

ASEN 3801: Aerospace Vehicle Dynamics and Control Lab

Spring 2024 Syllabus

Lab Schedule:

- **Section -001:** Wednesdays 8:30am-10:20am in AERO N100
- **Section -002:** Fridays 8:30am-10:20am in AERO 141
- **Section -003:** Fridays 10:35am-12:25pm in AERO 141

Instructors

First half of semester: Prof. Natasha Bosanac **Email:** natasha.bosanac@colorado.edu

Second half of semester: Prof. Melvin Rafi **Email:** melvin.rafi@colorado.edu

Teaching Assistants

Tim Behrer **Email:** Timothy.Behrer@colorado.edu **Sections:** TBD

Dakota Harris **Email:** Dakota.Harris@colorado.edu **Sections:** TBD

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Course Description

Overview:

This course emphasizes applications of engineering dynamics and control principles for modeling, simulating, designing, analyzing, and evaluating aerospace vehicle systems. Over several labs, there is experimental and computational focus on problems in aircraft flight stabilization and spacecraft attitude control.

Learning goals:

A student who successfully completes this course will:

1. Understand how to collect, analyze, and interpret data, and to form/support conclusions about applications of rigid body dynamics and dynamical systems theory to aerospace vehicles, as well as to make order of magnitude judgments and to use measurement unit systems and conversions.
2. Identify the strengths and limitations of theoretical models as predictors of real-world dynamical behavior in aerospace vehicle systems, and learn how to validate relationships between simulated/measured data and underlying physical principles.
3. Understand selection, operation, and application of appropriate sensors, instrumentation and/or software tools to make measurements of dynamic physical quantities in aerospace vehicle systems.
4. Understand how to select, modify, and operate appropriate engineering tools and resources.

The course will also reinforce understanding of fundamental concepts covered in ASEN 3728 Aircraft Dynamics and ASEN 3700 Orbital Mechanics/Attitude Dynamics and Control.

Prerequisites:

Requires prerequisite courses ASEN 2012 and ASEN 2703. Requires prerequisite or corequisite courses ASEN 3728 and ASEN 3700. Restricted to Aerospace Engineering (ASEN) majors and IDEN majors with an Aerospace emphasis.

Class format:

The class meets in-person once a week for one hour and fifty minutes of active laboratory instruction. Note that the activities vary week by week with some weeks focused on formal lecture or laboratory introductions, while others may be focused on carrying out hands-on laboratory measurements, programming analysis or post-processing code, carrying out simulations or writing laboratory reports and completing other laboratory deliverables. Lab instruction documents and rubrics will be provided by the first section of each lab, as listed in the schedule available on Canvas.

All labs will be carried out in small groups, assigned by the instructional team, which will be sized appropriately to match the amount of work expected. The group assignments will be posted to Canvas. All students are expected to contribute to and discuss each component of a lab within their group.

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 PILOT and Co-PILOT lab spaces all supply access to computers. The minimum requirement is some proficiency with MATLAB. If you are not familiar with MATLAB, it is your responsibility to gain this foundational knowledge on your own. In addition to writing a detailed report for each assignment, students may also be required to submit their post-processing or analysis code. Code may be written as a group, but each individual within the group is responsible for understanding exactly how all of the code works.

Teams can work together to discuss the means and methods for formulating and solving problems and even compare answers, but you are not free to copy work from other groups. Copying material from any resource (including code from another student, online resources, or prior course materials) 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 grade for the class and will be reported for an Honor Code Violation for additional punitive action.

Restrictions:

Course materials (including but not limited to notes, labs, instructions, videos, etc) may not be distributed publicly or shared with individuals who are not registered in the course this semester without prior instructor consent.

Students are not allowed to use artificial intelligence (AI) or machine learning tools (e.g., ChatGPT or Dall-E 2) on any labwork or reports for this course. Each student is expected to complete each lab without assistance from AI. Use of AI will be treated as a form of academic dishonesty akin to plagiarism or cheating.

Textbooks

While there are no required textbooks for this course, the textbooks associated with ASEN 3728 and ASEN 3700 are highly recommended as references for the material covered in the laboratory assignments.

Logistics

Course Website: canvas.colorado.edu

Please check that your settings in Canvas enable you to receive regular notifications, course announcements, and emails. All course documents, lab assignments, schedules, and supplemental documents will be posted to this site throughout the semester; please check the course Canvas page regularly. All course announcements outside of the laboratory periods will be sent as Canvas announcements.

Attendance is expected at all scheduled laboratory periods, and students should expect new material to be presented. Students who come to class prepared and participate actively typically have a more rewarding experience that will contribute to their learning. None of the laboratory introductions or lectures will be recorded or posted for asynchronous access. Students who miss important information during laboratory periods should coordinate with their assigned lab groups and catch-up independently on the material they may have missed.

Group work: Lab assignments are conducted in small teams assigned by the instructional staff. A single assignment is submitted for each lab group. Collaborations with other groups, including shared diagrams or extensive discussion of results, must be acknowledged at the end of your assignment. Specific requirements for what to submit are given with each assignment. Lab assignments are of different length and complexity, and therefore will have different amounts of points assigned to them. A student's score on the assignment will be a combination of the grade for each report (as a group effort) and anonymous peer evaluations from your lab teammates.

Lab report submissions: Lab reports and code should be submitted via Gradescope by the listed deadline; the deadline is the start of your assigned lab section on the listed date, except where otherwise specified. Further guidelines for each laboratory activity and report will be addressed in the respective lab assignment documents.

Peer evaluations: By 11.59pm MT on the deadline of a lab report, each student may submit a separate peer evaluation to assess the participation and contributions of their team members. This peer evaluation also offers an opportunity to report team members who did not sufficiently contribute to completion of the lab work and/or report. Instructions for how to complete the peer evaluations will be provided early in the semester.

Non-participating students: If a student does not participate in the group (i.e., attending lab periods, group meetings, online discussions, etc.) and/or does not contribute sufficiently to the

group work, there may be one of two consequences, depending on the severity: 1) the student's individual score will be less than the rest of the group's score for the lab, or 2) the team will be re-arranged, and the non-participating student might have to complete the assignment on their own. The instructors will decide the appropriate course of action, including the value of any lab score deductions. A lab group may also report an absent team member prior to the lab report deadline by emailing both the instructors and cc-ing all members of the group.

Extension requests: In the rare case of an extenuating circumstance, a lab group may submit a request for an extension by no later than 10am MT the business day before the deadline. The instructors will consider requests for extensions only for excusable reasons. Sending an extension request does not guarantee that it will be granted.

Late assignments will not be accepted without prior approval by an instructor or extenuating circumstances. Any groups that do not submit a lab report on time will receive a grade of zero for that specific lab.

Regrade requests must be made within 1 week of the graded lab reports being returned. These requests must be made in writing via Gradescope with a clear description of the suspected grading error and the relevant rubric item/s. Regrade requests will not be accepted verbally.

There is no **Final Exam** for this course.

Office hours are scheduled to provide additional opportunities for student questions. For office hours, the TAs will participate in the department Study Hall. The instructors will not hold office hours. You are strongly encouraged to ask questions during your assigned lab section.

Study Hall: To improve academic support, provide peer mentorship, and build community for undergraduate students, the Aerospace department launched the Undergraduate Study Hall program. During the Study Hall, course TAs and Engineering Fellows will be available to provide support.

Questions: For questions about technical concepts or the labs, you may use one of the following options, in order of preference:

1. During your assigned lab section
2. During the Study Hall
3. The optional Slack page
4. Emailing the teaching assistants assigned to your lab section

Students may email the instructors questions regarding individual, logistical, or administrative issues. Do not expect an immediate response; the instructional team will respond as soon as they can within reasonable business hours.

Course Grading Policy

The final course percentage grade will be calculated for each individual student as:

$$\text{Percentage grade} = (\sum_{i=1}^n \text{Score for Lab } i) / (\sum_{i=1}^n \text{Maximum possible score for Lab } i)$$

where $n = 5$, the total number of labs that will be completed in this course.

The score assigned to each student for a lab will be equal to their group's lab report score, except if their team reports in the peer evaluations that they did not sufficiently contribute to completing the lab; in that case, the individual score may either receive a substantial deduction or equal zero as determined by the instructors.

Assignments are graded to an absolute standard designed to indicate your level of competency in the course material. The final grade indicates your readiness to continue to the next level in the curriculum. The AES faculty have set these standards based on our experience, interactions with industry, government laboratories, others in academe, and according to the criteria established by the ABET accreditation board.

Final grades for the course are then set based on the following criteria:

- A, A-: Demonstrates superior understanding of the course material in both conceptual and quantitative aspects.
- B+, B: Demonstrates comprehensive understanding of the material, with a solid conceptual grasp of key concepts and strong quantitative work.
- B-, C+: Demonstrates good understanding of most key concepts, with few major quantitative errors.
- C: Demonstrates satisfactory understanding of the material, with sufficient quantitative work.
- C-: Demonstrates adequate understanding of the material to proceed to the next level; quantitative work with some persistent errors.
- D: Little understanding is evident, consistently poor quantitative work.
- F: Unsatisfactory performance.

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 Disease

Members of the CU Boulder community and visitors to campus must follow university, department, and building health and safety requirements and all applicable campus policies and public health guidelines to reduce the risk of spreading infectious diseases. If public health conditions require, the university may also invoke related requirements for student conduct and disability accommodation that will apply to this class.

If you feel ill and think you might have COVID-19 or if you have tested positive for COVID-19, please stay home and follow the [guidance of the Centers for Disease Control and Prevention \(CDC\) for isolation and testing](#). If you 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 but should follow the [guidance of the CDC for masking and testing](#).

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 required medical isolation for which you require adjustment, please notify both of the instructors as soon as possible.

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 [protected-class](#) discrimination and harassment, sexual misconduct (harassment, exploitation, and assault), intimate partner violence (dating or domestic violence), stalking, 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 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 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 Observances

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, please provide both of the instructors with a list of these conflicts in the first week of classes.

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.