CHEN3220 Chemical Engineering Separations - Syllabus
Spring 2025

Class Lecture 8:30-9:20 MWF in A108

Class email CHEN3220@colorado.edu

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CA Office Hours (subject to change)

The following office hours are primarily run by the CAs, GTA, and ATA. The instructors will be present for some of these office hours.

- **Tuesday 5-6pm in BIOT E1B11**
- **Wednesday 3:30-6:00pm in BIOT A108**
- **Thursday 3:30-6pm in BIOT A115**

Text *Separation Process Principles: With Applications Using Process Simulators, 4th Edition* by J. D. Seader, Ernest J. Henley, D. Keith Roper

Course Description

Studies separation methods including distillation, absorption, and extraction, and graphical and computer-based solutions to separation problems. Applies mass transfer rate theory to packed and tray columns. Prereq., CHEN 3210 and CHEN 3320 or MCEN 3022.

Course Objectives

Students will be able to:

- Explain what constitutes a separation and use the common metrics for assessing the performance of a separation process (e.g. product purity, product recovery, etc.).
- Apply concepts from mass transfer and thermodynamics to the design and analysis of transport-limited separation processes.
- Classify the major production-scale equilibrium and non-equilibrium separation methods used in industry (e.g. distillation, absorption, stripping, extraction, adsorption, membranes, and others), and explain the principles behind how each method works.
- For a specific separation need, make a preliminary choice of a separation method and predict separation performance using equilibrium data, mass balances, and energy balances.

- Predict qualitatively how changing an operating parameter or design parameter will affect separation performance.
- Utilize commercial simulation software such as Aspen Plus and Aspen HYSYS to model different separation systems.

Grading Breakdown

Clicker Quizzes	15 %
Homework	20 %
Projects	20 %
Peer Reviews	5 %
Midterm Exams	20 %
Final Exam	20 %

Grading Basis

90 / 93 / 100 %	A-, A
80 / 83 / 87 %	B-, B, B+
70 / 73 / 77 %	C-, C, C+
60 / 63 / 67%	D-, D, D+
< 60%	F

Exams

- Midterm Exams on Monday, February 17th and Monday, April 14th, from 7-9pm in BIOT A115 (seating chart will be sent to students closer to the exam; students with 1.5x time from 6:00-9:00pm).
- Final Exam on Wednesday, May 7 from 7:30 pm – 10:00 pm

Projects

Students will complete two projects, one on equilibrium separations and one on non-equilibrium separations. Details on projects will be given in class. Students may work individually or in teams of either two or three students on each project.

Teams

Students may work individually, in groups of two, or in groups of three on homework and projects. No groups of four will be allowed. It is the responsibility of every student to determine their team. Instructors will not determine teams but maintain the option to reorganize teams as necessary, potentially resulting in some students working with fewer team members or on their own.

Peer-Review

Instructors determine the final allocation of points, but heavily consider peer-review input. It is extremely important that everyone contributes to important aspects of group work. Students do not want to receive poor peer reviews because they did not have a lot of responsibility – take responsibility and come through for the team! Students will be asked to turn in written peer-review assessments to the instructors regarding their team effort. It cannot be overemphasized how important it is for the team to be functional and bring out the best in all members.

Homework

Written work must be neat and readable with adequate spacing and margins; points will be deducted by TAs if they cannot read homework or find answers (box your answers!). Homework will be turned in via Gradescope, either individually or in groups of 2 or 3 people. Homework will be graded primarily on the process, so showing your work is critical.

Clickers (in-person)

Clickers will be utilized during class. Students must click in person themselves in A108 to receive clicker points; students cannot have someone else click for them unless it has been pre-authorized by the instructor. Each question is worth two points: one point for answering, one point for getting the correct answer. The lowest ~ 10% of clicker points will be dropped.

Late Work

If you are having difficulties, please let the instructors know *before* due dates so we can work out a solution together; we understand you have quite a few priorities and are happy to work together so reach out to us! Homework and project folders close at the stated times; *no late work will be accepted except in the case of a documented emergency, a medical situation, or when it has been prearranged with the instructors.*

Course Communication

All class slides, homework, and videos will be placed on Canvas for students to download.

University Policies

Classroom Behavior

Students and faculty are responsible for maintaining an appropriate learning environment in all instructional settings, whether in person, remote, or online. Failure to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, marital status, political affiliation, or political philosophy.

For more information, see the classroom behavior policy, the Student Code of Conduct, and the Office of Institutional Equity and Compliance.

Accommodation for Disabilities, Temporary Medical Conditions, and Medical Isolation

If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to your faculty member in a timely manner so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the Disability Services website. Contact Disability Services at 303-492-8671 or DSinfo@colorado.edu for further assistance. If you have a temporary medical condition, see Temporary Medical Conditions on the Disability Services website.

Preferred Student Names and Pronouns

CU Boulder recognizes that students' legal information doesn't always align with how they identify. Students may update their preferred names and pronouns via the student portal; those preferred names and pronouns are listed on instructors' class rosters. In the absence of such updates, the name that appears on the class roster is the student's legal name.

Honor Code

All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the Honor Code. Violations of the Honor Code may include but are not limited to: plagiarism (including use of paper writing services or technology [such as essay bots]), cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, submitting the same or similar work in more than one course without permission from all course instructors involved, and aiding academic dishonesty. Understanding the course's syllabus is a vital part in adhering to the Honor Code.

All incidents of academic misconduct will be reported to Student Conduct & Conflict Resolution: StudentConduct@colorado.edu. Students found responsible for violating the Honor Code will be assigned resolution outcomes from the Student Conduct & Conflict Resolution as well as be subject to academic sanctions from the faculty member. Visit Honor Code for more information on the academic integrity policy.

Sexual Misconduct, Discrimination, Harassment and/or Related Retaliation

CU Boulder is committed to fostering an inclusive and welcoming learning, working, and living environment. University policy prohibits protected-class discrimination and harassment, sexual misconduct (harassment, exploitation, and assault), intimate partner abuse (dating or domestic violence), stalking, and related retaliation by or against members of our community on- and off-campus. The Office of Institutional Equity and Compliance (OIEC) addresses these concerns, and individuals who have been subjected to misconduct can contact OIEC at 303-492-2127 or email CUreport@colorado.edu. Information about university policies, reporting options, and support resources including confidential services can be found on the OIEC website.

Please know that faculty and graduate instructors must inform OIEC when they are made aware of incidents related to these policies regardless of when or where something occurred. This is to ensure that individuals impacted receive outreach from OIEC about resolution options and support resources. To learn more about reporting and support for a variety of concerns, visit the Don't Ignore It page.

Religious Accommodations

Campus policy requires faculty to provide reasonable accommodations for students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. Please communicate with your instructors the need for a religious accommodation in a timely manner, within the first two weeks of the semester for this course.

See the campus policy regarding religious observances for full details.

Mental Health and Wellness

The University of Colorado Boulder is committed to the well-being of all students. If you are struggling with personal stressors, mental health or substance use concerns that are impacting academic or daily life, please contact Counseling and Psychiatric Services (CAPS) located in C4C or call (303) 492-2277, 24/7.

Free and unlimited telehealth is also available through Academic Live Care. The Academic Live Care site also provides information about additional wellness services on campus that are available to students.

Look for Screencasts on topics at https://learncheme.com/screencasts/separations-mass-transfer/

CHEN 3220 Schedule – Spring 2025 (SUBJECT TO CHANGE!!!)

Date	Course Plan	Assignments	Textbook Chapters
Monday, January 13	1, Intro; review of separation techniques		Ch 1
Wednesday, January 15	2, Review of Mass Transfer & Batch Distillation		Ch 13
Friday, January 17	3, Batch Distillation (cont'd)		Ch 13
Monday, January 20	MLK Day, No Class		
Wednesday, January 22	4, Batch Distillation	Hwk #1 Due Thurs	Ch. 13
Friday, January 24	5, Membranes		Ch 14
Monday, January 27	6, Membranes (cont'd)		Ch 14
Wednesday, January 29	7, Membranes (cont'd)	Hwk #2 Due Thurs	Ch 14
Friday, January 31	8, Adsorption		Ch 15.1-15.6
Monday, February 3	9, Adsorption (cont'd)		Ch 15.1-15.6
Wednesday, February 5	10, Adsorption (cont'd)	Hwk #3 Due Thurs	
Friday, February 7	11, Ion Exchange		Ch 15.7
Monday, February 10	12, Chromatography		Ch 15.8
Wednesday, February 12	13, Review of Vapor-Liquid Equilibrium	Hwk #4 Due Thurs	Ch 4.0-4.2
Friday, February 14	14, Aspen for VLE; K Values		Ch 2.1, 2.11 (2.2-2.10)
Monday, February 17	**Midterm Exam 1: Monday 7-9PM**	**Review for Exam 1**	
Wednesday, February 19	NO CLASS		
Friday, February 21	16, Binary Flash Distillation		Ch 4.3.0-4.3.3
Monday, February 24	17, Multicomponent Flash Dist		Ch 4.3.4-4.3.5
Wednesday, February 26	18, Binary Column Dist, External Balances		Ch 5.0, 5.1, 5.3, 7.0-7.2.0
Friday, February 28	19, McCabe Thiele Internal Balances	**Project 1 Due 2/28**	Ch 7.2.1-7.2.2
Monday, March 3	20, McCabe Thiele Internal Balances		
Wednesday, March 5	21, Aspen/HYSYS	Hwk #5 Due Thurs	
Friday, March 7	22, Feed Stage, Partial vs Total Condensers/Reboilers		Ch 7.2.3, 7.2.4, 7.3.2, 7.3.4
Monday, March 10	23, Feed Quality, Total & Minimum Reflux (i.e. Limiting Conditions)		Ch 7.2.5
Wednesday, March 12	24, Multiple Feeds and Side Streams	Hwk #6 Due Thurs	Ch 7.3
Friday, March 14	25, Aspen/HYSYS		
Monday, March 17	26, Enriching/Stripping Columns, Open Steam Heating, Efficiency		Ch. 7.4, 12.0
Wednesday, March 19	27, Packed Column Dist	Hwk #7 Due Thurs	Ch. 7.6
Friday, March 21	28, Packed Column Dist (cont'd)		
March 24-28	Spring Break – No Class		
Monday, March 31	29, Multicomponent Distillation		Ch 4.3, 9.0-9.1.1
Wednesday, April 2	30, Multicomponent Distillation (cont'd)	Hwk #8 Due Thurs	
Friday, April 4	31, Absorption		Ch 4.7, 6.0-6.6
Monday, April 7	32, Absorption (cont'd)		
Wednesday, April 9	33, Absorption (cont'd) & Stripping	Hwk #9 Due Thurs	
Friday, April 11	34, Packed Column Absorption		Ch 6.1.2,6.7-6.9
Monday, April 14	**Midterm Exam 2: Monday 7-9PM**	**Review for Exam 2**	
Wednesday, April 16	(NO CLASS)		
Friday, April 18	36, Immiscible L-L Extraction		Ch 5.2, 8.0-8.1, 10.1
Monday, April 21	37, Immiscible L-L Extraction (cont'd)		
Wednesday, April 23	38, Leaching & Washing	Hwk #10 Due Thurs	
Friday, April 25	39, Single Stage Partially L-L Misc Extract	**Project 2 Due 4/25**	Ch 4.4-4.5, 8.2-8.3
Monday, April 28	40, Multiple Stage Partially Miscible LL Extraction, Min Solvent Rate		
Wednesday, April 30	41, Review for Final Exam		
Wednesday, May 7	Final Exam, 7:30pm-10:00pm		