Chem 410B, Physical Chemistry, Spring 2023

Lecture: MWF 9:00 – 9:50 PM
Room: GMCS-309

Instructor:
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Office hours
Tuesday 1:00 – 2:00 pm; CSL – 309
Thursday 8:00 – 9:00 pm; **Zoom** **Meeting ID:** 490 867 9421
https://SDSU.zoom.us/j/4908679421

Overview

The second semester of the physical chemistry course covers chemical thermodynamics, kinetics, and some statistical thermodynamics. Thermodynamics is the science that studies the relationship between heat and work, and the transfer of these quantities between a system and its surroundings. It forms a theoretical basis for predicting product and reactant concentrations in chemical systems at equilibrium. Kinetics is the study of the rates and mechanisms of chemical reactions. It is concerned with how fast a reaction occurs as it marches toward equilibrium. Statistical thermodynamics connects the microscopic properties to bulk (macroscopic) properties of matter. While thermodynamics relates macroscopic properties, microscopic details must often be considered in order to understand the relationships between reaction rates and mechanisms.

Catalog Course Description
CHEM 410B. Physical Chemistry (3) Three lectures. Prerequisites: Chemistry 232, 232L, 251, 410A. Theoretical principles of chemistry with emphasis on mathematical relations. Theory and practice in acquisition and statistical analysis of physical measurements on chemical systems.

Textbook

The required textbook for this course is ***Physical Chemistry, 11th Edition*** by Peter Atkins, Julio de Paula, and James Keeler (ISBN: 978-0-19-876986-6). We will be covering Chapters 1-6, 12, 17, and 18.

Learning Outcomes

By the end of this course, you will be able to

- Understand the basic principles of thermodynamics as applied to chemical reactions and processes, particularly in terms of enthalpy and entropy.
- Calculate equilibrium constants, enthalpies, and entropies from experimental data and from information found in the literature.
- Analyze equilibrium problems and predict the direction of spontaneous change as expressed by the chemical potential
- Apply the basic principles of kinetics to chemical reactions and processes.
- Determine rate parameters from experimental data.
- Analyze chemical reaction mechanisms through the corresponding rate equation.
- Calculate physical parameters of compounds using theoretical principles
- Derive fundamental equations in thermodynamics and kinetics
- Develop simple mechanisms which correspond to experimentally-derived rate laws
- Appreciate the molecular basis of chemical thermodynamics and kinetics

Chapter handouts

For each chapter (called "Focus" in the text), you will be given a handout that will guide you in your reading, provide problems for practice and understanding, and serve as a study guide for exams. The problems labelled "Q" are intended to be straightforward, although not always easy, and should be at least attempted immediately after reading the relevant section of the book. This will help you to better understand what you just read. Even if you aren't able to figure out the answer, trying the problem will help you on the daily quiz. The problems at the end of the handout (labelled "P") are generally more comprehensive and will help test your understanding.

Canvas discussion:

Each problem in the handout will be assigned to a specific person to solve in detail and post in the Discussion section in Canvas. A good attempt at the answer must be posted before the next class period after the problem is assigned; there is a one-point penalty for posting an initial attempt after this time. After the initial post, other students can comment, make suggestions, ask questions, and even post their own answer. The deadline for posting a complete answer to your assigned problem is usually one week after the assignment date, but may be sooner near exam time. Even if another student answers the question correctly, you must post your own correct answer to receive credit. Only the final submission will be graded; if other students have already given answers, summarize their results into a neat, readable, and complete final version. For full credit (8 points), your answer should be well written with the steps in any calculations explained. As part of the assignment, I also expect you to answer any questions other students may have about your problem after it is posted. These posted answers constitute an answer key.

Extra credit: Extra points will be given for helpful contributions to the Discussion Board regarding problem solutions. If you see that an answer is incorrect or unclear, post your comment so that the author has a chance to correct it. Each person can get a maximum of 10 extra-credit points for the semester.

Daily Quizzes

A short (~5 minute) quiz will be given at the beginning of class every day. It will usually cover the reading and problems assigned at the end of the previous class. There will be a total of about 40 quizzes given for 3 points each. The best 33 of these will be used toward your grade.

Homework Assignments

Throughout the semester I will assign homework problems for the whole class to turn in (more so than was done in Chem 410A). These generally will involve problems that require Excel or substantial mathematical work.

Exams

There will be three exams during the semester. These will be administered in class, and you will have the full class period to finish. The tentative schedule is as follows:

Exam I Friday, February 10
Exam II Wednesday, March 8
Exam III Friday, April 7

Final exam

The final exam takes place on Monday, May 8, 2023, 8:00 – 10:00 AM. The exam will have one section covering the last 3-4 weeks of the class, and another section that will be cumulative.

Grading

Three exams 300 pts (100 pts each)
Final exam 150 pts
Daily quizzes 99 pts (3 pts each; best out of 33)
Discussion questions ~56 pts (8 pts each; ~ 7 assigned questions)
Homework assignments ~50 pts
Total: ~655 pts

The grading scheme will be as follows:

A	89-100%	C	59-66%
A-	85-89%	C-	55-59%
B+	81-85%	D+	50-55%
B	74-81%	D	44-50%
B-	70-74%	D-	40-44%
C+	66-70%	F	< 40%

Topics/Modules

Module 9.	Focus 12	Magnetic Resonance
Module 1.	Focus 1	The Properties of Gases
Module 2.	Focus 2	The First Law
Module 3.	Focus 3	The Second and Third Laws
Module 4.	Focus 4	Physical Transformations of Pure Substances
Module 5.	Focus 5	Simple Mixtures
Module 6.	Focus 6	Chemical Equibrium
Module 7.	Focus 17	Chemical Kinetics
Module 8.	Focus 18	Reaction Dynamics

Add/Drop Procedure: The add/drop deadline is Jan. 31, 2023. For details, see *http://arweb.sdsu.edu/es/registrar/schedule_adjustment.html* (Links to an external site.)

Students with Disabilities:
If you are a student with a disability and believe you will need accommodations for this class, it is your responsibility to contact Student Disability Services at (619) 594-6473. To avoid any delay in the receipt of your accommodations, you should contact Student Disability Services as soon as possible. Please note that accommodations are not retroactive, and that I cannot provide accommodations based upon disability until I have received an accommodation letter from Student Disability Services. Your cooperation is appreciated.

Schedule. The lecture times for each chapter may vary during the course of the semester.

Week of:	Mon	Wed	Fri
Jan 16		First day of class; Focus 12	Focus 12 NMR
Jan 23	Focus 12 NMR	Focus 1 Properties of gases	Focus 1 Properties of gases
Jan 30	Focus 1 Properties of gases	Focus 1 Properties of gases	Focus 2 The First Law
Feb 6	Focus 2 The First Law	Focus 2 The First Law	**Exam I**
Feb 13	Focus 2 The First Law	Focus 2 The First Law	Focus 3 The 2nd and 3rd laws
Feb 20	Focus 3 The 2nd and 3rd laws	Focus 3 The 2nd and 3rd laws	Focus 3 The 2nd and 3rd laws
Feb 27	Focus 3 The 2nd and 3rd laws	Focus 3 The 2nd and 3rd laws	Focus 4 Pure substances
Mar 6	Focus 4 Pure substances	**Exam II**	Focus 4 Pure substances
Mar 13	Focus 5 Simple mixtures	Focus 5 Simple mixtures	Focus 5 Simple mixtures
Mar 20	Focus 5 Simple mixtures	Focus 6 Chemical equilibrium	Focus 6 Chemical equilibrium
Mar 27	Spring Break		
Apr 3	Focus 6 Chemical equilibrium	Focus 6 Chemical equilibrium	**Exam III**
Apr 10	Focus 6 Chemical equilibrium	Focus 17 Chemical kinetics	Focus 17 Chemical kinetics
Apr 19	Focus 17 Chemical kinetics	Focus 17 Chemical kinetics	Focus 17 Chemical kinetics
Apr 24	Focus 17 Chemical kinetics	Focus 18 Reaction dynamics	Focus 18 Reaction dynamics
May 1	Focus 18 Reaction dynamics	Focus 18/review **Last day of class**	No class
May 8	**Final Exam** **Monday, May 8** 8:00 – 10:00 AM		