CHEM 153: Physical Chemistry Laboratory  
Preliminary Course Syllabus

General information:
CHEM 153 introduces students to modern laboratory instrumentation and experimental techniques in physical chemistry. It consists of a number of experiments that use different techniques to explore fundamental concepts in spectroscopy, kinetics, and chemical thermodynamics. Students learn the fundamental physical principles behind each technique, use instruments to measure physical properties, and evaluate the data critically. This course is also intended to develop scientific writing skills by requiring two fairly detailed laboratory reports in scientific paper format.

Course learning outcomes:
After completing this course successfully, students will be able to:

- Explain the physical and chemical principles behind a number of common modern physical laboratory techniques;
- Operate and obtain accurate data from a number of common instruments used in modern physical chemistry research;
- Select the best experimental technique to answer specific questions in physical chemistry;
- Interpret instrumental data to obtain desired information and analyze sources of error;
- Write clear, concise, scientifically and grammatically correct laboratory reports that include appropriate citations to the chemical literature.

Instructor:
TBA.

Meeting times and location:
Six hours per week, times TBA, room SE 103.

Prerequisites:
One semester of quantum chemistry and spectroscopy (CHEM 112 or equivalent) is required. One semester of thermodynamics and kinetics (CHEM 113 or equivalent) is recommended and may be taken concurrently.

Required materials:
No textbook is required, but the following is suggested as a resource:
The following materials are required:
- A bound laboratory notebook (duplicate pages not required). Although most of the instruments record the data on a computer, a notebook is still needed to record information associated with preparation of the samples as well as observations while performing the experiments.
- Laboratory safety goggles, available at the bookstore.
- A USB flash drive for transferring and backing up electronic data. You don't need a separate one dedicated to this course; it can be shared with other uses.

Course Web site:
The CHEM 153 web site is part of the UCMCROPS course management system and will be automatically available to all students enrolled in the class (https://my.ucmerced.edu). The web site will contain the course syllabus and all of the experiment writeups.
Course structure:
The course consists of seven experiments, each addressing a different technique. Two or three experiments will be set up at the same time, with some students working on one experiment first and some on the other. Each set of experiments is allocated four to six class periods depending on its length and complexity. Students will work individually on some experiments while others will be done in groups of two or three assigned by me. If you are working individually you are allowed and encouraged to discuss the experiment with other students and exchange information, but each student must obtain his/her own data and be responsible for conducting the experiment correctly.

You are expected to read and think about the procedure for each experiment before coming to lab. Any preliminary calculations that are required should be completed before you come to lab.

Each student will write a lab report for each of the seven experiments. The lab reports are to be prepared individually even if the experiment was done with partners. Each student will write five "short" reports and two "long" reports. The formats for short and long reports will be given in the first week of the course. Different students will be assigned different experiments for their long reports, and those assignments will also be made during the first week of the course. Each report will be due seven days after the last day on which that experiment is done (see schedule). Some of the experiments may not require the full time allotted. Also, there will be times when you will have to wait for an instrument that is being used by others. You are encouraged to work on your lab reports during any extra time you have.

No exams or quizzes are planned. However, for each experiment I will also assign each student either zero, one, or two points for actual performance in the lab: being prepared ahead of time, following safety precautions, cleaning up after yourself, and (for the experiment performed with partners) doing a fair share of the work of the group.

Grading:
Each laboratory report will be assigned a letter grade (A, B, C, D, or F). The grade will be based on the quality of the data and its presentation, the correctness of your analysis and interpretation, and the adequacy of your references. The long reports will also be graded partially on proper scientific paper format and clear, grammatically correct English. Your final grade for the course will be an average of the grades earned for each experiment, with long reports weighted twice as heavily as short reports. You will also receive a letter grade, equivalent in value to one short report, for your overall "citizenship" in the lab. This includes coming to class on time, keeping your working area neat, following appropriate safety practices, cleaning up after yourself, and doing your fair share of the work when working in groups.

Academic honesty:
In order for science to progress, scientists must be able to rely on one another to report their procedures and results honestly and accurately. It is also important to give appropriate credit in written work to others for procedures employed or ideas used. Students in CHEM 153 are expected to be familiar with and adhere to UC Merced’s academic honesty policy (go to http://studentlife.ucmerced.edu/, click on “Student Judicial Affairs” and then “Academic Honesty Policy”).

Students with disabilities:
UC Merced is committed to ensuring equal academic opportunities and inclusion for students with disabilities. If you have a disability, please come to my office hours or make an appointment to discuss appropriate academic accommodations that you may require. Requests for such accommodations are to be made during the first three weeks of the semester, except for unusual circumstances. Students with disabilities are encouraged to register with Disability Services Center (KL 109; disabilityservices@ucmerced.edu) to verify their eligibility for appropriate accommodations.
Schedule of experiments

Expt. 0
Treatment of experimental data; writing laboratory reports; searching the chemical literature.

Expt. 1
Analysis of molecular structure through vibrational spectroscopy and electronic structure calculations.

Expt. 2
Bomb calorimetry.

Expt. 3
Excited state structure and photophysics through electronic absorption and fluorescence spectroscopy.

Expt. 4
Surfactant behavior and micelle formation through dynamic light scattering.

Expt. 5
Chemical kinetics by UV-VIS.

Expt. 6
Differential scanning calorimetry and phase transitions.

Expt. 7
Pulsed NMR: $T_1$ and $T_2$ of water doped with paramagnetic ions.