<table>
<thead>
<tr>
<th><strong>Instructor:</strong></th>
<th>Grant N. Holder, Ph.D., Adjunct Faculty</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Office Location:</strong></td>
<td>Duncan Hall 516</td>
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<tr>
<td><strong>Telephone:</strong></td>
<td>(408)-924-5482</td>
</tr>
<tr>
<td><strong>Email:</strong></td>
<td><a href="mailto:grant-holder@sjsu.edu">grant-holder@sjsu.edu</a></td>
</tr>
</tbody>
</table>
| **Office Hours:** | Mondays, 7:00-8:00 am  
Wednesday, 7:00-8:00 am  
or by appointment |
| **Class Days/Time:** | Tuesdays and Thursdays  
4:00pm– 6:50pm |
| **Classroom:** | Duncan Hall 10 |
| **Prerequisites:** | CHEM 100W or ENGR 100W; and  
CHEM 160 or CHEM 161A with concurrent enrollment in either CHE 158 or CHEM 161B  
A grade of “C” or better is required in all prerequisites. “C−” is not accepted. |
| **Credit:** | 2 units |

**Texts**

**Required:**  
Physical Chemistry Laboratory Manual, by Fleming, Van Wyngarden & Terrill (Fall or Spring 2014) – sold by the ChemClub from DH 20. Note: Versions from previous years are not acceptable since there have been significant changes.

**Optional:**  

**Materials**

**Required:**  
Permanently bound laboratory notebook
**Course Web Page**
Copies of the course materials such as this greensheet, major assignment handouts, extra materials, etc. may be found on the course website hosted by Canvas.

**Catalog Course Description**
Physical chemical measurements with data analysis and written reports.

**Overview**
In this course, we will conduct several experiments using physical methods to learn about properties of atoms, molecules, compounds and chemical reaction systems. In addition, we will pay very close attention to the critical handling of experimental data including the quantitative estimation of experimental uncertainties.

**Course Learning Objectives:** The following table indicates the learning objectives for each of the exercises/experiments.

<table>
<thead>
<tr>
<th>Exercise/Experiment</th>
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<tbody>
<tr>
<td><strong>Nuclear Chemistry.</strong> 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.</td>
</tr>
<tr>
<td><strong>Kinetics of the Bromination of Acetone.</strong> 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.</td>
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<tr>
<td><strong>The Joule-Thomson Effect.</strong> In this experiment, students will measure the Joule-Thomson coefficient for selected gasses and relate results to those predicted based on theoretical methods.</td>
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<tr>
<td><strong>Heat Capacity Ratio for Gasses.</strong> In this experiment, students will determine $\gamma$, 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.</td>
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<tr>
<td><strong>Enthalpy of Combustion.</strong> In this experiment, students will utilize bomb calorimetry to determine the enthalpy of combustion of a hydrocarbon.</td>
</tr>
<tr>
<td><strong>Electronic Spectrum of I$_2$.</strong> In this experiment, students will record and analyze an electronic transition of I$_2$ in order to determine the dissociation energy of the molecule in both ground and excited electronic states.</td>
</tr>
<tr>
<td><strong>Rotation-Vibration Spectroscopy of HCl and DCl.</strong> 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.</td>
</tr>
<tr>
<td><strong>Vibrational Spectroscopy and Greenhouse Warming Potentials of Polyatomic Molecules.</strong> In this experiment we will examine the greenhouse warming potential of a variety of polyatomic gasses based on the overlap of their infrared absorption spectra with the earth’s infrared emission spectrum.</td>
</tr>
</tbody>
</table>
In addition to the above, significant emphasis in this course will be placed on the following learning objectives:

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 laboratory equipment and the use of a laboratory notebook)
3. advanced methods of data analysis (including least-squares fitting methods and other statistical analyses)
4. preparation of written laboratory reports (including the format used in American Chemical Society publications and an introduction to the peer review process)
5. presentation of scientific data (including the preparation of publication-quality graphical representations)
6. error analysis (including the determination, representation and interpretation of experimental uncertainty)

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 Chemistry Program Learning Objectives

4) Demonstrate understanding of core concepts and to effectively solve problems in physical chemistry.
6) Answer questions regarding safe practices in the laboratory and chemical safety.
7) Demonstrate safe laboratory skills (including proper handling of materials and chemical waste) for particular laboratory experiments.
9) Effectively present a scientific paper orally, as per at an American Chemical Society symposium.
10) Write a formal scientific laboratory report, using the format and style of an article in a peer-reviewed American Chemical Society journal.

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 six 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. Scheduling of experiment rotation assignments will be done as soon as enrollment issues are settled. See the calendar for further details and due dates.

**Important Dates**

- January 28: First day of Instruction
- February 9: Last day to drop without a “W”
- February 16: Last day to add classes
- February 24: Enrollment census date for spring
- March 28-April 1: Spring Recess (No classes)
- April 26: Last day to withdraw for Spring
- May 16: Last day of instruction for Spring
- May 18-24: Final Examinations
- May 18: Final Presentation 4:45 – 7 pm
- May 27: Grades due from faculty

**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 Reports**

In addition to the introductory exercises, each student must complete six laboratory experiments. Four 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 her or his 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 both electronic (via Canvas) and hardcopy forms promptly at the beginning of the laboratory period on the date they are due. Late reports will be marked down 10% for each day or fraction of a day they are late.**

All laboratory reports will include a set of post-laboratory questions, worth 10 points.

*Informal laboratory reports* will be worth 50 pts. each and will focus on the analysis of the experimental data and, especially importantly, including uncertainty analysis. These reports should include a one page summary of the experiment, stating the major goals and conclusions (10 pts.), a complete presentation of the data and analysis of the data (20 pts.), and a quantitative uncertainty analysis that produces an estimated uncertainty in the final reported values and identifies the major quantitative source of experimental uncertainty (20 pts.).

*The formal lab report* will be worth 100 points and will be in a form similar to published papers in the *Journal of Physical Chemistry*. Major sections of the formal lab report include:
ABSTRACT (5 pts)

INTRODUCTION (15 pts) - including the background and theory needed to interpret the data

EXPERIMENTAL SECTION (25 pts) - including the procedure, the raw data and any graphical representations of raw data

RESULTS/DISCUSSION (30 pts) - including the analysis of the data, graphical representations of results derived from raw data and an interpretation of the results

UNCERTAINTY ANALYSIS AND COMPARISON TO LITERATURE (20 pts) - 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 (5 pts)

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 rotation, which will be the HCl/DCI rotation-vibration spectroscopy experiment.

Laboratory reports must be submitted in both printed and electronic form. Formats for electronic submission can be MS Word or Word-readable files such as RTF or ODC. Adobe PDF is acceptable, but not preferred. Electronic submission will be done through Canvas.

Peer Review

The formal laboratory report will be subject to peer review. On the due date for the formal laboratory report, each student must turn in three copies of their report, machine printed and double-spaced (for clarity and to give room for peer comments). Two students will review the papers and the instructor will provide a review of the third copy. 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 20 points (10 points for each report reviewed).

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 graded twice during the semester. The first notebook grading session will be during the peer review for the formal lab report. Additionally, students must turn in their notebook for grading at the time of their final presentation. Each notebook review will be worth 25 points. (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!) Students who are absent from the peer review or fail to turn in papers to participate in the peer review will receive a score of 0/25 in their laboratory notebook in addition to losing the peer review points.
Pre-lab Assignments

Students will complete a two part pre-laboratory assignment (forms available on Canvas) before beginning each experiment. This will include completion of a safety section and a one paragraph summary of the objectives of the experiment. The safety section will require consultation with the Material Safety Data Sheets (MSDSs) contained in the MSDS notebook. The summary will identify the physical properties to be explored in each experiment and 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.** Each pre-laboratory assignment will be worth 10 points.

Grading

Grades will be determined by scaling the total number of points earned on each type of assignment and adding the total according to the following scale:

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Points</th>
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</thead>
<tbody>
<tr>
<td>safety quiz</td>
<td>10</td>
</tr>
<tr>
<td>prelab assignments</td>
<td>60</td>
</tr>
<tr>
<td>notebook</td>
<td>50</td>
</tr>
<tr>
<td>kinetics of isotope decay mini-report</td>
<td>40</td>
</tr>
<tr>
<td>4 informal reports + final presentation</td>
<td>250</td>
</tr>
<tr>
<td>formal report</td>
<td>100</td>
</tr>
<tr>
<td>post-lab questions</td>
<td>60</td>
</tr>
<tr>
<td>peer review</td>
<td>20</td>
</tr>
<tr>
<td>instructor evaluation</td>
<td>60</td>
</tr>
<tr>
<td>Total</td>
<td>650</td>
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</tbody>
</table>

Any assignments that do not fit into the above categories will be included in the evaluation points. Final letter grades will be determined based on performance relative to my expectations rather than relative to a fixed and predetermined set of cutoffs with one exception. A **minimum of 50% of the total points will be required to receive a passing grade in the course.** All assignments must be submitted, even if they are not complete. The following scale indicates ranges for each letter grade. I reserve the right to adjust the scale downward if conditions warrant, but will not raise the minimum required for any particular grade.

- A: >90%
- B+: 82-86.9%
- C+: 67-71.9%
- D: 50-56.9%
- A-: 87-89.9%
- B: 77-81.9%
- C: 62-66.9%
- F: <50%
- B-: 72-76.9%
- C-: 57-61.9%

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. Also, as a courtesy to your fellow students, please turn pagers and cell phones off or to silent ring during class hours. **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 10% penalty on the score counted toward the grade for each attempt to get 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.

**Library Liaison**

Jennifer Dinalo, jennifer.dinalo@sjsu.edu

**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 at http://info.sjsu.edu/static/catalog/policies.html. Add/drop deadlines can be found on the current academic calendar web page located at http://info.sjsu.edu/home/schedules.html. 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 at http://www.sjsu.edu/advising/.

**University Policies**

**Academic integrity**

Students should know that the University’s Academic Integrity Policy is available at http://info.sjsu.edu/static/catalog/integrity.html. Your own commitment to learning, as evidenced by your enrollment at San Jose State University, and the University’s integrity policy, require you to be honest in all your academic course work. Faculty members are required to report all infractions to the office of Student Conduct and Ethical Development. The Student Conduct and Ethical Development website is available at http://www.sjsu.edu/studentconduct/.

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 graded materials must be the original work of the student to whom the grade is assigned unless otherwise specified. Under no circumstances may you look at another student’s written report prior to turning in your own report nor may you provide a copy of your report to another student. This includes materials submitted for peer review! Any text, diagram, chart or data that is not the product of the student author must cite a reference next to it 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.

If you would like to include in your assignment any material you have submitted, or plan to submit for another class, please note that SJSU’s Academic Policy F06-1 requires approval of instructors.

**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](http://www.sjsu.edu/president/docs/directives/PD_1997-03.pdf) requires that students with disabilities requesting accommodations must register with the Accessible Education Center (AEC) at [http://www.sjsu.edu/aec](http://www.sjsu.edu/aec) to establish a record of their disability.

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.

**Peer Connections**

Peer Connections is the campus-wide resource for mentoring and tutoring located in Room 600 in the Student Services Center. It is designed to inspire students to develop their potential as independent learners while they learn to successfully navigate through their university experience. The center provides support services which include course-content based tutoring, enhanced study and time management skills, more effective critical thinking strategies, decision making and problem-solving abilities, and campus resource referrals. The [Peer Connections website](http://peerconnections.sjsu.edu/) is located at [http://peerconnections.sjsu.edu/](http://peerconnections.sjsu.edu/)

**Chemical Safety**

Chem 120S is a required course for all chemistry majors and minors and a prerequisite for all Chem 180/298 research.
# Spring 2016

<table>
<thead>
<tr>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
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<tbody>
<tr>
<td>February</td>
<td>21st day of classes – Introduction Safety, waste</td>
<td>4 Safety Quiz Stats.</td>
<td>5</td>
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<tr>
<td></td>
<td>9 Uncert. Analysis</td>
<td>11 Uncert. Analysis</td>
<td>12 Last Day to Drop</td>
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<tr>
<td></td>
<td>16 Nuclear Lab</td>
<td>18</td>
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<td>19 Last Day to Add</td>
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<td></td>
<td>23</td>
<td>25 Prelab due Rotation I</td>
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<td>26</td>
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<td></td>
<td>1 Nuclear Lab Report Due</td>
<td>3</td>
<td>4</td>
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<tr>
<td>March</td>
<td>8</td>
<td>10 Prelab due Rotation II</td>
<td>11</td>
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<td></td>
<td>15 Report I Due</td>
<td>17</td>
<td>18</td>
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<td></td>
<td>22</td>
<td>24 Prelab due Rotation III</td>
<td>25</td>
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<tr>
<td><strong>March 27-April 1</strong></td>
<td><strong>NO CLASSES</strong></td>
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<tr>
<td>April</td>
<td>5 Report III Due</td>
<td>7 Prelab due Rotation IV – HCl/DCl</td>
<td>8</td>
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<td></td>
<td>12 Prelab due Rotation V</td>
<td>14 REPORT IV DUE LONG FORMAT for Peer Review</td>
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<td>19</td>
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<td></td>
<td>26 Prelab due Rotation VI and REVISED REPORT IV DUE LONG FORMAT</td>
<td>28</td>
<td>29</td>
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<tr>
<td>May</td>
<td>3 Report V Due</td>
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<td>6</td>
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<td>10</td>
<td>12 Locker Check-Out</td>
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<td></td>
<td>17</td>
<td>19 Final Presentations</td>
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