ASEN 5051
Introduction to Fluid Dynamics

Time: MWF, 9:35 am – 10:25 am

Location: AERO N240

Instructor: Brian M. Argrow, Distinguished Professor, CU President's Teaching Scholar

Teaching Facilitator: Aditi Deekshita Pallay

Graduate Instructor: Robert Sasse, PhD candidate

Course website: http://canvas.colorado.edu

Slack Channel:

All email correspondence must include "ASEN 5051" on the Subject line.

Applications: Engineering systems that involve flows of single-phase fluids and where the continuum assumption is valid.

Learning Goals

- Learn the conceptual and mathematical underpinnings of fluid dynamics most relevant for aerospace engineers
- Learn how to apply fluid mechanics for the design and analysis of engineering systems
- Prepare for advanced courses

Learning Outcomes

- Understanding of basic fluid dynamics
- Understanding of the appropriate applications and limitations of fluid mechanics
- Ability to formulate fluid-dynamics problems for preliminary engineering design and analysis

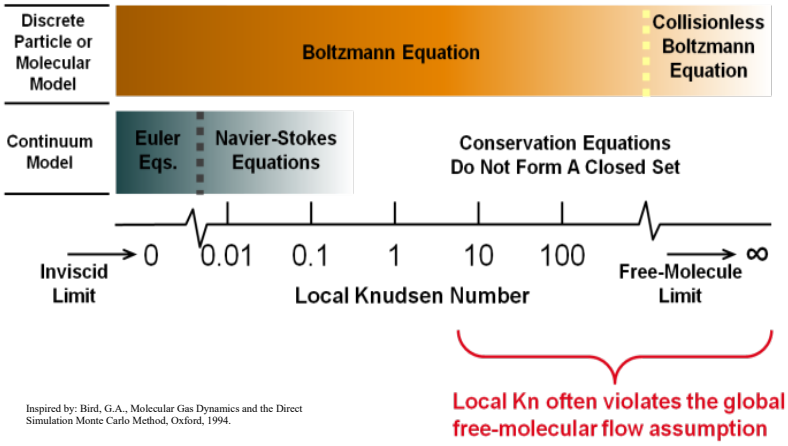
Catalog Description: A rigorous introduction to the fundamentals of fluid mechanics. The course provides a solid foundation for students intending to study fluids at the advanced level but is sufficiently broad that it serves as a valuable survey for many other students. Topics: Cartesian tensors, kinematics of fluid flows, conservation laws, vorticity dynamics, theory and application of irrotational flows, topics in geophysical fluid dynamics, dynamic similarity and nondimensional parameters, viscous flows, and boundary layers. Intended for students in all engineering majors.

Prerequisites: Undergraduate courses in fluid mechanics, thermodynamics, and ordinary and partial differential equations. Simple programming and numerical methods using a "high level language" such as C++ and/or a computing environment such as MATLAB, Python, Mathematica, etc.

Text: Fluid Mechanics, 6th Ed., Kundu, Cohen, and Dowling, Academic Press, 2016. *Text is available for download (PDF) from the CU Library.*

Topical Outline:

1. Introduction to Fluid Mechanics
2. Cartesian Tensors
3. Kinematics
4. Conservation Laws
5. Vorticity Dynamics
6. Ideal (Potential) Flow
7. Gravity Waves
8. Laminar Flow
9. Boundary Layers
10. Instability
11. Turbulence



Grading:		
	PROJECTS (2)	30%
	HOMEWORK, UNIT QUIZZES	20%
	EXAMS (2)	50%

Assignments:

Projects: Designed to motivate the exploration of topics and to apply subject matter to real, open-ended engineering design and analysis problems. Technical-writing requirement introduces students to the expectations of writing research papers.

Reading: To be completed before class session and before completing the Unit Quiz.

Unit Quiz: Also known as a knowledge quiz or reading quiz. A tool designed to explore your comprehension and understanding of the concepts discussed in the reading assignment.

Homework: Designed to encourage students to reflect and apply concepts and methods discussed in the text and in-class discussions. Assigned weekly with usually one week to complete the assignment. Students should make an effort to turn in assignments that are organized, professional looking, and legible. Students upload assignments as a PDF file. Messy work will be returned to a student ungraded and a score of zero will be recorded. Indicate a final answer with an arrow, underline, or box. Multiple answers (when only one is required) will be counted as incorrect. Although each homework assignment will have several problems, only few (one or two) will be selected for grading. Homework solutions will be provided on the class website. Homework is due at the start of class on the due date. Late assignments will not be accepted.

Exams: Designed to measure students' individual mastery of the subject.

Examination Policy: The two exams will cover all material in the course including lecture, discussions, and homework. Collaboration on exams is forbidden. Honor Code violations are discussed below.

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.

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, please contact Prof. Argrow to report that you will not attend class or must miss a submission deadline.

Preferred Student Names and Pronouns

CU Boulder recognizes that students' legal information does not 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. Understanding the course's syllabus is a vital part in 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 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 abuse (dating or domestic violence), stalking, and related retaliation by or against members of our community on- and off-campus. 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 CUreport@colorado.edu. Information about university policies, reporting options, and support resources including confidential services can be found on the OIEC website.

Please know that faculty and graduate instructors must 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 outreach from OIEC about resolution options and support resources. To learn more about reporting and support for a variety of concerns, visit the Don't Ignore It page.

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, you must inform the instructor no later than the first week (third class meeting) of any need for religious accommodations.

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.

Syllabus prepared by: Brian Argrow, 26 August 2024.