UTAH STATE UNIVERSITY

CHEMISTRY 3070

SPRING SEMESTER 2017

Instructor: Alexander I. Boldyrev

Office: ML369

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Class times:	Widtsoe330	MWF	9:30-10:20
Office hours:	ML369	M	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 30 (5:00 PM) – last day to receive tuition refund; January 30 (5:00 PM) – last day to add classes; January 30 (5:00 PM) - last day to drop w/o notation on transcript; January 31 – March 23 – drops show as "W" on transcript, March 23 – Last Day to Withdraw from Classes (W on transcript).

The final exam will be given at 9:30-11:20 am in EBB214, Monday, May 1.

There are no classes on January 16, February 20, and March 6-10.

CHEMISTRY 3070 PHYSICAL CHEMISTRY

Syllabus

Spring Semester 2017

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.

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Text: Physical Chemistry (5-th or 6-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.

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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 3070 WITHOUT PERMISSION OF THE INSTRUCTOR**. In the interest of fairness, grading cannot take into account math weaknesses.

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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. Calculate ε^o of a cell's reaction using $\Delta G^o = -nF\varepsilon^o$.
2. Calculate ΔG^o, ΔS^o, and ΔH^o of a cell's reaction from ε^o versus T data.
3. Define the rate of a reaction. Understand the definition of a rate constant and rate coefficient. Integrate the rate equation for simpler systems.
4. Understand the Schrodinger equation as an eigenvalue equation. Solve Schrodinger equation for some simple systems.
5. 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.
6. Write the Hamilton operator for a molecular system. Appreciate the types of wave functions that are obtained for various chemical bonds.
7. Understand the fundamental ideas of group theory as applied to molecules.
8. Understand the principles of molecular-orbital theory as applied to molecules.
9. Describe the principles of atomic adsorption and emission spectroscopy and the use of term symbols to describe atomic states.
10. Understand how spectroscopic studies in different regions of the spectrum probe different types of molecular transitions: rotational, rotational-vibrational, and electronic.
11. Understand that thermodynamics gives relationship between macroscopic observables and that these can be evaluated using statistical mechanics.
12. Clearly define the conditions of the kinetic-molecular theory and be able to calculate the pressure of an ideal gas from its premises.
13. 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.
14. Use the molecular partition function to obtain expression for equilibrium constants.
15. 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.
16. Relate the properties of liquids to those of gases.
17. 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. 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.

Course content: The following topics will be covered:

Electrochemical Systems
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, each will yield 100 points maximum. The final exam will be comprehensive, covering material from the entire Chem 3070 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 10.

The final exam will be given at 9:30-11:20 am in EBB214, on Monday, May 1 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 <u>NO</u> 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 than assigned in proportion.

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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.