CHEM 125 - PHYSICAL CHEMISTRY LABORATORY (3 UNITS)

COURSE OVERVIEW

SUMMARY

Chem 125 is an intensive physical chemistry course that is designed to help students learn not only techniques specific for experimental physical chemistry (spectroscopy, microscopy, calorimetry, etc.) but also to help students develop scientific writing and presentation skills. The class is set up into three units: Spectroscopy, Kinetics/Thermodynamics, Condensed Phase Structure and Dynamics. In each unit, the student is required to perform two experiments (from a list of 4-6 options), culminating in either a written formal report or an oral exam/presentation. At the end of the semester, there is a final exam based on lecture material.

PREREQUISITES

Formal: Two of the following: Chem 120A and 120B, C130, or 130B (one of which may be taken concurrently).

Additional Notes: In my opinion, only conceptual/general knowledge of physical chemistry is required because the experiments are extremely well prepared and self-contained. Some lecture topics may be easier to understand with some (very general) background in solid state inorganic (Chem 104A) or materials (Chem C150) chemistry, though it is not assumed that students will know it.

LABORATORY EXPERIMENT TOPICS COVERED

Unit I: Spectroscopy

- A(1): IR Spectra of HCl,DCl, and Methane
- A(2): IR Spectra of Ammonia
- B: Electronic-Vibrational Absorption Spectrum of Gaseous Iodine
- C: Raman Spectroscopy
- D: Optical Properties of CdSe Nanocrystals

Unit II: Kinetics and Thermodynamics

- A: Kinetics of the Reaction of Iodine with a Ketone
- B: Physical Adsorption of Gases
- C: Fluorescence Quenching in Gaseous Iodine
- D: Heat of Combustion: Bomb Calorimeter

Unit III: Condensed Phase Structure and Dynamics

- A: Light Scattering and Brownian Motion
- B: X-ray Diffraction
- C: Nuclear Magentic Resonance Specry by Fourier Transform
- D: Atomic Force Microscopy

SKILLS LEARNED

Unit I: Spectroscopy

- Fourier Transform Infrared (FTIR) Spectroscopy (A(1),A(2))
- Ultraviolet/Visible(UV-Vis) Spectroscopy (B,D)
- Raman Spectroscopy (C)
- Hot injection method (D)
- Emission Spectroscopy (D)

Unit II: Kinetics and Thermodynamics

- UV-Vis Spectroscopy (A)
- Pulsed Laser (ND:YAG) Work (C)
- Gas/Vacuum Line Work (B,C)
- Bomb Calorimetry (D)
- Labview (D)
- Parr Bomb Preparation (D)

- Wide Field Microscopy/Epifluorescence Microscopy (E)
- ImageJ (E)

Unit III: Condensed Phase Structure and Dynamics

- Laser (HeNe) induced motion (A)
- Pulsed NMR Specotroscopy(C)
- X-Ray Diffraction (B)
- Atomic Force Microscopy (D)

All

- Quantitative Data Analysis
- Error Propagation
- Scientific Writing
- Oral Presentation skills (Powerpoint style)
- Oral Exam skills

WORKLOAD

COURSEWORK

- 3 written reports; 2 oral exams; 1 oral presentation over the course of the semester
  - The general scheme is as follows: Unit 1 written report, Unit 1 oral exam, Unit 2 written report, Unit 2 oral presentation, Unit 3 written report, Unit 3 oral exam.
  - Each lab runs over the course of 3 weeks; you can perform the experiment during a lab section within the first two weeks, and the report/presentation is due on the Friday of the third week.
  - You sign up for lab sections at the beginning of the unit (Sections run from M-Th, 1-5 PM), with a maximum of 2 people performing a lab on a day (so you have eight opportunities to perform a lab per unit)
- Recommended Homework Handouts (not graded)
- Final Exam during the last week of class (in-lecture) based on lecture material

TIME COMMITMENT

One hour lab lecture each week. 4-5 hours of lab every other week (roughly, depending on when you sign up for lab sections). 15-30 hours per lab write up/oral exam (typically oral presentations take less time to finish).

CHOOSING THE COURSE

WHEN TO TAKE

You can choose to take this course in the fall or spring, either while taking 120B (in the fall) or after taking 120A and 120B (in the spring). It is unfavorable to take both this class and 120A at the same time, since both have quite a heavy workload associated with it.

Unlike what many students do, I highly suggest against taking this course during your last semester. No matter how you slice it, you will have to do at least some work in this class to pass it, so you might as well try to do the best you can. Also, saving this class for last only increases your own misery.

WHAT NEXT?

Unfortunately, there is no directly related course for those who may be interested in performing more physical chemistry experiments. The best option would be to join a physical chemistry lab. The following is a list of some potential options, though they are not directly related to all aspects of the course:

- CHEM 122 (Chem 222): Spectroscopy (chem122.html) - If you were interested in any of the experimental methods in the course
- CHEM 220A: Statistical Mechanics and Thermodynamics (chem220a.html) - If you were interested in Brownian Motion Lab or Unit 2 labs.
- Chem 221A: Advanced Quantum Mechanics (chem221a.html) - If you were interested in Unit 1
- Chem 208: X-Ray Diffraction (chem208.html) - If you were interested in the X-Ray Diffraction Lab
- Chem 223A: Kinetics (chem223a.html) - If you were interested in Unit 2.
- Chem 265: NMR Theory (chem265.html) - If you were interested in the Pulsed NMR Spectroscopy lab

ADDITIONAL COMMENTS AND TIPS

The difficulty of the class highly depends on the experiments you choose to perform. Those who wish to spend less time in lab should avoid Physical Adsorption of Gaseous (Unit 2B) and Nuclear Magnetic Resonance Spectra by Fourier Transform (Unit 3C).

The lab reports are a lot of work, but the lab manual is a pretty complete and all-encompassing guide on what to include for the introduction and how to perform the data analysis. I highly suggest finding some time to go to office hours/reaching out to GSIs for help with more difficult or less obvious discussion questions to maximize your grades on the reports. This is also a great opportunity to try your hand at using LaTEX to create nice looking lab reports.

Chem 125 differs from any other physical chemistry lab course because the labs are extremely interesting. The tradeoff, however, is that they are not exactly as straightforward as other analytical or physical chemistry labs, which makes them more difficult. Student should keep this in mind when preparing to take the course. Good luck!

Written by: Angela Lee

Last edited: Spring 2018