

# UTAH STATE UNIVERSITY

## CHEMISTRY 3070

### SPRING SEMESTER 2008

Instructor: Alexander I. Boldyrev

Office: ML 369

Email: boldyrev@cc.usu.edu

Class times:            ML151                            MWF            9:30-10:20

Office hours:            ML369                            MW            2:00-4:00

I will be happy to make appointments with anyone who has unavoidable conflicts at these times. The best way to contact me outside office hours is by email.

**January 28 – last day to receive tuition refund; January 28 – last day to add classes; January 28 - last day to drop w/o notation on transcript; January 29 – March 7 – drops show as “W” on transcript, March 8 – April 1 - drops require a late drop form (WF on transcript); April 1 – last day to submit petition for late drop form.**

**The final exam will be given at 9:30-11:20 am in ML151, on Monday, April 28.**

**There are no classes on January 21, February 18, and March 10-14.**

## CHEMISTRY 3070 PHYSICAL CHEMISTRY

### Syllabus

Spring Semester 2008

In accordance with the Americans with Disabilities Act, reasonable accommodation will be provided for all persons with disabilities in order to ensure equal participation in this course.

---

**Text:** Physical Chemistry (5-th edition) by Ira N. Levine.

I will make reading assignments from the text. You are responsible for studying all the material in these assignments even if it isn't covered in lectures.

---

### **Important information regarding Math Prerequisites:**

Physical chemistry is a course in chemistry not mathematics; however, weak math skills can cause considerable difficulties for students. The mathematical tools needed for physical chemistry are not very advanced, but it is vitally important that the student is able to use them well. In particular, multivariable calculus is used extensively in the course, so **if you have not completed Math 2210 (old Math 320) or an equivalent course, you MAY NOT register for Chem 3060 WITHOUT PERMISSION OF THE INSTRUCTOR.** In the interest of fairness, grading cannot take into account math weaknesses.

---

## Learning Objectives for Physical Chemistry

Divisional level learning objectives in physical chemistry are as follows. After completing the course students will be able to:

1. Define the rate of a reaction. Understand the definition of a rate constant and rate coefficient. Integrate the rate equation for simpler systems.
2. Understand the Schrodinger equation as an eigenvalue equation. Solve Schrodinger equation for some simple systems.
3. Formulate and solve the Schrodinger equation for the hydrogen atom. Understand how the hydrogen atom forms the basis for the electronic structure of the polyatomic atoms.
4. Write the Hamilton operator for a molecular system. Appreciate the types of wave functions that are obtained for various chemical bonds.
5. Understand the fundamental ideas of group theory as applied to molecules.
6. Understand the principles of molecular-orbital theory as applied to molecules.
7. Describe the principles of atomic adsorption and emission spectroscopy and the use of term symbols to describe atomic states.
8. Understand how spectroscopic studies in different regions of the spectrum probe different types of molecular transitions: rotational, rotational-vibrational, and electronic.
9. Understand that thermodynamics gives relationship between macroscopic observables and that these can be evaluated using statistical mechanics.
10. Clearly define the conditions of the kinetic-molecular theory and be able to calculate the pressure of an ideal gas from its premises.
11. Realize that the partition function is the most fundamental quantity available in equilibrium statistical mechanics, and that from the partition function all thermodynamic observables can be calculated.
12. Use the molecular partition function to obtain expression for equilibrium constants.
13. Understand the basics of X-ray crystallography and Bragg equation. Explain the basis ideas behind the bond model and the bend model of solids. Understand ionic crystal energy in relation to the Born-Huber cycle.
14. Relate the properties of liquids to those of gases.
15. Describe the different theories that explain the liquid state.

## Assessment

Assessment of student learning will be performed via gain-score exams. A gain score test (GST) is a method of assessing how well a course transmits knowledge and understanding of critical concepts. Two tests will be administered at the start and end of the course. Grading is anonymous. You may not keep a copy of this test and correct answers will not be supplied except upon request after the GST at the end of the semester has been done. You should not include any identifying information on the scantron.

Course content: The following topics will be covered:

Reaction Kinetics  
Quantum Mechanics  
Atomic Structure  
Molecular Electronic Structure  
Spectroscopy and Photochemistry  
Kinetic Theory of Gases  
Statistical Mechanics  
Theories of Reaction Rates  
Solids and Liquids

---

**Homeworks:** Homework assignments will be given at every lecture. I encourage you to work out every assignment before the next lecture. Homework will not be graded, but on every lecture there will be a short quiz which may contain one modified problem from the previous homework.

---

**Quizzes:** There will be approximately 30 short quizzes during lecture time (about 5 minutes). Every quiz will yield 5 points maximum.

---

**Exams:** There will be two one hour exams given during the regular class period. These will cover only chemical thermodynamics, each will yield 100 points maximum. The final exam will be comprehensive, covering material from the entire course. It will yield 150 points maximum.

**The first midterm exam will be given at the scheduled time on February 10.**

**The second midterm exam will be given at the scheduled time on March 7.**

**The final exam will be given at 9:20-11:20 am in ML151, on Monday, April 28 and WILL NOT be given early to accommodate travel arrangements, so plan accordingly.**

All exams are closed book. A typical exam will consist of 100 points worth of short answer questions that ask you to define important terms or state important principles introduced since the last exam.

**THERE WILL BE NO MAKE-UP EXAMS.** Arrangements to compensate for a missing exam may be requested only with verifiable medical certification.

---

**Grading:** The course grading is based on approximately 500 total points.

- I. Exams - 350 points total
- II. Every quiz will yield 5 point (total approximately 150 points).

**Final grades:** Final grades are computed by setting the dividing line between **B-** and **C+** at either 80% of the possible total points or the class average for total points, whichever is lower. The other grades are then assigned in proportion.

---

**Obtaining help:** I discourage the use of solution manuals or workbooks because they will fool you into thinking you know how to work the problems when you don't. The same applies to the answers given in the back of the text. **Too much reliance** on these makes it easy to fall into the **dangerous habit** of mindlessly plugging numbers into formulas until you obtain the given answer. This **does not constitute understanding** and will lead to **disaster** on exams where you will not know the answer you are supposed to obtain!

Collaborating on the problem sets is not forbidden and a certain amount can be helpful, **but you must learn to work the problems on your own, or you won't be able to pass the exams.**

I am more than willing to assist you with the problems; this is largely what my office hours are for. I only ask that you observe a few ground rules:

1. I won't give out help over the telephone or the internet.
2. When you come to see me, please be prepared with specific questions. ("I don't understand" is not a question.) There are only two questions (and all variations thereof) that I won't answer, "How do you work this?" and "Is this right?". Otherwise, any question is permissible, including questions having nothing to do with the problem sets. For example, you may wish to ask about unclear points in the lectures or reading assignments.
3. If you have a question about a problem, bring a calculator and any partial work you have completed on the problem as well.