ASEN 2402: Thermodynamics

University of Colorado **Boulder**

Fall Semester 2025, Last edited on: August 20, 2025

Syllabus

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Description: Introduces the fundamental concepts and principles of thermodynamics with an emphasis on understanding how these basic physical principles can be used to solve numerical problems. Covers the properties of pure substances, control volume analysis, first law of thermodynamics, ideal gas law, second law of thermodynamics, and thermodynamic cycles. Synthesizes as a primary goal basic science (physics) and mathematics for the analysis and design of thermodynamic systems.

Learning Goals: A student who successfully completes this course will:

1. **Demonstrate** understanding of thermodynamic properties and the concepts of energy, work, and power.
2. **Understand** and explain basic concepts related to energy and entropy as described by the first and second laws of thermodynamics, respectively.
3. Practice and **apply** understanding of the first law of thermodynamics to analyze steady systems
4. **Apply** engineering problem solving methods to analyze and design thermodynamic systems while understanding and describing applicable assumptions.

Prerequisites: Requires APPM 1360 or MATH 2300 and PHYS 1110 (all minimum grade C-). All seats are reserved for Aero UGs and IUT On-track students meeting pre-reqs until 8/20/25.

Recommended Co-requisites: MCEN 1024 or CHEN 1201 or CHEN 1211 or CHEM 1113 or CHEM 1400.

Required Text: Yunus Çengel, Michael Boles and Mehmet Kanoglu. "Thermodynamics: An Engineering Approach", 2023, 10th edition, McGraw Hill Education, ISBN-13: 978-1266152115 (or earlier edition)

Supplemental Reference: LearnChemE - `https://learncheme.com/` - screencasts, simulations, virtual labs, and student resources for Thermodynamics.

Class Format: The class meets in-person three times a week for fifty minutes of active classroom instruction. Note that the activities vary day by day with some class periods focused on formal lecture, while others may be focused on carrying out practice problems, group activities, or completing other deliverables. Note the specific calendar weeks are identified below in the "Schedule of Activities".

Class Deliverables: All assignments are expected to be carried out as an individual. Collaboration is permitted and expected on all homework assignments, but work that is turned in should reflect your work entirely.

To complete these assignments, students must have access to a computer, a digital or printed textbook, and a scientific or graphing calculator.

All assignments should be submitted to the appropriate Gradescope assignment by the due date, **no late assignments will be accepted**. You may submit as many times as you wish; the *last* on-time submission will be graded. It is your responsibility for confirming the intended files were uploaded properly and are legible.

Homework: There will be 11 homeworks, due on Thursdays by 11:59pm (No homework weeks 1, 2, 6, 12, and 15). The lowest score will be dropped at the end of the semester. Each homework will consist of 3-7 problems, it is expected that you will attempt each problem assigned, however only 1-2 problems (chosen randomly) will be graded in-depth, it is your responsibility to look at the posted solutions. Additional supplemental problems will be suggested within each assignment, these are not meant to be turned in.

Quizzes: There will be 11 quizzes, due on Sundays by 11:59pm (No quizzes weeks 1, 6, 12, 15, and 16). The lowest score will be dropped at the end of the semester. Each quiz will consist of concept questions and you will have unlimited attempts at each problem set, however, you will not receive feedback on the answers after each attempt.

Exams: There will be 3 exams during weeks 6 and 12, and during Finals Week. No exam scores will be dropped at the end of the semester. Exams will consist of conceptual and numerical problems that are multiple choice and/or worked out problems. All your work must be shown for credit. Exams are not cumulative, however, the material of Thermodynamics *does* build on itself.

Homework Formatting Requirements: It is your responsibility to make your solutions clear and legible. The graders have the discretion to deduct points (up to and including full credit) for solutions that are hard to read or unprofessional in appearance. Unless the problem requires only a conceptual or short answer, the following format is required. This will facilitate grading and will assist you to approach problems in a consistent, organized way that will lead to the correct solution.

- Begin each problem on a new page
- Number each page and total pages (e.g., 2/4 for page 2 of 4) in upper right corner
- Write a clear and succinct problem statement, include variables that are given and quantities to be found, in your own words

- Draw a sketch, show the system to be analyzed with dotted lines as the system boundary; list relevant information on the figure
- Detail any assumptions
- Write the physical laws/governing equations (could be 1st law, ideal gas law, etc.)
- List known values with units
- When using property tables, indicate the table number
- List unknowns, be sure these correspond with the sketch
- When solving, solve algebraically first, then plug in values with clearly labeled units and box your final answer, including units.
- Perform a reality check: do the units make sense? do the magnitudes make sense? If not, please be sure to discuss.

Honor Code Policy: You are responsible for all work submitted in this course. This means that you should be able to quickly and effectively communicate the meaning of every line of code or text in your submission. It is permissible to discuss problem-solving strategies with classmates, however, it would be highly inappropriate for your submissions to be alike. Copying material from any resource (including from another student or online) and submitting it as one's own is considered plagiarism and is an Honor Code violation. Students who are found in violation once will receive a zero grade for the assignment, and will be reported for an "Honor Code Violation" for additional non-academic actions. Students who are found in violation after the previous issue will receive an "F" for the class and will be reported for an "Honor Code Violation" for additional non-academic actions. Depending on the severity of the violation, different and/or additional repercussions may occur (including, but not limited to, loss of a letter grade, automatic failure for first offense, etc.) Additional information can be found in the CU Honor Code.

Attendance Policy: Attendance is expected at all scheduled class periods, and students should expect new material to be presented. None of the lectures will be recorded or posted for asynchronous consumption. Thus students who miss important information during class periods should review the schedule of activities, Canvas, coordinate with their peers and catch-up independently on the material they may have missed.

Course Website and Course Communications: There will be a class website on Canvas. All relevant documents, 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 class periods will be sent as Canvas announcements, so it is the student's responsibility to make sure their Canvas settings are appropriately configured to receive these announcements.

Students should e-mail the course instructors and teaching assistants/facilitators only if they have a pressing logistical or health issue. Always include ASEN2402 in the subject line, in addition to a complete subject line. The teaching team will aim to respond to e-mails within

one business day. All questions related to assignments and course content should be asked in office hours, at the consolidated Aerospace Study Hall periods or via Piazza (through Canvas).

Grading: The following presents the planned grading structure for the course. Be aware, that this is subject to change, however the class will be thoroughly notified and polled for agreement.

20% Exam 1
20% Exam 2
20% Exam 3
20% Weekly Quizzes
15% Homework
5% Professionalism

Grades are posted to the class website (Canvas).

Remarks on Grading: Our grading scheme is not designed to reward or punish. It is designed to indicate your level of competency compared to the standard that we set. Do you meet the minimum level of competency? Do you exceed the minimum? Are you below the minimum? The answers to these questions should be indicated by your final grade.

The final grade indicates your readiness to continue to the next level of courses. Meeting the minimum requirements indicates that you are prepared to continue at least at the minimum level required for the next in the 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, that is, you show some level of proficiency.

Professionalism: Students are required to act professionally towards their TA/TFs, AES staff and faculty, and fellow students. Students are required to utilize building spaces and resources correctly and respectfully. Failure treat fellow human beings professionally, or incorrectly utilize building spaces or resources will result in a reduction to the Professionalism grade. Both students and faculty are responsible for maintaining an appropriate learning environment in all instructional settings, whether in person, remote or online. Additionally, students are required to act ethically and abide by the CU Student Code of Conduct and the CU Honor Code. Those who fail to adhere to such standards may be subject to a loss in points relative to the nature of the infraction.

Regrading: All regrade requests must be made within two weeks of receiving the grade for an assignment in Gradescope. Any regrade requests made without substantiated reasoning will be denied. Regrade requests received verbally or without the instructor copied will **not** be considered.

Letter Grading Scheme: Course grade determinations are absolute and requests for makeup work, submissions of late assignments, or other general exceptions will not be considered. Letter grades will be assigned as follows:

Letter Grade	**Percent Grade**	**4.00 Scale**
A	93.00 - 100.00	4.00
A-	90.00 - 92.99	3.67
B+	87.00 - 89.99	3.33
B	83.00 - 86.99	3.00
B-	80.00 - 82.99	2.67
C+	77.00 - 79.99	2.33
C	73.00 - 76.99	2.00
C-	70.00 - 72.99	1.67
D	60.00 - 69.99	1.00
F	Below 60.00	0.00

Schedule of Activities: The following presents a nominal schedule for the semester:

Week	Date	Mon	Wed	Fri
1	Aug. 18	-	-	Introduction 1.1 to 1.2, 1.11
2	Aug. 25	1.3 to 1.6	1.7 to 1.9	3.1 to 3.3
3	Sep. 1	-	3.4 to 3.5	3.6 to 3.8
4	Sep. 8	2.1 to 2.5	2.6	4.1 to 4.2
5	Sep. 15	4.3 to 4.4	4.5	5.1
6	Sep. 22	Exam 1: Chapters 1-4	5.2	5.3 to 5.5
7	Sep. 29	5.5	6.1 to 6.2	6.3
8	Oct. 6	6.4 to 6.5	6.6 to 6.7	6.8 to 6.10
9	Oct. 13	7.1 to 7.2	7.2	7.3
10	Oct. 20	7.4 to 7.5	7.6 to 7.7	7.8
11	Oct. 27	7.9	8.3	11.1 to 11.2
12	Nov. 3	Exam 2: Chapters 5-7,8.3	11.2 to 11.4	10.3
13	Nov. 10	10.8	10.9	10.10
14	Nov. 17	10.11	11.9	10.4 to 10.5
15	Nov. 24	-	-	-
16	Dec. 1	10.6	10.7 (not on final)	Review for Final Ch. 1-8, 10-11

Sections refer to the 10th edition of the textbook.

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.

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. **Students should expect to receive accommodations for a timed assessment (e.g., exam) only if their faculty instructor(s) receive the student's accommodations letter at least 5 business days before the assessment, as a departmental policy, in order to facilitate administering the assessment.** 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 notify the instructor as soon as possible so that appropriate accommodations can be made.

If you are sick or require isolation please notify the instructor of your absence from in-person activities and continue in a completely remote mode, as you are able, until you are allowed or able to return to campus.

Please note that for health privacy reasons you are not required to disclose to the instructor the nature of your illness or condition, however you are welcome to share information you feel necessary to protect the health and safety of others within the course.

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. In this class, you must let the instructor know of any such conflicts within the first two weeks of the semester so that they can work with you to make reasonable arrangements. See the campus policy regarding religious observances for full details.

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.

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.

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 including confidential services can be found on the OIEC website.

Please know that faculty and graduate instructors are required to inform OIEC when they are made aware of incidents related to these concerns regardless of when or where something occurred. This is to ensure that individuals impacted receive outreach from OIEC about their options and support resources. To learn more about reporting and support for a variety of concerns, visit the Don't Ignore It page.

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.