

CHBE 2140 Syllabus

Chemical Engineering Thermodynamics, Section A, 4 credit hours

Fall 2026

Instructor Information

Instructor: Micah S. Ziegler

General Course Information

Description

First and second laws of thermodynamics, equations of state, PVT properties, power cycles and refrigeration. Phase equilibrium. Fugacity and activity coefficients. Multi-reaction equilibrium.

Course Learning Outcomes

By the end of this course, a student should be able to:

- 1) Define complex thermodynamic systems including transient materials and energy balances for open and closed systems.
- 2) Be able to correctly use the First Law of Thermodynamics to find heat, work, and changes in internal energy and enthalpy for the analysis of any system, open or closed, undergoing irreversible processes.
- 3) Apply the Second Law of Thermodynamics and the concept of entropy production to the analysis of reversible and real systems.
- 4) Use equations of state for gases and liquids to determine changes in PVT properties. Understand molecular concepts.
- 5) Understand the relationships among the internal energy, enthalpy, heat capacities, entropy, Gibbs and Helmholtz free energies.
- 6) Perform thermodynamic analyses of power and refrigeration cycles, and be able to calculate ideal efficiencies for these cycles.
- 7) Understand partial molar properties of components in a particular phase and apply to calculations of the heat of mixing, volume, and entropy changes on processing of ideal and real mixtures.
- 8) Understand the origin of chemical potential and fugacity

- 9) Determine the fugacity of a pure component non-ideal gas and of pure liquids and solids under high pressure.
- 10) Understand the molecular basis for ideal mixtures and calculate equilibrium phase compositions by relating chemical potential of fugacity to composition.
- 11) Calculate phase compositions for real mixtures at equilibrium based on EOS for gas phases, and activity coefficient models for non-ideal liquid or solid behavior, including colligative properties.
- 12) Understand when phase equilibrium calculations require use of an EOS applicable to all phases.
- 13) Determine the equilibrium composition of single and multi-phase reaction mixtures, and how they are affected by temperature, pressure, composition, and other variables.
- 14) Perform calculations of fluid properties and phase equilibrium of pure components and mixtures using computer software.

Required Course Materials

Introduction to Chemical Engineering Thermodynamics; Smith, Van Ness, Abbott, and Swihart, McGraw-Hill

Grading Policy:

General Principles

I strive to ensure that you are collaborating with your classmates to learn, and not competing against them for grades. As such, there is no set distribution of letter grades. In other words, there is no predetermined number of As, Bs, Cs, etc. that will be awarded.

Graded Components

Graded components will be designed to enable you to demonstrate your knowledge of the material, and letter grades will be determined based on your demonstration of this knowledge. These graded components include problem sets (nearly weekly), three midterm exams, and one final exam. The table below provides their relative weights in final grades.

Assignment	Weight
Problem sets (eleven)	15% (drop two lowest scores)
Midterm exams (three)	20%
Final exam (one)	25%

Despite our best intentions, we, your instructors, sometimes make mistakes. For example, sometimes a question we design is not interpreted as we intended. We may adjust our grading to compensate (e.g., reduce the weight of a question). When we do, we try to ensure fairness.

We also understand that everyone can have a bad day, and sometimes those bad days overlap with exams. To minimize the impact of any one exam, the weight of your lowest exam will be reduced by 5% and the weight of your best exam will be increased by 5%.

Grading Scale

Final letter grades will be assigned based on the distribution of numerical grades at the end of the semester. *At a minimum*, your final grade will be assigned as a letter grade, A to F, according to the following scale:

A	90–100%
B	80–89%
C	70–79%
D	60–69%
F	0–59%

However, these cutoffs may be adjusted downward based on the final distribution of grades, i.e., if midterms and exams are more difficult than we intend, then we will very likely shift these cutoffs down. For example, if two of the midterms are difficult, then hypothetically 87% might be the new cutoff for an A, with 77% for a B, etc. These shifts will only ever be downward, not upward, i.e., the cutoff for an A will never rise above 90%, even if we write exams that are too easy.

To provide clarity earlier and reduce stress, *tentative* cutoff shifts will be estimated and discussed in class after the third midterm, and if possible, after the second midterm as well. Final cutoff shifts will be determined when all of the grades are in, just in case we make the final too difficult, but we do not expect them to change dramatically from the tentative shifts we will provide earlier.

Problem Sets

Problem sets will be assigned nearly weekly. Problem sets are due at 11:59:59 PM on the dates indicated in the course schedule below.

Your answers should be submitted electronically via GradeScope. You can choose to complete problem sets with either digital tools (e.g., a tablet) or pencil and paper. If you choose the former, you can submit directly to GradeScope. If the latter, you can upload materials to GradeScope with a camera (please focus!) or scanner. More details on how to submit your answers can be found [here](#). Of course, if you encounter technical difficulties, please ask your instructors for help, and do not wait until the last minute before problem sets are due.

Individual problems, or components of problems, will be generally graded on a pass/fail basis. For most problem set problems, we will try to evaluate your understanding more than your ability to enter numbers into a calculator. To receive a pass, you need to have attempted all parts of the problem, and these attempts need to demonstrate logical steps toward solving the problem. Throughout, your work should be organized and legible. If we cannot interpret it, we cannot grade it.

Late problem sets will lose 15% of the total possible score for each day they are late, up until when answer keys are posted. We will typically provide answer keys between two and four days after problem sets are due. Problem sets submitted after answer keys are posted will receive a grade of zero. Your two lowest problem set grades can be dropped if you would like.

You may collaborate with your colleagues on problem sets. However, we strongly recommend that you complete as much as you can independently before you meet with your classmates. With your colleagues, you may discuss concepts and approaches to solve the problems. However, the final solutions you provide must be your independent work (e.g., do not simply copy someone else's answers). These strategies will help you because during exams everything you submit will be your independent work.

Exams

I have scheduled three midterm exams and one final exam. The three midterms are scheduled during MW (*i.e.*, longer) class times to provide you more time, as detailed in the schedule below.

If you have a medical emergency or severe illness that will cause you to miss an exam, please contact the Office of the Dean so that I can reschedule your exam. Similarly, I can

reschedule if you have an Institute-approved absence or a specific religious observance. For more details, see Georgia Tech's [Rules and Regulations](#). **If you have an approved conflict with an exam, you must email me (Dr. Ziegler) by the end of the second week of class to give us time to reschedule.**

Thermodynamics has many formulae, and we live in a world where many of these can be easily looked up. I care more that you understand the formulae and how they are applied than you remember every single one perfectly. As such, you will be allowed to use “formulae sheets.” Each sheet will be a single 8.5 inch by 11 inch piece of paper. You can write any information you would like on both sides, for a total of 1.3 square feet (or 0.12 square meters). For the first midterm exam, you will be allowed *one* formulae sheet. For the second midterm, you can prepare *one* new sheet and use the sheet you prepared for the first midterm, for a total of *two* sheets. For the third midterm, you can use both previous sheets as well as another new sheet, for a total of *three* sheets. For the final, you can use your three midterm sheets and one additional sheet, for a total of 5.2 square feet (or 0.48 meters squared). Feel free to organize and/or color these sheets so that they help you. Please do not write so small that you need a magnifying glass.

Regrading

We are human. Sometimes we make mistakes, both answering problems and grading those answers. You can request we regrade portions of problem sets or exams.

Please submit regrade requests in writing within seven calendar days of the date the assignment is returned in class. Your request should include a valid reason for regrading. For example, did we miss something you wrote? Did we not understand the approach you took?

Course Policies

Attendance and/or Participation

Your academic success will depend strongly on the level of engagement with the course material. Actively participating in all lectures and taking advantage of other learning opportunities offered (e.g., assignments, office hours) is critical for successful attainment of the learning outcomes. The Georgia Tech Catalog describes policies around “approved Institute activities” (e.g., field trips and athletic events) and accommodations around religious observances.

Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. Review [Georgia Tech's Honor Code](#) and the student [Code of Conduct](#).

Cases of suspected cheating or plagiarism on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Core IMPACTS

Not applicable for this course.

Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, [contact the Office of Disability Services](#) (404-894-2563) as soon as possible to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

Student-Faculty Expectations Agreement

At Georgia Tech, we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. [The Student-Faculty Expectations](#) articulate some basic expectations that you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.