

# CENG 122: SEPARATION PROCESSES

## Syllabus – Fall 2009

**Class Time:** 3:30-4:50 am, Tuesday & Thursday  
Warren Lecture Hall, Room 2205

**Instructor:** Professor Liangfang Zhang  
Moore's Cancer Center, 5308  
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**Teaching Assistant:** Darren Yang  
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**Office Hours:** Darren Yang (TA): 5:00 – 6:00 pm, Tuesday  
Atkinson Hall (CalIT 2), Open office area

Prof. Zhang: 5:00 – 6:00 pm, Thursday  
Atkinson Hall (CalIT 2), Room 2805

**Course Website:** <http://ne.ucsd.edu/faculty/17zhang/teaching.php>

**Textbook:** J.D. Seader and E.J. Henley, Separation Process Principles, John Wiley & Sons, 2<sup>nd</sup> edition, 2006.

### References on Reserve:

- Henley, E.J. and Seader, Equilibrium-Stage Separation Operations in Chemical Engineering, John Wiley & Sons (1981).
- King, J., Separation Processes, 2nd Ed., McGraw-Hill (1980).
- Perry and Chilton, Chemical Engineers' Handbook, 5<sup>th</sup> Ed., McGraw-Hill (1973).
- Shreve, R.N. and J.A. Brink, Jr., Chemical Process Industries, McGraw-Hill (1984).
- Treybal, R.E., Mass-Transfer Operations, 3rd Ed., McGraw-Hill (1980).

### Homework:

1. Problem sets will be assigned in class and due one week later in class. Late homework will receive no points.
2. Discussion with classmates is acceptable, but not collaboration. **You must do your homework individually.** No points will be given for collaborative homework.
3. All graphs are to be presented on appropriate graph paper, properly labeled on the axis with units and titled. References must be cited for all data, even from the text.
4. Write on only one side of the page. Number the pages and staple them together. No other method of attaching pages will be accepted.

5. Many of the problems will be DESIGN problems. These problems require a solution with the following format: Given - information given in the problem statement or from a CITED reference; Assumptions - state assumptions such as steady-state, equilibrium stage, ideal thermodynamics; Recommendation - the design solution.

<b>Grading:</b>	Homework (4 assignments)	20%
	Midterm Exam I	25%
	Midterm Exam II	25%
	Final Exam	30%

<b>Exam Dates:</b>	Midterm Exam I ( <b>Lecture 1-6</b> ): <i>Oct. 20<sup>th</sup></i> , in class
	Midterm Exam II ( <b>Lecture 7-11</b> ): <i>Nov. 10<sup>th</sup></i> , in class
	Final Exam ( <b>Lecture 12-18</b> ): <i>Dec. 7<sup>th</sup></i> , location: TBD

### **Course Description:**

CENG 122 is a course to develop familiarity and skill to perform basic design procedures for equilibrium and some rate separation processes. In CENG 122, design and analysis of equilibrium stage separations are mainly discussed. Computer-aided design will be introduced. More advanced design and analysis for multicomponent systems amenable to computational methods and more recent advances will be covered in CENG 124 A&B. Since we are dealing with equilibrium processes, review your thermodynamics (CENG 102) and/or physical chemistry (Chem 131). Gas absorption in packed columns is a differential contacting operation, which requires an understanding of diffusion (CENG 103B). Many of the problems require numerical solutions and will use methods covered in CENG 100.

### **Covered Topics:**

- 1) Introduction to separation processes
- 2) Thermodynamics of separation operations
- 3) Single equilibrium stages and flash calculations
- 4) Cascades and hybrid systems
- 5) Absorption and stripping of dilute mixtures
- 6) Distillation of binary mixtures
- 7) Multistage distillation
- 8) Batch distillation
- 9) Membrane separations

## Tentative CENG 122 Course Outline (Subject to Change)

Week	Date	Topic
Week 1	09/24	L1: Introduction to Separation Processes ( <i>Chapter 1</i> )
Week 2	09/29 10/01	L2: Thermodynamics (1) ( <i>Chapter 2</i> ) L3: Thermodynamics (2) ( <i>Chapter 2</i> )
Week 3	10/06 10/08	L4: Thermodynamics (3) ( <i>Chapter 2</i> ) <i>Homework Assignment #1</i> L5: Single Equilibrium Stages & Flash Calculations (1) ( <i>Chapter 4</i> ) <i>ASPEN Demo #1-Flash Calculations</i>
Week 4	10/13 10/15	L6: Single Equilibrium Stages & Flash Calculations (2) ( <i>Chapter 4</i> ) <i>Sample problems and Solutions A</i> L7: Cascades (1) ( <i>Chapter 5</i> )
Week 5	10/20 10/22	<b>Midterm Exam 1 (Lecture 1-6)</b> L8: Cascades (2) ( <i>Chapter 5</i> )
Week 6	10/27 10/29	L9: Cascades (3) ( <i>Chapter 5</i> ) <i>Homework Assignment #2</i> L10: Absorption & Stripping (1) ( <i>Chapter 6</i> )
Week 7	11/03 11/05	L11: Absorption & Stripping (2) ( <i>Chapter 6</i> ) <i>Sample problems and Solutions B</i> L12: Binary System Distillation (1) ( <i>Chapter 7</i> )
Week 8	11/10 11/12	<b>Midterm Exam 2 (Lecture 7-11)</b> L13: Binary System Distillation (2) ( <i>Chapter 7</i> )
Week 9	11/17 11/19	L14: Binary System Distillation (3) ( <i>Chapter 7</i> ) <i>Homework Assignment #3</i> <i>ASPEN Demo #2 – Multistage Distillation</i> L15: Multistage Distillation ( <i>Chapter 9</i> )
Week 10	11/24 11/26	L16: Batch Distillation ( <i>Chapter 13</i> ) <i>Homework Assignment #4</i> Thanksgiving holiday
Week 11	12/01	L17: Membrane Separations (1) ( <i>Chapter 14</i> )
Week 11	12/03	L18: Membrane Separations (2) ( <i>Chapter 14</i> ) <i>Sample problems and Solutions C</i>
Week 12	12/07	<b>Final Exam (Lecture 12-18)</b>