ME 106 - FLUID MECHANICS - FALL 2023

Instructor: A Kaminski	GSIs: V Laroche, K Clevenson
Lectures: MWF 9-10am*, Hearst Mining 390	Discussion 1: T 4-5pm in McCone 141 Discussion 2: Th 9-10am in Dwinelle 182 Discussion 3: Th 11am-12pm in SSB 175
Office hours: T 2-4pm in 6115 Etch or by appointment	GSI office hours: M 10-12, Th 12-1pm, location TBA

Course website: https://bcourses.berkeley.edu/courses/1526580

* lectures and discussion sections are on "Berkeley time", starting 10min after the posted time

Course description: From course catalogue: *This course introduces the fundamentals and techniques of fluid mechanics with the aim of describing and controlling engineering flows.* Topics include: fluid properties, hydrostatics, conservation equations, analytic description of simple flows, flow measurement, similitude, boundary layers, drag, engineering applications.

Prereqs: You are expected to be proficient in the fundamentals of mechanics (ME104, can be taken concurrently) and thermodynamics (ME40). You are also expected to be prepared in mathematics as needed for that proficiency (MATH53/54) and computer programming. Mathematically, you should be comfortable with vector calculus and ordinary differential equations. Computationally, you are expected to be proficient in a high-level programming environment of your choice (e.g. Java, C/C++, Fortran, Mathematica, Matlab, Python, Julia). Please contact me if you have any concerns about these prerequisites.

Textbook: The textbook for this course is *Munson, Young, and Okiishi's Fundamentals of Fluid Mechanics, 9th ed.* (PM Gerhart, AL Gerhart, JI Hochstein, 2020, Wiley). Note that used copies and earlier editions are also fine! You can find the 8th and 9th editions at the Library.

Other useful references:

- *Fluid Mechanics: Fundamentals and Applications, 3rd ed.* (YA Cengel & JM Cimbala, 2006, McGraw-Hill) and extra material for Cimbala
- *A Physical Introduction to Fluid Mechanics* (AJ Smits, 2022, online book) and related study guide and practice problems
- *All Things Flow: Fluid Mechanics for the Natural Sciences* (WD Smyth, 2019, online book)
- *An Album of Fluid Motion* (M Van Dyke, 1982, Parabolic Press)
- *Fluid Mechanics, 6th ed* (FM White, 2008, McGraw-Hill), available at the library
- National Committee for Fluid Mechanics Films
- CEE Prof. Variano's videos
- math resources: Patrick JMT's Math channel (youtube tutorials); math/physics/science/etc tutorials from Khan Academy; sosmath.com (text-based math review materials)

Grading:

Grade breakdown		Letter grade boundaries	
Homework (11 expected, lowest mark dropped)	40%	A	95.0%
Midterm exams (Friday, Oct. 6, 9:10-10:00am; Friday Nov. 3, 9:10-10:00am)	30%	B	85.0%
Final (Thursday, Dec. 14, 7-10pm)	30%	C	75.0%
Total	100%	D	65.0%

Assignments will be submitted online and are due at 11:59pm (CA time) on the due date.

You are not in competition with your classmates! In theory, everyone can get an A in this course. Grade limits will not be curved up, but may be curved down in some assignments were more difficult than intended. [*note: because assignments allow multiple attempts, percentages are expected to be higher than in most classes*]

Regrade policy: Grades are not up for negotiation, out of fairness to your fellow students.

Homework: There will be approximately 11 homework assignments this semester, or roughly one per week. The lowest assignment grade will be dropped (10 best grades count).

Homework will be completed on PrairieLearn – an online assignments tool that allows for multiple attempts for each solution and immediate feedback. Studies have shown the benefits of frequent testing, second-chance assignments, and timely constructive feedback. In addition, solution strategies will be reviewed during the discussion sections.

To access PrairieLearn (PL): Sign in with Google using your Berkeley email and add "UCB-ME 106: Fluid Mechanics, Fall 2023" as a course. [*note: PL link will be provided before HW1]*

Some tips:

1. When calculating answers, make sure constants match values in the ME106 reference sheet. Your answer may otherwise be marked incorrect.
2. You will have up to 8 attempts on each homework question. The number of available points will begin decreasing after the third attempt.
3. Homework questions are pulled at random from a question bank. Your questions may therefore be different from another student's questions.
4. Solution strategies will be reviewed during the following week's discussion section.

Deadlines for individual assignments will be listed in bCourses. The maximum percentage possible on a homework assignment will be reduced by 10% for each day (or fraction of a day) late. Assignments will be closed 5 days after their initial deadline so that their solutions may be discussed in the following week during discussion section.

Exams: There will be 2 midterm exams and a final exam. The midterms will be 50 minutes long and take place during the regular class sessions on the listed dates (Oct. 6 and Nov. 3). The final exam is scheduled for 7-10pm on Dec. 14; location information will be provided as it becomes available.

Material in the exams will be drawn from lectures and homework. You will be allowed to bring in a formula sheet (double-sided 8.5x11"). You will be asked on the exam to specifically confirm the honour code by agreeing to the phrase "I certify that I am [name] and I am allowed to take this assessment. I pledge on my honour that I will not give or receive any unauthorized assistance on this assessment and that all work will be my own."

Communication: Questions about this class can be asked during lectures, discussions, office hours, or over bCourses. For questions that arise outside of class, we will be using ED Discussion, because you are probably not the only one with that particular question! Others will likely have the same question, and you can help your peers by posting publicly. You may post anonymously (teaching team members can check who posted what, but will not check unless comments are inappropriate violating UC policy).

Email is for dealing with private personal matters – for example, if you have an ongoing health or family concern that will interfere with your assignments. If you email Prof. Kaminski about this course, please include "ME 106" in the email subject line.

Resiliency: If any member of the teaching team becomes ill, the course calendar will be shifted backwards, and end-of-term material will be cut. Remaining members will redistribute the load, cutting enough material so that they are not working extra hours and they have time to prepare for their new roles.

If events occur that cause many members of the class to need time for taking care of their (and their loved ones') mental and/or physical health, the course calendar will be shifted backwards, and end-of-term material will be cut.

If a synchronous session is interrupted due to an outside event, the session may not necessarily be cancelled. Either a make-up session will be provided within one week of the interrupted session or additional instructional material will be shared online (through bCourses).

Attendance is not going to be taken in this course (with the exception of the midterms). If you miss a lecture for any reason (illness, travel, etc.) you can request access to materials for that lecture via the following form: https://docs.google.com/forms/d/17I-wlFYGI-iijWTS-GW2zeZcVo1wkc6VKLy4C6MDMXI/viewform?edit_requested=true You can do this, no questions asked, up to 5 times, after which point you will need to contact Prof. Kaminski.

***Tentative* lecture schedule:** (dates and topics may be modified as the semester goes on)

#	date	topic	reading*	HW due
1	Aug. 23	introduction, what is a fluid?	ch 1.1, 1.3	
2	Aug. 25	dimensions and units, density	ch 1.2, 1.4	
3	Aug. 28	ideal gas, viscosity	ch 1.5, 1.6	
4	Aug. 30	pressure at a point, pressure distribution	ch 2.1, 2.2	**HW 1**
5	Sept. 1	hydrostatics	ch 2.3	
	Sept. 4	*no lecture – Labour Day*		
	Sept. 5	*discussion sections begin*		
6	Sept. 6	hydrostatics, pressure measurement	ch 2.4, 2.5	**HW 2**
7	Sept. 8	barometer and manometer	ch 2.6	
8	Sept. 11	hydrostatic forces on flat surfaces	ch 2.8, 2.9	
9	Sept. 13	hydrostatic forces on flat surfaces	ch 2.8, 2.9	**HW 3**
10	Sept. 15	hydrostatic forces on curved surfaces	ch 2.10	
11	Sept. 18	buoyancy	ch 2.11	
12	Sept. 20	fluids in motion, fluid flow patterns	ch 4.1	**HW 4**
13	Sept. 22	acceleration, material derivative	ch 4.2	
14	Sept. 25	control volumes, steady flow	ch 4.3, 4.4	
15	Sept. 27	Reynolds transport theorem	ch 4.4	**HW 5**
16	Sept. 29	conservation of mass (continuity)	ch 5.1	
17	Oct. 2	linear momentum conservation	ch 5.2	
18	Oct. 4	linear momentum, moment-of-momentum	ch 5.2	
*	Oct. 6	MIDTERM 1		
19	Oct. 9	conservation of energy	ch 5.3	
20	Oct. 11	Bernoulli equation	ch 3.1, 3.2	**HW 6**
21	Oct. 13	Bernoulli equation	ch 3.3, 3.4	
22	Oct. 16	applications of Bernoulli – flow from tanks	ch 3.5, 3.6	

#	date	topic	reading*	HW due
23	Oct. 18	applications of Bernoulli – flow in pipes	ch 3.6	**HW 7**
24	Oct. 20	applications of Bernoulli – flow measurement	ch 3.6	
25	Oct. 23	grade lines, unsteady Bernoulli	ch 3.7, 3.8	
26	Oct. 25	dimensional analysis	ch 7.1, 7.2	**HW 8**
27	Oct. 27	Buckingham pi theorem	ch 7.3, 7.4, 7.5	
28	Oct. 30	dimensionless numbers, similitude	ch 7.6, 7.8	
29	Nov. 1	differential flow equations	ch 6.2, 6.3	
*	Nov. 3	MIDTERM 2		
30	Nov. 6	Navier-Stokes equations, laminar pipe flow	ch 6.8, 6.9, 8.1	
31	Nov. 8	turbulent pipe flow, major losses	ch 8.3, 8.4	**HW 9**
	Nov. 10	*no lecture – Veteran's Day*		
32	Nov. 13	minor losses, pipe flow examples	ch 8.4, 8.5	
33	Nov. 15	external flow, boundary layers	ch 9.1, 9.2	**HW 10**
34	Nov. 17	boundary layers	ch 9.2	
35	*Nov. 20*	*no in-person lecture (may have prerecorded)*		
	Nov. 21-24	*no lecture or discussion sections – Thanksgiving*		
36	Nov. 27	drag, lift	ch 9.3, 9.4	
37	Nov. 29	open channel flow and hydraulic jumps	ch 10	
38	Dec. 1	compressible flow	ch 11	**HW 11**
	Dec. 1	*formal classes end*		
	Dec. 4-8	RRR week		
	Dec. 14	final exam (7:00-10:00pm, location TBD)		
	Dec. 15	*fall semester ends*		

* you can find the textbook table of contents here, if you are using a different edition and want to compare section numbers

How to do well in this course:

Learning and reviewing: Most people learn best when they see material presented several times in different ways. This can take different forms, including

- taking notes in class and reviewing notes after class
- finding a textbook and reading corresponding sections
- discussing with friends
- seeking out free videos, albums, and books (see page 1)

Experiment with these options and see which works best for you!

Collaboration: As said above, you are not competing with each other! One of the most valuable parts of your education is the network of people you meet. Find a study group, learn from each other, and if things get tense try not to blame each other (learning can be tough). Plus, teaching others is an excellent way to learn!

Berkeley honour code: Everyone in this class is expected to adhere to this code: "As a member of the UC Berkeley community, I act with honesty, integrity, and respect for others."

Student conduct: Ethical conduct is of utmost importance in your education and career. Instructors, the College of Engineering, and U.C. Berkeley are responsible for supporting you by enforcing all students' compliance with the Code of Student Conduct (https://sa.berkeley.edu/code-of-conduct) and the policies listed in the CoE Student Guide (https://engineering.berkeley.edu/students/undergraduate-guide/policies-procedures/). The Center for Student Conduct is your central source for guidance in these matters (https://sa.berkeley.edu/conduct).

Accommodation policy: If you need accommodations that provide equitable access, (e.g. religious observance, physical or mental health concerns, insufficient resources, etc.) please check https://diversity.berkeley.edu/ and, if needed, discuss with your specific case with Prof. Kaminski.

Incomplete grades: Incomplete grades must be resolved in a timely manner in less than a year or will automatically lapse to an F grade. Exceptions to the timeline can be made in both directions (shorter or longer) according to the instructor's judgment. The campus policy on incomplete grands can be reviewed here: https://registrar.berkeley.edu/faculty-staff/grading/incomplete-grades/

Inclusion: We are committed to creating an environment welcoming of all students where everyone can fulfill their potential for learning. To do so, I intend to support a diversity of perspectives and experiences and respect each others' identities and backgrounds (including race/ethnicity, nationality, gender identity, socioeconomic class, sexual orientation, language, religion, ability, etc.). To help accomplish this:

- If you feel like your performance in the class is being impacted by a lack of inclusion, please contact me, an academic advisor, or the departmental Faculty Equity Advisor (list and information at: https://diversity.berkeley.edu/faculty-equity-advisors). An anonymous feedback form is also available at https://engineering.berkeley.edu/about/equity-and-inclusion/feedback/.
- There is no tolerance for sexual harassment or violence. If your behaviour harms another person in this class, you may be removed from the class temporarily or permanently, or from the University.
- If you have a name and/or pronouns that differ from your legal name, designate a preferred name for use in the classroom at: https://registrar.berkeley.edu/academic-records/your-name-records-rosters.
- If you feel like your performance in the class is being impacted by your experiences outside of class (e.g., family matters, current events), please don't hesitate to come and talk with the instructor(s). I want to be a resource for you.
- If you have a name and/or pronouns that differ from your legal name, designate a preferred name for use in the classroom at: https://registrar.berkeley.edu/academic-records/your-name-records-rosters.
- As a participant in this class, recognize that you can be proactive about making other students feel included and respected.

Resources:

Disabled Students' Program (DSP): The Disabled Student's Program (260 César Chávez Student Center #4250; 510-642-0518; http://dsp.berkeley.edu) serves students with disabilities of all kinds. Services are individually designed and based on the specific needs of each student as identified by DSP's Specialists. If you have already been approved for accommodations through DSP, please know that DSP is ready to quickly adjust your accommodations if your situation changes. *[note: DSP informs Prof. Kaminski of all finalized accommodations, and she will inform you of how she plans to implement your accommodation.]*

Counseling and Psychological Services (CAPS): Counseling and Psychological Services (https://uhs.berkeley.edu/caps) is available as part of University Health Services (the Tang Center). Services are offered at many locations, including on-site in the College of Engineering (https://engineering.berkeley.edu/students/advising-counseling/counseling/). CAPS services are available to all students, regardless of insurance, and initial visits do not cost anything. CAPS has expanded allowing students to receive help immediately with same-day counselling (510-642-9494), online resources, and a 24/7 counselling line at (855) 817-5667. Short-term help is also available from the Alameda County Crisis hotline: 800-309-2131. If you, or someone you know, is experiencing an emergency that puts their health at risk, please call 911.

The Care Line (PATH to Care Center): The Care Line (510-643-2005; https://care.berkeley.edu/care-line/) is a 24/7, confidential, free, campus-based resource for urgent support around sexual assault, sexual harassment, interpersonal violence, stalking, and invasion of sexual privacy. The Care Line will connect you with a confidential advocate for trauma-informed crisis support including time-sensitive information, securing urgent safety resources, and accompaniment to medical care or reporting.

Ombudsperson for Students: The Ombudsperson for Students (102 Sproul Hall; 642-5754; http://students.berkeley.edu/Ombuds) provides a confidential service for students involved in a University-related problem (academic or administrative), acting as a neutral complaint resolver and not as an advocate for any of the parties involved in a dispute. The Ombudsman can provide information on policies and procedures affecting students, facilitate students' contact with services able to assist in resolving the problem, and assist students in complaints concerning improper application of University policies or procedures. All matters referred to this office are held in strict confidence.

Basic Needs Center: The Basic Needs Center provides housing, food, transportation support, among other support needed to thrive at UC Berkeley. https://basicneeds.berkeley.edu/ Specifically, the UC Berkeley Food Pantry (#68 Martin Luther King Student Union; https://pantry.berkeley.edu) aims to reduce food insecurity among students, especially the lack of nutritious food. Students can visit the pantry as many times as they need and take as much as they need while being mindful that it is a shared resource. The pantry operates on a self-assessed need basis; there are no eligibility requirements. The pantry is not for students and staff who need supplemental snacking food, but rather, core food support.