Thermodynamics (CHM ENG 141)

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Fall Semester 2020

Lectures: Tuesday/Thursday 12:30pm-2:00pm PST
Zoom: https://berkeley.zoom.us/j/93645257635?pwd=V0pYQ05uZUZLTnN2QTVuRXFiTjFxdz09

Discussion Section 104: Wednesday 2pm-3pm PST
Zoom: https://berkeley.zoom.us/j/97748242886?pwd=bVRZN3AydnFranNDdjRXTTUrV0ErUT09

Discussion Section 105: Thursday 11am-12pm PST
Zoom: https://berkeley.zoom.us/j/97936726291?pwd=eW9jSlhjakgxMGl6SHRuTmRpV3F2Zz09

Instructor's Office Hours: Thursday 4pm-5pm PST, Thursday 8pm-9pm PST
Zoom: https://berkeley.zoom.us/j/99363543734?pwd=YUdNaFpYRWp6ZmdwYk1NQXIvVStnZz09

TA's Office Hours: Wednesday 10am-11am PST, Thursday 5pm-6pm PST
Zoom: https://berkeley.zoom.us/j/99363543734?pwd=YUdNaFpYRWp6ZmdwYk1NQXIvVStnZz09

Learning Objectives:
In this course, we will pursue the study of thermodynamics from both conceptual and applied viewpoints. The conceptual perspective requires us to construct a broad intuitive foundation that provides us the ability to address the topics that thermodynamics spans. The applied perspective enables us how to actually use these concepts to solve problems of practical interest and thereby enhances our conceptual understanding.

Course Outline:
1. Introduction of thermodynamics: basic concepts, postulates and language
2. First law of thermodynamics: work and heat, reversible processes in closed systems and first law in open systems.
3. Carnot engine and refrigerator
4. Entropy and the second law of thermodynamics (part 1): concept of entropy from Carnot cycle
5. Entropy and the second law of thermodynamics (part 2): calculation of entropy change

6. Entropy and the second law of thermodynamics (part 3): microscopic view of entropy
7. Entropy and the second law of thermodynamics (part 4): second law in open systems, Rankine cycle
8. Thermodynamic potentials: fundamental equations
9. Using thermodynamic potentials: calculation of fundamental and derived properties
10. Equations of state
11. Intermolecular forces
12. Phase equilibrium in one component system: equilibrium criterion, Clapeyron-Clausius equation
13. Thermodynamics of mixture: partial molar properties, Gibbs-Duhem equation
14. Entropy of mixing and gas separation
15. Fugacity: calculation for pure substance, fugacity coefficient of mixture
16. Liquid phase mixture: ideal solution, Lewis-Randall rule and Henry's law, activity coefficient
17. Phase equilibrium (part 1): vapor liquid equilibrium (VLE)
18. Phase equilibrium (part 2): liquid-liquid equilibrium (LLE), metastability, surfactants
19. Phase equilibrium (part 3): colligative properties, osmotic pressure
20. Chemical reaction equilibrium (part 1): thermodynamics and kinetics, equilibrium constant
21. Chemical reaction equilibrium (part 2): calculation of equilibrium constant, multiphases, heterogeneous reactions
22. Chemical reaction equilibrium (part 3): equilibrium in electrochemical systems.

Homework:
Homework will be distributed every Friday and is due the next Friday before 6pm PST. You may collaborate on the homework; however, the solutions you write must reflect your own understanding. For your own benefit, it is recommended that you think through the homework independently before collaborating.

Credit of the Course:

Homework	+ Midterm1	+ Midterm2	+ Final
25%	25%	25%	25%

10% of the credit will be reduced if homework has not been handed in on time. Late submissions with a 10% reduction will be accepted until 11:59pm PST on the Friday each homework is due.

Textbook:
Engineering and Chemical Thermodynamics, by Milo D. Koretsky, 2nd Ed.

Reference Books:
1. Introduction to Chemical Engineering Thermodynamics, by J. M. Smith, H. C. Van Ness, M. M. Abbott and M. T. Swihart, 8th Ed.

2. Thermodynamics and its Applications, by J. W. Tester and M. Modell. 3rd Ed.

Technical Requirements

- This course is built on a Learning Management System (LMS) called Canvas and UC Berkeley's version is called bCourses. It can be accessed with a computer, tablet, or smartphone.
- If you are having technical difficulties, please alert one of the instructors immediately. In addition, please email tech support immediately to resolve any issues.
    - In bCourses, click on "Help" in the panel on the left.
- We will use Zoom for synchronous meetings (e.g., lecture, discussion, and office hours).
    - Activate your free UC Berkeley Zoom account and always join the Zoom meeting with your Berkeley account.
    - You may join a Zoom meeting with a computer, tablet, smartphone, or by calling in. Please join with a computer with a camera and microphone (built-in or external) if possible as it will give you the best access to content.
- We will use Gradescope for assignments (e.g., homework, midterms, and the final exam).
    - Gradescope can be accessed with a computer, tablet, or smartphone.
    - You do not need a printer/scanner to submit your Gradescope assignments. For handwritten work, please use a free scanning app like Scannable.

Lecture

- Tuesday/Thursday 12:30 pm - 2:00 pm PST via Zoom
- Zoom meetings will be scheduled through bCourses.
    - The Zoom links and passcodes will be posted on bCourses in the "Pages" tab.
    - Your primary email in bCourses must match your email address in Zoom.
- Lecture videos will be available to stream on bCourses within 24 hours after the lecture.
- We encourage students to attend lecture, but we understand that this may not always be possible due to your unique circumstances or technical difficulty. Therefore, lecture attendance will not be graded. If you miss a lecture, please watch the lecture video on bCourses as soon as you are able.

Zoom Policies

- Please keep the Zoom link private—do not share with anyone outside of the course.
- Please set your Zoom name to be the name you would like the instructors to call you. You may optionally include your personal pronouns.
    - Example: Elizabeth (she/her)
- Please set your Zoom picture to an appropriate profile picture of you to foster a sense of community and enhance interactions. If you are not comfortable using an image of yourself, you may use an appropriate picture of an avatar.
- We encourage participating in class and discussion with your video on to foster a sense of community and enhance interactions. However, we understand that some students are not comfortable with video or may not be able to participate by video.
- We will be recording all Zoom lectures. The instructor will announce when the

recording is beginning during each lecture. If you do not wish to be recorded, please turn off your video, mute your audio, and use chat to ask questions. The chat record will be deleted immediately after class ends.

- Please leave your audio on mute during the lecture, but be prepared to unmute yourself to ask or answer questions or participate in breakout rooms.
- We will use Zoom features such as breakout rooms, polls, and the whiteboard as well as external tools such as Google Drive, Mentimeter, and bCourses. To maximize your ability to participate during lecture we recommend joining Zoom via a computer or tablet with a video camera and microphone.
- We understand that your specific situation may present challenges to class participation. Please contact the instructors if you would like to discuss your ability to access course material. The Student Technology Equity Program (STEP) is available to help students get access to a laptop, Wi-Fi hotspot, and other peripherals (e.g. webcam, headphones, etc.).

- **Zoom chat**
    - In this course we will use Zoom chat as a mechanism to build community and foster information and resource sharing among students. To these ends, chat will be enabled before class and during breaks. In addition, we will enable chat periodically to gather input on specific questions and activities to benefit the full group. The same expectations for respectful communication hold for chat as they do for face to face interaction.

- **Questions during lecture**
    - If there is a technical difficulty during lecture you may unmute yourself to notify the instructor (e.g., the instructor is on mute, screen sharing isn't working, etc.).
    - The "raise hand" feature and chat will not be continuously monitored during lecture.
    - The instructor will periodically pause and ask for questions. At this time please use the "raise hand" feature in Zoom and unmute yourself when the instructor calls on you. You may also ask your question in the chat at this time.

- **Breaks**
    - If you need to take a break for any reason during a Zoom meeting simply turn off your video and audio to avoid disruption. You do not need to request permission or message the instructor.

bCourses Site

- The bCourses site will be the central hub for all course information.
- Please set your bCourses notifications so that you do not miss any announcements or assignments.
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Gradescope

- New homework assignments will be posted in bCourses every Friday and due by the following Friday.
- We will do our best to grade your assignment and post solutions within 1 week of submission.
- You will upload your assignment to Gradescope. Be sure to assign the correct pages to each problem, the grader will only grade what has been designated for each problem. We recommend writing each problem on a new page.
- Use a free scanning app like Scannable to upload handwritten work. Graders will not grade work that is not legible. Whether you use Scannable or another means of converting written work to submittable formats, it is your responsibility to make sure that it is legible.
- You may use the regrade request feature in Gradescope. Regrade requests must be submitted within 1 week of the grades being posted. Please include a comment thoroughly explaining why you believe more points should be awarded based on the rubric. We will only regrade the requested problem.

Piazza

- We will use Piazza as an alternative format to Office Hours to ask questions about course content.
- The same expectations for respectful communication hold for Piazza as they do for face to face interaction.
- Respond to your peers! We encourage you to help each other by responding to students' questions. Please do not share complete answers to homework problems until the solutions have been posted.
- Anonymous posting has been activated, you may post your questions anonymously.

Exams

- Exams will be submitted over Gradescope.
- The exams will be open-book, open-note–you may use any material you see fit. However, you may not collaborate or discuss the exam with other students. We rely on your academic integrity.

Academic Integrity

- It is considered academically dishonest to turn in work to be graded (homework, lab assignment, project, quiz, exam) that is not your own work, unless the assignment explicitly states otherwise. You may work with others in preparing homework and studying for exams, but the work you turn in must be the product of your own thinking. Academic dishonesty can result in no credit for an assignment or the course. It can also result in referral to UC Berkeley authorities for additional sanctions.