Chemistry 303: Physical Chemistry Laboratory

Department of Chemistry and Biochemistry, Loyola University Chicago

Spring 2013

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Office Hours:	TR 10:30 – 11:30 am, or by appointment (FH 103)
Lab:	M, 8:30 am – 12:30 pm Flanner 315 or as otherwise noted
Teaching Assistant:	Jon Derouin
	W 11:30-12:30, or by appointment

Course Prerequisites: A grade of C- or better in Chemistry 301. If you have not completed the course prerequisite, you may be administratively dropped from the class. Please discuss this with the instructor immediately!

Please see the backboard site for up-to-date information and posts.

A bound lab notebook is *required*. ALL data, calculations, graphs, and work must be written in the notebook. You must have such a notebook for the first lab.

Course Overview

This course will introduce laboratory techniques and analysis central to physical chemistry. We will pursue the following activities:

1) The quantification of information in experimental data. Mass spectra, IR spectra, and proteins will be the objects of interest.
2) The statistical analysis of experimental data: strategies for dealing with uncertainty. Measurements will focus on solution densities, crystallization velocities, electrochemical potentials, and evaporation rates.
3) The application of mathematical models to experimental data. Measurements will re-visit crystallization velocity. Temperature and time measurements will also be featured.
4) Experimental measurements of π. Let us measure π four different ways and celebrate π-Day along the way.
5) Techniques and applications of Fourier spectral analysis. We will inverstigate spectral analysis, infrared and laser light diffraction experiments.
6) We will further explore the interaction of light and matter over three lab sessions.
7) Techniques and applications of magnetic resonance.
8) Experimental study of periodic precipitation in electrolyte solutions.

Schedule

This is our tentative schedule for the semester. The topics and order may change.

Week	*Date*	*Topics*	*Quiz?*	*Other*
1	14 Jan	Logistics and handouts		
	21 Jan	*No class: MLK day*		
2	28 Jan	The quantification of information in experimental data		
3	4 Feb	Statistical analysis of experimental data	Y	On Wk 2
4	11 Feb	Application of mathematical models to experimental data	Y	On Wk 3
5	18 Feb	Let us dutifully celebrate π-Day!	Y	On Wk 4
6	25 Feb	Techniques and applications of Fourier analysis	Y	On Wk 5
	3 Mar	*No class: Spring Break*		
7	11 Mar	Electronic Abs / Diffraction / Work Function		
8	18 Mar	Electronic Abs / Diffraction / Work Function		
9	25 Mar	Electronic Abs / Diffraction / Work Function		
	1 Apr	*No class: Easter Monday*		
10	8 Apr	Techniques and applications of magnetic resonance		
11	15 Apr	Experimental study of periodic precipitation		
12	22 Apr	Research Presentations		

Course Structure:

This is a lab course, thus, attendance is mandatory for all meetings. Labs may not be 'made-up' or otherwise rescheduled. If you miss or will be absent, let your instructor know as soon as possible.

Chem 303 will consist of experiments and lessons in data analysis, presentation, and reporting.

You will work in small groups to conduct the experiments. It is important that each member be an active participant in the lab; contact the TA or instructor is there is a problem with this promptly.

Before each lab, you must thoroughly read the provide material and complete the first four sections of the report in your notebook (as described later in this syllabus). You (and you group) may not begin the experiment until these portions are complete. You will also be given a short pre-lab quiz on the objective and methods for the scheduled experiment.

Each student will have an informal 'consultation' with DK and/or JD at the end of each lab meeting. We will discuss the day's experiment, the data, and the work-up. Also, the work in your notebook for the *previous* weeks lab will be looked at as well. Your notebook will be collected near the midterm and in the final week for evaluation as well. The notebooks will be evaluated for thorough notes about each experiment and the completeness of the work.

The Lab quizzes will transpire at the start of four lab meetings.

Research Paper/Presentation: The last several meetings will concentrate on energy levels, spectroscopy, magnetic resonance, and periodic precipitation experiments. Each student will write a research-style paper on the experiment (lab after week 7) of his or her choice. We will discuss the research paper in greater detail after the first few meetings. Students will pair up to give a brief (≈10 min) oral presentation about the topic they chose in the final week of class.

Grading:

Grades will be determined on the following basis:

Lab Consultation Points:	20%
Notebook :	10%
Pre-Lab Quizzes:	15%
Quizzes :	15%
Research paper	20%
Research presentation:	20%

The following scale will be used:

90% - 100% A ; 80% - 89% B; 70% - 79% C; 60% - 69% D; < 60% F

Teamwork is integral to lab meetings. Points and grades, however, will be grounded upon individual effort and achievement. P-Chem is neither easy nor quick to learn, but the process is rewarding if good-faith effort is made. Students are urged to consult with the instructors to discuss problems before they become serious.

Notebook/report format

Each experiment should be organized as shown below. You must have the first four sections completed in order to begin the experiment.

1: **Title:** Provide a descriptive title for the experiment.

Example: Effect of Halide Electronegativity on the Band-gap of Makebelieveium Nanoparticles

2: **Objective:** Briefly state the objective of the experiment. What is the hypothesis and what data are you trying to obtain to verify the hypothesis, and how will you know if it is verified or not?

Example: The objective of this experiment is to determine if the electronegativity of the halide in Mb-halide nanoparticles shifts the band gap. We will measure the absorption of 10 nm nanoparticles of makebelievium (Mb) halides using UV/Vis spectroscopy. The energy of the absorption peak corresponds to the band-gap, thus by obtaining spectra of nanoparticles for three different halides will allow us to determine if the different halides alter the spacing between the valence and conduction bands in the nanoparticles. If only a small shift is observed, then the electronegativity of the halide is not an important aspect in the energy of the particles, but the observation of a shift among the three halides suggests the band-gap is not simply the result of electron confinement.

3: **Method:** State how you intend to obtain the desired data. For example, how will the materials be prepared, what instruments will be used, in what order must the steps be taken, etc.

4: **Expected Results:** Briefly state what results you expect to observe and why.

Example: The average diameter of the nanoparticles is 10 nm; using the particle-in-a-box approximation, I expect the band gaps to be on the order of 1 eV (100 kJ mol^{-1}) with only small differences for the three halides, for the confinement of the electron in the particle is much more significant that the bonding among the atoms for electrons in the conduction band.

5: **Data/Calculations/Analysis:** All data must be recorded here, as well as observations and the procedure you followed. All calculations and analysis must also be included. For computational work, provide adequate detail so the computation could be repeated if the file were lost.

6: **Results and Conclusions:** Describe the findings of this study. Were the results what you expected? Why not? What changes did you have to make to the procedure or equipment in order to obtain the data? How should the procedure be improved?

Academic Integrity

All students in this course are expected to have read and to abide by the demanding standard of personal honesty, drafted by the College of Arts & Sciences, that can be viewed at: http://www.luc.edu/cas/pdfs/CAS_Academic_Integrity_Statement_December_07.pdf

Anything you submit that is incorporated as part of your grade in this course (*e.g.*, quiz, examination, homework, lab report) must represent your own work. Any students caught cheating will, at the very minimum, receive a grade of "zero" for the item that was submitted and this grade cannot be dropped. If the cheating occurred during a course exam, the incident will be reported to the Chemistry Department Chair and the Office of the CAS Dean. Depending on the seriousness of the incident, additional sanctions may be imposed.

Any instance of dishonesty as detailed on the website provided above will result in a grade of zero for that particular item, be it homework or an exam. The Dean and Chair of The Department of Chemistry will also be notified. I truly hope to never have to invoke these processes. Please be honest with your work.

Teamwork: I strongly encourage you (the class) to work together. Work together with your classmates, if you don't understand something, someone else may. You will also find that explaining a solution to your classmate will cement the information in your mind, and make you a better student.

When working as a group, if each member contributes to the discussion, and you each hand in very similar work, that is perfectly acceptable given the nature of the assignments. On the other hand, if someone simply copies an assignment from someone else, that is plagiarism, and will be treated as such.

Students with Disabilities

If you have any special needs, please let me know in the first week of classes. The university provides services for students with disabilities. Any student who would like to use any of these university services should contact the Services for Students with Disabilities (SSWD), Sullivan Center, (773) 508-3700. Further information is available at http://www.luc.edu/sswd/.

Tutoring

Loyola maintains a Center for Academic Excellence & Tutoring (http://www.luc.edu/tutoring/). Again, this is a service included in your tuition, so I encourage you to utilize their assistance.

Your well-being

If there are events occurring in your life that cause school to diminish in its priority, please discuss this with me or contact the Wellness Center (http://www.luc.edu/wellness/index.shtml) or the dean of students (http://www.luc.edu/studentlife/dean_of_students_office.shtml) for assistance. These are services that **your** tuition pays for and can be invaluable for your personal health and maintaining progress towards your degree.

The Ten Commandments of Physical Chemistry (adapted from SU handout)

I. Thou Shalt maintain an open mind.

II Thou shalt never take anything for granted; thou shalt check up early and often and make sure of absolutely everything.

III. Thou shalt have a pretty good time and thy work shall be interesting.

IV. Thou shalt respect the intelligence of all parties.

V. Thou shalt not gather in small and divisive groups, nor do violence upon one another.

VI. Thou shalt fear no problem, theoretical or experimental. Yet shall ye fear and despise sloth, dullness, and gutlessness, for these will bring bad Karma and Mother Nature's wrath.

VII. Thou shalt hack away at problems with dignity and help thy associates to do likewise.

VIII. Thou shalt bend over backwards to record data, observations, and questions that come to mind.

IX. Thou shalt admit thy mistakes, for they shall be forgiven.

X. Thou shalt roll and bounce over and around the inevitable potholes. When everything aroundeth thee wirleth and seemeth to falleth aparteth, thou shalt adjust and say to thyself calmly, "This too shall pass".

The PChem Motto: No lies, no hate, no fear.