Advanced Physical Chemistry Laboratory
Spring Semester 2020

Lectures: Tuesdays & Thursdays 10:45-11:35 AM  HEB 2006
Laboratory:
Section 2: Tues & Thurs 1:00-5:00 PM  CSC 108
Section 3: Mon & Wed 1:00-5:00 PM  CSC 108
Section 4: Tues & Thurs 5:00-9:00 PM  CSC 108
Section 5: Mon & Wed 5:00-9:00 PM  CSC 108

Instructor: Rodrigo Noriega
Email: noriega@chem.utah.edu
Phone Number: (801) 579-7979
Office Hours: General office hours will be held once a week on Friday from 11am-noon. If it is not possible for you to attend during this time, please email me. If a significant portion of the class is unavailable, appropriate rescheduling efforts will be made. TA office hours will be posted on Canvas.
Office Location: TBBC 2428.
Preferred contact method: Email. If my office door is open, it means I’m available for drop-in consults.

Pre-/Co-requisites
Before taking this course, students should have already taken CHEM 3060 (Quantum Chemistry & Spectroscopy). Students should also have previously completed or should be concurrently enrolled in, CHEM 3070 (Thermodynamics & Chemical Kinetics) or CHEM 3090 (Physical Chemistry for Life Sciences).

Required Materials
There is no required textbook, as there are many sources that cover the material in appropriate depth. For a list of books I find useful, see below (these are available at the University Library).
• Donald A. McQuarrie, John D. Simon, Physical Chemistry: A Molecular Approach, University Science Book, Sausalito, CA.
• Thomas Engel, Philip Reid, Physical Chemistry, 2nd Ed., Pearson Education, Upper Saddle River, NJ.

Course Description
An introduction to time-independent quantum mechanics, including fundamental theorems and postulates, exact solutions to model problems, relations between wave functions and potentials, the hydrogen atom, approximation methods, multielectron atoms, including angular momentum coupling and term symbols. This course covers topics useful for chemists, physicists, and engineers, and provide essential background for subsequent courses in molecular electronic structure, time-dependent quantum mechanics, and spectroscopy.

Pre-/co-requisites: I will assume you have taken at least one Quantum Mechanics class during your undergrad. However, we will start from the very beginning and work our way through fundamental and applied concepts in Quantum Mechanics.

Credit hours: 2.0
Course Outcomes
By the end of this course, you will achieve a sound conceptual understanding of:
• master the safety requirements and lab skills to perform physico-chemical experiments
• thorough preparation for each experiment by studying lab handouts and links therein
• knowledge of how to keep records of instruments, parameters, and experimental observations
• reporting of experimental results (including error analysis) in a publication-style (journal paper)
• appreciation for modern problems and scientific controversies in physical chemistry
• key spectroscopic techniques including FTIR, UV-vis absorption, and luminescence
• use of chemistry software programs to model energy potentials and vibrational levels of molecules
• set-up and use of standard experimental techniques used in physico-chemical experiments

Teaching and Learning Methods
This course has a lecture and a laboratory component.
Lectures have a focus on core concepts and their implications, as well as learning skills necessary for
data analysis and model assignment.
The laboratory portion of this course has two sessions per week, with alternating experiment and
data analysis sessions (1/week each). Over the duration of the semester, each student will perform
6 experiments. Each experiment will be performed by teams of students (2-4) working together, but
all lab reports will be written and turned in as individual assignments.

The lab experiments of this course are:
• Vibrational and rotational energy levels of HCl/DCl
• Size and surface defects of nanocrystal Quantum Dots
• Energy Released by a Combustion Reaction

Laboratory safety
Prior to entering the laboratory, it is the responsibility of each student to become familiar with
potential safety hazards of each experiment and to learn the location and instructions of safety
equipment located in the lab. Each student shall wear personal protective equipment (PPE) at all
times in the laboratory. PPE includes a lab coat, safety glasses, appropriate gloves, and any other
equipment specific to the activities in lab. Any student who jeopardizes the safety of her/himself or
others in the lab as a result of failing to observe proper safety procedures will be dismissed from the
lab and given a zero for the lab report score.

Time management
The data analysis and report writing requirements for this course can be time consuming, and
students are strongly encouraged to practice effective time management skills to avoid the
workload piling up in the last 1-2 days.

Pre-Lab Quizzes
Before conducting a lab experiment each student is required to study the lab handout and review
the physico-chemical background information (as indicated on each lab handout) for the experiment
to be performed. The lab handouts for all experiments are available on Canvas. Each student must
take a pre-lab quiz at the beginning of the lab session where they start a new experiment. The pre-
lab quizzes will be handed out by the TA and will be used to determine if you are sufficiently
prepared. **Students who are not prepared to conduct an experiment will not be permitted to
perform it and will take a zero for this experiment/lab report score.**
Lab Notebooks
Each student is required to maintain a bound laboratory notebook with numbered pages. Spiral notebooks are acceptable and pages may be numbered by hand, but loose-leaf notebooks are not acceptable. For each of the six experiments all relevant information, special instructions, experimental procedure and data, notes, comments, etc. should be recorded directly into the lab notebook. At the end of each lab, have your TA review and sign/initial your lab notebook.

Lab Reports
Each student is required to write a lab report for each experiment they perform. These reports will be in a style suitable for publication in the Journal of Physical Chemistry. The exact format and expectations for these reports will be discussed in lecture, and a detailed guide is posted on Canvas. Due Date/Time: Lab reports are due one week from the day the data analysis of second part of each experiment is scheduled (see example calendars below). They must be submitted electronically (Word or PDF) via Canvas. Please include your name, section number, and experiment number in your filenames. You may be required to submit any additional files you may have used to complete the experiment, such as Excel and Mathematica files.

For groups on calendar type A

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Late Policy: A lab report will be considered “turned in” on time, only if both the online submission is uploaded and the physical copy is handed to your TA before the due date/time. For each weekday (Monday-Friday) that either (or both) are missing, your score will be penalized by subtracting 5%. Reports will not be accepted after 2 full weeks have passed.

Advice: While working on your lab reports, feel free to make use of the TAs and Prof. Noriega to ensure that you are providing what is expected of you BEFORE submitting the final product. Don’t go to them asking them to read your report in detail and ask them to essentially grade it. They will
be looking for places where students generally make common mistakes (e.g. not numbering tables/figures, not including captions on tables/figures, etc.). This will save the TAs time when grading and will most likely result in you getting a better grade for the lab report. This will be especially useful for the first couple of reports.

Plagiarism: Plagiarism on your lab reports will result in substantial loss of points, up to a complete loss of credit for the assignment, as well as reporting to the Chemistry Department integrity officer, the Dean of Students, and further academic sanctions.

Lab Conduct
Besides following the guidelines for the report and turning it in by its due date, points might be deducted from your assignment if you fail to follow instructions given by the TA or on the lab handout while you perform your experiment.

Lab Cleanliness
It is your responsibility to clean up after yourselves before you leave the lab each day. This includes, but isn’t limited to, appropriately disposing of any waste, cleaning glassware, throwing away trash, wiping down the bench top, and leaving all equipment in the state you came to it. If the TAs find that you have left a mess of your station after you have left for the day, points will be deducted from the lab reports of all group members. There is no excuse for not picking up after yourself.

University Policies
1. The Americans with Disabilities Act. The University of Utah seeks to provide equal access to its programs, services, and activities for people with disabilities. If you will need accommodations in this class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, (801) 581-5020. CDS will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in an alternative format with prior notification to the Center for Disability Services.

2. University Safety Statement. The University of Utah values the safety of all campus community members. To report suspicious activity or to request a courtesy escort, call campus police at 801-585-COPS (801-585-2677). You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit safeu.utah.edu.

3. Addressing Sexual Misconduct. Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a civil rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran’s status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to the police, contact the Department of Public Safety, 801-585-2677(COPS).
4. **Undocumented Student Support Statement.** Immigration is a complex phenomenon with broad impact—those who are directly affected by it, as well as those who are indirectly affected by their relationships with family members, friends, and loved ones. If your immigration status presents obstacles to engaging in specific activities or fulfilling specific course criteria, confidential arrangements may be requested from the Dream Center. Arrangements with the Dream Center will not jeopardize your student status, your financial aid, or any other part of your residence. The Dream Center offers a wide range of resources to support undocumented students (with and without DACA) as well as students from mixed-status families. To learn more, please contact the Dream Center at 801.213.3697 or visit dream.utah.edu.

5. **Drop/Withdrawal.** The last day to drop this course without paying tuition is Friday, August 23, 2019. After that date tuition is assessed. You may still withdraw from the course according to the University withdrawal policy. Please check the academic calendar for more information pertaining to dropping and withdrawing from a course. Withdrawing from a course and other matters of registration are the student’s responsibility.

6. Other important information to consider including:
   a. **Student Code:** http://regulations.utah.edu/academics/6-400.php
   b. **Accommodation Policy (Section Q):** http://regulations.utah.edu/academics/6-100.php

7. **Wellness Statement.** Personal concerns such as stress, anxiety, relationship difficulties, depression, cross-cultural differences, etc., can interfere with a student’s ability to succeed and thrive and the University of Utah. For helpful resources, contact the Center for Student Wellness at www.wellness.utah.edu or (801) 581-7776.

8. **Veterans Center.** If you are a veteran, service member, or a family member of a current or former service member, the University of Utah has a variety of resources to help you receive the benefits you earned. Please visit the Veteran Services office (https://registrar.utah.edu/veteran/) or the Veterans Support Center (https://veteranscenter.utah.edu/) for specific advice and guidance. Besides benefits concerns, they serve as a liaison between the student veteran community and the university, and they provide support to improve and enhance your individual and academic success.

9. **LGBT Resource Center.** If you are a member of the LGBTQ community, please be assured that this classroom is a safe zone. Additionally, the University of Utah has an LGBT Resource Center on campus (Room 409 in the Olin Union Building, M-F 8am-5pm). You can visit their website to find more information about the support they can offer, a list of events through the center and links to additional resources at http://lgbt.utah.edu/. Please also let the instructor know if there is any additional support you may need for this course.

10. **Learners of English as an Additional/Second Language.** If you are an English language learner, please be aware of several resources on campus that will support you with your language and writing development. These resources include:
    • The Writing Center – http://writingcenter.utah.edu/
    • The Writing Program – http://writing-program.utah.edu/
    • The English Language Institute – http://continue.utah.edu/eli
Please let the instructors and/or TAs know if there is any additional support you would like to discuss for this class.
Course Policies

Attendance & Punctuality: The instructors expect regular and on-time attendance at all class meetings, both lecture and lab. As the experiments are done in groups, all members must be present and working together. If you aren’t present to help your fellow groupmates, points will be deducted (which may include giving you a zero) from your report, at the TA’s discretion.

Participation: Participation in the discussion is encouraged and accounted for in your grade. To receive credit for class participation, you will need to lead the discussion of a homework problem during one of the assigned class sessions (volunteer or chosen at random).

Food & Drink: Food and drink in class or office hours are permitted as long as they are not disruptive or violate building/classroom regulations. Food and drink are not allowed in lab.

Electronic Devices in Class: Non-academic use of cell phones is not allowed in class. Laptops, notepads, etc. are OK if they serve an educational purpose (e.g., note-taking, follow lecture notes online, online class participation).

Canvas: Canvas will be the main source for class material – lecture notes, homework assignments, exams will be posted there. Occasionally, announcements will be made.

Assignments
There will be 3 lab report written assignments, as described above.
The final exam will take place at the time and location assigned by the Registrar.

Grading Policy

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<td>Lab reports (3)</td>
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<td>Final Exam</td>
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Note: This syllabus is meant to serve as an outline and guide for our course. Please note that I may modify it with reasonable notice to you. I may also modify the Course Schedule to accommodate the needs of our class. Any changes will be announced in class and posted on Canvas under Announcements.