Physical Chemistry II Lab
Chemistry 342L, Spring 2022

Instructor: Assoc. Prof. David Boucher
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Office Hours: MWF (12-1), T (12-1) and by appointment.

Lab Schedule: Section 1: T 1:40-4:40 (SSMB 329)

Due to the unpredictable nature of this semester resulting from the on-going COVID-19 pandemic, the syllabus is subject to change by the instructor.

Textbook and supplies: Handouts outlining the laboratory procedures will be distributed. Although there is not a formal textbook, you are strongly encouraged to consult the textbooks in Addlestone Library, as well as any other suitable texts or online materials that will assist you with the laboratory procedures and reports. Be sure that you properly cite the references that you use.

You will need a lab coat, safety goggles, nitrile gloves, a bound notebook, and a pen.

Attendance Policy: Students are required to attend and complete all laboratory experiments. In case of an unavoidable absence, speak with the instructor promptly. If you do not attend the lab you will receive zero lab conduct and notebook points, and you will not be permitted to turn in a lab report.

That being said, do not attend lab if you are sick. You are expected to alert your instructor about your illness as soon as possible so that alternative arrangements can be made for you. Students missing lab due to illness will be given data so they can complete the assignment in order to receive credit for that week’s lab. If this assignment is not completed within the allotted time period, a grade of zero will be assigned for that lab.

Classroom Conduct: In order to foster a cordial and secure learning environment, please be respectful of your instructor and you classmates. Do not obstruct or disrupt the teaching and learning processes by carrying on conversations on your cell phone or with other students in the class, sending text messages, or surfing the web on your laptop while you are conducting the labs. Proper laboratory conduct is important to ensure that the labs are performed correctly, thereby generating accurate experimental results, and, more importantly, to assure lab safety. If you fail to comply with these simple requests you will be asked to leave the lab and if the problems persist you will be referred to the office of Student Affairs for disciplinary action.
**CHEM342L Experiments:** Throughout this semester you will work in small groups to perform the experiments listed below. All of the handouts and the experimental rotation are available on the OAKS page for each lab section. You should consult the OAKS page to see when your group is performing each lab and to give you plenty of time to read the handout(s) before the lab period.

1. Absorption Spectra of Conjugated Dyes (1 week dry lab)
2. Flash Photolysis of Disperse Orange 1 (1 week lab)
3. Preferential Solvation of a Reichardt’s Dye (2 week lab)
4. Synthesis and Spectroscopy of CdSe Quantum Dots (2 week lab)
5. Molecular Mass of PVA Polymers (2 week lab)
6. Analysis of the FTIR Spectra of HCl and DCl (1 week dry lab)
7. Spectroscopy of the Iodine Molecule (1 week dry lab)
8. Raman Spectroscopy of ZXY\(_3\) Compounds (1 week dry lab)

**Learning Objectives:** Physical chemistry is a laboratory science. The laboratory portion of a physical chemistry course is designed not only to demonstrate experimentally the various laws and theories learned in the lecture portion of the course, but also to introduce the student to scientific research. Most of the theoretical background for each lab in this course can be found in the lecture course notes and textbook and the laboratory handouts, but library sources also should be used. A wise student will thoroughly study the experiment before coming to the laboratory and should have a good idea as to what he or she is going to do before attempting to perform the experiment. When studying these experiments, do not hesitate to draw on knowledge gained from prerequisite courses or your own independent research, particularly those techniques involving quantitative analysis.

Listed below are some of the general learning objectives for Chemistry 342L:

1. Understand the relationship between the quantum mechanical particle-in-a-box model and the spectroscopic behavior of conjugated dyes and quantum dots.
2. Analyze experimental vibrational, rovibrational and vibronic spectra of molecules, e.g., HCl, I\(_2\) and N\(_2\), and determine the fundamental spectroscopic constants.
3. Improve manipulative skills in the laboratory setting and develop aptitude for carrying out advanced laboratory procedures and data analysis involving UV/Vis absorption and luminescence spectroscopy and light scattering techniques.
4. Use chemistry software programs (Hyperchem, COSMO-RS) to compute molecular energy levels and molecular orbitals, and calculate activity coefficients of molecules in solution.

**Laboratory Preparation:** You are expected to arrive in lab on time and prepared to carry out your assigned experiment. Preparation consists of:

1. Reading the assigned materials from the lab handouts and any assigned reserve reading.
2. Performing any required calculations.
3. Preparing a *brief* outline of the procedure to be followed and answers to any pre-lab questions.

Students who have not completed their preparation before coming to lab will be required to complete
the preparation before proceeding. **Delays that result in the collection of incomplete data will adversely affect your lab report grade(s).** You must have your lab notebook initialed by the instructor before you leave at the end of the lab.

**Laboratory Notebook:** One of the most important parts of the laboratory procedure is recording permanently all procedures, observation, and numerical data in a bound notebook. Loose-leaf or spiral-bound notebooks are not acceptable because pages can easily be removed from these types of notebooks. Under no circumstances should pages be removed from a research or laboratory notebook. Pages should be numbered consecutively, leaving two or three blank pages at the beginning for a table of contents. *All entries must be made in permanent ink.* The procedures and observations should be recorded in the notebook at the time the experiment is being performed, not recalled from memory at some later time. While this approach may take extra time and appear to be a nuisance, it is the only acceptable way to keep a research notebook.

Any error made in recording data, procedures, etc., should be crossed out neatly with a single line. Never erase in a laboratory notebook, since, like tearing out pages, it immediately invalidates the notebook. A duplicate of each notebook page is to be attached to each laboratory report. A *good portion of the experiment will be based on how well the notebook is kept.* A good rule to follow is to ask yourself whether you could understand and perform the experiment from just the information given in the laboratory notebook. An experimental setup may be difficult to explain with words, so when appropriate include a figure of your experimental set-up.

All data must be recorded in a clear, legible fashion in your lab notebook during the laboratory period. A key skill for any scientist is learning to record data in a clear, organized and complete enough way that someone reading your lab book can understand what it is you have measured without you standing there to tell them. A person should be able to repeat the experiment using your notebook as a guide. As scientists you must present your results in a way which can be understood by others. Otherwise, they are essentially worthless.

Each experiment should be started on a new page. The title, date and lab partners should be recorded at the beginning of the write-up. Each lab write-up should consist of the following sections:

1. Purpose
2. Procedure
3. Experimental Data
4. Calculations
5. Results
6. Conclusions

The purpose and procedure sections should be written prior to the lab. Any changes in the procedure should be noted in the notebook. Data should be recorded with the appropriate significant figures. You should include clear headings and units to describe the measured quantities. If it is difficult or unfeasible for all the students in the research group to record the data in their notebook while performing the experiment, *each student must record the data into the notebook before leaving the laboratory.* You must include the Purpose, Procedure, and Experimental Data in your lab notebooks. You are strongly encouraged to also put your calculations, results, and conclusions in your notebook.

**Laboratory Reports:** A scientist must be able to convey his or her findings to the outside world. He or she does this by putting his or her experimental data and findings together in the form of a laboratory report. All experiments in Chemistry 342L will be the subject of brief lab reports. These reports will
consist of a minimum amount of prose and will focus instead on the quantitative results of the experiments. The content and form for each lab report, e.g., calculations to be performed, graphs to be handed in, questions to be answered, etc., will be outlined in the laboratory handouts.

**Grading:** Your laboratory grade is determined (100%) by your grades on the submitted lab reports.

*Your lab reports will be worth 100 points each. Reports are due by 11:59 pm one week after completing the experiment, unless otherwise stated by your instructor. There is a 10 point per day penalty for late lab reports (including the weekend). A dropbox folder for each student group will be set up on OAKS.*

**Lab reports must be submitted as a single pdf using the accompanying report sheets provided on the OAKS course page**

Letter grades will be assigned based on a “typical” grading scale, which is shown in the table below.

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<th>Score/%</th>
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<tr>
<td>90-92</td>
<td>A-</td>
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<td>87-89</td>
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The instructor reserves the right to increase a student’s grade if the instructor feels that it is warranted. Periodically you will be made aware of your class standing so that you can assess your progress and to help you avoid any surprises at the end of the semester.

**The Student Code of Conduct and Physical Chemistry:** The Honor Code of the College of Charleston forbids lying, cheating, stealing, plagiarism, and failing to report an Honor Code violation. The Student Code of Conduct can be found in the Student Handbook.

Science is inherently collaborative. If you go on to work in industrial or academic laboratories you will work with other scientists as a collaborator, as a mentor, and as a student throughout your career. Learning to work effectively with other people is therefore an important part of your undergraduate training. You may choose to work together on the data reduction and analysis with your lab partners, but you should not merely copy out their answers to homework questions. Working together means working together. There are two reasons for this. The first is that you will not really understand how to do the problem simply by copying it out, and understanding the problems should be your chief goal. Secondly, your peers will get tired of your mooching. If you do work with people on your assignments, please include the name(s) of your partner(s) on your work.

Plagiarism involves using another’s work without attribution, as if it were one’s own original work. The College of Charleston Honor Code forbids plagiarism and the Student Handbook defines plagiarism as follows:
1. The verbatim repetition, without acknowledgement, of the writings of another author. All significant phrases, clauses, or passages, taken directly from source material must be enclosed in quotation marks and acknowledged either in the text itself and/or in footnotes/endnotes.

2. Borrowing without acknowledging the source.

3. Paraphrasing the thoughts of another writer without acknowledgement.

4. Allowing any other person or organization to prepare work which one then submits as his/her own.

Beyond being an Honor Code violation at the College of Charleston, plagiarism is considered a serious ethical offense and can be detrimental to one’s academic reputation and integrity. You should begin now, during your undergraduate education, to develop good practices for avoiding plagiarism and to learn how to properly cite and reference resources from which you draw your facts, ideas, and inspiration. If you are in doubt as to whether or not you may be engaging in plagiarism do not hesitate to ask your instructor. Plagiarism on laboratory reports will not be tolerated.

Violations of the Honor Code, when identified, will be investigated. Each instance will be examined to determine the degree of deception involved. Incidents where your instructor believes the student’s actions are clearly related more to ignorance, miscommunication, or uncertainty can be addressed by consultation with the student. Cases of intentional and willful academic dishonesty will be reported directly to the Dean of Students for further consideration and, if necessary, disciplinary action.

Student Disability/Access Statement: This College abides by Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act and will make reasonable accommodations for persons with documented disabilities. Students should apply for services at the Center for Disability Services/SNAP located on the first floor of the Lightsey Center, Suite 104, (843) 953-1431. If you have a documented disability that may have some impact on your work in this class and for which you may require accommodations, you are responsible for notifying me as soon as possible and for contacting me one week before accommodation is needed.

Laboratory Safety Guidelines: Safety is an important issue in the Department of Chemistry and Biochemistry, and the department considers safe practice as essential to all activities in the building. The safe use of all equipment, devices, and procedures in this laboratory, as well as your future career, is of the utmost importance. It is the responsibility of ALL of the people in the lab to observe safe practices and to know what to do in the event of an accident. Failure to conduct yourself in a safe manner may result in your forced departure from a particular laboratory period. You will receive no points for lab, nor will you be allowed to hand in a report for that experiment.

Listed below are some general safety guidelines:

1. Follow all instructions given by your instructor. Special precautions will be noted by your instructor when necessary.
2. Always wear approved eye protection, lab coats, pants, and long sleeve shirts. Do not wear open toed shoes. If you do not comply, you will not be allowed in the lab.
3. “Horseplay” is strictly forbidden. Enjoy the lab period, but be mature.
4. No smoking, eating, or drinking in the lab.
5. Always wash your hands before leaving the lab.
6. Use good housekeeping practices in the lab, cleaning your individual work station, as well as general work areas.
7. Tightly cap all reagent bottles immediately after use. Do not place tops on benchtop in a manner that they can become contaminated.
8. Never return reagents to stock bottles.
9. Always add acids to water, never water to acids.
10. Dispose of unused or contaminated reagents properly. Consult your instructor before cleaning up a chemical spill.
11. Perform all reactions in a functional hood.
12. Report all mercury spills immediately to your instructor.
13. All broken glassware should be carefully and immediately cleaned up and disposed of in the proper “broken glassware” receptacle.
14. Report all broken or defective laboratory equipment to the instructor.
15. Never leave an experiment unattended.
16. Unauthorized or unsupervised experiments are not permitted.
17. Never take chemicals or other substances out of the lab, unless required to complete an experiment, e.g., performing an NMR scan.
18. Never wear gloves on both hands outside of the lab.
19. Bare feet, open toed shoes, and crocs are not acceptable in the laboratory. Clothes must come at least to the knee, and pants are strongly recommended.
20. Contact lenses are permitted in the lab, but they are not considered to be approved eye protection and, therefore, they do not replace safety goggles.
21. If you have long hair, tie it back.
22. Keep all experimental apparatus as far away from the edge of the benchtop as possible.
23. Report any accident, however minor, to your lab instructor at once.
24. Know how to get help in an emergency. Dial 3-5611 from a campus phone to contact emergency personnel.
25. When in doubt ask your instructor.
26. AT ALL TIMES, THINK ABOUT WHAT YOU ARE DOING!

You should familiarize yourself with the location of the safety equipment in the lab. If there is an accident, knowing the location of the fire extinguisher, fire blanket, shower, and eye wash, and, most importantly, where the exits are, can save lives.

Safety information about the chemicals used in this laboratory course is available in the yellow MSDS binders in the lab room and can also be found online on a number of sites, like http://www.msds.com/. Other sites for MSDS sheets can be found by searching "MSDS" on Google™.