San José State University
College of Science, Dept. of Chemistry
Chem 162L, Physical Chemistry Lab, Fall 2022

Course and Contact Information

Instructor:	Nicholas Esker PhD.
Office Location:	Esker: Duncan Hall 501, zoom link (below)
Zoom Personal ID:	Esker: 221 532 1796 (password required, see canvas page for details)
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Office Hours:	Wed 09:30am – 11:00 am Fri 09:30am – 11:00 am
Class Days/Time:	Tuesdays and Thursdays, 2:30 – 5:20 pm
Classroom:	In person: DH 010
Prerequisites:	CHEM 100W or ENGR 100W; and CHEM 160A or CHEM 161A with concurrent enrollment in either: CHE 158 or CHEM 161B
Credit:	2 units

Course Web Page

Course materials such as syllabus, handouts, notes, assignment instructions, and any other materials can be found on CANVAS. You are responsible for regularly checking CANVAS to learn any updates.

Course Description

Physical chemical measurements with data analysis and written reports.

Course Learning Outcomes (CLOs)

Significant emphasis in this course will be placed:

1. Laboratory safety, including the interpretation of material safety data sheets (MSDSs) and safe disposal of chemical waste as appropriate for individual experiments
2. Collection of scientific data, including the use of specialized equipment and a laboratory notebook
3. Advanced methods of data analysis, including least-squares fitting methods and other statistical analyses)
4. Preparation of written laboratory reports, specifically following the format used in American Chemical Society (ACS) publications
5. Presentation of scientific data, including the preparation of publication-quality graphical representations.

6. Error analysis and interpretation.

In addition, the following table indicates the learning objectives for each of the exercises/experiments:

Exercise / Experiment	Objective
Nuclear Chemistry	In this exercise, students will measure the rate of nuclear decay of a short-lived isotope to determine a number of statistical and physical properties.
Kinetics of the bromination of acetone	In this experiment, students will measure the rate of reaction for the bromination of acetone in order to determine the rate law for the acid-catalyzed reaction.
The Joule-Thompson Effect	In this experiment, students will measure the Joule-Thomson coefficient for selected gasses and relate results to those predicted based on theoretical methods.
Heat Capacity Ratio for Gasses	In this experiment, students will determine γ, the ratio of C_p /C_v for several gasses using the speed of sound method. Results will be related to those predicted based on statistical thermodynamics.
Enthalpy of Combustion	In this experiment, students will utilize bomb calorimetry to determine the enthalpy of combustion of a hydrocarbon.
Molecular Dynamics with Lennard-Jones model	In this experiment, students run a Lennard-Jones simulation to determine the parameters in the van der Waal's equation for a real gas.
Rotation-Vibration Spectroscopy of HCl and DCl	In this experiment, students will record the 1-0 infrared bands of HCl and DCl and analyze the spectra for structural and energetic data for these molecules.

Finally, a note about the experiments: This is an advanced laboratory class designed to give you a taste of what it is like to work in a real laboratory. In real life, you will rarely perform experiments that are neatly laid out with step-by-step instructions. Consequently, experiments in this course may require you to 1) come up with your own plan for accomplishing a goal, 2) read and follow instruction manuals for instruments, 3) experiment with different settings on an instrument to optimize performance, 4) familiarize yourself with software that runs an instrument, and/or 5) perform "quick and dirty" preliminary experiments to guide your "real" experiments. In addition, as in "real life," you will almost certainly make a mistake or experience an equipment malfunction and have to repeat some experimental work at some point. Again, this is natural and it is a good opportunity to learn how to deal with such a situation, so you will be prepared when you are on the job.

Program Learning Objectives

This course addresses the following BS/BA Chemistry Program Learning Objectives

1.1 –Students will be able to identify, formulate, and solve a range of chemistry problems (fundamental to complex) through application of mathematical, scientific, and chemical principles.
1.2 –Students will be able to recognize, relate, and/or apply chemistry terms and concepts to propose and solve interdisciplinary and multidisciplinary real world problems.
2.1 –Students will be able to develop an experiment to address a hypothesis using literature and execute the planned experiment using standard chemistry techniques.

2.2 –Students will be able to acquire, record, and critically evaluate data through use of instrumentation and software, appropriate record keeping practices, figure preparation, and scrutiny of experimental results.
2.3 –Students will be able to recognize and assess laboratory hazards, practice risk minimization, and conduct safe laboratory practices.
3.2 –Students will be able to identify as scientists within the scientific community through constructing peer reviews, engaging in collaborations, and participating in mentorship.
4.1 –Students will be able to design and deliver engaging presentations on diverse chemistry topics in a professional manner and with clear, concise organization that demonstrates mastery of the topic.
4.2 –Students will be able to integrate research findings into a concise original written report that either analyzes collected data and obtained results or reviews and reflects on published scientific work.
4.3 –Students will be able to identify an audience and construct a message tailored to that audience and act as a science ambassador by conveying the importance of the research or topic of study.

Required Texts

Textbooks

Optional: Experiments in Physical Chemistry; 7th ed., Shoemaker, Garland and Nibler, McGraw-Hill, New York, (2002), or similar

Materials

Required: Permanently bound laboratory notebook

Public Health Advisory: COVID-19 & Monkeypox

Students registered for a College of Science (CoS) class with an in-person component should view the CoS COVID-19 and Monkeypox Training slides for updated CoS, SJSU, county, state and federal information and guidelines, and more information can be found on the SJSU Health Advisories website. By working together to follow these safety practices, we can keep our college safer. Failure to follow safety practice(s) outlined in the training, the SJSU Health Advisories website, or instructions from instructors, TAs or CoS Safety Staff may result in dismissal from CoS buildings, facilities or field sites. Updates will be implemented as changes occur (and posted to the same links).

Emergencies and Building Evacuations

If you hear a continuously sounding alarm, or are told to evacuate the building by an Emergency Coordinator, walk quickly to the nearest exit. Take your personal belongings as you may not be allowed to return. Follow the instructions of the Emergency Coordinators. Be quiet so you can hear instructions. Once outside, move away from the building. Do not return to the building unless the Police or the Emergency Coordinator announces that this is permissible.

Library Liaison

Anne Marie Engelsen, annemarie.engelsen@sjsu.edu

Course Details

Schedule

The semester will be broken up into two-week time slots. An initial three-week period will be spent settling enrollment issues and completing a short set of exercises and lectures designed to introduce distributions of experimentally determined data and uncertainty analysis. During the remaining two-week time periods, each student will complete five laboratory experiments (in addition to the nuclear chem. mini-experiment). Each student will work as part of a group and will rotate through the experiments.

Attendance

Be considerate to your lab partners by arriving to class on time. You must complete all experiments in order to receive a passing grade in the class. You will not be allowed to make up laboratory time unless you have an excused absence that must be agreed to in advance by the instructor. In the case of unforeseen sickness or other circumstances, a Physician's or Dean's note is required.

Lab Notebook

A laboratory notebook will be required for all students. All primary data must be taken in the notebook in ink. A portion of the grade will be determined from how effectively each student uses the notebook. Notebooks will be evaluated periodically throughout the semester. (In many industry or research situations, the lab notebook can be used as an important legal document. Good notebook habits are essential for success in any branch of science!)

Pre-lab Assignments

Students will complete a two part pre-laboratory assignment before beginning each experiment. This will include completion of a safety section and a summary of the objectives & methods for the experiment. The safety section will require consultation with the Material Safety Data Sheets (MSDSs). The summary will (1) identify the physical properties to be explored in each experiment, (2) have a procedure written, in your own words, on the expected steps in the experiments, and (3) give an example of the application of the type of property in a commercial or research setting. Completion of the pre-laboratory assignment is required before a student will be allowed to perform an experiment.

Lab Reports

Each student must complete seven laboratory experiments. Five of the experiments will be written up as informal lab reports, one will be written up as a formal lab report that will be peer reviewed, and the results of the final experiment will be reported in an oral presentation (during the final exam period). Students will work in small groups to complete lab work, but each student must prepare and submit their own laboratory reports. All lab reports will be due at least one week after the lab work is concluded (see schedule for specific due dates). Reports are due in electronically (via Canvas) at the end of the laboratory period on the date they are due. Late reports will be marked down 1 letter grade for each day or fraction of a day they are late. Complete laboratory reports include a set of post-laboratory questions.

Informal laboratory reports will each be worth 9% of your overall grade and will focus on the analysis of the experimental data and, especially importantly, including uncertainty analysis. For each informal lab report, ~20% of the grade will come from a one page summary of the experiment, stating the major goals and conclusions. Roughly 40% of the grade will capture the complete presentation of the data and analysis of the data. 10% will go towards identifying the major quantitative source of

experimental uncertainty, and the remaining 30% focuses on quantitative uncertainty analysis that produces an estimated uncertainty in the final reported values.

The formal lab report will be worth two informal lab reports (20% of your overall grade). It will be in a form similar to published papers in the Journal of Physical Chemistry. Major sections of the formal lab report include:

- ABSTRACT
- INTRODUCTION - including the background and theory needed to interpret the data
- EXPERIMENTAL SECTION - including the procedure, the raw data and any graphical representations of raw data
- RESULTS/DISCUSSION - including the analysis of the data, graphical representation of results derived from raw data and an interpretation of the results
- UNCERTAINTY ANALYSIS AND COMPARISON TO LITERATURE - including the derivation of estimated uncertainties in the final reported parameters and an interpretation of the calculation pointing to the major source of uncertainty as supported by the computation
- REFERENCES

Students should consult the discussion in the lab manual to become more familiar with the requirements for both short and formal (long) laboratory reports. **Post laboratory questions should be added as an appendix.** The formal lab report will be required following the fourth experiment, which will be the HCl/DCl rotation-vibration spectroscopy experiment. Laboratory reports must be submitted in both printed and electronic form. Formats for electronic submission can be .docx, .odf, or .pdf. Electronic submission will be done through Canvas and checked by turnitin.com.

Peer Review

The formal laboratory report will be subject to peer review. On the due date for the formal laboratory report draft, each student must turn in a double-spaced copy of their report-spaced (for clarity and to give room for peer comments). One of your fellow students will review the paper and the instructor will provide a review of their review. Students will then be given an additional week to revise their reports, incorporating the comments as appropriate. Participation in the peer review process is mandatory and will be worth 5% of your overall grade.

Grading

Final letter grades will be determined based on the following assignments and weights. To determine your final letter grade, you must first average your scores on each category of assignment. This average will be between 0.0 and 4.0. You will then weight each category by the reported weight. Summing the weighted scores will get you your final grade on the 4.0 scale.

	Count	Weight (%)
Safety Quiz	1	2
Statistics Assignment	1	4
Prelab Assignments + Notebook Eval	6	6
Informal reports + Post-lab Questions	5	45
Formal report	1	20
Peer Review	1	9
Final oral report	1	14
Total		**100**

Failure to take the final will result in a failing grade (0.0 or F) for the course. The following scale indicates the letter grade has a function of the percentage of points received per student. I reserve

the right to adjust the scale downward if conditions warrant, but will not raise the minimum required for any particular grade. Standard rounding practices apply.

Grade	4.0 Scale
A	4.0
A-	3.6
B+	3.4
B	3.0
B-	2.6
C+	2.4
C	2.0
C-	1.6
D	1.0
F	0.0

Safety

Students will be expected to maintain safe practices in the lab. Food and drink are expressly forbidden in the laboratory. Proper eye protection must be worn whenever any experimental work is in progress in the laboratory. Failure to abide by safe laboratory practices will result in removal from the course with a grade of F. Students must pass a safety quiz (to be given in the second laboratory meeting) with a score of 80% or better to be allowed to begin experiments. The safety quiz may be repeated with a letter grade penalty on the score counted toward the grade for each attempt to get to the 80% of the questions correct.

Emergencies and Building Evacuations

If you hear a continuously sounding alarm, or are told to evacuate the building by an Emergency Coordinator, walk quickly to the nearest exit. Take your personal belongings as you may not be allowed to return. Follow the instructions of the Emergency Coordinators. Be quiet so you can hear instructions. Once outside, move away from the building. Do not return to the building unless the Police or the Emergency Coordinator announces that this is permissible.

University Policies

Per University Policy S16-9, relevant information to all courses, such as academic integrity, accommodations, dropping and adding, consent for recording of class, etc. is available on Office of Graduate and Undergraduate Programs' Syllabus Information web page. Make sure to visit this page, review and be familiar with these university policies and resources.

Dropping and Adding

Students are responsible for understanding the policies and procedures about add/drop, grade forgiveness, etc. Refer to the current semester's Catalog Policies section. Add/drop deadlines can be found on the current academic year calendars document on the Academic Calendars webpage.

The Late Drop Policy is available at http://www.sjsu.edu/aars/policies/latedrops/policy/. Students should be aware of the current deadlines and penalties for dropping classes. Information about the latest changes and news is available at the Advising Hub.

Academic integrity

Your commitment, as a student, to learning is evidenced by your enrollment at San Jose State University. The University Academic Integrity Policy S15-7 requires you to be honest in all your academic course work. Executive order 1098 also outlines student conduct and honesty policies and can be found on the student conduct website. Faculty members are required to report all infractions to the office of Student Conduct and Ethical Development. Please see the Student Conduct and Ethical Development website for more information.

Instances of academic dishonesty will not be tolerated. Cheating on exams or plagiarism (presenting the work of another as your own, or the use of another person's ideas without giving proper credit) will result in a failing grade and sanctions by the University. For this class, all assignments are to be completed by the individual student unless otherwise specified. Any text, diagram, chart or data that is not the product of the student author must cite a reference for the source as appropriate. This includes (but is not limited to) material taken from reference books, tables, primary research literature, laboratory manuals and computer programs. Failure to adhere to the principles that protect the academic integrity of this course will be dealt with according to the policies and procedures of the Department of Chemistry, the College of Science and San Jose State University.

Campus Policy in Compliance with the American Disabilities Act

If you need course adaptations or accommodations because of a disability, or if you need to make special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible, or see me during office hours. Presidential Directive 97-03 requires that students with disabilities requesting accommodations must register with the Accessible Education Center (AEC) to establish a record of their disability.

SJSU Peer Connections

Peer Connections, a campus-wide resource for mentoring and tutoring, strives to inspire students to develop their potential as independent learners while they learn to successfully navigate through their university experience. You are encouraged to take advantage of their services which include course-content based tutoring, enhanced study and time management skills, enhanced critical thinking strategies, decision making and problem-solving abilities, and campus resource referrals.

In addition to offering small group, individual, and drop-in tutoring for a number of undergraduate courses, consultation with mentors is available on a drop-in or by appointment basis. Workshops are offered on a wide variety of topics including preparing for the Writing Skills Test (WST), improving your learning and memory, alleviating procrastination, surviving your first semester at SJSU, and other related topics. A computer lab and study space are also available for student use in Room 600 of Student Services Center (SSC).

Peer Connections is located in three locations: SSC, Room 600 (10th Street Garage on the corner of 10th and San Fernando Street), at the 1st floor entrance of Clark Hall, and in the Living Learning Center (LLC) in Campus Village Housing Building B. Visit Peer Connections website for more information.

Chemical Safety

CHEM 120S Chemical Safety Seminar is a required course for all chemistry majors and minors. The additional Safety Training is a requirement/prerequisite for CHEM 180/298, if working in a wet/chemical research lab. Please visit the Safety Training website to sign up for more information.

Disclaimer

This document is subject to change with fair notice.

CHEM 162L / Physical Chemistry Lab, Fall 2022, Course Schedule

The following schedule of lecture topics is tentative and subject to change at the instructor's discretion. Readings should be completed **before** the lecture.

Week	Date	Topics
1	Tue Aug 23 Thu Aug 25	Introduction, Syllabus Review, Safety/COVID Training Uncertainty Analysis & Statistics Lecture
2	Tue Aug 30 Thu Sep 01	Uncertainty Analysis & Statistics Lecture, cont'd Thurs: Lab Exercise 1 – Nuclear Lab *Pre-lab 1 due*
3	Tue Sep 06 Thu Sep 08	Start of Rotations: Lab Exercise 2 *Tues: Pre-lab 2 due; Thurs: Lab 1 Report Due*
4	Tue Sep 13 **Thu Sep 15**	Lab 2 / Rotation 1, cont'd
5	Tue Sep 20 Thu Sep 22	Lab Exercise 3 / Rotation 2 *Tues: Pre-lab 3 Thurs: Lab 2 Report Due*
6	Tue Sep 27 Thu Sep 29	Lab 3 / Rotation 2, cont'd
7	Tue Oct 04 Thu Oct 06	Lab Exercise 4 / Rotation 3 *Tuesday: Pre-lab 4 Thurs: Lab 3 Report Due*
8	Tue Oct 11 Thu Oct 13	Lab 4 / Rotation 3, cont'd
9	Tue Oct 19 Thu Oct 20	Lab Exercise 5 – Vibration/Rotation of HCl and DCl *Tues: Pre-lab 5 due; Thurs: Lab 4 Report Due*
10	Tue Oct 25 Thu Oct 27	Lab 5, cont'd
11	Tue Nov 01 Thu Nov 03	Lab Exercise 6, Rotation 4 *Tues: Pre-lab 6 due; Thurs: First Draft of Formal Lab Report due*
12	Tue Nov 08 Thu Nov 10	Lab 6 / Rotation 4 cont'd *Thurs: Peer Review of Formal Lab Report*
13	Tue Nov 15 Thu Nov 17	Lab Exercise 7, Rotation 5 *Tues: Pre-lab 7 due, Lab 6 Report Due*
14	Tue Nov 22 Thu Nov 24	Lab 7 / Rotation 5 cont'd *Thurs: THANKSGIVING!*

Week	Date	Topics
15	Tue Nov 29 Thu Dec 01	Overflow / Data Analysis / Work on Oral Presentation *Thurs: Formal Lab Report Final Draft Due*
16	Tue Dec 06	Overflow / Data Analysis / Work on Oral Presentation
	Fri Dec 09	**Lab 6 Oral Presentation: 2:45-5:00 PM**

Important Dates

**	Sep 15	Last day to drop / add classes
##	Nov 23 – 25	Thanksgiving Holidays
	Dec 09	Final Examination