ASEN 6014 Spacecraft Formation Flying
Fall 2025

Instructor: Dr. Hanspeter Schaub
Office: AERO 224N
Email: hanspeter.schaub@colorado.edu

Lectures: AERO N240, recordings ons CU Canvas

Office Hours: Tuesday and Thursday 1:00-2:00pm (or by appointment)
ASEN 224N or https://cuboulder.zoom.us/j/92283575785

TA Information: Andrea López (andrea.lopez@colorado.edu)
Office Hours Location: AERO 403 or https://cuboulder.zoom.us/j/99490231327
Office Hours Times: Monday 1-2pm, Thursday 3:30-4:30

Final Exam: TBD

Text: H. Schaub and J. L. Junkins, *Analytical Mechanics of Space Systems*, 4th Edition, AIAA Education Series, 2017. (if needed, please download the errata sheet from the web page http://hanspeterschaub.info/books.html)
Course notes supplied on the class canvas web site.

Canvas Course Web Page: https://canvas.colorado.edu

Lecture Recording Web Page: .
All lectures on Coursera.org

Overview: Studies the dynamic modeling and control of spacecraft formations orbiting about a planet. Investigate linear and nonlinear relative motion descriptions, rectilinear and curvilinear coordinates, orbit element difference based descriptions, J_2-invariant relative orbits, as well as Lyapunov-based relative motion control strategies. Pre: ASEN 5050 or equivalent, or permission of instructor (3H, 3C)

Goal: To introduce students to the spacecraft formation flying kinematics, dynamics, and control.

Homework Policy: Each homework assignment is due on the specified due date and must be turned in at the beginning of the lecture. Normally, late homework will not be accepted. All homework should be submitted electronically on the canvas web site as a single PDF document. Combine separate PDFs into one. You don't have to type

up your homework (you can if you wish), but rather it is ok to scan in hand-written pages as well. Some homework will require simple programs to be created. These can be done in Python, Matlab, Maple, Mathematica, C, or Fortran. See instructor if not sure about the software package being used. If a homework has been graded incorrectly, you need to see me within 2 weeks of having the homework returned to you.

Exams: There will be a mid-term exam and no final exam. If you have exam grading issues, you must see me within 2 weeks of having the exam returned to you. There will also be two course projects which will require you to write a technical report. These reports must be type written and composed as a professional technical report.

Class Attendance: You are expected to attend class. If you need to miss a lecture, it is your responsibility to catch up on the material. Don't go to the instructor to catch up on missed material. Rather, catch up on the class recordings on canvas, or speak with class mates and get the notes from them. Campus policy regarding religious observances requires that faculty make every effort to reasonably and fairly deal with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. If you cannot attend a regularly scheduled class, it is up to the student to catch up on the missed material. If you cannot take an exam on a particular day, please let the instructor know at the time the exam is being scheduled.

Make-Up Policy: There are no make-up homework assignments. If you miss the assignment, you get a zero for it. If you can't make an exam or a pressing reason, you need to contact the instructor *one week prior* to the exam date. If you can't take the exam for some emergency reason, you still need to notify the instructor prior to the exam. Without prior consent, there will be no make-up exams.

Grading Policy: A conventional ten-point system will be used for grading. If I feel it necessary, I will curve the exam scores to reflect the difficulty level of the problems assigned. Thus, your final assigned scores on each set of papers is your true grade and should be interpreted on a 100 point scale (i.e. A(90-100), B(80-89), C(70-79), D(60-69), F(below 60)). I will assign "+" and "-" grades at my discretion. The percent worth of exams and class assignments are:
Homework/Quizzes – 20%
Project 1 – 25%
Mid-Term – 30%
Project 2 – 25%

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). If you do need to stay home you should be able to follow the class remotely through the class recordings, and all homework is submitted online through canvas.

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 policy may include: 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 who are 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 at the Honor Code Office 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.

See the campus policy regarding religious observances for full details. As the full course schedule with homework and project due dates, as well as the mid-term exam date, are posted at the beginning of class, religious holiday considerations must be requested within the first 2 weeks of class.

Conditional Generative AI Use You are permitted (but not required) to conditionally use generative AI tools in this course for the following purposes only:

- partial code generation (i.e. $\leq$ 30% as measured by total lines of code submitted) for programming exercises on homework assignments and for the final project assignment
- to review or study course material and topics on your own
- To spell check and improve clarity of a report

If you use gen AI tools for partial code generation on homeworks or the final project, you must document your usage by stating this explicitly at the top of your assignment and cite the portions (lines of code) that were generated by the specific tool you used. Failure to properly document gen AI usage for coding assignments on homeworks and the final project will be treated as a potential CU Honor Code violation. You may not use gen AI tools to produce solutions for other non-programming questions on homework or project assignments. You may not use gen AI tools for any kind of question (whether programming or non-programming) on midterm exams or on quizzes. Work submitted for grading must conform to these guidelines, in order to receive full credit reflective of your own individual competency, learning, and understanding of the material.