

CHEMICAL INSTRUMENTATION [CHEM 524]

Spring 2016

Department of Chemistry University of Wisconsin, Madison

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Location of Instructor Office Hours: Chemistry 4355

Instructor Office Hours: After lecture or by appointment

Course Website on Learn@UW: <https://learnuw.wisc.edu/>

Lecture: 9:55 AM TR; Room 2373 Chemistry

Laboratory: MTWR 1:20 PM to 4:20 PM or F 2:25 PM to 5:25 PM; Room 2330 Chemistry

Laboratory Director: Dr. Rob McClain mclain@chem.wisc.edu

Teaching Assistants: Paul Hebert, phebert@chem.wisc.edu
Michael Vermeuel, mvermeuel@wisc.edu

Course Description: This course is an intermediate (junior or senior) level course in chemical instrumentation. It assumes knowledge of quantitative analysis (Chem 327, 329 or 116), organic structure and nomenclature (Chem 343), and basic physics (Phys 202 or 208). The purpose of this course is to teach the principles of chemical instrumentation design, development, and use. The course will consist of two lecture/discussion sessions and one laboratory session per week, along with problem sets and exams.

COURSE INFORMATION

Lecture/Discussion: There are two 50 minute lecture/discussion sessions each week covering the theory and applications of various analytical instrumentation topics. During lectures I will introduce principles and illustrate concepts with example questions. Lectures will provide an opportunity for discussion as well as tackling problems in a group. As a result, participation is central in class. Topics to be explored include separations, spectroscopy, mass spectrometry, electrochemistry and electronics.

Laboratories: There is a three hour laboratory each week. In the laboratory, practical experience building and using chemical instrumentation will be provided. More details on the laboratory can be found below.

Problem Sets: Problem sets will be assigned to cover the course material and will be discussed during lecture/discussions. Some of the problems will require the use of Matlab or other mathematical modelling software. Assignments will be made available at least 7 days before they are due.

Exams: There will be two exams in this course. The first exam will be given in the middle of the semester and will cover the material up to that time. The second exam will be given during exam week. Both exams will count equally towards the final grade.

Grades: Your final grade will be computed with the following scheme:

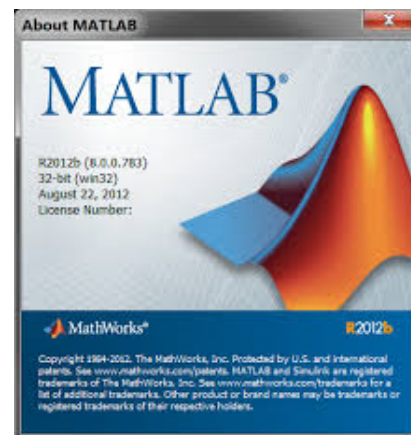
	Percent	Notes
Exams (2x, 15% each)	30%	No make-up exams
Laboratory	40%	More details below
Problem Sets	30%	P.S. are not equally weighted

Your scores are available to you at Learn@UW, with a 3-5 day time delay. There are no opportunities for extra credit.

Resources and Materials:

1. There is no single, formal textbook for Chem 524. Instead, select book chapters are posted on Learn@UW for each of the topics discussed in class and laboratory.
2. Numerous problem sets will require the use of mathematically modelling software. Mathworks Matlab is recommended for this. Matlab is available at no charge to students at UW Madison through a site license. Installation instructions for Matlab can be found at the campus software library: <https://www.doit.wisc.edu/services/software/>

If you have any questions or concerns regarding access to Matlab for your personal computer or to university computer labs that have Matlab installed, please contact us. It is important that you find a reliable mechanism for using MatLab early in the class.



ADDITIONAL RESOURCES

Numerous resources are available to assist you with either this course in particular or college life in general. It is up to you to take advantage of these resources to ensure your success both in this course and at UW-Madison.

Students with Disabilities: Appropriate accommodations for lecture, laboratory, discussion, and/or exams can be arranged for students with disabilities. The McBurney Disability Resource Center (<http://www.mcburney.wisc.edu/>) can provide assistance. Accommodations still must be made well in advance, so please pursue these avenues immediately.

Advising and Counseling Services (University Health Services): College life can be stressful. If you are struggling with your academic course load or other academic issues, your advisor is a good resource. If you are struggling emotionally with anxiety, depression, or other health issues, individual counseling is available at University Counseling and Consultation Services. For more information go their website (http://www.uhs.wisc.edu/home.jsp?cat_id=36) or call 265-5600. Crisis intervention services are also available 24 hours a day by dialing this same phone number and pressing option 9.

Academic Misconduct: It is expected that all students will conduct themselves with honesty, integrity, and professionalism. Any student caught cheating on an exam will receive an F in the course. Any student caught cheating on homework or lab will receive a zero for that assignment. A second infraction will result in an F for the course. More information on what constitutes academic misconduct and policies on handling misconduct can be found at the following website: <http://www.wisc.edu/students/saja/misconduct/UWS14.html>

Lecture Outline and Calendar: Content covered in lecture will closely follow that of the laboratory. The tentative schedule for lecture is:

1. Separations

- A. Liquid Chromatography
- B. Electrophoretic Methods

2. Spectroscopic Measurements

- A. Types of Spectroscopy
- B. Frequency Domain Measurements (e.g. absorption and emission)
- C. Instrumental Parameters (e.g. sensitivity, resolution, dynamic range)
- D. Instrumental Components (light sources, wavelength selectors, detectors)

3. Electrochemical Measurements

- A. Potential measurements
- B. Current measurements

4. Electronics

- A. Passive Measurements
- B. Operational Amplifiers
- C. Conversion between Analog and Digital Domains
- D. Signal to Noise Optimization

5. Mass Spectrometry

- A. General Introduction
- B. Types of Mass Spectrometers

Laboratory Syllabus and Schedule:

Laboratory Philosophy: The laboratory for Chemistry 524 is intended to provide you with hands on experiences with the design, development, and use of different types of chemical instrumentation. We want to facilitate a laboratory environment where you learn important physical concepts while practicing useful experimental laboratory skills. We expect you to bring active hands and an active mind to each laboratory period. The lab sections are kept small to encourage discussion with the instructors and other students. No formal laboratory reports will be required. All observations, data, results and discussions will be completed, recorded and collected during the laboratory period. This will give you practice with **thinking while doing** which is an essential skill for any laboratory scientist.

Laboratory Grading: To be consistent with our laboratory philosophy, the lab grading will reflect the quality of your lab work and not necessarily the quantity. For example, if you are faced with a technical problem during an experiment, and this problem prevents you from completing all of the day's activities, you will be graded only on the activities that you had time to complete. And if you worked diligently on the problem you faced, you would receive high marks in the category of lab work. The following point totals reflect the maximum points for each aspect of the laboratory activities. Throughout the semester, the report sheets may be corrected and resubmitted in order to obtain the maximum points for accuracy and presentation.

Lab Work: Present during the entire lab period and worked thoughtfully and diligently on the lab activities. [10 pts day⁻¹]

Report Sheet: Of the activities completed, calculations, plots, results, and conclusions are correct and accurate, and the report sheet is organized and readable, i.e. plots are of appropriate size, important calculations are highlighted, and conclusions are written in a precise and concise manner. [5 pts day⁻¹]

Laboratory Schedule:

Week 1 1/19– 1/22	No Lab
Week 2 1/25– 1/29	Lab 1: Introduction to Chromatography
Week 3 2/1– 2/5	Lab 2: HPLC
Week 4 2/8-2/12	Lab 3: Introduction to Electrophoresis
Week 5 2/15– 2/19	Lab 4: Spectroscopic Measurements
Week 6 2/22 – 2/26	Lab 4: Spectroscopic Measurements
Week 7 2/29 – 3/4	Lab 4: Spectroscopic Measurements
Week 8 3/7– 3/11	Lab 4: Spectroscopic Measurements
Week 9 3/14– 3/18	Lab 5: Electrochemical Measurements
Spring Break	No Lab
Week 10 3/28– 4/1	Lab 5: Electrochemical Measurements
Week 11 4/4- 4/8	Lab 6: Electronics
Week 12 4/11– 4/15	Lab 6: Electronics
Week 13 4/18– 4/22	Lab 6: Electronics
Week 14 4/25 – 4/29	Lab 6: Electronics

Group Work: The ability to work with others is an important skill and collaboration with other students, TAs, and instructors is encouraged in the instrumental laboratory. For the laboratory activities you will work with a partner and only submit a single report sheet. Both partners need to make significant contributions to the collection of data and the writing of the report sheet in order to receive full points.

Academic Misconduct: The small laboratory with close interactions with TAs and instructors should be enough to prevent any academic misconduct. However, you should be aware that any of the following actions will be considered academic misconduct and will result in disciplinary action according to UWS 14 (link below): creating false data, presenting other persons data as your own, cutting and pasting information from the web without citation, and intentionally damaging equipment or contaminating reagents and glassware.

UWS 14: <http://students.wisc.edu/saja/misconduct/UWS14.html>

Laboratory Safety: Potential safety risks are usually minimal in the instrumental laboratory, but chemicals and glassware are used routinely, and adequate eye protection and clothing should be worn. Safety glasses are required and are available in the laboratory. You must wear shoes that completely cover your feet; no sandals or other open toed shoes are allowed. In general you should wear clothing that protects your skin as much as possible. Shorts are not allowed in the laboratory. Gloves are not used for routine work in this laboratory. In some cases, additional personal protection may be required for special procedures, and the extra personal protective equipment will be provided for you. Examples might include gloves, fume hoods, goggles, lab coats, and face shields. You will occasionally work with high voltage power supplies and class III lasers. Make sure your TA reviews appropriate safety procedures before working with these items.