

CHEM 536 – PHYSICAL CHEMISTRY II LABORATORY

FALL 2017

Lecture meets: **Monday 1:00-1:50 pm** (2048 Malott)

Labs meet: **Tuesday 12:30-4:20 pm** or **Thursday 8:30-12:20 pm** (4014 Malott)

INSTRUCTOR: **Prof. Chris Elles**

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Available Monday 2-3 pm, drop-in, or by appt.

COURSE TAs: **Pubudu Wimalasiri**

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LAB DIR.: **Dr. Travis Witte**

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OVERVIEW: This course covers experimental techniques and concepts in physical chemistry, with emphasis on the principles of chemical thermodynamics, kinetics, and dynamics. The course emphasizes rigorous treatment of experimental data and proper communication of scientific results. You will perform four experiments and one independent project of your choosing (subject to approval).

MATERIALS Handouts for each of the first four experiments will be available on Blackboard. You will also need a pair of safety goggles, a bound laboratory notebook with numbered pages, access to a copy of the laboratory textbook *Experiments in Physical Chemistry* by Garland, Nibler, and Shoemaker, and a copy of any standard physical chemistry textbook. A condensed version of the laboratory textbook that was made available in previous semesters and contains the relevant chapters is suitable for this course. Additional reference material is available from the reserve desk at Anschutz Library (see below), or from other sources (electronic journals, etc.).

On Reserve You are strongly encouraged to take advantage of the following helpful resources that are available from the Anschutz Library reserve desk:

An Introduction to Error Analysis, by John R. Taylor; 2nd Ed., University Science Books, 1997. (QC39.T4 1997)

Writing the Laboratory Notebook, by Howard M. Kanare; American Chemical Society, 1985. (Q180.58.K36 1985)

ACS Style Guide: Effective Communication of Scientific Information, edited by Anne M. Coghill and Lorrin R. Garson; 3rd Ed., Oxford University Press, 2006. (QD8.5.A25 2006)

The Elements of Style, by William Strunk, Jr. and E. B. White; 4th Ed., Allyn and Bacon, 2000. (PE1408.S772 2000)

Experiments in Physical Chemistry, by Carl W. Garland, Joseph W. Nibler, and David P. Shoemaker; 8th Ed., McGraw Hill, 2009. (QD457.S56 2009)

GENERAL INFORMATION:

- Lecture* Monday lectures provide background information relevant for upcoming experiments, as well as an opportunity to discuss on-going and recently completed experiments. This will be done in an interactive format, so be prepared to actively participate in the discussion every week. Consult the attached schedule for a list of topics that will be covered. You should carefully read *all* of the relevant material before we discuss an experiment in class.
- Lab* You should be fully prepared to start an experiment when you come to lab. The handouts and textbook provide an outline of the work that you will perform for each experiment, but it is your responsibility to work with your partner to devise (and record in your notebook) a detailed procedure *before you arrive in lab*. The instructor and/or TA will be available during all scheduled lab times to assist with the experiments and calculations. ***Your attendance in every lab period is a necessary condition to pass the course.***
- Notebooks* Record **ALL** of your observations and results in the lab notebook, and submit a copy of these notebook pages along with your calculations for each experiment. For a detailed discussion about recording experimental data refer to pages 56-101 of *Writing the Laboratory Notebook*, by Howard Kanare, available from the reserve desk in Anschutz Library.
- Lab Reports* *Preliminary reports (calculations)* are due one week following the completion of an experiment. The preliminary report should include tabulated data that you have collected, along with supporting calculations, data analysis, etc. that will be used in the final report. Your TA will give you feedback on the calculations in your preliminary report, but it remains your responsibility to ensure that the calculations are done properly for the final report. Preliminary reports are due *at the beginning of lab* one week after the experiment is completed.
- Final reports* are due two weeks following the completion of an experiment. These formal reports account for the majority of your grade on each experiment. The format for written reports is similar to what you would submit to a professional journal for publication. More information about the lab reports will be posted on Blackboard, including expectations, the assessment form used for grading, and a template to help you prepare your report. Final written reports are due *at the beginning of lab* one week after the preliminary report was due.
- Late Policy* Late assignments (calculations and reports) will be penalized 10% of the total possible grade *per weekday* until they are received by your TA. Assignments that are more than 5 days late will NOT be accepted without prior approval from the instructor.
- Independent Projects* You will propose, design, and execute a physical chemistry experiment. The project should be similar in scope to the other experiments performed in CHEM 531 and 536. Ideas for suitable independent projects are available from several sources, including the laboratory textbook and the *Journal of Chemical Education*. More information will be provided in Blackboard. Briefly, you will propose at least three initial topics, one of which will be the foundation for a more comprehensive 3-4 page proposal. Upon acceptance of your full proposal by the instructor, you will create a suitable experimental procedure (including safety precautions), then perform the experiment and analyze the results. Approval of a project is subject to availability of materials and equipment needed

for the experiment, as well as the appropriateness of the experiment for this course. A ~10 minute progress report will be presented in lecture.

A *poster presentation* will be the culmination of your independent project. You and your partner will make a poster outlining the purpose, procedure, results, analysis, and conclusions for the experiment that you performed. The poster session will be scheduled during finals week. More information about the expectations and format of the poster presentation will be given in the lecture.

Safety

Proper attire must be worn at all times, including long pants, closed-toe shoes, and safety goggles. No contact lenses are allowed at any time because chemicals are present in the lab. Additional personal protective equipment (PPE), such as gloves, laser goggles, etc., should be used as needed. Lab safety begins with knowledge and preparation, therefore your pre-lab procedure **must** include a description of any potential hazards (chemical, electrical, etc.) associated with each experiment, and how you will minimize or eliminate the threat that they pose. Refer to MSDS for chemical safety information and handling procedures.

Academic Integrity

You are solely responsible for the work that you submit for grading. Although you are encouraged to work together, you must perform your own calculations and write your own reports based on your own interpretation of the results. Plagiarism, copying, and all other forms of academic misconduct **will not be tolerated**. All incidents will be reported and students found in violation will receive a zero on the assignment. *All reports will be scanned for plagiarism and retained in an electronic database for future reference.* Ignorance is not a valid excuse; if you have any questions about what constitutes plagiarism, consult your instructor and/or this helpful online resource: <https://www.indiana.edu/~istd/>

GRADING:

Your final grade will be based on the total accumulation of points throughout the semester. You are guaranteed an A for $\geq 90\%$, B for $\geq 80\%$, C for $\geq 70\%$, and D for $\geq 60\%$. An appropriate curve will be applied at the end of the semester if deemed necessary by the instructor. The curve will *not* compensate late penalties.

Statistical Analysis Exercise:	50 points
Experiments: (150 points each \times 4 experiments)	600 pts. total
<i>Pre-lab procedure (incl. safety protocol)</i>	10 pts.
<i>Preliminary reports (i.e. calculations)</i>	40 pts.
<i>Final written reports</i>	100 pts.
Independent Project:	300 pts. total
<i>Project proposals and comprehensive procedure</i>	75 pts.
<i>Progress report (incl. preliminary results, etc.)</i>	25 pts.
<i>Results and calculations (incl. notebook)</i>	100 pts.
<i>Poster presentation</i>	100 pts.
Overall Performance Evaluation: <i>(based on attitude, punctuality, etc.)</i>	50 points
Total	1,000 points

TENTATIVE LECTURE AND LAB SCHEDULE: (*subject to change*)

<u>Week</u>	<u>Lecture Topic</u>	<u>Lab Experiment</u>	<u>Calc. Due*</u>	<u>Report Due*</u>
Aug. 21	Solar Eclipse / Statistics Worksheet	Statistical Analysis	Week of 8/28	—
Aug. 28	Heat Capacities	Heat Capacity Ratios	Week of 9/11	Week of 9/18
Sept. 4	<i>Labor Day (no lecture)</i>	Heat Capacity Ratios		
Sept. 11	Calorimetry / Heats of Formation	Bomb Calorimetry	Week of 9/25	Week of 10/2
Sept. 18	Isodesmic Reactions	Bomb Calorimetry		
Sept. 25	Chemical Kinetics	Iodine Clock	Week of 10/9	Week of 10/23
Oct. 2	Kinetics / Choosing a Project	Iodine Clock		
Oct. 9	Photochemistry	Flash Photolysis	Week of 10/30	Week of 11/6
Oct. 16	<i>Fall Break (no lecture)</i>	<i>ACS Regional Meeting (no lab)</i>		
Oct. 23	Reaction Dynamics	Flash Photolysis		
Oct. 30	Project Presentations (~5 min.)	Independent Projects	— — — See Below — — —	
Nov. 6	<i>Special Topics / Discussion</i>	Independent Projects		
Nov. 13	<i>Special Topics / Discussion</i>	Independent Projects		
Nov. 20	Progress Reports (~10 min.)	<i>Thanksgiving Week (no lab)</i>		
Nov. 27	Progress Reports (~10 min.)	Independent Projects		
Dec. 4	Giving Effective Poster Presentations	<i>Lab Clean-up and make poster</i>		
Dec. 11	Finals Week: Poster Session on Friday, December 15 (10:30 am – 1:00 pm)			

*All assignments are due at the start of lab, unless otherwise noted.

Independent Project Dates:

Preliminary proposals due (15 pts.)	Monday 10/9
Full project proposal due (40 pts.)	Monday 10/23
Comprehensive procedure due (20 pts.)	Monday 10/30
Informal presentation (not graded)	Monday 10/30
Progress report presentation (25 pts.)	Monday 11/20 or 11/27
Calculations due (100 pts.)	Week of 12/4 (<i>by end of lab period</i>)
Posters due for printing	Wednesday 12/13 (<i>by noon</i>)
Poster presentation (100 pts.)	Friday 12/15 (10:30am-1:00pm)