

THE UNIVERSITY OF COLORADO BOULDER

ASEN 3111: Aerodynamics Spring 2022

SYLLABUS

Instructors:	Professor John Evans (Lecture Instructor) E-Mail Address: john.a.evans@colorado.edu Office Hours Location: Zoom Office Hours Times: Monday 1:00–2:00 pm, Thursday 3:00–4:00 pm
	Professor John Farnsworth (Lab Instructor) E-mail Address: john.farnsworth@colorado.edu Office Hours Location: In Lab Office Hours Times: In Lab
Lecture Location:	AERO 120
Lecture Time:	Monday/Wednesday/Friday, 11:45 am–12:35 pm
Lab Location:	Monday AERO 141 / Tuesday N100
Lab Time:	Monday 2:45 pm–4:35 pm / Tuesday 10:35 am–12:25 pm
Teaching Assistants:	Manoj Settipalli E-mail Address: manoj.settipalli@colorado.edu Office Hours Location: Zoom Office Hours Time: Wednesday 5:00–6:00 pm, Friday 5:00–6:00 pm
Teaching Fellows:	Sarah Leary E-mail Address: sarah.leary@colorado.edu Office Hours Location: Zoom Office Hours Time: Monday 5:00–6:00 pm, Tuesday 6:30–7:30 pm
	Fernando Enrique Chavez E-mail Address: fernando.chavezarroyo@colorado.edu
	William Edwards E-mail Address: william.l.edwards@colorado.edu
Web Page:	Canvas (https://canvas.colorado.edu)

Course Objectives:

The primary course objective is to develop a fundamental understanding of the origins and magnitude of aerodynamic forces and moments, primarily on aircraft where they provide the lift and balance needed to fly, and to develop methodologies for modeling and prediction of such forces and moments. A secondary course objective is to develop a fundamental understanding of gas dynamics in nozzles with application to aircraft and rocket propulsion.

Learning Goals:

Establish a level of competency in the following topics such that you may use this expertise in the design of operational aircraft.

1. Fundamentals

- a. Vector Calculus
- b. Fluid Mechanics
- c. Aerodynamics
- d. Gas Dynamics

2. Origins of Lift

- a. Airfoils and Circulation
- b. Subsonic Wings
- c. Wing Sweep
- d. Supersonic Wings

3. Origins of Drag

- a. Skin Friction Drag
- b. Form Drag
- c. Induced Drag
- d. Transonic Compressibility Drag
- e. Supersonic Wave Drag

4. Modeling and Prediction of Lift and Drag

- a. Potential Flow Theory
- b. Incompressible Thin Airfoil Theory
- c. Compressible Thin Airfoil Theory
- d. Panel Methods
- e. Prandtl Lifting Line Theory

Prerequisites:

Prerequisites include APPM 2350, ASEN 2002, and ASEN 2004 with a minimum grade of C in each class. This course is restricted to Aerospace Engineering majors only.

Textbook, References, and Material:

Fundamentals of Aerodynamics, J.D. Anderson, Fifth or Sixth Edition

Course Website and Course Communications:

There will be a class website on Canvas. All relevant documents, lab assignments, schedules, and supplemental documents will be posted to this site throughout the semester. Please check back to see what has been posted. All course announcements outside of lecture and lab will be sent as Canvas announcements, so it is the student's responsibility to make sure their Canvas settings are appropriately configured to receive these announcements.

Students should only e-mail the teaching team if they have a pressing logistical or health issue. The teaching team will aim to respond to e-mails within one business day. All questions on assignments, quizzes, exams, and course content should be asked during lecture, lab, or office hours.

Course Format:

The course will follow a blend of traditional lectures and laboratory exercises. Homework will be assigned every Monday to be due the next Monday at the start of class. There will be four computational assignments. There will be weekly concept quizzes and lab quizzes following each computational assignment. There will be three midterm exams throughout the semester and a final exam. Student assessment will be based on homework assignments, computational assignments, concept quizzes, lab quizzes, midterm exams, and the final exam.

Grading:

Course grades will be assigned based on the following percentages:

Individual Effort:

- 36% Midterm Exams (3 x 12%)
- 24% Final Exam
- 8% Individual Lab Quizzes (4 x 2%)

Group Effort:

- 5% Homework
- 5% Concept Quizzes
- 20% Computational Assignments (4 x 5%)
- 2% Group Lab Quizzes (4 x 0.5%)

Grades will be posted to the course website on Canvas. Group Effort only contributes to the final grade if the total Individual Effort grade is C or better.

Letter Grading Scheme:

Letter grades will be assigned as follows:

Letter Grade	Percent Grade	4.00 Scale
A	93.00 – 100.00	4.00
A-	90.00 – 92.99	3.67
B+	87.00 – 89.99	3.33
B	83.00 – 86.99	3.00
B-	80.00 – 82.99	2.67
C+	77.00 – 79.99	2.33
C	73.00 – 76.99	2.00
C-	70.00 – 72.99	1.67
D	60.00 – 69.99	1.00
F	Below 60.00	0.00

All three midterm exams as well as the final exam will be curved, while the homework, concept quizzes, lab quizzes, and computational assignments will not be curved.

Remarks on Grading:

Our grading scheme is not designed to reward or punish. It is designed to indicate your level of competency compared to the standard that we set. Do you meet the minimum level of competency? Do you exceed the minimum? Are you below the minimum? The answers to these questions should be indicated by your final grade.

The final grade indicates your readiness to continue to the next level of courses. Meeting the minimum requirements indicates that you are prepared to continue at least at the minimum level required for the next in the sequence of courses. Exceeding the minimum means you are ready to enter the next course and that you have mastery of material beyond the minimum, that is, you show some level of proficiency.

Homework Policy:

Homework will be assigned every Monday during lecture to be due the next Monday at the start of lecture. All homework submissions must be uploaded to Canvas as PDF files before they are due. ***Homework assignments are due at the start of lecture on the due date.***

Each homework assignment will be worth 10 points. Homework submissions will be graded for “completeness”, and solutions will be posted for self-assessment of “correctness”. Late assignments will not be accepted under any circumstance, but the lowest homework grade will be dropped.

Collaboration is permitted on homework. You may discuss the means and methods for formulating and solving problems and even compare answers, but you are not free to copy someone else’s assignment. ***Copying material from any resource (including solutions manuals) and submitting it***

as one's own is considered plagiarism and is an Honor Code violation. Students who are caught copying material, from either the solution manual or peer assignments, will receive a zero "Homework" grade for the class. Remember, the less you think about the problems yourself, the less you actually learn, and the more difficult it will be to succeed on exams.

Homework is meant both as a mechanism for students to learn and apply course material as well as practice solving problems for the midterm exams and final exam. As such, students should approach the homework assignments as if they were graded for "correctness". Students should strive to demonstrate an understanding of the principles involved by including diagrams, using correct notation and terminology, explaining the approach, showing the key steps to obtaining the solution, and outlining the answer with proper units. Students should also submit work with a professional appearance.

Concept Quiz Policy:

There will be a concept quiz each week of the semester except for the first and last week of class and midterm exam weeks. These concept quizzes will be administered as Canvas quizzes, and each quiz will be assigned on a Monday and due on the Friday of the same week at 11:59 PM. Students will have fifteen minutes to complete each quiz, and students will be able to take the concept quizzes as many times as they like before they are due. The concept quizzes will cover material assigned in readings during the week they are assigned, and they are intended to help students identify, practice, and comprehend important concepts. The concept quizzes will be closed-book, and there will be no make-up concept quizzes. However, the lowest concept quiz grade will be dropped.

Lab Quiz Policy:

There will be four lab quizzes throughout the semester, one following each computational assignment. The lab quizzes will cover material associated with the computational assignments as well as material presented or discussed within the lab. Each lab quiz will be administered in two parts: 1) an Individual Lab Quiz and 2) a Group Lab Quiz. First, students will be given 15 min to individually take the lab quiz, which will be closed book, additionally students will be prohibited from talking during this time. Once all of the students have turned in their Individual Lab Quiz, a second copy will be provided to each student and another 15 min will be allotted for the students to take the quiz as a small group of no more than 4. During this time students can discuss each question amongst their small group, but are not allowed to use additional resources. Each student must turn-in their own copy of the group lab quiz, and detail who their team members were.

There will be no makeup lab quizzes. If you are unable to attend a particular lab quiz due to an extraordinary situation, you must notify the laboratory instructor, via email, ahead of the scheduled time, and if an excused absence is granted, then the individual and group quiz grades will be dropped from your overall individual and group lab quiz grades respectively.

Midterm Exam Policy:

There will be three midterm exams:

Exam 1, February 16, 2022: Fundamentals and Potential Flow

Exam 2, March 9, 2022: Incompressible Flow About Airfoils and Finite Wings

Exam 3, April 20, 2022: Compressible Flow and Shock Waves

The midterm exams will cover all material in the course including lecture, discussions, assignments, and laboratory exercises.

Each midterm exam will consist of two parts. The first part will be fully closed book and will test understanding of concepts. The second part will be closed book except for a crib sheet and will involve derivation and problem solving. Collaboration on the midterm exams will not be tolerated. Students who are caught in these activities will receive an “F” for the course and reported to the Dean’s office for further punitive action.

There will be no makeup midterm exams. If you are unable to attend a particular midterm exam due to an excused absence, your midterm examination grade will be replaced by your final exam grade associated with the missed midterm material.

The course is broken into three topics that are assessed through three midterm exams. These same three topics will be tested on the final. Recognizing that testing is never an exact science, your final grade will be calculated from your best percentage of the two topic tests (one from midterm, one from final) according to the following policy. When the better performance on a given topic occurs on the final, the topic score from the final will always be chosen which allows the final to replace any (up to all) midterm scores. However, for a midterm topic score to replace a lower topic score on the final, a student must score at least a 70% on the topic score from the final (after accounting for any curve applied). Thus, failing a topic on the final will result in that topic score being used in the final exam score with the weighting described at the start of the Grading section above.

Final Exam Policy:

There will be a comprehensive final exam on Sunday, May 1, 2022 from 7:30 pm to 10:00 pm.

The date of the final exam is dictated by the University of Colorado Boulder registrar's office and can not be changed or modified. As a result the exam can not be offered early and no make-ups will be permitted. Students are advised to plan their end of semester schedules accordingly.

The final exam will cover all material in the course including lecture, discussions, assignments, and laboratory exercises.

The final exam will consist of two parts. The first part will be fully closed book and will test understanding of concepts. The second part will be closed book except for four crib sheets and will involve derivation and problem solving. Collaboration on the final exam will not be tolerated. Students who are caught in these activities will receive an “F” for the course and reported to the Dean’s office for further punitive action.

If a student has an “A” midterm exam average grade going into the final exam, the student may elect to not take the final exam. In this case, the student’s midterm exam average grade will replace the student’s final exam grade. ***Students qualifying for this option will be notified by no later than the final exam reading day, Friday, April 29, 2022.***

Computational Assignments Policy:

There will be four computational modeling assignments throughout the semester. These are:

- CA 1:** Introduction to Numerical Integration and Computation of Lift/Drag
- CA 2:** Computing Incompressible Flow over Thin and Thick Airfoils
- CA 3:** Computing Incompressible Flow over Finite Wings
- CA 4:** Computing Compressible Aerodynamics

To complete these assignments, students must have access to a computer, basic programming skills, and familiarity with some programming languages and/or environments similar to what is covered in introductory computing courses. The minimum requirement is some proficiency with MATLAB. If you are not familiar with MATLAB, it is your responsibility to become so.

Collaboration is permitted on the computational assignments. You may discuss the means and methods for formulating and solving problems and even compare answers, but you are not free to copy someone else’s work. ***Copying material from any resource (including code from another student or online) and submitting it as one’s own is considered plagiarism and is an Honor Code violation.*** Students who are caught copying material will receive a zero “Computational Assignments” grade for the class.

For each computational assignment, a zip file containing your code must be submitted to Canvas, including a “driver” or “main” MATLAB script producing all requested figures. Code must be written individually. If you have collaborated with others while designing your code, be sure to credit them in a comment section at the top of your “driver” or “main” MATLAB script. Each computational assignment will be due on a Sunday. ***Codes should be submitted via Canvas by 11:59 PM on the due date. Code will not be accepted after the given due date.***

Further guidelines for the code submission will be given in class.

Reading Assignments Policy:

There will be reading assignments associated with each lecture. These assignments may be found on the course schedule. These reading assignments are to be completed before the lecture. The lecture and discussions should help to clarify and supplement what you have read.

Attendance Policy:

Students are highly encouraged to attend scheduled lecture and laboratory periods. Expect new material to be presented in both the lecture and laboratory periods. Exams will cover all the material in the course, including lecture, discussions, homework, and laboratory exercises.

Evaluated Outcomes:

The Department of Aerospace Engineering Sciences has adopted a policy of assigning grades to “evaluated outcomes” in each course:

- O1:** Professional context and expectations
- O2:** Current and historical perspective
- O3:** Multidisciplinary systems perspective
- O4:** Written, oral, and graphical communication ability
- O5:** Knowledge of key scientific/engineering concepts
- O6:** Ability to define and conduct experiments and use experimentation
- O7:** Ability to lead independently and find information
- O8:** Ability to work in teams
- O9:** Ability to design
- O10:** Ability to formulate and solve problems
- O11:** Ability to use and program computers

Evaluation of these outcomes allows an assessment of your performances and provides a major portion of the process we, the Faculty, use for continuous assessment and improvement of the entire AES undergraduate curriculum. The model for these outcomes derives from several sources including the *Desired Attributes of an Engineer* as defined by The Boeing Company and “curriculum reviews” from major aerospace corporations including The Boeing Company, Lockheed Martin Corporation, and Ball Aerospace Corporation. These inputs were combined with the AES faculty vision of the desired attributes of an aerospace engineer and the requirements of the Accreditation Board for Engineering and Technology (ABET) to produce this list of evaluated outcomes. Each assignment is designed and graded to assess some combination of these outcomes.

For ASEN 3111, these outcomes are grouped according to:

- Knowledge of scientific and engineering principles (O5)
- Ability to formulate and solve problems (O7, O10)
- Ability to develop and use computer programs (O11)
- Ability to design with a multidisciplinary systems perspective (O3, O9)
- Ability to work in a team (O8)
- Ability to communicate effectively (O4)
- Ability to design and conduct experiments (O6)
- Ability to appreciate ethical, economic, historical, and technical context (O1, O2)

Requirements for COVID-19:

As a matter of public health and safety due to the pandemic, all members of the CU Boulder community and all visitors to campus must follow university, department and building requirements and all public health orders in place to reduce the risk of spreading infectious disease. Students who fail to adhere to these requirements will be asked to leave class, and students who do not leave class when asked or who refuse to comply with these requirements will be referred to [Student Conduct and Conflict Resolution](#). For more information, see the policy on [classroom behavior](#) and the [Student Code of Conduct](#). If you require accommodation because a disability prevents you from fulfilling these safety measures, please follow the steps in the “Accommodation for Disabilities” statement on this syllabus.

CU Boulder currently requires masks in classrooms and laboratories regardless of vaccination status. This requirement is a precaution to supplement CU Boulder’s COVID-19 vaccine requirement. Exemptions include individuals who cannot medically tolerate a face covering, as well as those who are hearing-impaired or otherwise disabled or who are communicating with someone who is hearing-impaired or otherwise disabled and where the ability to see the mouth is essential to communication. If you qualify for a mask-related accommodation, please follow the steps in the “Accommodation for Disabilities” statement on this syllabus. In addition, vaccinated instructional faculty who are engaged in an indoor instructional activity and are separated by at least 6 feet from the nearest person are exempt from wearing masks if they so choose.

If you feel ill and think you might have COVID-19, if you have tested positive for COVID-19, or if you are unvaccinated or partially vaccinated and have been in close contact with someone who has COVID-19, you should stay home and follow the further guidance of the [Public Health Office](#)(contacttracing@colorado.edu). If you are fully vaccinated and have been in close contact with someone who has COVID-19, you do not need to stay home; rather, you should self-monitor for symptoms and follow the further guidance of the [Public Health Office](#) (contacttracing@colorado.edu).

Accommodation for Disabilities:

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.

Classroom Behavior:

Both students and faculty are responsible for maintaining an appropriate learning environment in all instructional settings, whether in person, remote or online. Those who fail 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 policies on [classroom behavior](#) and the [Student Conduct & Conflict Resolution policies](#).

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 academic integrity policy. Violations of the Honor Code may include, but are not limited to: plagiarism, 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 the Honor Code (honor@colorado.edu; 303-492-5550). Students found responsible for violating the academic integrity policy will be subject to nonacademic sanctions from the Honor Code as well as academic sanctions from the faculty member. Additional information regarding the Honor Code academic integrity policy can be found on the [Honor Code website](#).

Sexual Misconduct, Discrimination, Harassment and/or Related Retaliation:

CU Boulder is committed to fostering an inclusive and welcoming learning, working, and living environment. The university will not tolerate acts of sexual misconduct (harassment, exploitation, and assault), intimate partner violence (dating or domestic violence), stalking, or protected-class discrimination or harassment by or against members of our community. Individuals who believe they have been subject to misconduct or retaliatory actions for reporting a concern should contact the Office of Institutional Equity and Compliance (OIEC) at 303-492-2127 or email cureport@colorado.edu. Information about university policies, [reporting options](#), and the 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 of sexual misconduct, dating and domestic violence, stalking, discrimination, harassment, and/or related retaliation, to ensure that individuals impacted receive information about their rights, support resources, and reporting options. To learn more about reporting and support options for a variety of concerns, visit [Don't Ignore It](#).

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