

155:309 – Chemical Engineering Thermodynamics II (Fall 2023)

Lectures Tuesday/Thursday 2:00-3:20 PM in Engineering B-120

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Study Group: Monday 2:00-3:20 PM / Wednesdays 12:10-1:30 PM in Busch Learning Center
(Beginning on Wednesday September 20)

Textbook (required): Milo Koretsky, "Engineering and Chemical Thermodynamics," 2nd edition (2013), Wiley

Course description

Students will learn and apply the principles and methods of thermodynamics to analyze and solve equilibrium thermodynamics problems encountered in chemical and biochemical engineering. This course provides opportunities for students to (i) analyze and interpret thermodynamic data, (ii) identify, formulate, and solve chemical engineering thermodynamics problems, and (iii) use advanced thermodynamic tools and techniques that are necessary in engineering practice.

Students will learn advanced thermodynamic methods to model the properties of fluids and their mixtures, phase equilibria, and chemical reaction equilibria. These methods are relevant and applicable across a wide range of industries, including chemical, petrochemical, biochemical, and pharmaceutical industries. Understanding these topics is required for later courses and essential for strong career development in chemical engineering.

Learning objectives

Students will learn to:

- Understand the principles of physical and chemical equilibrium
- Estimate equilibrium properties of fluid mixtures using thermodynamic models
- Calculate properties of liquid-vapor, liquid-liquid, and liquid-solid equilibrium
- Calculate chemical equilibrium of reactions
- Understand the assumptions and limitations of certain thermodynamic models (and when they may be used appropriately)
- Apply engineering methods and computational tools to calculate and predict thermodynamic properties

Material covered in this course provides a foundation in more advanced chemical engineering sciences and applications, including in the courses 155:324 Design of Separation Processes and 155:427/428 Chemical & Biochemical Engineering Design.

Assessment / Grading

Homework	40%
Project	10%
Midterm 1 (10/10)	15%
Midterm 2 (11/9)	15%
Final exam	20%
Attendance bonus (short quizzes)	3% (total 103%)

Homeworks & Project

Homework assignments are due by the start of class (2:00 PM) on their designated due date (Tuesdays). Each completed problem set should be submitted by uploading a file to Canvas. You may either submit work that is typed or a legible scan of handwritten work (PDF format is preferred). Students are encouraged to work together on problem sets, but each student must submit their own work (see *Academic Integrity*). Late homework will be deducted 10% per day for first two days past its deadline, and 20% per day for three days late and beyond. Unsubmitted homework will receive a grade of zero. Solutions to problem sets will be posted on Canvas once submissions have been received from all students.

There will be one group project during the semester, which will consist of a more challenging homework set with multiple components and involve a small programming component. Groups will be randomly assigned.

Attendance Policy

Attendance is not mandatory, but strongly encouraged. Attendance will be taken at each class with a short quiz answered via Google Forms, which may be completed on a phone or laptop. Quizzes have no penalty for incorrect answers and provide a way for us to identify any points of confusion or topics needed for review. Students who miss 2 or fewer short quizzes will be granted an additional 3% to their final grade.

Absences due to religious observances will be excused. Please let me know in writing at least two days in advance so that we may accommodate for any conflicts with assignments or exams.

Course Schedule:

Week	Dates	Topics	Chapters	HW Due
1	9/5 9/7	Introduction, Review Equations of State	4.1 – 4.3, 4.5	
2	9/12 9/14	Thermodynamic web, Calculating thermodynamic properties, Intro to Phase Equilibria	5.1 – 5.2, 5.3 6.1	HW 1
3	9/19 9/21	Single Component Phase Equilibria	6.2	HW 2
4	9/26 9/28	Thermodynamic properties of mixtures, Multicomponent phase equilibria	6.3, 6.4	HW 3
5	10/3 10/5	Multicomponent phase equilibria 10/5: Review	6.4	HW 4
6	10/10 10/12	10/10: Exam 1 Definition of Fugacity, Fugacity in the vapor phase	7.1-7.3	
7	10/17 10/19	Fugacity (liquid and solid phase)	7.3-7.5	HW 5
8	10/24 10/26	Vapor-liquid equilibrium, Liquid-liquid equilibrium	8.1, 8.2	HW 6
9	10/31 11/2	Liquid-solid equilibrium	8.2-8.4	HW 7
10	11/7 11/9	11/7: Review 11/9: Exam 2		
11	11/14 11/16	Colligative properties, Gibb's energy of reaction	8.5, 9.1-9.2	HW 8
12	11/21 11/23	Reaction equilibria 11/23: No class – Thanksgiving holiday	9.3	HW 9
13	11/28 11/30	Equilibrium constants	9.5	
14	12/5 12/7	Multiple reactions, electrochemical reactions	9.6-9.8	HW 10
15	12/12	Review for Final Exam		

Learning Accommodations

Rutgers University is committed to creating an inclusive and safe learning environment for all students. Students with disabilities are welcome to request accommodations through the Office of Disability Services (ODS). You can contact ODS at 848-445-6800 or via email at dsoffice@echo.rutgers.edu. Please submit requests to ODS as early in the term as possible, as accommodations are not retroactive. Letters of accommodation and arrangement of accommodations can be discussed in private during office hours or by special appointment.

Ethics & Academic Integrity

Students are expected to be familiar with and to follow the University's policy on academic integrity, which can be found at <http://academicintegrity.rutgers.edu>. Engineering is a profession demanding a high level of integrity and responsibility in collaborative environments. Students are encouraged to work together on problem sets, review course materials together, and learn from one another. However, cheating, plagiarizing, or misrepresenting another individual's work as one's own will not be tolerated. Assignments or exams in violation of this policy will be reported and given a grade of zero.