

SYLLABUS
UNDER GRADUATE PROGRAM (S1)
CURRICULUM ITS 2018 – 2023



CHEMICAL ENGINEERING DEPARTMENT
FACULTY OF INDUSTRIAL TECHNOLOGY
INSTITUT TEKNOLOGI SEPULUH NOPEMBER
SURABAYA 2018

Study Program	Chemical Engineering
Educational Level	Undergraduate Program

EXPECTED LEARNING OUTCOME		
ATTITUDE	1.1	Believing in the oneness of God and able to demonstrate religious attitude
	1.2	Upholding the value of humanity in undertaking the task based on religion, morality and ethics
	1.3	Contributing in improving the quality of community life, nation and state and the advance of civilization based on Pancasila
	1.4	Playing a role as a proud citizen who loves his/her homeland, having a nationalism and responsibility to the country and nation
	1.5	Appreciating the diversity of cultures, point of view, religion and belief as well as opinion or the original findings of others
	1.6	Working together, having social sensitivity and caring for community and environment
	1.7	Law abiding and disciplined in community and state life
	1.8	Internalizing values, norms and academic ethics
	1.9	Demonstrating attitude of responsibility on work in his/her field of expertise independently
	1.10	Internalizing spirit of independence, struggle and entrepreneurship
	1.11	Trying his/her best to achieve perfect results
	1.12	Working together to be able to make the most of his/her potential
GENERAL SKILL	1.1	Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise
	1.2	Being able to demonstrate independent performance, quality, and measurable
	1.3	Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas,

GENERAL SKILL		designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report , and uploaded it in the college page	
	1.4	Arrange the scientific description of the results of the above study in the form of a thesis or final project report, and upload it on the college page	
	1.5	Being able to take decisions appropriately in the context of problem solving in the area of expertise based on the results of information and data analysis	
	1.6	Being able to maintain an expanded network with mentors, colleagues, colleagues both inside and outside the institution	
	1.7	Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility	
	1.8	Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently	
	1.9	Being able to document, store, secure and recover data to ensure validity and prevent plagiarism	
	1.10	Being able to develop themselves and compete in national and international level	
	1.11	Being able to implement sustainability principles and develop knowledge	
	1.12	Being able to implement information and communication technology (ICT) in the context of implementation of his/her work	
	1.13	Being able to apply entrepreneurship and understand technology-based entrepreneurship	
	KNOWLEDGE	1.1	Engineering science concepts, engineering principles, and design engineering required for process design and analysis, processing system, and equipment required for converting raw materials into value-added products through chemical, physical, and biological processes
		1.2	Natural science concepts and mathematical engineering application principles on the design and analysis of process, processing system, and equipment required for converting raw materials into value-added products through chemical, physical, and biological processes

	1.3	Process design technique and principles, processing system, and equipment required for converting raw materials into value-added products through chemical, physical, and biological processes
	1.4	Principles and the latest issues in economy, social, general ecology
	1.5	Communication techniques and cutting-edge technologies
SPECIAL SKILL	1.1	Able to apply mathematics, natural science, and engineering principles to solve complex engineering problems of process, processing system, and equipment required for converting raw materials into value-added products through chemical, physical, and biological processes
	1.2	Able to find the engineering root cause of process, processing system, and equipment required for converting raw materials into value-added products through investigation process, analysis, interpretation of data and information according to engineering principles
	1.3	Able to do research that includes identification, formulation, and analysis on engineering problems of process, processing system, and equipment required for converting raw materials into value-added products through chemical, physical, and biological processes
	1.4	Able to formulate alternative solution to solve complex engineering problems of process, processing system, and equipment required for converting raw materials into value-added products through chemical, physical, and biological processes by considering factors such as economic, public health and safety, cultural, social and environment (environmental consideration)
	1.5	Able to design process, processing system, and equipment required for converting raw materials into value-added products through chemical, physical, and biological processes by analytical approach and taking into account the following aspects, such as technical standard, performance aspect, robustness, applicability, sustainability, as well as considering factors such as economic, public health and safety, cultural, social and environment
	1.6	Able to select appropriate resources and make use of

		design devices and appropriate IT-based engineering analysis to assist in engineering activities of process, processing system, and equipment required for converting raw materials into value-added products through chemical, physical, and biological processes
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COURSE LIST of BACHELOR PROGRAM

No.	Course Code	Course Name	Credit
SEMESTER I			
1	UG18490x	Religion	2
2	UG184913	Civics	2
3	UG184912	Indonesian	2
4	SF184101	Physics I	4
5	KM184101	Mathematic I	3
6	SK184101	Chemistry	3
7	TK184101	Introduction to Chemical Engineering	2
Number of Credits			18
SEMESTER II			
1	UG184911	Pancasila	2
2	KM184202	Mathematic II	3
3	SF184202	Physic II	3
4	UG184914	English	2
5	TK184201	Introduction to Industrial Chemistry	2
6	TK184202	Analytical Chemistry	4
7	TK184203	Data Processing and Analysis	2
Number of Credits			18
SEMESTER III			
1	TK184301	Chemical Engineering Thermodynamics I	3
2	TK184302	Organic Chemistry	4
3	TK184303	Chemical Engineering Principles I	3
4	TK184304	Momentum Transfer	3
5	TK184305	Physical Chemistry	4
Number of Credits			17
SEMESTER IV			

1	TK184401	Industrial Microbiology	3
2	TK184402	Chemical Engineering Mathematics	4
3	TK184403	Chemical Engineering Principles I	3
4	TK184404	Unit Operations I	3
5	TK184405	Chemical Engineering Thermodynamics II	3
6	TK184406	Mass and Heat Transfers	3
Number of Credits			19
SEMESTER V			
1	TK184501	Chemical Reaction Engineering I	3
2	TK184502	Chemical Engineering Application I	2
3	TK184503	Unit Operations II	3
4	TK184504	Construction Materials	2
5	TK184505	Chemical Equipment Design	4
6	UG184916	Concept and Application Technology	3
Number of Credits			17
SEMESTER VI			
1	TK184601	Chemical Reaction Engineering II	3
2	TK184602	Chemical Engineering Application II	2
3	TK184603	Unit Operations III	3
4	TK184604	Chemical Engineering Numerical Computation	3
5	TK184605	Process Dynamic and Control	4
6	TK18460x	Elective I	2
Number of Credits			17
SEMESTER VII			
1	TK184701*	Industrial Waste Treatment	3
2	TK184702	Synthesis and Process Simulation	3
3	TK184703	Plant Design and Economic	4
4	TK184704	Research Project	6
5	TK18470x	Elective II	4
Number of Credits			20
SEMESTER VIII			
1	TK184801*	Chemical Plant Safety	3
2	TK184802	Practical Field Work	2
3	TK184803	Plant Design Project	6

4	TK184804	Plant Utility System	2
5	xxxxxxx	Enrichment Course	3
6	UG184915	Technopreneurship	2
Number of Credits			18
Total Credits			144

LIST of ELECTIVE COURSES

No.	Course Code	Course Name	Credit
Elective I			
1	TK184606	Energy Technology	2
2	TK184607	Aerosol Technology	2
3	TK184608	Lipids Technology	2
4	TK184609	Project Management	2
5	TK184610	Introduction to Combustion Engineering	2
6	TK184611	Supercritical Technology	2
7	TK184612	Air Pollution Control	2
8	TK184613	Separation Column Design	2
9	TK184614	Membrane Technology	2
Elective II			
1	TK184705	Separation Technology	4
2	TK184706	Solid and Toxic and Hazardous Waste Management	4
3	TK184707	Essential Oil Processing	4
4	TK184708	Heterogeneous Catalyst	4
5	TK184709	Polymer Technology	4
6	TK184710	Biorefinery & Bioconversion of Biomass	4
7	TK184711	Natural Gas Processing Technology & HYSYS application	4
8	TK184712	Biochemical and Food Technology	4
9	TK184713	Electrochemical and Nanomaterial Engineering	4
10	TK184714	Process Design and Integration	4
11	TK184715	Fluid Mixing Technology	4

Elective III: Enrichment Course.

*: Enrichment course opened in Chemical Engineering Department.

COURSE	Course Name	: Analytical Chemistry
	Course Code	: TK184203
	Credit	: 4 SKS
	Semester	: II

DESCRIPTION of COURSE

This course learns about qualitative and quantitative analysis methods, and also analysis methods conventionally and instrumental. The subject studied included various analytical methods, acid-base equilibrium theory, precipitation and solubility products, complex ion-forming reactions, and redox reactions, volumetric, gravimetric, potentiometric, spectroscopic, and chromatographic methods. Following this course, students are able to apply the basics of qualitative and quantitative analysis to determine the composition of raw materials and products, both using conventional means and instrumentation that can be done independently or teamwork.

LEARNING OUTCOME

- 1.1 Engineering science concepts, engineering principles, and design engineering required for process design and analysis, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes.
- 1.2 Natural science concepts and mathematical engineering application principles on the design and analysis of process, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes.
- 1.3 Process design technique and principles, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes.
- 1.4 Communication techniques and cutting-edge technologies.
- 2.1 Able to select appropriate resources and make use of design devices and appropriate IT-based engineering analysis to assist in engineering activities of process, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes.
- 1.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise.
- 1.2 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under

<p>his/her responsibility.</p> <p>1.3 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently.</p> <p>1.1 Demonstrating attitude of responsibility on work in his/her field of expertise independently.</p>
COURSE LEARNING OUTCOME
<p>The learning outcome of this course is to be able to apply the basics of qualitative and quantitative analysis to determine the composition of raw materials and products, both using conventional means and instrumentation that can be done independently or teamwork.</p> <p>Sub-learning outcome of this course:</p> <ol style="list-style-type: none"> 1. Students are able to explain the various methods of analysis. 2. Students are able to apply the acid-base equilibrium theory, solubility product, formation of complex ions, redox reactions in volumetric titration. 3. Students are able to distinguish various kinds of volumetric analysis methods. 4. Students are able to apply gravimetric analysis methods. 5. Students are able to apply potentiometric and potentiometric titration. 6. Students are able to apply the spectroscopy method in quantitative analysis. 7. Students are able to apply the chromatography analysis method.
MAIN SUBJECT
<ol style="list-style-type: none"> 1. The types of various analytical method. 2. Equilibrium theory of acid-base, precipitation, complex ion formation, and reduction-oxidation reaction. 3. Method of volumetric analysis. 4. Method of gravimetric analysis. 5. Method of potentiometric analysis. 6. Method of spectrometric analysis. 7. Method of chromatographic analysis
PREREQUISITES
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REFERENCE
<ol style="list-style-type: none"> 1. Harris, D. C., "Quantitative Chemical Analysis", 7th ed., W.H. Freeman and Company, New York, 2007 2. Cristian, Gary D., Dasgupta, P. K., Schug, K. A., "Analytical Chemistry", 7th ed., John Wiley & Sons., Inc., 2014

3. Harvey, D, "Modern Analytical Chemistry", MacGraw-Hill Companies, Inc., 2000
4. Svehla, G, "Vogel's Textbook of Macro and Semi – Micro Qualitative Inorganic Analysis", 5th ed, 1982.
5. Day, RA Jr & Underwood, AL. "Quantitative Analysis", 6th ed, 1991

COURSE	Course Name	: Chemical Engineering Thermodynamics I
	Course Code	: TK184301
	Credit	: 3 SKS
	Semester	: III

DESCRIPTION of COURSE

This course learns about solving unit operation problems by integrating first and second law of thermodynamics; application equation of states (EoS) accurately in calculation of thermodynamic properties of pure fluids and understand the limitation of EoS used; calculation the heat effects occurred in industry associated by chemical reaction, sensible and phase transition; understanding the role of chemical engineering thermodynamic in process simulation. Teaching methods include introductory courses; Brainstorming; Examination (Quiz, etc, Final Exam) and group discussion.

LEARNING OUTCOME

- 1.1 Comprehend of engineering science concepts, engineering principles, and design engineering required for process design and analysis, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.2 Comprehend of natural science concepts and mathematical engineering application principles on the design and analysis of process, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.3 Comprehend of process design technique and principles, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.4 Able to understand the principles and the latest issues in economy, social, general ecology;
- 1.5 Comprehend of communication techniques and cutting-edge technologies
- 2.1 Able to apply mathematics, natural science, and engineering principles to solve complex engineering problems of process, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 3.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
- 3.2 Being able to take responsibility for the achievement of group work and

<p>supervise and evaluate the work completion assigned to the worker under his/her responsibility;</p> <p>3.3 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;</p> <p>4.1 Demonstrating attitude of responsibility on work in his/her field of expertise independently.</p> <p>4.2 Trying his/her best to achieve perfect results.</p>
COURSE LEARNING OUTCOME
<ol style="list-style-type: none"> 1. Being able to solve unit operation problems by integrating first and second law of thermodynamics. 2. Being able to apply equation of states (EoS) accurately in calculation of thermodynamic properties of pure fluids and understand the limitation of EoS used. 3. Being able to calculate the heat effects occurred in industry associated by chemical reaction, sensible and phase transition. 4. Fully understands the role of chemical engineering thermodynamic in process simulation.
MAIN SUBJECT
<ol style="list-style-type: none"> 1. The first and second laws of thermodynamics and their application in closed and open systems (steady state and unsteady state processes) 2. Concept of ideal and real gases, fluids and equation of state models 3. Thermodynamic network (combining the first and second laws) 4. Heat effects due to reaction, sensible and phase transition 5. Entropy balance and lost work 6. Carnot cycle, production of power from heat, refrigeration and liquefaction. 7. Introduction to commercial software (Aspen HYSYS 7) for process simulation (practice).
PREREQUISITES
None
REFERENCE
<ol style="list-style-type: none"> 1. Smith, J. M., Van Ness, H.C., Abbott, M. M., "Introduction to Chemical Engineering Thermodynamics" 6th ed., McGraw-Hill Co-Singapore (2001). 2. Wibawa, G., Pengantar Termodinamika untuk aplikasi pada Industri Kimia, ITS-Press, Surabaya 2017 3. Poling, B. E., Prausnitz, J. M., O'Connell, " The properties of gases and

liquids fifth edition, McGraw-Hill, (2001).

4. Winnick, J., “Chemical Engineering Thermodynamics”, John Wiley & Sons, Inc., USA (1997).
5. Relevance Journals

COURSE	Course Name : Organic Chemistry
	Course Code : TK184302
	Credit : 4 SKS
	Semester : III

DESCRIPTION of COURSE

This course studies to understand the radius of atoms, chemical bonds, orbitals in covalent bonds, structural isomers, stereochemistry, substitution and elimination reactions, free radical reactions, aldehydes and ketones, carboxylic acids, carboxylic acid derivatives, enolates and carbonions, amines, aromatic heterocyclic and polycyclic, amino acids and proteins, carbohydrates and lipids. With learning methods include lectures, discussions, case studies, problem-based learning, writing examination, (including quiz, assignments and EAS)

LEARNING OUTCOME

- 1.1 Engineering science concepts, engineering principles, and design engineering required for process design and analysis, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.2 Natural science concepts and mathematical engineering application principles on the design and analysis of process, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.3 Process design technique and principles, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.4 Principles and the latest issues in economy, social, general ecology;
- 1.5 Communication techniques and cutting-edge technologies.
- 2.1 Able to do research that includes identification, formulation, and analysis on engineering problems of process, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
- 1.2 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
- 1.3 Being able to conduct self-evaluation process to work group under

his/her responsibility, and able to manage learning independently; 4.1 Demonstrating attitude of responsibility on work in his/her field of expertise independently
COURSE LEARNING OUTCOME
<ol style="list-style-type: none"> 1. Being able to understand atoms and molecules include radius of atoms, chemical bonds, orbital in covalent bonds, structural isomers 2. Being able to understand about stereochemistry, substitution and elimination reactions, and free radical reactions 3. Being able to understand the properties and reactions in the aldehyde and ketone groups, carboxylic acids, carboxylic acid derivatives, enolates and carbonions, amines, heterocyclic aromatics and polycyclic 4. Being able to understand the properties and reactions that occur in amino acids and proteins, carbohydrates and lipids
MAIN SUBJECT
<ol style="list-style-type: none"> 1. Radius of atoms and chemical bonds 2. Orbitals in covalent bonds and structural isomers 3. Stereochemistry 4. Substitution and elimination reactions 5. Free radical reactions 6. Aldehydes and ketones 7. Carboxylic acids and carboxylic acid derivatives 8. Enolates and carbonions 9. Amines and aromatic heterocyclic and polycyclic 10. Amino acids and proteins, carbohydrates, lipids.
PREREQUISITES
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REFERENCE
<ol style="list-style-type: none"> 1. Fessenden, Ralph and Joan. "<u>Organic Chemistry I & II</u>", University of Montana, 6th ed, 1998 2. Pine, Stanley; Hendricson, James; Cram J, Donald; Hammond S, George. "<u>Organic Chemistry</u>", 4th ed, International Student Ed, Mc Graw Hill Book Comp, 1986. 3. Meislich, Herbert et al. "<u>Theory and Problems of Organic Chemistry</u>", Schaum Outline Series, Mc Graw Hill Book, New York, 1980 4. Peter Sybes, <u>Penuntun Mekanisme Reaksi Kimia Organik</u>, Edisi 6, penerbit PT Gramedia, Jakarta, 1989.

COURSE	Course Name : Chemical Engineering Principle I
	Course Code : TK184303
	Credit : 3 SKS
	Semester : III

DESCRIPTION of COURSE

This course explains the fundamentals of strong skills and knowledge to formulate and solve material balance problems as well as physical and chemical properties of fluids. This course also introduces an efficient, meticulous and sophisticated spreadsheet-based software method for students to analyze data and solve material balance problems.

LEARNING OUTCOME

- 1.1 Engineering science concepts, engineering principles, and design engineering required for process design and analysis, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.2 Natural science concepts and mathematical engineering application principles on the design and analysis of process, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.3 Process design technique and principles, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.4 Principles and the latest issues in economy, social, general ecology;
- 1.5 Communication techniques and cutting-edge technologies.
- 2.1 Able to do research that includes identification, formulation, and analysis on engineering problems of process, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 3.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
- 3.2 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
- 3.3 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
- 4.1 Demonstrating attitude of responsibility on work in his/her field of

expertise independently	
COURSE LEARNING OUTCOME	
<ol style="list-style-type: none"> 1. Able to understand the basics of calculation in the field of chemical engineering. 2. Able to apply basic calculations in the field of chemical engineering for single units without chemical reactions. 3. Able to apply the basics of calculation in the field of chemical engineering for single units by chemical reactions. 4. Able to resolve the material balance problem for complex systems or for systems consisting of multiple units. 5. Able to understand the physical and chemical properties of fluids to solve the mass and energy balance and multi-phase systems. 6. Able to apply the basics of mass balance and phase equilibrium using sophisticated techniques based on spreadsheet software. 	
MAIN SUBJECT	
<ol style="list-style-type: none"> 1. Units and dimensions. 2. The concept of mass balance. 3. Base calculation. 4. Mass balance for single unit without chemical reaction. 5. Mass balance for single unit with chemical reaction and stoichiometry. 6. Mass balance for unit system consisting of many units. 7. Physical and chemical properties of fluid. 	
PREREQUISITES	
<ol style="list-style-type: none"> 1. Introduction to Chemical Engineering 2. Introduction to Industrial Chemistry 	
REFERENCE	
<ol style="list-style-type: none"> 1. Felder, R. M., & Rousseau, R. W. (2005). <i>Elementary Principles of Chemical Processes</i> (3 ed.). Wiley. 2. Himmelblau, D. M., & Riggs, J. B. (2012). <i>Basic Principles and Calculations in Chemical Engineering</i> (8 ed.). Prentice Hall. 3. Hougen, O. A., Watson, K. M., & Ragatz, R. A. (1954). <i>Chemical process principles. Part 1, Material and Energy Balances</i> (2ed.). Wiley. 4. Reklaitis, G. V. (1983). <i>Introduction to Material and Energy Balances</i>. Wiley. 	
COURSE	Course Name : Momentum Transfer

	Course Code	: TK184304
	Credit	: 3 SKS
	Semester	: III

DESCRIPTION of COURSE

Study the analogy of heat, mass and momentum transfer; Fluids and transport properties; Fluid statics; Momentum transfer macroscopic dan microscopis; and Dimensional analysis.

LEARNING OUTCOME

- 1.1 Engineering sciences, engineering principles, and engineering designs required for the analysis and design of processes, processing systems and equipment necessary to convert raw materials into value-added products by chemical, physical and biological processes.
- 2.1 Able to apply mathematics, natural science, and engineering principles to solve complex engineering problems in processes, processing systems, and equipment necessary to convert raw materials into value-added products with chemical, physical and biological processes.
- 3.1 Able to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology that cares and implements the humanities value appropriate to their area of expertise.
- 4.1 Demonstrate a responsible attitude towards the work in the field of expertise independently.

COURSE LEARNING OUTCOME

Students must be able to understand and analyze: analogy of heat, mass and momentum transfer; Fluids and transport properties; Fluid statics; Momentum transfer macroscopic dan microscopis; and Dimensional analysis.

MAIN SUBJECT

1. Analogy of Heat, Mass and Momentum Transfer;
2. Fluids and Transport Properties;
3. Fluid Statics;
4. Momentum Transfer Makroskopis dan Mikroskopis;
5. Dimensional Analysis

PREREQUISITES
<p style="text-align: center;">Mathematics I Mathematics II</p>
REFERENCE
<ol style="list-style-type: none"> 1. Altway, A., Winardi, S. and Setyawan, H. (2012): Proses Perpindahan, ITS Press, Surabaya 2. Geankoplis, C.J. (2003): Transport Processes and Unit Operations, 3rd Edition, Prentice Hall 3. Brodkey, R.S. and Hershey (1989): Transport Phenomena, A Unified Approach, Int. Edition, McGraw Hill. 4. de Nevers, N. (1991): Fluid Mechanics for Chemical Engineers, 2nd Edition, McGraw Hill International 5. Welty, J.R., Wicks, C.E., Wilson, R.E. dan Rorrer, G.L. (2007): Fundamentals of Momentum, Heat, and Mass Transfer, 5th Edition, John Wiley & Sons, Inc.

COURSE	Course Name : Physical Chemistry
	Course Code : TK184305
	Credit : 4 SKS
	Semester : III

DESCRIPTION of COURSE

This course studies the phenomenon of physical change including the substance matter and the phase transition, theory kinetic of gases, transport processes, solution, electrochemistry, surface phenomenon and interface. After following this course, students are able to analyze the form of substances and physical changes as well as mixed system of substances related to the physical properties of the substance which can be done independently or in team.

LEARNING OUTCOME

- 1.1 Engineering science concepts, engineering principles, and design engineering required for process design and analysis, processing system, and equipment required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.2 Natural science concepts and mathematical engineering application principles on the design and analysis of process, processing system, and equipment required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.3 Process design technique and principles, processing system, and equipment required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.4 Principles and the latest issues in economy, social, general ecology;
- 1.5 Communication techniques and cutting-edge technologies.
- 2.1 Able to do research that includes identification, formulation, and analysis on engineering problems of process, processing system, and equipment required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 3.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
- 3.2 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
- 3.3 Being able to conduct self-evaluation process to work group under

his/her responsibility, and able to manage learning independently;
4.1 Demonstrating attitude of responsibility on work in his/her field of expertise independently.

COURSE LEARNING OUTCOME

The learning outcome of this course is the students are expected to be able to analyze the form of substances and phase transition, as well as mixed system of substances related to the physical properties of the substance that can be done independently or teamwork.

Sub-learning outcome of this course:

1. Students are able to analyze the form of substances and physical properties.
2. Students are able to explain the relation of theory kinetics of gases with gas and liquid properties and their transport properties.
3. Students are able to distinguish the properties of non-electrolyte solution and electrolyte solution.
4. Students are able to identify the electrochemical systems.
5. Students are able to analyze the properties of substances based on the surfaces and interfaces, adsorption, and colloid.

MAIN SUBJECT

1. Substances of matters.
2. Theory kinetics of gases.
3. Solution.
4. Electrochemistry.
5. Surfaces and interfaces, adsorption, and colloids.

PREREQUISITES

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REFERENCE

1. Setyawan, H., "Kimia Fisika", ITSPress, 2013
2. Levine, I., Physical Chemistry, Mc Graw Hill, 6th ed., 2008
3. Maron, S. H, and Lando, J. B., Fundamentals of Physical Chemistry, Mac Millan Publishing Co. Inc., New York., 1975
4. Bahl, B. S., Tuli, G. D., and Bahl, A., Essensial of Physical Chemistry, S Chand & Co. Ltd., 2000.

Course	Course Name : Chemical Engineering Mathematics
	Course Code : TK184402
	Credit : 4 SKS
	Semester : IV

DESCRIPTION OF COURSE

Chemical Engineering Mathematics is one of core courses in chemical engineering department. This course provides method to develop mathematical model or mathematical formulation for physical and chemical processes or problems and to solve the problem using known mathematical method or mathematical method to be described in this course. Basically this course will provide student with knowledge and competence to solve physical-chemical problems mathematically. Learning methods comprise lecture, tutorial and discussion, assignments, quizzes and exam.

LEARNING OUTCOME

- 1.1 Engineering science concepts, engineering principles, and design engineering required for process design and analysis, processing system, and equipment required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.2 Natural science concepts and mathematical engineering application principles on the design and analysis of process, processing system, and equipment required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.3 Process design technique and principles, processing system, and equipment required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.4 Communication techniques and cutting-edge technologies.
- 2.1 Able to apply mathematics, natural science, and engineering principles to solve complex engineering problems of process, processing system, and equipment required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 3.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
- 3.2 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
- 3.3 Being able to conduct self-evaluation process to work group under his/her

- responsibility, and able to manage learning independently;
- 4.1 Demonstrating attitude of responsibility on work in his/her field of expertise independently.

COURSE LEARNING OUTCOME

1. Student being able to formulate chemical engineering problems into mathematical problems
2. Student being able to solve ordinary first order differential equation problems derived from mathematical formulation of physical-chemical problems
3. Student being able to solve ordinary n-order differential equation and system of simultaneous ordinary first order differential equations derived from mathematical formulation of physical-chemical problems
4. Student understand the meaning of Laplace Transform, being able to determine Laplace Transform of a given function (in time) and being able to solve ordinary differential equation problem using Laplace Transform Method
5. Student understand the meaning of Fourier Series, and being able to determine Fourier series of a given periodic function
6. Student understand the meaning of power series
7. Student being able to solve second order ordinary differential equation with variable coefficient using power series
8. Student being able to solve second order ordinary differential equation with variable coefficient using Frobenius method
9. Student identify Bessel equation and being able to solve second order ordinary differential equation with variable coefficient in term of Bessel function
10. Student can identify special functions and being able to evaluate definite or improper integral in term of special function
11. Student can identify some problem types of Partial Differential Equation
12. Student being able to solve Partial Differential Equation Problems using Fourier Method, Laplace Transform Method, and Combination of Variable Method
13. Student being able to solve multiple (double and triple) integral problem
14. Student being able to apply multiple integral theory to determine volume and mass of a rigid body, area and mass of a slab, center of mass of a rigid body or a slab, area of curve surface, and moment inertia of a rigid body or a slab
15. Student being able to formulate stage wise process model
16. Student being able to solve stage wise process model problem using finite difference calculus.

MAIN SUBJECT
<ol style="list-style-type: none"> 1. Mathematical Modelling, 2. Ordinary Differential Equation, 3. Special Function, 4. Laplace Transform, 5. Fourier Series, 6. Partial Differential Equation, 7. Multiple Integral, 8. Stage wise Process Model and Finite Difference Calculus.
PREREQUIZITES
Mathematic I dan Mathematic II
REFERENCES
<ol style="list-style-type: none"> 1. Ali Altway, Margono, Lindu Sunarko, Heru Seyawan, Setiyo Gunawan, Tantular Nurtono, <i>Matematika Teknik Kimia</i>”, ITS Press, Surabaya, 2015 2. Rice, R.G. and Do, D.D., <i>Applied Mathematics and Modeling for Chemical Engineers</i>, John Wiley & Sons (1995). 3. Mickley, H.S., T.S. Sherwood and C.E.Reed , <i>Applied Mathematics in Chemical Engineering</i>, Mc Graw Hill, New York, 1984 4. Jenson, V.G. and G.V.Jeffrey, <i>Mathematical Methods in Chemical Engineering</i>, Academic Press, London, 1977

COURSE	Course Name : Chemical Engineering Principle II
	Course Code : TK184403
	Credit : 3 SKS
	Semester : IV

DESCRIPTION of COURSE

This course explains strong skills and knowledge to formulate and solve energy balance problems as well as integration between the balance of mass and energy. Students are educated to be able to apply sophisticated methods based on spreadsheets and chemical engineering process simulation software to solve complex problems as well as the balance of material and energy to be solved simultaneously.

LEARNING OUTCOME

- 1.1 Engineering science concepts, engineering principles, and design engineering required for process design and analysis, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.2 Natural science concepts and mathematical engineering application principles on the design and analysis of process, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.3 Process design technique and principles, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.4 Principles and the latest issues in economy, social, general ecology;
- 1.5 Communication techniques and cutting-edge technologies.
- 2.1 Able to do research that includes identification, formulation, and analysis on engineering problems of process, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 3.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
- 3.2 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
- 3.3 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;

1.1 Demonstrating attitude of responsibility on work in his/her field of expertise independently.
COURSE LEARNING OUTCOME
<ol style="list-style-type: none"> 1. Able to understand the concept of energy balance. 2. Able to apply energy balance concept for system without chemical reaction 3. Able to apply the concept of energy balance for the system with chemical reactions. 4. Able to apply the concept of problem solving to solve mass and energy balance simultaneously. 5. Able to apply the concept of material and energy balance problem to solve complex problems. 6. Able to apply energy balance concepts to complex systems using advanced techniques based on spreadsheet software and chemical engineering process simulator software.
MAIN SUBJECT
<ol style="list-style-type: none"> 1. The concept of energy balance 2. Energy balance for systems without chemical reactions 3. Energy balance for the System by chemical reaction 4. Simultaneous problem solving method of material and energy balance. 5. Material and energy balance for complex system.
PREREQUISITES
<ol style="list-style-type: none"> 1. Chemical Engineering Principle I 2. Physical Chemistry 3. Chemical Engineering Thermodynamics I
REFERENCE
<ol style="list-style-type: none"> 1. Felder, R. M., & Rousseau, R. W. (2005). <i>Elementary Principles of Chemical Processes</i> (3 ed.). Wiley. 2. Himmelblau, D. M., & Riggs, J. B. (2012). <i>Basic Principles and Calculations in Chemical Engineering</i> (8 ed.). Prentice Hall. 3. Hougén, O. A., Watson, K. M., & Ragatz, R. A. (1954). <i>Chemical process principles. Part I, Material and Energy Balances</i> (2ed.). Wiley. 4. Reklaitis, G. V. (1983). <i>Introduction to Material and Energy Balances</i>. Wiley.

COURSE	Course Name : Unit Operations I
	Course Code : TK184404
	Credit : 3 SKS
	Semester : IV

DESCRIPTION of COURSE

Study Pipe fluid flow; Measurement of fluid flow: Equipment of fluid transportation; Agitation and mixing of liquid; Flow past a submerged objects; Fixed and fluidized bed: Mechanical-physical separation of solid-liquid: Size reduction of particle solid: Solid-solid mixing.

LEARNING OUTCOME

- 1.1 Engineering sciences, engineering principles, and engineering designs required for the analysis and design of processes, processing systems and equipment necessary to convert raw materials into value-added products by chemical, physical and biological processes;
- 2.1 Able to apply mathematics, natural science, and engineering principles to solve complex engineering problems in processes, processing systems, and equipment necessary to convert raw materials into value-added products with chemical, physical and biological processes;
- 3.1 Able to apply logical, critical, systematic, and innovative thinking in the context of development or implementation of science and technology that cares and implements the humanities value appropriate to their area of expertise;
- 4.1 Demonstrate a responsible attitude towards the work in the field of expertise independently.

COURSE LEARNING OUTCOME

Students must be able to understand and analyze problems : pipe fluid flow, measurement of fluid flow, equipment of fluid transportation, agitation and mixing liquid, flow past a submerged objects, fixed and fluidized bed, mechanical-physical separation of solid-liquid, size reduction of particle solid, solid-solid mixing.

MAIN SUBJECT

1. Pipe fluid flow
2. Measurement of fluid flow
3. Equipment of fluid transportation
4. Agitation and mixing of liquid
5. Flow past submerged objects
6. Fixed bed and fluidized bed
7. Mechanical-physical solid-liquid separation
8. Size reduction of particle solid and classification
9. Solid-solid mixing

PREREQUISITES

TK184304 Momentum Transfer

REFERENCE

1. Geankoplis, C.J.,Hersel , A.H. dan Lepek, D.H. (to be release in 2018): Transport Processes and Separation Process Principles (5th Edition). Prentice Hall International
2. Geankoplis, C.J. (1993): Trasport Processes and Unit Operations. 3rd Edition. Pearson College Div
3. Geankoplis, C.J. (2003): Transport Processes and Separation Process Principles (Includes Unit Operations). 4th Edition. Prentice Hall.
4. McCabe, W., Smith, J. and Harriot, P.(2003): Unit Operations of Chemical Engineering. McGraw-Hill Education.

COURSE	Course Name : Chemical Engineering Thermodynamics II
	Course Code : TK184405
	Credit : 3 SKS
	Semester : IV

DESCRIPTION of COURSE

This course learns about the Introduction of Vapor-Liquid Equilibrium (VLE) and simple models for VLE such as Raoult's Law, Henry's Law and Raoult's Law application on real gas and real solutions. Calculation methods of VLE: BUBL, DEW and Flash calculations, Theory of Thermodynamics solution and its application to VLE, Approach methods in VLE calculation (activity coefficients and equations of state), Introduction to Liquid-Liquid Equilibrium (LLE) and Vapor-Liquid-Liquid Equilibrium (VLLE), Introduction to Thermodynamics for polymer-containing systems, Introduction to commercial software use (ASPEN HYSYS). The learning methods include: introductory courses; group discussion; brainstorming; exercises, writing exams, practices (including presentation and simulation software).

LEARNING OUTCOMES

- 1.1 Engineering science concepts, engineering principles, and design engineering required for process design and analysis, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.2 Natural science concepts and mathematical engineering application principles on the design and analysis of process, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.3 Process design technique and principles, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.4 Principles and the latest issues in economy, social, general ecology;
- 1.5 Communication techniques and cutting-edge technologies.
- 2.1 Able to apply mathematics, natural science, and engineering principles to solve complex engineering problems of process, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 3.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with

- their area of expertise;
- 3.2 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
 - 3.3 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
 - 4.1 Demonstrating attitude of responsibility on work in his/her field of expertise independently.

COURSE LEARNING OUTCOMES

The Students are able to

1. Calculate the solution properties and the phase equilibria with appropriate thermodynamic models.
2. Correlate experimental data with thermodynamic models.
3. Understand the limitations of thermodynamic models
4. Know the application of thermodynamic models in the process simulation (ex: HYSYS).

MAIN SUBJECTS

1. Introduction to Vapor-Liquid Equilibrium (VLE) and simple models for VLE, ex Raoult's Law, Henry's Law and Raoult's Law application on real gas and real solutions.
2. Calculation methods of VLE: BUBL, DEW, and Flash
3. The basic theory of the solution and its application for the phase equilibrium
4. The approach methods in VLE calculation (activity coefficients and equations of state)
5. Introduction to Liquid-Liquid Equilibrium (LLE) and Vapor-Liquid-Liquid Equilibrium (VLLE)
6. Introduction to Thermodynamics for the systems containing polymers
7. Practice using Aspen HYSYS 7 software.

PREREQUISITE

Minimum grade of Chemical Engineering Thermodynamics I is D

REFERENCES

1. Smith, J. M., Van Ness, H.C., Abbott, M. M., "Introduction to Chemical Engineering Thermodynamics" 6th ed., McGraw-Hill Co-Singapore (2001).
2. Poling, B. E., Prausnitz, J. M., O'Connell, "The properties of gases and

liquids fifth edition, McGraw-Hill, (2001).

3. Winnick, J., "Chemical Engineering Thermodynamics", John Wiley & Sons, Inc., USA (1997).
4. Modell, M., Reid, R. C., "Thermodynamics and its Applications", Prentice-Hall International, INC., USA (1974).

Course	Course Name : Mass and Heat Transfer
	Course Code : TK184406
	Credit : 3 SKS
	Semester : IV

DESCRIPTION OF COURSE

Mass and Heat Transfer is one of core courses in chemical engineering department. The course will give an introductory treatment of the governing laws for heat and mass transfer to be applied in chemical industrial equipment's unit operation calculation. Learning method and activities comprises lecture, tutorial (discussion), exercises, quiz and exam.

LEARNING OUTCOMES

- 1.1 Engineering science concepts, engineering principles, and design engineering required for process design and analysis, processing system, and equipment required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.2 Natural science concepts and mathematical engineering application principles on the design and analysis of process, processing system, and equipment required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.3 Process design technique and principles, processing system, and equipment required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.4 Communication techniques and cutting-edge technologies.
- 2.1 Able to apply mathematics, natural science, and engineering principles to solve complex engineering problems of process, processing system, and equipment required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 3.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
- 3.2 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
- 3.3 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
- 4.1 Demonstrating attitude of responsibility on work in his/her field of expertise independently.

COURSE LEARNING OUTCOMES

1. Student understand several mechanism of heat transfer
2. Student understand rate law to determine heat transfer rate with mechanism of conduction and convection
3. Student being able to solve one dimension heat transfer problem using combination of rate law and conservation law in shell balance
4. Student being able to solve two dimension conduction heat transfer problem and unsteady state one dimension conduction heat transfer problem
5. Student understand the meaning of equation of change and equation of energy
6. Student being able to simplify equation of energy to solve 1-D steady state conduction heat transfer problem
7. Student understand the definition of heat transfer coefficient
8. Student being able to determine the value of forced and natural convective heat transfer coefficient without phase change
9. Student being able to determine condensing and boiling heat transfer coefficient.
10. Student understand mechanism of radiation heat transfer and understand rate law to determine radiation heat transfer flux
11. Student understand view factor and being able to determine radiation heat transfer flux between two bodies with various geometries
12. Student understand the mechanism of mass transfer
13. Student understand rate law to determine diffusive and convective mass transfer rate
14. Student being able to solve mass transfer problem using rate law and conservation law in shell balance for 1-D system
15. Student being able to solve steady state 2-D diffusive mass transfer problem and unsteady state 1-D diffusive mass transfer problem
16. Student understand the meaning of equation of change and component continuity equation
17. Student being able to simplify component continuity equation to solve 1-D steady state diffusive-convective mass transfer problem
18. Student understand the meaning and definition of mass transfer coefficient for unicomponent and equimolar counter diffusion case
19. Student being able to determine the value of mass transfer coefficient for various geometries and being able to solve various interface mass transfer problems.

MAIN SUBJECT

1. Molecular Heat Transfer (conduction) and Shell Balance,

2. Energy Equation,
3. Interphase Heat Transfer (Heat Transfer Coefficient),
4. Radiation,
5. Molecular Mass Transfer (Diffusion) and Shell Balance,
6. Component Continuity Equation,
7. Interphase Mass Transfer (Mass Transfer Coefficient)

PREREQUIZITE

TK184304 Momentum Transfer

REFERENCES

1. Ali Altway, Sugeng Winardi, Heru Seyawan, *Proses Perpindahan*, ITS Press, Surabaya, 2012
2. C.J. Geankoplis: “*Transport Processes and Unit Operations*”, Prentice Hall, 4th edition.
3. Bird, R.B., Stewart, W.E., Lightfoot, E.N., “*Transport Phenomena*”, John Wiley & Sons, Singapore, edisi 1(1960) atau edisi 2 (2002).
4. Brodkey R.S. and H.C. Hershey: *Transport Phenomena :”A Unified Approach”*, McGraw Hill, 1988Rice, R.G. and Do, D.D., *Applied Mathematics and Modeling for Chemical Engineers*, John Wiley & Sons (1995).

COURSE	Course Name : Chemical Reaction Engineering I
	Course Code : TK184501
	Credits : 3 SKS
	Semester : V

DESCRIPTION of COURSE

This course studies the understanding of kinetics of reactions and designing reactors including Kinetics of homogeneous reactions; Interpretation of batch reactor data; Single and double ideal flow reactor design; The flow reactor is ideal for single reactions and multiple reactions; Effect of temperature and pressure.

LEARNING OUTCOME

- 1.1 engineering sciences, engineering designs and engineering designs necessary for the analysis and design of processes, systems of furnishings, and equipment necessary to convert raw materials into value-added products by chemically processing, physics and biology
- 1.2 the concept of natural science and the principles of application of engineering mathematics to the analysis and design of processes, processing systems, and equipment necessary to convert raw materials into value-added products by chemical, physical and biological processes.
- 1.3 principles and techniques of process design, processing systems and equipment necessary to convert raw materials into value-added products by chemical, physical and biological processes
- 1.4 principles and issues in economics, social, ecology in general
- 1.5 communication techniques and latest and latest technological developments
- 2.1 Able to apply mathematics, natural science, and engineering principles to solve complex engineering problems of process, processing system, and equipment required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 3.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
- 3.2 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
- 3.3 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;

4.1 Demonstrating attitude of responsibility on work in his/her field of expertise independently.
COURSE LEARNING OUTCOME
Students are able to understand the reaction kinetics and design a homogenous chemical reactor
MAIN SUBJECT
<ol style="list-style-type: none"> 1. Homogeneous Reaction Kinetics 2. Interpretation of batch reactor data. 3. Single and double ideal flow reactor design 4. The ideal flow reactor for single reaction and double reaction 5. 5. Effect of temperature and pressure
PREREQUISITES
-
MAIN REFERENCE
<ol style="list-style-type: none"> 1. Octave Levenspiel, “ <i>Chemical Reaction Engineering</i>” , 3rd Ed. McGraw-Hill, 2000Fogler,” <i>Elements of Chemical Reaction Engineering</i> ”, 3rd ed,Prentice-Hall, 1999. 2. Gilbert F.Froment, Kenneth B.Bischoff,”<i>Chemical Reactor Analysis and Design</i>”, 2nd ed, John Wiley & Sons, 1990
SUPPORTING REFERENCE
J.M.Smith, “ <i>Reaction Kinetics</i> ” 3 rd ed, McGraw-Hill,1982

COURSE	Course Name : Unit Operation II
	Course Code : TK184503
	Credits : 3 SKS
	Semester : V

DESCRIPTION of COURSE

This course learns about the understanding of the operation of process equipment based on heat and mass transfers, i.e: evaporation, humidification, drying and crystallization. This course includes the calculation of mass and energy balance in evaporator equipment, drying, continuous humidification process, and crystallization. The strategies of learning activities are an introductory course, brainstorming, written test including quizzes and final examination, and group discussion.

LEARNING OUTCOME

- 1.1 Comprehend the engineering science concepts, engineering principles, and design engineering required for process design and analysis, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.2 Comprehend the natural science concepts and mathematical engineering application principles on the design and analysis of process, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.3 Comprehend the process design technique and principles, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.4 Able to understand the principles and the latest issues in economy, social, general ecology;
- 1.5 Comprehend the communication techniques and cutting-edge technologies;
- 2.2 Able to apply mathematics, natural science, and engineering principles to solve complex engineering problems of process, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 2.3 Able to find the engineering root cause of process, processing system, and equipments required for converting raw materials into value-added products through investigation process, analysis, interpretation of data and information according to engineering principles
- 1.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with

<p>their area of expertise;</p> <p>1.2 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;</p> <p>1.3 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;</p> <p>4.1 Demonstrating attitude of responsibility on work in his/her field of expertise independently.</p>
COURSE LEARNING OUTCOME
<ol style="list-style-type: none"> 1. Students are able to comprehend the concepts and principles of chemical engineering to handle problems related to the chemical engineering fields. 2. Students are able to comprehend the evaporation concept and design the required mass and heat transfer in evaporator to handle problems related to the chemical engineering fields. 3. Students are able to comprehend the drying concept and design the required mass and heat transfer in drying to solve the problem in chemical engineering fields. 4. Students are able to comprehend the continuous humidification concept and design the required tower to handle problems related to the chemical engineering fields. 5. Students are able to comprehend the crystallization concept and calculate the yield in the final process to solve the problem in chemical engineering fields. 6. Students are able to solve the problems in unit operation related to the chemical engineering fields.
MAIN SUBJECT
<ol style="list-style-type: none"> 1. Evaporation 2. Drying 3. Continuous humidification process 4. Crystallization
PREREQUISITES
-
MAIN REFERENCE
<ol style="list-style-type: none"> 1. C.J. Geankoplis: "Transport Processes and Separation Process Principles", Prentice Hall, 4th edition, 2003. 2. McCabe, W.L., J. C. Smith and P. Harriott, "Unit Operations of Chemical Engineering", 6th Ed., McGraw-Hill, Inc., 2001

3. Badger and Banchero, "Introduction to Chemical Engineering", McGraw Hill, 1955
4. Peters, "Elementary Chemical Engineering", 2nd ed, Mc Graw Hill, 1984

SUPPORTING REFERENCE

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COURSE	Course Name : Chemical Reaction Engineering II
	Course Code : TK184601
	Credits : 3 SKS
	Semester : VI

DESCRIPTION of COURSE

This course studies the understanding of kinetics of reactions and designing reactors including Kinetics of homogeneous reactions; Interpretation of batch reactor data; Single and double ideal flow reactor design; The flow reactor is ideal for single reactions and multiple reactions; Effect of temperature and pressure.

LEARNING OUTCOME

- 1.1 Engineering science concepts, engineering principles, and design engineering required for process design and analysis, processing system, and equipment required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.2 Natural science concepts and mathematical engineering application principles on the design and analysis of process, processing system, and equipment required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.3 Process design technique and principles, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.4 Principles and the latest issues in economy, social, general ecology;
- 1.5 Communication techniques and cutting-edge technologies.
- 2.1 Able to do research that includes identification, formulation, and analysis on engineering problems of process, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 3.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
- 3.2 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
- 3.3 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
- 4.1 Demonstrating attitude of responsibility on work in his/her field of

expertise independently.
COURSE LEARNING OUTCOME
Students are able to understand the reaction kinetics and design a homogenous chemical reactor
MAIN SUBJECT
<ol style="list-style-type: none"> 1. Homogeneous Reaction Kinetics 2. Interpretation of batch reactor data. 3. Single and double ideal flow reactor design 4. The ideal flow reactor for single reaction and double reaction 5. Effect of temperature and pressure
PREREQUISITES
-
MAIN REFERENCE
<ol style="list-style-type: none"> 1. Octave Levenspiel, “ <i>Chemical Reaction Engineering</i>” , 3rd Ed. McGraw-Hill, 2000Fogler,” <i>Elements of Chemical Reaction Engineering</i> ”, 3rd ed,Prentice-Hall, 1999. 3. Gilbert F.Froment, Kenneth B.Bischoff,”<i>Chemical Reactor Analysis and Design</i>”, 2nd ed, John Wiley & Sons, 1990
SUPPORTING REFERENCE
J.M.Smith, “ <i>Reaction Kinetics</i> ” 3 rd ed, McGraw-Hill,1982

COURSE	Course Name : Unit Operations III
	Course Code : TK184603
	Credit : 3 SKS
	Semester : VI

DESCRIPTION of COURSE

This course learns and develops the understanding of the theory of separation operations, in particular the units of absorption, distillation, leaching, and extraction and determine the basic specifications of the separation process equipment with stage-wise and packing. The learning methods include the Introduction to separation, Absorption, Distillation, Leaching, and Extraction operations. Strategies of learning activities are: introductory courses; brainstorming; group discussion; assignments; written exams (including Quiz and EAS).

LEARNING OUTCOMES

- 1.1 Engineering science concepts, engineering principles, and design engineering required for process design and analysis, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.2 Natural science concepts and mathematical engineering application principles on the design and analysis of process, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.3 Process design technique and principles, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.4 Principles and the latest issues in economy, social, general ecology;
- 1.5 Communication techniques and cutting-edge technologies.
- 2.1 Able to apply mathematics, natural science, and engineering principles to solve complex engineering problems of process, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
- 1.2 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;

- 1.3 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently; and
- 4.1 Demonstrating attitude of responsibility on work in his/her field of expertise independently.

COURSE LEARNING OUTCOMES

The students are able to

1. understand the principles of separation operations, especially the units of absorption, distillation, leaching, and extraction.
2. determine the basic specifications of separation process equipment with stage-wise and packing types.

MAIN SUBJECTS

1. Introduction to the separation operations
2. Absorption
3. Distillation
4. Leaching
5. Extraction

PREREQUISITES

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REFERENCES

1. McCabe, W.L., J.C. Smith dan P. Harriott, "*Unit Operations of Chemical Engineering*", 7th ed., McGraw-Hill, New York, 2005.
2. Geankoplis, C.J., "*Transport Processes and Separation Process Principles (Includes Unit Operations)*", 4th ed., Pearson Education, Inc., New Jersey, 2003.

COURSE	Course Name : Chemical Engineering Numerical Computation
	Course Code : TK184604
	Credit : 3 SKS
	Semester : VI

DESCRIPTION OF COURSE

This course learns and develops students' abilities on Chemical Engineering issues that are solved using numerical calculation methods and concepts, Solutions of nonlinear equations, Solutions of linear and nonlinear simultaneous equations, Interpolation, Numerical Differentiation and Integration, Numerical solutions for ordinary differential equations, Numerical solutions for partial differential equations. The learning method used is simulation and applied computation including practice and writing exams.

LEARNING OUTCOMES

- 1.1 Engineering science concepts, engineering principles, and design engineering required for process design and analysis, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.2 Natural science concepts and mathematical engineering application principles on the design and analysis of process, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.3 Process design technique and principles, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.4 Communication techniques and cutting-edge technologies.
- 2.1 Able to select appropriate resources and make use of design devices and appropriate IT-based engineering analysis to assist in engineering activities of process, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 3.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
- 3.2 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;

- 3.3 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;
- 1.1 Demonstrating attitude of responsibility on work in his/her field of expertise independently.

COURSE LEARNING OUTCOME

The students are able to solve numerically the problems of Chemical Engineering.

MAIN SUBJECTS

1. The concept of numerical calculation
2. Solving nonlinear equations
3. Solving sets of linear and nonlinear equations
4. Interpolation, numerical differentiation and integration
5. Numerical solutions of ordinary differential equations
6. Numerical solutions of partial differential equations

PREREQUISITES

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REFERENCES

1. Gerald, C. F. and Wheatley, P.O., Applied Numerical Analysis, 7th ed., Addison Wesley Publishing Co., Boston, 2004.
2. Constantinides, A. and Mostoufi, N., Numerical Methods for Chemical Engineers with Matlab Application, Prentice Hall, New Jersey, 1999.
3. Cutlip M.B. and Shacham, M., Problem Solving in Chemical Engineering with Numerical Methods, Prentice Hall, New Jersey, 1999.
4. Chapra, S.C., Applied Numerical Methods with Matlab for Engineers and Scientists, McGraw-Hill, New York, 2005

COURSE	Course Name : Process Dynamics and Control
	Course Code : TK184605
	Credit : 4 SKS
	Semester : VI

DESCRIPTION of COURSE

The use of process dynamics and control in industry. Introduction to mass and energy transient balance. Review Laplace Transformation. Understanding chemical processes in industry based on process dynamics in first order, second order and higher order processes through mathematical model and empirical method. Understanding simple control process. Introduction to closed loop block diagram. Understanding response of first, second, and higher order processes. Process stability based on Routh, Bode and Nyquist criteria. Understanding advanced process control to apply for SISO system.

LEARNING OUTCOME

- 1.1 Engineering science concepts, engineering principles, and design engineering required for process design and analysis, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.2 Natural science concepts and mathematical engineering application principles on the design and analysis of process, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.3 Process design technique and principles, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.4 Communication techniques and cutting-edge technologies;
- 2.1 Able to select appropriate resources and make use of design devices and appropriate IT-based engineering analysis to assist in engineering activities of process, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 3.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
- 3.2 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker

<p>under his/her responsibility;</p> <p>3.3 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;</p> <p>4.1 Demonstrating attitude of responsibility on work in his/her field of expertise independently.</p>
COURSE LEARNING OUTCOME
<ol style="list-style-type: none"> 1. Students can do theoretical mathematical models and empirical methods for physical process in industries. 2. Students are able to solve problems on ordinary differential equation using Laplace Transform. 3. Students are able to give examples dynamics on all order of the process in the openloop system. 4. Students are able to do problems on closed loop block diagram. 5. Students are able to show open loop and closed loop responses for all orders of the processes. 6. Students are able to do tuning controller parameters to prevent the processes become unstable.
MAIN SUBJECT
<ol style="list-style-type: none"> 1. The use of process dynamics and control in industry. 2. Derivation mathematical models end empirical models on physical processes in industry. 3. Review Laplace Transform with its application. 4. Transfer function of first, second and higher order and their dynamics. 5. Feedback and feedforward control systems. 6. Routh, Bode and Nyquist stabilities for first, second and higher order processes.
PREREQUISITES
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REFERENCE
<ol style="list-style-type: none"> 1. Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp, Francis J. Doyle III, "Process Dynamics and Control", 4th ed. , John Wiley & Sons, New. York., 2016. 2. Donald R. Coughanowr, Steven E. Le Blanc,"Process Systems Analysis and Control, 3rd ed, Mc Graw Hill, New York, 2009. 3. William L Luyben, "Process Modelling, Simulation and Control for Chemical Engineers", 2nd ed, Mc Graw Hill, New York, 1996.

COURSE	Course Name : Industrial Waste Treatment*
	Course Code : TK184701
	Credits : 3 SKS
	Semester : VII

DESCRIPTION of COURSE

Industrial Waste Treatment Course studies the design of industrial waste treatment system biologically, both aerobic and anaerobic by using batch reactor, mixed flow and plug flow reactor. Knowledge of biological kinetic parameters such as specific maximum biomass (microbial), yield, loading factor, as well as sludge age and washout residence time as the basis for calculation in design are required.

LEARNING OUTCOME

- 1.1 Engineering science concepts, engineering principles, and design engineering required for process design and analysis, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.2 Natural science concepts and mathematical engineering application principles on the design and analysis of process, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.3 Process design technique and principles, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.4 Communication techniques and cutting-edge technologies;
- 2.1 Able to select appropriate resources and make use of design devices and appropriate IT-based engineering analysis to assist in engineering activities of process, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 3.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
- 3.2 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker under his/her responsibility;
- 3.3 Being able to conduct self-evaluation process to work group under

his/her responsibility, and able to manage learning independently;
4.1 Demonstrating attitude of responsibility on work in his/her field of expertise independently.

COURSE LEARNING OUTCOME

1. Students understand the source and understanding of pollutant parameters
2. Students understand the parameters of kinetics in biological waste treatment
3. Students are able to design industrial wastewater treatment system by using biological method in batch, mixed flow and plugflow reactor

MAIN SUBJECT

1. Waste and environmental management, water resources, Legislation, environmental quality standards
2. Liquid Waste Processing: Source and type of waste, main parameters, pretreatment. Secondary treatment (aerobics), advanced processing
3. Liquid Waste Treatment (anaerobic)

PREREQUISITES

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REFERENCE

Main Reference:

1. Wesley W Eckenfelder Jr, "Industrial Water Pollution Control", McGraw Hill Book International Edition, 1989
2. Donald W. Sundstrom, "Wastewater Treatment", Prantice Hall ind, Englewood Cliffs, New York, 1979

Supporting Reference:

1. Metcalf & Eddy. "Wastewater Engineering", McGraw Hill International edition, 3rd editions, 1991
2. Albert Parker, "Industrial Air Pollution Handbook", McGraw Hill, Maidenhead, Englnad, 1st edition, 1978

COURSE	Course Name : Synthesis and Process Simulation
	Course Code : TK184702
	Credit : 3 SKS
	Semester : VII

DESCRIPTION of COURSE

Synthesis and Simulation Process aim to teach strategies that used in synthesis or design of chemical processes. Synthesis and process design usually starts from a statement about an opportunity to produce a new product or a new way to create an existing product. Often this initial idea is driven by the economy, ie one sees economic opportunities that involve new products or new process concepts. For new products, the synthesis process is part of the most creative design process. This is also the thing that requires the most experience from the designer. He must know the performance of many operating units so that they can be integrated into a process. There are many guides for steps in process synthesis but there is no general method that explicitly "generates" the best process. Instead, the synthesis process is a trial-and-error activity (which experienced designers try to avoid). However, modern tools such as ASPEN Hysys or ASPEN Plus software packages allow simulate the process quickly and accurately enough. With tools such as ASPEN, it is recommended that the designer construct a relatively fast of Process Flow Diagram even though it will be substantially modified later. The development of this PFD forces the designer to learn the process from feed to product, through main equipment (reactor and separator) as well as supporting equipment such as heat exchangers. The synthesis and design also learn types of reactors and separators for the homogen and heterogeneous materials, especially distillation columns as they are the most commonly used separator devices in the chemical industry. The thing that should be highlight is heat integration of heat exchangers or heat exchanger network. With the deepening of HEN, it is expected that the utility needs will be reduced, reusable energy will be higher in other words or higher energy efficiency. Scheduling of batch processes and some examples of batch processes is studied because in fact several chemical industrial process are combine between continuous and batch processes

LEARNING OUTCOME

- 1.1 Engineering science concepts, engineering principles, and design engineering required for process design and analysis, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;

- 1.2 Natural science concepts and mathematical engineering application principles on the design and analysis of process, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.3 Process design technique and principles, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.4 Principles and the latest issues in economy, social, general ecology;
- 1.5 Communication techniques and cutting-edge technologies.
- 2.1 Able to apply mathematics, natural science, and engineering principles to solve complex engineering problems of process, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 2.2 Able to find the engineering root cause of of process, processing system, and equipments required for converting raw materials into value-added products through investigation process, analysis, interpretation of data and information according to engineering principles;
- 2.3 Able to do research that includes identification, formulation, and analysis on engineering problems of process, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 3.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
- 3.2 Being able to demonstrate independent performance, quality, and measurable;
- 3.3 Being able to examine the implications of the development or implementation of the science of technology which concerns and implements the value of humanities in accordance with its expertise based on rules, procedures and scientific ethics in order to produce solutions, ideas, designs or art criticism, compile scientific descriptions of the study results in the form of thesis or final project report, and uploaded it in the college page;
- 4.1 Believing in the oneness of God and able to demonstrate religious attitude;
- 4.2 Demonstrating attitude of responsibility on work in his/her field of expertise independently.

COURSE LEARNING OUTCOME

1. Understanding the concept of synthesis and process simulation to make the chemical process is more efficient, safe and economical.

2. Understanding appropriate selection of reactors and separators, to produce the desired product by involving physical and thermodynamic properties of a mixture.
3. Understanding heat exchangers network to be efficient in energy use.
4. Understanding the batch process and its scheduling for.

MAIN SUBJECT

1. Concept of synthesis and process simulation
2. Calculation of equipment and economic evaluation
3. Review of chemical engineering unit operations, chemical reaction and thermodynamics
4. Design of distillation and azeotropic distillation processes
5. Design of distillation sequence
6. Continuous process design, application of mass and heat balance using commercial software
7. Design of batch process and its application
8. Concept of heat exchangers network

PREREQUISITES

TK184405 Chemical Engineering Thermodynamics II
TK184505 Chemical Equipment Design
TK184601 Chemical Reaction Engineering II
TK184603 Unit Operation III

REFERENCE

1. Robin Smith, "Chemical Process Design and Integration", John Wiley and Son, 2005
2. James M Douglas, "Conceptual Design of Chemical Processes", New York McGraw-Hill - McGraw-Hill chemical engineering series , 1998
3. Warren D. Seider, J. D. Seader, Daniel R. Lewin , Widagdo , "Process Design Principles: Synthesis, Analysis and Evaluation", 3th edition, John Wiley & Sons, 2008
4. Lorenz T. Biegler, Ignacio E. Grossmann , Arthur W. Westerberg , "Systematic Methods of Chemical Process Design", Prentice Hall, 1997

COURSE	Course Name : Chemical Plant Safety
	Course Code : TK184801
	Credit : 3 SKS
	Semester : VIII

DESCRIPTION of COURSE

Chemical Plant Safety (KPK) is a final semester course in the Department of Chemical Engineering. This course examines the understanding of basic concepts of chemical process safety based on Health and Safety Act and Regulation in Indonesia and the OHS basis according to the ILO. Includes discussion; Risks of loss in the working environment of chemical plant, Occupational health (process safety management), Recognizing accident occurrence, Hazards identification and occurrence, Human error and contribution, Changes in chemical properties and hazard, Removal, Case Histories, Confined space, Log out and tag out, Fire and explosion, and HAZOP. The learning methods include: Introductory lecture; Brainstorming; The Writing Exam (covering Quiz, Duties, and Final Exam of the semester), Practice includes Presentations and group discussions. Basically, in this lecture students are able to understand the basics of process safety in a chemical plant.

LEARNING OUTCOME

- 1.1 The concept of science-engineering (engineering sciences), engineering principles, and engineering design required for the analysis and design of processes, processing systems, and equipment necessary to convert raw materials into value-added products by process chemistry, physics and biology;
- 1.2 The concept of natural science and the principles of application of engineering mathematics to the analysis and design of processes, processing systems, and equipment necessary to convert raw materials into value-added products by chemical, physical and biological processes;
- 1.3 Principles and techniques of process design, processing systems, and equipment necessary to convert raw materials into value-added products by chemical, physical and biological processes;
- 1.4 Communication techniques and latest technological developments and current;
- 2.1 Able to formulate alternative solutions to solve complex engineering problems in processes, processing systems, and equipment necessary to convert raw materials into value-added products by chemical, physical and biological processes with due regard to economic, health and safety factors of the public, cultural, social and environmental considerations, capable of

applying logical, critical, systematic, and innovative thinking in the context of the development or implementation of science and technology that cares and implements the humanities value appropriate to their area of expertise;

- 3.1 Able to apply logical, critical, systematic, and innovative thinking in the context of the development or implementation of science and technology that cares for and implements a humanitarian value appropriate to its area of expertise;
- 3.2 Able to take responsibility for the achievement of group work and to supervise and evaluate the completion of work assigned to the worker under his / her responsibility, able to conduct the self-evaluation process against the working group under his responsibility, and able to manage the learning independently;
- 3.3 Able to conduct a self-evaluation process against working groups under their responsibility, and able to manage learning independently;
- 1.1 shows a responsible attitude towards the work in the field of expertise independently;

COURSE LEARNING OUTCOME

1. Students are able to formulate process issues in the industry and understand their relationship to process issues with the effort to prevent loss.
2. Students are able to make initial risk and hazard analysis and resolve possible initiation, propagation and termination of possible accidents
3. Students are able to understand the hazard identification of a chemical industry that includes essential equipment such as tank, reactor, distillation column and others. Analyze the possibility of accident events by analyzing the relationship between threat, top event, barrier, effects on humans, environment, assets, and reputation.
4. Discuss the practical issues in industry. Understanding the problem of human error as one contributor to the occurrence of accidents that are outside the system of industrial equipment. Strictly human error needs to be considered as an object of study to minimize
5. Understand the operation of confined space (limited space), for various types of industrial operations.
6. Establish confined space as a workspace, as a space isolated from any process flow, and energy flow.
7. Be able to isolate limited space by applying the principle of log out and tag out, so. Confined space and Log out must be applied simultaneously.
8. Recognize leakage / release of chemicals, and students recognize passive control with safety valve and procedures to safely design based on the nature of the fluid they protect.
9. Understand the principles of fire, fire, explosion and prevention.

10. Students are able to apply the principle of fire in the process of combustion in industrial equipment that applies combustion as a source of energy to produce raw materials and sources of working fluid, such as furnace boilers, glass furnaces, and kilns.
11. Students able to formulate can be operated and safe a process from flowsheet or P & ID process.
12. Working in groups that describe various background skills in solving process operations in terms of process instruments, and control
13. Study real cases in industry, with HAZOP studies (hazard and operability).

MAIN SUBJECT

Indonesia Safety Act and Regulation; OH3 Basics according to the ILO; accidents, consequences and losses; The risk of loss and prevention; Process safety management; Accident and their Effects; Hazard identification and occurrence, Human error and its contribution, Changes in chemical and hazard properties, Removal, Case Histories, Confined space, Log out and tag out, Fire and explosion, and HAZOP.

PREREQUISITES

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REFERENCE

1. Goetsch DL (2005), "Occupational Safety and Health for Technologists Engineers, and Managers, 5th ed, Prentice Hall
2. Crowl and Louvar (1999), "Chemical Process Safety", 2nd ed, Prentice Hall.
3. Ketentuan Keselamatan Kerja dan Perundang-undangan RI.
4. Keltz T(1999), "What When Wrong?", 4th ed, Gulf Publishing
5. King, Ralph & Magid, John (1982), "Industrial hazard and Safety Handbook", Butterworth Scientific, London.
6. Wong W (2002), "How did that Happen?", Professional Eng. Publ.

COURSE	Course Name : Lipids Technology
	Course Code : TK184608
	Credit : 2 SKS
	Semester : VI

DESCRIPTION of COURSE

This course learns about lipid technology so as to be able to further deepen this knowledge with ease. Materials of lecture material covering the lipid learn about technology proppertis nature of raw materials, processing and handling, quality, and application lipids. With the strategy of learning activities namely: an introductory course; brainstorming; Writing Exam, Practice (covering Quiz, UAS and Duties); discussion groups.

COURSE LEARNING OUTCOME

- 1.1 Engineering science concepts, engineering principles, and design engineering required for process design and analysis, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.2 Natural science concepts and mathematical engineering application principles on the design and analysis of process, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.3 Process design technique and principles, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.4 Principles and the latest issues in economy, social, general ecology;
- 1.5 Communication techniques and cutting-edge technologies.
- 2.1 Able to apply mathematics, natural science, and engineering principles to solve complex engineering problems of process, processing system, and equipments required for converting raw materials into value-added products through chemical, physical, and biological processes;
- 1.1 Being able to apply logical, critical, systematic and innovative thinking in the context of development or implementation of science and technology that concerns and implements the value of humanities in accordance with their area of expertise;
- 1.2 Being able to take responsibility for the achievement of group work and supervise and evaluate the work completion assigned to the worker

<p>under his/her responsibility;</p> <p>1.3 Being able to conduct self-evaluation process to work group under his/her responsibility, and able to manage learning independently;</p> <p>4.1 Demonstrating attitude of responsibility on work in his/her field of expertise independently.</p>
LEARNING OUTCOME
Students are able to understand the production technology of vegetable oil.
MAIN SUBJECT
<ol style="list-style-type: none"> 1. The nature and properties of lipids, 2. Sources of lipids, 3. Nutritional and health aspects of lipids, 4. Lipid processing, bleaching, hydrogenase, fractionation, interestifikasi, packaging, and quality of lipids 5. Lipids application
PREREQUISITES
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REFERENCE
<ol style="list-style-type: none"> 1. R. D. O'Brien, W. E. Farr, P. J. Wan, Introduction to Fats and Oils Technology, 2nd edition, AOCS, Champaign, Illinois, 2000 2. Jason E. Maxwell, Soybean: Cultivation, Uses and Nutrition, Nova Science Publisher, New York, 2011. 3. Hong NGUYEN, Seed Oil: Production, Uses and Benefits, Nova Science Publisher, New York, 2017.

