CHEN 3200 Fluid Mechanics

Spring 2025
Tu/Th 10:00–11:15 AM
JSCBB A115

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Office Hours: (see Canvas for locations, Zoom links and times)

Course Management System: Canvas will be used for class problems, grades, reading assignments, lecture templates, and other announcements.

Email: Please send email related to class issues to chen3200@colorado.edu .

Pre-requisites:
CHEN 2120 Material and Energy Balances (grade of C or better)
APPM 1350, 1360, 2350 (grade of C- or better); co–req APPM 2360

Required text: *Fundamentals of Fluid Mechanics*, Gerhart *et al.*, 9th edition, Wiley

Materials including Ebook and online resources can be found though the Course Materials link on the Canvas site.

Grading

A flexible grading policy will be employed, permitting a balanced review of all aspects of the class to assign final letter grades. For example, students with 90% or above will receive an A, but students with total scores below 90% may potentially be upgraded based on overall performance. Thus, the final **overall** grade is subject to adjustment upward from a standard scale.

The weightings of the different course components are as follows:

Homework:	30%
Midterm 1:	20%
Midterm 2:	20%
Final Exam:	30%

Exams
There will be two midterms and one final exam. Listed below are the dates and times.

Midterm 1: Tuesday, February 18th, 10-11:15am
Midterm 2: Thursday, March 20th, 10-11:15am
Final Exam: Tuesday, May 6th, 4:30–7pm

Any student who misses an exam without excuse will be dropped from the class. If a student has an excused absence for a Midterm Exam, that exam score will be automatically replaced by their Final Exam score. The Final Exam is required to complete the course. For the majority of students who take all three exams, if their Final Exam score is higher than their lowest Midterm score, the Final Exam score will replace that Midterm score. All exams are closed-book unless noted by the instructor. Please note that a final grade of C- or better is required in order to enroll in future chemical engineering courses that require CHEN 3200 as a pre-requisite.

Homework
Answers to homework problems will be submitted by one member of each three-person group through the Gradescope portal. Assignments will be made available through the site on Wednesday and will be due the following Wednesday by 9:00 am, unless otherwise indicated. Late submissions will not be accepted by the system. In the case of emergency circumstances, the student should inform the instructor *before the due date* to make alternative arrangements. The solutions to homework assignments will be posted immediately after the due date.

COURSE LEARNING GOALS

Fluid Mechanics Knowledge

1. **Fundamentals of Fluid Mechanics**
   - understand characteristics of fluid behavior
   - use force balances to solve basic fluids problems
   - understand units and dimensions
   - understand properties of fluids
2. **Fluid Statics**
   - derive basic equation for a pressure field
   - solve manometry problems
   - analyze hydrostatic forces on different surfaces
   - understand and use buoyancy equations
3. **Incompressible Fluid Dynamics**
   - derive and understand when to use Bernoulli's equation
   - interpret velocity and acceleration fields
4. **Fluid Kinematics**
   - understand velocity and acceleration fields
   - understand Eulerian and Lagrangian descriptions of flow
   - understand the material derivative
   - derive and use Reynolds Transport Theorem
5. **Control Volume Analysis**
   - use finite control analysis to apply conservation of mass and Newton's second Law to analyze fluid flow
   - understand and apply continuity, linear momentum, and energy equations
6. **Differential Analysis of Flow**
   - understand differential mathematical formulation of flow
   - use differential analysis to apply conservation of mass to fluid flow
   - understand and apply equations of motion for inviscid and viscous flow
7. **Dimensional analysis**
   - apply Buckingham Pi Theorem to develop dimensionless groups
   - Correlate experimental data with pi terms
   - understand and apply modeling and similitude
8. **Pipe Flow**
   - understand and compare laminar and turbulent flow
   - apply appropriate equations for entrance length/fully developed flow
   - analyze major and minor losses in a pipe
   - calculate parameters such as velocity and pressure drop in pipe systems
9. **Flow over Immersed Bodies**
   - apply lift and drag concepts
   - derive and use boundary-layer equations

Cross-Cutting Engineering Skills

- *Understand Abstract Concepts* – Engineering methods are based on complex underlying science and often expressed in the language of mathematics. By understanding these concepts, engineers are able to develop ways to solve specific problems that they have not previously encountered.
- *Choose Correct Methods* – Engineering problems are often complex and require different approaches in different scenarios. Engineers must therefore understand the distinctions between exact, approximate, numerical, and empirical approaches to solving engineering problems, the advantages and limitations of each, and when to use each approach.
- *Get Resources* – Engineers must be able to identify, find, and employ the necessary resources (e.g. tabulated data and/or governing equations) to solve engineering problems.
- *Use Math* – Engineers employ sophisticated mathematical concepts (e.g. symmetry) and methods (e.g. multivariable calculus and differential equations) to simplify and solve concrete engineering problems.
- *Teamwork* – Solve engineering problems with teams that comprise members with diverse backgrounds, skill-sets and perspectives.
- *Solve Problems* – Engineers are often presented a problem expressed in plain real-world language and use the skills described above (and others) to develop quantitative and accurate solutions, and express the solutions in ways that have practical utility.

Class Format:

This class will be taught via a combination of lectures and office hours. The textbook is an important resource, and you will be responsible for the material in the assigned reading assignments. To get the most out of lectures, you should read each assignment before class. To facilitate note-taking, lecture templates will be provided in advance for some classes.

Academic Dishonesty, Ethics, and Discipline:

Any discovered incidents of academic dishonesty will be reported to the departmental Academic Ethics Committee, which will recommend an academic sanction. Sanctions can range from an F for the particular assignment and a lowering of your grade at least a full letter grade to an F for the course. In addition, all confirmed incidents will be reported to the University Honor Code where further disciplinary action can be taken. Group activities in which a student asks another student for a helpful suggestion will not constitute such an incident. However, using someone else's work, or allowing another student to use your work will be considered a dishonest act. When in doubt, ASK!!! The following list includes some of the examples of acts (not all of them) for which a hearing will result:

- Communicating with anyone during an individual exam.
- Using any information in an exam that is not expressly permitted.
- Plagiarizing solutions to homework such as using information from an Official Solutions Manual. This includes using solutions from previous class takers.
- Any alteration, forgery, or falsification of official records (such as modification of graded homework problems or exams for which you are seeking additional credit).
- Allowing another person to take an exam for you (false identification).
- Knowingly providing material of your own or of others to a fellow student.
- Possession of or observation of examinations or solutions to examinations prior to the date and time of the exam.
- Copying answers from other students during an exam.

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, 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.

If you have a temporary illness, injury or required medical isolation for which you require adjustment, {Faculty: insert your procedure here for students to alert you about absence due to illness, injury, or medical isolation. Because of FERPA student privacy laws, do not require students to state the nature of their illness when alerting you. Do not require "doctor's notes" for classes missed due to illness; campus health services no longer provide "doctor's notes" or appointment verifications.}

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.

All incidents of academic misconduct will be reported to Student Conduct & Conflict Resolution: honor@colorado.edu, 303-492-5550. 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 violence (dating or domestic violence), stalking, and related retaliation by or against members of our community on- and off-campus. These behaviors harm individuals and our community. The Office of Institutional Equity and Compliance (OIEC) addresses these concerns, and individuals who believe they 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 can be found on the OIEC website.

Please know that faculty and graduate instructors have a responsibility to 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 an outreach from OIEC about their options for addressing a concern and the support resources available. To learn more about reporting and support resources for a variety of issues, visit Don't Ignore It.

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 the need for a religious accommodation in a timely manner. In this class, {Faculty: *insert your procedures here*}.

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.