

SYLLABUS: CHEMICAL ENGINEERING THERMODYNAMICS

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.

Examples of violations of the honor code include—but are not limited to—the following actions:

- Using someone else's clicker in class or giving your clicker to someone else
- Using a solutions manual or equivalent (e.g., solutions posted on the internet or from previous course offerings) in the preparation or submission of homework
- Copying the solution of another team
- Presenting someone else's work as your own
- Submitting a team assignment in which you did not do all the problems
- Obtaining answers to on-line quizzes from someone or giving someone answers to on-line quizzes (i.e., any time you present someone else's work as your own)

In-class ethics: Your behavior in class should neither disrupt the class nor affect the ability of other students to learn. You will be required to sign a contract that commits you to the following rules:

- Not having a computer open in class, except a tablet that you write on with a stylus. You cannot type on a keyboard (including an on-screen keyboard) in class.
- Turning off your cell phone ringer
- Not talking while the instructor or other students are talking

Importance of Course: An understanding of thermodynamics is needed to become a chemical, biological, or environmental engineer; thermodynamics is one of the most important courses in the curriculum. Thermodynamics is used to determine the feasibility of a process. The concepts are used in subsequent courses (i.e., thermodynamics II, kinetics, biokinetics, separations and mass transfer, design, and materials), and they are applicable to many areas of engineering. The increased emphasis on energy utilization and transformation due to increased demand, diminishing supply, and global warming requires the engineers who will solve these problems to have a clear understanding of thermodynamics.

This course will review the first and second laws; it will emphasize non-ideal properties of single-component; and it will devote a significant amount of time to applying thermodynamic principles to nonideal systems, phase equilibrium, power generation, and refrigeration.

"A theory is more impressive the greater the simplicity of its premises is, the more different kinds of things it relates, and the more extended its area of applicability. Therefore, the deep impression classical thermodynamics made upon me. It is the only physical theory of universal content which, within the framework of the applicability of its basic concepts, I am convinced will never be overthrown." Albert Einstein

Objectives: *With your help, make this the class where you learn the most.*

- Increase your understanding of and ability to apply thermodynamics.
- Develop a conceptual understanding of the equations and processes.
- Prepare you for subsequent courses and the F.E. exam.

- Prepare you to tackle the unusual problems that arise so often in engineering.
- Improve your problem-solving ability.
- Improve your ability to work in teams.

Topics covered:

- Intermolecular forces
- Ideal gases
- First law: Energy, work, heat
- Energy balanced and throttles
- Enthalpy, state functions
- Engines and Carnot cycle
- Entropy, second law
- Cycles, compressors, turbines
- Refrigeration cycle
- Free Energy
- Differential forms of thermodynamic variables and Maxwell relations
- Single component phase diagrams
- Cubic equation of state/corresponding states
- Departure functions/nonideality
- Phase equilibrium/fugacity/Vapor-liquid equilibrium
- Gibbs phase rule

Expectations:

- Attend all classes and be on time.
- Silence your cell phone and put your computers away during class.
- Participate in class. **You will receive extra credit for participation** (see below).
- Interact with on Perusall while you are viewing the screencasts, and working through the interactive simulations *before* class.
- Answer the quizzes and worksheets on Perusall *before* class.

To summarize, your major responsibilities are (i) reading the book, (ii) watching the screencasts, (iii) doing the simulations, and (iv) completing the homework. We will use class time to discuss the most important concepts, as well as applications and examples.

Resources to help you succeed in this course: Extra resources are on www.LearnChemE.com, including

- Approximately 400 thermodynamics screencasts (organized by topic and by textbook chapters)
- Approximately 100 interactive thermodynamics simulations with accompanying screencasts. They are organized by topic (<http://www.learncheme.com/simulations/thermodynamics>) and by textbook chapter (<http://www.learncheme.com/simulations/thermodynamics/elliott-and-lira>).
- More than 30 self-study interactive modules
- Extensive resources on how to study (<http://www.learncheme.com/student-resources/how-to-study-resources>)

Resources on Canvas and Perusall

Before class, we will post slides that will have the clicker questions but not the answer for you to download. After class, we will post notes that contain both (i) everything written down in class and (ii) explanations of clicker questions. We will also post course handouts, files, announcements, assignments on Canvas. Screencasts, screen cast quizzes, and interactive simulations worksheets will be on Perusall. Canvas also contains chapter objectives/exam study guides and two practice exams.

Office hours: We will hold group office hours on days and times to be announced on Canvas and . Individual office hours with Dr. Bay are on Tuesdays at 4:30-5:30 pm. Office hours are most effective if you come prepared with specific questions. You may also email questions at chen3320@colorado.edu. **Please email both logistics questions (e.g., illness and absence) and conceptual questions to this account.**

Format: This class will consist of ConcepTests (using an iClicker), homework quizzes, and in-class worksheets.

Prerequisites: Grades of "C-" or better must be obtained in APPM 2350 or MATH 2400 and CHEN 1211 or CHEN 1203 or CHEM 1133. Requires a prereq or coreq course of APPM 2360 or MATH 2130 and MATH 3430 (min. grade C-).

Text: *Introductory Chemical Engineering Thermodynamics*, 2nd edition by J.R. Elliott and C.T. Lira. Only some sections will be covered in some chapters (see chapter objectives, course schedule).

Grading:

Homework Quizzes	10%
Perusall Participation	10%
iClicker Questions	10%
2 Midterm exams	35%
Final Exam	35%
Participation	2% extra credit

Notes: The evening exam with the higher grade will count 20%, and the other will count 15%.

The fixed grading scale for the final course grade is as follows:

88 < A
78 < B < 88
62 < C < 78
52 < D < 62
F < 52

You are guaranteed the indicated letter grade (with a minus) if you have the minimum numerical grade (e.g., if your course average is 78, you are guaranteed at least a grade of B- in the course). Grades may be adjusted, but only in your favor.

Exams: *The equations list for each exam (posted on Canvas under Exam Review modules) should be printed out and brought to the exams.* For exam 2, you should bring the equations for both exam 1 and 2, and same for exam 3. For the final exam, you should bring the equations for exams 1, 2, and final exam. You must have your name on each page of the equations, and you may make a few notes on the front of the pages. Additional pages on Canvas (steam tables, physical properties, etc.) should also be brought to the exams. Please use a pencil that writes dark. Note that exams are on Tuesdays during class.

Your midterm exams are scheduled for during class on Tuesday, February 17 and Tuesday, March 31. The final, which is set by the college, is tentatively scheduled for 10:30-1 pm on Thursday, April 30. Please add these exams to your calendar. NO MAKE-UP EXAMS WILL BE GIVEN.

In class: Conceptual problems will be given nearly every class. To allow for a few missed classes, the five days with the lowest percentage grades will be dropped when computing the Clicker grade. The class average for the clickers has historically been in the 90's.

Homework Quizzes: There will be eight in-class homework quizzes (dates on Canvas). The quizzes will assess your knowledge of material covered in the ungraded homework, and they will help prepare you for the midterms and final exams. The quizzes are open homework, meaning you can use your completed homework for that week as a reference in the quiz. Additional pages on Canvas (steam tables, physical properties, etc.) should also be brought to the quizzes. Please use a pencil that writes dark. The lowest quiz grade will be dropped when computing the quiz grade.

Class participation: A total of 2 bonus points (the 2% participation points in the grading scale) will be added to the final numerical average for each student who satisfies the following criteria:

1. The student must offer an individual question, comment, or response during classroom discussion that is **related to the technical material covered in the course** (i.e., administrative questions such as "When is the next exam?" don't count six times during the semester).
2. Each student must keep track of the specific dates on which they completed the above requirements. They must then *submit a signed form* (available on Canvas) before the end of the last class period.

Perusall Participation: A total of 10% of your course grade will be determined by your participation on Perusall on the assigned reading, screencast viewing, and simulation worksheets. **Must be completed before 9:00 am** the day of each class. The goal of this is to encourage you to actively engage the material, and to create an individual dialog between you,

your classmates, the TAs, and the instructor. We will use the responses before class to help identify the most important topics to cover during the class period.

Artificial intelligence (AI) language models: 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.

You may use gen AI tools on specific assignments in this course, but their use is limited to the following particular tasks: as a starting tool for your assignments, but you need to understand the approach to be successful on the midterms and final exam. If you use gen AI tools on assignments in this class, document your usage with the Chicago Manual of Style or appropriate citation guidelines for this course. Note it on your quiz assignment.

ABET Student Outcome addressed by the course: an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

Final exam policy: If you have too many final exams on one day, the university allows for accommodations if you notify the instructor of the last exam of the day before 6 weeks of the semester are over. Our final exam is scheduled for 10:30 AM on Thursday, April 30.

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.

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 required medical isolation for which you require adjustment, email Dr. Bay to make the appropriate arrangements for missed lectures or exams.

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](#).

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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 [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. In this class, please contact the instructors at the beginning of the semester if you have a conflict with one of the exams so we can make appropriate arrangements.

See the [campus policy regarding religious observances](#) for full details.