ChBE 2140 Chemical Engineering Thermodynamics
Summer 2025

Location: Georgia Tech Europe, TBD
Time: TBD
Credits: 04
Prerequisites: ChBE 2100, and MATH 2551.
Co-requisite: BIOL 1107 + 1107L
Textbook: Introduction to Chemical Engineering Thermodynamics, Eighth Ed., by Smith, Van Ness, Abbott, & Swihart, McGraw Hill, ISBN: 978-1-259-69652-7

Instructor:

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Office Hours: TBD

Learning Outcomes:

This course covers fundamental aspects of phase and chemical equilibrium and shows how the principles are applied in process technologies. Upon satisfactory completion of this course, you should be able to do the following:

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 the molecular concepts.
5) Understand the relationships among the interval energy, enthalpy, heat capacities, entropy, Gibbs and Helmholtz free energies.
6) Perform thermodynamic analysis 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 idea 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 or 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.
12) Understand when phase equilibrium calculations require use of an EOS applicable to all phases, and perform such calculations using computer software.
13) Determine the equilibrium composition of single and multi-phase reaction mixtures, and how they are affected by temperature, pressure, composition, and other variables.

Active Participation and Attendance:

Students are expected to attend all lectures unless you have a compelling reason not to do so. If you miss class, you must find out what was presented and obtain any handouts or other materials you may have missed. Problems on exams will directly reflect the material discussed in class and the textbook. The textbook and class lectures are complementary, but neither replaces the other.

In the case of an absence when an exam is given, a make-up Exam may be given when the absence is caused by an official GT event or illness; such absences must be documented with a letter from the appropriate Georgia Tech official, a physician, or the Dean of Students. Additional information about Georgia Tech policies about class attendance and other general policies can be found at https://catalog.gatech.edu/rules/4/

Tentative Grading System (this may be updated by the first day of classes):

IMPORTANT: One of the main aims of this course is the assessment **of each individual students' ability** to grasp the basic concepts of Thermodynamics which is harder to assess only through HWs or project. Please note below that HW + Quizzes accounts for a total of 35% of your grade while **the exams account for 65% of your overall grade**.

Midterm 01		15 %
Midterm 02		20 %
Final Exam		30 %
Quiz I		10 %
Quiz II		10 %
Homework		15 %
	Total:	100**%**

Honor Code:

Students are expected to follow the Georgia Tech Honor Code at all times. (http://osi.gatech.edu/content/honor-code) and avoid all instances of academic misconduct, including, but not limited to:

1. Possessing, using, or exchanging improperly acquired written or oral information in preparation for exams or the final.
2. Copying homework solutions from classmates, previous students, solution manuals, or otherwise representing the work of others as their own.
3. Using prohibited materials or means to complete homework, exams or the final.
4. False claims of performance or work that have been submitted by a student.

All worked turned in for grading must be original. Copying from other students (current and former), solution manuals, web sites or other sources are considered violations of the Georgia Tech Honor Code. Students will be asked to acknowledge their acceptance of these stipulations and their willingness to abide by all terms of the Honor Code by signing an "Honor Agreement" attached to all exams and the final. Violations of the *Student Honor Code* – plagiarism, copying problem solution from previous years or from solution manuals, etc. – will be reported to the Office of Student Integrity.

Accommodations

Students may request an accommodation through the Office of Disability Services (ODS). Registering with ODS is a 3-step process that includes completing an application, uploading documentation related to the accommodation request, and scheduling an appointment for an "intake meeting" (either in person or via phone or video conference) with a disability coordinator. If you have been approved by ODS for an accommodation, Dr. Cuba-Torres will work closely with you to understand your needs and make a good faith effort to investigate whether or not requested accommodations are possible for this course. If the accommodation request results in a fundamental alteration of the stated learning outcomes of this course, ODS, academic advisors, and the school will work with you to find a suitable alternative that as far as possible preserves your progress toward graduation.

CARE Center, Counseling Center, Stamps Health Services, and the Student Center

These uncertain times can be difficult, and many students may need help in dealing with stress and mental health. The **CARE Center** and the **Counseling Center**, and **Stamps Health Services** will offer both in-person and virtual appointments. Face-to-face appointments will require wearing a face covering and social distancing, with exceptions for medical examinations. Student Center services and operations are available on the **Student Center** website. For more information on these and other student services, contact the Vice President and Dean of Students or the **Division of Student Life**.

Diversity and Disability Statement

Your experience in this class is important to us. If there are aspects of the instruction or design of this course that result in barriers to your inclusion or accurate assessment or achievement, please notify the instructor as soon as possible.

Students with disabilities should contact the Office of Disability Services to discuss options of removing barriers in this course, including accommodations. If you have already established accommodations with the Offices of Disability Services, please communicate this to your instructor so we can discuss your needs in this course. If you have not yet established services through Disability Services, but have a temporary health condition or permanent disability that requires accommodations (conditions include but not limited to; mental health, attention-related, learning, vision, hearing, physical or health impacts), please contact the Office of Disability Services at 404.894.2563 or dsinfo@gatech.edu or https://disabilityservices.gatech.edu

Health and Well-being Statement

Wellness is about maintaining an overall quality of life and the pursuit of optimal emotional, mental, physical, and interpersonal health. Wellness not as the absence of disease, illness, or stress but the presence of purpose in life, active involvement in satisfying work and play, joyful relationships, a healthy body and living environment, and happiness.

The way to achieve wellness is through making proactive, healthy choices. The road to wellness begins with becoming more aware of your present condition, and then making the conscious decision to change the way you live.

Balance is a key component to achieving wellness and optimal functioning. The path to greater wellness is through living in a manner that is consistent with your own personal needs, values, and goals.

Advice:

- **Do** the assigned reading before class, not just the night before the exam.
- **Do not** be afraid to ask questions and interact in class.
- **Do** take homework assignments seriously. They confirm that you understand key concepts and may even introduce variations on those concepts.
- **Do not** fall behind. Later topics depend heavily on earlier topics.

A good rule of thumb for this class is to spend **3 hours outside of class** reading and practicing problems **for every 1 hour of class.**

Brief list of topics to be covered

a. First Law: Energy balance in open and closed systems; steady state and transient processes.
b. Second Law: reversible and irreversible processes; entropy balance for open and closed, steady-state and transient systems.
c. Properties of pure fluids: phase diagrams, equations of state, compressibility factor, generalized correlations, residual properties, equations of state for gases and liquids.
d. Ideal gas and real fluids: cubic equations; departure functions.
e. Relationship among thermodynamic functions: fundamental relationships between thermodynamic properties; Maxwell equations; thermodynamic property calculations.
f. Thermodynamics of devices: turbines, tubes, throttling, nozzles, pumps.
g. Thermodynamics of energy conversion: power production.
h. Refrigeration: Carnot and vapor compression cycles.
i. Pure-component multi-phase systems.
j. Ideal multi-component systems: Raoult's law; flash calculations.
k. Partial molar properties; Gibbs-Duhem equation.
l. Chemical potential; fugacity: fugacity of pure component, fugacity of component in a mixture.
m. Excess properties and activity coefficients: definition and models.
n. Non-ideal multi-component systems: VLE, LLE; relating models to experimental data.
o. Reacting systems: reaction coordinates; equilibrium constant from Gibbs energy; pressure and temperature effects.