ASEN 3801 Aerospace Vehicle Dynamics and Controls Lab

Syllabus

Lab Sections:	Sec 001	AERO N100	Fridays	8:30 – 10:20 am
	Sec 002	AERO N100	Fridays	10:35 – 12:25 pm
	Sec 003	AERO N100	Fridays	12:40 – 2:30 pm

Instructors

Prof. Eric Frew
Office: AERO 269 Phone:

Office Hours: Tuesdays 3-4PM AERO 269

Teaching Assistants / Fellows

Seung Ryu
Luke Roberson

Text

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.

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.

Overview

This course emphasizes applications of engineering dynamics and control principles for modeling, simulating, designing, analyzing, and evaluating aerospace vehicle systems. 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.

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.

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. If students do not participate in the group (i.e. attending lab periods, group meetings, online discussions, etc.) and do not contribute sufficiently to the group work, the team will be re-arranged, and the non-participating students might have to complete the assignment on their own. 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 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 grade for the class and will be reported for an Honor Code Violation for additional punitive action.

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. 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

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.

Logistics

Course Website: There will be a class website on Canvas. All course 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 the laboratory periods will be sent as Canvas announcements.

Office hours are scheduled to provide dedicated time for student questions and feedback. Students are encouraged to come to office hours with questions regarding course material and lab assignments, etc. The instructor will hold one hour per week and the TAs will participate in the department Study Hall. Private meetings with instructors or TAs can also be arranged if needed.

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

Email questions: Students are able to email the instructor questions throughout the week regarding course material. DO NOT expect an immediate response. Any question received by 2PM should receive a response by 5PM the same day. Questions received after 2PM may not receive a response until 5PM the next day.

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 in discussions typically have a more rewarding experience. None of the laboratory introductions or lectures will be recorded or posted for asynchronous consumption. 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.

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. Lab reports and code should be submitted via Gradescope (accessible from the course website or directly in Gradescope) by the due date, no late assignments will be accepted with prior approval by the instructor.

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.

Some lab assignments will have pre-lab questions that must be completed and submitted individually. The pre-lab questions will be assigned on the first day of the new lab assignment and will be due before the next lab period. The pre-lab question scores will be included in the student's final lab assignment score.

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 all members of the group.

Late assignments will only be accepted with prior approval by the instructor or under extenuating circumstances.

Regrade requests must be made within two weeks of receiving the grade for an assignment. 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.

Grading

The **final course grade** is based on the **final course percentage score**, which is the sum of points received by the student for all 5 assignments divided by the total possible points for all 5 assignments.

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.

Grades for the course are set based on the following criteria:

A, A-	Demonstrates mastery 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, 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 illness, injury or required medical isolation for which you require adjustment, notify the instructor and your lab group for the section you will miss. 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 (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.

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.

Schedule

ASEN 3801 Fall 2024 Schedule

Week	Dates		Topic	
1	30-Aug	**Lab 1** Simulating	Course Introduction. Lab 1	Lab 1 Assigned
2	6-Sep	Dynamical Systems	Lab 1 Finish	
3	13-Sep	**Lab 2** Rotating	Lab 2 Data collection in ASPEN	**Lab 1 due**, Lab 2 assigned
4	20-Sep	Coordinate Frames	Lab 2 Finish	
5	27-Sep	**Lab 3** Spacecraft	Lab 3 Sensors and actuators	**Lab 2 due**, Lab 3 assigned
6	4-Oct	Pointing Control	Lab 3 Continued	
7	11-Oct		Lab 3 Continued, implement	
8	18-Oct		Lab 3 Finish	
9	25-Oct	**Lab 4** Quadrotor	Lab 4 Introduction	**Lab 3 due**, Lab 4 assigned
10	1-Nov	Control	Lab 4 Continued	
11	8-Nov		Lab 4 Continued, implement	
12	15-Nov		Lab 4 Finished	
13	22-Nov	**Lab 5** Fixed Wing	Lab 5 Introduction	**Lab 4 due**, Lab 5 assigned
14	29-Nov		Fall Break - NO CLASS	
15	6-Dec	Aircraft Dynamics	Lab 5 Continue	
16	13-Dec	and Control	NO CLASS	**Lab 5 due by end of day**

NO FINAL EXAM