

CHEMISTRY 563

Advanced Thermodynamics and Equilibrium

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Office: LSC 451

Text: Molecular Thermodynamics, D.A. McQuarrie and J.D. Simon, University Science Books, Sausalito, CA, 1999.

This course provides the student an advanced view of thermodynamics, taken from a molecular perspective. All students enrolled should have had at least two semesters of undergraduate physical chemistry. Students will find that familiarity with spreadsheet and mathematical software will be useful in the completion of assignments for this course. Upon completion of this course, the student should be able to predict bulk thermodynamic properties of systems from the appropriate molecular properties and manipulate thermodynamic data to determine molecular properties. Topics not covered by the text will be covered in the lecture, with some references to other sources, including journal articles. Similarly, some topics covered in the text will not be discussed in the lecture.

DATE	LECTURE TOPIC	CHAPTER
8/30	Energy Levels	1
9/6	Gases	2
9/13	Partition Functions	3
9/20	Partition Functions and Ideal Gases-Statistical Thermodynamics	4
9/27	EXAM I	
10/4	Thermodynamics- The First Law	5
10/11	Entropy- The Second and Third Laws	6,7
10/18	Helmholtz and Gibbs Energies	8
10/25	Phase Equilibrium	9
11/1	EXAM II	
11/8	Liquid-Liquid Solutions	10
11/15	Solid-Liquid Solutions	11
11/22	No Class- Thanksgiving Break	
11/29	Chemical Equilibrium	12
12/6	Electrochemistry/Nonequilibrium Thermodynamics	13,14
	FINAL EXAM	

GRADING POLICY

The grading for this course will be based on examination performance (300 points for each semester exam, 400 points for the final exam). Homework problems from the text will be assigned, but not collected. The exams may include take-home components. **All in-class exams must be done with non-communicating devices (pencil, pen, slide rule, abacus, noncommunicating calculator). Use of a communicating calculator on an in-class exam will result in a score of 0 on that assignment. The instructor reserves the right to further limit the use of calculators on in-class exams.**

Students with Disabilities

Request for Accommodations: Reasonable academic accommodations may be provided to students who submit appropriate and current documentation of their disability. Students are encouraged to contact the Office of Student Support and Success (OSSS) at disabilityservices@scranton.edu or (570) 941-4038 if they have, or think they may have, a disability and wish to determine eligibility for any accommodations. For more information, please visit www.scranton.edu/disabilities.

Writing Center Services

A valuable resource, the Writing Center welcomes student writers engaged in the writing process. Trained writing consultants from various academic disciplines work one-on-one with student writers on all aspects of writing.

Students can make an appointment through the My.Scranton portal: my.scranton.edu -> Self Service -> Student & Financial Aid -> CTLE Menu.

For more information, please visit the Writing Center webpage

<https://www.scranton.edu/academics/ctle/writing/index.shtml> .

Academic honesty:

The first time that a student is caught plagiarizing or using fabricated data in a report, he or she will receive a grade of zero points for that assignment. For further consequences of violating academic ethics please refer to the University of Scranton Student Handbook.

<https://www.scranton.edu/studentlife/studentaffairs/dean/studenthandbook2022-2023.pdf>

HOMEWORK ASSIGNMENTS

<u>CHAPTER</u>	<u>PROBLEMS</u>
1	1-3,17,18, 21,22,28-31,36,38,48
2	1-3,7,10,13-15,37,38,41
3	8,10,11,12,14,17,28,42,43
4	4,7,9,12,19,21,23,25,29
5	1-7,20,22,25,35,42,45,46
6	8,18,19,25-29,33,40-43,45
7	2-5,14,15,26,40,41,47
8	8,9,26,51,52
9	4,6,17,20,26,31,36
10	12,19-22,48,50-52
11	1-4,15,16,22,24,27,29,31,40
12	1,3-5,15,21-27,30,35,39,61,63-65
13	1-5,11-14,30,37,39,58
14	24,28,43

The SLO Track

In completing this course students should be able to:

1. demonstrate that the energy levels of an atomic/molecular system contribute to thermodynamic properties.
2. determine key properties of a gas from its equation of state.
3. generate partition functions for atomic and molecular systems.
4. determine thermodynamic properties of a perfect gas from partition functions.
5. calculate the thermodynamic changes that occur in a gas upon expansion.
6. predict the entropy of a substance from its molecular properties.
7. calculate entropy, enthalpy, Helmholtz energy and Gibbs energy changes.
8. apply the laws of thermodynamics to phase and chemical equilibrium systems.
9. use thermodynamics to determine the properties of dilute solutions.
10. use thermodynamics to determine the behavior of electrochemical systems.
11. predict behavior of systems not at equilibrium.

My Reporting Obligations as a Required Reporter

As a faculty member, I am deeply invested in the well-being of each student I teach. I am here to assist you with your work in this course. Additionally, if you come to me with other non-course-related concerns, I will do my best to help. It is important for you to know that all faculty members are required to report incidents of sexual harassment or sexual misconduct involving students. This means that I cannot keep information about sexual harassment, sexual assault, sexual exploitation, intimate partner violence or stalking confidential if you share that information with me. I will keep the information as private as I can but am required to bring it to the attention of the University's Title IX Coordinator, Elizabeth M. Garcia, or Deputy Title IX Coordinator, Diana M. Collins, who, in conversation with you, will explain available support, resources, and options. I will not report anything to anybody without first letting you know and discussing choices as to how to proceed. The University's Counseling Center (570-941-7620) is available to you as a confidential resource; counselors (*in the counseling center*) do not have an obligation to report to the Title IX Coordinator.

Non-Discrimination Statement

The University is committed to providing an educational, residential, and working environment that is free from harassment and discrimination. Members of the University community, applicants for employment or admissions, guests, and visitors have the right to be free from harassment or discrimination based on race, color, religion, ancestry, gender, sex, pregnancy, sexual orientation, gender identity or expression, age, disability, genetic information, national origin, veteran status, or any other status protected by applicable law.

Students who believe they have been subject to harassment or discrimination based on any of the above class of characteristics, or experience sexual harassment, sexual misconduct or gender discrimination should contact Elizabeth M. Garcia, Title IX Coordinator, (570) 941-6645 elizabeth.garcia2@scranton.edu, or Deputy Title IX Coordinators Diana M. Collins (570) 941-6645 diana.collins@scranton.edu, or Ms. Lauren Rivera, AVP for Student Life and Dean of Students, at (570)941-7680 lauren.rivera@scranton.edu. The United States Department of Education's Office for Civil Rights (OCR) enforces Title IX. Information regarding OCR may be found at www.ed.gov/about/offices/list/ocr/index.html