Chemistry 384: Introduction to Physical Chemistry II, Spring 2009

http://www.cem.msu.edu/~beck/CEM384

Instructor and Teaching Assistants

Professor Warren F. Beck: *email:* beckw@msu.edu; office, 3 Chemistry; office hours: 4–5 pm MWF after lectures, and additional hours *ad libitum* and/or by appointment.

TAs: Kevin Dillman and Yves Coello

Schedule

Lectures: 3:00–3:50 pm MWF, 1415 BPS.

Section 001: Monday, 11:30 am–12:20 pm, 281 Chemistry.

Section 002: Tuesday, 11:30 am–12:20 pm, 085 Chemistry.

Section 003: Tuesday 12:40 pm–1:30 pm, 085 Chemistry

Test #1: Monday, 9 February 2009, 3:00–3:50 pm, 1415 BPS

Test #2: Monday, 23 March 2009, 3:00–3:50 pm, 1415 BPS

Test #3: Monday, 20 April 2009, 3:00–3:50 pm, 1415 BPS

Final Examination: Thursday, 7 May 2009, 3:00–5:00 pm, 1415 BPS

Textbook and Goals

Peter Atkins and Julio de Paula, *Physical Chemistry for the Life Sciences*, New York: W. H. Freeman, 2006. The course will primarily cover selections from sections III and IV of this text (quantum mechanics, electronic structure, spectroscopy, and statistical mechanics) but additional material from other texts will be presented in lecture. The course will provide a physical basis for the models used to define the structure and properties of small and large molecules; a particular interest will be taken in the structure and dynamics of biological macromolecules, so the course will be taught from that perspective throughout.

Outline

1. Principles of Quantum Mechanics
   (a) Quantization and wavelike behavior of matter and radiation
   (b) Classical Mechanics: harmonic oscillator
   (c) Postulates of Quantum Mechanics
   (d) Particle-in-a-box problem
   (e) Harmonic and anharmonic oscillators
   (f) Rigid-rotor problem
   (g) Hydrogen Atom
   (h) Angular Momentum
2. Chemical Bonding and Electronic Structure
   (a) Many-electron atoms
   (b) Covalent bonding: valence and molecular orbital theories
   (c) Intermolecular forces: hydrogen bonds, van der Waals interactions
   (d) Diatomic molecules
   (e) Polyatomic molecules
   (f) Biological macromolecules

3. Statistical Thermodynamics
   (a) Statistics and Entropy
   (b) Boltzmann distribution
   (c) Partition function
   (d) Thermodynamic properties
4. Spectroscopy and Crystallography
   (a) Vibrational Spectroscopy
   (b) Electronic Spectroscopy
   (c) Magnetic Resonance Spectroscopy
   (d) Crystallography: X-ray, electron, and neutron diffraction

Course Rules

Students are required to take the tests and the final examination during the scheduled class or examination period. Absences for the tests will be approved for religious holidays and for University-sponsored activities, such as a road trip for a varsity sports team. The student is required to provide Professor Beck advance notice of the planned absence in writing. Notice of illness on a test day must be substantiated after the fact by a note from a doctor or nurse. Absences will *not* be approved for discretionary travel and other personal scheduling confects. The score for a missed test will be obtained from the final examination percentage if the absence is approved by Professor Beck.

The final examination will be conducted as a closed-book exercise with comprehensive coverage of the course material. Students are reminded of the MSU Final Examination Policy outlined under "General Information, Policies, Procedures and Regulations" in *Academic Programs* that an absence from a final examination will result in a course grade of 0.0 and that the student must notify the associate dean of the student's college if an absence from the final examination occurs.

Discussion Sections and Homework Problems

The discussion sections provide a weekly question-and-answer session that can be used by the students to discuss the reading assignments, lecture material, and homework problems. From time to time the TAs will provide additional detail on the lecture content. The discussion sections will not meet the first week of classes nor during the weeks of the hour tests.

Homework problems will be assigned during the lectures; the collected problems for each week can be downloaded from the course web site. The problem sets will be due on Wednesdays at the beginning of lecture.

Course Grade

The course grade on the 0.0–4.0 scale will be determined from the final course percentage on an absolute scale. The course percentage will be calculated as follows: sum of homework scores and in-class quizzes, 15%, with the lowest two papers dropped from the sum; sum of three tests (60%), and final examination (25%). The following scale will be used to assign the grades: 4.0 for >87%; 3.5 for >80%; 3.0 for >73%; 2.5 for >66%; 2.0 for >59%; 1.5 for >52%; 1.0 for >45%; and 0.0 for >45%. At his discretion, Professor Beck may *lower* the percentage breakpoints in order to *raise* the average grade for the class.