CHEN 4520: Chemical Process Design
Syllabus ~ Fall 2025

Instructors Trevor Franklin, Assistant Teaching Professor & Faculty Director of Engagement
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Class Email chen4520@colorado.edu

Please use the class email for general course questions, including support understanding course contents, clarification of homework assignments, questions related to homework progress, concerns regarding assignments requirements and deadlines. Emails of a personal nature (e.g., related to accommodations) or issues with teamwork or group cohesion may be sent directly to the instructors instead.

Teaching Assistants

Lauren Sullivan	lauren.sullivan-3@colorado.edu
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Lectures

CHEN 4520-001: T/Th 8:30-9:45 am in BIOT A108
CHEN 4520-002: T/Th 10:00-11:15 am in BIOT A108
You must attend your enrolled section in person in order to receive clicker points.

Office Hours

Note: times subject to change due to student need; see Canvas home page for most up to date times.

Mon: 4:30-5:30 in B231
Wed: 12:00-1:00 in E225
7:00-8:00pm in B231 and zoom (URL TBD)
Thurs: 12:30-2:00 in E1B11

Text *Product and Process Design Principles (4th Edition)* by Warren D. Seider, Daniel R. Lewin, J.D. Seader, Soemantri Widagdo, Rafiqul Gani and Ka Ming Ng; 2016 (Wiley)

Prerequisites

CHEN 3010, 3210, 3220 (all C- or higher)
CHEN 4330 or BIEN 4830 (C- or higher)
This is the 1st course in the capstone design sequence of classes. The Chemical and Biological Engineering Department enforces all pre-requisites.

Course Content

The fall semester CHEN 4520 Chemical Process Design course, along with the spring semester CHEN 4530 Design Projects course, is the *capstone* course sequence in chemical and chemical & biological engineering. The design activities, the considerations of numerous options, and the practical application of the fundamentals all need to be integrated from first year courses through to this senior capstone course. The sequence provides a culmination for all previous chemical and biological engineering courses (transport processes, thermodynamics, reaction kinetics, unit

operations, etc.). Students are expected to know the basics of fluids, heat transfer, separations, and reactor engineering (kinetics). In CHEN 4520, students will be exposed to design of pumps, compressors, heat exchangers, distillation columns, and chemical reactors. Students will be taught how to select process units and interconnect them in an overall process flowsheet with the primary goal being to find the optimal design conditions for the best possible design scenario among various conceptualized alternatives. With the exception of cost estimation, process economics, heat integration, separation trains, and some of the simulation tools, the material is not new. However, the conceptualization approach required to build a process flowsheet will help students to take their understanding of previous subjects to a new and higher level.

Course Learning Objectives

- Provide a culminating major engineering design experience that incorporates appropriate engineering standards and constraints and is based on the knowledge and skills acquired in earlier course work
- Emphasize safety, ethical responsibilities, engineering standards, and impacts of engineering solutions in global, economic, environmental and societal contexts
- Review and apply prerequisite knowledge, including fluid mechanics, heat transfer, separations, and reaction kinetics, in conceptualizing chemical processes
- Complete a well-defined, team-based chemical process design project, including process material and energy balances, equipment design, and economic analysis, and write a detailed project report
- Utilize software and prepare a Gantt chart for team project management
- Set up complex chemical process material and energy balance systems and use commercial chemical and biological process simulation software to solve them and to specify unit operations equipment; software includes Aspen Plus™, Aspen HYSYS™, and SuperPro Designer™
- Incorporate heat integration methodology for efficiency improvement
- Carry out economic analysis for chemical processes, including capital cost, variable cost, cash flow, and profitability analysis
- Prepare students with working knowledge to carry out a capstone design project working with an external liaison CHEN 4530

Every student who passes Chemical Process Design, CHEN 4520, will be well-prepared to tackle Design Projects, CHEN 4530, from Day 1. Students will "hit the ground running" and will know how to approach the less defined project problems posed in CHEN 4530.

Simulation, Design, Costing, and Economics Software

Students are expected to know how to carry out spreadsheet type engineering calculations using Microsoft Excel™ or equivalent, as well as how to use differential equation solvers such as MATLAB. The process simulation programs Aspen HYSYS™, Aspen Plus™ and SuperPro Designer® will be used extensively throughout the course. It is the responsibility of the students to learn how to use the process simulators and all software programs as needed. Basic instruction will be given for process simulation via tutorials and/or videos. All the simulation software is available in the BIOT A205 computer lab, in the Engineering Center computer labs, and remotely; remote access instructions will be given separately. Students are also encouraged to use the many screencasts available for Design on LearnChemE.com.

ABET Student Outcomes Addressed

(1) an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

(2) an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
(3) an ability to communicate effectively with a range of audiences
(4) an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
(5) an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
(7) an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Recording of Lectures and Office Hours

Lectures will be recorded and available on Canvas under "Lecture Videos" on the left sidebar. Class recordings will not be distributed outside the audience of students, instructors, and other class staff. Access to a recording is limited to class participants and staff through one's CU Boulder IdentiKey. Only the course instructors and staff are authorized to record a class; students are not authorized to record a class through any means.

Course Communication

All class slides, extra reading materials, tutorials/homework, and videos will be placed on Canvas for students to download.

Overall Course Grading

Overall Grade Breakdown	Grading Scheme	
10% - Clicker Questions (drop lowest 4)	*90/93.33/100*	*A-, A*
40% - Homework	*80/83.33/86.67/90*	*B-, B, B+*
30% - Design Report	*70/73.33/76.67/80*	*C-, C, C+*
20% - Peer/Instructor Review	*60/63.33/66.67/70*	*D-, D, D+*
	<60	*F*

Homework

No late *GROUP* homework will be accepted for any reason because you are on a team; make sure to have a backup and a backup of the backup. When Canvas closes the submission folder, no additional submissions can be made regardless of the reason (for instance, it was done but not turned in; our submitter got sick; turned in the wrong file; missed one file by accident; it took a long time to upload; don't want teammates to suffer because of my mistake).

Talk with the instructors AHEAD OF THE DEADLINE if there are extenuating circumstances warranting a deadline push.

Clicker Questions

Clickers will be used in this course and every student needs one (physical, desktop app, or mobile app). The lowest four (4) clicker scores will be discarded. Note that this is 20% of the total lectures with clickers. One point will be awarded for each incorrect answer and two points for correct answers. Each student must be in class to respond to clicker question and can only click for themself; if a student is found clicking for another student for any reason, both will fail the class. If a student is found responsible for clicker fraud in the form of responding to clicker questions when not in class, that student will receive no credit for clickers for the semester. For the structure of the class to provide a high learning value, students need to come prepared by reading the assigned pre-class material shown in the class schedule at the end of this syllabus.

Team Organization

It is the responsibility of every student to determine their team. Instructors will not determine teams but maintain the option of approving final teams and of moving students into/out of teams to ensure that everyone is placed on a team. Students should be thinking of who might comprise their teams from the 1st day in class. Teams will have 4 students. Because teammates must be in the same class section, switching sections after the teams are assigned will not be permitted. Instructors maintain the option to reorganize teams as necessary throughout the semester, **potentially resulting in some students working with fewer team members (for instance, on 2-or 3-person teams) or even on their own.**

Peer Review

Instructors determine the final allocation of points based on observed workloads 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 complete three peer-evaluations throughout the semester to provide feedback regarding team effort. It cannot be overemphasized how important it is for the team to bring out the best in all members!

In The Classroom

The main goal of this course is to expand the ways in which you approach engineering problems. We learn from mistakes and failure. Those are an essential part of learning and are **not** a determination of your abilities. To support the messy side of learning and focus on the process (rather than the product of the "right answer" or the highest grade), a classroom that prioritizes respect is essential. We expect you to help create that community. We will need patience or courage or imagination or any number of qualities in combination to engage in our materials, bring out the best in ourselves and classmates, and leverage our ideas and experiences for learning and growing. It is our intent that the various perspectives that students bring to this class be framed as a resource, strength, and benefit. Your suggestions are encouraged and appreciated. Please do not wait until the end of the semester to give this feedback. Please let us know ways to improve the effectiveness of the course for you personally or for other students. You can email the instructor at any time, come to office hours, or provide anonymous feedback during opportunities in this course.

Use of Generative Artificial Intelligence (AI)

You may use generative AI tools in this course as you see fit in the draft stages but you must edit to make this work your own and accurate. If you use generative AI tools on assignments in this class, document your usage with the Chicago Manual of Style or the citation style you decide to use (APA, MLA, etc.). Keep in mind that the goal of generative AI tools is to reproduce content that seems to have been produced by a human, not to produce accurate or reliable content; therefore, if you wish to use AI, use it as a draft and then edit to apply to your system accurately. It is your responsibility—not the tool's—to ensure the quality, integrity, and accuracy of work you submit in any college course. In addition, you must be wary of unintentional plagiarism or data fabrication. Please act with integrity for the sake of both your personal character and your academic record.

You're not seen and heard if AI is speaking for you.

UNIVERSITY POLICIES

The campus policies can also be found here.

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]; see details in AI section of syllabus above), 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.

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.

If you have a temporary illness, injury or required medical isolation for which you require adjustment, please contact the course instructors in addition to seeking the support for Temporary Medical Conditions (link above).

Accommodation for Religious Obligations

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 the need for a religious accommodation in a timely manner. In this class, please talk with the instructors if conflicts arise. See the campus policy regarding religious observances for full details.

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.

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.

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

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.

Fall, 2025 CHEN-4520 Honor Code

Please turn in this signed Honor Code to Canvas by 11:59 Thurs, 8/28

On my honor, as a University of Colorado Boulder student in the Department of Chemical and Biological Engineering, I will not receive unauthorized assistance outside of my team on homework or the final project. I will not attempt to obtain or use any prior year's course project information that may be available to me through personal contacts or organized filing systems whether electronic or paper. I will not complete any clicker questions other than my own and I will only click in if I am in the classroom JSCBB A108 during class. I will turn in my own, original work and not submit content produced solely by AI such as ChatGPT or Bard. I understand that course work submitted by me, if contrived/completed/written in part or in whole by someone other than myself, shall be considered to constitute fraud under the University Honor Code, and will result in the assignment of an 'F' for the entire course. I understand that plagiarism for work will be investigated using software available to the University of Colorado. I understand that 20% of my grade in CHEN 4520 is based on peer-reviews within my team per the guidelines in the Syllabus. I understand that Instructors maintain the option to reorganize teams as necessary, **potentially resulting in some students working with fewer team members or on their own**.

I understand the CHEN-4520 class Honor Code as stipulated herein and understand the ramifications for breaking the code.

_____ Signed

_____ Printed Name

Tentative CHEN 4520 Course Schedule – Fall 2025

SUBJECT TO CHANGE

Week	Tuesday	Thursday
#1 8/21	Summer Break	L01 Intro to the Class; Teamwork (Ch 1)
#2 8/26	L02 Process Design, Engineering Standards & Heuristics, Gross Profit (Ch 2 & 6)	L03 Impacts, Regulations & Ethics (Ch 3) HW#1 due 11:59pm Thurs
#3 9/2	L04 Safety (Ch 3)	L05 HAZOP, P&IDs, Lean Six Sigma & FMEA (Ch 3) HW#2 due 11:59pm Thurs
#4 9/9	L06 Pumps (Ch 14)	L07 Compressors & Heat Exchanger Design (Ch 12) HW#3 Due 11:59pm Thurs
#5 9/16	L08 HX (cont'd) & Misc Equipment Design	L09 Separation Tower & Train Design (Ch 9 & 13) HW#4 Due 11:59pm Thurs
#6 9/23	L10 Heat Integration (Ch 11)	L11 Product Design & Batch Processing (Ch 1 & 22) HW#5 Due 11:59pm Thurs Peer Review #1 Due Fri 9/26 by 11:59 PM
#7 9/30	L12 Batch Scheduling (Ch 22)	L13 Reactor Design (PDFs Provided) HW#6 Due 11:59pm Thurs
#8 10/7	L14 Reactor Design, cont. (PDFs Provided)	*Midterm Reading Day – No Lecture* HW#7 Due 11:59pm **FRIDAY 10/10**
#9 10/14	L15 Downstream Bioprocessing (PDFs Provided)	L16 Accounting & Capital Estimation (Ch 16) HW#8 Due 11:59pm Thurs
#10 10/21	L17 Estimating Total Capital Investment (Ch 16)	L18 Cash Flow & Depreciation (Ch 17) HW#9 Due 11:59pm Thurs
#11 10/28	L19 Profitability Analysis (Ch 17)	L20 Design Project Description HW#10 Due 11:59pm **SUNDAY 11/2** Peer Review #2 Due Fri 10/31 by 11:59 PM
#12 11/4	No lecture, meeting with groups	No lecture, meeting with groups
#13 11/10	No lecture, meeting with groups	No lecture, meeting with groups
#14 11/18	No lecture, meeting with groups	No lecture, meeting with groups
11/24	Fall Break	Fall Break
#15 12/2	No lecture, meeting with groups	No lecture, meeting with groups Design Report Due Fri, Dec 5 by 11:59 pm
#16	Peer Review #3 Due 11:59pm Mon 12/8 ~ **No Final**	