

ASEN 5051
Fundamentals of Fluid Dynamics
Fall 2023

Lectures: Tuesday/Thursday 11:30- 12:45 AERO N250
Final Exam: Tuesday December 19, 2023; 1:30 p.m. - 4 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 Office: AERO Phone: 303-492-4359 jansenke@colorado.edu	Tomaz Remec tore0450@colorado.edu Office hours: Tuesday 9-10 Friday 3-4
Office hours: Monday 12-1, Wednesday 11-12	

Text: Fluid Mechanics, 4th Ed., Kundu and Cohen. Academic Press.
Supplemental text on indicial notation, continuum mechanics: **A First Course in Continuum Mechanics**, Y.C. Fung, Prentice Hall.

Class Web Site and email List: 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 Thursday 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.
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.

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](#).

Requirements for Infectious Diseases

Members of the CU Boulder community and visitors to campus must follow university, department, and building health and safety requirements and all public health orders to reduce the risk of spreading infectious diseases.

The CU Boulder campus is currently mask optional. However, if masks are again required in classrooms, students who fail to adhere to masking requirements will be asked to leave class. Students who do not leave class when asked or who refuse to comply with these requirements will be referred to Student Conduct & Conflict Resolution. Students who require accommodation because a disability prevents them from fulfilling safety measures related to infectious disease will be asked to follow the steps in the “Accommodation for Disabilities” statement on this syllabus.

For those who feel ill and think you might have COVID-19 or if you have tested positive for COVID-19, please stay home and follow the [further guidance of the Public Health Office](#). For those who have been in close contact with someone who has COVID-19 but do not have any symptoms and have not tested positive for COVID-19, you do not need to stay home.

Accommodation for Disabilities, Temporary Medical Conditions, and Medical Isolation

[Disability Services](#) determines accommodations based on documented disabilities in the academic environment. If you qualify for accommodations because of a disability, submit your accommodation letter from Disability Services to your faculty member in a timely manner so your needs can be addressed. Contact Disability Services at 303-492-8671 or dsinfo@colorado.edu for further assistance.

If you have a temporary medical condition or required medical isolation for which you require accommodation, please email both the instructor and the TA. Also see [Temporary Medical Conditions](#) on the Disability Services website.

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 sexual misconduct (harassment, exploitation, and assault), intimate partner violence (dating or domestic violence), stalking, protected-class discrimination and harassment, and related retaliation by or against members of our community on and off campus.

Visit [OIEC](#) for or more information about university policies, [reporting options](#), and support resources. If you believe you may have been subjected to misconduct, [email OIEC](#) or call 303-492-2127

Faculty and graduate instructors are required to inform OIEC when they learn of any issues related to these policies regardless of when or where they occurred. This ensures that individuals impacted receive information about their rights, support resources, and resolution options. Visit the [Don't Ignore It page](#) to learn more about reporting and support options.

Religious Holidays

Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. In this class we will follow this policy.

See the [campus policy regarding religious observances](#) for full details.