

Chemistry 303: Physical Chemistry Laboratory
Department of Chemistry and Biochemistry, Loyola University Chicago
Spring 2021

Instructor: Dr. Dan Killelea
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Office Hours: *by appointment*
Lab: Fr, 8:00 am – noon (Chicago time) via Zoom.
Zoom Link: <https://luc.zoom.us/j/86386434006>
Teaching Assistant: Liz Jamka () and Luke Landry ()
Office Hours: *TBD*

Course Prerequisites: A grade of C- or better in Chemistry 302 or coenrollment in Chem 302. If you have not completed the course prerequisite, you may be administratively dropped from the class. Please discuss this with the instructor immediately!

Lab Safety

The kits you have been supplied with present minimal hazards. Be careful not to shine lasers in anything's eyes and keep all electronics dry. Be aware of proper use of a multimeter.

A bound lab notebook is provided. You will need to be turning in written work, so you will need to scan the pages for submission. ALL work will go in the lab notebook.

You must have your kit and a reliable method for submitting you notebook pages by the first meeting on 22 January 2021.

Course Overview

This course will introduce laboratory techniques and analysis central to physical chemistry. We will pursue the following activities (note these topics are subject to change):

- 1) Computer programming, electronic circuits, and device development
- 2) The basics of information and mathematical transformations
- 3) We will further explore the interaction of light and matter over three lab sessions.
- 4) A bit of spectroscopy
- 5) Principles of vacuum and Thermal Desorption from surfaces

Schedule

This is our tentative schedule for the term. The topics and order may change. All times Chicago local (CST).

<i>Lab</i>	<i>Date</i>	<i>Topics</i>
1	22 Jan	Introduction, Electronics and Information (hybrid)
2	29 Jan	Diffraction and Solid Structure (hybrid)
3	5 Feb	Absorption/Particle in a Box (synchronous)
4	19 Feb	Determination of Planck's Constant (synchronous)
5	26 Feb	Principles of Fourier Transformations (hybrid)
6	5 March	Arduino day (asynchronous)
7	12 March	II day, perhaps (synchronous)
8	19 March	Electrochemical Etching and SEM imaging (synchronous)
9	26 March	TPD experiment (hybrid)
10	9 April	Principles of solid surfaces and STM (hybrid)
11	16 April	Theoretical Calculations of HCl/DCl (hybrid)
12	23 April	Rovibrational Spectroscopy of HCl/DCl (asynchronous)
13	30 April	Conversations (synchronous)

Synchronous: You must prepare ahead of time and will have post-lab work, but the bulk of the lab will be conducted in real-time. Start at 8:30am.

Hybrid: There will be a real-time component, and a portion to be completed outside of our meeting. Start at 9:30am.

Asynchronous: I will be available for consultation, but the lab has no real-time component.

Grading:

Grades will be determined out of 700 total points:

Attendance of synchronous sessions: 100 (10 points per lab)
Lab Reports: 500 (10 reports used for grade)
Final Vocal Conversation 100

There are 10 experiments, all will used for your grade. Each report is worth 50 points.

The following scale will be used:

>92%: A	88-92%: A-	84-88%: B+	80-84%: B
76-80%: B-	72-76%: C+	68-72%: C	60-68%: C-
50-60%: D	< 50%: F		

Points and grades will be grounded upon individual effort and achievement. P-Chem is neither easy nor quick to learn, but the process is rewarding if good-faith effort is made. Students are urged to consult with the instructors to discuss problems before they become serious. Feel free to work with your fellow students, I strongly encourage collaboration amongst you all.

Course Structure:

- This is a lab course, thus, attendance is **mandatory** for all synchronous meetings. Labs may not be ‘made-up’ or otherwise rescheduled. If you miss or will be absent for a synchronous session, contact DRK as soon as possible. You will receive 10 points for attending each synchronous or hybrid session.
- Chem 303 will consist of experiments and lessons in data acquisition, analysis, and reporting.
- Before each lab, you **must thoroughly read the provided material and complete the first four sections of the report in your notebook** (as described later in this syllabus). You may not begin the experiment until these portions are complete.

Consultation / Safety: Each student will have an informal ‘consultation’ with the instructor during each synchronous or hybrid lab meeting. We will discuss the day’s experiment, the data, and the work-up. We will evaluate each student’s knowledge of the fundamental chemical principles the lab covered, their experimental technique, the quality of their observations, and their insight into the significance of their observations.

Lab Reports: Reports for each lab will be turned in (via PDF) the following meeting by 11:59pm CST. No reports will be accepted after Saturday, 1 May 2021. The reports will be evaluated for *thorough notes* about each experiment and the *completeness* of the work.

Exams: There will be a final vocal conversation worth 100 points. The instructor will conduct this with each of you individually on our final meeting day.

Notebook/report format

Each experiment should be organized as shown below. You **must** have the first four sections completed in order to begin the experiment. Some experimental procedures have questions to answer or other stated objectives that must be included in the results/discussion. Because we are running on a tight schedule, keep things concise! Having your report started will allow you to keep notes in your report, and then you just turn in the whole thing.

1: **Title:** Provide a descriptive title for the experiment.

Example: Effect of Halide Electronegativity on the Band-gap of Makebelieveium Nanoparticles

2: **Objective:** Briefly state the objective of the experiment. What is the hypothesis and what data are you trying to obtain to verify the hypothesis, and how will you know if it is verified or not?

Example: The objective of this experiment is to determine if the electronegativity of the halide in Mb-halide nanoparticles shifts the band gap. We will measure the absorption of 10 nm nanoparticles of makebelieveium (Mb) halides using UV/Vis spectroscopy. The energy of the absorption peak corresponds to the band-gap, thus by obtaining spectra of nanoparticles for three different halides will allow us to determine if the different halides alter the spacing between the valence and conduction bands in the nanoparticles. If only a small shift is observed, then the electronegativity of the halide is not an important aspect in the energy of the particles, but the observation of a shift among the three halides suggests the band-gap is not simply the result of electron confinement.

3: **Method:** State how you intend to obtain the desired data. For example, how will the materials be prepared, what instruments will be used, in what order must the steps be taken, etc.

4: **Expected Results:** Briefly state what results you expect to observe and why.

Example: The average diameter of the nanoparticles is 10 nm; using the particle-in-a-box approximation, I expect the band gaps to be on the order of 1 eV (100 kJ mol⁻¹) with only small differences for the three halides, for the confinement of the electron in the particle is much more significant than the bonding among the atoms for electrons in the conduction band.

5: **Data/Calculations/Analysis:** All data must be recorded here, as well as observations and the procedure you followed. All calculations and analysis must also be included. For computational work, provide adequate detail so the computation could be repeated if the file were lost.

6: Results and Conclusions: Describe the findings of this study. Were the results what you expected? Why not? What changes did you have to make to the procedure or equipment in order to obtain the data? How should the procedure be improved?

Academic Integrity

All students in this course are expected to have read and to abide by the demanding standard of personal honesty, drafted by the College of Arts & Sciences, which can be viewed at:

<http://www.luc.edu/cas/advising/academicintegritystatement/>

A basic mission of a university is to search for and to communicate the truth as it is honestly perceived. A genuine learning community cannot exist unless this demanding standard is a fundamental tenet of the intellectual life of the community. Students of Loyola University Chicago are expected to know, to respect, and to practice this standard of personal honesty.

Academic dishonesty can take several forms, including, but not limited to cheating, plagiarism, copying another student's work, and submitting false documents.

Any instance of dishonesty (including those detailed on the website provided above or in this syllabus) will **immediately result in a grade of F for the entire course** and will also be reported to The Chair of The Department of Chemistry & Biochemistry who will decide what the next steps may be.

Absence Policy for Students in Co-Curricular Activities (including ROTC):

Students missing classes while representing Loyola University Chicago in an official capacity (e.g., intercollegiate athletics, debate team, model government organization) shall be allowed by the faculty member of record to make up any assignments and to receive notes or other written information distributed in the missed classes.

Students should discuss with faculty the potential consequences of missing lectures and the ways in which they can be remedied. Students must provide their instructors with proper documentation (develop standard form on web) describing the reason for and date of the absence.

This documentation must be signed by an appropriate faculty or staff member, and it must be provided as far in advance of the absence as possible. It is the responsibility of the student to make up any assignments. If the student misses an examination, the instructor is required to give the student the opportunity to take the examination at another time.

(<https://www.luc.edu/athleteadvising/attendance.shtml>)

Accommodations for Religious Reasons

If you have observances of religious holidays that will cause you to miss class or otherwise effect your performance in the class you must alert the instructor **within 10 calendar days of the first class meeting of the semester** to request special accommodations, which will be handled on a case-by-case basis.

Online Class Specifics

Any and all material shall not be shared; all intellectual property remains with me and/or the university.

Recording of Lectures: I will record our lectures (not discussions) on Zoom and share with the class. These will not, and may not, be shared outside the class.

You may not have another person or entity 'take your place' for any course-related activity.

Recording of Zoom class meetings

In this class software will be used to record live class discussions. As a student in this class, your participation in live class discussions will be recorded. These recordings will be made available only to students enrolled in the class, to assist those who cannot attend the live session or to serve as a resource for those who would like to review content that was presented. All recordings will become unavailable to students in the class when the course has concluded. *Students will be required to turn on their cameras at the start of class. Students who have a need to participate via audio only must reach out to me to request audio participation only without the video camera enabled.* The use of all video recordings will be in keeping with the University Privacy Statement shown below.

Privacy Statement

Assuring privacy among faculty and students engaged in online and face-to-face instructional activities helps promote open and robust conversations and mitigates concerns that comments made within the context of the

class will be shared beyond the classroom. As such, recordings of instructional activities occurring in online or face-to-face classes may be used solely for internal class purposes by the faculty member and students registered for the course, and only during the period in which the course is offered. Students will be informed of such recordings by a statement in the syllabus for the course in which they will be recorded. Instructors who wish to make subsequent use of recordings that include student activity may do so only with informed written consent of the students involved or if all student activity is removed from the recording. Recordings including student activity that have been initiated by the instructor may be retained by the instructor only for individual use.

Course Repeat Rule

Effective with the Fall 2017 semester, students are allowed only THREE attempts to pass Chemistry courses with a C– or better grade. The three attempts include withdrawals (W).

After the second attempt, the student must secure approval for a third attempt. Students must come to the Chemistry Department, fill out a permission to register form or print it from the Department of Chemistry & Biochemistry website: <http://www.luc.edu/chemistry/forms/> and personally meet and obtain a signature from either the Undergraduate Program Director, Assistant Chairperson, or Chairperson in Chemistry. A copy of this form is then taken to your Academic Advisor in Sullivan to secure final permission for the attempt.

Student Accommodations

The Student Accessibility Center (formerly known as Services for Students with Disabilities), Sullivan Center (773-508-3700), www.luc.edu/sswd, has the mission “to serve students with documented disabilities by creating and fostering an accessible learning environment,” including “support[ing] faculty, staff, and administrators on matters such as ADA and Section 504 compliance, as it relates to individuals with disabilities.” Please direct all questions concerning accommodations of disabilities to the Student Accessibility Center. Academic accommodations afforded to students require documentation and review. The Student Accessibility Center will issue accommodation letters for registered students to present to their instructors: accommodations are not active until students present these letters to their instructors. If students’ accommodations involve attendance or deadlines, instructors and students will jointly complete and execute an Agreement Form articulating their terms. See <https://www.luc.edu/sac/faculty/facilitatingaccommodations/> for guidance about implementing various kinds of accommodations in a way that is appropriate to your class. The Student Accessibility Center stands ready to work with you.

Your well-being

If there are events occurring in your life that cause school to diminish in its priority, please discuss this with me or contact the Wellness Center (<http://www.luc.edu/wellness/index.shtml>) or the dean of students (http://www.luc.edu/studentlife/dean_of_students_office.shtml) for assistance. These are services that **your** tuition pays for and can be invaluable for your personal health and maintaining progress towards your degree. I am always willing to discuss how I can adapt the class and its materials so that you are successful.