8	5

2020 then:

a. For students who have passed these subjects, the credits that are achieved will be counted in the calculation of graduation 145 credits.

b. For students who did not pass these courses, they can take new compulsory courses or choose elective subjects in the curriculum 2020 to complete 145 credits.

7. In addition to changes in curriculum structure from 2016 to 2020, there are also the addition of several elective courses: Teknologi Elektrokimia), Teknologi Pencampuran (Mixing Technology), Teknologi Pengembangan dan Pemanfaatan Mikroalga (Microalgae Cultivation and Development Technology), Teknologi Ekstraksi dan Isolasi Bahan Alam (Extraction & Isolation Technology for Natural Products), Konversi Termokimia Biomassa (Biomass Termochemical Conversion Technology), Modifikasi Genetik Makhluk Hidup (Genetically Modified Organism), dan Dasar Pemrograman Computer (Basic Computer Programming)

SYLLABUS OF UNDERGRADUATE PROGRAM IN CHEMICAL ENGINEERING FOR REGULER, NON REGULER AND INTERNATIONAL CLASSES

Course Sylabus of University Subjects

INTEGRATED CHARACTER BUILDING

UIGE600007/UIGE610011
6 credits

Syllabus :

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

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

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

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

Graduate Learning Outcomes :

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

Course Learning Outcomes :

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

Prerequisite : -

ACADEMIC WRITING

UIGE610002
2 credits

The objectives 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 strat-

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

Main Competencies :

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

Learning Method :

Active learning, Contextual language learning, small group discussion.

Prerequisite : Students Learning Orientation/Orientasi Belajar Mahasiswa (OBM)

ENGLISH

UIGE610003
2 credits
Learning Objectives :

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

Syllabus :

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

ISLAMIC STUDIES

UIGE600010/UIGE610005
2 credits
General instructional objectives :

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

Learning Objectives :

Course participants are expected to do the following when faced with a problem or issue which they must solve :
1. Analyze the problem based on the Islamic values they adopted;
2. Analyze the problem by implementing active learning stages;
3. Discuss and express their thoughts and ideas by using proper and correct Indonesian language in discussion and academic writing.

Syllabus :

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

CATHOLIC STUDIES

UIGE600011/UIGE610006
2 credits
General instructional objectives :
1. To help deliver students as intellectual capital in implementing lifelong learning process to become scientists with mature personality who uphold humanity and life.
2. Be scholars who believe in God according to the teachings of Jesus Christ by continuing to be responsible of his faith in life in church and society.

Syllabus :

Almighty God and the God teachings; Man, Morals,

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

CHRISTIAN STUDIES
UIGE600012/UIGE610007
2 credits
General instructional objectives :

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

Learning Objectives :

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

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

Syllabus :

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

HINDU STUDIES
UIGE600013/UIGE610008
2 credits

Syllabus :

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

BUDDHIST STUDIES
UIGE600014/UIGE610009
2 credits
Syllabus :

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

KONG HU CU STUDY
UIGE600015/UIGE610010
2 credits

Syllabus Of Basic Engineering Subjects

CALCULUS 1
ENGE600001/ENGE610001
3 credits
Course Learning Outcomes:

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

Graduates Learning Outcomes:

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

Prerequisite: None

Textbooks:

Main reference:

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

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

CALCULUS 2

ENGE600002/ENGE610002
3 SKS
Course Learning Outcomes:

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

Graduates Learning Outcomes:

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

Syllabus :

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

Prerequisite: Calculus 1

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

CALCULUS

ENGE600003/ENGE610003
4 SKS
Course Learning Outcomes:

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

Graduates Learning Outcomes:

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

Syllabus :

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

Prerequisite: None

Textbooks:

Main reference:

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

Additional:

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

LINEAR ALGEBRA

ENGE600004/ENGE610004
4 SKS
Course Learning Outcomes:

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

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

Syllabus :

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

Prerequisite: None

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

MECHANICAL AND HEAT PHYSICS

ENGE600005 / ENGE610005
3 credits
Course Learning Outcomes:

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

Graduate Learning Outcomes:

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

Syllabus:

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

Prerequisite: none

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

ELECTRICAL MAGNETIC, OPTICAL AND WAVE PHYSICS

ENGE600007 / ENGE610007
3 credits
Course Learning Outcomes:

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

Graduate Learning Outcomes:

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

Syllabus:

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

Prerequisite: none

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

BASIC CHEMISTRY

ENGE600009 / ENGE610009
2 credits
Course Learning Outcomes:

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

Graduates' Learning Outcomes:

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

Syllabus:

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

Prerequisite: none

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

ENGINEERING ECONOMY

ENGE600011 / ENGE610011
3 credits
Course Learning Outcomes:

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

Graduate Learning Outcomes:

Able to apply the principles of technical management and decision making based on economic consider-

ations, in individual and group, as well as in project management.

Syllabus:

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

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

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

STATISTICS AND PROBABILISTICS

ENGE600010 / ENGE610010
2 credits
Course Learning Outcomes:

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

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

Syllabus:

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

Prerequisite: none

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

HSE PROTECTION

ENGE600012 / ENGE610012
2 credits
Course Learning Outcomes:

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

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

Syllabus:

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

Prerequisite: none

Textbooks :

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

Chemical Engineering Courses

INTRODUCTION TO CHEMICAL ENGINEERING

ENCH600001 / ENCH610001
3 CREDITS
Learning Objectives:

Able to distinguish chemical engineering from other techniques, able to explain the development of chemical engineering, understand the basics of chemical engineering and existing process systems, and able to do simple mass and energy balance calculations and know the criteria of process equipment.

Syllabus:

Introduction to Chemical Engineering (understanding and history); Profile, employment, and contribution of Chemical Engineering; Code of Ethics of the Chemical Engineering profession; Chemical engineering processes (units and dimensions and basic process systems); Chemical engineering equipment; The flow of chemical engineering processes in certain industries

Prerequisites: -

Textbooks:

1. Chemical Process Industries, McGraw Hill, 1984.
2. R.M., Felder and R.W. Rosseau, Elementary Principles of Chemical Processes, 3rd Edition, Wiley, 2005.
3. R. Schizininger and M.W. Martin, Introduction to Engineering Ethics, Mc. Graw-Hill, 2000.

COMMUNICATION SKILLS

ENCH600002 / ENCH610002
2 CREDITS
Learning Objectives:

Able to plan communication products through audience analysis, then compile them into a coherent and logical sequence of messages, and can present them effectively using appropriate technology media.

Syllabus:

Effective communication, audience analysis, writing process, making memos, making summaries / abstracts, structure of technical papers, oral presentation.

Prerequisites: -

Textbooks:

Donald R. Woods, Communicating effectively, McMaster University Bookstore, 1996

ORGANIC CHEMISTRY

ENCH600003 / ENCH610003
3 CREDITS
Learning Objectives:

Able to apply the concepts and laws of analytical, organic, and physical chemistry and apply them in solving everyday problems.

Syllabus:

Naming of organic compounds; The role of structure and stereochemistry in the physical/chemical properties of an organic compound; Cracking reactions or alkane free radicals; Alkene polymerization; Aromatic electrophilic substitution in benzene; Ubtstitution reaction and elimination; Acylation and esterification reaction; Dehydration-polymerization reaction

Prerequisites: -

Textbooks:

1. Fessenden, alih bahasa: A. Hadiyana Pujatmaka, Kimia Organik, edisi Kedua Erlangga 1986
2. Morrison, RT and Boyd, RN, Organic Chemistry, 6th ed., Prentice Hall 1998
3. Organic Chemistry Lecture Note.

BASIC AND ORGANIC CHEMISTRY LAB

ENCH600004 / ENCH610004
1 CREDITS
Learning Objectives:

Able to make a preliminary report, conduct experiments in the laboratory, analyze data from the results of practicum and explain the phenomena that occur from the results of practicum done, which are outlined in the form of a final report.

Syllabus:

Physical and Chemical Properties; Separation and Refining of Compounds; Metal Reaction with Acid; Crystal Water; Suspension Formation Reaction; Identification of Hydrocarbon Compounds; Alcohol and phenol identification; Identification of Carbonyl Compounds; Carbohydrate; Lipid Analysis; Extraction and Identification of Fatty Acids from Corn Oil

Prerequisites: -

Textbooks:

1. Brown, T.L., et al., Chemistry The Central Science, 8th ed., Prentice Hall, 2000.
2. Morrison, R.T., R. N. Boyd, Organic Chemistry, 6th ed., Prentice Hall, 2002.
3. Vogel's Qualitative Inorganic Analysis, 7th ed., 1996.
4. Penuntun Praktikum Kimia Dasar dan Kimia Organik, Teknik Kimia FTUI.

NUMERICAL COMPUTATION

ENCH600005 / ENCH610007
3 CREDITS
Learning Objectives:

Able to solve chemical process problems with computational methods.

Syllabus:

Programming with Pascal and Fortran; Regression; Systems of linear algebraic equations; Numerical integration; Finding the roots of non-linear algebraic equations' The system of non-linear algebraic equations; An explicit method for solving first-order differential equations;

Prerequisites: -

Textbooks:
1. Handouts dari dosen
2. Constantinides, Alkis. 2008. "Numerical Methods for Chemical Engineers with Mathlab Applications". Pearson Education, United States.
3. Bismo, S. & Muharam, Y. 2015. "Metode Numerik dengan Pemrograman Fortran dan Pascal".

INSTRUMENTAL ANALYTICAL CHEMISTRY

ENCH600006 / ENCH610008
3 CREDITS
Learning Objectives:

Able to apply the concepts and laws of analytical, organic, and physical chemistry and apply them in solving everyday problems.

Syllabus:

Process skills workshop; Electrochemistry; Potentiometry; Atomic absorption spectroscopy; Infrared molecular spectroscopy; Gas chromatography;

Prerequisites: -

Textbooks:
1. D. A. Skoog, et.al., Fundamentals of Analytical Chemistry 9th., Cengage Learning, Inc., 2013.
2. G. D. Christian and J. E. O' Reilly, Instrumental Analysis, 7th. Ed., Allyn Bacon Inc., 2003.
3. D.A. Skoog, et al. Principles of Instrumental Analysis 7th Ed. Cengage Learning, Inc. 2016.
4. D.L. Pavia, et al. Introduction to Spectroscopy 5th Ed. Cengage Learning, Inc. 2014

PHYSICAL CHEMISTRY

ENCH600007 / ENCH610005
3 CREDITS
Learning Objectives:

Able to apply basic principles, laws, and theories related to gases, liquids, equilibrium, and solutions in solving problems in the field of physical chemistry; Able to solve problems in the form of working groups by applying stages of problem-solving.

Syllabus:

The nature of gases and liquids: Definition, laws of ideal gases and real gases, use of gas laws, gas kinetics theory (velocity, collisions, average free way), phase diagrams, critical conditions, viscosity; Chemical reaction equilibrium: Definition, homogeneous equilibrium constant, factors affecting equilibrium constant, heterogeneous equilibrium, Le Chatelier's principle, effect of P on K, effect of T on K; Ideal solution: Definition, type of solution, solution concentration, Raoult's law, Henry's law, case examples, partial molar volume, vapor pressure, boiling point, freezing point, and solution osmosis pressure; Electrolyte solutions: Definition, colligative properties, electrolytic conductance, factors affecting conductance, case examples, ion migration, Hittorf's law and transport numbers; Chemical Reaction Kinetics: Basic understanding, first, second, third order reactions, reversible, Non Reguler, consecutive reactions, chain reactions, Arrhenius equations and activation energies, collision theory of bimolecular reactions, transition form theory; Surface phenomena: Basic understanding, surface tension, monolayer and multilayer adsorption, catalytic reaction kinetics, heterogeneous reaction order, catalytic reaction inhibitors, temperature effects on heterogeneous reactions.

Prerequisites: -

Textbooks:
1. Levine, I.N., Physical Chemistry, 6th ed., McGraw-Hill, 2008.
2. Atkins & de Paula, Atkin's Physical Chemistry, 9th ed., Oxford University Press, 2009

PHYSICAL & ANALYTICAL CHEMISTRY LAB

ENCH600008 / ENCH610009
1 CREDITS
Learning Objectives:

Able to compile a preliminary report which is a theory that supports the practicum module; carry out experiments in the laboratory; and compile the final report that contains the results of processing and analysis of experimental data and an explanation of the phenomena that occur

Syllabus:

Isothermic adsorption; Effect of concentration and temperature on the reaction rate; Colligative nature of the solution; Determination of chemical equilibrium constants; Determination of gas molecular weight; Volumetric analysis; Potentiometric methods; Visible light spectrophotometry; The conductometry method; Gas chromatography

Prerequisites:

Basic Chemistry, Physical Chemistry and Instrumental Analytical Chemistry

Textbooks:

1. Petunjuk Praktikum Kimia Fisika TGP-FTUI 1989.
2. Penuntun Praktikum Kimia Fisika dan Kimia Analitik, Departemen Teknik Kimia FTUI
3. D. A. Skoog, et al., Fundamentals of Analytical Chemistry 5th., Saunders College Publishing, 1998 atau edisi terbaru
4. Shoemaker, D.P., C.W. Garland, J.W. Nibler, Experiments in Physical Chemistry, ed. 6, Mc-Graw Hill, 1996.
5. Atkins & de Paula, Atkin's Physical Chemistry, 9th ed., Oxford University Press, 2009

MASS AND ENERGY BALANCE

ENCH600009 / ENCH610006
3 CREDITS
Learning Objectives:

Able to use basic principles in chemical engineering for mass and energy calculations, which will form the basis of calculations for many operating units and processes in the chemical/bioprocess industry; Formulate and solve problems in the form of mass and energy balance sheets related to chemical processes.

Syllabus:

The scope of the mass and energy balance sheet; Mass balance without chemical reactions and multi-unit systems; Mass balance of chemical reactions; Biological reaction mass balance; Chemical / biological reaction mass based on the component mass balance and element mass balance; General chemical energy balance; Energy balance of chemical reactions

Prerequisites: -

Textbooks:

1. Himmelblau D.M. Basic Principles and Calculation in Chemical Engineering, 7th ed, Prentice Hall 2004.
2. Pauline Doran, Basic Principles of Bioprocess Engineering, Wiley VCH, 2006.
3. Sumber data: Perry's Chemical Handbook dan lainnya yang terkait data *physical and chemical properties*

TRANSPORT PHENOMENA

ENCH600010 / ENCH610010
3 CREDITS
Learning Objectives:

Able to identify and explain and analyze the phenomena of momentum, mass, and heat transfer through the application of microscopic and macroscopic balances.

Syllabus:

Preliminary; Viscosity; Thermal Conductivity and Diffusivity; Shell's momentum balance and Shell's energy balance; Shell mass balance; The equation of change; Mass transfer, momentum, and energy with two independent variables; The transfer of momentum, energy, and mass in a turbulent flow; Movement between two phases; Macroscopic balance of an isothermal system; Macroscopic balance of non-isothermal systems; Macroscopic balance sheet of multi-component systems

Prerequisites:
Introduction to Chemical Engineering; Calculus

Textbooks:

1. Referensi wajib: R.B. Bird, W.E. Stewart, and E.N. Lightfoot, Transport Phenomena, John Wiley and Sons, New York, 2nd edition, 2002.
2. Referensi pilihan: Harry C. Hershey, Robert S. Brodkey, Transport Phenomena: A Unified Approach, Vol. 1, McGraw-Hill, New York, 1987, pp. 847.

CHEMICAL ENGINEERING MODELLING

ENCH600011 / ENCH610014
3 CREDITS
Learning Objectives:

Able to develop mathematical equations from chemical process systems; able to solve mathematical equations that describe chemical process systems.

Syllabus:

An explicit method for solving ordinary differential equations; Finite difference method for solving ordinary & partial differential equations; Empirical Model; Phenomenological model for multi-component separation systems; Phenomenological model for chemical reaction systems; Phenomenological model for reactor systems;

Prerequisites:
Komputasi Numerik/Numerical Computation

Textbooks:

1. Constantinides, A. dan Mostouvi, N., Numerical Methods for Chemical Engineers with MATLAB Applications, Prentice Hall, 1999.
2. Davis, M.E., Numerical Methods and Modeling

for Chemical Engineer, John Willey & Sons, New York, 1984.
3. Rice, G.R. dan Duong D.D., Applied Mathematics and Modeling for Chemical Engineers, John Willey & Sons, New York, 1995.
4. Tosun, I., Modeling in Transport Phenomena: A Conceptual Approach, Elsevier, 2002.

FLUID AND PARTICLE MECHANICS

ENCH600012 / ENCH610011
3 CREDITS
Learning Objectives:

Able to apply the basic concepts of fluid mechanics and apply them in solving real problems. In addition, students are able to apply the principles of fluid mechanics (press. Continuity, Bernoulli, etc.), to solve problems in the unit process through energy and force calculations, etc., especially in fluid flow systems in piping, rate measuring devices and transportation tools fluid, as well as in fluid-solid flow systems (fluidization, filtration, sedimentation, movement of particles in the gas.

Syllabus:

Fluid property; Static fluid and its application; The basic equation of fluid flow (mass & press balance. Continuity, energy balance and press. Bernoulli); Press application. Bernoulli for flow rate measurement; Friction Loss of fluid flow through pipes, porous media, fluid transport devices: pumps, compressors, turbines; High-speed gas flow; Movement of particles through fixed and fluidized beds and Filtration; Sedimentation of particles in a liquid

Prerequisites:

Transport Phenomena

Textbooks:

1. Noel de Nevers, Fluid Mechanics for Chemical Engineers, 2nd Ed., McGraw-Hill, 1991.
2. Bruce R. Munson, Donald F. Young, Theodore H. Okiishi, Fundamentals of Fluid Mechanics, John Wiley & Sons, 2006.

CHEMICAL ENGINEERING THERMODYNAMICS

ENCH600013 / ENCH610012
4 **CREDITS**
Learning Objectives:

Able to apply heuristics of problem solving skills and basic concepts of thermodynamics to solve various thermodynamic triggers in the Problem-Based Learning (PBL) learning format; able to increase the ability to direct learning independently (self-directed learning) at the individual or group level

Syllabus:

PVP properties of pure compounds, process trajectories, steamed tables (Trigger 1); Steady and non-steady system energy balance (Trigger 2); Cyclic processes: Rankine cycle for energy generation and refrigeration cycle (Trigger 3); Ideal system phase equilibrium and the activity coefficient approach (Trigger 4); Phase equilibrium at high pressure: a coefficient of fugacity approach through the cubic state equation (Trigger 5); Reaction balance (Trigger 6)

Prerequisites:
Mass and Energy Balance

Textbooks:

1. M.J. Moran and H.N. Saphiro, Fundamentals of Engineering Thermodynamics, 2nd/3rd ed., Wiley.
2. J.M. Smith, H.C. Van Ness, and M.M. Abbott, Introduction to Chemical Engineering Thermodynamics, 6th/7th ed., McGraw Hill.
3. Kamarza Mulia dan Praswasti PDK Wulan, Diktat Termodinamika Teknik Kimia.
4. Donald R. Woods, Problem-Based Learning: How to gain the most from PBL, McMaster Bookstore, Hamilton, Ontario, Canada, 1994.
5. Internet sites, books, manuals, software instructions, and other reliable sources of information.

HEAT TRANSFER

ENCH600014 / ENCH610015
3 CREDITS
Learning Objectives:

Able to analyze the phenomenon of heat transfer and apply it to solve problems in the heat transfer process unit.

Syllabus:

Skills Workshop Review which includes: The importance of self-assessment, awareness of the thought process, problem-solving strategies and work skills in groups; Steady conduction; Induction Conduction; Natural Convection; Forced Convection; Radiation; Heat Exchanger

Prerequisites:
Transport Phenomena

Textbooks:

1. Holman, J.P., "Perpindahan Kalor (alih bahasa: E. Jasjfi), Edisi ke-6, Penerbit Erlangga, Jakarta 1993.
2. Mc. Adam, W. H., "Heat Transmission", 3rd Ed., Mc.Graw-Hill International Book Company, 1981.
3. Kern, D. Q., "Process Heat Transfer", Mc.Graw-Hill International Book Company, 1984.
4. Treybal, R.E., "Mass Transfer Operation", McGraw-Hill International Book Company, 1984.

5. Coulson, J.M. dan Richardson, J.R., "Chemical Engineering", Vol.2, Pergamon Press, 1989.
6. Donald R. Woods, Problem based learning: How to gain the most from PBL, McMaster University, Hamilton, 1994.

PROCESS ENGINEERING DRAWING

ENCH600015 / ENCH610017
3 CREDITS
Learning Objectives:

Able to manually draw process flow diagrams, P&ID and plant layouts, recognize the use of software for drawing, understand, and be able to read the meaning of images.

Syllabus:

Introduction to drawing techniques; Basics of drawing technique; Block Process Flow Diagram; Symbols basic symbols of equipment Chemical industry and process flow; Process Flow Diagram (PFD); Equipment symbols, pipes, instrumentation; Piping and Instrumentation Diagram (P&ID); Software for drawing; Plant Plots & Plant Layouts; Piping Route and Isometric Drawing; Spool Drawing and Bill of Materials (BOM). Bill of Quantity (BOQ)

Prerequisites: -

Textbooks:

1. W. Boundy, Engineering Drawing, McGraw-Hill Book Company
2. Colin Simmons & Dennis Maguire, Manual of Engineering Drawing, Edward Arnold
3. ISO 1101, Mechanical Engineering Drawings, International Organization for Standardization
4. Japanese Industrial Standard, Technical Drawing for Mechanical Engineering, Japanese Standard Association.
5. Warren J. Luzadder, Fundamentals of Engineering Drawing, Prentice-Hall, Inc.

MATERIAL SCIENCE & CORROSION

ENCH600016 / ENCH610013
3 CREDITS
Learning Objectives:

Able to understand the role of material selection in designing equipment; able to understand the properties of materials; able to understand corrosion: the process, prevention, testing and protection; Calculate and design simple corrosion protection

Syllabus:

History of Material Science in human civilization; Application of Material Science in Chemical Engineering; Atoms, Molecules, Chemical Bonds and their correlation with material properties; Crystal Structure; Phase Diagrams and their relationship to metal making; Material Mechanical Properties and Test Equipment; Metals and alloys; Corrosion and Chemical Industry; Basic concepts of corrosion, electrochemistry, polarization, passivity; Types of corrosion-mechanisms and their prevention; Cathodic Protection and Corrosion Inhibitors & Monitoring

Prerequisites: -

Textbooks:

Ilmu Bahan dan Teknologi Bahan (Lawrence H.Van Vlack diterjemahkan oleh Ir. Sriati Djaprie, M.E.,M. Met), Bagian Pendahuluan.

MASS TRANSPORT

ENCH600017 / ENCH610016
3 CREDITS
Learning Objectives:

Able to use basic technical principles for the calculation of major mass transfer operations: Distillation, Absorption, Extraction, Humidification and Drying.

Syllabus:

Introduction; Distillation; Drying / Humidification; Absorption; Extraction; Leaching

Prerequisites:

Termodinamika Teknik Kimia; Peristiwa Perpindahan (Thermodynamics of Chemical Engineering; Trasport Phenomena)

Textbooks:

1. Treyball, "Mass Transfer Operation", MGH, 1984.
2. McCabe and Smith, "Unit Operation for CE", JWS, 1989.
3. Coulson and Richardson, "Chemical Engineering", Pergamon, 1991.
4. Geankoplis, "Transport Processes and Unit Operation", Prentice Hall, 1993.

UNIT OPERATION PROCESS LAB I

ENCH600018 / ENCH610020
1 CREDITS
Learning Objectives:

Students practice operating the equipment of fluid mechanics and heat transfer units and able to analyze experimental data obtained through written reports.

Syllabus:

Introduction of miniature forms of tools and Laboratory-scale Chemical Engineering Process Operation Units; Application of various principles of displacement events, fluid mechanics, heat transfer given in lectures on the Process equipment and Chemical Engineering Operations Unit

Prerequisites:

Fluid and Particle Mechanics, Heat Transfer

Textbooks:

Buku Petunjuk Praktikum Proses dan Operasi Teknik Kimia 1, DTK FTUI.

CHEMICAL REACTION ENGINEERING 1

ENCH600019 / ENCH610021
3 CREDITS
Learning Objectives:

Able to understand the basic concepts of chemical reaction kinetics (reaction rates, reaction mechanisms), both for homogeneous and heterogeneous reactions, and are able to determine the equation of reaction rates and understand surface phenomena and catalysis.

Syllabus:

Basic Concepts of Chemical Kinetics and Thermodynamics of Chemical Reactions; Molecular Reaction; Homogeneous Elementary Reactions: Data Modeling and Analysis; Homogeneous Non-Elementary Reactions; Kinetics of Heterogeneous Reactions; Heterogeneous Catalytic Reaction Data Analysis; Effects of External Diffusion on Heterogeneous Catalytic Reactions; Diffusion and Reaction; Case Study in the Methanol & Sulfuric Acid Industry; Case Study in the Fertilizer Industry

Prerequisites:
Physical Chemistry

Textbooks:

1. H. Scott Fogler, Elements of Chemical Reaction Engineering, Prentice-Hall, 4th Edition, 2006.
2. O. Levenspiel, Chemical Reaction Engineering, 3rd Edition, John Wiley & Sons, New York, 1999.
3. S.H., Fogler, and LeBlanc, Strategies for Creative Problem Solving, Prentice-Hall, 1995.
4. K. J. Leidler, Chemical Kinetics, 3rd ed., Harper Publish, 1987.
5. Widodo, W. P., Slamet, Diktat Kuliah Kinetika dan Perancangan Reaktor Kimia, TGP-FTUI, 2002.
6. CRE course onlines:
7. http://www.engin.umich.edu/~cre/344/
8. http://ocw.mit.edu/OcwWeb/Chemical-Engineering/10-37Spring-2007/CourseHome/

CHEMICAL PROCESS SIMULATION

ENCH600020 / ENCH610018
3 CREDITS
Learning Objectives:

Able to use the latest chemical engineering software to create steady-state and dynamic simulations and able to manipulate variable processes and unit topology processes in the chemical industry.

Syllabus:

Steady-state and dynamic models; Stream; Heat exchangers equipment; Piping equipment and rotating equipment; Separation Equipment; Columns and Towers; Reactor; Refrigeration system; PID Controller Selection for Temperature, Pressure, Level and Flow; Cascade Controller; Model Testing and Adjustment of PID Controllers.

Prerequisites: Chemical Engineering Thermodynamics, Mass and Energy Balances

Textbooks:

1. Fogler, H.S., Elements of Chemical Reaction Engineering, Prentice-Hall.
2. Douglas, J. M., Conceptual Design of Chemical Processes, McGraw-Hill, 1998.
3. Peter, M.S, and K.D. Timmerhaus, Plant Design and Economic for Chemical Engineering 4th Edition, McGraw-Hill, 1991.
4. HYSYS Steady State Model and Tutorial.
5. SuperPro Designer User Guide and Tutorial, Inteligent, Inc.

PROCESS CONTROL

ENCH600021 / ENCH610023
3 CREDITS
Learning Objectives:

Able to design a single loop control system and connect the dynamics of the process with performance.

Syllabus:

Introduction to Process Control; Objectives and Benefits of Control; Principles of Mathematical Modeling; Process Control Modeling and Analysis; Dynamic Behavior of a Typical Process System; Empirical Model Identification; Feedback loop; PID controller; PID Control Settings; Stability Analysis;

Prerequisites:
Mass and Energy Balance, Numerical Computation

Textbooks:

1. T. Marlin, Process Control: Designing Processes and Control Systems for Dynamic Performance, 2nd Edition, McGraw-Hill, New York, 2000.
2. Carlos A. Smith, Armando B. Corripio, Principles and Practice of Automatic Process Control, John Wiley & Sons, 1985, ISBN 0-471-88346-8 2.
3. D. E Seborg, T. F. Edgar, D. A. Mellichamp, Process Dynamics and Control, John Wiley & Sons, 1989, ISBN 0-471-86389-0 3.
4. Ogata, Katsuhiko, Teknik Kontrol Automatik (Sistem Pengaturan), Jilid 1, Penerbit Erlangga, 1985, Bandung.
5. Bequette, R. W., Process Dynamics: Modeling, Analysis, and Simulation, Prentice Hall, 1998.
6. Luyben, William L., Process Modeling,

Simulation and Control for Chemical Engineers, Second Edition, McGraw-Hill International Edition, 1990.
7. Kuo, Benjamin C., Automatic Control Systems, Sixth Edition, Prentice-Hall International Editions, 1991.
8. Stephanopoulos, George, Chemical Process Control: An Introduction to Theory and Practice, Prentice-Hall International, 1984.

UNIT OPERATION PROCESS LAB 2

ENCH600022 / ENCH610024
1 CREDITS
Learning Objectives:

Students practice operating the equipment of fluid mechanics and heat transfer units and able to analyze experimental data obtained through written reports.

Syllabus:

Introduction of miniature forms of tools and Laboratory-scale Chemical Engineering Process Operation Units; Application of various principles of mass transfer and process control events to the Process Equipment and Chemical Engineering Operations Unit.

Prerequisites:

Mass Transfer, Heat Transfer, Fluid & Particle Mechanics, Process Control

Textbooks:

Buku Petunjuk Praktikum Proses dan Operasi Teknik 2, Departemen Teknik Kimia UI.

CHEMICAL REACTION ENGINEERING 2

ENCH600023 / ENCH610025
3 CREDITS
Learning Objectives:

Able to understand the basic concepts of chemical reactor design, do the basic design of chemical reactors, and conduct analysis to determine the types and operating conditions of chemical reactors.

Syllabus:

The basic concept of chemical reactor design; Ideal-Isothermal Reactor Design; Non-Isothermal Reactor Design; Visitation to industry or guest lectures; RTD concept to analyze flow patterns in ideal and non-ideal reactors; Concentration is based on various models of non-ideal reactors and analyzing the profile of real (non-ideal) reactor paths.

Prerequisites:
Chemical Reaction Engineering 1

Textbooks:

1. H. Scott Fogler, Elements of Chemical Reaction Engineering, Prentice-Hall, 4th Edition, 2006.
2. O. Levenspiel, Chemical Reaction Engineering, 3rd Edition, John Wiley & Sons, New York, 1999.
3. S.H., Fogler, and LeBlanc, Strategies for Creative Problem Solving, Prentice-Hall, 1995.
4. E. B. Nauman, Chemical Reactor Design, Optimization, and Scale up, McGraw-Hill, 2002.
5. Widodo, W. P., Slamet, Diktat Kuliah Kinetika dan Perancangan Reaktor Kimia, TGP-FTUI, 2002.
6. CRE course onlines
7. http://www.engin.umich.edu/~cre/344/
8. http://ocw.mit.edu/OcwWeb/Chemical-Engineering/10-37Spring-2007/CourseHome/
9. O. Levenspiel, Tracer Technology Modeling the Flow of Fluids in Fluid Mechanics and its Applications Vol. 96.
10. Series Editor: R. Moreau Madylam, Springer, 2012.

PROCESS EQUIPMENT DESIGN

ENCH600024 / ENCH610026
3 CREDITS
Learning Objectives:

Able to design chemical process equipment in accordance with applicable standards. Syllabus: Pumps, compressors, piping, pressure vessels and tanks, distillation columns, heat exchangers.

Syllabus: Pumps, compressors, piping, pressure vessels and tanks, distillation columns, heat exchangers.

Syllabus:

Introduction to process design; Fluid Transportation: Piping systems, pump designs, compressors; Distillation Column Design; Heat Exchanger Design: Double pipe HE, Shell and Tube, SHTE; Vessel Design

Prerequisites:

Fluid Mechanics and Particles; Heat Transfer; Mass Transfer; Material Science & Corrosion

Textbooks:

1. Kern, D. Q., “Process Heat Transfer”, Mc.Graw-Hill International Book Company, 1984.
2. Ludwid, Applied Process Design for Chemical and Petrochemical Plant, Vol. 2, Gulf Publishing Co.
3. Towler, G. and Sinnott, R., Chemical Engineering Design: Principles, Practice and Economics of Plant and Process Design, Elsevier, 2008.

CHEMICAL PRODUCT DESIGN

ENCH600025 / ENCH610027
4 **CREDITS**
Learning Objectives:

Able to use the knowledge gained from several previous subjects to be applied to the design of a

complete chemical product which includes: Needs, Ideas, Selection and Manufacture, Supply Chain, Intellectual Property Rights, HSE, and Economics; Students have problem-solving skills and work in teams; Students are capable of entrepreneurship.

Syllabus:

Understanding of consumer needs, product specifications, creating and selecting product concepts, product formulations, product manufacturing, supply chains, economics.

Prerequisites:

Mass and Energy Balance; Fluid Mechanics and Particles; Heat Transfer; Mass Transfer; Chemical Reaction Engineering; Engineering Economics.

Textbooks:

1. Cussler, L., G.D. Moggridge, Chemical Product Design, Cambridge University Press, 2011.
2. Seider W.D., Seader J.D., Lewin D.R., Product and Process Design Principles, Synthesis, Analysis and Evaluation, Wiley and Sons Inc., 2009.
3. Wesselingh J.A., Kiil, S. and Vigild M.E., Design and Development of Biological, Chemical, Food and Pharmaceutical Products, John Wiley & Sons, Ltd., 2007.
4. Ulrich K.T., Eppinger S.D., Product Design and Development, 5th edition, McGraw Hill.
5. Birgit Kamm, Patrick R. Grubber, Michael Kamm, Biorefineries – Industrial Processes and Products, Wiley-VCH, Swiss, 2005.
6. Peter, M.S. and K.D. Timmerhaus, Plant Design and Economic for Chemical Engineering 4th edition, McGraw Hill, 1991.
7. Dolgui A., Soldek J. and Zaikin O., Supply Chain Optimization: Product/Process Design, Facility Location and Flow Control, Springer, 2005.
8. Douglas, J.M., Conceptual Design of Chemical Processes, McGraw Hill, 1998.
9. Kirk-Othmer, Enyclopedia of Chemical Technology, 3rd edition, McGraw Hill, 1991.
10. Perry's Chemical Handbook

INDUSTRIAL PROJECT MANAGEMENT

ENCH600026 / ENCH610028
2 CREDITS
Learning Objectives:

Able to apply project management concepts in their field of work well.

Syllabus:

Concept of Project-Production; Project Life Cycle; Project Selection; Project Planning; Project Implementation; Project Completion & Evaluation.

Prerequisites:

Engineering Economics

Textbooks:

Suharto, Imam, Manajemen Proyek, 1990

PLANT DESIGN

ENCH600027 / ENCH610029
4 CREDITS
Learning Objectives:

Able to theoretically design a factory/industry by explore information from books, journals and the internet to find the latest solutions in product and factory design with due regard to standards and regulations.

Syllabus:

Conceptual design of processes/plants, process development flow diagrams, heuristic synthesis and analysis of processes, process simulations, rule of thumb design of process tools and construction meters, heat/process integration, plant layouts, and economic analysis.

Prerequisites:

Process Control, Process Equipment Design, Chemical Process Simulation, Engineering Economics

Textbooks:

1. Douglas, J. M., 1998, Conceptual Design of Chemical Processes, McGraw-Hill.
2. Seider W. D., Seader J. D., Lewin D. R., Sumatri Widagdo, 2008, Product and Product Design Principles. Synthesis, Analysis and Evaluation, Wiley and Sons Inc, 3 edition.
3. Turton, R., R. C. Bailie, W. B. Ehiting and J. A. Shaeiwitz, 1998, Analysis, Synthesis, and Design of Chemical Process, Prentice-Hall
4. Gavin Towler, R K Sinnott, 2012, Chemical Engineering Design: Principles, Practice and Economics of Plant and Process Design, Butterworth-Heinemann, Second Edition.
5. Peter, M. S, and K. D. Timmerhaus, Ronald West, and Max Peters, 2002, Plant Design and Economic for Chemical Engineering, 5 Edition, McGraw-Hill.
6. Biegler L. T, I. E, Grossmann and A. W. Westerberg, 1997, Systematic Methods for Chemical Process Design, Prentice-Hall.
7. Branan, C., 1998, Rule of Thumb for Chemical Engineers : A manual of quick, accurate solutions to everyday process engineering problems, 2nd edition, Gulf Publishing, Co.
8. Wallas, Stanley M. 1990, Chemical Process Equipment : Selection and Design, Buther Worths.
9. Ed Bausbacher, Roger Hunt, 1993, Process Plant Layout and Piping Design, Prentice Hall; 1 edition

10. CHEMCAD Manual, HEATEXET Manual, HYSYS/UNISIM ManualBerk, Z, Food Process Engineering and Technology, Academic Press, 2009
11. Lydersen BK, Bioprocess Engineering: System, Equipment and Facilities, John & Wiley & Sons, Inc., New York, 1993.
12. Peter, M. S. dan K. D. Timmerhaus, Plant design and Economic for Chemical Engineering, 4th Ed., McGraw Hill.
13. SuperPro Designer Manual. Intelligen, Inc

CAPITA SELECTA
ENCH600030 / ENCH610030
2 CREDITS
Learning Objectives:

Able to make a summary of the material presented by guest lecturers

Syllabus:

Held by inviting competent guest lecturers in the fields according to the needs in each study program (may vary in each semester)

Prerequisites:
passed 90 credits

Textbooks: -

Special Courses

ON THE JOB TRAINING (INTERNSHIP)
ENCH600028 / ENCH610031
2 CREDITS
Learning Objectives:

At the end of the lecture, students have real knowledge and experience in the field of oil and gas, petrochemical, pharmacy, oleochemical, and other chemical industries that involve aspects of technology, processes, operations, and management.

Syllabus: -

Prerequisites:

Already taken at least 110 credits (minimum D) with GPA 2,5

Textbooks: -

RESEARCH METHODOLOGY & SEMINAR
ENCH600029 / ENCH610032
2 CREDITS
Learning Objectives:

Able to determine the right method for research activities as well as express ideas, processes, and results of scientific research verbally and in writing

Syllabus:

Introduction, techniques to identify problems and form hypotheses, logical and critical thinking, scientific writing techniques, research proposal writing techniques, research design techniques, presentation techniques, data collection techniques, analyze and present the results.

Prerequisites:
Already taken at least 90 credits (minimum D) with IPK 2,5

Textbooks:
1. Handout
2. Research proposal format from various institutions

UNDERGRADUATE THESIS
ENCH600033 / ENCH600033
5 CREDITS
Learning Objectives:

Able to analyze and solve chemical technology problems and present them in oral and written forms in the form of scientific papers.

Syllabus:

Following topics taken

Prerequisites:
Research methodology & Seminar

Textbooks:
1. Pedoman Teknis Penulisan Tugas Akhir Mahasiswa Universitas Indonesia.
2. IEEE Citation Reference.
3. Ivan Stojmenovic, "How To Write Research Articles in Computing and Engineering Disciplines," IEEE Transactions on Non Reguler And Distributed Systems, Vol. 21, No. 2, February 2010.
4. Buku petunjuk praktis pelaksanaan MK. Skripsi, Depok, 1999.

Elective Courses

ELECTIVE COURSES IN ODD SEMESTER

OLEOCHEMICAL INDUSTRY
ENCH800014
3 CREDITS
Learning Objectives:

Able to know the various processes that commonly used in the oleochemical industry, and able to make a plan to develop the produce of oleochemicals from vegetable oils.

Syllabus:

Fatty acids, biodiesel, paints and polymers, detergents, soaps, fatty alcohol, glycerin, oils and fats, oil and greese, the development of oleochemicals, vegetable

oil processing, vegetable oil technology in the process.

Prerequisites:
Organic Chemistry

Textbook:

Oleochemical Manufacture and Applications by Frank D. Gunstone, Richard J. Hamilton. Blackwell

FOOD TECHNOLOGY

ENCH800015
3 CREDITS
Learning Objectives:

Able to understand the processes of making food in the food industry, which includes the selection, handling, and processing of raw materials, the operating unit of food production, packaging, storage, and control of the process from the beginning stage to the end.

Syllabus:

Introduction, physical properties of raw materials, the basic concepts of energy and mass transfer, reaction kinetics, process control. Mixing, filtration, centrifugation, extraction and membrane processes, adsorption and ion exchange column, with the temperature settings, drying, preservation, packaging, food storage, and hygiene.

Prerequisites: -

Textbook:

1. Zeki Berk, Food Process Engineering and Technology, Academic Press, Elsevier 2009
2. Food Technology: an introduction by Anita Tull. Oxford University Press, 2002
3. Introduction to Food Engineering by R. Paul Singh, R. Paul Singh, and Dennis R. Heldman.
4. Academic Press
5. Introduction to Food Process Engineering by P. G. Smith. Springer
6. Fundamentals of Food Process Engineering by Romeo T. Toledo. Springer

PROTEIN ENGINEERING

ENCH800016
3 CREDITS
Learning Objectives:

Abble to determine protein engineering strategies for the benefit of separation, biocatalysts and medic.

Syllabus:

Introduction, Protein docking methods, Protein tagging strategies, Gen synthesis design, Enzyme stabilization, Molecular exploration, Protein engineering, Case study.

Prerequisite:

Organic Chemistry

Textbook:

1. Protein Engineering in Industrial Biotechnology, Lilia Alberghina, Harwood academic publishers, 2005
2. Proteins: Biotechnology and Biochemistry by Dr. Gary Walsh. Wiley
3. Protein engineering and design by Sheldon J. Park, Jennifer R. Cochran. CRC Press
4. Protein Engineering and Design by Paul R. Carey. Academic Press
5. Protein Engineering: Principles and Practice. Wiley-Liss

HERBAL TECHNOLOGY

ENCH800017
3 CREDITS
Learning Objectives:

Able to explain the development of herbal technology, herbal separation technology, herbal formulation basis, herbal regulation, and distinguish with other pharmaceutical products

Syllabus:

Definition and basic concepts of herbs, herbal materials, herbal separation technology, herbal formulations, herbal regulation.

Prerequisites:
Organic Chemistry

Textbook:

The Complete Technology Book on Herbal Perfumes & Cosmetics by H. Panda. National Institute of Industrial Research 2003

COMPOSITE MATERIAL

ENCH800018
3 CREDITS
Learning Objectives:

Able to: Explain the characteristics of composite materials and compare it with conventional materials; Explain the manufacturing process, and research development of composite materials.

Syllabus:

The position of composite materials in materials science in general, common characteristics of composite materials, the type of composite based on the composition, the types of polymer matrix and reinforcement, the role of surface treatment in the strength of composite materials, manufacturing processes, durability, the process of splicing and repair of composite materials, code and standards for application of composite materials, the development of composite materials research.

Prerequisites:
Organic Chemistry

Textbook:
1. Fiber-reinforced Composites (Materials Engineering, Manufacturing and Design), P. K. Mallick, Marcel Dekker, Inc., 1993.
2. Handbook of Plastics, Elastomers, and Composites, 3rd ed., Charles A. Harper, McGraw-Hill, 1996.
3. Reinforced Plastics - Theory and Practice, 2nd ed., M. W. Gaylord, Chaners Books, 1974.

APPLIED THERMODYNAMICS

ENCH800019
3 CREDITS
Learning Objectives:

Students are able to analyze problems of thermodynamics based on a thorough review including fundamental aspects of thermodynamics, experimental, and green chemistry, based on current information from scientific journals

Syllabus:

The case study of industrial thermodynamic, example cycle processes, phase equilibrium, and chemical reaction equilibrium to process and product engineer; friendly solvents such as supercritical CO2 and ionic liquid

Prerequisites:
Chemical Engineering Thermodynamics

Textbook:
1. References relevant to a given problem
2. Mulia, K dan Wulan, PPDK, Buku Teks Termodinamika Kimia

DYNAMIC SYSTEM

ENCH800020
3 CREDITS
Learning Objectives:

Able to build dynamic models of process systems, biological, industrial, social and economic.

Syllabus:

Introduction to dynamical systems, causal loops, model and validation, analysis, case study.

Prerequisites:
Numerical Computation

Textbook:
1. Forrester, J. W., 2002, Principles of Systems, Productivity Press
2. Goodman, Michael R., 1998, Study Notes in System Dynamics, Productivity Press
3. Richardson, George P. and Pugh III, Alexander L., 1999, Introduction to System Dynamics Modeling, Pegasus Communications
4. Andersen, David, etc., Introduction to Computer Simulation - A System Dynamics: Systems Thinking and Modeling for a Complex World, McGraw-Hill

THERMODYNAMICS PROPERTIES OF HYDROCARBON

ENCH800021
3 CREDITS
Learning Objectives:

Able to predict the magnitude of thermodynamic properties of hydrocarbons and the phase condition, either manually or using software calculations.

Syllabus:

Introduction to hydrocarbon thermodynamics properties, basic thermodynamic concepts, P-V-T data correlations, physical properties of hydrocarbon fluids, computing aided thermodynamics properties, the vapor-liquid behavior of two-phase systems, water-hydrocarbon system behavior, product specifications in the disposal lease of hydrocarbon

Prerequisites:
Chemical Engineering Thermodynamics

Textbook:
1. Wayne C. Edmister, Byung Ik Lee, Applied hydrocarbon thermodynamics, Volume 1, Gulf Publishing Company (1988), Houston, Texas.
2. John M. Campbell, Gas Conditioning and Processing, Vol. 1, 8th Edition Campbell Petroleum Series 2001.

LUBRICANT TECHNOLOGY

ENCH800022
3 CREDITS
Learning Objectives:

Able to explain the working principles of lubrication, lubricant function, and several parameters of the quality and lubricant classification, lubricant chemical, and its production technology, either mineral lubricant, synthesis and vegetal.

Syllabus:

Principles of lubrication on friction and wear phenomena on the two surfaces of solid objects are moving together; mode lubrication: hydrodynamic and elastohydrodynamic; lubricants: mineral, synthetic, and vegetable; additives, formulations, degradation, contamination, and maintenance of lubricants; latest development of lubricant technology.

Prerequisites:
Organic Chemistry

Textbook:

1. E. Richard Booster, Handbook of Lubricant: Theory and Practice of Tribology, Vol. I, Vol. II, Vol. III, CRC Press (1984), Inc., Boca Raton, Florida
2. Mervin H. Jones, Industrial Tribology: The Practical Aspect of Friction, Lubricant, and Wear, Elsevier Scientific Publishing Co., New York, 1983.
3. J. Halling, Principle of Tribology, Macmillan Press Ltd., London, 1978
4. Handout

CRYOGENIC TECHNOLOGY

ENCH800023
3 CREDITS
Learning Objectives:

Able to explain the various processes to liquefy gas in cryogenic technology

Syllabus:

History and development of cryogenic, cryogenic scope of work. Refrigeration and liquefaction of natural gas, air, oxygen, nitrogen, helium, neon, and argon.

Prerequisites:
Chemical engineering thermodynamics

Textbook:

1. Timmerhaus, K.D., Cryogenic Process Engineering, Plenum Press 1989, New York.
2. Barron, Randall. Cryogenic Systems, McGraw Hill, 1985, New York.

COMBUSTION TECHNOLOGY

ENCH800024
3 CREDITS
Learning Objectives:

Able to explain the phenomenon of combustion and resolve the problems that rendered correctly.

Syllabus:

Chemical kinetics and combustion, the flame, premix flame, diffusion flame, the combustion process applications.

Prerequisite:

Transport Phenomena, Chemical Reaction Engineering 1, Chemical Engineering Thermodynamics

Textbook:

1. Warnatz, J., Maas, U. dan Dibble, R.W., Combustion: Physical and Chemical Fundamentals, Modeling and Simulation, Experiments, Pollutant Formation, 2nd ed., Springer, Heidelberg, 1999.
2. Turns, S.R., An Introduction to Combustion: Concepts and Applications, 2nd ed, McGraw-Hill, 2000.
3. Glassman, I., Combustion, Academic Press, 1997.
4. El-Mahallawy dan el-Din Habik, S., Fundamental and Technology of Combustion, Elsevier, 2002.
5. Combustion, T. J. Poinsot and D. P. Veynante, in Encyclopedia of Computational Mechanicsedited by Erwin Stein, Ren´e de Borst and Thomas J.R. Hughes, 2004 John Wiley & Sons, Ltd.
6. Introduction to Combustion, Concepts and Applications, Stephen R. Turns, 2nd edition, McGraw Hill, 2000
7. Introduction to Combustion Phenomena, A. Murty Kanury, Gordon and Breach Science Publishers, 1975
8. Heat Transfer from Burners, Charles E. Baukal, in Industrial Burners Handbook, edited by Charles E. Baukal, CRC Press, 2004.

PLASMA AND OZONE TECHNOLOGY

ENCH800025
3 CREDITS
Learning Objectives:

Able to explain the physics and chemistry phenomena of plasma formation and release of electromagnetic energy and the use of plasma and ozone technology.

Syllabus:

Basic phenomena and physical-chemical processes of gases that are given an electrical charge (corona discharge), the generation process or formation of ozone, role and use of plasma technology and ozone in chemical engineering processes, the potential of ozone technology in control technology environmental pollution, the ozone generator module manufacturing equipment.

Prerequisite:
Physics Electricity Magnetism

Textbook:

1. E. T. Protasevich: "Cold Non-Equilibrium Plasma", Cambridge International science Publishing, Cambridge, 1999.
2. Rice, R. G., and M. E. Browning: "Ozone Treatment of Industrial Water water", Notes Data Corporation, Park Ridyl, 1981.
3. Metcalf & Eddy, Inc. (Tchobano-glous, G., and FL Burton): "Wastewater Engineering: Treatment, Disposal, and Reuse", McGraw-Hill Book. Co., Singapore, 1991.

HETEROGENEOUS CATALYST

ENCH800026
3 CREDITS
Learning Objectives:

Able to explain the phenomenon of basic concepts heterogeneous catalysts and its application

Syllabus:

The general property of catalyst, thermodynamic of the reaction with catalyst, the distribution of the catalyst based on the type of reaction, the core function is active, the method of selecting catalysts for certain reactions, characterization of the corresponding want to know the nature of the target, the catalyst test methods, methods of development of the catalyst, and reaction products.

Prerequisites:
Chemical Reaction Engineering 1

Textbook:

1. Nasikin M, Susanto BH, "Katlaisis Heterogen", UI Press, 2010
2. Satterfield, C. N., heterogeneous Catalysis in Industrial Practice, McGraw-Hill Inc., New York, 1991.
3. Rase, F. R., Commercial Catalyst, CRC Press, New York, 1991
4. Richardson, T, J., Principles of Catalyst Development, Plenum Press, New York, 1989
5. Thomas J.M. And WJ Thomas, Principles and Practice of Heterogeneous Catalysis, VCH, Weinhem, Germany, 1997
6. Emmet, R. H., Catalysis, Reinhold Publishing Corporation, New York, 1961

SUSTAINABLE ENERGY

ENCH800027
3 CREDITS
Learning Objectives:

Able to explain the relationship of energy with a social aspect, economic and environmental and sustainability concepts, and able to analyze the performance of techno-economy and the continuity, especially fossil energy system, new, and renewable.

Syllabus:

Concept of sustainability and sustainable energy, energy hierarchy, energy linkages with economic, environmental and social, fossil energy/fuels and Impacts, global climate change and its mitigation, conversion, transportation/distribution and storage, the analysis method of energy sustainability: LCA, sustainability index, hydrogen and fuel cells and nuclear energy, solar energy (PV and thermal), wind and ocean, hydropower, bioenergy, geothermal energy, energy efficiency and conservation, carbon capture, and storage.

Prerequisites:

Chemical Engineering Thermodynamics or Biochemical Engineering

Textbook:

1. Jefferson W. Tester, et al., Sustainable Energy: Choosing Among Options, MIT Press, 2005.
2. Godfrey Boyle, et al., Energy Systems and Sustainability: Power for a Sustainable Future,
3. Oxford University Press, 2003.
4. E. Cassedy S, Prospects for Sustainable Energy: A critical assessment, Cambridge University Press, 2000.
5. DeSimone et al., Eco-Efficiency. The Business Link to Sustainable Development, MIT Press, 1997.
6. D. Elliot, Energy, Society, and Environment, Technology for a sustainable future, Rouledge, 1997
7. Miller, G. T., Environment Science. Sustaining Earth, Wardworld Publish Co. 1993

RISK MANAGEMENT

ENCH800028
3 CREDITS
Learning Objectives:

Able to explain and apply risk management in a risk assessment.

Syllabus:

Introduction to the risk, the basic principles and guidelines concerning risk, risk management standards, risk assessment, risk analysis, risk analysis and simulation, simulation of the risk with Montecarlo method, the risk of using software simulation crystal ball.

Prerequisites: -

Textbook:

J. F. A. Stoner, Management, 1986

ELECTROCHEMICAL TECHNOLOGY

ENCH800029
3 CREDITS
Learning Objectives:

Able to understand the basic principles of electrochemical technology and apply them in the design of electrochemical systems for various applications.

Syllabus:

Basic electrochemical principles and electrochemical cell concepts; electrochemical cell thermodynamics (Nernst equation, Pourbaix diagram, etc.); electrochemical cell kinetics (the mechanism of electrochemical redox reactions, Marcus theory, Butler-Volmer model, etc.); polarization/overpotential on electrochemical cells (ohm polarization, activation polarization, concentration polarization, etc.); the phenomenon of mass transfer in electrochemical cells (migration, diffusion, convection, etc.); electrochemical analysis (voltammetry, chronoamperometry, AC impedance, etc.); electrode-electrolyte interface phenomena (double layer theory, surface capacitance,

ion adsorption, etc.); semiconductor electrodes (photoelectrochemical); and various electrochemical applications (fuel cells, solar cells, batteries, etc.)

Prerequisite:

Physical Chemistry, Thermodynamics of Chemical Engineering, Chemical Reaction Engineering 1

Textbook:

1. Keith B. Oldham dan Jan C. Myland. Fundamentals of Electrochemical Science, Academic Press, Inc., 1st Edition, London, 1994.
2. Richard G. Comption dan Craig E. Banks. Understanding Voltammetry, 3rd Edition, World Scientific, London, 2018
3. Norio Sato. Electrochemistry at Metal and Semiconductor Electrodes, 1st Edition, Elsevier Science & Technology, Oxford, 1998.
4. Marcel Pourbaix. Atlas of Electrochemical Equilibria in Aqueous Solutions, 2nd Edition, NACE International, Brussels, 1974
5. Allen J. Bard, Martin Stratmann, and all authors. Encyclopedia of Electrochemistry, 1st Edition, *John Wiley & Sons*, New York 2007

EXTRACTION & ISOLATION FOR NATURAL PRODUCTS TECHNOLOGY

ENCH800030
3 CREDITS
Learning Objectives:

Able to compare various principles that relate to extraction technology and isolation of natural materials; Determine extraction and / or isolation techniques appropriate for certain natural materials; Developing process skills to solve problems related to the field of extraction technology and natural material isolation

Syllabus:

Natural substances and secondary metabolites, Variety of natural material products, Selection and preparation of materials for extraction, Selection and preparation of materials for isolation, Natural material extraction techniques, Fractionation techniques and isolation of natural materials

Prerequisite: -

Textbook:

1. Rydberg, Cox, & Musikas. Solvent Extraction Principles and Practice 2nd Edition. Marcel Dekker, Inc. 2004.
2. Meireles, M. Angela A. Extracting Bioactive Compounds for Food Products: Theory and Applications. CRC Press – Taylor & Francis Group, LLC. 2009.
3. Rostagno, Mauricio A. & Prado, Juliana M. Natural Product Extraction: Principles and Applications. RSC Publishing. 2013.

SPECIAL TOPIC 1

ENCH800031
3 **CREDITS**

BIOCHEMISTRY

3 **CREDITS**

Learning Objectives:

Able to describe the relationship of structure and chemical compounds in living things, including the functions, synthesis processes and metabolism of these chemical compounds that occur in living things.

Syllabus:

Introduction to cells and tissues; Membranes and organelles; The role of DNA and protein; Energy in cells; Nucleic acid; Structure and replication of DNA and RNA; Transcription and translation; Amino acid; Synthesis and structure of proteins; Enzyme; Metabolism

Prerequisites: -

Textbooks:

1. Lehninger Principles of Biochemistry & eBook by Albert Lehninger, David L. Nelson and Michael M. Cox (Jun 15, 2008)
2. Biochemistry (3rd Edition) by Christopher K. Mathews, Kensal E. van Holde and Kevin G. Ahern (Dec 10, 1999)
3. Bruckner, Monica Z. Basic Cellular Staining.Serc. carleton.edu.
4. Aryulina, D., Manaf, S., Muslim, C., & Winarni, E.W. 2007. BIOLOGI 3. Jakarta : Esis. Binur
5. Robi. 2011. Teknologi RNA Interference. Retrieved from Campbell, Reece. 2009. Biology. Sansome Street, San Francisco: Pearson Benjamin Cummings.

NATURAL GAS PROCESSING

ENCH800033
3 **CREDITS**

Learning Objectives:

Able to design natural gas refineries for piped gas, pressurized natural gas, or LNG if given a fluid composition that reaches the surface of the reservoir.

Syllabus:

Introduction and terms in Natural Gas Processing; Physical Properties of Hydrocarbon Fluid; Hydrocarbon Water System; Hydrate; Dew Point Control Unit; AGRU; Absorption Dehydration Unit; Adsorption Dehydration Regeneration Unit; Heavy Hydrocarbon Recovery Unit; LNG Processing

Prerequisites: Chemical Process Simulation

Textbooks:

1. Gas Conditioning and Processing Vol. 1
2. Gas Conditioning and Processing Vol. 2

ELECTIVE COURSES IN EVEN SEMESTER

PACKAGING AND STORAGE TECHNOLOGY

ENCH800034
3 CREDITS
Learning Objective :

Students are able to describe characteristics, packaging and storage food technology, the relation between storage and packaging with quality of food, describe factors affecting deviation of food qualities as well as able to choose storage methods and packaging types which is appropriate to food materials.

Syllabus:

hydratase, material storage technology and food products, deviation of food material qualities, microbial contaminant, purpose and function of food packaging, interaction between food packaging and packaging material types

Prerequisite : -

Textbook :
1. Examining Food Technology by Anne Barnett. Heinemann Secondary,1996
2. Julianti, Sri. The Art of Packaging. Gramedia Pustaka Utama. 2014.
3. Han, Jung H., et al. Innovations in Food Packaging. Elsevier. 2005.

BIOINFORMATICS

ENCH800035
3 CREDITS
Learning Objective :

Are able to explore database and programs to be applied in genetic engineering sectors, proteomic etc

Syllabus :

Database, genomics, genetic molecular, phylogeny, protein structure, metabolism and tissues

Textbook:
1. Bioinformatics by Shalini Suri. APH Publishing, 2006
2. Bioinformatics: A Primer by Charles Staben and Staben. Jones & Bartlett Publishers, 2005

DRUGS AND COSMETICS TECHNOLOGY

ENCH800036
3 CREDITS
Syllabus:

Definition of drugs and cosmetics, types of skins and characteristics, cosmetic types, ethics and regulation of drugs and cosmetics, new drug development technology, process technology in drug and cosmetics industries, packaging technology of drugs and cosmetics technology.

Prerequisite:
Organic Chemistry

Textbook:
1. Handbook of Cosmetic Science and Technology by Andre O. Barel, Marc Paye, Howard I. Maibach. INFRMA-HC 2009
2. Biodesign: The Process of Innovating Medical Technologies by Stefanos Zenios, Josh Makower , Paul Yock , Todd J. Brinton, Uday N. Kumar, Lyn Denend, Thomas M. Krummel.

PETROLEUM PROCESSING

ENCH800037
3 CREDITS
Learning Objectives:

Able to explain petroleum characteristics and its refined product and the stages of the process from various petroleum processing technologies.

Syllabus:

Introduction terminology, oil composition, thermal properties of petroleum, chemical processing of petroleum processing, distillation, hydrogenation and dehydrogenation, cracking processes, the processes of reforming, gas processing and petroleum light products, product improvement.

Prerequisites:

Fluid and Particle Mechanics, Thermodynamics, Mass Transfer.

Textbook:
1. James G. Speight, The Chemistry and Technology of Petroleum, 5th Edition. CRC Press, 2014.
2. Mark J. Kaiser, Arno de Klerk, James H. Gary and Glenn E. Handwerk, Petroleum Refining: Technology, Economics, and Markets, 6th Edition. CRC Press, 2019.
3. D. S. J. Jones, Elements of Petroleum Processing, John & Sons Wiley

PETROCHEMICAL PROCESSING

ENCH800038
3 CREDITS
Learning Objectives:

Able to explain the development of petrochemical products and raw material potential, upstream / downstream petrochemical production lines (olefin center, aromatic center, and the pathways of methane) and the major production processes of several petrochemical industries through methane, olefins and aromatics; able to analyze the impact of industrial processes and petrochemical products to

the environment.

Syllabus:

History of the general petrochemical products development and raw material potential, the scope of the petrochemical industry, petrochemical classification process, the type and processing raw materials into petrochemical products, the details of various petrochemical industry: olefins center, aromatics and the center line of methane, industrial and environmental impact of products petrochemicals.

Prerequisites:
Organic Chemistry

Textbook:

1. Martyn V. Twigg, "Catalyst Handbook", 2nd Ed., Wolfe Pub. Ltd.
2. Lewis T. Hatch, Sami Matar, "From Hydrocarbon to Petrochemical".
3. Wells, Margaret G., "Handbook of Petrochemicals and Processes", Gower Publishing Company Ltd., 1991.
4. Pandjaitan Maraudin, Industri Petrokimia dan Pengaruh Lingkungan, Gadjah Mada University Press, 2002.

PHOTOCATALYSIS TECHNOLOGY

ENCH800039
3 CREDITS
Learning Objectives:

Able to understand the basic concepts and photocatalysis and apply them in the various simple daily problem, especially related to environment, health, and energy.

Syllabus:

The basic concept photocatalysis processes, thermodynamics and kinetics of photocatlytic process, semiconductor photocatalyst materials, the basic parameters of photocatlytic process, Photocatalyst Nanomaterial Engineering, photocatlytic applications for degradation of organic pollutants and heavy metals, photocatalysis applications for self-cleaning and anti fogging, photocatalysis applications for anti-bacterial and cancer therapy, photocatalysis applications for engineering 'daily life tools', photocatalysis applications in renewable energy sector, solar detoxification engineering with photocatalysis, intensification of photocatalysis process.

Prerequisites:
Chemical Reaction Engineering 1

Textbook:

1. M. Schiavello, Heterogeneous Photocatalysis, John Wiley & Sons, 1997.
2. A. Fujishima, K. Hashimoto, and T. Watanabe, TiO2 Photocatalysis: Fundamentals and Applications, BKC Inc. Japan, 1999.
3. J.B. Galvez, et.al., Solar Detoxification, Natural Sciences, Basic and Engineering Sciences, UNESCO.
4. M. Kaneko, I. Okura, Photacatalysis Science and Technology, Springer USA, 2002.
5. C.A. Grimes, G.K. Mor, TiO2 Nanotube Arrays: Synthesis, Properties, and Applications, Springer, New York, 2009.
6. Paper-paper dan bahan lain dari berbagai Jurnal Ilmiah dan website.

EXPLORATION AND PRODUCTION OF HYDROCARBON

ENCH800040
3 CREDITS
Learning Objectives:

Students are able to explain the economic concept of natural gas and analyze the 4e economy.

Syllabus:

Introduction of hydrocarbon, life cycle of field development, hydrocarbon form and hydrocarbon property and reservoir, hydrocarbon exploration: geology, geophysics, and drilling, field appraisal, reservoir development, drilling development, hydrocarbon production, HSE, hydrocarbon economy and lease, coal and hydrocarbon unconventional (CBM, Shale gas, and Hydrate Gas)

Prerequisites:-

Textbook:

1. Frank Jahn et all, 2008, Hydrocarbon Exploration and Production, Developments in Petroleum Science, second edition
2. Babusiauz et al., 2004, Oil and Gas Exploration and Production. Reserves, Cost and Contracts, IFP-Technip,
3. M. Kelkar, 2008, Natural Gas Production Engineering, PennWell Publications
4. Norman J. Hyne, 2001, Nontechnical Guide to Petroleum Geology, Exploration, Drilling and Production, Pennwell Books, 2 edition.

WASTE MANAGEMENT AND PREVENTION

ENCH800041
3 CREDITS
Learning Objectives:

Able to explain the concepts of pollution prevention and able to design the waste treatment system.

Syllabus:

Introduction to the concept of pollution prevention, wastewater treatment outline and preparation, wastewater treatment in physical, biological, and

chemical as well as the operating unit, bioremediation, bioseparation and biodegradation, advanced oxidation processes, the handling of waste gas, waste handling B3, solid waste handling, effluent treatment, gas, is unconventional.

Prerequisites: Chemical Reaction Engineering 1.

Textbook:

1. Freeman, H. M., Industrial Pollution Prevention Handbook, McGraw-Hill, New York, 1995.
2. Eckenfelder, W. W., Jr.., Industrial Water Pollution Control. 3rd ed. McGraw-Hill International Editions, New York, 2000.
3. Metcalf & Eddy. (Revised by Tchobanoglous, G. & F. L. Burton). Waste Water Engineering: Treatment, Disposal, Reuse, 3rd ed., McGraw-Hill, Singapore, 1991.
4. Heinson R. J. & R. L. Cable. Source and Control of Air Pollution. Prentice Hall. New Jersey. Of 1999.
5. Legislation on the prevention of pollution and waste management.
6. Journals, the Internet.

MICROALGAE CULTIVATION AND DEVELOPMENT TECHNOLOGY

ENCH800042
3 CREDITS
Learning Objectives:

Able to have insight into the use of microalgae from the cultivation process to its conversion into products of high economic value; able to develop the utilization of microalgae by using a variety of technologies that are currently developing.

Syllabus:

Introduction to microalgae, microalgae cultivation process, microalgae harvesting techniques, the process of extracting microalgae into algal oil and its residues, economic analysis of the development and utilization of microalgae.

Prerequisites:

Textbook:

1. Richmond, Amos, et al. 2013. Handbook of Microalgal Culture: Applied Phycology and Biotechnology, 2nd Ed. John Wiley and Sons
2. E.W. Becker. 1994. Microalgae: Biotechnology and Microbiology. London, Cambridge University Press.

UTILITIES AND PLANT MAINTENANCE

ENCH800043
3 CREDITS
Learning Objectives:

Able to explain the strategy of plant and utility maintenance.

Syllabus:

Plant maintenance strategy: maintenance program, maintainability, reliability, planning and scheduling

Prerequisite:
Chemical Engineering Thermodynamics

Textbook:

1. Dhillon, B.S., Engineering Maintenance: A Modern Approach, CRC Press, 2002.
2. Higgins, L.R., Mobley, R.K. dan Smith, R., Maintenance Engineering Handbook, McGraw-Hill, 2002.
3. Sanders, R.E., Chemical Process Safety, Elsevier, 2005.
4. Palmer, D., Maintenance Planning and Scheduling Handbook, McGraw-Hill, 1999.

TRANSPORTATION AND UTILIZATION OF NATURAL GAS

ENCH800042
3 CREDITS
Learning Objectives:

Able to analyze several options for the use of natural gas for both energy and feedstocks

Syllabus:

Overview of natural gas: nature and quality, historical milestones, environmental aspects, international issues, and structure of the natural gas industry; transportation and storage of natural gas in the gas phase and liquid phase; natural gas utilization: gas as fuels, gas to synfuels and chemicals, gas to wires/power

Prerequisite: -

Textbook: -

MIXING TECHNOLOGY

ENCH800045
3 CREDITS
Learning Objectives:

Able to understand the basic principles of mixing technology and apply them in the design of mixing systems for various applications in industry.

Syllabus:

Definition of mixing, basic principles and basic concepts of mixing; mixing and mixing mechanism, mixing thermodynamics, mixing fluid flow, friction in mixing, etc.), types of mixing (gas-liquid, liquid-liquid, liquid-solid, suspension, emulsification), mixing techniques (agitation, blending, mixing, particle size reduction, sear etc.), mixing equipment both batch and continuous (mixer type, drainage type, etc.), mixing monitoring and control. Examples of the application of blending in the chemical, pharmaceutical, cosmetic and food industries.

Prerequisites:
Physical Chemistry, Fluid Mechanics and Materials Science

Textbooks:
1. Handbook of Industrial Mixing: Science and Practice edited by Edward L. Paul, Victor A. Atiemo-Obeng, Suzanne M. Kresta, John Wiley and Sons Inc. Publication (2003).
2. Food Mixing: Principles and Applications, edited by P. J. Cullen, Ireland, John Wiley and Sons Inc. Publication (2007).
3. Pharmaceutical Blending and Mixing 1st Edition by P. J. Cullen (Editor), Rodolfo J. Romañach (Editor), Nicolas Abatzoglou (Editor), Chris D. Rielly, John Wiley and Sons Inc. Publication (2015)..

PROBLEM SOLVING SKILLS

ENCH800046
3 CREDITS
Learning Objectives:

Able to develop an understanding of the Problem Based Learning (PBL) learning method in order to be able to direct their own learning (independent learning), communicate effectively and work in groups; able to develop the ability to think critically, creatively, innovatively and have the intellectual ability to solve problems effectively both individually and in groups

Syllabus:

Introduction to PBL, individual problem-solving concepts, problem-solving concepts in groups

Precondition: -

Textbooks:
1. Woods, D. R., 1994, Problem based learning: How to gain the most from PBL, McMaster University, Hamilton, ON L8S 4L8.
2. Journal or articles related to each PBL problem.

POLYMER TECHNOLOGY

ENCH800047
3 CREDITS
Learning Objectives:

Able to develop an understanding of the basic principles of polymer synthesis and characterization, so that they can understand, solve polymer problems found in daily life and in industry, and can keep abreast of developments in the latest polymer technology.

Syllabus:

The concept of polymers, Synthesis and kinetics of polymerization, Polymer solutions, Characterization, Plastic manufacturing processes.

Prerequisite:
Organic Chemistry

Textbooks:
1. Billmeyer, F.W, 2011, Textbook of Polymer Science,3rd edition, John Wiley & Sons Inc.
2. Young, R.J. and Lovell, P.A, 2011, Introduction to Polymers, R.J.Lovell, 3rd edition, CRC Press. Taylor & Francis Group, Boca Raton, FL 33487-2742.
3. Seymour, R.B, 1989, Polymers for Engineering Applications, ASM International.
4. Crawford, R.J, 1998, Plastic Engineering, 3rd edition, Butterworth-Heinemann, Woburn, MA 01901-2041.
5. Woods, D. R., 1994, Problem based learning: How to gain the most from PBL, McMaster University, Hamilton, ON L8S 4L8.
6. Journal or articles related to each PBL problem.

GENETICALLY MODIFIED ORGANISM

ENCH800048
3 CREDITS
Learning Objectives:

Students are able to plan the design of transgenic organisms for purposes in the fields of food, pharmacy and health, energy, or the environment as one of the supporting knowledge in Bioprocess Technology courses

Syllabus:

Gene expression and function, genome, introduction and development of GMO organisms, genome modification techniques, methods of analyzing GMO organisms, GMO organisms in food, GMO organisms in pharmacy and health, GMO organisms in energy, GMO organisms in the field the environment, and the latest research and applications related to GMO organisms.

Prerequisite:
Genetic Engineering

Textbooks:
1. Harvey Lodish, Arnold Berk, Chris A. Kaiser and Monty Krieger. W. H. Molecular Cell Biology. 6th edition. FreemanS
2. T. A. Brown. 2010. Gene Cloning and DNA Analysis. 6th edition. Willey Blackwell: Hongkong.
3. Jurnal ilmiah terbaru terindeks scopus

DRUG CONTROLLED RELEASED TECHNOLOGY

ENCH800049
3 CREDITS
Learning Objective:

Able to describe the principle of control drug release or bioactive compound for medical purposes and utilize the principle to apply control drug released

technology

Syllabus:

Polymeric biomaterial that is easily degradable, various methods to drug encapsulation and bioactive compounds in nano/microsphere, diffusion and permeation, the strategy of control released, case study

Prerequisite:
Organic Chemistry

Textbook:
1. Juergen Siepmann et al. (ed.) Fundamentals and Applications of Controlled Release Drug Delivery, Springer
2. Clive Wilson and Patrick Crowley (ed.) Controlled Release in Oral Drug Delivery, Springer
3. Hong Wen and kinam Park (ed.) Oral Controlled Release Formulation Design and Drug Delivery, Wiley, 2010.
4. WM Saltzman, Drug Delivery: Engineering Principles for Drug Therapy, Oxford University Press, 2001.
5. Nissim Garti, Delivery and *controlled release of bioactives in foods and nutraceuticals*, CRC Press, 2008.

SPECIAL TOPIC 2
ENCH800050
3 CREDITS

BIOMASS TERMOCHEMICAL CONVERSION TECHNOLOGY
ENCH800051
3 CREDITS
Learning Objectives:

Able to understand the chemical characteristics of biomass and the basic principles of thermo-chemical biomass conversion technology and its application in the design of biomass thermochemical conversion systems to produce fuels and chemicals.

Syllabus:

Chemical characteristics of biomass, biomass classification, thermo-chemical conversion through pyrolysis (fast pyrolysis, slow pyrolysis, co-pyrolysis, hydrodeoxygenation, catalytic pyrolysis, catalytic co-pyrolysis, pyrolysis reactor), thermo-chemical conversion through biomass gasification, thermo-chemical conversion through biomass ligation , physical and chemical analysis of biomass feed and biomass thermo-chemical conversion products, pyrolysis for the manufacture of biofuels and chemicals, biomass gasification for the manufacture of synthetic gases, liquefaction of biomass for the manufacture of biofuels.

Prerequisites:

Organic Chemistry, Heat Transfer, Chemical Reaction Techniques 1

Textbooks:
1. Robert C. Brown, Thermochemical processing of biomass: conversion into fuels, chemicals and power, 2nd edition, Wiley Series in Renewable Resources, 2019
2. Mark Crocker, Laurie Peter, Ferdi Schuth, Tim Z. Zhao, Heinz Frei, Thermochemical conversion of biomass to liquid fuels and chemicals, RSC Publishing, 1st edition, 2010
3. James Clark and Fabien Deswarte, Introduction to chemicals from biomass, 2nd edition, John Wiley and Sons, 2015
4. Piet Schenkelaars, Value-added chemicals from biomass, Pira International Ltd, 2012

BASIC COMPUTER PROGRAMMING
ENCH800052
3 CREDITS

Learning Objectives:

Able to formulate and solve cases using logical concepts and programming algorithms and able to construct simple programs consisting of consecutive instructions in Python and MATLAB.

Syllabus:

Introduction: Why should one learn to write programs; Variables, expressions, and statements; Conditional executions; Functions; Iteration; Strings; Files; Lists; Dictionaries; Tuples; Using Python for numerical integration with the Simpson's rule, to solve root finding problem employing the secant method, to solve ordinary differential equation; Introduction to MATLAB/GNU Octave; Numerical methods with MATLAB/GNU Octave; Application of MATLAB/GNU Octave in transport phenomena and chemical reaction engineering.

Prerequisite:

Textbooks:
1. Charles R. Severance: Python for Everybody, accessible via https://www.py4e.com
2. John. M. Zelle: Python Programming: An Introduction to Computer Science, 3rd edition, 2016.
3. Yeong Koo Yeo: Chemical Engineering Computation with MATLAB, CRC Press, 2017.

Undergraduate Program in Bioprocess Engineering

Program Specification

Employment Prospects

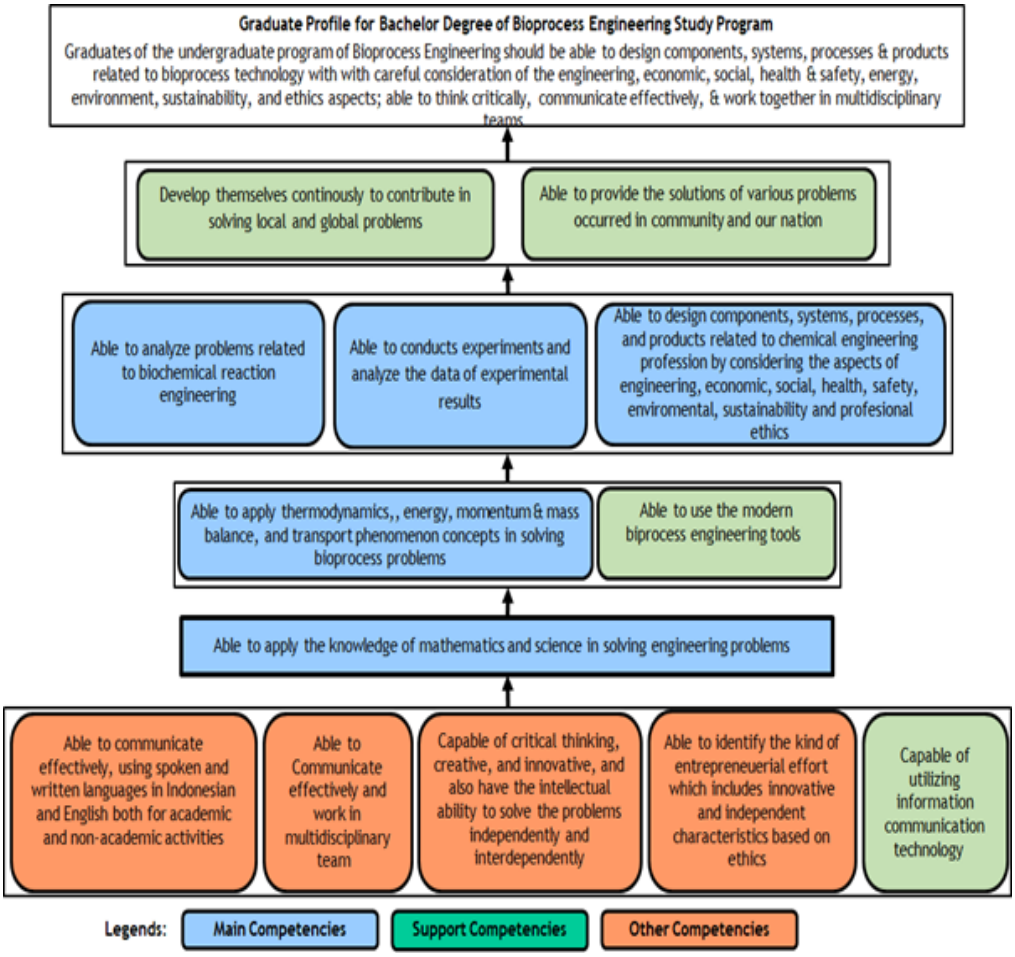
1.	**Awarding Institution**	Universitas Indonesia	
2.	**Host Institution**	Universitas Indonesia	
3.	**Faculty**	Engineering	
4.	**Program Tittle**	Undergraduate Program in Bioprocess Engineering	
5.	**Vision and Mission**	**Vision** Becoming a superior and competitive Bioprocess Engineering Study Program, through efforts to educate the nation's life to improve people's welfare, thus contributing to the development of Indonesian and world society **Missions** • Providing broad and fair access, as well as quality education and teaching in Bioprocess Engineering; • Organizing quality Tridharma activities that are relevant to national and global challenges; • Creating graduates of Bioprocess Engineering who are of high quality, noble character, and able to compete globally; • Creating an academic climate that can support the realization of the vision of the Department	
6.	**Class**	Regular, International	
7.	**Final Award**	Sarjana Teknik (S.T.)	
8.	**Accreditation / Recognition**	Accredited: BAN-PT (Excellent) and IABEE Assessment: AUN QA	
9.	**Language(s) of Instruction**	Bahasa Indonesia	
10.	**Study Scheme (Full Time / Part Time)**	Full Time	
11.	**Entry Requirements**	High Shool / Equivalent	
12.	**Study Duration**	8 (eight) Semesters or 4 (Four) years	
	Type of Semester	Number of Semester	Number of weeks / semester
	Regular	8	16
	Short (optional)	3	8
13.	**Aims of the program is to provide the highest quality education so that graduates have:** 1. Able to apply their knowledge in working in the field of bioprocess technology 2. Able to develop themselves as industrial planners and managers 3. Able to contribute to science and technology		
14.	**Graduate Profile:** Graduates of The Undergraduate Program of PSTB-FTUI should be able to contribute to the field of bioprocess engineering by applying bioprocess engineering principles with careful consideration of the engineering, economic, social, health and safety, energy, environment, sustainability, and ethical aspects; able to think critically, communicate effectively, and work in together in a multidisciplinary team.		

15.	**Expected Learning Outcomes:** 1. Able to communicate effectively, using spoken and written languages in Indonesian and English both for academic and non-academic activities 2. Able to work in a multidisciplinary team. 3. Capable of critical, creative, and innovative thinking, and also have the intellectual ability to solve problems independently and interdependently. 4. Capable of utilizing communication information technology 5. Able to apply knowledge of mathematics and science in solving engineering problems. 6. Able to apply mass and energy balances, thermodynamics, transport phenomena, and chemical reaction engineering concepts in solving chemical engineering problems. 7. Able to analyze problems related to biochemical reaction engineering 8. Able to use modern bioprocess engineering tools. 9. Able to conducts experiments and analyze the data obtained. 10. Able to design components, systems, processes, and products related to the bioprocess engineering profession with careful consideration of the engineering, economic, social, health and safety, energy, environment, sustainability, and ethical aspects. 11. Able to provide solutions to various problems that occurred wherever they live and work. 12. Able to identify the kind of entrepreneurial approach needed based on innovation, self-reliance, and ethics. 13. Continuously develop oneself to contribute in solving local and global problems.
16.	**Course Composition**

No.	**Type of Courses**	**Credits**	**Percentage**
I	University General Subjects	10	6,25%
II	Basic Engineering Subjects	25	17,36%
III	Core Subjects	75	52,08%
IV	Elective Subjects	26	18,06%
V	Special Subject (Internship, Seminar, Undergraduate Thesis or Skripsi)	9	6,25%
	Total	145	100 %
	Total Credits for Graduation		**145**

A graduate of Bioprocess Engineering Study Program at UI can be contributed in the following areas: food, pharmaceuticals, cosmetics and biotechnology industries, engineering contractor companies (engineering, procurement, construction, and trial operation), renewable energy, and environmental treatment industry, government officer, researcher, education, etc.

The Network of Expected Learning Outcome (ELO)



Mapping Table for Achieving ELO in the Bioprocess Engineering Undergraduate Program

Expected Learning Outcome (ELO)	Name of Courses							
	1st Semester	2nd Semester	3rd Semester	4th Semester	5th Semester	6th Semester	7th Semester	8th Semester
Able to communicate effectively, using spoken and written languages in Indonesian and English both for academic and non-academic activities	Communication Skills English Religion	Integrated Character Building	Instrumental Analytic Chemistry Physical Chemistry	Heat Transfer Thermodynamic in Biological System		Bio Product Design	Plant Design	
Able to work in a multidisciplinary team	Communication Skills Religion	Integrated Character Building				Bio Product Design	Plant Design	
Capable of critical, creative, and innovative thinking, and also have the intellectual ability to solve problems independently and interdependently			Instrumental Analytic Chemistry Physical Chemistry	Heat Transfer Thermodynamic in Biological System				
Capable of utilizing communication information technology			Numerical Computation	Bioprocess Engineering Modelling Genetic Engineering	Bioprocess System Simulation			
Able to apply knowledge of mathematics and science in solving engineering problems	Basic Chemistry Physics (Electricity, MWO) Calculus	Linear Algebra Statistics & Probability Physics (Mechanics and Thermal)	Biochemistry Numerical Computation	Cell Culture Genetic Engineering Bioprocess Engineering Modelling	Engineering Economics			

Expected Learning Outcome (ELO)	Name of Courses							
	1st Semester	2nd Semester	3rd Semester	4th Semester	5th Semester	6th Semester	7th Semester	8th Semester
		Organic Chemistry	Instrumental Analytical Chemistry					
		Basic & Organic Chemistry Lab	Physical Chemistry					
			Physic Chemistry & Analytics Lab					
Able to apply mass, energy balances, thermodynamics, transport phenomena, and chemical reaction engineering concepts in solving bioprocess engineering problems	Introduction to bioprocess engineering		Transport Phenomena in Biological Systems	Fluid and Particle Mechanics	Biochemical Reaction Engineering	Bioreactor Engineering		
			Mass and Energy Balance	Heat Transfer	Separation			
				Thermodynamic in Biological System		Process Control		
Able to analyze problems related to biochemical reaction engineering				Cell Culture	Biochemical Reaction Engineering	Bioreactor Engineering		
				Genetic Engineering				
Able to use modern bioprocess engineering tools			Numerical Computation	Genetic Engineering	Bioprocess System Simulation	Bioprocess Equipment Design	Plant Design	
						Bio Product Design		
Able to conducts experiments and analyze the data obtained	Physics (Electricity, MWO) Lab	Basic & Organic Chemistry Lab	Physic Chemistry & Analytics Lab	Biochemistry Laboratory	Bioprocess Unit Operation Lab I	Bioprocess Unit Operation Lab II	Research Methodology & Seminar	Undergraduate Thesis
		Physics (Mechanics and Thermal) Lab						
Able to design components, systems, processes, and products related to the bioprocess engineering profession					Bioprocess System Simulation	Bioprocess Equipment Design	Industrial Project Management	Undergraduate Thesis

Expected Learning Outcome (ELO)	Name of Courses							
	1st Semester	2nd Semester	3rd Semester	4th Semester	5th Semester	6th Semester	7th Semester	8th Semester
with careful consideration of the engineering, economic, social, health and safety, energy, environment, sustainability, and ethical aspects					HSE Protection	Bio Product Design	Plant Design	
					Engineering Economics	Process Control	Research Methodology & Seminar	
Able to provide solutions to various problems that occurred wherever they live and work					HSE Protection	Bio Product Design	Plant Design	Undergraduate Thesis
Able to identify the kind of entrepreneurial approach needed based on innovation, self-reliance, and ethics.						Bio Product Design	Plant Design	Undergraduate Thesis
								Capita Selecta
Continuously develop oneself to contribute in solving local and global problems						Bio Product Design	Plant Design	Undergraduate Thesis
								Capita Selecta

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List of Course

Code	Name of Course	Credit
University Courses (9 Credits)		
UIGE600007	MPK Terintegrasi / Integrated Character Building	6
UIGE600003	MPK Bahasa Inggris / English	2
UIGE600004	MPK Agama / Religion	2
Faculty Courses (25 Credits)		
ENGE600003	Kalkulus / Calculus	4
ENGE600004	Aljabar Linear / Linear Algebra	4
ENGE600005	Fisika Mekanik dan Panas / Physics (Mechanics and Thermal)	3
ENGE600006	Praktikum Fisika Mekanik dan Panas / Physics (Mechanics and Thermal) Lab	1
ENGE600007	Fisika Listrik, Magnet, Gelombang dan Optik / Physics [Electricity, Magnetic, Wave, Ophtics (MWO)]	3
ENGE600008	Praktikum Fisika Listrik, Magnet, Gelombang dan Optik / Physics (Electricity, MWO) Lab	1
ENGE600009	Kimia Dasar / Basic Chemistry	2
ENGE600010	Statistik dan Probablitas / Statistic and Probability	2
ENGE600011	Ekonomi Teknik / Engineering Economics	3
ENGE600012	Kesehatan, Keselamatan Kerja & Lindung Lingkungan / HSE Protection	2
Special Courses (9 Credits)		
ENBE600029	Kerja Praktek / On The job Training (Internship)	2
ENBE600030	Metodologi Penelitian dan Seminar / Research Methodology & Seminar	2
ENBE600032	Skripsi / Undergraduate Thesis	5
Biprocess Engineering Courses (75 Credits)		
ENBE600001	Pengantar Teknik bioproses / Introduction to bioprocess engineering	2
ENBE600002	Kecakapan Komunikasi / Communication Skills	3
ENBE600003	Praktikum Kimia Dasar dan Kimia Organik / Basic & Organic Chemistry Lab	1
ENBE600004	Kimia Organik / Organic Chemistry	2
ENBE600005	Komputasi Numerik / Numerical Computation	3
ENBE600006	Kimia Nalaitik Intrumental / Instrumental Analytical Chemistry	3
ENBE600007	Kimia Fisika / Physical Chemistry	3
ENBE600008	Praktikum Kimia Fisika dan Kimia Analitik / Physic Chemistry & Analytics Lab	1
ENBE600009	Neraca Massa dan Energi / Mass and Energy Balance	3
ENBE600010	Biokimia / Biochemistry	3
ENBE600011	Peristiwa Perpindahan dalam Sistem Hayati / Transport Phenomena in Biologycal System	3
ENBE600012	Mekanika Fluida dan Partikel / Fluid and Particle Mechanics	3
ENBE600013	Kultur Sel / Cell Culture	3
ENBE600014	Perpindahan Kalor / Heat Transfer	3
ENBE600015	Praktikum Biokimia / Biochemistry Laboratory	2

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ENBE600016	Rekayasa Genetik / Genetic Engineering	3
ENBE600017	Termodinamik Sistem Hayati / Thermodynamic in Biologycal System	3
ENBE600018	Teknik Reaksi Biokimia / Biochemical Reaction Engineering	3
ENBE600019	Separasi / Separation	3
ENBE600020	Praktikum Unit Operasi Bioproses I / Bioprocess Unit Operation Lab I	1
ENBE600021	Simulasi Sistem Bioproses / Bioprocess System Simulation	3
ENBE600022	Praktikum Unit Operasi Bioproses I / Bioprocess Unit Operation Lab II	1
ENBE600023	Rekayasa Bioreaktor / Bioreactor Engineering	3
ENBE600024	Perancangan Alat Bioproses / Bioprocess Equipment Design	3
ENBE600025	Perancangan Produk Hayati / Bio Product Design	4
ENBE600026	Pengendalian Bioproses / Bioprocess Control	3
ENBE600027	manajemen Proyek industry / Industrial Project Management	2
ENBE600028	perancangan Pabrik / Plant Design	4
ENBE600031	kapita Selekta / Capita Selecta	2
Elective Courses (26 Credits)		
	Mata Kuliah Pilihan 1 / Elective 1	3
	Mata Kuliah Pilihan 2 / Elective 2	3
	Mata Kuliah Pilihan 3 / Elective 3	3
	Mata Kuliah Pilihan 4 / Elective 4	3
	Mata Kuliah Pilihan 5 / Elective 5	3
	Mata Kuliah Pilihan 6 / Elective 6	3
	Mata Kuliah Pilihan 7 / Elective 7	3
	Mata Kuliah Pilihan 8 / Elective 8	3
	Mata Kuliah Pilihan 9 / Elective 9	2

Curriculum Structure Undergraduate Bioprocess Engineering

Code	Subject	SKS
	1st Semester	
UIGE600003	English	2
UIGE600004	Religion	2
ENGE600003	Calculus	4
ENGE600007	Physics (Electricity, MWO)	3
ENGE600008	Physics (Electricity, MWO) Lab	1
ENGE600009	Basic Chemistry	2
ENBE600001	Introduction to bioprocess engineering	2
ENBE600002	Communication Skills	2
	Sub Total	**18**
	2nd Semester	
UIGE600007	Integrated Character Building	6
ENGE600004	Linear Algebra	4
ENGE600005	Physics (Mechanics and Thermal)	3
ENGE600006	Physics (Mechanics and Thermal) Lab	1
ENGE600010	Statistic and Probability	2
ENBE600003	Basic & Organic Chemistry Lab	1
ENBE600004	Organic Chemistry	3
	Sub Total	**20**
	3rd Semester	
ENBE600005	Numerical Computation	3
ENBE600006	Instrumental Analytical Chemistry	3
ENBE600007	Physical Chemistry	3
ENBE600008	Physic Chemistry & Analytics Lab	1
ENBE600009	Mass and Energy Balance	3
ENBE600010	Biochemistry	3
ENBE600011	Transport Phenomena in Biologycal System	3
	Sub Total	**19**
	4th Semester	
ENBE600012	Fluid and Particle Mechanics	3
ENBE600013	Cell Culture	3
ENBE600014	Heat Transfer	3
ENBE600015	Biochemistry Laboratory	1
ENBE600016	Genetic Engineering	3
ENBE600017	Thermodynamic in Biologycal System	3
	Elective 1	3
	Elective 2	2
	Sub Total	**21**
	5th Semester	
ENGE600011	Engineering Economics	3
ENGE600012	HSE Protection	2
ENBE600018	Biochemical Reaction Engineering	3
ENBE600019	Separation	3
ENBE600020	Bioprocess Unit Operation Lab I	1
ENBE600021	Bioprocess System Simulation	3
	Elective 3	3
	Elective 4	3
	Sub Total	**21**
	6th Semester	
ENBE600022	Bioprocess Unit Operation Lab II	1
ENBE600023	Bioreactor Engineering	3
ENBE600024	Bioprocess Equipment Design	3
ENBE600025	Bio Product Design	4
ENBE600026	Process Control	3
	Elective 5	3
	Elective 6	3
	Sub Total	**20**
	7th Semester	
ENBE600027	Industrial Project Management	2
ENBE600028	Plant Design	4
ENBE600029	On The job Training (Internship)	2
ENBE600030	Research Methodology & Seminar	2
	Elective 7	3

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	Elective 8	3
	Elective 9	3
	Sub Total	**19**
	8th Semester	
ENBE600031	Capita Selecta	2
ENBE600032	Undergraduate Thesis	5
	Sub Total	**7**
	Total	**145**

Elective Courses

Code	Odd Semester	SKS
ENCH800014	Oleochemical Industry	3
ENCH800015	Food Technology	3
ENCH800016	Protein Engineering	3
ENCH800017	Herbal Technology	3
ENCH800018	Composite Material	3
ENCH800019	Applied Thermodynamics	3
ENCH800020	Dynamic System	3
ENCH800021	Thermodynamic Properties of Hydrocarbon	3
ENCH800022	Lubricant Technology	3
ENCH800023	Cryogenic Technology	3
ENCH800024	Combustion Technology	3
ENCH800025	Plasma and Ozone Technology	3
ENCH800026	Heterogeneous Catalytic	3
ENCH800027	Sustainable Energy	3
ENCH800028	Risk Management	3
ENCH800029	Electrochemical Technology	3
ENCH800030	Extraction Technology & Isolation for Natural Products	3
ENCH800031	Special Topic 1	3
ENCH800033	Natural Gas Processing	3
	Even Semester	
ENCH800034	Storage and Packing Technology	3
ENCH800035	Bioinformatics	3
ENCH800036	Drugs and Cosmetics Technology	3
ENCH800037	Petroleum Processing	3
ENCH800038	Petrochemical Processing	3
ENCH800039	Photocatalytic Technology	3
ENCH800040	Hydrocarbon Exploration and Production	3
ENCH800041	Waste Management and Prevention	3
ENCH800042	Microalgae Cultivation and Development Tech.	3
ENCH800043	Plant Utility and Maintenance	3
ENCH800044	Transportation and Utilization of Natural Gas	3
ENCH800045	Mixing Technology	3
ENCH800046	Problem Solving Skills	3
ENCH800047	Polymer Technology	3
ENCH800048	Genetically Modified Organism	3
ENCH800049	Controlled Drug Release Technology	3
ENCH800050	Special Topic 2	3
ENCH800051	Biomass Thermochemical Conversion Tech.	3
ENCH800052	Basic Computer Programming	3
ENCH800053	Bioprocess Engineering Model	3
ENCH800054	Bioprocess Engineering Drawing	2

Courses Placement of Fast Track Undergraduate to Master Courses in Chemical Engineering Study Program from Bioprocess Engineering Undergraduate Program

Code	Subject	SKS
	7th Semester	
ENBE600027	Industrial Project Management	2
ENBE600028	Plant Design	4
ENBE600029	On The job Training (Internship)	2
ENBE600030	Research Methodology & Seminar	2
ENCH800001	Advanced Chemical Engineering	3
ENCH800027	Sustainable Energy	3
ENCH800033	Natural Gas Processing	3
	Elective 7	3
	Subtotal	**22**

	8th Semester	
ENBE600031	Capita Selecta	2
ENBE600032	Undergraduate Thesis	5
ENCH800003	Advanced Transport Phenomenon	3
ENCH800004	Advanced Chemical Reaction Engineering	3
ENCH800005	Advanced Chemical Engineering Modelling	3
	Elective 8	3
	Elective 9	3
	Subtotal	**22**
	9th Semester	
ENCH800006	Research Methodology	3
ENCH800007	Pre-Thesis	2
	Elective 10	3
	Elective 11	3
	Elective 12	3
	Subtotal	**14**
	10th Semester	
ENCH800008	Thesis	6
ENCH800055	Research Publication	2
	Subtotal	**8**

Courses Placement of Fast Track Undergraduate to Doctor Courses in Chemical Engineering Study Program from Bioprocess Engineering Undergraduate Program

Code	Subject	SKS
	7th Semester	
ENBE600027	Industrial Project Management	2
ENBE600028	Plant Design	4
ENBE600029	On The job Training (Internship)	2
ENBE600030	Research Methodology & Seminar	2
ENCH800001	Advanced Chemical Engineering	3
ENCH800027	Sustainable Energy	3
ENCH800033	Natural Gas Processing	3
	Elective 7	3
	Subtotal	**22**

	8th Semester	
ENBE600031	Capita Selecta	2
ENBE600032	Undergraduate Thesis	5
ENCH800003	Advanced Transport Phenomenon	3
ENCH800004	Advanced Chemical Reaction Engineering	3
ENCH800005	Advanced Chemical Engineering Modelling	3
	Elective 8	3
	Elective 9	3
	Subtotal	**22**
	9th Semester	
ENCH800006	Research Methodology	3
ENCH800007	Pre-Thesis	4
	Elective 10	3
	Elective 11	3
ENCH900003	Research Group Periodic Seminar	8
	Subtotal	**21**
	10th Semester	
ENCH800008	Thesis	**4**
ENCH800055	Research Publication	**2**
ENCH900005	Research Proposal	**6**
	Elective 12	**3**
	Subtotal	**15**
	11th Semester	
ENCH900007	Publication 1 – International Conference	**6**
	Subtotal	**6**
	12th Semester	
ENCH900008	Research Defense	**10**
	Subtotal	**10**
	13th Semester	
ENCH900010	Publication 2 – International Journal	**8**
	Subtotal	**8**
	14th Semester	
ENCH900011	Publication 3 – International Journal	**8**
ENCH900012	Doctoral Promotion	**6**
	Subtotal	**14**

Curriculum of International Program In Bioprocess Engineering

Code	Subject	SKS
	1st Semester	
UIGE610004	Religion Studies	2
ENGE610003	Calculus	4
ENGE610007	Physics (Electric, Magnet, Wave & Optic)	3
ENGE610008	Physics (Electric, Magnet, Wave & Optic) Laboratory	1
ENGE610009	Basic Chemistry	2
ENBE610001	Introduction to Bioprocess Engineering	2
ENBE610002	Communication Skills	2
ENGE610010	Statistics and Probability	2
	Sub Total	**18**
	2nd Semester	
UIGE610002	Academic Writing	2
ENGE610004	Linear Algebra	4
ENGE610005	Physics (Mechanics and Thermal)	3
ENGE610006	Physics (Mechanics and Thermal) Laboratory	1
ENBE610004	Organic Chemistry	3
ENBE610003	Basic Chemistry and Organic Chemistry Laboratory	1
ENBE610005	Physical Chemistry	3
ENBE610006	Mass and Energy Balances	3
	Sub Total	**20**
	3rd Semester	
ENBE610007	Numerical Computation	3
ENBE610009	Instrumental Analytical Chemistry	3
ENBE610008	Physical Chemistry and Analytical Chemistry Laboratory	1
ENBE610011	Transport Phenomena in Biological System	3
ENBE610012	Fluid and Particle Mechanics	3
ENBE610013	Thermodynamics in Biological System	3
ENBE610010	Biochemistry	3
	Sub Total	**19**
	4th Semester	
ENGE610012	Health, Safety and Environmental Protection	2
ENBE610017	Cell Culture	3
ENBE610014	Heat Transfer	3
ENBE610019	Separation	3
ENBE610016	Genetics Engineering	3
ENBE610018	Bioprocess System Simulation	3
ENBE610015	Biochemistry Laboratory	1
ENGE610011	Engineering Economics	3
	Sub Total	**21**
	5th Semester	
ENBE610020	Bioprocess Unit Operation Laboratory 1	1
ENBE610021	Biochemical Reaction Engineering	3
ENBE610022	Process Control	3
ENBE610023	Bioreactor Engineering	3
ENBE610024	Bioprocess Equipment Design	3
Elective	Elective 1	3
	Elective 2	3
	Sub Total	**19**
	6th Semester	
UIGE610011	Integrated Character Building	6
ENBE610026	Bioprocess Unit Operation Laboratory 2	1
ENBE610025	Biological Product Design	4
ENBE610027	Research Methodology and Seminar	2
ENBE610028	Capita Selecta	2
Elective	Elective 3	3
	Elective 4	3
	Sub Total	**21**
	7th Semester	
Elective	Elective 6	3
	Elective 7	3
	Elective 8	3
	Elective 9	2
	Sub Total	**11**

	8th Semester	
ENBE610030	Industrial Project Management	2
ENBE610031	Plant Design	4
ENBE610029	On the Job Training	2
ENBE610032	Undergraduate Thesis	5
Elective	Elective 5	3
	Sub Total	**16**

Elective Courses

Code	Elective Courses	SKS
ENCH610025	Applied Termodynamics	3
ENCH610026	Thermodynamic Properties of Hydrocarbon	3
ENCH610027	Special Topics 1	3
ENCH800014	Oleochemical Industry	3
ENCH800015	Food Technology	3
ENCH800016	Protein Engineering	3
ENCH800017	Herbal Technology	3
ENCH800018	Composite Material	3
ENCH800019	Applied Thermodynamics	3
ENCH800020	Dynamic System	3
ENCH800021	Thermodynamic Properties of Hydrocarbon	3
ENCH800022	Lubricant Technology	3
ENCH800023	Cryogenic Technology	3
ENCH800024	Combustion Technology	3
ENCH800025	Plasma and Ozone Technology	3
ENCH800026	Heterogenous Catalytic	3
ENCH800027	Sustainable Energy	3
ENCH800028	Risk Management	3
ENCH800029	Electrochemical Technology	3
ENCH800030	Technology of Extraction and Isolation for Natural Products	3
ENCH800031	Special Topics 1	3
ENCH800032	Natural Gas Processing	3
ENCH610028	Polymer Engineering	3
ENCH610029	Technology of Controlled Drug Release	3
ENCH610030	Special Topics 2	3
ENCH800034	Storage and Packing Technology	3
ENCH800035	Bioinformatics	3
ENCH800036	Drugs and Cosmetics Technology	3
ENCH800037	Petroleum Processing	3
ENCH800038	Petrochemical Processing	3
ENCH800039	Photocatalytic Technology	3
ENCH800040	Microalgae Cultivation and Development Technology	3
ENCH800041	Waste Management and Prevention	3
ENCH800042	Hydrocarbon Exploration and Production	3
ENCH800043	Plant Utility and Maintenance	3
ENCH800044	Transportation and Utilization of Natural Gas	3
ENCH800045	Mixing Technology	3
ENCH800046	Problem Solving Skills	3
ENCH800047	Polymer Technology	3
ENCH800048	Genetically Modified Organism	3
ENCH800049	Technology of Controlled Drug Release	3
ENCH800050	Special Topics 2	3
ENCH800051	Technology of Biomass Termochemical Conversion	3
ENCH800052	Basic Computer Programming	3
ENCH800053	Bioprocess Engineering Modeling	3
ENCH800054	Bioprocess Engineering Drawing	2

Transition Guidance from Curriculum 2016 to 2020 for Regular Undergraduate Class

1. New curriculum 2020 will be applied effectively from Odd Semester 2020/2021. In principle, after curriculum 2020 is implemented, then only courses from this new curriculum will be opened.
2. For class 2019 and above will follow these transition rules.
3. The enforcement of the transitional period is one year. During this transition period, if a course in curriculum 2020 is in odd Semester while in the previous curriculum in even Semester (vice versa), then this course can be held (if necessary) in both semesters.
4. For students who have not passed the compulsory courses in curriculum 2016, are required to take the same course or equivalent in curriculum 2020. Equivalence courses can be seen in the table below. All courses in the curriculum 2016 that are not listed in the equivalence table have not changed, both in names and credits.
5. When there is a change in the course credits, then the number of graduation credits counted in is the number of credits when it was taken. The same or equivalent courses, when are equated with different credits, if retaken, or just taken, will be acknowledged under a new name and credits.

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

No	Name of Courses in Curriculum 2016	Semester	Credits 2016	Name of Courses in Curriculum 2020	Semester	Credits 2020
1	MPKT A (Integrated Character Building A)	2	6	MPKT Terintegrasi (Integrated Character Building)	2	6
2	MPKT B (Integrated Character Building B)	1	6			
3	MPK Bahasa Inggris (English)	3	3	MPK Bahasa Inggris (English)	1	2
4	-	-	-	Praktikum Kimia Dasar dan Kimia Organik (Basic and Organic Chemistry Lab)	2	1
5	Pengantar Teknik Bioproses (Introduction to Bioprocess Engineering)	1	3	Pengantar Teknik Bioproses (Introduction to Bioprocess Engineering)	1	2
6	Biologi Molekular (Molecular Biology)	3	3	Biokimia (Biochemistry)	3	3
7	Biologi sel (Cel Biology)	2	3	Teknik Reaksi Biokimia (Biochemistry Reaction Engneering)	5 -	3 -
8	Biokatalisis	5	3			
9	Rekayasa Biokimia	5	3			
10	Bioenergetika (Bioenergetica)	5	2	Termodinamika Sistem Hayati (Thermodynamic in Biological System)	4	3
11	MPK Olah raga/seni (Sport/ Art)	1	1	MPK Olah raga/seni (Sport/ Art)	-	-
12	Skripsi (Undergraduate Thesis)	8	4	Skripsi (Undergraduate Thesis)	8	5
13	Statistik & Probabilistik (Statistic and Probability)	4	2	Statistik & Probabilistik (Statistic and Probability)	2	2

6. When a compulsory subject in the curriculum 2016 is deleted, and there is no equivalence in the curriculum 2020 then:

a. For students who have passed these subjects, the credits that are achieved will be counted in the calculation of graduation 145 credits.

b. For students who did not pass these courses, they can take new compulsory courses or choose elective subjects in the curriculum 2020 to complete 145 credits.

7. In addition to changes in curriculum structure from 2016 to 2020, there are also the addition of several elective courses: Teknologi Elektrokimia), Teknologi Pencampuran (Mixing Technology), Teknologi Pengembangan dan Pemanfaatan Mikroalga (Microalgae Cultivation and Development Technology), Teknologi Ekstraksi dan Isolasi Bahan Alam (Extraction & Isolation Technology for Natural Products), Konversi Termokimia Biomassa (Biomass Termochemical Conversion Technology), Modifikasi Genetik Makhluk Hidup (Genetically Modified Organism), dan Dasar Pemrograman Computer (Basic Computer Programming)

Course Sylabus of University Subjects

INTEGRATED CHARACTER BUILDING

UIGE600007/UIGE610011
6 credits

Syllabus :

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

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

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

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

Graduate Learning Outcomes :

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

Course Learning Outcomes :

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

Prerequisite : -

ACADEMIC WRITING

UIGE610002
2 credits
The Objectives :

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

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

independent learners)

Main Competencies :

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

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

Prerequisite :

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

ENGLISH

UIGE600003
2 credits
Learning Objectives :

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

Syllabus :

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

ISLAMIC STUDIES

UIGE6000010/UIGE610005
2 credits
General Instructional Objectives :

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

Learning Objectives :

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

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

Syllabus :

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

CATHOLIC STUDIES

UIGE6000011/UIGE610006
2 credits
General Instructional Objectives :

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

Be scholars who believe in God according to the

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

Syllabus :

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

CHRISTIAN STUDIES
UIGE6000012/UIGE610007
2 credits
General Instructional Objectives :

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

Learning Objectives :

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

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

Syllabus :

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

HINDU STUDIES
UIGE6000013/UIGE610008
2 credits

Syllabus :

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

BUDDHIST STUDIES
UIGE6000014/UIGE610009
2 credits

Syllabus :

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

KONG HU CU STUDY
UIGE6000015/UIGE610010
2 credits

Course Syllabus of Faculty Subjects

CALCULUS 1

ENGE600001/ENGE610001
3 credits
Course Learning Outcomes:

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

Graduates Learning Outcomes:

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

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

Prerequisite: None

Textbooks:

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

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

CALCULUS 2

ENGE600002/ENGE610002
3 SKS
Course Learning Outcomes:

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

Graduates Learning Outcomes:

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

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

Prerequisite: Calculus 1

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

CALCULUS

ENGE600003/ENGE610003
4 SKS
Course Learning Outcomes:

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

Graduates Learning Outcomes:

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

Syllabus :

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

Prerequisite: None

Textbooks:

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

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

LINEAR ALGEBRA

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

Graduates Learning Outcomes:

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

Syllabus :

Linear Systems and matrix equations, Determinants, Euclid vector spaces, Common vector spaces, eigenvalues and eigenvectors, inner product spaces, Diag-

onalization and General Linear Transformation.

Prerequisite: None

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

MECHANICAL AND HEAT PHYSICS

ENGE600005 / ENGE610005
3 credits
Course Learning Outcomes:

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

Graduate Learning Outcomes:

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

Syllabus:

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

Prerequisite: none

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

ELECTRICAL MAGNETIC, OPTICAL AND WAVE PHYSICS

ENGE600007 / ENGE610007
3 credits
Course Learning Outcomes:

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

Graduate Learning Outcomes:

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

Syllabus:

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

Prerequisite: none

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

BASIC CHEMISTRY

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

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

Syllabus:

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

Prerequisite: none

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

ENGINEERING ECONOMY

ENGE600011 / ENGE610011
3 credits
Course Learning Outcomes:

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

Graduate Learning Outcomes:

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

Syllabus:

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

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

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

STATISTICS AND PROBABILISTICS

ENGE600010 / ENGE610010
2 credits
Course Learning Outcomes:

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

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

Syllabus:

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

Prerequisite: none

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

HSE PROTECTION

ENGE600012 / ENGE610012
2 credits
Course Learning Outcomes:

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

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

Syllabus:

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

Safety Health and Environment audits.

Prerequisite: none

Textbooks :

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

Bioprocess Engineering Courses

INTRODUCTION TO BIOPROCESS ENGINEERING

ENBE600001
2 CREDITS
Learning Objectives:

Able to explain the scope of bioprocess technology and industries related to.

Syllabus:

Microbial Structure, Microbial Growth, Nutrition & Culture Media, Control. ; Biochemistry, physiology, stoichiometry and growth kinetics and metabolism. ; Basic genetic engineering of prokryot and mushrooms. ; Food Industry, Health Industry; Energy industry.

Prerequisites: -

Textbooks:

1. Hand Out/diktat perkuliahan dari dosen
2. Mosler, N. S, Modern Biotechnology, John Wiley & Sons, 2009
3. Bioprocess Engineering: Basic Concepts by Michael Shuler. Pearson

COMMUNICATION SKILLS

ENBE600002
2 CREDITS
Learning Objectives:

Able to plan communication products through audience analysis, then compile them into a coherent and logical sequence of messages, and can present them effectively using appropriate technology media.

Syllabus:

Effective communication, audience analysis, writing process, making memos, making summaries / abstracts, structure of technical papers, oral presentation.

Prerequisites: -

Textbooks:

Donald R. Woods, Communicating effectively, McMaster University Bookstore, 1996.

BASIC AND ORGANIC CHEMISTRY LAB

ENBE600003
1 CREDITS
Learning Objectives:

Able to make a preliminary report, conduct experiments in the laboratory, analyze data from the results of practicum and explain the phenomena that occur from the results of practicum done, which are outlined in the form of a final report.

Syllabus:

Physical and Chemical Properties; Separation and Refining of Compounds; Metal Reaction with Acid; Crystal Water; Suspension Formation Reaction; Identification of Hydrocarbon Compounds; Alcohol and phenol identification; Identification of Carbonyl Compounds; Carbohydrate; Lipid Analysis; Extraction and Identification of Fatty Acids from Corn Oil

Prerequisites: -

Textbooks:

1. Brown, T.L., et al., Chemistry The Central Science, 8th ed., Prentice Hall, 2000.
2. Morrison, R.T., R. N. Boyd, Organic Chemistry, 6th ed., Prentice Hall, 2002.
3. Vogel's Qualitative Inorganic Analysis, 7th ed., 1996.
4. Penuntun Praktikum Kimia Dasar dan Kimia Organik, Teknik Kimia FTUI

ORGANIC CHEMISTRY

ENBE600004
3 CREDITS
Learning Objectives:

Able to apply the concepts and laws of analytical, organic, and physical chemistry and apply them in solving everyday problems.

Syllabus:

Naming of organic compounds; The role of structure and stereochemistry in the physical/chemical properties of an organic compound; Cracking reactions or alkane free radicals; Alkene polymerization; Aromatic electrophilic substitution in benzene; Ubtstitution reaction and elimination; Acylation and esterification reaction; Dehydration-polymerization reaction

Prerequisites: -

Textbooks:

1. Fessenden, alih bahasa: A. Hadiyana Pujatmaka,

Kimia Organik, edisi Kedua Erlangga 1986
2. Morrison, RT and Boyd, RN, Organic Chemistry, 6th ed., Prentice Hall 1998
3. Organic Chemistry Lecture Note.

NUMERICAL COMPUTATION

ENBE600005
3 CREDITS

Learning Objectives:

Able to solve chemical process problems with computational methods.

Syllabus:

Programming with Pascal and Fortran; Regression; Systems of linear algebraic equations; Numerical integration; Finding the roots of non-linear algebraic equations' The system of non-linear algebraic equations; An explicit method for solving first-order differential equations;

Prerequisites: -

Textbooks:
1. Handouts dari dosen
2. Constantinides, Alkis. 2008. "Numerical Methods for Chemical Engineers with Mathlab Applications". Pearson Education, United States.
3. Bismo, S. & Muharam, Y. 2015. "Metode Numerik dengan Pemrograman Fortran dan Pascal".

INSTRUMENTAL ANALYTICAL CHEMISTRY

ENBE600006
3 CREDITS
Learning Objectives:

Able to apply the concepts and laws of analytical, organic, and physical chemistry and apply them in solving everyday problems.

Syllabus:

Process skills workshop; Electrochemistry; Potentiometry; Atomic absorption spectroscopy; Infrared molecular spectroscopy; Gas chromatography;

Prerequisites: -

Textbooks:
1. D. A. Skoog, et.al., Fundamentals of Analytical Chemistry 9th., Cengage Learning, Inc., 2013.
2. G. D. Christian and J. E. O' Reilly, Instrumental Analysis, 7th. Ed., Allyn Bacon Inc., 2003.
3. D.A. Skoog, et al. Principles of Instrumental Analysis 7th Ed. Cengage Learning, Inc. 2016.
4. D.L. Pavia, et al. Introduction to Spectroscopy 5th Ed. Cengage Learning, Inc. 2014.

PHYSICAL CHEMISTRY

ENBE600007
3 CREDITS

Learning Objectives:

Able to apply basic principles, laws, and theories related to gases, liquids, equilibrium, and solutions in solving problems in the field of physical chemistry; Able to solve problems in the form of working groups by applying stages of problem-solving.

Syllabus:

The nature of gases and liquids: Definition, laws of ideal gases and real gases, use of gas laws, gas kinetics theory (velocity, collisions, average free way), phase diagrams, critical conditions, viscosity; Chemical reaction equilibrium: Definition, homogeneous equilibrium constant, factors affecting equilibrium constant, heterogeneous equilibrium, Le Chatelier's principle, effect of P on K, effect of T on K; Ideal solution: Definition, type of solution, solution concentration, Raoult's law, Henry's law, case examples, partial molar volume, vapor pressure, boiling point, freezing point, and solution osmosis pressure; Electrolyte solutions: Definition, colligative properties, electrolytic conductance, factors affecting conductance, case examples, ion migration, Hittorf's law and transport numbers; Chemical Reaction Kinetics: Basic understanding, first, second, third order reactions, reversible, Non Reguler, consecutive reactions, chain reactions, Arrhenius equations and activation energies, collision theory of bimolecular reactions, transition form theory; Surface phenomena: Basic understanding, surface tension, monolayer and multilayer adsorption, catalytic reaction kinetics, heterogeneous reaction order, catalytic reaction inhibitors, temperature effects on heterogeneous reactions.

Prerequisites: -

Textbooks:
1. Levine, I.N., Physical Chemistry, 6th ed., McGraw-Hill, 2008.
2. Atkins & de Paula, Atkin's Physical Chemistry, 9th ed., Oxford University Press, 2009

PHYS. & ANAL. CHEM. LAB

ENBE600008
1 CREDITS
Learning Objectives:

Able to compile a preliminary report which is a theory that supports the practicum module; carry out experiments in the laboratory; and compile the final report that contains the results of processing and analysis of experimental data and an explanation of the phenomena that occur

Syllabus:

Isothermic adsorption; Effect of concentration and temperature on the reaction rate; Colligative nature

of the solution; Determination of chemical equilibrium constants; Determination of gas molecular weight; Volumetric analysis; Potentiometric methods; Visible light spectrophotometry; The conductometry method; Gas chromatography

Prerequisites:

Kimia Dasar, Kimia Fisika dan Kimia Analitik Instrumental/ Basic Chemistry, Physical Chemistry and Instrumental Analytical Chemistry

Textbooks:

1. Petunjuk Praktikum Kimia Fisika TGP-FTUI 1989.
2. Penuntun Praktikum Kimia Fisika dan Kimia Analitik, Departemen Teknik Kimia FTUI
3. D. A. Skoog, et al., Fundamentals of Analytical Chemistry 5th., Saunders College Publishing, 1998 atau edisi terbaru
4. Shoemaker, D.P., C.W. Garland, J.W. Nibler, Experiments in Physical Chemistry, ed. 6, Mc-Graw Hill, 1996.
5. Atkins & de Paula, Atkin's Physical Chemistry, 9th ed., Oxford University Press, 2009

MASS AND ENERGY BALANCE

ENBE600009
3 CREDITS
Learning Objectives:

Able to use basic principles in chemical engineering for mass and energy calculations, which will form the basis of calculations for many operating units and processes in the chemical/bioprocess industry; Formulate and solve problems in the form of mass and energy balance sheets related to chemical processes.

Syllabus:

The scope of the mass and energy balance sheet; Mass balance without chemical reactions and multi-unit systems; Mass balance of chemical reactions; Biological reaction mass balance; Chemical / biological reaction mass based on the component mass balance and element mass balance; General chemical energy balance; Energy balance of chemical reactions

Prerequisites: -

Textbooks:

1. Himmelblau D.M. Basic Principles and Calculation in Chemical Engineering, 7th ed, Prentice Hall 2004.
2. Pauline Doran, Basic Principles of Bioprocess Engineering, Wiley VCH, 2006.
3. Sumber data: Perry's Chemical Handbook dan lainnya yang terkait data *physical and chemical properties*

BIOCHEMISTRY

ENBE600010
3 CREDITS
Learning Objectives:

Able to describe the relationship of structure and chemical compounds in living things, including the functions, synthesis processes and metabolism of these chemical compounds that occur in living things.

Syllabus:

Introduction to cells and tissues; Membranes and organelles; The role of DNA and protein; Energy in cells; Nucleic acid; Structure and replication of DNA and RNA; Transcription and translation; Amino acid; Synthesis and structure of proteins; Enzyme; Metabolism

Prerequisites: -

Textbooks:

1. Lehninger Principles of Biochemistry & eBook by Albert Lehninger, David L. Nelson and Michael M. Cox (Jun 15, 2008)
2. Biochemistry (3rd Edition) by Christopher K. Mathews, Kensal E. van Holde and Kevin G. Ahern (Dec 10, 1999)
3. Bruckner, Monica Z. Basic Cellular Staining.Serc. carleton.edu.
4. Aryulina, D., Manaf, S., Muslim, C., & Winarni, E.W. 2007. BIOLOGI 3. Jakarta : Esis. Binur
5. Robi. 2011. Teknologi RNA Interference. Retrieved from Campbell, Reece. 2009. Biology. Sansome Street, San Francisco: Pearson Benjamin Cummings

TRANSPORT PHENOMENA IN BIOLOGYCAL SYSTEM

ENBE600011
3 CREDITS
Learning Objectives:

Able to identify and explain and analyze the phenomena of momentum, mass, and heat transfer through the application of microscopic and macroscopic balances.

Syllabus:

Preliminary; Viscosity; Thermal Conductivity and Diffusivity; Shell's momentum balance and Shell's energy balance; Shell mass balance; The equation of change; Mass transfer, momentum, and energy with two independent variables; The transfer of momentum, energy, and mass in turbulent flow; Movement between two phases; Macroscopic balance of an isothermal system; Macroscopic balance of non-isothermal systems; Macroscopic balance sheet of multi-component systems

Prerequisites:

Pengantar Teknik Kimia; Kalkulus (Introduction to

Chemical Engineering; Calculus)

Textbooks:

1. Rubenssien, D, Bioflued Mechanics, Elsevier Academic Press, 2012
2. Konsool, Signal and System for Bioengineer,Academic Press, 2nd Ed, 2012
3. Sekar V, Transport Phenomena of Food and Biological Material, CRC,2000
4. R. B. Bird, W. E. Stewart dan E. N. Lightfoot, Transport Phenomena, John Wiley, 1965.
5. J.R. Welty et al., Fundamentals of Momentum, Heat and Mass Transfer, 3rd ed., Wiley, 2984.
6. Brodkey, R. S dan RC Herskey, Transport Phenomena, McGraw-Hill, 1998

FLUID AND PARTICLE MECHANICS

ENBE600012
3 CREDITS
Learning Objectives:

Able to apply the basic concepts of fluid mechanics and apply them in solving real problems. In addition, students are able to apply the principles of fluid mechanics (press. Continuity, Bernoulli, etc.), to solve problems in the unit process through energy and force calculations, etc., especially in fluid flow systems in piping, rate measuring devices and transportation tools fluid, as well as in fluid-solid flow systems (fluidization, filtration, sedimentation, movement of particles in the gas.

Syllabus:

Fluid property; Static fluid and its application; The basic equation of fluid flow (mass & press balance. Continuity, energy balance and press. Bernoulli); Press application. Bernoulli for flow rate measurement; Friction Loss of fluid flow through pipes, porous media, fluid transport devices: pumps, compressors, turbines; High-speed gas flow; Movement of particles through fixed and fluidized beds and Filtration; Sedimentation of particles in a liquid

Prerequisites:

Peristiwa Perpindahan (Transport Phenomena)

Textbooks:

1. A. W. Nienow, Bioreactor and Bioprocess Fluid Dynamics - Wiley, 1 edition (April 15, 1993)
2. Noel de Nevers, Fluid Mechanics for Chemical Engineers, 2nd Ed., McGraw-Hill, 1991.
3. Bruce R. Munson, Donald F. Young, Theodore H. Okiishi, Fundamentals of Fluid Mechanics, John Wiley & Sons, 2006.

CELL CULTURE

ENBE600013
3 CREDITS
Learning Objectives:

Able to apply the basic principles of cell culture at an industrial level

Syllabus:

Cell types (prokaryotes and eukaryotes); Cell structure; Introduction to cell culture; Cell culture procedures; Media Development grows; Bioprocess cell line development

Prerequisites:

Biokimia (Biochemistry)

Textbooks:

1. Cell Culture Engineering (Advances in Biochemical Engineering Biotechnology) by Wei Shu Hu (Editor). Springer
2. Cell Culture Engineering VI by Michael J. Betenbaugh. Springer

HEAT TRANSFER

ENBE600014
3 CREDITS
Learning Objectives:

Able to analyze the phenomenon of heat transfer and apply it to solve problems in the heat transfer process unit.

Syllabus:

Skills Workshop Review which includes: The importance of self-assessment, awareness of the thought process, problem-solving strategies and work skills in groups; Steady conduction; Induction Conduction; Natural Convection; Forced Convection; Radiation; Heat Exchanger

Prerequisites:

Peristiwa Perpindahan/ Transport Phenomena

Textbooks:

1. Holman, J.P., "Perpindahan Kalor (alih bahasa: E. Jasjfi)", Edisi ke-10, Penerbit Erlangga, Jakarta 2010.
2. Bergman, T.L. et al. "Fundamentals of Heat & Mass Transfer", Edisi ke-8, John Wiley & Sons, New York 2017.
3. Cengel, Yunus A. "Heat and Mass Transfer: Fundamentals & Applications", Edisi ke-5, McGraw Hill, Singapore 2014.
4. Cengel, Yunus A. "Introduction to Thermodynamics & Heat Transfer", Edisi ke-2, McGraw Hill, United States 2009.

BIOCHEMISTRY LAB

ENBE600015
2 CREDITS
Learning Objectives:

Able to compile a preliminary report on the theory

that supports the practicum module, carry out experiments in the laboratory, process and analyze experimental results data, explain phenomena that occur, and, compile the final report

Syllabus:

Physical and chemical properties; Separation and purification of substances; Reaction of metals with acids; Crystal Water; Identification of hydrocarbon compounds; Identification of alcohols and phenols; Identification of protein compounds; Nucleic acid; Carbonyl; Carbohydrate; Lipid analysis; Extraction and identification of fatty acids from corn oil; Bacterial culture

Prerequisites:

Kimia organik, Biokimia, dan Kultur sel (Organic Chemistry, Biochemistry, and Cell Culture)

Textbooks:

1. Fessenden, alih bahasa: A. Hadiyana Pujatmaka, Kimia Organik, Erlangga 1986
2. Morrison, RT and Boyd, RN, Organic Chemistry, 6th ed., Prentice Hall 1998.
3. Vogel, Practical Organic Chemistry
4. Penuntun Praktikum Kimia Dasar dan Kimia Organik, Departemen Teknik Kimia, FTUI
5. Moran, L. dan Masciangioli, T. Keselamatan dan Keamanan Laboratorium Kimia, the National Academies Press, 2010
6. Brown, T.L., H. E. LeMay and B.E. Bursten, Chemistry, ed. 8, Prentice Hall, 2000.
7. Vogel, Analisis Anorganik Kualitatif, PT. Kalman Media Pustaka, 1985.
8. Lehninger Principles of Biochemistry & eBook by Albert Lehninger, David L. Nelson and Michael M. Cox (Jun 15, 2008)
9. Biochemistry (3rd Edition) by Christopher K. Mathews, Kensal E. van Holde and Kevin G. Ahern (Dec 10, 1999)

GENETIC ENGINEERING

ENBE600016
3 CREDITS
Learning Objectives:

Able to apply the concepts and techniques of genetic and protein engineering to apply them for cloning and protein production

Syllabus:

Introduction; Basic techniques for genetic engineering, DNA cutting and unification; Simple genetic engineering in bacteria; Mutagenesis; Application of genetic engineering technology

Prerequisites:

Biokimia (Biochemistry)

Textbooks:

1. Primrose SB, Twyman RM, and Old RW. "Principles of Gene Manipulation" sixth edition, Blackwell science Ltd. 2001
2. An Introduction to Genetic Engineering by Desmond S. T. Nicholl (Jun 23, 2008). Cambridge University Press
3. Genetic Engineering: Manipulating the Mechanisms of Life (Genetics & Evolution) by Russ Hodge and Nadia Rosenthal (May 2009). Facts on File
4. Principles of Gene Manipulation and Genomics by Sandy B. Primrose and Richard Twyman. Wiley-Blackwell
5. Introduction to Biotechnology and Genetic Engineering by A. J. Nair. Jones & Bartlett Publishers
6. Gene Cloning & DNA Analysis, T.A. Brown. 2016. Wiley – Black Will.

THERMODYNAMIC IN BIOLOGICAL SYSTEM

ENBE600017
3 CREDITS
Learning Objectives:

Able to apply the basic concepts of thermodynamics and principles of energy transformation involving living organisms; able to apply heuristics of problem solving skills and basic concepts of thermodynamics to solve various thermodynamic problems; able to increase the ability to direct learning independently (self - directed learning) at the individual or group level

Syllabus:

Energy Transformation (Energy, System and Environment Distribution, Energy Consumption, carbon, energy and life); 1st Law of Thermodynamics (Energy in, work, application of law 1, enthalpy, standard state, heat capacity and energy conversion in living things); 2nd Law of Thermodynamics (Entropy, Entropy of the universe, isothermal system, 3rd law and biology, Irreversibility and life); Gibbs Energy Theory and its application to biological systems; Equilibrium ties in the biological system; Border Biodynamic system thermodynamics

Prerequisites:

Neraca Massa dan Energi (Mass and Energy Balance)

Textbooks:

1. Haynie, D.T., Biological Thermodynamics, Cambridge University Press, 2008.
2. Hammes, G.G., Thermodynamics and Kinetics for The biological sciences, Wiley-Interscience, 2000.
3. Stockar U.V., Biothermodynamics: The Role of Thermodynamics in Biochemical Engineering, EFPL Press, 2013.

4. J.M. Smith, H.C. van Ness, and M.M. Abbott, Introduction to Chemical Engineering Thermodynamics, 6th/7th ed., McGraw Hill.
5. Donald R. Woods, Problem-Based Learning: How to gain the most from PBL, McMaster Bookstore, Hamilton, Ontario, Canada, 1994
6. Situs internet, buku, manual, petunjuk piranti lunak, dan sumber-sumber informasi lainnya yang dapat dipercaya.

BIOCHEMICAL REACTION ENGINEERING

ENBE600018
3 CREDITS
Learning Objectives:

Able to apply biochemicalreaction engineering processes in solving bioprocess problems

Syllabus:

Review of catalysts and biocatalysts; Enzyme classification and activity; Biocatalyst immobilization techniques; Factors affecting biocatalysis performance; The kinetics of ordinary reactions and the kinetics of biocatalytic reactions; Enzyme production and recovery product techniques; Application of biocatalysis in industry; Non-elementary homogeneous reaction; Enzymatic reaction; Cell Review; Kinetics of cell growth; Respiration, Photosynthesis, Biosynthesis; Displacement through cell membranes; Stoichiometry of cell growth & energy requirements

Prerequisites:

Kimia Fisika (Physical Chemistry)

Textbooks:

1. James E. Bailey, David F. Ollis, Biochemical Engineering Fundamentals, McGraw-Hill International Editions, second edition, 1986.
2. Douglas S Clark, Harvey W Blanch, Biochemical Engineering, Marcel Dekker Inc, 1997.

SEPARATION

ENBE600019
3 CREDITS
Learning Objectives:

Able to apply the concepts of separation techniques in the biological production system.

Syllabus:

Separation concept; The concept of mass transfer; Distillation; Absorption and Stripping; Extraction; Leaching; Membrane Process; Ion Exchange; Crystallization; Bubble and Foam Separation; Chromatography; Ultrafiltation and Reverse osmosis; Dialysis membrane membrane; Separation process selection strategy

Prerequisites:

Peristiwa Perpindahan (Transport Phenomena)

Textbooks:

1. Warren L. McCabe, Julian C. Smith, Peter Harriot. Unit Operation of Chemical Engineering, Mc. Graw Hill. 1993
2. Coulson and Richardson's Chemical Engineering: Chemical Engineering Design v. 6 (Coulson & Richardson's chemical engineering) by R.K. Sinnott. Butterworth-Heinemann Ltd

BIOPROCESS UNIT OPERATION LAB I

ENBE600020
1 CREDITS
Learning Objectives:

Able to operate the process equipment and plan an activity or experiment, can analyze and explain the phenomena that occur in each practicum module activity

Syllabus:

Fluid Circuit Mechanics; Conduction heat transfer in multiple pipe systems; Filtration Process; The process of fluidization and its influence in the heat transfer system; Fermentation process in the Biofermentor reactor system;

Prerequisites:

Separasi, Mekanika Fluida dan Partikel, dan Teknik Reaksi Biokimia (Separation, Fluid Mechanics and Particles, and Biochemical Reaction Engineering)

Textbooks:

1. Buku Petunjuk Praktikum Proses dan Operasi Bioproses 1, DTK FTUI
2. Literatur untuk mata kuliah

BIOPROCESS SYSTEM SIMULATION

ENBE600021
3 CREDITS
Learning Objectives:

At the end of the lecture, students can design the stages of the solution of the problem given correctly

Syllabus:

Benefits and position of Bioprocess Simulation; Software requirements (Installation, Unit structure, Task, Economic, etc.); Simple system: Fermentation and Filtration; Registration of pure components available / not available in the software; Mixed component registration; Selecting Units; Case Study: Galactosidase

Prerequisites:

Komputasi Numerik (Numerical Computation)

Textbooks:

1. SuperPro Designer Manual, Intelligen, Inc.
2. Biorefineries – Industrial Processes and Prod-

ucts: Status Quo and Future Directions (Volume 1-2), by Birgit Kamm and Patrick R. Gruber.

BIOPROCESS UNIT OPERATION LAB II

ENBE600022
1 CREDITS
Learning Objectives:

Students are able to operate the process equipment and or experiment, can analyze and explain the phenomena that occur in each practicum module activity.

Syllabus:

Absorption process; Flow control; Wet Wetted Colum; Pressure Control; Biofilter / CO2 Biofixation

Prerequisites:

Separasi,Pengendalian Proses, Teknik Reaksi Biokimia (Separation, Process Control, Biochemical Reaction Engineering)

Textbooks:

Buku Petunjuk Praktikum Proses dan Operasi Bioproses 1, DTK FTUI

BIOREACTOR ENGINEERING

ENBE600023
3 CREDITS
Learning Objectives:

At the end of the lecture, students are able to design bioreactors.

Syllabus:

Ideal reactor; Stirred vessel reactor; Bubble column reactor; Silent/trickle bed reactors; Fluidization reactor;

Prerequisites:

Teknik Reaksi Biokimia (Biochemical Reaction Engineering)

Textbooks:

1. Blanch HW and DS Clark, Biochemical Engineering, Marcel Dekker Inc., New York, 1997.
2. Bailey JE and Ollis, Biochemical Engineering Fundamental, McGraw Hill Book Co., New York, 1986.
3. John Viladsen, Jens Nielsen, Gunar Liden, Bioreaction engineering fundamental, springer, 2011
4. K Schugerl, KH Bellgardt, Bioreaction Engineering Modelling and Control

BIOPROCESS EQUIPMENT DESIGN

ENBE600024
3 CREDITS
Learning Objectives:

Able to design biological process equipment.

Syllabus:

Distillation column, tray, and packing; Absorption, tray and packing columns; Adsorption, tray and packing columns; Batch and continuous extraction; Evaporation, filtration, crystallization, and centrifugation

Prerequisites:

Mekanika Fluida dan Partikel, Separasi, Perpindahan Kalor

Textbooks:

1. Kern, D. Q., "Process Heat Transfer", Mc.Graw-Hill International Book Company, 1984.
2. Wallace & Ludwig, Applied Process Design for Chemical and Petrochemical Plant, Vol. 2, Gulf Publishing Co.

BIO PRODUCT DESIGN

ENBE600025
4 CREDITS
Learning Objectives:

Able to theoretically design a factory/industry by explore information from books, journals and the internet to find the latest solutions in product and factory design with due regard to standards and regulations

Syllabus:

Understanding of consumer needs, product specifications, creating and selecting product concepts, product formulations, product manufacturing, supply chains, economics

Prerequisites:

Perancangan Alat Proses (Equipment Process Design), Ekonomi Teknik (Engineering Economics)

Textbooks:

1. Cussler, L., G. D. Moggridge, 2011, Chemical Product Design, Cambridge University, 2 edition
2. Ulrich K. T., Eppinger S. D., 2003, Product Design and Development, 3rd ed., McGraw-Hill
3. Seider W. D., Seader J. D., Lewin D. R., Soemantri Widagdo, 2008, Product and Product Design Principles. Synthesis, Analysis and Evaluation, Wiley and Sons Inc, 3 edition
4. Wesselingh, J.A., et al., 2007, Design and Development of Biological, Chemical, Food, and Pharmaceutical Products, John Wiley & Sons.

PROCESS CONTROL

ENBE600026
3 CREDITS
Learning Objectives:

Able to design a single loop control system and connect the dynamics of the process with perfor-

mance.

Syllabus:

Introduction to Process Control; Objectives and Benefits of Control; Principles of Mathematical Modeling; Process Control Modeling and Analysis; Dynamic Behavior of a Typical Process System; Empirical Model Identification; Feedback loop; PID controller; PID Control Settings; Stability Analysis;

Prerequisites:

Neraca massa dan energi, Komputasi Numerik (Mass and Energy Balance, Numerical Computation)

Textbooks:

1. T. Marlin, Process Control: Designing Processes and Control Systems for Dynamic Performance, 2nd Edition, McGraw-Hill, New York, 2000.
2. Carlos A. Smith, Armando B. Corripio, Principles and Practice of Automatic Process Control, John Wiley & Sons, 1985, ISBN 0-471-88346-8 2.
3. D. E Seborg, T. F. Edgar, D. A. Mellichamp, Process Dynamics and Control, John Wiley & Sons, 1989, ISBN 0-471-86389-0 3.
4. Ogata, Katsuhiko, Teknik Kontrol Automatik (Sistem Pengaturan), Jilid 1, Penerbit Erlangga, 1985, Bandung.
5. Bequette, R. W., Process Dynamics: Modeling, Analysis, and Simulation, Prentice Hall, 1998.
6. Luyben, William L., Process Modeling, Simulation and Control for Chemical Engineers, Second Edition, McGraw-Hill International Edition, 1990.
7. Kuo, Benjamin C., Automatic Control Systems, Sixth Edition, Prentice-Hall International Editions, 1991.
8. Stephanopoulos, George, Chemical Process Control: An Introduction to Theory and Practice, Prentice-Hall International, 1984

INDUSTRIAL PROJECT MANAGEMENT

ENBE600027
2 CREDITS
Learning Objectives:

Able to apply project management concepts in their field of work well.

Syllabus:

Concept of Project-Production; Project Life Cycle; Project Selection; Project Planning; Project Implementation; Project Completion & Evaluation

Prerequisites:

Ekonomi Teknik (Engineering Economics)

Textbooks:

Suharto, Imam, Manajemen Proyek, 1990

PLANT DESIGN

ENBE600028
4 CREDITS
Learning Objectives:

Able to theoretically design a factory/industry by explore information from books, journals and the internet to find the latest solutions in product and factory design with due regard to standards and regulations

Syllabus:

Conceptual design of processes/plants, process development flow diagrams, heuristic synthesis and analysis of processes, process simulations, rule of thumb design of process tools and construction meters, heat/process integration, plant layouts, and economic analysis

Prerequisites:

Pengendalian Proses, Perancangan Alat Proses, Simulasi Sistem Kimia, Ekonomi Teknik (Process Control, Process Equipment Design, Chemical Process Simulation, Engineering Economics)

Textbooks:

1. Douglas, J. M., 1998, Conceptual Design of Chemical Processes, McGraw-Hill.
2. Seider W. D., Seader J. D., Lewin D. R., Sumatri Widagdo, 2008, Product and Product Design Principles. Synthesis, Analysis and Evaluation, Wiley and Sons Inc, 3 edition.
3. Turton, R., R. C. Bailie, W. B. Ehiting and J. A. Shaeiwitz, 1998, Analysis, Synthesis, and Design of Chemical Process, Prentice-Hall
4. Gavin Towler, R K Sinnott, 2012, Chemical Engineering Design: Principles, Practice and Economics of Plant and Process Design, Butterworth-Heinemann, Second Edition.
5. Peter, M. S, and K. D. Timmerhaus, Ronald West, and Max Peters, 2002, Plant Design and Economic for Chemical Engineering, 5 Edition, McGraw-Hill.
6. Biegler L. T, I. E, Grossmann and A. W. Westerberg, 1997, Systematic Methods for Chemical Process Design, Prentice-Hall.
7. Branan, C., 1998, Rule of Thumb for Chemical Engineers : A manual of quick, accurate solutions to everyday process engineering problems, 2nd edition, Gulf Publishing, Co.
8. Wallas, Stanley M. 1990, Chemical Process Equipment : Selection and Design, Buther Worths.
9. Ed Bausbacher, Roger Hunt, 1993, Process Plant Layout and Piping Design, Prentice Hall; 1 edition
10. CHEMCAD Manual, HEATEXET Manual, HYSYS/ UNISIM ManualBerk, Z, Food Process Engineer-

ing and Technology, Academic Press, 2009
11. Lydersen BK, Bioprocess Engineering: System, Equipment and Facilities, John & Wiley & Sons, Inc., New York, 1993.
12. Peter, M. S. dan K. D. Timmerhaus, Plant design and Economic for Chemical Engineering, 4th Ed., McGraw Hill.
13. SuperPro Designer Manual. Intelligen, Inc

CAPITA SELECTA
ENBE600031
2 CREDITS
Learning Objectives:

Able to make a summary of the material presented by guest lecturers

Syllabus:

Held by inviting competent guest lecturers in the fields according to the needs in each study program (may vary in each semester)

Prerequisites:

Passed 90 Credits

Textbooks: -

Special Courses

INTERNSHIP
ENBE600029
2 CREDITS
Learning Objectives:

At the end of the lecture, students have real knowledge and experience in the field of oil and gas, petrochemical, pharmacy, oleochemical, and other chemical industries that involve aspects of technology, processes, operations, and management.

Syllabus: -

Prerequisites:

Already taken at least 110 credits (minimum D) with GPA 2,0

Textbooks: -

RESEARCH METHOD & SEMINAR
ENBE600030
2 CREDITS
Learning Objectives:

Able to determine the right method for research activities as well as express ideas, processes, and results of scientific research verbally and in writing

Syllabus:

Introduction, techniques to identify problems and form hypotheses, logical and critical thinking, scientific writing techniques, research proposal writing techniques, research design techniques, presentation techniques, data collection techniques, analyze and present the results.

Prerequisites:

Already taken at least 90 credits (minimum D) with IPK 2,0

Textbooks:
1. Handout
2. Research proposal format from various institutions

UNDERGRADUATE THESIS
ENBE600032
5 CREDITS
Learning Objectives:

Able to analyze and solve chemical technology problems and present them in oral and written forms in the form of scientific papers.

Syllabus:

Materi skripsi sesuai dengan Syllabus penelitian yang diambil

Prerequisites:

Metodologi Penelitian dan Seminar

Textbooks:
1. Pedoman Teknis Penulisan Tugas Akhir Mahasiswa Universitas Indonesia.
2. IEEE Citation Reference.
3. Ivan Stojmenovic, "How To Write Research Articles in Computing and Engineering Disciplines," IEEE Transactions on Non Reguler And Distributed Systems, Vol. 21, No. 2, February 2010.
4. Buku petunjuk praktis pelaksanaan MK. Skripsi, Depok, 1999.

Elective Courses in Odd Semester

OLEOCHEMICAL INDUSTRY
ENCH800014
3 CREDITS
Learning Objectives:

Able to know the various processes that commonly used in the oleochemical industry, and able to make a plan to develop the produce of oleochemicals from vegetable oils.

Syllabus:

Fatty acids, biodiesel, paints and polymers, detergents, soaps, fatty alcohol, glycerin, oils and fats, oil and greese, the development of oleochemicals, vegetable oil processing, vegetable oil technology in the process.

Prerequisites:

Organic Chemistry

Textbook:

1. Oleochemical Manufacture and Applications by Frank D. Gunstone, Richard J. Hamilton. Blackwell

FOOD TECHNOLOGY

ENCH800015
3 CREDITS
Learning Objectives:

Able to understand the processes of making food in the food industry, which includes the selection, handling, and processing of raw materials, the operating unit of food production, packaging, storage, and control of the process from the beginning stage to the end.

Syllabus:

Introduction, physical properties of raw materials, the basic concepts of energy and mass transfer, reaction kinetics, process control. Mixing, filtration, centrifugation, extraction and membrane processes, adsorption and ion exchange column, with the temperature settings, drying, preservation, packaging, food storage, and hygiene.

Prerequisites: -

Textbook:

1. Zeki Berk, Food Process Engineering and Technology, Academic Press, Elsevier 2009
2. Food Technology: an introduction by Anita Tull. Oxford University Press, 2002
3. Introduction to Food Engineering by R. Paul Singh, R. Paul Singh, and Dennis R. Heldman.
4. Academic Press
5. Introduction to Food Process Engineering by P. G. Smith. Springer
6. Fundamentals of Food Process Engineering by Romeo T. Toledo. Springer

PROTEIN ENGINEERING

ENCH800016
3 CREDITS
Learning Objectives:

Able to determine protein engineering strategies for the benefit of separation, biocatalysts and medic.

Syllabus:

Introduction, Protein docking methods, Protein tagging strategies, Gen synthesis design, Enzyme stabilization, Molecular exploration, Protein engineering, Case study.

Prerequisite:

Organic Chemistry

Textbooks:

1. Protein Engineering in Industrial Biotechnology, Lilia Alberghina, Harwood academic publishers, 2005
2. Proteins: Biotechnology and Biochemistry by Dr. Gary Walsh. Wiley
3. Protein engineering and design by Sheldon J. Park, Jennifer R. Cochran. CRC Press
4. Protein Engineering and Design by Paul R. Carey. Academic Press
5. Protein Engineering: Principles and Practice. Wiley-Liss

HERBAL TECHNOLOGY

ENCH800017
3 CREDITS
Learning Objectives:

Able to explain the development of herbal technology, herbal separation technology, herbal formulation basis, herbal regulation, and distinguish with other pharmaceutical products

Syllabus:

Definition and basic concepts of herbs, herbal materials, herbal separation technology, herbal formulations, herbal regulation.

Prerequisites:

Organic Chemistry

Textbook:

The Complete Technology Book on Herbal Perfumes & Cosmetics by H. Panda. National Institute of Industrial Research 2003

COMPOSITE MATERIAL

ENCH800018
3 CREDITS
Learning Objectives:

Able to: Explain the characteristics of composite materials and compare it with conventional materials; Explain the manufacturing process, and research development of composite materials.

Syllabus:

The position of composite materials in materials science in general, common characteristics of composite materials, the type of composite based on the composition, the types of polymer matrix and reinforcement, the role of surface treatment in the strength of composite materials, manufacturing processes, durability, the process of splicing and repair of composite materials, code and standards for application of composite materials, the development of composite materials research.

Prerequisites:

Organic Chemistry

Textbook:

1. Fiber-reinforced Composites (Materials Engineering, Manufacturing and Design), P. K. Mallick, Marcel Dekker, Inc., 1993.
2. Handbook of Plastics, Elastomers, and Composites, 3rd ed., Charles A. Harper, McGraw-Hill, 1996.
3. Reinforced Plastics - Theory and Practice, 2nd ed., M. W. Gaylord, Chaners Books, 1974.

APPLIED THERMODYNAMICS

ENCH800019
3 CREDITS
Learning Objectives:

Students are able to analyze problems of thermodynamics based on a thorough review including fundamental aspects of thermodynamics, experimental, and green chemistry, based on current information from scientific journals

Syllabus:

The case study of industrial thermodynamic, example cycle processes, phase equilibrium, and chemical reaction equilibrium to process and product engineer; friendly solvents such as supercritical CO2 and ionic liquid

Prerequisites:

Chemical Engineering Thermodynamics

Textbook:

1. References relevant to a given problem
2. Mulia, K dan Wulan, PPDK, Buku Teks Termodinamika Kimia

DINAMIC SYSTEM

ENCH800020
3 CREDITS
Learning Objectives:

Able to build dynamic models of process systems, biological, industrial, social and economic.

Syllabus:

Introduction to dynamical systems, causal loops, model and validation, analysis, case study.

Prerequisites:

Numerical Computation

Textbook:

1. Forrester, J. W., 2002, Principles of Systems, Productivity Press
2. Goodman, Michael R., 1998, Study Notes in System Dynamics, Productivity Press
3. Richardson, George P. and Pugh III, Alexander L., 1999, Introduction to System Dynamics Modeling, Pegasus Communications
4. Andersen, David, etc., Introduction to Computer Simulation - A System Dynamics: Systems Thinking and Modeling for a Complex World, McGraw-Hill

THERMODYNAMICS PROPERTIES OF HYDROCARBON

ENCH800021
3 CREDITS
Learning Objectives:

Able to predict the magnitude of thermodynamic properties of hydrocarbons and the phase condition, either manually or using software calculations.

Syllabus:

Introduction to hydrocarbon thermodynamics properties, basic thermodynamic concepts, P-V-T data correlations, physical properties of hydrocarbon fluids, computing aided thermodynamics properties, the vapor-liquid behavior of two-phase systems, water-hydrocarbon system behavior, product specifications in the disposal lease of hydrocarbon

Prerequisites:

Chemical Engineering Thermodynamics

Textbook:

1. Wayne C. Edmister, Byung Ik Lee, Applied hydrocarbon thermodynamics, Volume 1, Gulf Publishing Company (1988), Houston, Texas.
2. John M. Campbell, Gas Conditioning and Processing, Vol. 1, 8th Edition Campbell Petroleum Series 2001.

LUBRICANT TECHNOLOGY

ENCH800022
3 CREDITS
Learning Objectives:

Able to explain the working principles of lubrication, lubricant function, and several parameters of the quality and lubricant classification, lubricant chemical, and its production technology, either mineral lubricant, synthesis and vegetal.

Syllabus:

Principles of lubrication on friction and wear phenomena on the two surfaces of solid objects are moving together; mode lubrication: hydrodynamic and elastohydrodynamic; lubricants: mineral, synthetic, and vegetable; additives, formulations, degradation, contamination, and maintenance of lubricants; latest development of lubricant technology.

Prerequisites:

Organic Chemistry

Textbook:

1. E. Richard Booster, Handbook of Lubricant: Theory and Practice of Tribology, Vol. I, Vol. II, Vol. III, CRC Press (1984), Inc., Boca Raton, Florida
2. Mervin H. Jones, Industrial Tribology: The Practical Aspect of Friction, Lubricant, and Wear, Elsevier Scientific Publishing Co., New York, 1983.
3. J. Halling, Principle of Tribology, Macmillan Press Ltd., London, 1978
4. Handout

CRYOGENIC TECHNOLOGY

ENCH800023
3 CREDITS
Learning Objectives:

Able to explain the various processes to liquefy gas in cryogenic technology

Syllabus:

History and development of cryogenic, cryogenic scope of work. Refrigeration and liquefaction of natural gas, air, oxygen, nitrogen, helium, neon, and argon.

Prerequisites:

Chemical engineering thermodynamics

Textbook:

1. Timmerhaus, K.D., Cryogenic Process Engineering, Plenum Press 1989, New York.
2. Barron, Randall. Cryogenic Systems, McGraw Hill, 1985, New York.

COMBUSTION TECHNOLOGY

ENCH800024
3 CREDITS
Learning Objectives:

Able to explain the phenomenon of combustion and resolve the problems that rendered correctly.

Syllabus:

chemical kinetics and combustion, the flame, premix flame, diffusion flame, the combustion process applications.

Prerequisite:

Transport Phenomena, Chemical Reaction Engineering 1, Chemical Engineering Thermodynamics

Textbook:

1. Warnatz, J., Maas, U. dan Dibble, R.W., Combustion: Physical and Chemical Fundamentals, Modeling and Simulation, Experiments, Pollutant Formation, 2nd ed., Springer, Heidelberg, 1999.
2. Turns, S.R., An Introduction to Combustion: Concepts and Applications, 2nd ed, McGraw-Hill, 2000.
3. Glassman, I., Combustion, Academic Press, 1997.
4. El-Mahallawy dan el-Din Habik, S., Fundamental and Technology of Combustion, Elsevier, 2002.
5. Combustion, T. J. Poinsot and D. P. Veynante, in Encyclopedia of Computational Mechanicsedited by Erwin Stein, Ren´e de Borst and Thomas J.R. Hughes, 2004 John Wiley & Sons, Ltd.
6. Introduction to Combustion, Concepts and Applications, Stephen R. Turns, 2nd edition, McGraw Hill, 2000
7. Introduction to Combustion Phenomena, A. Murty Kanury, Gordon and Breach Science Publishers, 1975
8. Heat Transfer from Burners, Charles E. Baukal, in Industrial Burners Handbook, edited by Charles E. Baukal, CRC Press, 2004.

PLASMA AND OZONE TECHNOLOGY

ENCH800025
3 CREDITS
Learning Objectives:

Able to explain the physics and chemistry phenomena of plasma formation and release of electromagnetic energy and the use of plasma and ozone technology.

Syllabus:

Basic phenomena and physical-chemical processes of gases that are given an electrical charge (corona discharge), the generation process or formation of ozone, role and use of plasma technology and ozone in chemical engineering processes, the potential of ozone technology in control technology environmental pollution, the ozone generator module manufacturing equipment.

Prerequisite:

Physics Electricity Magnetism

Textbook:

1. E. T. Protasevich: "Cold Non-Equilibrium Plasma", Cambridge International science Publishing, Cambridge, 1999.
2. Rice, R. G., and M. E. Browning: "Ozone Treatment of Industrial Water water", Notes Data Corporation, Park Ridyl, 1981.
3. Metcalf & Eddy, Inc. (Tchobano-glous, G., and FL Burton): "Wastewater Engineering: Treatment, Disposal, and Reuse", McGraw-Hill Book. Co., Singapore, 1991.

HETEROGENEOUS CATALYST

ENCH800026
3 CREDITS
Learning Objectives:

Able to explain the phenomenon of basic concepts

heterogeneous catalysts and its application

Syllabus:

The general property of catalyst, thermodynamic of the reaction with catalyst, the distribution of the catalyst based on the type of reaction, the core function is active, the method of selecting catalysts for certain reactions, characterization of the corresponding want to know the nature of the target, the catalyst test methods, methods of development of the catalyst, and reaction products.

Prerequisites:

Chemical Reaction Engineering 1

Textbook:

1. Nasikin M, Susanto BH, "Katlaisis Heterogen", UI Press, 2010
2. Satterfield, C. N., heterogeneous Catalysis in Industrial Practice, McGraw-Hill Inc., New York, 1991.
3. Rase, F. R., Commercial Catalyst, CRC Press, New York, 1991
4. Richardson, T, J., Principles of Catalyst Development, Plenum Press, New York, 1989
5. Thomas J.M. And WJ Thomas, Principles and Practice of Heterogeneous Catalysis, VCH, Weinhem, Germany, 1997
6. Emmet, R. H., Catalysis, Reinhold Publishing Corporation, New York, 1961

SUSTAINABLE ENERGY

ENCH800027
3 CREDITS
Learning Objectives:

Able to explain the relationship of energy with a social aspect, economic and environmental and sustainability concepts, and able to analyze the performance of techno-economy and the continuity, especially fossil energy system, new, and renewable.

Syllabus:

Concept of sustainability and sustainable energy, energy hierarchy, energy linkages with economic, environmental and social, fossil energy/fuels and Impacts, global climate change and its mitigation, conversion, transportation/distribution and storage, the analysis method of energy sustainability: LCA, sustainability index, hydrogen and fuel cells and nuclear energy, solar energy (PV and thermal), wind and ocean, hydropower, bioenergy, geothermal energy, energy efficiency and conservation, carbon capture, and storage

Prerequisites:

Chemical Engineering Thermodynamics or Biochemical Engineering

Textbook:

1. Jefferson W. Tester, et al., Sustainable Energy: Choosing Among Options, MIT Press, 2005.
2. Godfrey Boyle, et al., Energy Systems and Sustainability: Power for a Sustainable Future, Oxford University Press, 2003.
3. E. Cassedy S, Prospects for Sustainable Energy: A critical assessment, Cambridge University Press, 2000.
4. DeSimone et al., Eco-Efficiency. The Business Link to Sustainable Development, MIT Press, 1997.
5. D. Elliot, Energy, Society, and Environment, Technology for a sustainable future, Rouledge, 1997
6. Miller, G. T., Environment Science. Sustaining Earth, Wardworld Publish Co. 1993

RISK MANAGEMENT

ENCH800028
3 CREDITS
Learning Objectives:

Able to explain and apply risk management in a risk assessment.

Syllabus:

Introduction to the risk, the basic principles and guidelines concerning risk, risk management standards, risk assessment, risk analysis, risk analysis and simulation, simulation of the risk with Montecarlo method, the risk of using software simulation crystal ball.

Prerequisites: -

Textbook:

J. F. A. Stoner, Management, 1986

ELECTROCHEMICAL TECHNOLOGY

ENCH800029
3 CREDITS
Learning Objectives:

Able to understand the basic principles of electrochemical technology and apply them in the design of electrochemical systems for various applications.

Syllabus:

Basic electrochemical principles and electrochemical cell concepts; electrochemical cell thermodynamics (Nernst equation, Pourbaix diagram, etc.); electrochemical cell kinetics (the mechanism of electrochemical redox reactions, Marcus theory, Butler-Volmer model, etc.); polarization/overpotential on electrochemical cells (ohm polarization, activation polarization, concentration polarization, etc.); the phenomenon of mass transfer in electrochemical cells (migration, diffusion, convection, etc.); electrochemical analysis (voltammetry, chronoamperometry, AC

impedance, etc.); electrode-electrolyte interface phenomena (double layer theory, surface capacitance, ion adsorption, etc.); semiconductor electrodes (photoelectrochemical); and various electrochemical applications (fuel cells, solar cells, batteries, etc.)

Prerequisite:

Physical Chemistry, Thermodynamics of Chemical Engineering, Chemical Reaction Engineering 1

Textbook:

1. Keith B. Oldham dan Jan C. Myland. Fundamentals of Electrochemical Science, Academic Press, Inc., 1st Edition, London, 1994.
2. Richard G. Comption dan Craig E. Banks. Understanding Voltammetry, 3rd Edition, World Scientific, London, 2018
3. Norio Sato. Electrochemistry at Metal and Semiconductor Electrodes, 1st Edition, Elsevier Science & Technology, Oxford, 1998.
4. Marcel Pourbaix. Atlas of Electrochemical Equilibria in Aqueous Solutions, 2nd Edition, NACE International, Brussels, 1974
5. Allen J. Bard, Martin Stratmann, and all authors. Encyclopedia of Electrochemistry, 1st Edition, *John Wiley & Sons*, New York 2007

EXTRACTION & ISOLATION FOR NATURAL PRODUCTS TECHNOLOGY

ENCH800030
3 CREDITS
Learning Objectives:

Able to compare various principles that relate to extraction technology and isolation of natural materials; Determine extraction and / or isolation techniques appropriate for certain natural materials; Developing process skills to solve problems related to the field of extraction technology and natural material isolation

Syllabus:

Natural substances and secondary metabolites, Variety of natural material products, Selection and preparation of materials for extraction, Selection and preparation of materials for isolation, Natural material extraction techniques, Fractionation techniques and isolation of natural materials

Prerequisite: -

Textbook:

1. Rydberg, Cox, & Musikas. Solvent Extraction Principles and Practice 2nd Edition. Marcel Dekker, Inc. 2004.
2. Meireles, M. Angela A. Extracting Bioactive Compounds for Food Products: Theory and Applications. CRC Press – Taylor & Francis Group, LLC. 2009.
3. Rostagno, Mauricio A. & Prado, Juliana M. Natural Product Extraction: Principles and Applications. RSC Publishing. 2013.

SPECIAL TOPIC 1

ENCH800031
3 CREDITS

NATURAL GAS PROCESSING

ENCH800033
3 CREDITS
Learning Objectives:

Able to design natural gas refineries for piped gas, pressurized natural gas, or LNG if given a fluid composition that reaches the surface of the reservoir.

Syllabus:

Introduction and terms in Natural Gas Processing; Physical Properties of Hydrocarbon Fluid; Hydrocarbon Water System; Hydrate; Dew Point Control Unit; AGRU; Absorption Dehydration Unit; Adsorption Dehydration Regeneration Unit; Heavy Hydrocarbon Recovery Unit; LNG Processing

Prerequisites:

Chemical Process Simulation

Textbook:

1. Maddox, R.N. dan Morgan, D.J., Pengondisian dan pemrosesan gas, Vol 4: Mengolah gas dan sulfur pemulihan, Campbell Petroleum Series, 1998.
2. Kohl, A. dan Nielsen, R., pemurnian gas, Edisi ke-5, Gulf Publishing Company, 1997.
3. Kidnay, A.J. dan Parrish, W.R., Fundamentals of natural gas processing, Taylor & Francis, 2006
4. Gas Conditioning and Processing Vol. 1
5. Gas Conditioning and Processing Vol. 2

Elective Courses in Even Semester

PACKAGING AND STORAGE TECHNOLOGY

ENCH800034
3 CREDITS
Learning Objective:

Students are able to describe characteristics, packaging and storage food technology, the relation between storage and packaging with quality of food, describe factors affecting deviation of food qualities as well as able to choose storage methods and packaging types which is appropriate to food materials.

Syllabus:

Hydratase, material storage technology and food products, deviation of food material qualities, microbial contaminant, purpose and function of food packaging, interaction between food packaging and

packaging material types

Prerequisite : -

Textbook :
1. Examining Food Technology by Anne Barnett. Heinemann Secondary,1996
2. Julianti, Sri. The Art of Packaging. Gramedia Pustaka Utama. 2014.
3. Han, Jung H., et al. Innovations in Food Packaging. Elsevier. 2005.

BIOINFORMATICS

ENCH800035
3 CREDITS
Learning Objective:

Are able to explore database and programs to be applied in genetic engineering sectors, proteomic etc

Syllabus:

Database, genomics, genetic molecular, phylogeny, protein structure, metabolism and tissues

Textbook:
1. Bioinformatics by Shalini Suri. APH Publishing, 2006
2. Bioinformatics: A Primer by Charles Staben and Staben. Jones & Bartlett Publishers, 2005

DRUGS AND COSMETICS TECHNOLOGY

ENCH800036
3 CREDITS
Syllabus:

Definition of drugs and cosmetics, types of skins and characteristics, cosmetic types, ethics and regulation of drugs and cosmetics, new drug development technology, process technology in drug and cosmetics industries, packaging technology of drugs and cosmetics technology.

Prerequisite:

Organic Chemistry

Textbook:
1. Handbook of Cosmetic Science and Technology by Andre O. Barel, Marc Paye, Howard I. Maibach. INFRMA-HC 2009
2. Biodesign: The Process of Innovating Medical Technologies by Stefanos Zenios, Josh Makower , Paul Yock , Todd J. Brinton, Uday N. Kumar, Lyn Denend, Thomas M. Krummel.

PETROLEUM PROCESSING

ENCH800037
3 CREDITS
Learning Objectives:

Able to explain petroleum characteristics and its refined product and the stages of the process from various petroleum processing technologies.

Syllabus:

Introduction terminology, oil composition, thermal properties of petroleum, chemical processing of petroleum processing, distillation, hydrogenation and dehydrogenation, cracking processes, the processes of reforming, gas processing and petroleum light products, product improvement.

Prerequisites:

Fluid and Particle Mechanics, Thermodynamics, Mass Transfer.

Textbook:
1. James G. Speight, The Chemistry and Technology of Petroleum, 5th Edition. CRC Press, 2014.
2. Mark J. Kaiser, Arno de Klerk, James H. Gary and Glenn E. Handwerk, Petroleum Refining: Technology, Economics, and Markets, 6th Edition. CRC Press, 2019.
3. D. S. J. Jones, Elements of Petroleum Processing, John & Sons Wiley

PETROCHEMICAL PROCESSING

ENCH800038
3 CREDITS
Learning Objectives:

Able to explain the development of petrochemical products and raw material potential, upstream / downstream petrochemical production lines (olefin center, aromatic center, and the pathways of methane) and the major production processes of several petrochemical industries through methane, olefins and aromatics; able to analyze the impact of industrial processes and petrochemical products to the environment.

Syllabus:

History of the general petrochemical products development and raw material potential, the scope of the petrochemical industry, petrochemical classification process, the type and processing raw materials into petrochemical products, the details of various petrochemical industry: olefins center, aromatics and the center line of methane, industrial and environmental impact of products petrochemicals.

Prerequisites:

Organic Chemistry

Textbook:
1. Martyn V. Twigg, “Catalyst Handbook”, 2nd Ed., Wolfe Pub. Ltd.
2. Lewis T. Hatch, Sami Matar, “From Hydrocarbon to Petrochemical”.
3. Wells, Margaret G., “Handbook of Petrochemi-

cals and Processes", Gower Publishing Company Ltd., 1991.
4. Pandjaitan Maraudin, Industri Petrokimia dan Pengaruh Lingkungan, Gadjah Mada University Press, 2002.

PHOTOCATALYSIS TECHNOLOGY

ENCH800037
3 CREDITS
Learning Objectives:

Able to understand the basic concepts and photocatalysis and apply them in the various simple daily problem, especially related to environment, health, and energy.

Syllabus:

The basic concept photocatalysis processes, thermodynamics and kinetics of photocatlytic process, semiconductor photocatalyst materials, the basic parameters of photocatlytic process, Photocatalyst Nanomaterial Engineering, photocatlytic applications for degradation of organic pollutants and heavy metals, photocatalysis applications for self-cleaning and anti fogging, photocatalysis applications for anti-bacterial and cancer therapy, photocatalysis applications for engineering 'daily life tools', photocatalysis applications in renewable energy sector, solar detoxification engineering with photocatalysis, intensification of photocatalysis process.

Prerequisites:

Chemical Reaction Engineering 1

Textbook:

1. M. Schiavello, Heterogeneous Photocatalysis, John Wiley & Sons, 1997.
2. A. Fujishima, K. Hashimoto, and T. Watanabe, TiO2 Photocatalysis: Fundamentals and Applications, BKC Inc. Japan, 1999.
3. J.B. Galvez, et.al., Solar Detoxification, Natural Sciences, Basic and Engineering Sciences, UNESCO.
4. M. Kaneko, I. Okura, Photacatalysis Science and Technology, Springer USA, 2002.
5. C.A. Grimes, G.K. Mor, TiO2 Nanotube Arrays: Synthesis, Properties, and Applications, Springer, New York, 2009.
6. Paper-paper dan bahan lain dari berbagai Jurnal Ilmiah dan website.

EXPLORATION AND PRODUCTION OF HYDROCARBON

ENCH800040
3 CREDITS
Learning Objectives:

Students are able to explain the economic concept of natural gas and analyze the 4e economy.

Syllabus:

Introduction of hydrocarbon, life cycle of field development, hydrocarbon form and hydrocarbon property and reservoir, hydrocarbon exploration: geology, geophysics, and drilling, field appraisal, reservoir development, drilling development, hydrocarbon production, HSE, hydrocarbon economy and lease, coal and hydrocarbon unconventional (CBM, Shale gas, and Hydrate Gas)

Prerequisites:-

Textbook:

1. Frank Jahn et all, 2008, Hydrocarbon Exploration and Production, Developments in Petroleum Science, second edition
2. Babusiauz et al., 2004, Oil and Gas Exploration and Production. Reserves, Cost and Contracts, IFP-Technip,
3. M. Kelkar, 2008, Natural Gas Production Engineering, PennWell Publications
4. Norman J. Hyne, 2001, Nontechnical Guide to Petroleum Geology, Exploration, Drilling and Production, Pennwell Books, 2 edition.

POLLUTION PREVENTION

ENCH800041
3 CREDITS
Learning Objectives:

Able to explain the concepts of pollution prevention and able to design the waste treatment system.

Syllabus:

Introduction to the concept of pollution prevention, wastewater treatment outline and preparation, wastewater treatment in physical, biological, and chemical as well as the operating unit, bioremediation, bioseparation and biodegradation, advanced oxidation processes, the handling of waste gas, waste handling B3, solid waste handling, effluent treatment, gas, is unconventional.

Prerequisites:

Chemical Reaction Engineering 1.

Textbook:

1. Freeman, H. M., Industrial Pollution Prevention Handbook, McGraw-Hill, New York, 1995.
2. Eckenfelder, W. W., Jr.., Industrial Water Pollution Control. 3rd ed. McGraw-Hill International Editions, New York, 2000.
3. Metcalf & Eddy. (Revised by Tchobanoglous, G. & F. L. Burton). Waste Water Engineering: Treatment, Disposal, Reuse, 3rd ed., McGraw-Hill, Singapore, 1991.
4. Heinson R. J. & R. L. Cable. Source and Control of Air Pollution. Prentice Hall. New Jersey. Of 1999.

5. Legislation on the prevention of pollution and waste management.
6. Journals, the Internet.

MICROALGAE CULTIVATION AND DEVELOPMENT TECHNOLOGY

ENCH800042
3 CREDITS
Learning Objectives:

Able to have insight into the use of microalgae from the cultivation process to its conversion into products of high economic value; able to develop the utilization of microalgae by using a variety of technologies that are currently developing.

Syllabus:

Introduction to microalgae, microalgae cultivation process, microalgae harvesting techniques, the process of extracting microalgae into algal oil and its residues, economic analysis of the development and utilization of microalgae.

Prerequisites: -

Textbook:
1. Richmond, Amos, et al. 2013. Handbook of Microalgal Culture: Applied Phycology and Biotechnology, 2nd Ed. John Wiley and Sons
2. E.W. Becker. 1994. Microalgae: Biotechnology and Microbiology. London, Cambridge University Press.

UTILITIES AND PLANT MAINTENANCE

ENCH800043
3 CREDITS
Learning Objectives:

Able to explain the strategy of plant and utility maintenance.

Syllabus:

Plant maintenance strategy: maintenance program, maintainability, reliability, planning and scheduling

Prerequisite:

Chemical Engineering Thermodynamics

Textbook:
1. Dhillon, B.S., Engineering Maintenance: A Modern Approach, CRC Press, 2002.
2. Higgins, L.R., Mobley, R.K. dan Smith, R., Maintenance Engineering Handbook, McGraw-Hill, 2002.
3. Sanders, R.E., Chemical Process Safety, Elsevier, 2005.
4. Palmer, D., Maintenance Planning and Scheduling Handbook, McGraw-Hill, 1999.

TRANSPORTATION AND UTILIZATION OF NATURAL GAS

ENCH800044
3 CREDITS
Learning Objectives:

Able to analyze several options for the use of natural gas for both energy and feedstocks

Syllabus:

Overview of natural gas: nature and quality, historical milestones, environmental aspects, international issues, and structure of the natural gas industry; transportation and storage of natural gas in the gas phase and liquid phase; natural gas utilization: gas as fuels, gas to synfuels and chemicals, gas to wires/power

Prerequisite: -

Textbook: -

MIXING TECHNOLOGY

ENCH800045
3 CREDITS
Learning Objectives:

Able to understand the basic principles of mixing technology and apply them in the design of mixing systems for various applications in industry.

Syllabus:

Definition of mixing, basic principles and basic concepts of mixing; mixing and mixing mechanism, mixing thermodynamics, mixing fluid flow, friction in mixing, etc.), types of mixing (gas-liquid, liquid-liquid, liquid-solid, suspension, emulsification), mixing techniques (agitation, blending, mixing, particle size reduction, sear etc.), mixing equipment both batch and continuous (mixer type, drainage type, etc.), mixing monitoring and control. Examples of the application of blending in the chemical, pharmaceutical, cosmetic and food industries.

Prerequisites:

Physical Chemistry, Fluid Mechanics and Materials Science

Textbooks:
1. Handbook of Industrial Mixing: Science and Practice edited by Edward L. Paul, Victor A. Atiemo-Obeng, Suzanne M. Kresta, John Wiley and Sons Inc. Publication (2003).
2. Food Mixing: Principles and Applications, edited by P. J. Cullen, Ireland, John Wiley and Sons Inc. Publication (2007).
3. Pharmaceutical Blending and Mixing 1st Edition by P. J. Cullen (Editor), Rodolfo J. Romañach (Editor), Nicolas Abatzoglou (Editor), Chris D. Rielly, John Wiley and Sons Inc. Publication (2015)..

PROBLEM SOLVING SKILLS

ENCH800046
3 CREDITS
Learning Objectives:

Able to develop an understanding of the Problem Based Learning (PBL) learning method in order to be able to direct their own learning (independent learning), communicate effectively and work in groups; able to develop the ability to think critically, creatively, innovatively and have the intellectual ability to solve problems effectively both individually and in groups

Syllabus:

Introduction to PBL, individual problem-solving concepts, problem-solving concepts in groups

Precondition: -

Textbooks:

1. Woods, D. R., 1994, Problem based learning: How to gain the most from PBL, McMaster University, Hamilton, ON L8S 4L8.
2. Journal or articles related to each PBL problem.

POLYMER TECHNOLOGY

ENCH800047
3 CREDITS
Learning Objectives:

Able to develop an understanding of the basic principles of polymer synthesis and characterization, so that they can understand, solve polymer problems found in daily life and in industry, and can keep abreast of developments in the latest polymer technology.

Syllabus:

The concept of polymers, Synthesis and kinetics of polymerization, Polymer solutions, Characterization, Plastic manufacturing processes.

Prerequisite:

Organic Chemistry

Textbooks:

1. Billmeyer, F.W, 2011, **Textbook** of Polymer Science,3rd edition, John Wiley & Sons Inc.
2. Young, R.J. and Lovell, P.A, 2011, Introduction to Polymers, R.J.Lovell, 3rd edition, CRC Press. Taylor & Francis Group, Boca Raton, FL 33487-2742.
3. Seymour, R.B, 1989, Polymers for Engineering Applications, ASM International.
4. Crawford, R.J, 1998, Plastic Engineering, 3rd edition, Butterworth-Heinemann, Woburn, MA 01901-2041.
5. Woods, D. R., 1994, Problem based learning: How to gain the most from PBL, McMaster University, Hamilton, ON L8S 4L8.
6. Journal or articles related to each PBL problem.

GENETICALLY MODIFIED ORGANISM

ENCH800048
3 CREDITS
Learning Objectives:

Students are able to plan the design of transgenic organisms for purposes in the fields of food, pharmacy and health, energy, or the environment as one of the supporting knowledge in Bioprocess Technology courses

Syllabus:

Gene expression and function, genome, introduction and development of GMO organisms, genome modification techniques, methods of analyzing GMO organisms, GMO organisms in food, GMO organisms in pharmacy and health, GMO organisms in energy, GMO organisms in the field the environment, and the latest research and applications related to GMO organisms.

Prerequisite:

Genetic Engineering

Textbooks:

1. Harvey Lodish, Arnold Berk, Chris A. Kaiser and Monty Krieger. W. H. Molecular Cell Biology. 6th edition. FreemanS
2. T. A. Brown. 2010. Gene Cloning and DNA Analysis. 6th edition. Willey Blackwell: Hongkong.
3. Jurnal ilmiah terbaru terindeks scopus

DRUG CONTROLLED RELEASED TECHNOLOGY

ENCH800049
3 CREDITS
Learning Objective:

Able to describe the principle of control drug release or bioactive compound for medical purposes and utilize the principle to apply control drug released technology

Syllabus:

Polymeric biomaterial that is easily degradable, various methods to drug encapsulation and bioactive compounds in nano/microsphere, diffusion and permeation, the strategy of control released, case study

Prerequisite:

Organic Chemistry

Textbook:

1. Juergen Siepmann et al. (ed.) Fundamentals and Applications of Controlled Release Drug Delivery, Springer
2. Clive Wilson and Patrick Crowley (ed.) Controlled

Release in Oral Drug Delivery, Springer
3. Hong Wen and kinam Park (ed.) Oral Controlled Release Formulation Design and Drug Delivery, Wiley, 2010.
4. WM Saltzman, Drug Delivery: Engineering Principles for Drug Therapy, Oxford University Press, 2001.
5. Nissim Garti, Delivery and *controlled release of bioactives in foods and nutraceuticals*, CRC Press, 2008.

SPECIAL TOPIC 2

ENCH800050
3 CREDITS

BIOMASS TERMOCHEMICAL CONVERSION TECHNOLOGY

ENCH800051
3 CREDITS
Learning Objectives:

Able to understand the chemical characteristics of biomass and the basic principles of thermo-chemical biomass conversion technology and its application in the design of biomass thermochemical conversion systems to produce fuels and chemicals.

Syllabus:

Chemical characteristics of biomass, biomass classification, thermo-chemical conversion through pyrolysis (fast pyrolysis, slow pyrolysis, co-pyrolysis, hydrodeoxygenation, catalytic pyrolysis, catalytic co-pyrolysis, pyrolysis reactor), thermo-chemical conversion through biomass gasification, thermo-chemical conversion through biomass ligation , physical and chemical analysis of biomass feed and biomass thermo-chemical conversion products, pyrolysis for the manufacture of biofuels and chemicals, biomass gasification for the manufacture of synthetic gases, liquefaction of biomass for the manufacture of biofuels.

Prerequisites:

Organic Chemistry, Heat Transfer, Chemical Reaction Techniques 1

Textbooks:

1. Robert C. Brown, Thermochemical processing of biomass: conversion into fuels, chemicals and power, 2nd edition, Wiley Series in Renewable Resources, 2019
2. Mark Crocker, Laurie Peter, Ferdi Schuth, Tim Z. Zhao, Heinz Frei, Thermochemical conversion of biomass to liquid fuels and chemicals, RSC Publishing, 1st edition, 2010
3. James Clark and Fabien Deswarte, Introduction to chemicals from biomass, 2nd edition, John Wiley and Sons, 2015
4. Piet Schenkelaars, Value-added chemicals from biomass, Pira International Ltd, 2012

BASIC COMPUTER PROGRAMMING

ENCH800052
3 CREDITS

Learning Objectives:

Able to formulate and solve cases using logical concepts and programming algorithms and able to construct simple programs consisting of consecutive instructions in Python and MATLAB.

Syllabus:

Introduction: Why should one learn to write programs; Variables, expressions, and statements; Conditional executions; Functions; Iteration; Strings; Files; Lists; Dictionaries; Tuples; Using Python for numerical integration with the Simpson's rule, to solve root finding problem employing the secant method, to solve ordinary differential equation; Introduction to MATLAB/GNU Octave; Numerical methods with MATLAB/GNU Octave; Application of MATLAB/GNU Octave in transport phenomena and chemical reaction engineering.

Prerequisites:

Textbooks:

1. Constantinides, A. dan Mostouvi, N., 1. Numerical Methods for Chemical Engineers with MATLAB Applications, Prentice Hall, 1999.
2. Davis, M.E., Numerical Methods and 2. Modeling for Chemical Engineer, John Willey & Sons, New York, 1984.
3. Rice, G.R. dan Duong D.D., Applied 3. Mathematics and Modeling for Chemical Engineers, John Willey & Sons, New York, 1995.
4. Tosun, I., Modeling in Transport Phenomena: 4. A Conceptual Approach, Elsevier, 2002.

PEMODELAN TEKNIK BIOPROSES

ENCH800053
3 CREDITS
Learning Objectives:

Able to develop mathematical equations from biochemical process systems; able to solve mathematical equations that describe biochemical process systems.

Syllabus:

An explicit method for solving ordinary differential equations; Finite difference method for solving ordinary & partial differential equations; Empirical Model; Phenomenological model for multi-component separation systems; Phenomenological model for chemical reaction systems; Phenomenological model for reactor systems

Prerequisites:

Komputasi Numerik (Numerical Computation)

Textbooks:

1. Constantinides, A. dan Mostouvi, N., 1. Numerical Methods for Chemical Engineers with MATLAB Applications, Prentice Hall, 1999.
2. Davis, M.E., Numerical Methods and 2. Modeling for Chemical Engineer, John Willey & Sons, New York, 1984.
3. Rice, G.R. dan Duong D.D., Applied 3. Mathematics and Modeling for Chemical Engineers, John Willey & Sons, New York, 1995.
4. Tosun, I., Modeling in Transport Phenomena: 4. A Conceptual Approach, Elsevier, 2002.

BIOPROCESS ENGINEERING DRAWING

ENCH800054
3 CREDITS
Learning Objectives:

Able to manually draw process flow diagrams, P&ID and plant layouts, recognize the use of software for drawing, understand, and be able to read the meaning of images.

Syllabus:

Introduction to drawing techniques; Basics of drawing technique; Block Process Flow Diagram; Symbols basic symbols of equipment Chemical industry and process flow; Process Flow Diagram (PFD); Equipment symbols, pipes, instrumentation; Piping and Instrumentation Diagram (P&ID); Software for drawing; Plant Plots & Plant Layouts; Piping Route and Isometric Drawing; Spool Drawing and Bill of Materials (BOM). Bill of Quantity (BOQ)

Prerequisites: -

Textbooks:

1. W. Boundy, Engineering Drawing, McGraw-Hill Book Company
2. Colin Simmons & Dennis Maguire, Manual of Engineering Drawing, Edward Arnold
3. ISO 1101, Mechanical Engineering Drawings, International Organization for Standardization
4. Japanese Industrial Standard, Technical Drawing for Mechanical Engineering, Japanese Standard Association.
5. Warren J. Luzadder, Fundamentals of Engineering Drawing, Prentice-Hall, Inc

CHAPTER 5

MASTER PROGRAM

Master Program in Chemical Engineering

Program Specification

1.	**Awarding Institution**	Universtas Indonesia	
2.	**Host Institution**	Universtas Indonesia	
3.	**Faculty**	Engineering	
4.	**Program Title**	Master Program in Chemical Engineering	
5.	**Vision and Mission**	Vision Becoming a superior and competitive Chemical Engineering Study Program, through efforts to educate the nation's life to improve people's welfare, thus contributing to the development of Indonesian and world society Missions - Providing broad and fair access, as well as quality education and teaching in Chemical Engineering; - Organizing quality Tridharma activities that are relevant to national and global challenges; - Creating graduates of Chemical Engineering who are of high quality, noble character, and able to compete globally; - Creating an academic climate that can support the realization of the vision of the Department	
6.	**Class**	a. Chemical Engineering b. Gas Management c. Energy and Sustainable Process d. Process Intensification Technology e. Process Safety Management	
7.	**Final Award**	Magister Teknik (MT)	
8.	**Accreditation / Recognition**	BAN-PT: accredited A	
9.	**Language(s) Of Instruction**	Bahasa Indonesia	
10.	**Study Scheme (Full Time / Part-Time)**	Full Time	
11.	**Entry Requirements**	Bachelor degree / equivalent	
12.	**Study Duration**	4 (four) Semesters or 2 (two) Years	
	Type of Semester	Number of semester	Number of weeks/semesters
	Reguler	4	16
	Short (opsional)		
13.	**Aims of the programme:** The aim of the Master in Chemical Engineering program is to provide high-quality graduate-level education so that graduates have the knowledge, abilities, and experience in researching the latest topics in chemical engineering		
14.	**Graduate Profile:** The graduate who is able to develop alternative solutions to the problem deeply through the management of research activities based on scientific principles in the field of specific specialization in chemical engineering and contribute to meeting the Sustainable Development Goals (SDGs)		

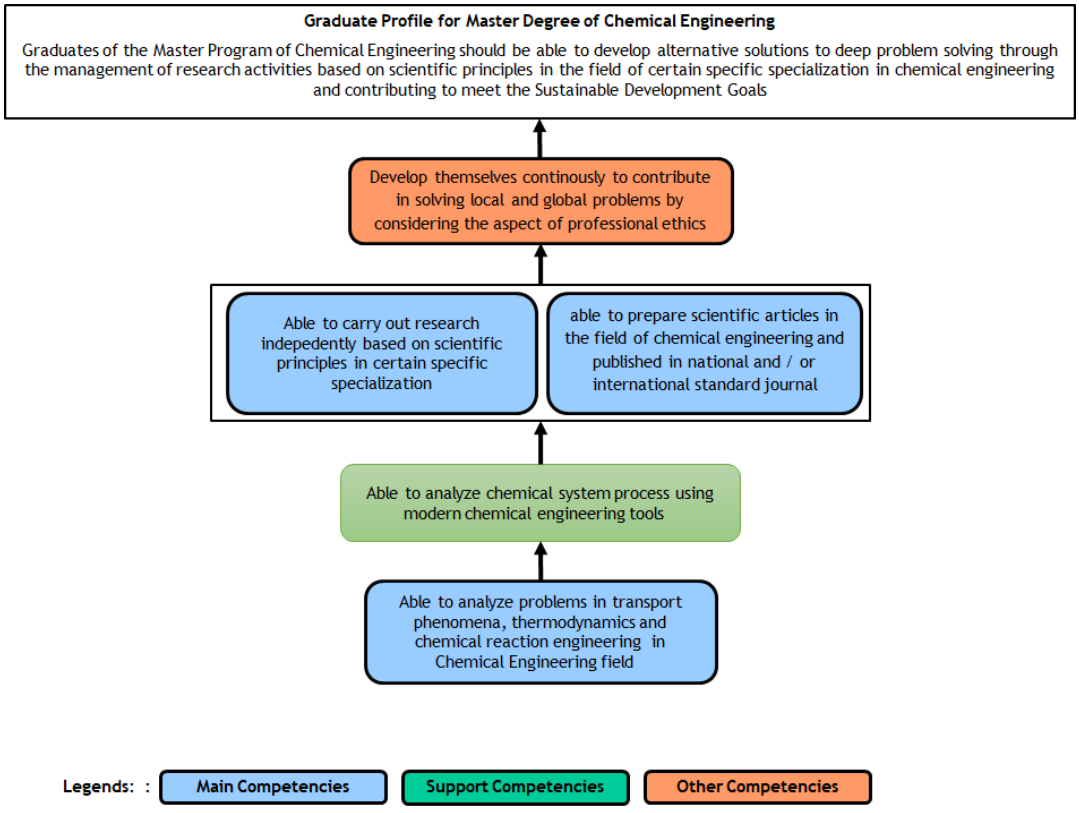
15.	**Expected Learning Outcomes (ELO):** 1. Able to analyze problem-related to thermodynamics, transport phenomena, and chemical reaction engineering in the field of chemical engineering 2. Able to analyze chemical process system using modern computation tools 3. Able to manage research activities independently based on scientific principles in certain fields of specialization 4. Able to write and manage scientific articles in the field of chemical engineering and published in national or international publication 5. Able to develop themselves continuously to be able to contribute according to professional ethics in solving local and global problems
16.	**Course composition**

No.	Type of Courses	Credit Hours (SKS)	Percentage
I	**Total Compulsory Credits**	21	52,5%
II	**Total Elective Credits**	9	22,5%
III	**Scientific Publication, Pra Thesis and Thesis**	10	25,0%
	Total	40	100 %
	Total Credit Hours To Graduate		40 Credits

Employment Prospects

A Graduate of Master in Chemical Engineering study program at UI can be contributed in the following areas: in various industrial companies, research, and education institutions such as the chemical industries, oil and gas industries, engineering consultants, LIPI, Lemigas, and other related fields. Job names suitable for graduates of this program include process engineers, control engineers, program managers, project managers, technical managers, lecturers, and researchers. Some graduates have started working before graduating from the study program.

The Network of Expected Learning Outcome (ELO)



Mapping Table for Achieving ELO in the Chemical Engineering Master Program for Regular Class

Expected Learning Outcome (ELO)	Name of Course			
	1st Semester	2nd Semester	3rd Semester	4th Semester
Able to analyze problem related to thermodynamics, transport phenomena, and chemical reaction engineering in field of chemical engineering	Adv Chemical Eng Thermodynamics	Advanced Transport Phenomena Advanced Chemical Reaction Engineering		
Able to analyze chemical process system using modern computation tools	Natural Gas Processing	Advanced Chemical Engineering Modeling		
Able to manage research activities independently based on scientific principles in certain fields of specialization		Research Methodology	Pre Thesis	Thesis
Able to write and manage scientific articles in the field of chemical engineering and published in national or international publication				Scientific Publication
Able to develop themselves continuously to be able to contribute according to professional ethics in solving local and global problems	Sustainable Energy Elective 1		Elective 2 Elective 3	

Mapping Table for Achieving ELO in the Chemical Engineering Master Program for Gas Management Class

Expected Learning Outcome (ELO)	Name of Course			
	1st Semester	2nd Semester	3rd Semester	4th Semester
Able to analyze problem related to thermodynamics, transport phenomena, and chemical reaction engineering in field of chemical engineering	Adv Chemical Eng Thermodynamics			
Able to analyze chemical process system using modern computation tools	Natural Gas Processing	Natural Gas Economics		
Able to manage research activities independently based on scientific principles in certain fields of specialization			Pre Thesis	Thesis
Able to write and manage scientific articles in the field of chemical engineering and published in national or international publication				Scientific Publication
Able to develop themselves continuously to be able to contribute according to professional ethics in solving local and global problems	Sustainable Energy	System Eng Management.	Natural Gas Project Management	
	Elective 1	Elective 2	Health and Safety in Natural Gas Industry	
		Elective 3		

List of Courses for Chemical Engineering Master Program (Regular Class)

Code	Subject	SKS
	Compulsary Courses (21 Credits)	
ENCH800001	Adv Chemical Eng Thermodynamics	3
ENCH800003	Advanced Transport Phenomena	3
ENCH800004	Advanced Chemical Reaction Engineering	3
ENCH800005	Adv Chemical Eng. Modeling	3
ENCH800006	Research Methodology	3
ENCH800009	Natural Gas Processing	3
ENCH800027	Sustainable Energy	3
	Elective Courses (9 Credits)	
	Elective 1	3
	Elective 2	3
	Elective 3	3
	Special Courses (10 Credits)	
ENCH800007	Pre Thesis	2
ENCH800008	Thesis	6
ENCH800055	Scientific Publications	2
	Matriculation Courses for Non-Chemical Engineering Bachelor (13 Credits)	
ENCH600005	Numerical Computation	3
ENCH600010	Transport Phenomena	3
ENCH600013	Chemical Eng Thermodynamics	4
ENCH600019	Chemical Reaction Engineering 1	3

Curriculum Structure Master Program Chemical Engineering

Courses Structure of Master Program in Chemical Engineering for Regular Class

Code	Subject	SKS
	1st Semester	
ENCH800001	Adv Chemical Eng Thermodynamics	3
ENCH800027	Sustainable Energy	3
ENCH800009	Natural Gas Processing	3
	Elective 1	3
	Sub Total	**12**
	2nd Semester	
ENCH800003	Advanced Transport Phenomena	3
ENCH800004	Advanced Chemical Reaction Engineering	3
ENCH800005	Adv Chemical Eng. Modeling	3
ENCH800006	Research Methodology	3
	Sub Total	**12**
	3rd Semester	
ENCH800007	Pre-Thesis	2
	Elective 2	3
	Elective 3	3
	Sub Total	**8**
	4th Semester	
ENCH800008	Thesis	6
ENCH800055	Scientific Publication	2
	Sub Total	**8**
	Total	**40**

Courses Structure of Master Program in Chemical Engineering for Regular Class from Non-Chemical Engineering Bachelor

Code	Subject	SKS
	1st Semester	
Matrikulasi-ENCH600010	Transport Phenomena	-
Matrikulasi-ENCH600005	Numerical Computation	-
Matrikulasi-ENCH600019	Chemical Reaction Engineering 1	-
	Elective 1	3
	Elective 2	3
	Sub Total	**6**
	2nd Semester	
Matrikula-	Chemical Eng Thermodynamics	-

ENCH800003	Advanced Transport Phenomena	3
ENCH800004	Advanced Chemical Reaction Engineering	3
ENCH800005	Adv Chemical Eng. Modeling	3
ENCH800006	Research Methodology	3
	Sub Total	**12**
	3rd Semester	
ENCH800001	Adv Chemical Eng Thermodynamics	3
ENCH800027	Sustainable Energy	3
ENCH800009	Natural Gas Processing	3
ENCH800007	Pre-Thesis	2
	Elective 3	3
	Sub Total	**14**
	4th Semester	
ENCH800007	Thesis	6
ENCH800008	Scientific Publication	2
	Sub Total	**8**
	Total	**40**

List of Elective Courses

Code	List of Elective Courses Odd Semester	SKS	Code	List of Elective Courses Even Semester	SKS
ENCH800014	Oleochemical Industry	3	ENCH800034	Storage and Packing Technology	3
ENCH800015	Food Technology	3	ENCH800035	Bioinformatics	3
ENCH800016	Protein Engineering	3	ENCH800013	Drugs and Cosmetics Technology	3
ENCH800017	Herbal Technology	3	ENCH800037	Petroleum Processing	3
ENCH800018	Composite Material	3	ENCH800038	Petrochemical Processing	3
ENCH800019	Applied Thermodynamics	3	ENCH800039	Photocatalytic Technology	3
ENCH800020	Dynamic System	3	ENCH800040	Exploration and Production of Hydrocarbon	3
ENCH800021	Thermodynamics System of Hydrocarabon	3	ENCH800041	Waste Management and Prevention	3
ENCH800022	Lubricats Engineering	3	ENCH800042	Microalgae Cultivation & Development Tech	3
ENCH800023	Cryogenic Engineering	3	ENCH800043	Plant Utility and Maintenance	3
ENCH800024	Combustion Engineering	3	ENCH800044	Transp & Utilization of Natural Gas	3
ENCH800025	Plasma and Ozone Engineering	3	ENCH800045	Mixing Technology	3
ENCH800026	Heterogeneous Catalysts	3	ENCH800046	Problem Solving Skills	3
ENCH800028	Risk Management	3	ENCH800047	Polymer Technology	3
ENCH800029	Electrochemical Technology	3	ENCH800048	Genetic Modification Orgasnism	3
ENCH800030	Extraction & Isolation For Natural Product	3	ENCH800049	Technology of Controlled Drug Release	3
ENCH800031	Special Topics 1	3	ENCH800050	Special Topics 2	3
ENCH800032	Biochemical	5	ENCH800051	Biomass Termochemical Conversion	3
			ENCH800052	Basic Computer Programming	3

List of Courses of Master Program in Gas Management Specialization

Code	Subject	SKS
	1st Semester	
ENCH800001	Adv Chemical Eng Thermodynamics	3
ENCH800027	Sustainable Energy	3
ENCH800009	Natural Gas Processing	3
	Elective 1	3
	Sub Total	**12**
	2nd Semester	
ENCH800011	Natural Gas Economics	3
ENCH800012	Management Systems Eng.	3
	Elective 2	3
	Elective 3	3
	Sub Total	**12**
	3rd Semester	
ENCH800007	Pre Thesis	2
ENCH800010	Natural Gas Project Management	3
ENCH800002	OHS in Natural Gas Industry	3
	Sub Total	**8**
	4th Semester	
ENCH800008	Thesis	6
ENCH800055	Scientific Publication	2
	Sub Total	**8**
	Total	**40**

List of Elective Courses

Code	Subject	SKS
	List of Elective Courses Odd Semester	
ENCH800040	Exploration and Production of Hydrocarbon	-3
	List of Elective Courses Even Semester	
ENCH800028	Risk Management	3-
ENCH800044	Transp & Utilization of Natural Gas	3

List of Courses of Master Program in Energy and Sustainable Process

Code	Subject	SKS
	1st Semester	
ENCH800001	Adv Chemical Eng Thermodynamics	3
ENCH800027	Sustainable Energy	3
ENCH800009	Natural Gas Processing	3
ENCH800029	Electrochemical Technology	3
	Sub Total	**12**
	2nd Semester	
ENCH800051	Biomass Termochemical Conversion	3
ENCH800053	Green Hydrogen and Ammonia Production	3
ENCH800054	Carbon Capture, Utilization & Storage	3
	Elective 1	3
	Sub Total	**12**
	3rd Semester	
ENCH800007	Pre Thesis	2
	Elective 2	3
	Elective 3	3
	Sub Total	**8**
	4th Semester	
ENCH800008	Thesis	6
ENCH800055	Scientific Publication	2
	Sub Total	**8**
	Total	**40**

List of Elective Courses

Code	Subject	SKS
	List of Elective Courses Odd Semester	
ENCH800025	Plasma and Ozone Engineering	-3
ENCH800014	Oleochemical Industry	3
ENCH800020	Dynamic System	3

	List of Elective Courses Even Semester	
ENCH800042	Microalgae Cultivation & Development Tech	3
ENCH800039	Photocatalytic Technology	3
ENCH800046	Problem Solving Skills	3

List of Courses of Master Program in Process Intensification Technology

Code	Subject	SKS
	1st Semester	
ENCH800001	Adv Chemical Eng Thermodynamics	3
ENCH800027	Sustainable Energy	3
ENCH800009	Natural Gas Processing	3
ENCH800056	Membrane Sepration Technology	3
	Sub Total	**12**
	2nd Semester	
ENCH800004	Advanced Chemical Reaction Engineering	3
ENCH800057	Membrane Technology for Advanced Treatment	3
	Elective 1	3
	Elective 2	3
	Sub Total	**12**
	3rd Semester	
ENCH800007	Pre Thesis	2
ENCH800025	Plasma and Ozone Engineering	3
	Elective 3	3
	Sub Total	**8**
	4th Semester	
ENCH800008	Thesis	6
ENCH800055	Scientific Publication	2
	Sub Total	**8**

List of Elective Courses

Code	Subject	SKS
	List of Elective Courses Odd Semester	
ENCH800026	Heterogeneous Catalysts	3
ENCH800018	Composite Material	3
ENCH800029	Electrochemical Technology	3
Code	**Subject**	**SKS**
	List of Elective Courses Odd Semester	
ENCH800039	Photocatalytic Technology	3
ENCH800041	Waste Management and Prevention	3
ENCH800065	Simulation for Waste Water Treatment	3

List of Courses of Master Program in Process Safety Management

Code	Subject	SKS
	1st Semester	
ENCH800001	Adv Chemical Eng Thermodynamics	3
ENCH800027	Sustainable Energy	3
ENCH800009	Natural Gas Processing	3
ENCH800058	Failure Prob & Process Safety Stat	3
	Sub Total	**12**
	2nd Semester	
ENCH800059	Process Control and Safety	3
ENCH800064	Risk Management of Process	3
	Elective 1	3
	Elective 2	3
	Sub Total	**12**
	3rd Semester	
ENCH800007	Pre Thesis	2
ENCH800060	Hazard Identification	3
	Elective 3	3
	Sub Total	**8**
	4th Semester	
ENCH800008	Thesis	6
ENCH800055	Scientific Publication	2
	Sub Total	**8**
	Total	**40**

List of Elective Courses

Code	Subject	SKS
	List of Elective Courses Odd Semester	
ENCH800063	Data Analysis in Process Safety	-3
	List of Elective Courses Even Semester	
ENCH800062	Asset Integrity Management	3-
ENCH800061	Process Safety Design	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 Guidance from Curriculum 2016 to 2020 for Master of Regular and Management Gas Classes

1. New curriculum 2020 will be applied effectively from Odd Semester 2020/2021. In principle, after curriculum 2020 is implemented, then only courses from this new curriculum will be opened.
2. For class 2019 and above will follow these transition rules.
3. The enforcement of the transitional period is one year. During this transition period, if a course in curriculum 2020 is in odd Semester while in the previous curriculum in even Semester (vice versa), then this course can be held (if necessary) in both semesters.
4. For students who have not passed the compulsory courses in curriculum 2016, are required to take the same course or equivalent in curriculum 2020.
5. When there is a change in the course credits, then the number of graduation credits counted in is the number of credits when it was taken. The same or equivalent courses, when are equated with different credits, if retaken, or just taken, will be acknowledged under a new name and credits.
6. When a compulsory subject in the curriculum 2016 is deleted, and there is no equivalence in the curriculum 2020 then: For students who have passed these subjects, the credits that are achieved will be counted in the calculation of graduation 40 credits. For students who did not pass these courses, they can take new compulsory courses or choose elective subjects in the curriculum 2020 to complete 40 credits.
7. In addition to changes in curriculum structure from 2016 to 2020, there are also the addition of several elective courses: Teknologi Elektrokimia), Teknologi Pencampuran (Mixing Technology), Teknologi Pengembangan dan Pemanfaatan Mikroalga (Microalgae Cultivation and Development Technology), Teknologi Ekstraksi dan Isolasi Bahan Alam (Extraction & Isolation Technology for Natural Products), Konversi Termokimia Biomassa (Biomass Termochemical Conversion Technology), Modifikasi Genetik Makhluk Hidup (Genetically Modified Organism), dan Dasar Pemrograman Computer (Basic Computer Programming)

Syllabus of Master Program in Chemical Engineering Department for Regular Class

Compulsory Courses

Advanced Chemical Engineering Thermodynamics

ENCH800001
3 CREDITS
Learning Objectives:

Able to understand the basics of thermodynamics, fluid properties, phase equilibrium and reaction and be able to apply it to solve problems of chemical engineering.

Syllabus:

Analysis of the system using the several forms of the first and second laws, the equation network of thermodynamic for thermodynamic properties, condition equation, fluid-phase equilibrium, chemical reaction equilibrium

Prerequisite: Chemical Engineering Thermodynamics

Textbook:
1. Kyle, B.G., Chemical and Process Thermodynamics, 2nd ed., Pretice Hall, 1992.
2. Hand-out Kuliah.
3. Smith J.M. dan van Ness, H.C., Introduction to Chemical Engineering Thermodynamics, 4th ed., McGraw-Hill, 1985.
4. Callen, H.B., Thermodynamics and An Introduction to Thermostatics, 2nd ed., John Wiley and Sons, 1985.

Advanced Transport Phenomena

ENCH800003
3 CREDITS
Learning Objectives:

Able to understand the transport phenomenon of momentum, mass and heat simultaneously and able to apply it at the unit processes that involve the flow of single-phase or multiple phases

Syllabus:

Review of the theory of transfer of momentum, mass and heat simultaneously; analysis and application of single-phase system: mixing and dispersion, mixer; analysis and application of a combination system of gas-liquid phase, gas-solid, liquid-liquid, liquid-solid, gas-liquid-solid

Prerequisite: Transport Phenomena.

Textbook:
1. Bird R.B., Stewart, W.E. dan Lightfoot, E.N., Transport Phenomena, John Wiley & Sons, 2002.
2. Tosun, I., Modellling in Transport Phenomena, Elsevier, 2002.
3. Griskey, R.G., Transport Phenomena and Unit Operation: A Combined Approach, John Wiley & Sons, 2002.
4. Brodkey, R.S. dan Hershey, H.C., Transport Phenomena: A Unified Approach, McGraw-Hill, 1988.

Advanced Chemical Reaction Engineering

ENCH800004
3 CREDITS
Learning objectives:

Able to analyze the phenomenon of chemical kinetics, the kinetics reaction data to determine the equation mechanistic reaction rate; able to design and analyze the performance of non-ideal homogeneous and multiphase chemical reactors.

Syllabus:

Thermodynamics of the reaction; definitions and basic concepts: the rate of reaction, the reaction rate equation, the Arrhenius equation: reaction modeling and data analysis for the determination of reaction rate equations; the introduction of gas-solid heterogeneous catalysts: a reduction in reaction rate equations and data of heterogeneous catalytic reactions of solid-gas; effects of diffusion and heat transfer in the catalytic reaction data interpretation. Design of batch reactor and CSTR (isothermal, non-isothermal) reactor design PFR and PBR (isothermal, non-isothermal) sphere and the membrane reactor design; design-solid heterogeneous catalytic reactors with interstage gas cooler/heater; design of reactors for multiple reactions and mss (multiple steady-state). Design of non-ideal reactor (residence time distribution).

Prerequisite: Chemical Reaction Engineering 2

Textbook:
1. Fogler, H.S., Elements of Chemical Reaction Engineering, Prentice-Hall, 4th Ed., 2006.
2. Smith, J.M., Chemical Engineering Kinetics, 3rd ed., 1981, McGraw-Hill.
3. Thomas, JM, and Thomas WJ., Principles and Practice of Heterogeneous Catalysis, VCH Weinheim, 1997.

Advanced Chemical Engineering Modelling

ENCH800005
3 CREDITS
Learning Objectives:

Able to develop physicochemical model systems in chemical processes and solve it by using numerical methods with the assistance of software program

Syllabus:

Emphirical modelling and physicochemical system in Chemical process ; linear and non linear algebra equation system, simple differential equation, initial problem value and limits problem value, partial differential equation.

Prerequisite: Numerical Computation

Textbook:
1. Bismo, S. dan Muharam, Y., Metode Numerik & Komputasi dengan FORTRAN dan Pascal, 2011.
2. Constantinides, A. dan Mostouvi, N., Numerical Methods for Chemical Engineers with MATLAB Applications, Prentice Hall, 1999.
3. Davis, M.E., Numerical Methods and Modeling for Chemical Engineer, JohnWilley & Sons, New York, 1984.
4. Rice, G.R. dan Duong D.D., Applied Mathematics and Modeling for Chemical Engineers, John Willey & Sons, New York,1995.
5. Tosun, I., Modeling in Transport Phenomena: A Conceptual Approach, Elsevier, 2002.

Research Methodology

ENCH800006
3 CREDITS
Learning Objectives :

Able to determine the appropriate method for research activities and produce the ideas, processes, and scientific research in writing and oral.

Syllabus:

Introduction, techniques to identify problems and arrange hypotheses, think logically, the techniques of scientific writing, technical writing research proposals, designing research techniques, presentation techniques, techniques to collect data, analyze it and present it.

Prerequisites: Students have to take a minimum of 12 credits (minimum value of D) with a GPA of 2.0

Textbook
1. Handout.
2. Research Proposal Format The preparation of various agencies

Natural Gas Processing

ENCH800009
3 CREDITS
Learning Objectives :

Able to design natural gas refineries for piped gas, pressurized natural gas, or LNG if given a fluid composition that reaches the surface of the reservoir.

Syllabus:

Introduction and terms in Natural Gas Processing; Physical Properties of Hydrocarbon Fluid; Hydrocarbon Water System; Hydrate; Dew Point Control Unit; AGRU; Absorption Dehydration Unit; Adsorption Dehydration Regeneration Unit; Heavy Hydrocarbon Recovery Unit; LNG Processing

Prerequisite

Chemical Process Simulation

Textbook :
1. Gas Conditioning and Processing Vol. 1
2. Gas Conditioning and Processing Vol. 2

Sustainable Energy

ENCH800027
3 CREDITS
Learning Objectives:

Able to explain the relationship of energy with a social aspect, economic and environmental and sustainability concepts, and able to analyze the performance of techno-economy and the continuity, especially fossil energy system, new, and renewable.

Syllabus:

Concept of sustainability and sustainable energy, energy hierarchy, energy linkages with economic, environmental and social, fossil energy / fuels and Impacts, global climate change and its mitigation, conversion, transportation / distribution and storage, analysis method of energy sustainability: LCA , sustainability index, hydrogen and fuel cells and nuclear energy, solar energy (PV and thermal), wind and ocean, hydropower, bioenergy, geothermal energy, energy efficiency and conservation, carbon capture and storage

Prerequisites: Chemical Engineering Thermodynamics or Biochemical Engineering

Textbook:
1. Jefferson W. Tester, et al., Sustainable Energy: Choosing Among Options, MIT Press, 2005.
2. Godfrey Boyle, et al., Energy Systems and Sustainability: Power for a Sustainable Future, Oxford University Press, 2003.
3. E. Cassedy S, Prospects for Sustainable Energy: A critical assessment, Cambridge University Press, 2000.
4. DeSimone et al, Eco-Efficiency. The Business Link to Sustainable Development, MIT Press, 1997.
5. D. Elliot, enerfy, Society, and Environment, Technology for a sustainable future, Rouledge, 1997
6. Miller, G. T., Environment Science. Sustaining

Earth, Wardworld Publish Co. 1993

Special Courses

Pre-Thesis
ENCH800007
2 CREDITS
Learning Objectives :

Able to produce ideas, processes, and scientific research in writing and oral.

Syllabus:

Introduction, techniques to identify problems and arrange hypotheses, think logically, the techniques of scientific writing, technical writing research proposals, designing research techniques, presentation techniques, techniques to collect data, analyze it and present it.

Prerequisite: -

Thesis
ENCH800008
6 CREDITS
Learning Objectives :

Able to design, conduct, and analyze research in Chemical fields; present research result in oral and writing

Syllabus :

Thesis material based on research topic

Prerequisite:

Based on regulation

Textbook :
1. Petunjuk Penulisan Tugas Akhir UI

Scientific Publications
ENCH800055
2 CREDITS
Learning Objective : -

Syllabus : -

Prerequisite : -

Textbook : -

Matriculation

Numerical Computation
ENCH600005
Learning Objective :

Able to solve Mathematical problems by using numerical methods : method of calculat- ing root of a non-linear algebra equation, method of calculating a linear algebra equation system, methods of calculating non-linear algebra equation system, regression, numerical integration, numerical differentation.

Syllabus :

The solution of single non-linear algebra equation, solution of linear algebra equation system, solution of non linear algebra equations system, regression, numerical integration, numeri- cal differentation.

Prerequisite :

Calculus

Textbook :

1. Bismo, S. dan Muharam, Y., Metode Numerik & Komputasi dengan FORTRAN dan Pascal, 2011.
2. Constantinides, A. 1. dan Mostouvi, N., Numerical Methods for Chemical Engineers with MATLAB Applications, Prentice Hall, 1999.

Transport Phenomena
ENCH600010
Learning Objective:

Students can identify and describe as well as analyze momentum, mass, and heat transfer phenomenon, through the application of macroscopic and microscopic balance.

Syllabus:

Viscosity and momentum transfer phenomenon, Velocity distribution of laminar flow, Thermal conductivity and energy transfer mechanism, Temperature and concentration distribution in solids and laminar flow, Diffusivity and mass transfer mechanism, Converter equation for isothermal system, Momentum transfer in turbulent flow, Mass and energy transfer in turbulent flow, Transfer between two phases, Macroscopic balance of isothermal and non-isothermal system, Macroscopic balance of multi-component system.

Prerequisite: -

Textbook:
1. R.B. Bird, W.E. Stewart dan E.N. Lightfoot, Transport Phenomena, John Wiley, 1965.
2. Tosun, I., Modeling in Transport Phenomena: A Conceptual Approach, Elsevier, 2002.
3. J.R. Welty et al., Fundamentals of Momentum, Heat and Mass Transfer, 3rd ed., Wiley, 2984.
4. Brodkey, R. S dan RC Herskey, Transport Phenomena, McGraw-Hill, 1998.

Chemical Reaction Engineering 1
ENCH600019
Learning Objective:

Able to comprehend the concept of chemical kinetics and catalysis

Syllabus:

Basic concepts of chemical reaction kinetics, chemical reaction thermodynamics, experiments and kinetics data, formulation of kinetic models, the estimation method of constant values of the kinetic model, the sensitivity analysis of the kinetics model, catalyst and the influence of external and internal diffusion of the chemical reaction rate, the effectiveness factor, the effect of heat displacement at the catalytic reaction.

Prerequisite:

Physical Chemistry

Textbook:

1. Fogler, H.S., Elements of Chemical Reaction Engineering, Prentice-Hall, 3rd Ed., 1999
2. Fogler, H. S., and LeBlanc, Strategies for Creative Problem Solving, Prentice-Hall, 1995.
3. Levenspiel, O., Chemical Reaction Engineering, 2nd Ed., John Wiley & Sons., 1972.
4. K. J. Leidler, Chemical Kinetics, 3rd ed., Parper Publish, 1987.
5. Widodo, W.P., Slamet, Diktat Kuliah Kinetika dan Perancangan Reaktor Kimia, TGP-FTUI, 2002.

Chemical Engineering Thermodynamics

ENCH600013
Learning Objective:

Able to explain the basic principles relating to the PVT and thermodynamic properties of pure and mixtures compounds, mass and energy balance, thermodynamic cycles, phase equilibrium and reaction, and be able to apply problem-solving strategies to resolve the thermodynamic problems in a group.

Syllabus:

Skills assessment: The first law of thermodynamics: energy, enthalpy, steam tables, mass and energy balance of steady state and non-steady system; second law of thermodynamics and cyclic processes: entropy signification, Rankine cycle and refrigeration cycle; thermodynamic properties of pure and mixed compounds: the amount of residual and partial molar quantities; Equilibrium: Raoult's law and liquid-vapor phase equilibrium, activity coefficients and coefficients fugacity no ideal system, the chemical reaction equilibrium and Le Chatelier's principle; Simulation process: module of thermodynamics properties, phase equilibrium module, and reaction equilibrium module .

Prerequisites: -

Textbook:

1. J. M. Smith, H.I.C. van Ness, and M. M. Abbott, Introduction for Chemical Engineering Thermodynamic, 5th ed., McGraw-Hill, 1996.
2. Donald R. Woods, Problem-based Learning: How to gain the most PBL, 1994, Mc-Master University, Hamilton, ON L8S 4L8.
3. Mulia, K dan Wulan, PPDK, Buku Ajar Termodinamika Teknik Kimia.

Elective Courses

Elective Courses in Odd Semester

Oleochemical Industry

ENCH800014
3 CREDITS
Learning Objectives:

Able to know the various processes that commonly used in the oleochemical industry, and able to make a plan to develop the produce of oleochemicals from vegetable oils.

Syllabus:

Fatty acids, biodiesel, paints and polymers, detergents, soaps, fatty alcohol, glycerin, oils and fats, oil and greese, the development of oleochemicals, vegetable oil processing, vegetable oil technology in the process.

Prerequisites:

Organic Chemistry

Textbook:

Oleochemical Manufacture and Applications by Frank D. Gunstone, Richard J. Hamilton. Blackwell

Food Technology

ENCH800015
3 CREDITS
Learning Objectives:

Able to understand the processes of making food in the food industry, which includes the selection, handling, and processing of raw materials, the operating unit of food production, packaging, storage, and control of the process from the beginning stage to the end.

Syllabus:

Introduction, physical properties of raw materials, the basic concepts of energy and mass transfer, reaction kinetics, process control. mixing, filtration, centrifugation, extraction and membrane processes, adsorption and ion exchange column, with the temperature settings, drying, preservation, packaging, food storage, and hygiene.

Prerequisites: -

Textbook:
1. Zeki Berk, Food Process Engineering and Technology, Academic Press, Elsevier 2009
2. Food Technology: an introduction by Anita Tull. Oxford University Press, 2002
3. Introduction to Food Engineering by R. Paul Singh, R. Paul Singh and Dennis R. Heldman. Academic Press
4. Introduction to Food Process Engineering by P. G. Smith. Springer
5. Fundamentals of Food Process Engineering by Romeo T. Toledo. Springer

Protein Engineering

ENCH800016
3 CREDITS
Learning Objectives:

Students are able to determine protein engineering strategies for the benefit of separation, biocatalysts and medic.

Syllabus:

Introduction, Protein docking methods, Protein tagging strategies, Gen synthesis design, Enzyme stabilization, Molecular exploration, Protein engineering, Case study.

Prerequisite: Organic Chemistry

Textbook:
1. Protein Engineering in Industrial Biotechnology, Lilia Alberghina, Harwood academic publishers, 2005
2. Proteins: Biotechnology and Biochemistry by Dr. Gary Walsh. Wiley
3. Protein engineering and design by Sheldon J. Park, Jennifer R. Cochran. CRC Press
4. Protein Engineering and Design by Paul R. Carey. Academic Press
5. Protein Engineering: Principles and Practice. Wiley-Liss

Herbal Technology

ENCH800017
3 CREDITS
Learning Objectives:

Able to explain the development of herbal technology, herbal separation technology, herbal formulation basis, herbal regulation, and distinguish with other pharmaceutical products

Syllabus:

Definition and basic concepts of herbs, herbal materials, herbal separation technology, herbal formulations, herbal regulation.

Prerequisites: Organic Chemistry

Textbook:
1. The Complete Technology Book on Herbal Perfumes & Cosmetics by H. Panda. National Institute of Industrial Research 2003

Composite Material

ENCH800018
3 CREDITS
Learning Objectives:

Able to: Explain the characteristics of composite materials and compare it with conventional materials; Explain the manufacturing process, and research development of composite materials.

Syllabus:

The position of composite materials in materials science in general, common characteristics of composite materials, the type of composite based on the composition, the types of polymer matrix and reinforcement, the role of surface treatment in the strength of composite materials, manufacturing processes, durability, the process of splicing and repair of composite materials, code and standards for application of composite materials, the development of composite materials research.

Prerequisites: Organic Chemistry

Textbook:
1. Fiber-reinforced Composites (Materials Engineering, Manufacturing and Design), P. K. Mallick, Marcel Dekker, Inc., 1993.
2. Handbook of Plastics, Elastomers, and Composites, 3rd ed., Charles A. Harper, McGraw-Hill, 1996.
3. Reinforced Plastics - Theory and Practice, 2nd ed., M. W. Gaylord, Chaners Books, 1974.

Applied Thermodynamics

ENCE800019
3 CREDITS
Learning Objectives:

Students are able to analyze problems of thermodynamics based on a thorough review including fundamental aspects of thermodynamics, experimental, and green chemistry, based on current information from scientific journals

Syllabus:

The case study of industrial thermodynamic, example cycle processes, phase equilibrium, and chemical reaction equilibrium to process and product engineer; friendly solvents such as supercritical CO_2 and ionic liquid

Prerequisites: Chemical Engineering Thermodynamics

Textbook:
1. References relevant to a given problem.
2. Mulia, K and Wulan, PPDK, Textbook of Chemical Thermodynamics

Dynamic System

ENCE800020
3 CREDITS
Learning Objectives:

Able to build dynamic models of process systems, biological, industrial, social and economic.

Syllabus:

Introduction to dynamical systems, causal loops, model and validation, analysis, case study.

Prerequisites: Numerical Computation

Textbook:
1. Forrester, J. W., 2002, Principles of Systems, Productivity Press
2. Goodman, Michael R., 1998, Study Notes in System Dynamics, Productivity Press
3. Richardson, George P. and Pugh III, Alexander L., 1999, Introduction to System Dynamics Modeling, Pegasus Communications
4. Andersen, David, etc., Introduction to Computer Simulation - A System Dynamics: Systems Thinking and Modeling for a Complex World, McGraw-Hill

Thermodynamic System of Hydrocarbon

ENCE800021
3 CREDITS
Learning Objectives:

Able to predict the magnitude of thermodynamic properties of hydrocarbons and the phase condition, either manually or using software calculations.

Syllabus:

Introduction to hydrocarbon thermodynamics properties, basic thermodynamic concepts, P-V-T data correlations, physical properties of hydrocarbon fluids, computing aided thermodynamics properties, the vapor-liquid behavior of two-phase systems, water-hydrocarbon system behavior, product specifications in the disposal lease of hydrocarbon

Prerequisites: Chemical Engineering Thermodynamics

Textbook:
1. Wayne C. Edmister, Byung Ik Lee, Applied hydrocarbon thermodynamics, Volume 1, Gulf Publishing Company (1988), Houston, Texas.
2. John M. Campbell, Gas Conditioning and Processing, Vol. 1, 8th Edition Campbell Petroleum Series 2001.

Lubricant Technology

ENCE800022
3 SKS
Learning Objectives:

Able to explain the working principles of lubrication, lubricant function, and several parameters of the quality and lubricant classification, lubricant chemical, and its production technology, either mineral lubricant, synthesis and vegetal.

Syllabus:

Principles of lubrication on friction and wear phenomena on the two surfaces of solid objects are moving together; mode lubrication: hydrodynamic and elastohydrodynamic; lubricants: mineral, synthetic, and vegetable; additives, formulations, degradation, contamination, and maintenance of lubricants; latest development of lubricant technology .

Prerequisites: Organic Chemistry

Textbook: -
1. E. Richard Booster, Handbook of Lubricant: Theory and Practice of Tribology, Vol. I, Vol. II, Vol. III, CRC Press (1984), Inc., Boca Raton, Florida
2. Mervin H. Jones, Industrial Tribology: The Practical Aspect of Friction, Lubricant, and Wear., Elsevier Scientific Publishing Co., New York, 1983.
3. J. Halling, Principle of Tribology, Macmillan Press Ltd., London, 1978
4. Handout

Cryogenic Technology

ENCE800023
3 CREDITS
Learning Objectives:

Able to explain the various processes to liquefy gas in cryogenic technology

Syllabus:

History and development of cryogenic, cryogenic scope of work. Refrigeration and liquefaction of natural gas, air, oxygen, nitrogen, helium, neon and argon.

Prerequisites: Chemical engineering thermodynamics

Textbook:
1. Timmerhaus, K.D., Cryogenic Process Engineering, Plenum Press 1989, New York.
2. Barron, Randall. Cryogenic Systems, McGraw Hill, 1985, New York.

Combustion Technology

ENCE800024
3 CREDITS
Learning Objectives:

Able to explain the phenomenon of combustion and resolve the problems that rendered correctly.

Syllabus:

Chemical kinetics and combustion, the flame, premix flame, diffusion flame, the combustion process applications.

Prerequisite: Transport Phenomena, Chemical Reaction Engineering 1, Chemical Engineering Thermodynamics

Textbook:

1. Warnatz, J., Maas, U. dan Dibble, R.W., Combustion: Physical and Chemical Fundamentals, Modeling and Simulation, Experiments, Pollutant Formation, 2nd ed., Springer, Heidelberg, 1999.
2. Turns, S.R., An Introduction to Combustion: Concepts and Applications, 2nd ed, McGraw-Hill, 2000.
3. Glassman, I., Combustion, Academic Press, 1997.
4. El-Mahallawy dan el-Din Habik, S., Fundamental and Technology of Combustion, Elsevier, 2002.
5. Combustion, T. J. Poinsot and D. P. Veynante, in Encyclopedia of Computational Mechanics, edited by Erwin Stein, Ren´e de Borst and Thomas J.R. Hughes, 2004 John Wiley & Sons, Ltd.
6. Introduction to Combustion, Concepts and Applications, Stephen R. Turns, 2nd edition, McGraw Hill, 2000
7. Introduction to Combustion Phenomena, A. Murty Kanury, Gordon and Breach Science Publishers, 1975
8. Heat Transfer from Burners, Charles E. Baukal, in Industrial Burners Handbook, edited by Charles E. Baukal, CRC Press, 2004.

Plasma and Ozone Technology

ENCE800025
3 CREDITS
Learning Objectives:

Able to explain the physics and chemistry phenomena of plasma formation and release of electromagnetic energy and the use of plasma and ozone technology.

Syllabus:

Basic phenomena and physical-chemical processes of gases that are given an electrical charge (corona discharge), the generation process or formation of ozone, role and use of plasma technology and ozone in chemical engineering processes, the potential of ozone technology in control technology environmental pollution, the ozone generator module manufacturing equipment.

Prerequisite: Physics Electricity Magnetism

Textbook:

1. E. T. Protasevich: "Cold Non-Equilibrium Plasma", Cambridge International science Publishing, Cambridge, 1999.
2. Rice, R. G., and M. E. Browning: "Ozone Treatment of Industrial Water wate", Notes Data Corroraion, Park Ridyl, 1981.
3. Metcalf & Eddy, Inc. (Tchobano-glous, G., and FL Burton): "Wastewater Engineering: Treatment, Disposal, and Reuse", McGraw-Hill Book. Co., Singapore, 1991.

Heterogeneous Catalyst

ENCE800026
3 CREDITS
Learning Objectives:

Able to explain the phenomenon of basic concepts heterogeneous catalysts and its application

Syllabus:

The general property of catalyst, thermodynamic of the reaction with catalyst, the distribution of the catalyst based on the type of reaction, the core function is active, the method of selecting catalysts for certain reactions, characterization of the corresponding want to know the nature of the target, the catalyst test methods, methods of development of the catalyst, and reaction products.

Prerequisites: Chemical Reaction Engineering 1

Textbook:

1. Nasikin M, Susanto BH, "Katlaisis Heterogen", UI Press, 2010
2. Satterfield, C. N., heterogeneous Catalysis in Industrial Practice, McGraw-Hill Inc., New York, 1991.
3. Rase, F. R., Commercial Catalyst, CRC Press, New York, 1991
4. Richardson, T, J., Principles of Catalyst Development, Plenum Press, New York, 1989
5. Thomas J.M. And WJ Thomas, Principles and Practice of Heterogenous Catalysis, VCH, Weinhem, Germany, 1997
6. Emmet, R. H., Catalysis, Reinhold Publishing Corporation, New York, 1961

Risk Management

ENCH800028
3 CREDITS
Learning Objectives:

Able to explain and apply risk management in a risk assessment.

Syllabus:

Introduction to the risk, the basic principles and guidelines concerning risk, risk management standards, risk assessment, risk analysis, risk analysis and simulation, simulation of the risk with Montecarlo method, the risk of using software simulation crystal ball.

Prerequisites:

Textbook:

J. F. A. Stoner, Management, 1986

Electrochemical Technology

ENCH800029
3 CREDITS
Learning Objectives:

Able to understand the basic principles of electro-chemical technology and apply them in the design of electrochemical systems for various applications.

Syllabus:

Basic electrochemical principles and electrochemical cell concepts; electrochemical cell thermodynamics (Nernst equation, Pourbaix diagram, etc.); electrochemical cell kinetics (the mechanism of electrochemical redox reactions, Marcus theory, Butler-Volmer model, etc.); polarization/ overpotential on electrochemical cells (ohm polarization, activation polarization, concentration polarization, etc.); the phenomenon of mass transfer in electrochemical cells (migration, diffusion, convection, etc.); electrochemical analysis (voltammetry, chronoamperometry, AC impedance, etc.); electrode-electrolyte interface phenomena (double layer theory, surface capacitance, ion adsorption, etc.); semiconductor electrodes (photoelectrochemical); and various electrochemical applications (fuel cells, solar cells, batteries, etc.)

Prerequisites:

Physical Chemistry, Thermodynamics of Chemical Engineering, Chemical Reaction Engineering 1

Textbook:

1. Keith B. Oldham dan Jan C. Myland. Fundamentals of Electrochemical Science, Academic Press, Inc., 1st Edition, London, 1994.
2. Richard G. Comption dan Craig E. Banks. Understanding Voltammetry, 3rd Edition, World Scientific, London, 2018
3. Norio Sato. Electrochemistry at Metal and Semiconductor Electrodes, 1st Edition, Elsevier Science & Technology, Oxford, 1998.
4. Marcel Pourbaix. Atlas of Electrochemical Equilibria in Aqueous Solutions, 2nd Edition, NACE International, Brussels, 1974
5. Allen J. Bard, Martin Stratmann, and all authors. Encyclopedia of Electrochemistry, 1st Edition, John Wiley & Sons, New York 2007

Extraction & Isolation for Natural Products Technology

ENCH800030
3 CREDITS
Learning Objectives:

Able to compare various principles that relate to extraction technology and isolation of natural materials; Determine extraction and / or isolation techniques appropriate for certain natural materials; Developing process skills to solve problems related to the field of extraction technology and natural material isolation

Syllabus:

Natural substances and secondary metabolites, Variety of natural material products, Selection and preparation of materials for extraction, Selection and preparation of materials for isolation, Natural material extraction techniques, Fractionation techniques and isolation of natural materials

Prerequisites:

Textbook:

1. Rydberg, Cox, & Musikas. Solvent Extraction Principles and Practice 2nd Edition. Marcel Dekker, Inc. 2004.
2. Meireles, M. Angela A. Extracting Bioactive Compounds for Food Products: Theory and Applications. CRC Press – Taylor & Francis Group, LLC. 2009.
3. Rostagno, Mauricio A. & Prado, Juliana M. Natural Product Extraction: Principles and Applications. RSC Publishing. 2013.

Special Topic 1

ENCH800031
3 CREDITS

Biochemistry

ENCH800032
3 CREDITS
Learning Objectives:

Able to describe the relationship of structure and chemical compounds in living things, including the functions, synthesis processes and metabolism

of these chemical compounds that occur in living things.

Syllabus:

Introduction to cells and tissues; Membranes and organelles; The role of DNA and protein; Energy in cells; Nucleic acid; Structure and replication of DNA and RNA; Transcription and translation; Amino acid; Synthesis and structure of proteins; Enzyme; Metabolism

Prerequisites:

Textbook:

1. Lehninger Principles of Biochemistry & eBook by Albert Lehninger, David L. Nelson and Michael M. Cox (Jun 15, 2008)
2. Biochemistry (3rd Edition) by Christopher K. Mathews, Kensal E. van Holde and Kevin G. Ahern (Dec 10, 1999)
3. Bruckner, Monica Z. Basic Cellular Staining.Serc. carleton.edu.
4. Aryulina, D., Manaf, S., Muslim, C., & Winarni, E.W. 2007. BIOLOGI 3. Jakarta : Esis. Binur
5. Robi. 2011. Teknologi RNA Interference. Retrieved from Campbell, Reece. 2009. Biology. Sansome Street, San Francisco: Pearson Benjamin Cummings.

Elective Courses in Even Semester

Packaging and Storage Technology

ENCE800034
3 CREDITS
Learning Objective :

Students are able to describe characteristics, packaging and storage food technology, the relation between storage and packaging with quality of food, describe factors affecting deviation of food qualities as well as able to choose storage methods and packaging types which is appropriate to food materials.

Syllabus :

Hydratase, material storage technology and food products, deviation of food material qualities, microbial contaminant, purpose and function of food packaging, interaction between food packaging and packaging material types

Prerequisite : -

Textbook :

1. Examining Food Technology by Anne Barnett. Heinemann Secondary,1996
2. Julianti, Sri. The Art of Packaging. Gramedia Pustaka Utama. 2014.
3. Han, Jung H., et al. Innovations in Food Packaging. Elsevier. 2005.

Bioinformatics

ENCE800035
3 CREDITS
Learning Objective :

Are able to explore database and programs to be applied in genetic engineering sectors, proteomic etc

Syllabus :

Database, genomics, genetic molecular, philogeny, protein structure, metabolism and tissues

Textbook :

1. Bioinformatics by Shalini Suri. APH Publishing, 2006
2. Bioinformatics: A Primer by Charles Staben and Staben. Jones & Bartlett Publishers, 2005

Drugs and Cosmetics Technology

ENCE800036
3 CREDITS
Syllabus :

Definition of drugs and cosmetics, types of skins and characteristics, cosmetic types, ethics and regulation of drugs and cosmetics, new drug development technology, process technology in drug and cosmetics industries, packaging technology of drugs and cosmetics technology.

Prerequisite : Organic Chemistry

Textbook :

1. Handbook of Cosmetic Science and Technology by Andre O. Barel, Marc Paye, Howard I. Maibach. INFRMA-HC 2009
2. Biodesign: The Process of Innovating Medical Technologies by Stefanos Zenios, Josh Makower , Paul Yock , Todd J. Brinton, Uday N. Kumar, Lyn Denend, Thomas M. Krummel. Cambridge University Press 2009

Petroleum Processing

ENCE800037
3 CREDITS
Learning Objectives:

Able to explain petroleum characteristics and its refined product and the stages of the process from various petroleum processing technologies.

Syllabus:

Introduction terminology, oil composition, thermal properties of petroleum, chemical processing of petroleum processing, distillation, hydrogenation and dehydrogenation, cracking processes, the

processes of reforming, gas processing and petroleum light products, product improvement.

Prerequisites: Fluid and Particle Mechanics, Thermodynamics, Mass Transfer.

Textbook:
1. James G. Speight, The Chemistry and Technology of Petroleum, Marcel Dekker, 1991.
2. James H. Gary and Glenn E. Handwerk, Petroleum Refining, Marcel Dekker, 1974.
3. D. S. J. Jones, Elements of Petroleum Processing, John & Sons Woley

Petrochemical Processing

ENCE800038
3 CREDITS
Learning Objectives:

Able to explain the development of petrochemical products and raw material potential, upstream / downstream petrochemical production lines (olefin center, aromatic center, and the pathways of methane) and the major production processes of several petrochemical industries through methane, olefins and aromatics; able to analyze the impact of industrial processes and petrochemical products to the environment.

Syllabus:

History of the general petrochemical products development and raw material potential, the scope of the petrochemical industry, petrochemical classification process, the type and processing raw materials into petrochemical products, the details of various petrochemical industry: olefins center, aromatics and the center line of methane, industrial and environmental impact of products petrochemicals.

Prerequisites: Organic Chemistry

Textbook:
1. Martyn V. Twigg, "Catalyst Handbook", 2nd Ed., Wolfe Pub. Ltd..
2. Lewis T. Hatch, Sami Matar, "From Hydrocarbon to Petrochemical".
3. Wells, Margaret G., "Handbook of Petrochemicals and Processes", Gower Publishing Company Ltd., 1991.
4. Pandjaitan Maraudin, Petrochemical Industry and The effect of environment, Gadjah Mada University Press, 2002.

Photocatalysis Technology

ENCE800039
3 CREDITS
Learning Objectives:

Able to understand the basic concepts and photocatalysis and apply them in the various simple daily problem, especially related to environment, health, and energy.

Syllabus:

The basic concept photocatalysis processes, thermodynamics and kinetics of photocatlytic process, semiconductor photocatalyst materials, the basic parameters of photocatlytic process, Photocatalyst Nanomaterial Engineering, photocatlytic applications for degradation of organic pollutants and heavy metals, photocatalysis applications for self-cleaning and anti fogging, photocatalysis applications for anti-bacterial and cancer therapy, photocatalysis applications for engineering 'daily life tools', photocatalysis applications in renewable energy sector, solar detoxification engineering with photocatalysis, intensification of photocatalysis process.

Prerequisites: Chemical Reaction Engineering 1

Textbook:
1. M. Schiavello, Heterogeneous Photocatalysis, John Wiley & Sons, 1997.
2. A. Fujishima, K. Hashimoto, and T. Watanabe, TiO_2 Photocatalysis: Fundamentals and Applications, BKC Inc. Japan, 1999.
3. J.B. Galvez, et.al., Solar Detoxification, Natural Sciences, Basic and Engineering Sciences, UNESCO.
4. M. Kaneko, I. Okura, Photacatalysis Science and Technology, Springer USA, 2002.
5. C.A. Grimes, G.K. Mor, TiO_2 Nanotube Arrays: Synthesis, Properties, and Applications, Springer, New York, 2009.
6. Paper-paper dan bahan lain dari berbagai Jurnal Ilmiah dan website.

Exploration and Production of Hydrocarbon

ENCE802110
3 CREDITS
Learning Objectives:

Students are able to explain the economic concept of natural gas and analyze the 4e economy.

Syllabus:

Introduction of hydrocarbon, life cycle of field development, hydrocarbon form and hydrocarbon property and reservoir, hydrocarbon exploration: geology, geophysics, and drilling, field appraisal, reservoir development, drilling development, hydrocarbon production, HSE, hydrocarbon economy and lease, coal and hydrocarbon unconventional (CBM, Shale gas, and Hydrate Gas)

Prerequisites:-

Textbook:

1. Frank Jahn et all, 2008, Hydrocarbon Exploration and Production, Developments in Petroleum Science, second edition
2. Babusiauz et al, 2004, Oil and Gas Exploration and Production. Reserves, Cost and Contracts, IFP-Technip,
3. M. Kelkar, 2008, Natural Gas Production Engineering, PennWell Publications
4. Norman J. Hyne, 2001, Nontechnical Guide to Petroleum Geology, Exploration, Drilling and Production, Pennwell Books, 2 edition.

Waste Management and Prevention

ENCE800041
3 CREDITS
Learning Objectives:

Students are able to explain the concepts of pollution prevention and able to design the waste treatment system.

Syllabus:

Introduction to the concept of pollution prevention, waste water treatment outline and preparation, waste water treatment in physical, biological, and chemical as well as the operating unit, bioremediation, bioseparation and biodegradation, advanced oxidation processes, the handling of waste gas, waste handling B3, solid waste handling , effluent treatment, gas, is unconventional.

Prerequisites: Chemical Reaction Engineering 1.

Textbook:

1. Freeman, H. M., Industrial Pollution Prevention Handbook, McGraw-Hill, New York, 1995.
2. Eckenfelder, W. W., Jr.., Industrial Water Pollution Control. 3rd ed. McGraw-Hill International Editions, New York, 2000.
3. Metcalf & Eddy. (Revised by Tchobanoglous, G. & F. L. Burton). Waste Water Engineering: Treatment, Disposal, Reuse, 3rd ed., McGraw-Hill, Singapore, 1991.
4. Heinson R. J. & R. L. Cable. Source and Control of Air Pollution. Prentice Hall. New Jersey. Of 1999.
5. Legislation on the prevention of pollution and waste management.
6. Journals, the Internet.

Microalgae Cultivation and Development Technology

ENCH800042
3 CREDITS
Learning Objectives:

Able to have insight into the use of microalgae from the cultivation process to its conversion into products of high economic value; able to develop the utilization of microalgae by using a variety of technologies that are currently developing.

Syllabus:

Introduction to microalgae, microalgae cultivation process, microalgae harvesting techniques, the process of extracting microalgae into algal oil and its residues, economic analysis of the development and utilization of microalgae.

Prerequisites:

Textbook:

1. Richmond, Amos, et al. 2013. Handbook of Microalgal Culture: Applied Phycology and Biotechnology, 2nd Ed. John Wiley and Sons
2. E.W. Becker. 1994. Microalgae: Biotechnology and Microbiology. London, Cambridge University Press.

Utilities and Plant Maintenance

ENCE800043
3 CREDITS
Learning Objectives:

Able to explain the strategy of plant and utility maintenance.

Syllabus:

Plant maintenance strategy: maintenance program, maintainability, reliability, planning and scheduling

Prerequisite: Chemical Engineering Thermodynamics

Handbook:

1. Dhillon, B.S., Engineering Maintenance: A Modern Approach, CRC Press, 2002.
2. Higgins, L.R., Mobley, R.K. dan Smith, R., Maintenance Engineering Handbook, McGraw-Hill, 2002.
3. Sanders, R.E., Chemical Process Safety, Elsevier, 2005.
4. Palmer, D., Maintenance Planning and Scheduling Handbook, McGraw-Hill, 1999.

Transportation and Utilization of Natural Gas

ENCH800044
3 CREDITS
Learning Objectives:

Able to analyze several options for the use of natural gas for both energy and feedstocks

Syllabus:

Overview of natural gas: nature and quality, historical milestones, environmental aspects, international issues, and structure of the natural gas industry; transportation and storage of natural gas in the gas

phase and liquid phase; natural gas utilization: gas as fuels, gas to synfuels and chemicals, gas to wires/ power

Prerequisites: -

Textbook: -

Mixing Technology

ENCH800045
3 CREDITS
Learning Objectives:

Able to understand the basic principles of mixing technology and apply them in the design of mixing systems for various applications in industry.

Syllabus:

Definition of mixing, basic principles and basic concepts of mixing; mixing and mixing mechanism, mixing thermodynamics, mixing fluid flow, friction in mixing, etc.), types of mixing (gas-liquid, liquid-liquid, liquid-solid, suspension, emulsification), mixing techniques (agitation, blending, mixing, particle size reduction, sear etc.), mixing equipment both batch and continuous (mixer type, drainage type, etc.), mixing monitoring and control. Examples of the application of blending in the chemical, pharmaceutical, cosmetic and food industries.

Prerequisites:

Physical Chemistry, Fluid Mechanics and Materials Science

Textbook:

1. Handbook of Industrial Mixing: Science and Practice edited by Edward L. Paul, Victor A. Atiemo-Obeng, Suzanne M. Kresta, John Wiley and Sons Inc. Publication (2003).
2. Food Mixing: Principles and Applications, edited by P. J. Cullen, Ireland, John Wiley and Sons Inc. Publication (2007).
3. Pharmaceutical Blending and Mixing 1st Edition by P. J. Cullen (Editor), Rodolfo J. Romañach (Editor), Nicolas Abatzoglou (Editor), Chris D. Rielly, John Wiley and Sons Inc. Publication (2015)

Problem Solving Skills

ENCH800046
3 CREDITS
Learning Objectives:

Able to develop an understanding of the Problem Based Learning (PBL) learning method in order to be able to direct their own learning (independent learning), communicate effectively and work in groups; able to develop the ability to think critically, creatively, innovatively and have the intellectual ability to solve problems effectively both individually and in groups

Syllabus:

Introduction to PBL, individual problem-solving concepts, problem-solving concepts in groups

Prerequisites:

Textbook:

1. Woods, D. R., 1994, Problem based learning: How to gain the most from PBL, McMaster University, Hamilton, ON L8S 4L8.
2. Journal or articles related to each PBL problem.

Polymer Technology

ENCH800047
3 CREDITS
Learning Objectives:

Able to develop an understanding of the basic principles of polymer synthesis and characterization, so that they can understand, solve polymer problems found in daily life and in industry, and can keep abreast of developments in the latest polymer technology.

Syllabus:

The concept of polymers, Synthesis and kinetics of polymerization, Polymer solutions, Characterization, Plastic manufacturing processes.

Prerequisites: Organic Chemistry

Textbook:

1. Billmeyer, F.W, 2011, Textbook of Polymer Science,3rd edition, John Wiley & Sons Inc.
2. Young, R.J. and Lovell, P.A, 2011, Introduction to Polymers, R.J.Lovell, 3rd edition, CRC Press. Taylor & Francis Group, Boca Raton, FL 33487-2742.
3. Seymour, R.B, 1989, Polymers for Engineering Applications, ASM International.
4. Crawford, R.J, 1998, Plastic Engineering, 3rd edition, Butterworth-Heinemann, Woburn, MA 01901-2041.
5. Woods, D. R., 1994, Problem based learning: How to gain the most from PBL, McMaster University, Hamilton, ON L8S 4L8.
6. Journal or articles related to each PBL problem.

Genetically Modified Organism

ENCH800048
3 CREDITS
Learning Objectives:

Students are able to plan the design of transgenic organisms for purposes in the fields of food, pharmacy and health, energy, or the environment as one of the supporting knowledge in Bioprocess Technology courses

Syllabus:

Gene expression and function, genome, introduction and development of GMO organisms, genome modification techniques, methods of analyzing GMO organisms, GMO organisms in food, GMO organisms in pharmacy and health, GMO organisms in energy, GMO organisms in the field the environment, and the latest research and applications related to GMO organisms.

Prerequisites: Genetic Engineering

Textbook:

1. Harvey Lodish, Arnold Berk, Chris A. Kaiser and Monty Krieger. W. H. Molecular Cell Biology. 6th edition. FreemanS
2. T. A. Brown. 2010. Gene Cloning and DNA Analysis. 6th edition. Willey Blackwell: Hongkong.
3. Jurnal ilmiah terbaru terindeks scopus

Drug Controlled Released Technology

ENCE800049
3 CREDITS
Learning objective :

Able to describe the principle of control drug release or bioactive compound for medical purposes and utilize the principle to apply control drug released technology

Syllabus :

Polymeric biomaterial that is easily degradable, various methods to drug encapsulation and bioactive compounds in nano/microsphere, diffusion and permeation, the strategy of control released, case study

Prerequisite : Organic Chemistry

Textbook :

1. Juergen Siepmann et al. (ed.) Fundamentals and Applications of Controlled Release Drug Delivery, Springer
2. Clive Wilson and Patrick Crowley (ed.) Controlled Release in Oral Drug Delivery, Springer
3. Hong Wen and kinam Park (ed.) Oral Controlled Release Formulation Design and Drug Delivery, Wiley, 2010.
4. WM Saltzman, Drug Delivery: Engineering Principles for Drug Therapy, Oxford University Press, 2001.
5. Nissim Garti, Delivery and controlled release of bioactives in foods and nutraceuticals, CRC Press, 2008.

Special Topic 2

ENCH800050
3 CREDITS

Biomass Thermochemical Conversion Technology

ENCH800051
3 CREDITS
Learning Objectives:

Able to understand the chemical characteristics of biomass and the basic principles of thermo-chemical biomass conversion technology and its application in the design of biomass thermochemical conversion systems to produce fuels and chemicals.

Syllabus:

Chemical characteristics of biomass, biomass classification, thermo-chemical conversion through pyrolysis (fast pyrolysis, slow pyrolysis, co-pyrolysis, hydrodeoxygenation, catalytic pyrolysis, catalytic co-pyrolysis, pyrolysis reactor), thermo-chemical conversion through biomass gasification, thermo-chemical conversion through biomass ligation , physical and chemical analysis of biomass feed and biomass thermo-chemical conversion products, pyrolysis for the manufacture of biofuels and chemicals, biomass gasification for the manufacture of synthetic gases, liquefaction of biomass for the manufacture of biofuels.

Prerequisites:

Organic Chemistry, Heat Transfer, Chemical Reaction Techniques 1

Textbook:

1. Robert C. Brown, Thermochemical processing of biomass: conversion into fuels, chemicals and power, 2nd edition, Wiley Series in Renewable Resources, 2019
2. Mark Crocker, Laurie Peter, Ferdi Schuth, Tim Z. Zhao, Heinz Frei, Thermochemical conversion of biomass to liquid fuels and chemicals, RSC Publishing, 1st edition, 2010
3. James Clark and Fabien Deswarte, Introduction to chemicals from biomass, 2nd edition, John Wiley and Sons, 2015
4. Piet Schenkelaars, Value-added chemicals from biomass, Pira International Ltd, 2012

Basic Computer Programming
ENCH800052
3 CREDITS

Learning Objectives:

Able to formulate and solve cases using logical concepts and programming algorithms and able to construct simple programs consisting of consecutive instructions in Python and MATLAB.

Syllabus:

Introduction: Why should one learn to write programs; Variables, expressions, and statements; Conditional executions; Functions; Iteration; Strings; Files; Lists; Dictionaries; Tuples; Using Python for numerical integration with the Simpson's rule, to solve root finding problem employing the secant method, to solve ordinary differential equation; Introduction to MATLAB/GNU Octave; Numerical methods with MATLAB/GNU Octave; Application of MATLAB/GNU Octave in transport phenomena and chemical reaction engineering.

Prerequisites:

Textbook:

1. Charles R. Severance: Python for Everybody, accessible via https://www.py4e.com
2. John. M. Zelle: Python Programming: An Introduction to Computer Science, 3rd edition, 2016.
3. Yeong Koo Yeo: Chemical Engineering Computation with MATLAB, CRC Press, 2017.

Syllabus of Master Program in Chemical Engineering Department for Gas Management Class

Compulsary Courses

Advanced Chemical Engineering Thermodynamics
ENCH800001
3 CREDITS
Learning Objectives:

Able to understand the basics of thermodynamics, fluid properties, phase equilibrium and reaction and be able to apply it to solve problems of chemical engineering.

Syllabus:

Analysis of the system using the several forms of the first and second laws, the equation network of thermodynamic for thermodynamic properties, condition equation, fluid-phase equilibrium, chemical reaction equilibrium

Prerequisite: Chemical Engineering Thermodynamics

Textbook:
1. Kyle, B.G., Chemical and Process Thermodynamics, 2nd ed., Pretice Hall, 1992.
2. Hand-out Kuliah.
3. Smith J.M. dan van Ness, H.C., Introduction to Chemical Engineering Thermodynamics, 4th ed., McGraw-Hill, 1985.
4. Callen, H.B., Thermodynamics and An Introduction to Thermostatics, 2nd ed., John Wiley and Sons, 1985.

Health and Safety in Natural Gas Industry
ENCH800002
3 CREDITS
Learning Objectives:

Able to identify the condition of health and safety in the geothermal industry and propose ways of overcoming problems of health and safety with observe to safety laws and regulations relating to the work environment.

Syllabus:

The law and regulations relating to safety, national standards and international standards related to safety analysis work, Dual–function chemicals, Hazard Identification and Risk Assessment (HIRA), Hazard Identification (HAZID) and Hazard Operability Study (HAZOPS).

Prerequisites: -

Textbook:

1. Safety Act of 1970 1
2. Regulation of the Minister of Labor, Technical Guidelines for Safety Audit management system and Occupational Health, 1996.
3. International Labor Office, Prevention of Major Industrial Accidents, 1991.
4. Chemical Process Safety Modules

Natural Gas Processing
ENCH800009
3 CREDITS
Learning Objectives :

Able to design natural gas refineries for piped gas, pressurized natural gas, or LNG if given a fluid composition that reaches the surface of the reservoir.

Syllabus:

Introduction and terms in Natural Gas Processing; Physical Properties of Hydrocarbon Fluid; Hydrocarbon Water System; Hydrate; Dew Point Control Unit; AGRU; Absorption Dehydration Unit; Adsorption Dehydration Regeneration Unit; Heavy Hydrocarbon Recovery Unit; LNG Processing

Prerequisite

Chemical Process Simulation

Textbook :

1. Gas Conditioning and Processing Vol. 1
2. Gas Conditioning and Processing Vol. 2
3. Maddox, R.N. dan Morgan, D.J., Pengondisian dan pemrosesan gas, Vol 4: Mengolah gas dan sulfur pemulihan, Campbell Petroleum Series, 1998.
4. Kohl, A. dan Nielsen, R., pemurnian gas, Edisi ke-5, Gulf Publishing Company, 1997.
5. Kidnay, A.J. dan Parrish, W.R., Fundamentals of natural gas processing, Taylor & Francis, 2006

Natural Gas Project Management

ENCH800010
3 CREDITS
Learning Objectives:

Able to apply project management in their fields with appropriate as well as apply it in our main fields

Syllabus:

Concept Project - Production, Project Life Cycle, Project Selection, Project Planning, Project Implementation, Project Completion & Evaluation.

Prerequisite -

Textbook :

1. Suharto, Imam, Manajemen Proyek,1990

Natural Gas Economics

ENCH800011
3 CREDITS
Learning Objective :

Able to explain the concept of natural gas economics and analyze the economics of the natural gas supply chain and natural gas projects.

Syllabus :

Introduction to the structure of the natural gas industry, natural gas market, gas prices and tariffs, natural gas contracts, the economics of the natural gas supply chain from the production, transportation and use of natural gas, gas projects and financial aspects.

Prerequisite :

Engineering Economics

Textbook : -

Engineering System Managemen

ENCH800012
3 CREDITS
Learning Objectives:

Able to describe analysis system, simulation, and related processes until becoming an engineering product which is appropriate with consumer needs

Syllabus:

Design, manufacture, and complex system operation that is the main challenge from a manager nowadays. This system has a strict schedule as well as a financial limitation by pressure in technological development, requires new tools for project planning, organizing, and controlling. This course gives essential knowledge for new management system development as well as a modified complex system. This course also gives a brief understanding of marketing strategy, determining the relation between superior value versus price. These strategies based on marketing as well as how this activity is connected to basic marketing functions such as sales and promotions.

Prerequisites: -

Textbook: -

Sustainable Energy

ENCH800027
3 CREDITS
Learning Objectives:

Able to explain the relationship of energy with a social aspect, economic and environmental and sustainability concepts, and able to analyze the performance of techno-economy and the continuity, especially fossil energy system, new, and renewable.

Syllabus:

Concept of sustainability and sustainable energy, energy hierarchy, energy linkages with economic, environmental and social, fossil energy/fuels and Impacts, global climate change and its mitigation, conversion, transportation/distribution and storage, the analysis method of energy sustainability: LCA, sustainability index, hydrogen and fuel cells and nuclear energy, solar energy (PV and thermal), wind and ocean, hydropower, bioenergy, geothermal energy, energy efficiency and conservation, carbon capture, and storage

Prerequisites:

Chemical Engineering Thermodynamics or Biochemical Engineering

Textbook:

1. Jefferson W. Tester, et al., Sustainable Energy: Choosing Among Options, MIT Press, 2005. Godfrey Boyle, et al., Energy Systems and Sustainability: Power for a Sustainable Future, Oxford University Press, 2003.
2. E. Cassedy S, Prospects for Sustainable Energy: A critical assessment, Cambridge University Press, 2000.
3. DeSimone et al., Eco-Efficiency. The Business Link to Sustainable Development, MIT Press, 1997.
4. D. Elliot, Energy, Society, and Environment, Technology for a sustainable future, Rouledge, 1997
5. Miller, G. T., Environment Science. Sustaining Earth, Wardworld Publish Co. 1993

Special Courses

Pre-Thesis
ENCH800007
2 CREDITS
Learning Objectives :

Able to produce ideas, processes, and scientific research in writing and oral.

Syllabus:

Introduction, techniques to identify problems and arrange hypotheses, think logically, the techniques of scientific writing, technical writing research proposals, designing research techniques, presentation techniques, techniques to collect data, analyze it and present it.

Prerequisite: -

Thesis
ENCH800008
6 CREDITS
Learning Objectives :

Able to design, conduct, and analyze research in Chemical fields; present research result in oral and writing

Syllabus :

Thesis material based on research topic

Prerequisite:

Based on regulation

Textbook :
1. Petunjuk Penulisan Tugas Akhir UI

Scientific Publications
ENCH800055
2 CREDITS
Learning Objective : -

Syllabus : -

Prerequisite : -

Textbook : -

Elective Courses

Elective Courses in Odd Semester

Hydrocarbon Exploration and Processing
ENCH800040
3 CREDITS
Learning Objectives:

Able to explain the economic concept of natural gas as well as analyze the economics of exploration oil and natural gas production

Syllabus:

Introduction of hydrocarbon, the life cycle of field development, hydrocarbon form and hydrocarbon property and reservoir, hydrocarbon exploration: geology, geophysics, and drilling, field appraisal, reservoir development, drilling development, hydrocarbon production, HSE, hydrocarbon economy and lease, coal and hydrocarbon unconventional (CBM, Shale gas, and Hydrate Gas)

Prerequisites:

Textbook:

1. Frank Jahn et all, 2008, Hydrocarbon Exploration and Production, Developments in Petroleum Science, second edition.
2. Babusiauz et al., 2004, Oil and Gas Exploration and Production. Reserves, Cost and Contracts, IFP-Technip.
3. M. Kelkar, 2008, Natural Gas Production Engineering, Pennwell Publications.
4. Norman J. Hyne, 2001, Nontechnical Guide to Petroleum Geology, Exploration, Drilling and Production, Pennwell Books, 2 edition

Elective Courses in Even Semester

Risk Management
ENCH800028
3 CREDITS
Learning Objectives:

Students can explain and apply risk management in a risk assessment.

Syllabus:

Introduction to the risk, the basic principles and

guidelines concerning risk, risk manage- ment standards, risk assessment, risk analysis, risk analysis and simulation, simulation of the risk with Montecarlo method, the risk of using software simulation crystal ball.

Prerequisites:

Textbook:

J. F. A. Stoner, Management, 1986

Transportation and Utilization of Natural Gas

ENCH800044
3 CREDITS
Learning Objectives:

Able to analyze several options for the use of natural gas for both energy and feedstocks

Syllabus:

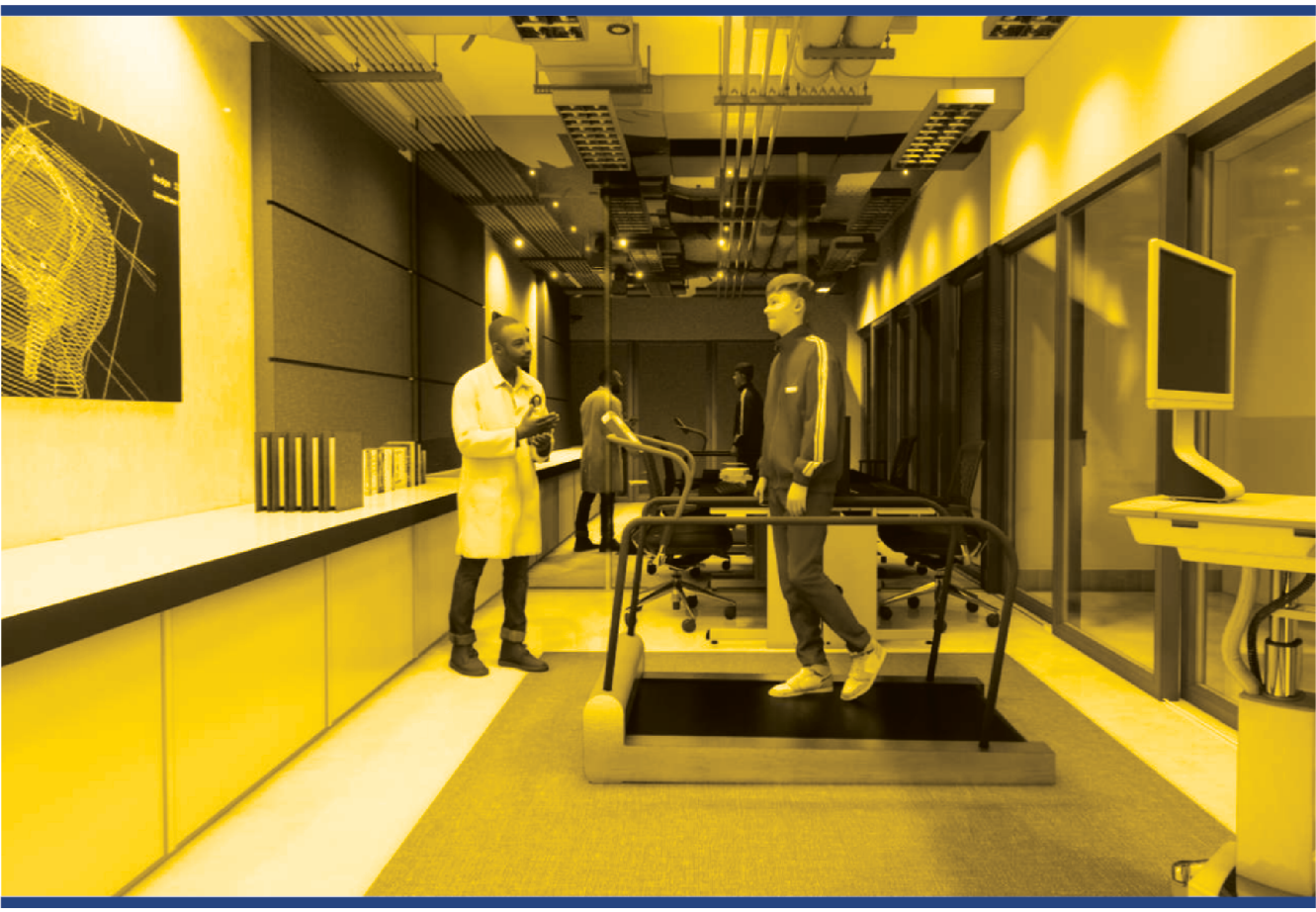
Overview of natural gas: nature and quality, historical milestones, environmental aspects, international issues, and structure of the natural gas industry; transportation and storage of natural gas in the gas phase and liquid phase; natural gas utilization: gas as fuels, gas to synfuels and chemicals, gas to wires/ power

Prerequisites: -

Textbook: -

CHAPTER 6

DOCTORAL PROGRAM



Doctoral Program

FTUI holds Doctoral Program for the seven following study programs:

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

FTUI Doctoral program was officially opened in 2000 with the opening of the Civil Engineering and Electrical Engineering Doctoral program followed by the emersion of the Opto-electrotechnique and Laser Application study program into the Postgraduate Program of FTUI. The Mechanical Engineering study program was officially opened in 2006 while the Metallurgy & Material Engineering and Chemical Engineering followed in 2007. And In 2009, respectively Department of Architecture opened the Architecture Doctoral Program. In 2001, the Opto-electrotechnique and Laser Application was closed and was emerged into the Electrical Engineering study program. Each Doctoral study program is headed by the Head of Study Program which is held ex-officio by the Head of Department in the Faculty of Engineering UI. The Doctoral study programs have one or more focus subjects to give a more specific knowledge on engineering field to all students of the program.

Currently, the Doctoral Program is held in two ways: Lecture & Research; and Research.

New Students Selection

Selection process for new students for the FTUI Doctoral Program is as follow:

1. Pre-admission stage: future student is encouraged to informally contact their prospective Promotor or the Head of Department to further discuss his/her desired dissertation topic. This is important to make sure the availability of Promotor in accordance to said research topic. Communication may be done through email or face to face. The Head of Department and future Promotor then would discuss the student's proposal internally.
2. Future student should register online via http://penerimaan.ui.ac.id and complete the required documents and prerequisites.
3. Future student will then take the entrance examination (SIMAK UI) which consists of: (i) Academic Potential Examination and (ii) English Proficiency Test.
4. The results of the Entrance Examination will then be sent to FTUI by the UI Entrance Examination Committee. These results will then be discussed in a Department Committee Meeting headed by the Head of Department to determine which students accepted, and the proposed research topic approved, and the availability of future Promotor. An interview have to be arrange with the future student to determine the suitability of research topic, with previous study field, and the student's commitment to participate in the Doctoral program full time. Interview may be done directly or through email or messanger application.
5. The outcome of the Department Committee Meeting will then be submitted to the UI Entrance Examination Committee to be announced.

Academic Counseling

Since the day a student is registered as student for the Doctoral program until the time that he/she passes qualification examination, the student will be under the guidance of an academic advisor who the student expected to be their Promotor or Co-Promotor. Head of Department accepts a proposal of future Promotor/Academic Advisor from a committee in the Department. Once the student pass the qualification examination, the student will earn status as Doctor Candidate and the Academic Advisor's status will revert to Promotor/Co-Promotor.

Promotor and Co-Promotor

Promotor and Co-Promotor for Doctoral Program are lecturers or experts from related field and are assigned by Head of Department based on a Rector's Decree to guide and advise a Doctor candidate in conducting research and dissertation writing. Academic Advisor consist of 1 Promotor and a maximum of 2 (two) Co-Promotors. Promotor is a first chair Advisor who holds an academic degree of Professor or Doctor and a minimum of Senior Lecture academic position; has a relevant expertise in the field which the student's dissertation topic is; and is acknowledge as a full time faculty at the Universitas Indonesia, and for the last five years has produced at the latest: one scientific paper in an accredited national journal or a reputable international journal; or one other form of scientific product which is acknowledge by a group of experts set up by the Academic Senate of Universitas Indonesia.

Co-Promotors are the Promotor's companions who act as second and/or third chair advisor who hold academic degree of Doctor or Senior Lecturer, and has a relevant expertise in the field with the student's dissertation topic. Co-Promotor from outside of the Faculty of Engineering UI must have the approval from the Promotor. Promotor and Co-Promotors are appointed by the Rector based on the proposal submitted by the Dean which are also based on suggestions from the Head of Department after the student has pass the qualification examination. The appointment must be done at the latest 1 (one) semester after the qualification examination. A change of Promotor/Co-Promotor must be proposed by the Dean to the Rector based on a proposal from the Head of Department.

Program Specifications

1.	**Awarding Institution**	Universitas Indonesia	
2.	**Teaching Institution**	Universitas Indonesia	
3.	**Programme Title**	Doctoral Program in Civil Engineering Doctoral Program in Mechanical Engineering Doctoral Program in Electrical Engineering Doctoral Program in Metallurgy & Material Engineering Doctoral Program in Architecture Doctoral Program in Chemical Engineering Doctoral Program in Industrial Engineering	
4.	**Class**	Regular	
5.	**Final Award**	Doctor (Dr.)	
6 .	**Accreditation / Recognition**	Civil Engineering Doctoral Program: Accreditation A from BAN-PT Mechanical Engineering Doctoral Program: Accreditation A from BAN-PT Electrical Engineering Doctoral Program: Accreditation A from BAN-PT Metallurgy & Material Engineering Doctoral Program: Accreditation A from BAN-PT Chemical Engineering Engineering Doctoral Program: Accreditation A from BAN-PT Architecture Doctoral Program: Accreditation A from BAN-PT Industrial Engineering Doctoral Program: Accreditation A from BAN-PT	
7.	**Language(s) of Instruction**	Bahasa Indonesia	
8.	**Study Scheme (Full Time / Part Time)**	Full Time	
9.	**Entry Requirements**	Master graduate from study programs in line with study program chosen and pass the entrance examination	
10.	**Study Duration**	Programmed for 3 years	
	Type of Semester	Number of Semester	Number of weeks / semester
	Regular	6	14-17
	Streams: The Civil Engineering Doctoral Program has six streams as follow: • Structure • Construction Management • Transportation • Water Resource Management • Project Management • Geotechnique The Mechanical Engineering Doctoral Program has four streams as follow: • Energy Conversion		

	• Engineering Design and Product Development • Manufacture Engineering • Fire Safety Engineering and Management The Electrical Engineering Doctoral Program has eight streams as follow: • Telecommunication Engineering • Electrical Power and Energy Engineering • Photonic and Electronic Engineering • Control Engineering • Multimedia and Information Engineering • Security of Information Network Engineering • Telecommunication Management • Electrical Power and Energy Management The Metallurgy & Material Engineering Doctoral Program has two fields of specialization: • Corrosion and Protection • Material Engineering and Manufacture Process The Chemical Engineering Doctoral Program has five streams as follow: • Industry Catalist • Gas Management • Product Design and Chemical Process • Environmental Protection and Work Safety • Gas Technology The Industrial Engineering Doctoral Program has several research focus areas: 1. Manufacturing Systems Engineering • Industrial Policy and Analysis • Value Chain and Logistics • Quality and Reliability • Product/Process Design and Innovation 2. Service Systems Engineering • Product - Service - System • Service Design • Service Quality & Improvement • Decisions, Uncertainty & Risk 3. Optimization and Data Analytics • Operations Research • Data analytics and Forecasting • Real-time optimization
11..	**Graduate Profiles:** FTUI Doctoral Program Graduates haves the capabilities of demonstrating expansion, novelty breakthrough in research in the engineering or architecture field in accordance to certain stream or sub-stream. The FTUI Doctoral Program prepares student to work in academic and research in accordance to their own stream; dedicate their expertise in research laboratory, industry or government institution; or create a business based on their innovation. Graduates are able to posess the following skill: • Be able to show expertise in the engineering or architecture discipline; • Be able to uphold the academic and research ethics; • Be able to work collaboratively in research; • Be able to position themselves as leader in their community; • Be able to communicate well in their community and build networks; • Be able to demonstrate individual live skill in connection to human relationship; • Be able to demonstrate attitude, behavior and way of thinking which support their success in society.

12..	**Graduates Competencies:** The aim of Doctoral Program in FTUI is in line with the Doctoral Program of Universitas Indonesia, to produce quality graduates with the following competence: 1. Able to independently update their knowledge on science and technology in engineering or architecture through research based innovation breakthrough. 2. Able to show professionalism in their field of study that can be accountable towards the development of science and technology. 3. Able to write a scientific paper in engineering or architecture and convey the result of their research to the public both orally or written in an international scientific activity. 4. Able to recommend a solution for a complex problem faced by society in the field of engineering or architecture through inter, multi and trans discipline approach. 5. Able to lead a working or research team to solve problem in the field of engineering or architecture that can be of benefit for the good of mankind. 6. Able to develop and maintain a network of cooperation with fellow researcher and research community in the field of engineering and architecture both in national and international level.
13.	**Course Composition (Course & Research)**

No.	Classification	Credit Hours (SKS)	Percentage
i	Course Component	16	32%
ii	Research Component	34	68%
	Total	50	100%

14. Classification of Subjects. (Research)

No.	Classification	Credit Hours (SKS)	Percentage
i	Course Component	0	0 %
ii	Research Component	50	100 %
	Total	50	100%
	Total Credit Hours to Graduate	50 CP	

Curriculum Structure for FTUI Doctoral Program

The curriculum structure for the Doctoral Program in all study programs are the same, they are only differentiated by their codes for the research component. The code "xx" for each study programs are as follow:

ENCV for Civil Engineering, ENME for Mechanical Engineering, ENEE for Electrical Engineering, ENMT for Metallurgy & Material Engineering, ENAR for Architecture, and ENCH for Chemical Engineering, ENIE for Industrial Engineering

The FTUI Doctoral Program is held in two program: Course and Research and Research.

Doctoral Program (Course & Research)

The following is the curriculum structure for Course & Research Doctoral Program in Table 1.

Table 1. The Curriculum Structure – Doctoral Program in Course and Research

Code	Subject	SKS
	1st Semester	
ENGE901001	Advanced Research Method	6
ENXX900001	Special Subject I	3
	Sub Total	**9**
	2nd Semester	
ENGE902002	Qualitative & Quantitative Analysis	4
ENXX900002	Special Subject II	3
ENXX900004	Research Proposal	6
	Sub Total	**13**
	3rd Semester	
ENXX900006	Publication – International Conference	4
	Sub Total	**4**
	4th Semester	
ENXX900008	Research Result Examination	10
	Sub Total	**10**
	5th Semester	
ENXX900010	Publication International Journal	8
	Sub Total	**8**
	6th Semester	
ENXX900012	Promotion Examination	6
	Sub Total	**6**
	Total	**50**

The Lecture Component includes four subjects:

a. Advanced Research Method, 6 sks
b. Qualitative and Quantitative Analysis, 4 sks
c. Special Subject I, 3 SKS.
d. Special Subject II, 3 SKS.

The Research Component includes:

1. Research Proposal, 6 SKS
2. Publication – International Conference, 4 SKS
3. Research Result Examination, 10 SKS
4. Publication – International Journal, 8 SKS
5. Promotion Exam, 6 SKS

Doctoral Program (Research)

The following is the curriculum structure for Research Doctoral Program in Table 2.

Table 2. The Curriculum Structure – Doctoral Program in Research

Code	Subject	SKS
	1st Semester	
ENXX900003	Research Group Periodic Seminar	6
	Sub Total	**6**
	2nd Semester	
ENXX900005	Research Proposal	6
	Sub Total	**6**
	3rd Semester	
ENXX900007	Publication I – International Conference	6
	Sub Total	**6**
	4th Semester	
ENXX900008	Research Result Examination	10
	Sub Total	**10**
	5th Semester	
ENXX900009	Publication II – National Journal	8
	Sub Total	**8**

	6th Semester	
ENXX900011	Publication III – International Journal	8
ENXX900012	Promotion Examination	6
	Sub Total	**14**
	Total	**50**

Description of Subjects

Advanced Research Method

ENGE901001
6 SKS

Learning Objective(s): Course participants are expected to: (a) master the scientific work process based on science philosophy, which is the scientific justification aspects, innovative aspects and scientific ethics aspects, (b) able to write a research proposal and or draft of scientific writing related to the student's doctoral topic, (c) can map research result from the latest international journal in their field and understand the state-of-the-art from their research topic, and can determine the knowledge gap yet explored in the international level for further research in their Doctoral Program.

Syllabus: (1) Relationship between philosophy and engineering science; (2) Science Philosophy; (3) Epystemology in Engineering Science; (4) Research Method; (5) Problem formulation and hypothesis; (6) Research and state of the art; (7) Research Evaluation; (8) Design Evaluation and research Stages; (9) Introduction to the analysis of the data processing method; (10) Benchmark on research output and conclusion formulation; (11) Various citation method; (12) Finalization of research proposal draft and /or scientific article draft.

Prerequisite(s): None

Textbooks:

1. Haryono Imam R dan C. Verhaak, Filsafat Ilmu Pengetahuan, Gramedia, Jakarta, 1995
2. Willie Tan, "Practical Research Methods", Prentice Hall, 2002.
3. R. Kumar, *Research Methodology, A Step-by-step Guide for Beginner,* 3rd ed., Sage Pub, 2012

Qualitative and Quantitative Analysis

ENGE902002
4 SKS

Learning Objective(s): Discuss the qualitative and quantitative in data analysis and exploring specific data analysis areas. After participating in this subject which discuss the qualitative and quantitative approach in data analysis in exploring specific areas of data analysis. Students are expected to be able to build the following learning outcome: (1) awareness to situations requiring qualitative data analysis in the inductive paradigm; (2) awareness to situations requiring quantitative data analysis in the deductive paradigm; (3) appreciation toward various approaches; (4) possessing skills in giving critical appraisal; (5) possessing skills in performing qualitative and quantitative data analysis.

Syllabus: Introduction; Qualitative Analysis; Quantitative Analysis; Non-Parametric Analysis; Uncertainty Analysis; Critical Appraisal; Design of Experiment; ANOVA revisit; Multivariate Techniques.

Prerequisite(s): None

Textbooks:

1. Miles M & Huberman M, Qualitative Data Analysis, London Sage Publications, (1994)
2. Montgomery, D.C., & Runger, G.C, Applied Statistics and Probability for Engineers 3rd Ed., John Wiley and Sons, Inc., New York, (2003)
3. Kirkup, L, Experimental Method: An Introduction to the Analysis and Presentation, John Wiley and Sons, Australia, Ltd., Queensland, (1994)
4. Montgomery, D.C, Design and Analysis of Experiments 6th Ed., John Wiley and Sons, Inc., New York, (2005)
5. Hair, J.F., B.Black, B.Babin and R.E Anderson, Multivariate Data Analysis 6th Ed., Pearson Education Inc., New Jersey, (2006)

Special Subject 1

ENXX900001
4 SKS

Special Subject 2

ENXX900002
4 SKS

Special Subject 1 in the 1st first semester (4 SKS) and Special Subject 2 in the 2nd semester (4 SKS) are determined together with the student's Academic Advisor to support the student's research and/or to develop the student's knowledge with information and knowledge from unrelated field. Academic Advisor is also allowed to propose a special content for the student to Head of Department.

The following are the requirements for the implementation of Special Subject 1 and 2:

1. For students who do not have in line Master degree educational background from the Faculty of Engineering Universitas Indonesia, they are allowed to take the similar courses of the related field of study available at the Master Program in FTUI during the running semester.
2. Students are also allowed to take courses from other study programs within the Faculty of

1. Engineering Universitas Indonesia or courses from other faculties in UI as stated in the Guidance Book or the Master/Doctoral Program Catalog.
2. Students are allowed to take classes in other Master Program in the Faculty of Engineering Universitas Indonesia or other faculties within the Universitas Indonesia as deemed necessary by their Academic Advisor
3. In the event where neither conditions is viable for the students, the Academic Advisor is allowed to conduct a class of said course.

Research Group Periodic Seminar
ENXX900003
6 SKS

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

Research Proposal
ENXX900005
6 SKS

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

Research Result Examination
ENXX900008
10 SKS

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

Publication – International Conference
ENXX900006
4 SKS

Publication I – International Conference
ENXX900007
6 SKS

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

Publication II – International Journal
ENXX900009
8 SKS

Publication III – National Journal
ENXX900011
8 SKS

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

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

Promotion Examination

ENXX900012
6 SKS

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

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

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

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

Facilities for Doctoral Program Students

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

Doctoral Program Students' Workstation

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

International Journal Article Writing Training

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

Research Proposal Writing Training

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

Line Editing Draft for International Journal Article

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

Doctoral Program Mailing-List

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

Research and Incentive Grants for Master and Doctoral Program

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

International Journal Writing Incentive

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

UNIVERSITAS INDONESIA
Veritas, Probitas, Iustitia

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