## ASEN 5051

## Introduction to Fluid Dynamics

## A blue sky with clouds

**Time:** T, Th 8:30 am – 9:45 am **Location:** AERO N250

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

Office: AERO 261 (AERO 273 starting 26 Aug)

Email: [brian.argrow@colorado.edu](mailto:brian.argrow@colorado.edu)

Tele: 303-492-5312

Office Hours (in-office/zoom): M, T, Th 10:00 am – 11:00 am

Zoom: <https://cuboulder.zoom.us/j/4885173259>

**Teaching Assistant:** Juan Sanchez

Email: [juan.sanchez@colorado.edu](mailto:juan.sanchez@colorado.edu)

Office Hours:

**Course website:** <http://canvas.colorado.edu>

**Slack channel:** <https://join.slack.com/t/asen-5051/shared_invite/zt-3c262mhbl-~KYVdCTja5pZ242dBtDrgQ>

*All email correspondence must include “ASEN 5051” on the Subject line.*

**Application:** Engineering systems involving flows of single-phase fluids.

**Learning Goals**

* Learn the conceptual and mathematical foundation 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**

* Understand the fundamentals of fluid dynamics
* Understand the appropriate applications and limitations of fluid dynamics
* Ability to formulate fluid-dynamics problems for engineering design and analysis

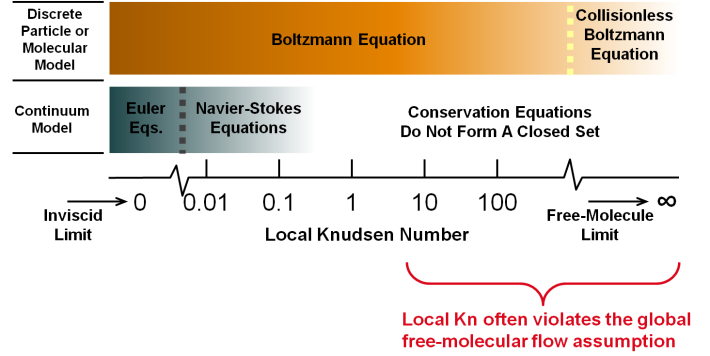
**Catalog Description:** A rigorous introduction to the fundamentals of fluid mechanics. The course provides a solid foundation for students intending to study fluids at the advanced level but is sufficiently broad that it serves as a valuable survey for many other students. Topics: Cartesian tensors, 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.

**Topical Outline:**

1. Introduction to Fluid Mechanics



Inspired by: Bird, G.A., Molecular Gas Dynamics and the Direct Simulation Monte Carlo Method, Oxford, 1994.

1. Cartesian Tensors
2. Kinematics
3. Conservation Laws
4. Vorticity Dynamics
5. Ideal (Potential) Flow
6. Gravity Waves
7. Laminar Flow
8. Boundary Layers
9. Instability
10. 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. Working collectively on the homework assignments is acceptable.

*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.

**CU Boulder Required Syllabus Statements**

**Honor Code**

All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the[Honor Code](https://www.colorado.edu/sccr/students/honor-code-and-student-code-conduct). 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](mailto:StudentConduct@colorado.edu). Students found responsible for violating theHonor 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](https://www.colorado.edu/sccr/students/honor-code-and-student-code-conduct) 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](mailto:Disability%20Services%20website). Contact Disability Services at 303-492-8671 or [DSinfo@colorado.edu](mailto:DSinfo@colorado.edu) for further assistance. If you have a temporary medical condition, see [Temporary Medical Conditions](https://www.colorado.edu/disabilityservices/students/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.

**Accommodation for Religious Obligations**

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](https://www.colorado.edu/compliance/policies/observance-religious-holidays-absences-classes-or-exams) for full details.

**Preferred Student Names and Pronouns**

CU Boulder recognizes that students' legal information does not always align with how they identify. If you wish to have your preferred name (rather than your legal name) and/or your preferred pronouns appear on your instructors’ class rosters and in Canvas, visit the [Registrar’s website](https://www.colorado.edu/registrar/students/records/info/preferred) 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](https://www.colorado.edu/compliance/policies/student-classroom-course-related-behavior).
* [Student Code of Conduct](https://www.colorado.edu/sccr/students/honor-code-and-student-code-conduct).
* [Office of Institutional Equity and Compliance](https://www.colorado.edu/oiec/).
* [Student Code of Conduct](https://www.colorado.edu/sccr/students/honor-code-and-student-code-conduct).
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**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](https://www.colorado.edu/oiec/policies/protected-class-nondiscrimination-policy/protected-class-definitions) 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 [OIEC@colorado.edu](mailto:OIEC@colorado.edu). Information about university policies, [reporting options](https://www.colorado.edu/oiec/reporting-resolutions/making-report), and [OIEC support resources](https://www.colorado.edu/oiec/support-resources) including confidential services can be found on the [OIEC website](https://www.colorado.edu/oiec/).

Please know that faculty and graduate instructors are required to inform OIEC when they are made aware of incidents related to these concerns regardless of when or where something occurred. This is to ensure the person impacted receives outreach from OIEC about resolution options and support resources. To learn more about reporting and support a variety of concerns, visit the [Don’t Ignore It page](https://www.colorado.edu/dontignoreit/).

**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)](https://www.colorado.edu/counseling/), located in C4C, or call (303) 492-2277, 24/7.

**Acceptable Use of AI in This Class**

Generative artificial intelligence tools—software that reproduces text, images, computer code, audio, video, and other content—have become widely available. Well-known examples include ChatGPT for text and DALL-E for images.

This course is not designed to purposefully incorporate gen AI tools. **You may NOT use gen AI tools in solving problems or answering questions for “fundamental-assessment assignments.” Fundamental-assessment assignments are the graded assignments that include homework, quizzes and exams.** Project assignments are also graded but are categorized as “synthesis assignments,” emulating the process of producing a research article. Gen AI may be used for the purpose of drafting text for project assignments. Acknowledging the potential to enhance the learning experience, you may also use gen AI for learning activities that are not directly assessed (graded), such as online searches, literature surveys, organizing course notes, etc.

Keep in mind that the goal of gen AI tools is to reproduce content that seems to have been produced by a human, not to produce accurate or reliable content; therefore, relying on a gen AI tool may result in your submission of inaccurate content. It is your responsibility—not the tool’s—to assure the quality, integrity, and accuracy of work you submit in any college course.

If gen AI tool use is suspected in completing assignments for this course in ways not explicitly authorized, I will follow up with you. I may contact the Office of Student Conduct & Conflict Resolution to report suspected Honor Code violations. In addition, you must be wary of unintentional plagiarism or data fabrication. Please act with integrity, for the sake of both your personal character and your academic record.

*Syllabus prepared and updated by: Brian Argrow, 22 August 2025.*