

ASEN 2804 – Summer 2024
Aerospace Vehicle Design Laboratory

Lab: M/T/TH/F 12:00 pm – 1:50 pm (Room AERO 141 PILOT)

Instructors: Nhat Dang
He/him

Lab Coordinator: Trudy Schwartz
She/her

Lab Assistants: Alyx Ellington
Jackson Snodgrass

Class Canvas Website:

Texts (Optional): Anderson, **Introduction to Flight**, 8th or 9th ed. (hardcopy or electronic version)
Sellers, **Understanding Space: An Introduction to Astronautics**, 4th ed.

Pre/Co-requisites: (PR) ASEN 1320; (PR or CR); ASEN 2704, 2012

Required Equipment / Software

- Access to a computer or laptop
- Computational / Programming Software
 - Many assignments will require access to a computer and basic programming skills. Computer programming skills are a prerequisite for this class, e.g. GEEN 1300, ASEN 1320/CSCI 1300. We will not teach computer programming, although we will make an effort to formulate the assignments to emphasize proper computing skills.
 - MATLAB is highly recommended but not required. You can download a free MATLAB license for your personal computer from CU at <https://oit.colorado.edu/software-hardware/software-downloads-and-licensing/matlab>. You can also use MATLAB Online for this course at <https://matlab.mathworks.com/>.
 - Use of Excel, Python, or any other programming language is allowed; however, you must consider ease of integration across your team members as some consistency across your team is required.
- Any CAD software of your choice

Course Material Costs: This course does not require the purchase of a textbook; however, material fees for the fabrication of your vehicle are required. The lab will provide basic fabrication materials and tools to build your prototype vehicle at no cost; however, all students are expected to contribute an

additional \$10 towards their team fabrication budget for this course to augment the provided materials with any additional fabrication needs not provided. *Total in-pocket expenses by students is capped at up to \$10 and cannot be exceeded by any team or individual regardless of willingness to spend more to ensure all teams operate on the same constrained budget. Materials provided by the course do not count against your budget costs.*

Course Objectives: To introduce the theory and methods for design and analysis of aerospace vehicles through a design project framework. Specific learning objectives are:

- 1. Gain experience as a member of an engineering team on an applied, multi-disciplinary aerospace engineering design problem**
 - a. Demonstrate ability to integrate lower division engineering knowledge towards meeting engineering design requirements
 - b. Exercise engineering judgement in an open-ended, complex engineering design problem
 - c. Exercise engineering agility in developing design solutions under conditions of uncertainty
 - d. Gain exposure to problems that arise from integration of sub-components / sub-disciplines in an aerospace system
- 2. Develop and assess first-order models in the design of an aerospace system (Application of lower-division engineering concepts)**
 - a. Conduct experimentation and/or benchmarking to validate components of engineering models used in design
 - b. Identify key design parameters and conduct parametric sizing and sensitivity analysis to optimize your design for requirements
 - c. Discuss concept of uncertainty in models and understand why first-order models are useful
- 3. Analyze performance of an aerospace system**
 - a. Develop technical skills in hands on rapid prototyping for the purpose of conceptual design risk and uncertainty mitigation
 - b. Compile, condition, and analyze experimental data
- 4. Develop effective technical communication and team skills necessary for both intra-team coordination as well as formal technical reviews.**

Course Structure: This course is meant to serve as an integrator of your lower division engineering knowledge as well as preparation for the first semester of your senior capstone project course (ASEN 4018) through exposing you to multidisciplinary team-based engineering and basic concepts of aerospace vehicle design. While you will have more choice in the type of project, team structure, and project management of your senior project, this course will pre-define for you the project, team structure and roles, and tasks to provide you an introductory experience before you have full responsibility for all these aspects in ASEN 4018.

Team Structure: The team size will be 3 - 4 students depending on section enrollment. You will be required to switch teammates between the glider and rocket labs.

Evaluation & Assessments: As this is a project-based design course, most of your grade will be determined through team assignments; however, **peer evaluations of your professionalism and engineering quality of work may significantly alter your individual grade from your teammates!** Additionally, the instructor will have the ability to further adjust your grade based on their observations of your work and contributions during in-person lab times.

Assignment Summary & Weights

Lab Project	Assignment Breakdown	Weight of Total Grade
Glider Lab (50% of total grade)	Milestone #1 Report	15%
	• Wood Shop Training Complete	2%
	• Parasite Drag Model Check	4%
	• Induced Drag Model Check	4%
	Milestone #2 Presentation	15%
	• Configuration In-lab Check	1%
	• Wing Parameters In-lab Check	2%
	• Wing & Fuselage Sizing In-lab Check	2%
	• Stability Design In-lab Check	2%
	• Glider Fabrication & Flight Test	3%
	Glider Lab Peer / Instructor Eval*	May result in up to +/- 20% variation of your individual grade from total glider lab team points
Rocket Lab (50% of total grade)	Static Test Stand Report	20%
	Rocket Model Check	5%
	Rocket Launch Day Analysis	5%
	Rocket Lab Final Presentation	20%
	Rocket Lab Peer / Instructor Eval*	May result in up to +/- 20% variation of your individual grade from total glider lab team points
*NOTE: IF THE INSTRUCTOR HAS SUFFICIENT CAUSE TO ASSESS THAT A STUDENT DID NOT SUBSTANTIALLY CONTRIBUTE TO A LAB ASSIGNMENT, THE INSTRUCTOR MAY GIVE THAT STUDENT A ZERO FOR THE ENTIRE LAB ASSIGNMENT.		

- Please verify all your scores and grades on Canvas within 4 days after they are posted; requests to change a score need to be made within this period.
- For this class to meet minimum grade accepted as achieving pre-requisite requirements for AES degree progression, a final grade of a "C" with a baseline of 73% average across these weighted elements.
 - **Minor adjustments may be made in the determination of final letter grades and with grade cut lines, but there is no "curving" in this course.**
 - **Grades will be rounded to whole percentage in the final calculation of total grade (i.e. a 89.4% will be an 89% and an 89.5% will round to a 90%). No deviations from this policy will be considered.**
 - **73% is the maximum for which the C cutline will be set but may be set lower after instructor review of the course (never higher). Students should not assume this baseline will be lowered for final grades.**

Course Delivery: All labs will be conducted in-person only. Due to the emphasis on team learning objectives of the course, students are expected to attend all scheduled lab periods in person, and attendance for will be a part of a student's individual grade determination. Lab sections and instruction will NOT be recorded.

Final Exam: There is no final exam for this course.

Evaluated Outcomes

The Department of Aerospace Engineering Sciences has adopted a policy of assigning grades according to evaluated outcomes (Ox) in each course. Each assignment designed and graded to assess some combination of several or a few of the following outcomes:

- O1** Professional context and expectations (ethics, economics, etc.)
- O2** Historical perspective and vision
- O3** Multidisciplinary, system perspective
- O4** Written, oral, graphical communication ability
- O5** Knowledge of key scientific/engineering concepts
- O6** Ability to define and conduct experiments, use instrumentation
- O7** Ability to learn independently, find information
- O8** Ability to work in teams
- O9** Ability to design systems
- O10** Ability to formulate and solve problems
- O11** Ability to use and program computers

Evaluation of these outcomes allows an assessment of your performance and provides a major portion of the process we 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 Co., Lockheed Martin Corp. and Ball Aerospace Corp. 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 designed and graded to assess some combination of these outcomes.

Additional Administrative Notes:

1. All questions regarding course content should be posted to the course Canvas discussion page or asked during lab or office hours. Discussion post questions that are received 24 hours or less before the deadlines will not be responded to. All other questions, concerns, or issues not regarding course content should be e-mailed to the instructor. E-mails and discussion posts will be responded to during business hours, i.e. Monday through Friday, 8:00 am – 5:00 pm MST/MDT. Do not expect weekend emails to be responded to until the following Monday at the earliest.
2. We reserve the right to make changes to the weekly course schedule based on occurring events that require different dispositions. We will give sufficient advance notice through announcements in class and posting on the web. Changes to this syllabus and assignments-table may be announced at any time during class periods. We will post the current syllabus and assignments-table on the web. Both are dated in the footnote.
3. Canvas will be used to send out announcements, to provide comments to you daily on class activities, and to provide general information about course assignments.

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 classroom behavior policy, the Student Code of Conduct, and the Office of Institutional Equity and Compliance.

REQUIREMENTS FOR COVID-19

As a matter of public health and safety, 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. CU Boulder currently requires COVID-19 vaccination and boosters for all faculty, staff and students. Students, faculty and staff must upload proof of vaccination and boosters or file for an exemption based on medical, ethical or moral grounds through the MyCUHealth portal.

The CU Boulder campus is currently mask-optional. However, if public health conditions change and masks are again required in classrooms, students who fail to adhere to masking 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.

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). Immediately notify your instructors of your illness and we will coordinate with you to mitigate course issues that arise due to illness.

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.

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, 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. 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. 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. These behaviors harm individuals and our community. The Office of Institutional Equity and Compliance (OIEC) addresses these concerns, and individuals who believe they 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 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 any issues related to these policies regardless of when or where they occurred to ensure that individuals impacted receive information about their rights, support resources, and resolution 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. **In this class, all conflicts with scheduled exams, quizzes, or assignments should be coordinated within the first week of class (NLT 9 Jun 23) to ensure enough time to plan any adjustments that result. See the campus policy regarding religious observances for full details.**