CENG 2210
Chemical and Biological Engineering Thermodynamics

Hong Kong University of Science and Technology, Spring 2025

Course Syllabus

Instructor

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Course Website

https://canvas.ust.hk/courses/61220/

Course Description

CENG 2210 covers the fundamental principles of thermodynamics and their application in the chemical and biological engineering profession. As an entry-level course, it also equips the aspiring engineer, through examples, with quantitative problem-solving skills that are necessary for higher-level studies and for subsequent engineering practice. Its target audience is first-year undergraduate students in chemical engineering or related majors, with some prior coursework in elementary physical chemistry.

Thermodynamics deals with the transformation of energy from a macroscopic perspective. It is a foundational subject of science, and an expected core competency of any chemical engineer. The principles of thermodynamics find application both in the design of the chemical plant (e.g., reactors, heat exchangers, separation processes), and in the engineering of products (e.g., materials, biomolecules, formulations).

CENG 2210 is designed primarily for chemical and biological engineers, in that it covers topics of practical interest in chemical and biological processing. This includes the calculation of thermodynamic properties for real, non-ideal fluids and fluid mixtures, the estimation of the amount and efficiency of heat and work interactions in chemical processes, and the elucidation of phase and chemical equilibria.

EXPECTED LEARNING OUTCOMES

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

- State, explain, and apply the laws of thermodynamics.
- Use the machinery of thermodynamics to calculate thermodynamic properties of interest.
- Use published thermodynamic property tables and diagrams.
- Formulate and solve problems pertaining to simple chemical processes.
- Present solutions to problems in an organized, transparent, and precise manner.
- Apply the concepts of thermodynamics to interpret physical phenomena in nature.

COURSE REQUIREMENTS

LECTURES

Tuesdays and Thursdays 4:30pm – 5:50pm, in Rm 5620. The lectures will introduce the principles and concepts of thermodynamics. Students are ***required*** to attend the lecture and participate actively in quizzes and discussions. Class attendance will be recorded.

TUTORIALS

Tuesdays, 6:00 – 6:50pm, in Rm 5620. ***You are expected to attend the tutorials in this course***. The tutorials follow the Tuesday lectures in the same room, and are intended to provide more time for questions, homework and group discussion.

QUIZZES

There will be short quizzes at the beginning of most lectures. These are mainly intended to test whether the student read the lecture notes and attend the previous lecture. For grading purpose, the ***3 worst scores*** obtained among all in-class quizzes will be dropped. ***No make-up quiz*** for this course.

TEXTBOOK

The textbook, *Introduction to Chemical Engineering Thermodynamics,* by J. M. Smith, H. C. Van Ness, M. M. Abbott and M. T. Swihart (McGraw Hill, 8th edition) is available as an online book through the HKUST library (https://lbdiscover.ust.hk/bib/991012900569003412). The textbook serves as supplementary reading material to reinforce the lecture notes. The textbook sections corresponding to the lectures are listed in the tentative schedule below.

HOMEWORK

There will be 5 homework assignments, which you need to complete on your own. However, we will use part of the lecture (as needed) and the tutorial to help you through the homework, and you are encouraged to discuss with your classmates or TAs (PG or UG). The homework will be graded both on *technical accuracy* and *presentation*. A detailed grading rubric for the presentation component will be provided.

EXAMS

There will be 1 mid-term exam scheduled in class on **27th March 2025**, and 1 final exam during the university's exam period, exact date to be announced.

Grading Policy

The final grade will be awarded based on performance in the following categories, with weights in parentheses:

Class participation and surveys (10%)

In-class quizzes (10%, worst 3 scores will be dropped)

Homework (25%)

Midterm exam (25%)

Final exam (30%)

Class participation is graded by the teaching team based on your participation in both in-class activities and quizzes.

Homework submitted after the deadline will not be graded, *no exceptions*. This is because the solutions will be posted immediately after the deadline.

Academic Integrity

Please be informed of the University's policy on academic integrity, which can be found here: http://tl.ust.hk/integrity/. In this course, violation of academic integrity includes (i) cheating in quizzes or examinations, (ii) copying homework from other students or from homework solutions in past offerings of the course.

In this course, learning takes place mainly through the homework. Therefore, special care will be given to detect plagiarism in homework assignments. *If the grader has strong ground to suspect plagiarism, the homework assignment will not be graded.* A zero score will result for that homework assignment. Students can appeal this decision by setting up a face-to-face meeting with the instructors to demonstrate, on the spot, mastery of the homework.

Repeated offenders will be referred to the University for disciplinary actions prescribed under the University's policy on academic integrity.

TENTATIVE COURSE SCHEDULE

This tentative schedule is subject to revision throughout the semester, depending on the feedback and course progress. Updated schedules will be announced and posted on the course website.

Note: In the following table, "SVAS" denotes the online textbook J. M. Smith, H. C. Van Ness, M. M. Abbott and M. T. Swihart (McGraw Hill, 8th edition). If you have an earlier edition of the book, the chapter/section numbers may be different.

Date	**Lecture Module**	**Reading / Homework**
4/2 (Tue)	00. Course Overview	
6/2 (Thu)	01. Getting started	SVAS 1
11/2 (Tue)	02. Calculus for Thermodynamics	Handout 1
13/2 (Thu)	03. Energy; Ideal gas; Reversibility	SVAS 2.1-2.2, 2.5-2.6, 3.3
18/2 (Tue)	04. First Law for Closed Systems	SVAS 2.3-2.4, 2.8
20/2 (Thu)	05. First Law for Open Systems	SVAS 2.9, 4.1 **HW1 Due**
25/2 (Tue)	06. Simple Transient Processes	
27/2 (Thu)	07. Second Law Concepts	SVAS 5.1-5.4, 5.9-5.10
4/3 (Tue)	08. Second Law for Closed Systems	SVAS 5.5
6/3 (Thu)	09. Second Law for Open Systems	SVAS 5.6-5.8
11/3 (Tue)	10. PVT Correlations for Real Gases	SVAS 3.2,3.4-3.7, **HW2 Due**
13/3 (Thu)	11. Fundamental Equations	SVAS 6.1, Handout 2
18/3 (Tue)	12. Property Relations	SVAS 6.2-6.4
20/3 (Thu)	13. Liquids	SVAS 3.2, 3.8
25/3 (Tue)	14. Exam Review	**HW3 Due**
27/3 (Thu)	**Midterm Exam *(4:30pm - 6:30pm)***	
1/4 (Tue)	*NO CLASS – Mid-term Break*	
3/4 (Thu)	*NO CLASS – Mid-term Break*	
8/4 (Tue)	15. Phase Behavior of Pure Substances I	SVAS 3.1, 4.2, 6.5-6.7
10/4 (Thu)	16. Phase Behavior of Pure Substances II	SVAS 10.1–10.2
15/4 (Tue)	16. Mixtures I	SVAS 10.1–10.2
17/4 (Thu)	17. Mixtures II	SVAS 10.4, Handout 3
22/4 (Tue)	18. Fugacities and Activities	SVAS 10.5-10.9
24/4 (Thu)	19. Phase equilibria I	SVAS 12.1-12.4, 13.3
29/4 (Tue)	20. Phase equilibria II	**HW4 Due**
1/5 (Thu)	*NO CLASS – Ching Ming Festival*	
6/5 (Tue)	21. Chemical equilibria I	SVAS 4.3-4.6,14.1-14.5,14.8
8/5 (Thu)	22. Chemical equilibria II / Finale	SVAS 4.7, 14.6-14.7, **HW5 Due**
17-29/5	**Final Exam *(Date and time TBA)***	