Physical Chemistry: Thermodynamics and Kinetics - Chemistry 561

3 credits

http://learnuw.wisc.edu

Course Designations and Attributes
Breadth - Physical Sci. Counts toward the Natural Sci req
Level - Advanced
L&S Credit - Counts as Liberal Arts and Science credit in L&S
Honors - Accelerated Honors

Class: MWF 9:55 – 10:45 AM, Chemistry 1315

Instructional Mode
The course will be taught in-person, with additional course materials provide on line.

Specify how Credit Hours are met by the Course
Course hours are met vi the traditional Carnegie definition.

INSTRUCTORS AND TEACHING ASSISTANTS

Instructor Title and Name
Prof. J.R. Schmidt

Instructor Availability
JRS is available immediate after class and for one office hour (8305d) to be determined based on student survey.

Instructor Email/Preferred Contact
Email: schmidt@chem.wisc.edu

Teaching Assistant (if applicable)
Kai Cui

TA Office Hours
Office hour and location to be determined based on student survey.

TA Email/Preferred Contact
Email: kcui7@wisc.edu

OFFICIAL COURSE DESCRIPTION

Course Description

Macroscopic theory: equilibrium thermodynamics, chemical kinetics and transport properties.

Requisites

CHEM 327 or 329; MATH 222; PHYSICS 201 or 207.

LEARNING OUTCOMES

Course Learning Outcomes

- Appreciate the connection between macroscopic variables and microscopic / atomic structure
- Exploit the mathematical connections dictated by thermodynamics to derive connections between macroscopic observables / variables
- Understand the implications of the 1st and 2nd laws of thermodynamics, and the interconversion of heat and work
- Utilize the concept of free energy and chemical potential to calculate work and phase equilibrium

GRADING

1) Exam 1	20%
2) Exam 2	20%
3) Final Exam	30%
4) Homework	20% 11 problem sets
5) Four Quizzes	10% (2.5% each)

DISCUSSION SESSIONS

Our discussion sections will focus on problem solving, including sample problems that will help you solve assigned problems. It is absolutely vital that you attend and participate in every discussion section. We cannot emphasize this strongly enough.

REQUIRED TEXTBOOK, SOFTWARE & OTHER COURSE MATERIALS

Text: Atkins and de Paula, *Physical Chemistry* **9th edition** (used copy/online bookseller)

Tentative Course Outline

Thermodynamics is a "theory of everything", and is one of the most beautiful branches of science we know, touching every aspect of our lives. It's also incredibly fun to learn (really). We will learn this subject by following the textbook in order:

Chapter 0 Fundamentals (on your own)
Chapter 1 Gases
Chapter 2 The First Law of Thermodynamics (Heat, Work, and Energy)
Chapter 3 The Second Law of Thermodynamics (Entropy and Irreversibility)
Chapter 4 The Phases of a Pure Substance
Chapter 5 Mixtures and Solutions
Chapter 6 Chemical Equilibrium

Thermodynamics tells us "what" we get when we get there, but the subject of kinetics describes "how" we get there as well as "how fast". One goal of kinetics is to describe chemical reactions at the molecular level. We will cover selected portions of the following chapters:

Chapter 20 Molecules in Motion
Chapter 22 Molecular Reaction Dynamics

Exams

We will have two in-class exams, one two-hour final exam, and four in-class quizzes. The final exam will be comprehensive. **Tentative dates given below. There are no makeup exams or quizzes. You may drop your lowest quiz.**

1) Exam 1: Wednesday, February 28 (tentative)	20% (17)
2) Exam 2: Monday, April 16 (tentative)	20% (15)
3) Final Exam: Friday, May 11	30% 120 minutes, 10:05 AM – 12:05 PM
4) Homework	20% 11 problem sets
5) Four Quizzes	10% (2.5% each)

Problem Sets

Problem sets will be assigned most weeks (see the calendar). **You may hand in three submissions late, by the start of the next class**. These three late submissions are intended to cover all circumstances. A fourth late submission will not be accepted. Not all problems on the problem sets will be fully graded, but we will do our best.

Power-point presentations will be posted electronically on learn@UW, but lecture notes will not. *Please attend all classes!* Not all subjects presented in class will be from our textbook.

Our discussion sections will focus on problem solving, including sample problems that will help you solve assigned problems. It is absolutely vital that you attend and participate in every discussion section. We cannot emphasize this strongly enough.

Hints on Problem Sets: We encourage you to work with your fellow classmates after you first try solving the problems on your own. When you work together, you will solve problems in a way you had not thought of before, but you will also need to practice solving problems solo.

After you solve a problem, look over your answer to make sure that you understand the mathematical steps and physical picture. *Each equation tells a story – we will create these stories together. This story telling is what make thermodynamics and kinetics meaningful.*

If your problem set solutions are not neat and readable, please copy over your answers on a new sheet of paper. The grades on problem sets will reflect not only your final answer but also the clarity and neatness of your solution. Although I encourage you to work together in solving problems, the solutions you submit should be your own.

Please also fully utilize our office hours. I will linger after each class to answer any questions. And please, please ask questions during class, especially if you are confused.

Grading Scheme

My goal is for everyone to learn thermodynamics and kinetics, to appreciate their importance, and to earn a good grade. Historically, the average GPA for chem 561 is about 2.85, with similar numbers of grades in the categories of (A + AB) and (B + BC).

Electronic data websites: http://webbook.nist.gov/chemistry/ for molecular properties
See also www.library.edu/chemistry/ for links to the CRC, Web of Science, and Scifinder Scholar. You can download the PHET demos at https://phet.colorado.edu.