



Chemistry 443  
Instrumental Analysis  
Dr. Jeremy Ramsey  
Spring 2014



### Course Description

The material presented in this course covers the basic principles of instrumental analytical chemistry, including the fundamentals of spectroscopy, separation science, and electrochemistry. The course will require use of the fundamentals of quantitative measurement science as presented in Chemistry 232—Quantitative Chemical Analysis.

### Learning Objectives

Upon completion of this course, students should be able to

- Understand the principles by which chemical instrumentation operates
- Identify components of chemical instrumentation and relate it to the function of the instrument
- Understand how basic instrumentation components can be combined to produce different, working instruments
- Perform calculations involving stoichiometry and solution concentration as they relate to laboratory problems
- Use the conclusion of statistical analysis to determine sources of experimental error and to direct the path of subsequent chemical experimentation
- Analyze written scientific literature to understand chemical instrumentation
- Communicate scientific data clearly in oral presentations
- Analyze student presentations critically to determine their quality
- Use graphical analysis software to analyze data and prepare publishable quality graphs

The Lycoming Chemistry Department believes that students completing a major in chemistry will be able to:

1. Exhibit proficiency in the major sub-disciplines of chemistry
2. Perform wet laboratory techniques as appropriate to the major sub-disciplines of chemistry
3. Understand and use modern chemical instrumentation
4. Exhibit integrative, problem-solving skills, such as experimental design, data manipulation, and data interpretation
5. Communicate the results of chemical investigations effectively in written and oral form
6. Search the chemical literature, evaluate the results of the search, and access desired research materials
7. Demonstrate responsible conduct in the laboratory, including laboratory safety and ethical research practices

This course will provide instruction in all areas covered by the departmental learning goals. The course also provides instruction in support of the Lycoming College mission statement in the areas of developing communication, developing critical thinking skills, and exploring scientific traditions.

"In the middle of difficulty lies opportunity."  
-- Albert Einstein

"Success is a lousy teacher. It makes smart people think they can't lose."  
-- Bill Gates

"Opportunity is missed by most people because it's dressed in overalls and looks like work."  
-- Thomas Edison

### Philosophy of Instruction

Ultimately, the purpose of this course is for you to learn the foundations upon which modern instrumental analysis is based. In my opinion, grades are secondary to your understanding of the subject, and ideally, I am willing to present each of you with an A. In reality, some students will be more/less motivated or be more/less inclined toward the material. These differences will lead to differences in performance. My goal is to see each student achieve mastery of the subject and I am dedicated to reaching this goal. The motivation, however, must begin with you. Please take advantage of the opportunities available to you and we will both achieve the goals that we have for the semester.

### Meeting Times

Lecture	MWF	11:30-12:20 am	215 Heim
Laboratory	T	1:00-4:50 pm	207 Heim

### Prerequisites

- Chemistry 331 and 232 (or permission of instructor)
- Knowledge of chemical reaction stoichiometry and equilibrium
- Introductory statistical analysis techniques
- Basic skills in Microsoft Excel and Igor Pro

### Required Course Materials

- Principles of Instrumental Analysis, 6<sup>th</sup> edition; Authors: Skoog, Holler, and Crouch
- Bound laboratory notebook
- Safety Glasses
- Calculator capable of performing logarithmic, exponential, and statistical functions

### Office Hours

Since I tend to spend a lot of time in and around my office, I will not be having formal office hours for this course. As many of you know, I encourage you to just stop by when you have a question or concern.

### Quizzes

While uncommon, we MAY have a maximum of three quizzes in this course, which may be unannounced. The purpose of these quizzes is to ensure attendance in class and to provide motivation for staying current with the course material. As with the examinations, quizzes should be considered cumulative and may contain information from the laboratory or lecture portion of the course.

### Colloquium Attendance

All chemists use chemical analysis techniques to some degree. This is most clearly observed by watching others discuss chemical research. For us this opportunity is chemistry colloquium and you will receive the full participation grade for attending at least FIVE colloquia (each is worth three points). If you are unable to attend colloquia due to a scheduling conflict, you can receive the participation points by summarizing research articles. You should discuss this with me before you begin.

### Homework

In this course, homework assignments will not be collected, but it is strongly suggested that you attempt them. The selected homework problems provide an indication of the topics that I think are important. This makes solving them of utmost importance to your grade and your performance in the course will likely correlate with the amount of time spent solving problems. Because learning can be much more efficient through failure, I feel strongly that the problems should be attempted individually before seeking help from others. Your answers can be checked with answers in the back of the textbook. Please feel free to stop by my office to discuss any difficulties you may have with any of the suggested problems.

### Presentation

Although it is often thought to be painful, the ability to orally present complicated concepts is one of the most important skills that you can possess. Each student will be required to present the results from the experiments that they design/perform. The grade for each presentation will be based on evaluation by the instructor. Students will work in groups to complete the experiments. Each group member will receive the same grade unless a group member does not fully participate (during the experimental or the presentation phases), in which case, a student may earn a grade lower than their group. It is in your best interest to help your fellow group members and encourage them to perform to their best ability.

### Examinations

Examinations will be given during laboratory sessions and will be administered on the following dates. Because the material presented in the class builds upon concepts presented earlier (and from Chemistry 232), all exams should be considered cumulative. Changes to the exam schedule will be made only with unanimous consent of the class and must be made prior to January 17<sup>th</sup>.

Examination 1	February 18
Examination 2	April 8
Final Examination **	April 23; 1:00 pm

\*\* The final examination time and date is established by the registrar. It cannot be changed.

### Safety

Safe laboratory practices, including proper attire, will be expected at all times. Long pants are required as well as closed toe shoes (no sandals). Wearing contact lenses during laboratory session is strongly discouraged, but may be tolerated with prior approval. You will not be permitted to begin any experimental procedures until all safety concerns have been addressed. **Repeated safety violations will cause a zero to be rewarded for the safety portion of the grade and the student will be asked to leave the laboratory for the day.**

The class behavior will also be evaluated for its safety and cleanliness. If any member of the class is found to be in violation (leaving a chemical spill, not cleaning balances after using them, squirting water, etc.), the entire class will be penalized. **It is in your best interest to make sure that your classmates are acting appropriately during lab time.**

Grading

- There will be no makeup examinations or quizzes, so attendance in class on exam dates is mandatory. One legitimate exam absence (excuse must be approved by the Provost's office: for instance, an illness or a funeral) can be replaced by the final, standardized exam score.
- Attendance in laboratory is mandatory since we will be working in groups. Makeup laboratory experiments will be nearly impossible and will only be permitted for legitimate reasons (excuse must be approved by the Provost's office). You should contact the instructor (not your classmates) before any laboratory period has been missed.

	<u>Points</u>
Examinations (3)	400
<i>Midterm exam 1</i>	125
<i>Midterm exam 2</i>	125
<i>Take home/Open Book final exam</i>	75
<i>ACS standardized final exam</i>	75
Lab Performance	100
<i>Presentations</i>	95
Safety and Cleanliness	5
Participation	15
Colloquium Attendance	10
	<hr style="width: 10%; margin: 0 auto;"/>
	525

"If you don't make mistakes, you're not working on hard enough problems. And that's a big mistake."

-- Frank Wilczek

"You have to be confused before you can reach a new level of understanding anything."

-- Dudley Herschbach

"Discipline is just choosing between what you want now and what you want most."

-- Unknown Author

"The best way to learn and get better is to screw up and not do it again."

-- Greg Maddux

"Anyone who stops learning is old, whether at twenty or eighty."

-- Henry Ford

Laboratory Topic/Examination Schedule

The class schedule presented here is tentative and can change during the semester.

<u>Week Beginning</u>	<u>Laboratory Topic</u>
January 6	Determination of Caffeine in Coffee (Day 1)
January 13	Determination of Caffeine in Coffee (Day 2)
January 20	Christmas Again! Fabrication of a pH Electrode (Day 1)
January 27	Christmas Again! Fabrication of a pH Electrode (Day 2)
February 3	Christmas Again! Fabrication of a pH Electrode (Day 3)
February 10	Christmas Again! Fabrication of a pH Electrode (Day 4)
February 17	<b>Exam 1 (during lab)</b>
February 24	pH Electrode Presentations (during lab)
March 3	<b>Spring Break—No class</b>
March 10	Fabrication and Use of an Absorbance Spectrometer (Day 1)
March 17	Fabrication and Use of an Absorbance Spectrometer (Day 2)
March 24	Fabrication and Use of an Absorbance Spectrometer (Day 3)
March 31	Fabrication and Use of an Absorbance Spectrometer (Day 4)
April 7	<b>Exam 2 (during lab)</b>
April 14	Absorbance Spectrometer Presentations (during lab)/Check Out
April 21	<b>Final Exam (4/24; 8:30-11:30 am)</b>