Physical Measurements: Chem 3440  
Fall 2019

The University of Iowa  
The College of Liberal Arts and Sciences  
Department of Chemistry

Dr. Renée Cole  
Office: W331 CB  
Phone: 319-384-1883  
E-mail: renee-cole@uiowa.edu  
Office Hours: M 9-10 am, W 11 am -12 pm, Th 1-2 pm  
I will also generally be available during lab hours

Andrew Horvath (T/Th)  
Office Hours: M/W 8:30-9:30 am  E208 CB

Lauren Lambach (T/Th)  
Office Hours: W/Th 9:30-10:30 am  E208 CB

Teaching Assistants:

Nicholas Luedtke (M/W)  
Office Hours: T 2:30-3:30 pm; Th 12:30-1:30 pm  E208 CB

Whitney Harmon (M/W)  
Office Hours: T/Th 1:30-2:30 pm  E208 CB

Lecture:  
TTh 11:00 – 11:50 am  E264 CB

Laboratory:  
CHEM 3440:A01  MW 2:00 – 4:50 pm  W428 CB  
CHEM 3440:A02  TTh 2:00 – 4:50 pm  W428 CB

Course Materials:
- Course web site: (https://icon.uiowa.edu)
- Required:
  - Laboratory Manual for Physical Measurements by Mark Young, Renée Cole, and Alexei Tivanski, August 2019. (access experiments from ICON)
  - Laboratory notebook with numbered pages
  - Safety goggles
- Recommended:
  - Physical Chemistry textbook
- Optional:

*SAFETY NOTE* Appropriate safety guidelines must be followed at all times, including wearing goggles and appropriate apparel. Violation of this policy without the express permission of the instructor will result in dismissal from the lab and a grade of zero for that lab period.
Description of Course
The lecture portion of the course will provide background for the statistical treatment of experimental data (error analysis, graphical analysis, etc.) and discussion of scientific communication. In addition, the lectures will cover some of the experimental and theoretical aspects of the planned laboratory experiments. Most of these will be available as short on-line videos so students can review as appropriate for each experiment. Each student will work as part of a team to perform a number of experiments that have been selected to represent various techniques and concepts of relevance to physical chemistry and which use modern instrumentation.

Each student will perform 7 experiments that have been selected to represent various techniques and concepts of relevance to physical chemistry, including thermodynamics, kinetics, quantum mechanics, and spectroscopy. Laboratory experiments provide for the development of technical skills as well as critical thinking and analytical skills. Students will work in assigned teams on a schedule of experiments, but the laboratory reports are to be prepared individually by each student unless otherwise instructed. Students will design and conduct an experiment (independent project) at the end of the semester. Students will also complete assignments designed to develop skills in using the scientific literature.

Objectives and Goals of the Course
This course seeks to develop the following knowledge and skills required by graduates of the UI chemistry program (and scientists in general). Specifically, students should gain skills in the following areas ...

1) Knowledge and understanding of Chemistry:
   - Mastery of major concepts, theoretical principles and experimental findings in chemistry
   - An understanding of the relationship between molecular structure and physical/chemical properties
   - An understanding of the relationship between the microscopic, macroscopic, and symbolic descriptions of matter and the changes it undergoes
   - An understanding of the conditions that affect stability and factors that control rates of change

2) Laboratory skills:
   - Assess chemical and procedural hazards involved in laboratory work, including retrieval and analysis of SDS information
   - Use strategies such as proper personal protective equipment (PPE), responsible handling and disposal of chemicals, and preparation for emergencies to minimize the risks associated with laboratory work
   - Maintain a clearly organized laboratory notebook as a record of experimental procedures and findings
   - Use instrumentation and laboratory techniques to separate, purify, identify, quantify, and characterize chemical species
   - Use computers as tools for data acquisition, management, and analysis

3) Scientific Thinking:
   - Pose scientific questions
• Plan and carry out scientific investigations
• Analyze data in order to make inferences about chemical and physical behavior and properties, and construct scientific arguments to support conclusions
• Use scientific theory and/or interpretations of experimental results to explain chemical phenomena in the context of health, energy, environment, agriculture, etc.
• Use mathematics and computational thinking to understand and predict chemical behavior
• Identify and quantify uncertainties in measurements and limitations in methods
• Use graphs, diagrams, and other models to communicate chemical information

4) Chemical Information Skills:
• Use modern library search tools such as SciFinder to locate and retrieve chemical information
• Read, analyze and critically evaluate journal articles in various subfields of chemistry
• Reference and cite chemical literature appropriately using ACS or other designated citation style

5) Professional Skills:
• Report on experimental work and scientific findings in written reports, for instance through formal laboratory reports or technical memos
• Communicate results of scientific work to non-technical audiences
• Work collaboratively with peers to plan and conduct experiments, interpret chemical information, and solve problems
• Engage in responsible and ethical scientific conduct such as appropriately citing sources and reporting findings accurately

Grading:
Your grade will be determined based on your scores on the 7 laboratory experiments, independent project, and scores on additional assessments. Each laboratory report will include a prelab assignment, a written laboratory report, and a submission of your laboratory notebook pages. Additional assessments will include the safety laboratory activity, laboratory technique assessments, chemical literature assignments, writing assignments, and peer review activities. Plus and minus letter grades will be awarded.

The following grading scale is guaranteed if you score the minimum percentile for that range. If warranted, minor adjustments to minimum percentages may be made at the end of the semester.

<table>
<thead>
<tr>
<th>Component</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online Prelab Quizzes</td>
<td>35</td>
</tr>
<tr>
<td>Pre-lab Assignments</td>
<td>105</td>
</tr>
<tr>
<td>Laboratory Reports</td>
<td>425</td>
</tr>
<tr>
<td>Lab notebook pages</td>
<td>80</td>
</tr>
<tr>
<td>Independent project</td>
<td>130</td>
</tr>
<tr>
<td>Chemical literature assignments</td>
<td>75</td>
</tr>
<tr>
<td>Peer review of reports</td>
<td>50</td>
</tr>
<tr>
<td>------------------------</td>
<td>----</td>
</tr>
<tr>
<td>Safety</td>
<td>50</td>
</tr>
<tr>
<td>Laboratory technique</td>
<td>50</td>
</tr>
<tr>
<td><strong>Total Points</strong></td>
<td><strong>1000</strong></td>
</tr>
</tbody>
</table>

*This is a laboratory course. Students must complete all of the experiments in order to receive a grade higher than D.*

**Laboratory Reports**

Separate laboratory reports must be completed for each experiment. A guide for writing formal reports and general expectations is posted on ICON. Different experiments will have different report formats and requirements. A lab report guide will be posted for each experiment. The laboratory report is due one week from the last day scheduled for the experiment. For reports undergoing review and revision, the revised reports will be due one week after receipt of the reviews. Late reports will be penalized at a rate of 3 pts per day late up to 50% of the possible points.

<table>
<thead>
<tr>
<th>Report type</th>
<th>Required for</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long</td>
<td>CIC, EK, ES</td>
<td>75</td>
</tr>
<tr>
<td>Short</td>
<td>CO, PIB</td>
<td>50</td>
</tr>
<tr>
<td>Technical memo</td>
<td>AFM</td>
<td>50</td>
</tr>
<tr>
<td>Analysis report</td>
<td>PMV lab</td>
<td>50</td>
</tr>
</tbody>
</table>

**Laboratory Prelab**

The laboratory prelab has two components for the 7 experiments: an online quiz (5 pts) and a written portion (15 pts per experiment). The online quiz is based on the prelab videos and key safety issues. The written portion is designed to ensure that students are prepared to complete the laboratory and have considered relevant theory, methods, and safety concerns. Prelab write-ups will be submitted through ICON and are due at least 24 hours before the laboratory period. Students may not begin an experiment prior to completing the prelab quiz posted on ICON and submitting the prelab document on ICON for review.

The prelab is expected to include the following components:

- Title of the Experiment
- Question being answered/addressed by completing the experiment
- Safety Analysis
  - Complete the analysis identifying:
    - Risks & hazards
    - Appropriate PPE and procedures to minimize these risks and hazards
- Procedure
  - Create a procedure that can be followed in lab with all relevant information.
  - You must include data tables for recording data during the experiment. Take time to think about the data you will collect and how it should be organized.
  - If you need to make changes to your procedure during the lab, simply mark one line through a mistake and initial next to it.
- Answers to any prelab questions

**Laboratory Notebooks**

Your laboratory notebook is the means by which you convey to the reader (your instructor/TA in this case) what you have done when completing an experiment. Keeping a lab
A laboratory notebook is an essential part of “doing good science”. Therefore, you will want the contents of your lab book to be organized, neat, and easy to read, and reflect your understanding and completion of the experiment. Other than sharing data with your lab partner(s), never allow other students to copy from your lab book or otherwise obtain information from your lab book without permission of the instructor. See the University Policy for a discussion of plagiarism and academic honesty.

The laboratory notebook should contain procedural aspects of the prelab, experimental details and observations, and the original experimental data. Important observations might include such details as the make and model of commercial equipment or the purity and source of the chemicals used. Follow the guidelines in the Laboratory Manual and/or in Garland et. al, Chapter 1 for the preparation of the notebook. Be sure to note all original graphical, numerical, and spectrometer output in your notebook. Only notebooks with numbered pages are to be used. The notebook pages will be part of each laboratory report.

Notebooks with numbered pages should be used. You will scan and submit pdfs of your notebook pages along with your laboratory reports in ICON (10 pts per experiment).

**Chemical Literature Assignments**
You will complete a series of assignments that will further develop your skills in reading and critiquing the chemical literature as well as helping you design an experiment to complete at the end of the semester.

**Peer Review of Reports**
You will provide peer review for two laboratory reports. Part of scientific communication is the peer-review process for providing a critique of research results before they are widely disseminated.

**Safety**
You must complete the safety protocol analysis and complete the relevant safety modules before you will be permitted to conduct experiments in the laboratory. This is part of the prelab that must be completed and submitted 24 hours before the laboratory period.

**Laboratory Technique**
Points dependent on general laboratory skills, preparation, and participation will be awarded by the TA/instructor on a discretionary basis. Points will be deducted for inappropriate laboratory behavior.

**Independent Project**
The independent project requires students to select a published laboratory experiment (the *Journal of Chemical Education* is a good resource) and complete a four-part project that includes a project proposal, experimental protocol, data report, and a presentation.

---

**Course Policies**

**Course Attendance**
Prompt laboratory attendance is mandatory. You are expected to be in the laboratory during scheduled laboratory times even if you are not actively collecting data. Only University approved absences are permitted and appropriate documentation is required. Arrangements for making up the missed laboratory work must be made with Prof. Cole within one week of the missed laboratory
period. If at all possible, arrangements should be made before missing a laboratory period.

**Safety**
Safety goggles and appropriate clothing and footwear must be worn at all times in the laboratory. All other safety precautions, as posted on the door to the laboratory, such as proper attire, must be adhered to. No food or drinks are permitted in the laboratory. Violation of this policy without the express permission of the instructor will result in dismissal from the lab and a grade of zero for that lab period.

**Laboratory Etiquette**
Students should leave all glassware, equipment, and bench tops in good condition when they are finished. Problems with equipment should be reported to the instructor or TAs as soon as possible. Chemical waste must be disposed of in the appropriate waste jar. Students may lose points for leaving their laboratory areas in unsuitable condition or not following appropriate protocols. Students are financially responsible for the damage or destruction of glassware and equipment and improperly disposed of waste.

**Regrades**
If you feel that an error was made in the grading of your work, you may request a re-grade by notifying the instructor within one week of receiving the graded material. The request should be in writing and indicate the section of the material that is in question. Please note that the entire document may be subject to re-grade.

**Communication**
The instructor will respond to student questions via email with a typical response time of two working days (and often sooner). In addition, general notices concerning the course will be posted on ICON and/or sent to students using email. Due to privacy considerations, the official University of Iowa email address as listed on the class roster will be used for all communications. Each student is considered to be on notice for information sent to their official email address.

**Collaboration**
*Pre-lab:* Students in a team may collaborate on collecting information and answering questions. However, each student is required to write their own answers in their respective laboratory notebooks. Students should NOT simply copy a teammate’s answers.

*Lab-notebook:* Each student should record data and observations in their own notebook. It is expected that all members of a team will use the same data.

*Individual lab reports:* Students in a team may collaborate on analyzing data and finding appropriate references. However, each student should do their own calculations and writing (the only section that may look identical is the data tables). Students must write their own introduction and results/discussion sections, although discussion among partners is permitted.

*Other assignments:* Students are expected to work individually unless given express permission to collaborate.
Resources for Students

Computer Center
Most of the data analysis will be facilitated by a computer. The 20 Macintosh and PC workstations in the Chemistry Computer Facility, 238 CB, will be available to students for the duration of the semester. Access to the Facility is via an electronic cardkey system activated with a University ID card. Word processing, spreadsheet, plotting, and data analysis software is available on all computers.

Writing Center
Students may find the Writing Center useful for this course. Writing Center: http://www.uiowa.edu/~writingc/

Chemistry Resource Room
Department teaching assistants have regularly-scheduled office hours in Chemistry Resource Room E208 CB (east side of building, 2nd floor). This room is usually open 8:30 AM - 6:30 PM, Monday – Thursday and 9:30 AM - 3:30 PM, Friday. TAs for other chemistry courses may be able to assist you in CB E208. Specific TA office hours for the course are posted on ICON and listed above.

Additional Instructional Resources for Students
Alpha Chi Sigma Chemistry Fraternity (AXE) tutoring: https://tutor.uiowa.edu/find-help/help-labs/alpha-chi-sigma-chemistry-fraternity-axe/

The College of Liberal Arts and Sciences: Information for Undergraduates
Absences and Attendance
Students are responsible for attending class and for contributing to the learning environment of a course. Students are also responsible for knowing their course absence policies, which will vary by instructor. All absence policies, however, must uphold the UI policy related to student illness, mandatory religious obligations, including Holy Day obligations, unavoidable circumstances, or University authorized activities (https://clas.uiowa.edu/students/handbook/attendance-absences). Students may use this absence form to aid communication; the instructor will decide if the absence is excused or unexcused (https://clas.uiowa.edu/sites/default/files/ABSENCE%20EXPLANATION%20FORM2019.pdf).

Academic Integrity
All undergraduates enrolled in courses offered by CLAS have, in essence, agreed to the College's Code of Academic Honesty. Misconduct is reported to the College, resulting in suspension
or other sanctions, with sanctions communicated with the student through the UI email address (https://clas.uiowa.edu/students/handbook/academic-fraud-honor-code).

**Accommodations for Disabilities**

UI is committed to an educational experience that is accessible to all students. A student may request academic accommodations for a disability (such as mental health, attention, learning, vision, and physical or health-related condition) by registering with Student Disability Services (SDS). The student is then responsible for discussing specific accommodations with the instructor. More information is at https://sds.studentlife.uiowa.edu/.

**Administrative Home of the Course**

The College of Liberal Arts and Sciences (CLAS) is the administrative home of this course and governs its add/drop deadlines, the second-grade-only option, and related policies. Other colleges may have different policies. CLAS policies may be found here: https://clas.uiowa.edu/students/handbook.

**Communication and the Required Use of UI Email**

Students are responsible for official correspondences sent to the UI email address (uiowa.edu) and must use this address for all communication within UI (Operations Manual, III.15.2).

**Complaints**

Students with a complaint about an academic issue should first visit with the instructor or course supervisor and then with the Chair of the department or program offering the course; students may next bring the issue to the College of Liberal Arts and Sciences. For more information, see https://clas.uiowa.edu/students/handbook/student-rights-responsibilities.

**Final Examination Policies**

The final exam schedule is announced around the fifth week of classes; students are responsible for knowing the date, time, and place of a final exam. Students should not make travel plans until knowing this information. No exams of any kind are allowed the week before finals. Visit https://registrar.uiowa.edu/final-examination-scheduling-policies.

**Nondiscrimination in the Classroom**

UI is committed to making the classroom a respectful and inclusive space for all people irrespective of their gender, sexual, racial, religious or other identities. Toward this goal, students are invited to optionally share their preferred names and pronouns with their instructors and classmates. The University of Iowa prohibits discrimination and harassment against individuals on the basis of race,
class, gender, sexual orientation, national origin, and other identity categories set forth in the University's Human Rights policy. For more information, contact the Office of Equal Opportunity and Diversity (diversity.uiowa.edu).

**Sexual Harassment**
Sexual harassment subverts the mission of the University and threatens the well-being of students, faculty, and staff. All members of the UI community must uphold the UI mission and contribute to a safe environment that enhances learning. Incidents of sexual harassment must be reported immediately. For assistance, please see [https://osmrc.uiowa.edu/](https://osmrc.uiowa.edu/).