

ASEN 5051

Fundamentals of Fluid Dynamics

Fall 2026

Lectures: Monday/Wednesday 10:00- 11:15 AERO 114

Final Exam: Friday December 11, 2026; 10:30 a.m. - 1 p.m.

Purpose: Establish a fundamental understanding of fluid dynamics.

Topic outline: Physical properties of gases and liquids; viscosity concept and its molecular interpretation; continuum postulate applied to a fluid; Knudsen number; kinematics of flow fields including Lagrangian and Eulerian representation, flow acceleration, Reynolds transport equation, conservation laws (mass, momentum and energy) and the governing equations of general fluid flows; relation between stress and deformation-rate tensors; internal and kinetic energy equations; viscous dissipation; conservation; vorticity equations; dimensionless form of the equations and Reynolds number; Kelvin's circulation theorem; rotational and irrotational flows; potential flows; compressible and incompressible flows; exact solutions; unidirectional flows; Couette and Poiseuille flows; Stokes flows; similarity solutions; boundary layer concept; Boundary layer, displacement, and momentum thicknesses; Blasius and Falkner-Skan solutions; Flow stability; Squire transformation; Orr-Sommerfeld and Rayleigh equations; Rayleigh and Fjortoft's theorems; various averaging concepts; averaged turbulent equations; Reynolds decomposition; Reynolds stress; kinetic energy budget of mean flow and turbulent fluctuations; eddy viscosity approximation. If time allows more topics on compressible and geophysical flows.

Instructor: Professor Kenneth Jansen jansenke@colorado.edu	
Office hours: AERO 302 Thursday 12:30-2:00	

Text: Fluid Mechanics, 4th Ed., Kundu and Cohen. Academic Press.
<https://ebookcentral.proquest.com/lib/ucb/detail.action?docID=534929>

Supplemental text on indicial notation, continuum mechanics: **A First Course in Continuum Mechanics**, Y.C. Fung, Prentice Hall.

Class Web Site: There will be class website on CANVAS. All relevant documents, schedules, supplemental documents will be posted to this site throughout the semester. Please check back to see what has been posted and configure notifications.

Prerequisites: This class requires an undergraduate course in fluid mechanics and thermodynamics. It attacks the subject at a graduate mathematics level with extensive use of indicial notation and vector calculus. Students will find the fluid mechanics much easier to understand by studying these topics before and/or early-while taking this course as only a rapid review of the background material will be given.

Grading

Grade Breakdown According to Assignments: Your final grade is determined according to the following percentage breakdown:

Homework	10
Midterm Exam	40
Final Exam	50
Total	100%

Important Notes and some Q&A:

1. Homework be assigned via the schedule document and due the Wednesday after it is assigned. Homework will not be graded for correctness, only for completion. Collaboration is permitted on homework. This means you may discuss the means and methods for solving problems and even compare answers, but you are not free to copy someone's assignment.

The work that you turn in must be your own—copying is not allowed for any assignments. **Collaboration on exams, using another student's work as your own, or allowing another student to use your work as their own is academic misconduct and is not tolerated.** If you are caught in any of these activities, you will receive a grade of “F” for the course and a report will be made (see Honor Code section below).

2. Your name (last, first), assignment number, and due date should be visible on the outside in the upper portion of each page, to the right of the fold. Written work must be neat and readable with adequate spacing and margins.
3. Exams cover all material in the course including lecture/discussions, homework. Note exams will have two parts, roughly equally weighted. The first part is conceptual—no detailed problems or formulas required and no crib sheets or other aid allowed. The second part solves problems and a crib-sheet is allowed.
4. Students enrolled in the distance section are encouraged to take the exam in the class room we are given for the exam (at that same time) but, if they live too far away for that to be practical then they are required to find a proctor to administer the exam, still at the same start and end time. In that case, the student needs to provide contact information for the proposed proctoring service for my approval at least 1 week in advance.
5. Why have reading assignments, homework, exams?
 - Reading assignments are to be completed *before* the lecture/discussion. The lecture/discussions should help to clarify and supplement what you have read.
 - Homework reinforces the mental processes that help you to become proficient in a subject. In addition to the assigned homework, we encourage you to work additional problems for practice. Before beginning any homework assignment, you should read the text and work the examples in the text.
 - Exams provide a gauge to determine independently what *you* have learned.

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 of 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 Student Conduct & Conflict Resolution and will 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, you should communicate as soon as is practical.

Accommodation for Religious Obligations

Instructional faculty members must make every reasonable effort to accommodate all students who have conflicts with scheduled exams, assignment deadlines or required attendance due to a religious observance. Whenever possible, students must notify the instructional faculty member at least two weeks in advance of the expected exam, assignment deadline, or attendance conflict to request an accommodation for religious observance. If the start date of the course is less than two weeks before the date of requested accommodation, students must notify the instructional faculty member on the start date of the course. See the [Student Academic Accommodations for Religious Observances Policy](#) for more information.

In this class, you should communicate about any accommodation needed as soon as is practical.

Student Names and Pronouns

CU Boulder recognizes that students' legal information does not always align with how they identify. If you wish to have a name other than your legal name appear on your instructors' class rosters and in Canvas, or if you wish to choose pronouns to appear on your instructors' class rosters and in Canvas, visit the [Registrar's website](#) for instructions on how to change your personal information in university systems.

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.

Additional classroom behavior information

- [Student Classroom and Course-Related Behavior Policy](#).
- [Student Code of Conduct](#).
- [Office of Institutional Equity and Compliance](#).

Sexual Misconduct, Discrimination, Harassment and/or Related Retaliation

CU Boulder is committed to fostering a productive 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- or off-campus. Denial of an approved accommodation for disability, religious observance, or pregnancy or pregnancy related medical conditions may be discriminatory.

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 OIEC@colorado.edu. Information about university policies, [OIEC reporting options](#), and [OIEC support resources](#) including confidential services can be found on the [OIEC website](#).

Faculty and graduate instructors are required to inform OIEC when someone discloses misconduct regardless of when or where it occurred. This is to ensure that those impacted receive outreach from OIEC about resolution options and support resources. To learn more about reporting and support options for a variety of concerns, visit the [Don't Ignore It page](#).

Mental Health and Wellness

The University of Colorado Boulder is committed to supporting students' mental health and overall wellbeing. If personal, academic, or emotional challenges are affecting your wellbeing or success, [Counseling and Psychiatric Services \(CAPS\)](#), is here to help. CAPS offers counseling, referrals, psychiatric care, crisis support, and much more. Visit CAPS in the C4C, or call (303) 492-2277, 24/7.

Acceptable Use of AI in This Class

There are no explicit restrictions on the use of AI outside of exams but, since it will not be available on exams, there is a good chance that using it on homework will rob you of the learning that the HW was intended to provide. That said, after doing the homework in the traditional way there are likely effective ways to use AI to enhance your understanding of the material, but it is your responsibility to assess what usage is productive for your learning.