

ASEN 4013 – Foundations of Propulsion

Course Syllabus, Spring 2026

LECTURE INSTRUCTOR

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OFFICE HOURS AND CONTACT INFORMATION

Instructor Office Hours: Mondays 11:00am to 12:00pm
Zoom Virtual Office Link: *(link provided in course)*
Instructor Office Location: AERO 369
Aerospace Study Hall: Tuesday / Thursday 5:30pm – 7:00pm
Aerospace Study Hall: AERO N250

Email Policy: It is my intent to make myself as accessible as possible to you during this semester within the bounds of my other responsibilities. In general, I will do my best to accommodate student needs and respond as promptly as possible to e-mails. In your email, please identify yourself by providing your name and the course number (**ASEN 4013**) at the start of your message. However, all technical questions on course content should be asked during lecture, office hours, or on the course Slack Workspace. One-on-one meetings with the instructor will only be scheduled to address individual administrative or academic issues.

COURSE SCHEDULE, LOCATION, AND LINKS

Lecture Time and Location: All lectures will be held in AERO N240 at the following times

- **ASEN 4013 Section 001:** 1:55 PM – 2:45 PM, Monday, Wednesday, and Friday

Course Links:

- **Website Link:** *(link provided in course)*
- **Slack Link:** *(link provided in course)*

COURSE OVERVIEW

The goal of this course is to build an understanding of the different types of aerospace propulsion systems (both airbreathing and rocket), their relative performance trade-offs, and how they fit within the context of a vehicle “system”. Specific emphasis will be placed on fundamental cycle analyses, component and propulsion system level understanding, and challenges with propulsion integration. Students will apply thermodynamics, aerodynamics/fluid mechanics, compressible and viscous gas flows, structural/thermal systems, physics and chemistry.

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Course Objective: Given regular class attendance, reading of assigned text material in preparation for quizzes, careful and comprehensive completion of all assignments, students should be able to: (1) understand the general concepts of thermodynamics and heat transfer in order to develop an intuitive grasp of the subject matter; (2) develop an ability to apply these basic concepts to engineering design problems. Expect new material to be presented in lecture/discussion periods. Quizzes, exams, and homework can cover any material in the course including information from the textbook, lecture, and handouts.

Course Reading: Reading assignments are to be completed before the lecture/discussion since this material will be on the quizzes. The lecture/discussions should help to clarify and supplement what you have read.

Course Quizzes: Quizzes will be conducted on Canvas. Students will take quizzes on their own time to be completed prior to the due date and time indicated. Aside from completion by the required due date, the quizzes are not timed. Quizzes cover reading assignments and lectures.

Course Assignments: There will be homework assignments issued in the course on an approximately weekly basis. Each homework assignment will include a set of problems, which you are expected to completely solve using the Engineering Solution Approach. These problem-solving steps are critical for developing problem formulation skills. Homework reinforces classroom instruction such that you may become proficient in the field of propulsion. In addition to the assigned homework, it is encouraged to work additional problems for practice. Before beginning any homework assignment, read the text and review the examples in the text.

Course Exams: There will be three term exams, consisting of two in-class exams and a final exam, weighted equally. Make ups for exams are extremely difficult to accommodate. There will be no unexcused exam makeups provided. If you miss an exam, the course instructor will evaluate each case on an individual basis to decide if a makeup exam will be provided. Students are encouraged to provide as much documentation as possible to enable an informed decision. The instructor may choose to use your existing grades to cover your missed grade(s).

Course Schedule: The specific weekly course schedule (lectures, exams, assignments) will be posted to Canvas.

COURSE TEXTBOOK AND PREREQUISITES

The required textbook will be followed but some additional material may be introduced to broaden a particular subject. This material will be distributed to the class. In addition, there are some other references listed below:

Required Course Textbook:

- Mattingly and Boyer (2016). *Elements of Propulsion: Gas Turbines and Rockets*, 2nd Ed., ISBN-13: 978-1-62410-371-1 (including supplementary material available by download)

Other Helpful Course References:

- Textbooks:
 - Oates, *Aerothermodynamics of Gas Turbine and Rocket Propulsion*, AIAA
 - Hill P., and C. Peterson. *Mechanics and Thermodynamics of Propulsion*, 2nd Ed., Addison-Wesley
 - Sutton, G. P. and O. Biblarz. *Rocket Propulsion Elements*, 8th Ed., Wiley
- Journal articles, Conference papers, and Technical Reports
- Instructor Provided Notes

Course Pre-Requisites: ASEN 3713 and APPM 2360

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COURSE TOPICAL OUTLINE

A detailed schedule will be made available on Canvas and updated as needed. **The topics covered will be:**

- 1. Introduction & Overview (Chapter 1)**
- 2. Fundamentals (Chapters 2 & 3)**
 - a. Engineering solution method
 - b. Thermodynamics
 - c. Control volume analysis
 - d. Perfect gas
 - e. Chemical reactions
 - f. Inviscid & compressible flows
 - g. Normal shock
- 3. Compressible flows (Chapters 3)**
- 4. Analysis and performance of airbreathing propulsion systems (Chapters 4-8, 11)**
 - a. Aircraft gas turbine engine
 - b. Parametric cycle analysis of idealized engines
 - c. Component performance - inlets, nozzles and combustors
 - d. Parametric cycle analysis of real engines
 - e. Engine performance analysis
- 5. Rocket Propulsion (Chapter 10, instructor provided material)**
 - a. Cold gas and monopropellant thrusters
 - b. Liquid bi-propellant engines
 - c. Solid rockets and rocket motor modeling & simulation
 - d. Hybrid motors
 - e. Electric propulsion

COURSE GRADING AND POLICIES

Assignments are graded to an absolute standard designed to indicate your level of competency in the course material. Minor adjustments may be made in the assignment of final grades, yet grading on a “curve” will be limited. 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 education, experience, interactions with industry, government laboratories, others in academia, and the criteria established by the ABET accreditation board.

The final grade indicates your individual competency with the course material. Meeting the minimum requirements indicates that you are prepared to continue, at least at the minimum level required for the next sequence of courses. Exceeding the minimum means you are ready to enter the next course and that you have mastery of material beyond the minimum, i.e., you show some level of proficiency. This course consists of several graded components, with your final grade determined by the following breakdown:

Grading Breakdown:

Quizzes	10%
Three Exams: Two Midterms and One Final (20% each)	60%
Homework	30%
Total	100%

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Grading Notes:

- This class is not graded on a curve; there are absolute expectations of performance. However, we reserve the right to normalize and adjust the class grades based on the highest performance in the class. This process will not lower a person's grade.
- Any grade question/dispute must be resolved within two weeks after the grade is posted. This will avoid undue complications at the end of the semester when final grades are being determined. For the final exam and final grade, any issues will be resolved at the beginning of the next semester (not during the break). There are certain due processes to be followed.

General Course Policies:

- A cordial atmosphere is expected at all times within the classroom. Respect and be courteous to other students. **Please note, Lectures and Office Hours may be recorded.**
- We expect students to be professional by attending class and submitting assignments on time.
- Lectures are an important part of your education. Some of the lecture material is not in the textbook.
- In the case of homework, quiz, or exam conflicts, you must make arrangements with the professor at least two weeks in advance. **There are no unexcused make-up assignments, quizzes, or exams.**
- Always have a laptop, tablet or calculator and your textbook for lectures and office hours.

Assignment Policies:

- All assignments will be submitted through GradeScope or Canvas in an appropriate format (PDF)
- Homework must be submitted before the due date and time. **Please box final answers for each question.**
- Use of MATLAB is permitted, but not always desirable. MATLAB code will not suffice for homework solutions without prior permission, please write out your work in “human” readable format (we will not try to decipher your code). MATLAB figures should be legible, and have meaningful axes and legends.
- All individual submissions must follow the naming convention: LastName_FirstName_AssignmentName, for example: Smith_John_HW1.pdf
- Always submit work in a professional form. Neatness, clarity, and completeness count! If submitted work is not legible, you may not receive full credit. Please review before and after submitting. It is your responsibility to make sure the submission is complete.
- **Late submissions will not be accepted.** If you know in advance that you must miss a homework due date for a legitimate reason, send the relevant Instructors/TA/TFs an e-mail to make arrangements.

Collaboration Policy: Collaboration is permitted on homework. This means you may discuss the means and methods for solving problems even compare answers, but you are not free to copy someone's assignment. The work that you turn in must be your own—copying is not allowed for any assignments. Collaboration on quizzes and exams or using another student's work or allowing another student to use your work is academic misconduct.

Slack Policy: To help better facilitate communication a Slack Workspace has been set-up for this course. An invitation link will be posted as a Canvas announcement. You must sign in with your CU email address (@colorado.edu) to be successfully added to the workspace. Please note that you are not required to use Slack and all course wide notifications will still be sent out via the course webpage. This tool is primarily to improve communication and collaboration within the course. Please note that while the Teaching Team aims to regularly monitor the Slack Workspace, you should not expect communication outside of business hours.

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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 medical condition, see [Temporary Medical Conditions](#) on the Disability Services website. If you have a temporary medical condition or required medical isolation for which you require accommodation, please email the instructor.

PREFERRED STUDENT NAMES AND PRONOUNS

CU Boulder recognizes that students' legal information does not always align with how they identify. If you wish to have your preferred name (rather than your legal name) and/or your preferred pronouns appear on your instructors' class rosters and in Canvas, visit the [Registrar's website](#) for instructions on how to change your personal information in university systems.

CU COMMUNITY OF CARE

CU Boulder is committed to a community of care in which students are supported by faculty and staff throughout their college journey. You don't have to face academic challenges alone – CU and the college are here to help you learn and succeed in your coursework and campus life. Part of this community of care is your connection to faculty and staff across campus. Our college promotes and hopes you will connect with faculty or staff who may reach out during your educational journey at CU.

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.

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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](#).

ACCOMMODATION FOR RELIGIOUS OBLIGATIONS

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 (a minimum of two week's advance notice). In this class, please email the instructor if a conflict arises due to religious observance. 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.

ACCEPTABLE USE OF AI IN THIS CLASS

Generative artificial intelligence tools—software that reproduces text, images, computer code, audio, video, and other content—have become widely available. Well-known examples include ChatGPT for text and DALL•E for images. This statement governs all such tools, including those released during our semester together. Keep in mind that the goal of gen AI tools is to reproduce content that seems to have been produced by a human, not to produce accurate or reliable content; therefore, relying on a gen AI tool may result in your submission of inaccurate content. It is your responsibility—not the tool's—to assure the quality, integrity, and accuracy of work you submit in any college course. If gen AI tool use is suspected in completing assignments for this course in ways not explicitly authorized, I will follow up with you. I may contact the Office of Student Conduct & Conflict Resolution to report suspected Honor Code violations. In addition, you must be wary of unintentional plagiarism or data fabrication. Please act with integrity, for the sake of both your personal character and your academic record. In this class, the use of gen AI tools is discouraged on assignments (limited to checking grammar and format but not generating any content—see policy on assignments and all work being the students' own). In line with the course policy prohibiting collaboration of any kind on exams, the use of gen AI in any way is strictly prohibited on exams in this course.