SYLLABUS
CHEMISTRY 329, Physical Chemistry Laboratory
rooms 350 and 335 NSC, Fall 2007

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Text Book

There is no required textbook. Extensive notes for experiments, lab lectures, and special projects will be distributed. Students should maintain these notes in a three-ring binder.

Course Content

Students are required to perform five experiments, submit a Lab Report for each of these, and attend related lectures. In addition, students may carry out any one of the optional Special Projects. There are no exams or quizzes.

Course Grade

Each of the five experiments and related Lab Report are weighted equally in determining the course grade. A student who conscientiously attends all assigned lab and lecture sessions, and responsibly prepares the five Lab Reports will earn a grade not lower than a $C+$, and possibly as high as $A-$. Completing an optional Special Project can not lower, and usually will raise, a students grade. The Special Project is required for a course grade of A. 10% of the course grade is based on the joint-instructor-TA general evaluation of a student's performance during the semester.

Lab Reports

Preparation of the Lab Report is a major component of che 329, equally important as performance of the experiment itself. Note that technical writing will most likely be an essential part of your future professional experience whether you work in industry, academia, or government laboratories. Treat an assigned Lab Report as preparation for this. Students work in pairs in the laboratory, and in the preparation of the Lab Report. The two lab partners submit one jointly-prepared Lab Report, which is due two weeks after the day the experiment is performed.

Lectures

Attendance is required at lectures scheduled on days for which a student is not assigned to perform one of the five lab experiments. Lecture subjects include physical chemical

background relevant to assigned experiments, mathematical statistics, and methods of error analysis. These are also opportunities for students to discuss Lab Reports, either Reports in preparation or Reports that have been submitted, graded, and returned. Lecture days later in the semester will also be the occasion for student presentations of Special Projects.

Error Analysis

When reporting the measured value of a physical quantity the Report should include the numerical value (with physical units) of the measured quantity, and a quantitative estimate of the reliability of that numerical value.

Required Lab Experiments

1. **Carbon dioxide critical point** The goal of this experiment is to determine the critical temperature and density of carbon dioxide, and the liquid-vapor coexistence curve (temperature vs density) in the region just below the critical point, and relate the results to Wilson's theory of critical exponents.
2. **Virial coefficients of real gases** The goal of this experiment is to measure the second and third virial coefficients of carbon dioxide and helium at a temperature near room temperature.
3. **Bomb calorimetry** The goal of this experiment is to measure heat of combustion using a Parr adiabatic calorimeter, and determine related enthalpy changes.
4. **FTIR** The goal of this experiment is to understand the principles of the Fourier transform spectrometer, to measure the infrared absorption spectrum of a mixture of four isotopes of hydrogen chloride gas, assign the spectrum, interpret the spectrum in terms of quantum mechanical energy levels, and extract from the spectrum values of the following spectroscopic constants: harmonic vibration frequency, force constant, moment of inertia, vibration-rotation coupling constant , and anharmonic constant.
5. **NMR Spectroscopy** The goal of this experiment (demonstration) is to better understand the underlying physical principles of nuclear magnetic resonance spectroscopy, and gain familiarity with the Chemistry Department's high resolution instrument.

Optional Special Project

Students may chose any one from a list of Special Projects related to the five required lab experiments, *e.g.* computation of a virial coeficient from a quantum mechanically computed, intermolecular interaction potential. Each Project is to be performed by a team consisting of one to five students. Some Projects are more appropriate for a small team, others for a larger team. Students form their own teams, not necessarily preserving the student pairs that worked together on the five required lab experiments. All Special Projects have theoretical or computational components. Some also have a laboratory experimental component. In that case some team members may assume major responsibility for the experimental component while others assume major responsibility for the computational component. In any case, team members must collaborate and jointly prepare a written Project Report and a class presentation. Students who opt to perform a Special Project should choose their Project and form their team as soon as possible, but no later than the last week in October.