SYLLABUS:

Date / Revision 23 May 2015 / 02 May 2017 / PP
Faculty Life Sciences (LS)
Study Programs Food Technology, Chemical Engineering

SUBJECT: Physical Chemistry

1 Basic Information

1.01	**Subject Name**	**Physical Chemistry**
1.02	**Semester**	3
1.03	**Level**	*1*
1.04	**SKS**	3
1.05	**Mandatory / Curriculum**	*D-02*
1.06	**Subject Code**	PHCH
1.07	**Subject Code**	CHE-FTE-D-LS-117
1.08	**Year**	2017 (7)
1.09	**Quality Control**	Final Test, OFSE, see evaluation
1.10	**Limitations**	Min 12 and Max 32 students in one class
1.11	**Combined with**	Food Technology, Chemical Engineering
1.12	**Pre-requisite**	Chemistry, Physics, Engineering Math, Fluid & Particle Mechanics, Mass and Energy Balance, Heat and Mass Transfer
1.13	**Responsible**	Dr. Tutun Nugraha
1.14	**Revision**	15-05-2017/pp

2 Description of Subject

This course provides more insight into chemistry following the basic chemistry courses that the students have learned in the previous year. The course focuses on the topics of thermodynamics and kinetics, the concept of ideal gas, and the 0th, 1st, 2nd, and 3rd law of thermodynamics. Students will also learn to utilize tables of enthalpy, entropy, as well as Cp and Gibbs energy. On the kinetics side, the students will learn the basic concept of kinetics in both gas phase and liquid phase starting with the more theoretical material and continued with the derivation of rate equation from elementary reactions that forms the mechanisms of reaction. The students would also get the opportunity to use their mathematical skills particularly in the use of Calculus, which is used substantially throughout the course.

PO Box 150, BSD CPA 15330
Tel. +62 85212318000
info@iuli.ac.id
www.iuli.ac.id
IULI – Eco Campus, The Breeze
Jl. BSD Grand Boulevard
BSD City 15345
Island of Java

3 Objectives

This course will introduce to the students the next level of fundamental courses within the study program of Food Technoogy and Chemical Engineering. The concept of Chemistry, physics and the use of calculus is emphasized throughout. The course will prepare the students to tackle the more complex phenomena in physical chemistry.

4 Competency

After having the course, students are expected to:

a) Understand the the underlying physical principles that govern the properties and behaviour of chemical systems.
b) Use critical thinking and logic in the solution of problems
c) knwo the applications of calculus into various problems that are faced in this course. The uses of Calculus ie. integral and differenctial are inseparable. This will provide the opportunities for the students to begin to link various concepts in basic mathematics into the realm of physics and chemistry. Integration of basic knowledge beins in this course.
d) students will be introduced to new concepts and to some were given the chances to study in depth various phenomena in thermodynamics, chemical equilibrium as well as kinetics in the gas phase and in theliquid phase.

5 Learning Approach / Methodology

- Lectures/ Class contact (time-tabled) supplemented with interactive questions and answers to build the projects;
- Tutorial/Laboratory/Practice Classes: preview of materials, revision and/or reports writing;
- Student Study Effort: homework/assignment; preparation for test/quizzes/ examination.
- Writing assignments/preseantations

6 Evaluation

5.1	**Absence maximum**	25%
5.2	**Participation in Discussion**	-
5.3	**Homework / Classwork**	20 points
5.4	**Presentation /Simulation**	-
5.5	**Daily Quiz**	20 Points
5.6	**Final Examination**	60 Points
	Total	100 Points

PO Box 150, BSD CPA 15330
Tel. +62 85212318000
info@iuli.ac.id
www.iuli.ac.id
IULI – Eco Campus, The Breeze
Jl. BSD Grand Boulevard
BSD City 15345
Island of Java

7 Text Book and Reference

1	**Main Text Book:** a) Physical Chemistry, Ira N Levine, McGraw Hill, 6th Edition, ISBN 978-007-127636-8, 2009 , Estimated Price of book: Rp 305,000,- Also: b) R. J. Silbey, R. A. Alberty, M.G. Bawendi, Physical Chemistry, Edisi ke-4, John Wiley & Sons, Inc. 2005.
2	**Supplement Textbooks:**

8 Content / Topics of Lecture

Week	Content/ Topics of Lecturing	Text Book Chapter	Remark
1, 2	**Introductionand zeroth law of thermodynamics and the properties of gases** • To provide an overview to the students concerning the course as well as the general requirement and the marking scheme • To introduce the properties of matter at equilibrium (T, P, V, n, system boundary, and degree of freedom) • To discuss the 0th law of thermodynamics, and how it leads to the ideal gas temperature scale To introduce the critical phenomena • To introduce the concept of ideal gas and ideal gas mixture including the • Dalton's law as applied to partial pressure Followed by the discussion of Equation of States for real gases, including van der Waals and Virial EoS which will allow • students to evaluate relationships between P, V, T, and n for real gases • Exercises/review of problem set	Lecture, Group discusion, tutorial for exercise Chapter 1 & 2 (law of thermodynamics) Chapter 8 on ideal and real gas)	2 x 3 x 50 minutes
3, 4	**First law of thermodynamics** • To introduce processes that take a chemical system from one state to another is described • 1st law of thermodynamics, also referred to as law of conservation of energy, is discussed; which is followed by the introduction of Work (W), Internal Energy (U) as well as Enthalpy (H). • Heat capacities (Cv and Cp) are then discussed • The concept of thermochemistry whichdeals with the production of heat during a chemical process is discussed • Students are also learning how to use or read various table of thermodynamics data to extract needed physical constant • Exercises/review of problem set	Lecture, Group discusion, tutorial for exercise Chapter 1 & 2	2 x 3 x 50 minutes

PO Box 150, BSD CPA 15330
Tel. +62 85212318000
info@iuli.ac.id
www.iuli.ac.id
IULI – Eco Campus, The Breeze
Jl. BSD Grand Boulevard
BSD City 15345
Island of Java

5,6	**2nd and 3rd law of thermodynamics** • Students learned the concept of Entropy (S) and how it is related to the natural/ spontaneous direction of a process or a chemical reaction • The 2nd law is discussed as related to the determination whether a process will occur in the forward or the backward direction through evaluation of DS • Calculation of entropy at any desired temperature relative to its entropy at zero Kelvin through integration of dq_{rev}/T is discussed • To introduce to student the 3rd law of thermodynamics • Heat engine and its efficiency is introduced	Lecture, Group discusion, tutorial for exercise Chapter 3	2 x 3 x 50 minutes
7	**Fundamental equations of thermodynamics** • To introduce the Gibbs and Helmholtz • Energy to determine spontaneity of a process • To discuss the effects of T and P on Gibbs energy • To introduce the concept of fugacity & activity as well as how they are related to the calculation Gibss energy for real gases • Exercises/review of problem set	Lecture, Group discusion, tutorial for exercise Chapter 4 & 5	3 x 50 minutes
8	**Midterm Break**		
9, 10	**Chemical Equilibrium** • To introduce the concept of chemical equilibrium and derive mathematical equations that describe it • To discuss the evaluation of equilibrium constant through the values of Gibbs energy • The effects of the values of T, P, and the concentrations of the initial compositions as well as the presence of inert compounds are described Students will also learn the concept of heterogeneous reactions where solid phase are involved in the chemical reactions	Lecture, Group discusion, tutorial for exercise Chapter 6	2 x 3 x 50 minutes
11	**Phase equilibrium** • To introduce the Gibbs and Helmholtz Energy to determine spontaneity of a process • To discuss the effects of T and P on Gibbs energy • To introduce the concept of fugacity & activity as well as how they are related to the calculation Gibss energy for real gases • Exercises/review of problem set	Lecture, Group discusion, tutorial for exercise Chapter 12	3 x 50 minutes
12	**Electrochemical Equilibrium** • To introduce the concept of chemical equilibrium and derive mathematical equations that describe it • To discuss the evaluation of equilibrium constant through the values of Gibbs energy • The effects of the values of T, P, and the concentrations of the initial compositions as well as the presence of inert compounds are described • Students will also learn the concept of heterogeneous reactions where solid phase are involved in the chemical reactions	Lecture, Group discusion, tutorial for exercise Chapter 13	3 x 50 minutes

PO Box 150, BSD CPA 15330
Tel. +62 85212318000
info@iuli.ac.id
www.iuli.ac.id
IULI – Eco Campus, The Breeze
Jl. BSD Grand Boulevard
BSD City 15345
Island of Java

13	**Reaction Kinetics in the gas phase** • Introduction to kinetic theory of gases • Rate and order of reaction • Reversible first order reactions • Consecutive first order reactions • Effects of temperature • Mechanisms of chemical reactions • relations between rate constants for forward and backward reactions • Unimolecular, bimolecular and trimolecular reactions \Unbranched and branched chain reactions	Lecture, Group discusion, tutorial for exercise Chapter 14 & 15	3 x 50 minutes
14	**Reaction Kinetics in the liquid phase** • Mobility of an ion • Encounter pairs and solvent cage • Diffusion controlled reactions in liquids • Acid and Base catalysis • Enzyme catalyses • Exercises/review of problem set	Lecture, Group discusion, tutorial for exercise Chapter 16	3 x 50 minutes
15	**Review/evaluation/quizes**		
16, 17	**Final Examination**		

PO Box 150, BSD CPA 15330
Tel. +62 85212318000
info@iuli.ac.id
www.iuli.ac.id
IULI – Eco Campus, The Breeze
Jl. BSD Grand Boulevard
BSD City 15345
Island of Java