

ASEN 3128 Aircraft Dynamics

Syllabus

Lecture: AERO 120 M, W 2:30 – 3:45 pm
Lab: AERO 141 F 8:30 – 10:20 am, 1:30 – 3:20 pm

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difficult, they do lie outside most common experience, and they depend on new nomenclature and strange notation that can seem overwhelming at first. It is only through diligent and careful use of this new language that the underlying simplicity can be grasped and conveyed on exams; mastery of the language of aircraft dynamics is perhaps the most important predictor for success in the course.

The course has been designed to develop a conceptual grasp of the key ideas below, and to demonstrate proficiency in using these concepts to solve problems, construct and validate simulations, and to explain behaviors and results obtained. In particular, engineering reasoning skills using these concepts are stressed in assignment solutions and examinations. The key learning objectives are:

Vector mechanics

- < Vector representation in coordinate frames
- < Change of coordinate frame representation (coordinate rotation)
- < Relative motion, frame derivatives
- < Change of derivative frame: velocity rule

How aircraft dynamics models are created and what the terms mean

- < 3D rigid body translational model
 - o Kinematics
 - o Dynamics, external forces
 - o Effects of wind
- < 3D rigid body rotational model
 - o Kinematics, Euler angle attitude representation
 - o Dynamics, Euler moment equations, external moments
- < External forces and moments
 - o Aerodynamic effects
 - o Control effects
 - o Steady flight conditions, trim states

How aircraft dynamics models are simulated

- < State space models
- < Matlab integration
- < Good naming and commenting habits

How dynamical behavior is understood and specified

- < Linearization
- < Decoupling
- < Stability derivatives
- < Modal solutions
- < Stability characterizations
- < Modal specifications

How feedback control is designed to meet behavioral objectives

- < Sensor selection, control structure
- < Effects on mode eigenvalues

Material and concepts are introduced, and student mastery is evaluated using several mechanisms throughout the course:

Reading – The textbook provides the essential basis for the course, including the concepts, terminology, notation, methods, and examples used to convey the course topics. Specific reading assignments will be given covering key sections of the book; some book sections are not covered in the course. Some supplementary material will also be provided.

Lectures – These are intended to emphasize key ideas and methods that make the material easier to grasp. They are therefore a counterpart to the reading, not a replacement. The value of lectures is dependent on your participation in them. Passive “watching” will provide little benefit. Active note taking is critical to developing first-hand familiarity with the notation, terminology, and methods, and to gaining comfort in using them. Although lectures will be recorded, this is a poor substitute for your own lecture notes. Questions are encouraged during lectures, and will be prompted often. Professor Lawrence will lecture primarily for the first half of the course, and Professor Ahmed will lecture primarily for the second half.

Assignments – These provide first-hand experience employing the reading and lecture material. They consist of analysis and computation exercises, simulation development, and simulation use to address aircraft stability and control design problems. Assignments will be carried out in small groups. Although assignments will be graded individually, group collaboration in their preparation is encouraged through a peer evaluation process that rates group work contributions and has a strong effect on an individual’s group work grade in the course. Please see the **Assignment_Format** and **Peer_Eval_Grading** documents for details. Students are expected to use these assignments and the associated group learning opportunities to strengthen their **individual** mastery of the subject. Dividing up the learning on assignments by dividing up the work is a recipe for failure on the individual exams in this course.

Proper presentation of engineering work is important throughout the ASEN curriculum, as in professional life thereafter, and students are expected to properly describe what was done and explain results using graphical and written descriptions based on the precise terminology and notation introduced in the course.

A secondary objective of the Assignments is the development of proficiency with numerical simulation, and to develop good programming habits. Simulation is becoming an indispensable tool in engineering, and proficiency is expected of professionals in this field.

Exams – These are the primary means of evaluation of your individual grasp of the course material. Three in-class written exams will be conducted at approximately five-week intervals. Exams will include both conceptual questions and quantitative problems. Precise use of terminology and notation is stressed. The final exam is comprehensive and will contain material from the entire course, but emphasis will be placed on the final third of the course material.

1. Office hours for Instructors and TAs will be held nominally during the arranged “lab” times for the course, in the Pilot Laboratory (AERO 141). This is intended to provide ease-of-access to instructor and TA help, primarily during group work on the weekly assignments, but any questions about course material are welcome. To help avoid congestion, students assigned to a lab section have priority for that section. However, instructors and TAs

4. Collaboration is required on Assignments with the assigned group. Group membership will be rotated several times during the semester. Collaboration outside the assigned groups is also encouraged, provided it is used to assist your individual learning, rather than substitute for it. Discussing the means and methods for solving problems, comparing answers, etc. can be valuable to you, but blindly copying is not. Grading in the course is designed to evaluate **individual** understanding, and this is only developed through personal experience with the material. Moreover, the peer evaluations of group work are designed to fairly evaluate group contributions, and group grades will **strongly** depend on member contributions.

5. Quizzes will be given weekly in an on

The course grade is primarily dependent on **individual** measures of competency, i.e. exams. The other course assignments are designed to enrich the learning experience and to enhance individual performance, not to substitute for sub-standard individual competency. Accordingly, group assignment grades are only incorporated into the final grade when the individual grade is a C or better. **In other words, if your individual average is below a C, the group-based grade fraction will not be averaged into your final grade, which will then be based solely on your exam/quiz score**

Assignment Schedule

Assignments will be posted on Friday and due before the Friday two weeks later. The first week of each Assignment is designed for preliminary “first-pass” individual attempts of the problems, and the second week is designed for group finalization of the Assignment solutions and for instructor/TA help during “lab” times.

Quiz Schedule

Quizzes will be conducted on-line through Canvas. They will be open each week from Friday until 11:59 PM on Sunday. Only one attempt of each question is allowed, and Quiz answers will not be accepted after the deadline. Solutions will be posted after the deadline.

All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to [the academic integrity policy](#) of the institution. Violations of the policy may include: plagiarism, cheating, fabrication, lying, bribery, threat, unauthorized access, clicker fraud, resubmission, and aiding academic dishonesty. All incidents of academic misconduct will be reported to the Honor Code Council (honor@colorado.edu; 303-735-2273). Students who are found responsible of violating the academic integrity policy will be subject to nonacademic sanctions from the Honor Code Council as well as academic sanctions from the faculty member. Additional information regarding the academic integrity policy can be found at <http://honorcode.colorado.edu>.

Accommodation for Disabilities

If you qualify for accommodations because of a disability, please submit to your professor a letter from Disability Services in a timely manner (for exam accommodations provide your letter at least one week prior to the exam) so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities. Contact Disability Services at 303-492-8671 or by e-mail at dsinfo@colorado.edu. If you have a temporary medical condition or injury, see [Temporary Injuries guidelines](#) under the Quick Links at the [Disability Services website](#) and discuss your needs with your professor.

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, you must let the instructors know of any such conflicts within the first two weeks of the semester so that we can work with you to make reasonable arrange

Class Behavior

Students and faculty each have responsibility for maintaining an appropriate learning environment, not only while in class but also while working outside of class. 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 differences of race, color, culture, religion, creed, politics, veteran's status, sexual orientation, gender, gender identity and gender expression, age, disability, and nationalities. Class rosters are provided to the instructor with the student's legal name. We will gladly honor your request to address you by an alternate name or gender pronoun. Please advise us of this preference early in the semester so that we may make appropriate changes to our records. For more information, see the [policies on classroom behavior](#) and [the student code](#).

Discrimination and Harassment

The University of Colorado Boulder (CU-Boulder) is committed to maintaining a positive learning, working, and living environment. CU-Boulder will not tolerate acts of sexual misconduct, discrimination, harassment or related retaliation against or by any employee or student. CU's Sexual Misconduct Policy prohibits sexual assault, sexual exploitation, sexual harassment, intimate partner abuse (dating or domestic violence), stalking or related retaliation. CU-Boulder's Discrimination and Harassment Policy prohibits discrimination, harassment or related retaliation based on race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. Individuals who believe they have been subject to misconduct under either policy should contact the Office of Institutional Equity and Compliance (OIEC) at 303-492-2127. Information about the OIEC, the above referenced policies, and the campus resources available to assist individuals regarding sexual misconduct, discrimination, harassment or related retaliation can be found at the [OIEC website](#).