Colorado State University
Department of Chemical and Biological Engineering

CBE 210: Thermodynamic Process Analysis

Course Outline – Spring 2009

Prerequisite: CBE 201; MATH 261 or concurrent registration
Lecture: MWF 2:00~2:50pm
Location: Clark C 146

Instructor: David WANG
Office: Glover 108
Phone: 491-2763
E-mail: q.wang@colostate.edu
Office Hours: Friday 4~5pm in Glover 108, or by appointment.

TAs:	Chen Guo	631-3271	tongtongforever@gmail.com
		Office Hours:	Thursday 4~5pm in Glover 109.
	Jing Zong	491-1188	dellus1981@gmail.com
		Office Hours:	Wednesday 4~5pm in Glover 123.
	Meghan Meno	719-321-0371	mmmeno@engr.colostate.edu
		Office Hours:	Tuesday 5~6pm in Glover 109.
	Khalil Al Pelekeya	491-1188	khalil.alpelekeya@colostate.edu
		Office Hours:	Monday 4~5pm in Glover 123.

Textbook

Elliott and Lira, *Introductory Chemical Engineering Thermodynamics*, Prentice Hall, 1999.

Reference Book

Smith, Van Ness, and Abbott, *Introduction to Chemical Engineering Thermodynamics*, 7th Ed., McGraw-Hill, 2005.

Course Description

This course examines the basic principles of thermodynamics and applications to ideal and non-ideal mixtures, power cycles, and chemical equilibria. Topics covered include the first and second laws of thermodynamics, volumetric properties of pure fluids, thermodynamic properties of ideal and non-ideal mixtures, and phase and chemical equilibria.

Grading

Homework & participation	25%
Quizzes	20%
Midterm exam	20%
Final exam	20%
Group project	15%

Additional Information

Learning objectives (can also be used as your study guide for exams)

The student successfully completing this course will be able to:

1. Apply the mass, energy and entropy balance to closed and open systems;
2. Derive the relations among various thermodynamic quantities (transform derivatives);
3. Apply the equilibrium and stability criteria to pure materials and binary mixtures;
4. Given an equation of states, calculate property changes of pure materials;
5. For mixtures, explain the concepts of partial molar property, mixing function, departure function, excess function, and their combinations (e.g., partial molar excess mixing Gibbs free energy);
6. Calculate fugacity coefficient given an equation of state, and activity coefficient given an excess Gibbs free energy (or Gibbs free energy of mixing) model;
7. Select appropriate thermodynamic models and solve phase equilibrium problems for both pure materials and mixtures;
8. Solve the basic chemical reaction equilibria.

Homework

There will usually be weekly homework assignments. Students may discuss with each other, but copying is not allowed. Homework will be due at the beginning of class. ***Late homework will not be accepted***. Students who are unable to attend class may submit assignments early by placing them in the instructor's mailbox in Glover 100.

Quizzes and Exams

There will be two in-class quizzes, one mid-term exam, and one final exam. Both the mid-term and final exams will be cumulative. All the quizzes and exams will be closed book, and students may use one sheet (letter size, can be written on both sides) of notes. Please bring your calculator. There will be no makeup exam and students will receive 0 credit for any exam they fail to take, unless the absence is excused. Requests for an excused absence from an examination must be submitted in writing to the instructor prior to the next scheduled lecture following the exam. ***The final exam is scheduled for 7:00~9:00am on May 14, 2009.*** If you have another exam at the same time, please let the instructor know as soon as possible.

Group Project

There will be one group project. Each group of 5~6 students will give a short (less than 20 minutes) lecture on a selected topic, and answer any questions related to it. A sign-up sheet will be distributed later for each student to choose his/her group. The presentation will be graded by the rest of the class, including TAs and instructor.

Academic Integrity Policy

A statement of the university's academic integrity policy can be found in the General Catalog at http://www.catalog.colostate.edu/front/policies.aspx (scroll down to the section on "Students' Responsibilities"). The policy is zero tolerance. The ***minimum*** action taken for academic dishonesty will be a failing grade for the course. In particular:

- Students may not copy any part of a homework assignment or an exam from other students, ***including those in previous years***. The student who knowingly provides his/her assignment or exam to be copied is also in violation of the CSU policy. Students, however, are allowed and encouraged to work in groups on homework assignments.
- Students are forbidden to use solution manuals from any source. The resources that the students are allowed to use for homework and exams are limited to textbook, reference or similar books, lecture notes and handouts, and data handbooks. For the project, other resources may be used.
- Discussing the content of an exam with someone who has not taken the exam is not allowed.

Preliminary Class Schedule (1-19-09)

Week	Day	Topic	Text
1	Jan. 21	Introduction	Chap. 1.4
	Jan. 23	The First Law	Chaps. 2.1~2.3, 2.7, 2.9~2.11, 2.13
2	Jan. 26		
	Jan. 28		
	Jan. 30		
3	Feb. 2	The Second Law	Chaps. 3.3~3.5, 3.14
	Feb. 4		
	Feb. 6		
4	Feb. 9		
	Feb. 11	Review 1	
	Feb. 13	***Quiz 1***	
5	Feb. 16	Project – Throttles, Nozzles, Compressors and Pumps	Chaps. 2.12, 2.14, 3.9, 3.11, 4.1~4.2, 4.4~4.8
	Feb. 18	Project – Turbines	
	Feb. 20	Project – Carnot and Rankine Cycles	
6	Feb. 23	Project – Vapor-Compression Cycle and Liquefaction	
	Feb. 25	Project – Internal Combustion Engines	
	Feb. 27	Project – Fluid Flow	
7	Mar. 2	Thermodynamic Analysis of Processes	Handouts
	Mar. 4	Thermodynamic Transformation	Chaps. 5.1~5.3
	Mar. 6		
8	Mar. 9	Pure Materials	Chaps. 6.2~6.5, 6.9, 7.1, 7.3~7.6
	Mar. 11		
	Mar. 13		
9	Mar. 16	***No Class This Week – Spring Break***	
	Mar. 18		
	Mar. 20		
10	Mar. 23	Review 2	
	Mar. 24	***Mid-term Exam*** (5~8pm in classroom)	
	Mar. 25	Mixtures	Chap. 9
	Mar. 27		
11	Mar. 30		
	Apr. 1		
	Apr. 3		
12	Apr. 6		
	Apr. 8		
	Apr. 10		
13	Apr. 13	Review 3	
	Apr. 15	***Quiz 2***	
	Apr. 17	Phase Equilibria	Chaps. 8, 10~11
14	Apr. 20		
	Apr. 22		
	Apr. 24		
15	Apr. 27		
	Apr. 29		
	May 1	Chemical Reaction Equilibria	Chap. 14
16	May 4		
	May 6		
	May 8	Review 4	
	May 14	***Final Exam*** (7~9am in classroom)	

Note: *This schedule may be modified during the semester.*