Chemistry 3090
Physical Chemistry Laboratory II
Spring 2019

Course Name: Physical Chemistry Laboratory II

Time/Location: T or H 2:30-5:20 p.m. MCL-350/354

Instructor: Stephen Bialkowski *Office* MCL-359 *Phone*: 7-1907, email: stephen.bialkowski@usu.edu

Teaching Assistant: Abram Bernard abram.bernard@gmail.com

Office Hours: During the laboratory, meeting by appointment or using email.

Text: *Experiments in Physical Chemistry 8th Edition,* C. W. Garland, J. W. Nibler and D. P. Shoemaker, McGraw-Hill (2009)

Materials: Bound laboratory notebook, safety goggles; laboratory coat highly recommended, pencil, pen, etc.

Course Content: This course consists of 8 laboratories. Laboratories include experiments in kinetics; electric, magnetic and optical properties or substances; several types of spectroscopy; and perhaps some solid state thermodynamics.

Examinations: Course performance will be evaluated based on 8 formal laboratory reports that are written using the data obtained during the laboratory session, calculations and supporting information, laboratory notebook and digital data integrity checks, and a short final quiz.

Grading: Grades are based on scores obtained on individual laboratory reports**,** the student's laboratory notebook, and a final quiz. Each laboratory report has a maximum score of 10 points. The two laboratory notebook and data integrity checks will count 5 points each. The final quiz is 10 points**.**

Maximum Points	**Task**
80	8 Experiments
10	Laboratory notebook and data checks
10	Oral Presentations**
100	**Total Points**

The maximum letter grade ranges will be: A, 90-100%; B, 80-89%; C, 70-79%; D, 60-69%. The rages may be lowered but will not be raised. Plus (+) and minus (-) grade modifier will be used. The upper 1/3 of a letter grade % range will be assigned (+), the lower 1/3 will receive a (-) modifier.

Laboratory Reports: Laboratory reports are due two weeks after the laboratory is finished. Read Chapter 1 in the text book for information regarding the format of these reports. Reports are typically 6-8 pages and are typed (printed). The use of a computer to prepare the reports is recommended. Each student writes their own report.

Treatment of Experimental Data: Chapter II is an overview of the statistical treatment of experimental data. Much of this was addressed in the Chem 3000 lecture but it is good to review this all the same. New material covered in this chapter deals with the propagation of uncertainty. A mini-lecture will be given on this as an aid to learning this important material.

Scientific Computer Software: Chapter III discusses the use of computer software for data collection and analysis. Of course we also use computers for preparing laboratory reports. Students will have the opportunity to work on spreadsheets and other scientific software with the TA or the professor.

Oral Communication Skills: There will be two oral presentations during the semester

> Presentation 1 will follow the first laboratory experiment. Each group will prepare a 10-15 min presentation on the lab they were assigned for Week 1. This presentation will consist of an introduction of the physical chemistry concepts, a detailed experimental procedure (including tips and tricks for avoiding pitfalls), and finally a discussion of their results. The purpose of this is to practice communication of experimental results, open a discussion to aid in the preparation of your first lab report and finally to prepare other groups for performing the experiment.
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> Presentation 2 will occur following the completion of all laboratories. Each group will select one of the courses experiments and prepare a presentation/discussion of the experiment. This presentation should include a thorough discussion of the physical chemistry principles and properties measured during the experiment, a discussion on the results obtained by the 4 groups this semester and a proposal for improving the accuracy of the experimental measurements/procedure.

Experiments: Students will work in groups of 2 to 4 (depending on enrollment). The department has the equipment for students to perform laboratories taken from the textbook. The following is a list of laboratories performed this semester.

X. Chemical Kinetics

20. Method of Initial Rates: Iodine Clock

XIII. Electric, Magnetic and Optical Properties

29. Dipole Moment of Polar Molecules in Solution
---- Measuring Solvent Polarity with Reichardt's Dye
32. NMR Determination of Paramagnetic Susceptibility

XIV. Spectroscopy

34. Raman Spectroscopy: Vibrational Spectrum of CCl_4
37. Vibrational-Rotational Spectrum of HCl and DCl
39. Absorption Spectrum of Iodine (no emission spectrum)
41. NMR Determination of Keto-Enol Equilibrium Constants
45. Spectroscopic Properties of CdSe Nanoparticles

Withdrawal Policy: This course will follow the University policy on withdrawals stated in the current Undergraduate Catalog. Drop dates are listed in the Schedule of Classes.

Missed Examination Policy: Students may be excused from a laboratory in cases of emergency. Documentation must be supplied to be excused. In cases of excused absence, grades will be assigned based on % of adjusted total score. For other absences, late assignments will be penalized 10% of the

maximum score per meeting day to a maximum of 50%. No repetition of experiments is permitted once a result is submitted.

Attendance Policy: Attendance is mandatory for successful performance in this course. Attendance is monitored through laboratory notebook checks.

Student Disability Statement: Any student with a disability that requires accommodations must contact the Instructor. The disability must be documented by the Disability Resource Center. Course materials may be requested in alternative formats.

Laboratory Fee Statement: A laboratory fee is required for this course. Laboratory fees for this course are used for the purchase of equipment and supplies and to help pay teaching assistants.

Assessment Statement: The purpose of the physical chemistry laboratory is to learn laboratory procedures to measure physical properties of chemicals and to interpret these measurements with the theories describing the phenomena. Laboratory learning objective performance is evaluated through the formal written reports describing the experiments and data analysis.

Learning Objectives:

- Understand laboratory and chemical safety
- Comprehend concept of and perform chemical measurement calibration
- Relate the microscopic and macroscopic properties of matter to each other
- Use statistical methods for evaluating and interpreting data
- Assess sources of error in chemical and instrumental analysis and account for errors in data analysis
- Demonstrate competency in written and oral communication using mathematics if needed
- Comprehend the importance of stoichiometry, chemical equilibrium and kinetics
- Apply thermodynamic, kinetic and quantum methods in an integrated way in all areas of chemistry and biochemistry