

# Chemistry 313: Experimental Physical Chemistry

## Dr. A. Loh

### Instructor

Dr. Adrienne Loh  
Office: 4016 Cowley Hall  
Phone: 608-785-8275  
Email: aloh@uwlax.edu

Office Hours: Tuesday 9:00-10:00  
Wednesday 9:00-10:00  
Website: <http://www.uwlax.edu/faculty/loh/>

You are also welcome to stop by my office outside of office hours, make an appointment, or ask me questions by e-mail.

### About the Course

The primary goal of this course is to teach, illustrate, and strengthen basic concepts in physical chemistry. In the process I hope that you will also develop two of the essential tools in any professional scientist's toolbox: skill in the laboratory, and excellence in scientific communication.

In Chem313 you will learn experimental applications of error analysis, thermodynamics, kinetics, and spectroscopy. In the second half of the semester you be conducting an independent project of your choosing based on your experience with the experiments conducted during the first half of the semester.

You will also work on both the written and oral aspects of scientific communication. Quality scientific writing takes significant effort and time to achieve; therefore Chem313 has been designated a **writing emphasis** course, and comprises a significant component of the **Writing across the Major** program in the Chemistry & Biochemistry Department.

### Specific Student Learning Outcomes:

- Familiarity with a variety of equipment used for measuring physical properties
- Ability to process and interpret experimental data
- Ability to evaluate the amount and type of error in scientific measurements
- Proficiency in making physical measurements in the laboratory
- Ability to design experiments with appropriate controls for the measurement of physical properties
- Proficiency in using scientific writing and oral communication to describe the process, result, and meaning of physical measurements
- Ability to critically review others' scientific writing

### Required Texts

- A. P. Loh, *Experimental Physical Chemistry Manual* (and handouts)
- D. P. Shoemaker, C. W. Garland, and J. W. Nibler, *Experiments in Physical Chemistry*, 6<sup>th</sup> Ed.

### Required Supplies

- Bound notebook with duplicate numbered pages
- Safety goggles
- Electronic storage devices (USB pen) as needed

### Safety

**Goggles must be worn as directed by the instructor, and you must not work alone in the lab.** Unsafe or careless behavior will be grounds for immediate expulsion from the lab. You will have an opportunity to work with state-of-the-art instrumentation for most experiments in this course. Please treat the equipment with the care and respect that it deserves.

### Disability Access

Any student with a documented disability (e.g., physical, learning, psychiatric, vision, hearing, etc.) who needs to arrange reasonable accommodations should contact the instructor and the Disability Resource Services office (165 Murphy Library) at the beginning of the semester. Students who are documented with DRS will be accommodated as required by section 504 of the Rehabilitation Act of 1973.

### Academic Conduct

All students are expected to maintain a high level of academic honesty and integrity, and any indication that these standards are not being met will be confronted. Plagiarism, cheating on exams, and copying the work of fellow students *at any time (including laboratory notebooks)* will invoke severe penalties and may even lead to dismissal from the University. For complete details of UW-L's policy on student conduct, please refer to the following website:

[http://www.uwlax.edu/StudentLife/academic\\_misconduct.htm](http://www.uwlax.edu/StudentLife/academic_misconduct.htm)

**Late Assignment Policy**

Life events can interfere with even the best of plans, but also sometimes deadlines are inflexible. To reach a compromise, you will be given a **late bank of 3 days**. You may use them one day at a time or all at once, but only on written assignments (not on oral presentations or exams).

- **Assignments that are more than 15 minutes late will be considered one day late and charged against your bank.**
- Once your bank is empty, **late assignments will be penalized 10 points per day.**
- Each unused bank day will be counted as an extra credit percentage point on the final exam. If **all three days remain in your bank, you will receive a bonus for a total of 5 extra credit points** on the final exam.

**Grading Policy**

Final grades will be determined based on the number of points earned out of a total of 100 possible points. Lab reports are due at the beginning class on the designated day.

<b>Lab Reports:</b> (10 points each)	<b>60 %</b>
<b>Midterm exam:</b>	<b>10 %</b>
<b>Independent Project:</b>	<b>18 %</b>
<b>Final Exam:</b>	<b>12 %</b>

Letter grades will be awarded according to the following percentage scale:

**A** 85-100; **AB** 80-84; **B** 73-79; **BC** 67-72; **C** 60-66; **D** 50-59; **F** <50

**Laboratory Experiments****Error Analysis/Kinetics**

1. Linear Least Squares and Differential Error Analyses of Sample Kinetic Data
2. The Acid-Catalyzed Bromination of Acetone

**Thermodynamics:**

3. Determination of the Resonance Energy of Benzene from Bomb Calorimetry
4. Equilibrium Thermodynamics of a Keto-Enol Tautomerization Reaction

**Spectroscopy:**

5. The Absorbance Spectrum of Dyes with Conjugated Chains
6. Extraction of Molecular Constants from the IR Spectrum of HBr Isotopes

**Independent Project**

During the last third of the semester, you will design and conduct an experiment as a part of a guided independent project. These projects will use the skills that you have developed in the first part of the course, and will be projects that can be completed (researched, conducted and written up) in a short period of time (see syllabus). Each group of students will ultimately present their work together in a professional style poster presentation or final paper (TBA), and will individually explain their project to Dr. Loh in an oral exam. Projects that are well-designed and which yield reasonable results have the potential to be included in a manuscript for peer-reviewed publication in a professional journal such as the *Journal of Chemical Education* or the *Journal of Physical Chemistry*.

Date	Lecture Period (11:00 am)	Laboratory Period (2:15 pm)
Jan. 29	Introduction; Error Analysis	<u>L1</u> : Analysis of the error in sample kinetic data
Jan. 31		Error Analysis/ L1 continued
Feb. 5	Kinetics <b>Draft 1 of L1 discussion due</b>	Peer reviews of L1 discussions
Feb. 7		<u>L2</u> : Kinetics of the bromination of acetone ( <i>measure m</i> ) <b>L1 report due</b>
Feb. 12	Kinetics	<u>L2</u> : Kinetics of the bromination of acetone ( <i>measure n,p</i> ) <b>Determination of m due (in notebook + printouts)</b>
Feb. 14	♥ ♥ ♥	<u>L2</u> : Kinetics of the bromination of acetone ( <i>data workup</i> )
Feb. 19	Calorimetry & Heats of Reaction <b>Draft 1 of L2 abstract due</b>	<u>L3</u> : Determination of the Resonance Energy of Benzene ( $C_v$ )
Feb. 21		<u>L3</u> : Cont. ( <i>data processing, more measurements of <math>C_v</math></i> ) <b>Peer review of L2 abstract due</b>
Feb. 26	Equilibrium Thermodynamics <b>L2 report due</b>	<u>L3</u> : Cont. ( <i>more measurements of <math>\Delta H_{comb}^{TTCC}</math></i> ) <b>Calculation of average <math>C_v</math> due (in notebook + printouts)</b>
Feb. 28		NMR training <u>L3</u> : Cont. ( <i>data processing</i> )
Mar. 5	Equilibrium Thermodynamics <b>L3 report due</b>	<u>L4</u> : Keto-Enol Equilibrium Thermodynamics ( <i>all at 2:15, then sign up for time slots</i> )
Mar. 7		<u>L4</u> : Keto-Enol Equilibrium Thermodynamics ( <i>all at 2:15, then sign up for time slots</i> )
Mar. 12	Quantum Mechanical PIB	<u>L5</u> : Visible Spectra of Conjugated Dyes <b>Draft 1 of L4 discussion due</b>
Mar. 14		Discussion of L4 peer reviews & discussions <b>Peer review of L4 discussion due</b>
Mar. 18-22	<b>SPRING BREAK</b>	
Mar. 26	Rovibrational Spectroscopy <b>L4 report due</b>	<b>L5 oral presentations (15 min slots)</b>
Mar. 28		<b>L5 oral presentations (15 min slots)</b>
Apr. 2	Rovibrational Spectroscopy <b>L5 report due</b>	<u>L6</u> : Rovib Spectra of HBr/DBr
Apr. 4		<u>L6</u> : Rovib Spectra of HBr/DBr
Apr. 9	About Independent Projects	Research independent project <b>Draft 1 of L6 abstract due</b>
Apr. 11	NCUR	<u>IP</u> : Day 1 of data acquisition <b>Peer review of L6 abstract due</b>
Apr. 16	Introductions & Results <b>L6 report due</b>	<u>IP</u> : Day 2 of data acquisition
Apr. 18		<u>IP</u> : Day 3 of data acquisition
Apr. 23	<b>Midterm Exam: L1-L6</b>	Work on Posters
Apr. 25		<b>Draft 1 of Posters Due</b> : In-Class Review of Posters
Apr. 30	Catch-up day <b>Peer review of Posters Due</b>	<u>IP</u> : Conduct additional experiments to address reviews; Revise posters; Lab Cleanup
May 2		<u>IP</u> : Conduct additional experiments to address reviews; Revise posters; Lab Cleanup
May 7	Wrap-Up/About Final Exam	<b>Formal Poster Presentations</b>
May 9		<b>Formal Poster Presentations</b>
??	<b>FINAL EXAM **</b> Th, May 16 4:45 - 6:45 pm/ F, May 17 7:45 - 9:45 am/ F, May 17 10:00 am - 12:00 pm	

\*\* Doodle Survey TBA