Department of Chemical Engineering
College of Engineering
University of the Philippines
Diliman, Quezon City

ChE 123

Chemical Engineering Thermodynamics II

Course Description: Thermodynamic properties of homogeneous mixtures. Phase and reaction equilibria. Calculations involving models of homogeneous mixtures, phase and reaction equilibria.

Course Prerequisites: ChE 106 and ChE 122

Course Credit: 3.0 units (3 h lecture)

Program Educational Objectives (BS Chemical Engineering)
The program aims to educate students such that three to five years from graduation, they:

1. take leadership roles in their respective fields and/or effectively work in or manage a team;
2. are equipped with the extensive knowledge and relevant skills necessary to succeed in their chosen careers and to become responsive citizens;
3. are able to demonstrate strong research & innovative capability as they recognize and address opportunities and challenges in their respective spheres of influence;
4. have shown strong commitment to the ethical practice of their profession; to health, safety and environment; and service to society.

Course Outcomes
At the end of the course, the student should be able to:

1. Apply the concepts of physical chemistry and techniques in calculus to
   a. derive other thermodynamic property relations from fundamental property relations
   b. calculate changes in the thermodynamic properties of homogeneous mixtures
   c. derive the phase equilibrium relation and chemical equilibrium relation
2. Identify and solve vapor-liquid equilibrium problems for both ideal and non-ideal solutions,
3. Apply vapor-liquid equilibrium relations based on cubic equations of state and other EOS models,
4. Derive solution properties from vapor-liquid equilibrium experimental data,
5. Interpret data from phase equilibrium diagrams,
6. Use spreadsheets and computer programming in vapor-liquid equilibrium calculations and construction of phase equilibrium diagrams,
7. Solve for the equilibrium conversion of single reaction systems,
8. Use numerical computing software to solve for the equilibrium conversion of multi-reaction systems,
9. Analyze the effect of operating variables on chemical reaction conversion,
10. Apply concepts of chemical reaction equilibrium to selection of reaction pathways in process development and reactor design, and
11. Formulate logical assumptions to simplify engineering calculations

Student Outcomes Satisfied by Course Outcomes

[a] Ability to apply knowledge of mathematics and science to solve engineering problems
[e] Ability to identify, formulate, and solve engineering problems

Course Content

Meeting	Topic	Sub-topics
1	Introduction and Review	
	1N-2P Equilibrium	Nature of Equilibrium
		Phase Rule and Duhem's Theorem
2	Introduction to VLE	Qualitative Behavior
3 **4**		Models for VLE
5		Chemical Potential and Phase Equilibria
6 **7**	Solution Thermodynamics	Partial Properties
8		Ideal-Gas Mixture Model
First Long Examination		
9 **10**		Fugacity and Fugacity Coefficients
11		Ideal-Solution Model
12		Excess Properties
13 **14**		Property Changes and Heat Effects of Mixing
15 **16**		Models for Excess Properties
17 **18**		Liquid Phase Properties from VLE Data
Second Long Examination		
19 **20**	Phase Equilibrium	Gamma-Phi Formulation of VLE
21		Equilibrium and Stability
22		Liquid-Liquid Equilibrium
23		Vapor-Liquid-Liquid Equilibrium
24		Solid-Liquid Equilibrium
25	Chemical Reaction Equilibria	Reaction Coordinates
		Gibbs Energy Change and Equilibrium Constants
		Temperature Effect on Equilibrium Constants
26		Evaluation of Equilibrium Constants
27		Composition and Equilibrium Constants
		Phase & Gibbs-Duhem Rule for Reacting Systems
28		Equilibrium Conversions for Single Reactions
29 **30**		Multi-reaction Equilibria
Third Long Examination		

Course Assessment

Long Exams (3)	75%
Classworks	10%
Special Project	15%

Course Policies

1. Long exams (LE's) may be closed- or open-book exams. Necessary tables and figures shall be agreed upon prior to the examination date.

2. Grievances regarding checked LE's shall be entertained only within the day upon the return of papers or announcement of scores. All grievances (for any reason) will not affect the grades if they are raised after the grievance day.
3. A student who misses an exam with valid excuse must approach his/her instructor to discuss the options that can be taken. He/she may take a make-up exam for the one he/she missed. He/she can make up for only one missed exam. The other missed exams will be given a grade of zero. The validity of the excuse is within the instructor's discretion.
4. There will be no rules on attendance.
5. The instructor reserves the right to change class policies when deemed necessary.

Grading System

1.00	1.25	1.50	1.75	2.00	2.25	2.5	2.75	3.00	5.00
[92,100]	[88,92)	[84,88)	[80,84)	[76,80)	[72,76)	[68,72)	[64,68)	[60,64)	[0,60)

List of Instructors

Dr. Maria Lourdes Dalida
Prof. Jonas Karl Christopher Agutaya
Prof. Jhud Mikhail Aberilla
Engr. Louie Arelvi Villanueva

References

1. Green and Perry: *Perry's Chemical Engineers' Handbook*
2. Koretsky: *Engineering and Chemical Thermodynamics*
3. Poling, Prausnitz and Connell: *Properties of Liquids and Gases*
4. Smith, Van Ness and Abbott: *Introduction to Chemical Engineering Thermodynamics*
5. Sandler: *Chemical and Engineering Thermodynamics*