Chemical & Biomolecular Engineering 150A
Spring Semester, 2021

Description: The subject of this course is fluid mechanics and an introduction to heat transfer. These two processes together with mass transfer, covered in CBE150B, comprise transport phenomena which are central to all processes of interest in chemical engineering. Remarkably, these fundamental physical processes are amenable to a rigorous mathematical description based on ordinary and partial differential equations. Students are expected to have a working knowledge of univariate calculus and solution methods to simple ordinary differential equations.

Lectures:	MWF 9-10 am	Zoom
Discussion sections:	101: M 2-3 pm (ZH) 103: W 11-12 pm (SB) 104: W 3-4pm (ZH) 105: Th 4-5pm(KS) 106: F 12-1pm (SB)	Zoom

Instructors:	Professor Susan Muller muller2@berkeley.edu	Office Hours:	M 10-11 am Tu 10-11 am
	Professor Karthik Shekhar kshekhar@berkeley.edu	Office Hours:	Tu 11-12 pm F 10-11am
GSIs:	Salwan Butrus salwan@berkeley.edu	Office Hours:	Tu 2:30-3:30 pm M 6-7 pm
	Zach Hoffman zach.hoffman@berkeley.edu	Office Hours:	M 1-2 pm W 2-3 pm
	Ketong Shao ketong_shao@berkeley.edu	Office Hours:	Th 3-4 pm F 4-5 pm

Text: **Denn, *Process Fluid Mechanics*, Prentice-Hall, NJ (1980).**

This is the primary text for the first 10 weeks of the course. The last 4 weeks of the course will draw on the text by Welty, Wicks, Wilson, and Rorrer below, which is one of the required texts for ChE 150B.

Other references:

1. White, *Fluid Mechanics*, 2nd edition (or later), McGraw-Hill, NY (1986).
2. Bird, Stewart, and Lightfoot, *Transport Phenomena*, 2nd ed., Wiley, NY (2002).
3. **Welty, Wicks, Wilson, & Rorrer, *Fundamentals of Momentum, Heat, and Mass Transfer*, 5th edition, John Wiley & Sons, NY (2008).**
4. Incropera and DeWitt, *Fundamentals of Heat and Mass Transfer,* 5thed.,Wiley, NY (2002).
5. Deen, *Introduction to Chemical Engineering Fluid Mechanics,* 1st ed., Cambridge University Press (2016)

Course Grade:	Homework	12%
	Midterms (3)	17% each
	Final Exam	34%
	Weekly assignments	3%

Remote instruction:

Per the university guidelines the first two weeks of classes will be delivered via remote instruction using **Zoom**, and it is likely that this will continue further into the semester. The plan for transitioning to in class instruction is unclear at this stage, and we will await further instructions from the university leadership. In addition to Zoom, we will use **bCourses**, **Gradescope** and **Piazza** for this class. If you are facing difficulties in accessing any of these platforms, please alert the instructors/GSIs immediately.

Zoom: Lectures and discussion sections will be held at the regularly scheduled time via Zoom. ***We strongly encourage you to attend the live lectures and the live discussion sections if you can***. We will endeavor to post all lecture and discussion section recordings and notes on bCourses following the live sessions. Please review additional instructions for zoom below and **find all relevant zoom links at the end of this document.**

bCourses: The instructors and GSIs will communicate all course related information as well as material (lecture notes, homeworks, solutions) via bCourses. Please check the website regularly for announcements, assignments, quizzes, and other resources. Please set your bCourses notifications so that you do not miss any announcements or assignments.

Gradescope: All submissions (homework and examinations) will be made through Gradescope, and grades will also be returned via Gradescope. Please check your emails for an invitation to join the class on gradescope. If you have not been added, please contact the GSIs immediately.

Piazza: Piazza will be used as the online Q&A platform. Enrollment in Piazza is mandatory, and as a general rule all questions related to clarifications on the lectures, discussion sections and homeworks *must* be posted on Piazza rather than mailing the instructors or GSIs. Please do not post anything resembling solutions to a homework problem before it is due. To join the class on piazza, please either follow this link or alternatively, locate "Piazza" on the left hand column of the CBE150A homepage on bCourses, and follow instructions. *Also, please review the Piazza Etiquette pdf in the Files/Handouts folder on bCourses, and be sure to follow guidelines listed there.*

All questions about course content (e.g., homework problems, lecture concepts, due dates, exam format) must be asked during lecture, discussion section, office hours, or over Piazza so that all may benefit from the answer. While the instructors will monitor Piazza daily, please note that we cannot respond to your questions instantaneously. We highly encourage you to answer each others' questions.

The only questions that may be asked by email are those related to your personal situation, such as technical difficulties you are experiencing or if you need an extension/ accommodation due to a health issue. We will do our best to respond to your email within 24 hours on weekdays. **Please note that we cannot guarantee responses to Piazza questions if they are asked within a 12 hour period preceding exams and homeworks.**

Homework:

Homework will be **assigned on Wednesdays and will be due the following Wednesday at the beginning of the lecture on gradescope**. Late homework will NOT be accepted. Working on the homework problems and understanding their solution is critical to your learning in this course. Homework problems will be made available through bCourses each Wednesday; you should upload your solution to Gradescope. Solutions will be made available within 24 hours following the submission deadline under bCourses > Files > Homework. While homework sets will be graded, you should consult the published solution each week to ensure that you understand the material. **Homework is worth 10% of your course grade.** No credit will be given for late homework, and there are no regrades of homework.

Examinations:

Your understanding of the homework material, lectures, discussion section, and associated reading will be assessed through **three midterms**, **each accounting for 17% of the course grade** conducted on the following days during lecture hours,

MT1: Wednesday 2/17
MT2: Wednesday 3/17
MT3: Friday 4/30

Midterms will be open book and open notes (with some restrictions: you may use the course text and notes, any materials on the course bCourses website, a plotting tool such as Desmos, or an online tool for integration such as WolframAlpha but you may not use other books, notes, or online resources), and will be conducted during class hours and will be proctored via zoom. Midterm problems are expected to test not only your familiarity with the homework problems and course material, but your ability to synthesize and think critically about the material.

The **Final Exam will be worth 34% of the course grade**, and will be a 3 hour exam. It will be conducted synchronously on **Monday 5/10/2021 from 7-10pm** and proctored via zoom similar to the midterms.

We will not provide make-up exams if you miss any of them. If you miss a midterm for a valid medical reason with prior approval from the instructors, we will assign you a grade based on your average performance in the other exams. Missing an exam without a valid reason will result in a zero grade on that exam.

Zoom:

- Activate your free UC Berkeley Zoom account and always join the Zoom meeting with your Berkeley account.
- Please keep the Zoom link private—do not share with anyone outside of the course.
- Please set your Zoom name to be the name you would like the instructors to call you.
- Please leave your audio on mute during the lecture, but be prepared to unmute yourself to ask or answer questions or participate in breakout rooms.
- We will be recording all Zoom lectures. The instructor will announce when the recording is beginning during each lecture. If you do not wish to be recorded, please turn off your video, mute your audio, and use chat to ask questions. The chat record will be deleted immediately after class ends.

- We understand that your specific situation may present challenges to class participation. Please contact the instructors if you would like to discuss your ability to access course material. The Student Technology Equity Program (STEP) is available to help students get access to a laptop, Wi-Fi hotspot, and other peripherals (e.g. webcam, headphones, etc.).
- You may ask questions during lecture and discussion section by unmuting yourself or via the chat or the "raise hand" feature.

Expectations of Academic Integrity and Ethics:
We are privileged to participate in the pursuit of knowledge and truth in higher education at UC Berkeley, where students and instructors are expected to maintain academic integrity and an environment of respect for the course of study and one another at all times. Direct any concerns about classroom environment immediately to the instructor.

The student community at UC Berkeley has adopted the following **Honor Code:** ***"As a member of the UC Berkeley community, I act with honesty, integrity, and respect for others."*** The transition to remote instruction means that exams will not be proctored in person and creates the need for each member of our learning community to commit fully to the Honor Code. The instructors expect that you will adhere to this code without fail. *Anyone caught cheating on a quiz or exam, including working with a peer where individual work was specifically required, will receive a failing grade in the course and will be reported to the Office of Student Conduct. You will be asked to sign an extended version of the Honor Code, that includes any restrictions on materials that may be accessed, as part of each quiz and the final exam.*

Below are links to important University policies and resources.

1. UC Berkeley Academic Honor Code.
2. Accommodation of Religious Creed.
3. Conflicts Between Extracurricular Activities and Academic Requirements.
4. Absences Due to Illness.
5. Accommodation for Disability.
6. Accommodation for Pregnancy and Parenting.
7. Reading, Review, Recitation (RRR) Week.
8. Commencement Ceremonies and Final Exams.
9. Hardship Accommodations.
10. Accommodation and Support Measures for Sexual Harassment and Sexual Violence.

Help is available for students:
College can be a simultaneously rewarding and challenging experience. To support students at UC Berkeley counseling services are available to you through the Tang Center:

https://uhs.berkeley.edu/counseling
https://uhs.berkeley.edu/coronavirus/student-mental-health

In addition, help is available for students requiring extra assistance with basic needs and with

technology during the COVID-19 pandemic:

UC Berkeley Basic Needs Center.

UC Berkeley Student Technology Fund.

Peer tutoring services are for the College of Chemistry are available online. For more information, see https://chemistry.berkeley.edu/ugrad/current-students/tutoring

COURSE OUTLINE & READING ASSIGNMENTS

Week #	Chapters	Topics
1	1, 2	physical properties, dimensional analysis, hydrostatics
2	3, 4	pipe flow, flow past a sphere, particulates
3	4, 5	macroscopic balances: conservation of mass, energy, and linear momentum
4	6	applications of macroscopic balances
5	6, 7	macroscopic balances, the Bernoulli equation, viscous losses, intro to microscopic balances
6	7	Navier-Stokes equations
7	8	one-dimensional flows, applications of microbalances
8	9.1-9.4, 11	accelerating flow, ordering & approximation
9	12	creeping flow, flow past a sphere, form & friction drag
10	14, 15.1-15.4	potential flow, the boundary layer approximation
11	16	turbulence, introduction to heat transfer
12	tba	Fourier's law, microscopic conservation of energy equation, solution to conduction problems
13	tba	convective heat transfer, dimensional analysis, thermal boundary layers
14	tba	turbulent heat transfer, correlations for convective heat transfer, heat transfer equipment
15	tba	Review & Recitation

Zoom Links

1. **Lectures (MWF 9am-10am)**

https://berkeley.zoom.us/j/95673808242?pwd=S1QwNnJ1bW03YWhWR1QvQmVyaVR0dz09

Meeting ID: 956 7380 8242
Passcode: CBE150AL

2. **Discussion sections**
    a. DS 101 (Monday 2-3 pm)

Link: https://berkeley.zoom.us/j/99120065367?pwd=cGJKMzlUTDJiNWg1QWlFaEtES1VVUT09
ID: 991 2006 5367
Passcode: 150Amonday

    b. DS 103 (Wednesday 11am- noon)

https://berkeley.zoom.us/j/6651406643?pwd=VkEzSW1IQTJwd3E0cnh6WHpJakwvZz09

    c. DS 104 (Wednesday 3-4 pm)

Link: https://berkeley.zoom.us/j/97668191625?pwd=b2ZFVkQrN3dyK0FtdmpEZTZVelB0QT09
ID: 976 6819 1625
Passcode: 150Awedaft

    d. DS 105 (Thursday 4-5 pm)
https://berkeley.zoom.us/j/93962517007?pwd=U3dOYlUyWGNWUDQ1V29jekkrbnFCZz09

    e. DS 106 (Friday noon- 1pm)

https://berkeley.zoom.us/j/6651406643?pwd=VkEzSW1IQTJwd3E0cnh6WHpJakwvZz09

3. Office Hours
    a. Prof. Muller
https://berkeley.zoom.us/j/95846993384?pwd=WlVGT2ExS2tQaVpVZWpwYjVtQlhndz09
Meeting ID: 958 4699 3384 Passcode: 826638

    b. Prof. Shekhar (Tu 11-12pm; F 10-11am)

    https://berkeley.zoom.us/j/9992109662

    c. Zach Hoffman (M 1-2pm; W 2-3pm)

Link: https://berkeley.zoom.us/j/93531297152?pwd=eXAwMld5TXR6c09zRjNTMXoyQncrZz09
ID: 935 3129 7152
Passcode: 150AZachOH

d. Salwan Butrus (Tu 2:30-3:30 pm, M 6-7pm)
https://berkeley.zoom.us/j/6651406643?pwd=VkEzSW1IQTJwd3E0cnh6WHpJakwvZz09

e. Ketong Shao (Th 3-4pm; F 4-5pm)
https://berkeley.zoom.us/j/92681730676?pwd=c0VwUnNQRkJFU1k3dEdUbDBHMXNEZz09