Sample Syllabus

CHEM 457 - Experimental Physical Chemistry
Fall 2008

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Office hours: Mon 2:00-4:00 pm or by email appointment

Course Website http://courses.chem.psu.edu/chem457/
ANGEL website https://cms.psu.edu

Prerequisite Introductory level physical chemistry course for chemistry majors
(Such as CHEM 451 at Penn State or the equivalent)

Course Schedule

Section 1:	Tuesday 8:00 am - 11:00 am
Section 2:	Tuesday 11:15 am - 2:15 pm
Section 3:	Tuesday 2:30 pm - 5:30 pm

The detailed course schedule including project due dates will be posted to the course web and ANGEL website.

Course Location 332 Whitmore

Required Materials

You MUST have the following 4 items before you can be checked in to lab:

1. CHEM 457 lab packet
2. Lab Notebook with alternate tear-out carbonless copy pages
3. A three-ring binder
4. Approved safety GOGGLES

Optional but recommended: Scientific calculator

Course Description

This course is designed to reinforce the theoretical physical chemistry courses with the introduction of physical chemistry application in a laboratory environment. Placing the abstract concepts from a theory into an experimental framework will improve your understanding of physical chemistry. Eight experiments will cover different physical chemistry topics ranging from kinetics, thermodynamics, and surface chemistry to spectroscopy. Analysis of collected experimental data includes statistical error analysis and estimation of uncertainties, writing reports, oral presentation and poster presentation. In addition, students will have the chance to work on a special project to demonstrate their critical scientific thinking skills by reviewing literature, designing experiment, writing report in the format of journal paper, and presenting a poster in verbal scientific language.

Course Goals

- To develop good laboratory techniques and skills in performing physical chemistry experiment
- To be familiar with error analysis
- To gain the skills of presenting experimental results in a logic way with high scientific quality
- To show critical scientific thinking and independence

Course Objectives

- Students will operate experimental equipment and instrument properly, record data accurately, keep lab workspace clean and organized, and work safely after demonstrations and lectures.
- Students will practice error analysis and estimation of uncertainties in homework assignment after lecture and then apply error analysis method to experiment data for each experiment.
- Students will fully analyze and present the experimental results in a logic and clear way. The student will explain what is learned from the experiment and what parts of the experiment can be improved.
- Students will search and review literature, design the experiment, execute the experiment, and report results in both written and oral format independently by working on a special projects

Course Format

The class time will mainly be experiments performed by 2-3 people groups under structured but flexible atmosphere. The instructor will give mini-lectures and/or demonstrations before each experiment and after that your TA will be circulating around the lab the whole time and ready to

provide any help. Data collected from experiment will be analyzed and reported after class by the students. There will be time in class for group discussion to address issues related to data analysis, report writing, and oral/poster presentations.

Course Requirements

You need to complete two homework, eight experiments and a special project to fulfill the requirements of this course. For each experiment you need to complete the pre-lab quiz and in-lab questions. Three out eight experiments are required to be written in full lab report format, and one experiment requires an oral presentation along with the supplementary information. Special projects are to be reported by a full lab report and a poster presentation. Only special projects report and the poster presentation will be submitted per group basis and all the remaining will be submitted individually.

- Homework Assignments: There will be two homework assignments related to error analysis.
- Pre-lab Quiz: Student will take pre-lab quiz after lecture and before starting real experiment. Those quizzes are designed to help you read lab materials and prepare for the experiment. Each quiz has 3 questions with multiple choice answers.
- In-lab Questions: Student will need to answer the in-lab questions during experiments and turn them in to your TA before leaving the lab.
- Lab Notes and Evaluation from TA: Lab notes are the records of your observation and data during the whole experiment. You need to hand in a copy of the primary data collected during the experiment to your TA before leaving the lab. TA will also evaluate your lab performance by his/her own observation.
- Full Lab Reports: These reports will be submitted to your TA or instructor two weeks later upon the completion of the experiment. Although students work in groups, reports must be prepared individually. Full lab report will be the format of a journal paper. Please refer your lab manual for details about full lab report format.
- Short Lab Reports: These reports will be submitted to your TA or instructor one week later upon the completion of the experiment. Although students work in groups, reports must be prepared individually. Short lab report will be less formal, and please refer to your lab manual for details about short lab report format.
- Supplementary Information: this part will include sample calculations, error analysis and report questions.
- Special Project: Students will undertake a special project. The aim of this project is to carry out small independent research by students themselves. The project can either be an extended version of one of the standard experiments or something unique. More information will be provided in the 3rd week of the semester.

Grades

Grades will be based on approximately equal weighting of 8 experiments, a special project, and error analysis homework. Each student has the ability to acquire a total of 2000 points for the semester. The points are distributed as noted below:

Activities	Assignments	Pts per assignment
8 Experiments:	Pre-Lab Quiz	10
	In Lab Questions	15
8 Experiments and Special Project:	Lab Note	20
	Supplementary Information	30
	Evaluation from TA	25
3 Experiments and Special Project	Full Report	125
4 Experiments	Short Report	75
1 Experiment	Oral Presentation	125
Special Project	Proposal	50
	Poster	50
2 Error Analysis Set	Homework	50
	Total	**2000**

In addition a student may get 45 extra points by participating in-class surveys and ungraded quizzes.

The grade cut-offs for this semester are as follows

Points	Grade
< 900	F
900-1209	D
1210-1449	C

1450-1529	C+
1530-1609	B-
1610-1689	B
1690-1769	B+
1770-1849	A-
1850-2000	A

Attendance

Each student is expected to be in the lab at the beginning of each session and to remain in the lab for all the scheduled time unless explicit instructions to the contrary are given. A grade of zero will be assigned for any laboratory missed unless permission for a make-up has been given. If students have a **legitimate** excuse for missing a lab, they will have a chance to attend a special make-up experiment which will be held during your normal lab period on the week before final exam week.

Lab Policy

- Wear appropriate clothing: Lab is potentially a messy experience. A T-shirt, blue jeans and shoes (or sneakers) would be reasonable. NO sandals allowed. We reserve the right to send you home to change if you are not dressed appropriately.
- NO food or drink inside the lab.

Academic Integrity

Academic Integrity is an essential component of your education. The following is quoted from the "PSU Faculty Senate Policies for Students" and defines academic integrity as "the pursuit of scholarly activity free from fraud and deception and is an educational objective of this institution. "Academic dishonesty" includes, but is not limited to, cheating, plagiarizing, fabricating of information or citations, facilitating acts of academic dishonesty by others, having unauthorized possession of examinations, submitting work of another person or work previously used without informing the instructor, or tampering with the academic work of other students." All University and Eberly College of Science policies regarding academic integrity/academic dishonesty apply to this course and the students enrolled in this course. Refer to the following URL for further details:

http://www.science.psu.edu/academic/Integrity/index.html .

Matters of academic dishonesty will be turned over to the University disciplinary system and may result in the failing of the course.

If you have any questions, please not hesitate to contact the course instructors.

Outline of experiments

Resonance Energy of Naphthalene by Oxygen Bomb Calorimetry

The resonance energy of naphthalene will be determined by calculating its standard enthalpy of combustion both experimentally using bomb calorimeter and by using bond energies.

Dissociation of a Propionic Acid Vapor

The equilibrium constant for the dissociation of propionic acid dimer in the vapor phase will be determined as a function of temperature. From this data, thermodynamic constants and enthalpy and entropy changes will be calculated. The change in enthalpy is a measure of the strength of the hydrogen bonds in the dimer.

Fe^{+3} - Tiron Kinetics I

The rate law and rate constant for the formation of the iron(III) - Tiron complex at pH 5.5 and 25^{o}C will be determined using the rate of change of the complex's absorbance with time.

Fe^{+3} - Tiron Kinetics II

The temperature dependence of the formation of the iron(III) - Tiron complex will be explored. From these data, the activation energy for the process will be determined as well as the equilibrium constant, ΔG^{o}, ΔH^{o}, and ΔS^{o}.

Solid-Liquid Phase Diagram of a Mixture

A phase diagram of mixture of organic solids will be constructed using the cooling curve data for different concentrations of the mixture. The eutectic point of the mixture and the heat of fusion of each component will be calculated.

The Rate Constant for Fluorescence Quenching Via the Stern-Volmer Mechanism

The quenching rate constant, k_q, for the quenching of anthracene by carbon tetrachloride will be determined. A Stern-Volmer plot will be constructed to find an experimental k_q. The fundamental principles of fluorescence measurements and quenching will be covered.

Adsorption from Solution

An adsorption isotherm will be constructed for the adsorption of acetic acid onto charcoal. Using this isotherm, the surface area of the charcoal will be determined. The relation between adsorption and surface chemistry will be introduced.

Modeling Stretching Modes of Common Organic Molecules with the Quantum Mechanical Harmonic Oscillator

The use of the harmonic oscillator model to interpret a vibrational spectroscopy will be introduced. Using a refined value for the effective single-bond force constant, stretching mode frequencies will be estimated to within about ±10% with a simple calculation.