



Chemistry 327: Fundamentals of Analytical Science SYLLABUS

Chemistry 327 is a combined lecture/laboratory course that is an introduction to analytical chemistry. The lectures will begin with a discussion of the treatment of experimental error, including the use of statistics. Other topics addressed include acid-base equilibria, solubility equilibria, complexation equilibria, and oxidation-reduction equilibria. Electrochemistry will be covered in connection with the discussion of oxidation-reduction equilibria.

Course Credit: CHEM 327 is a 4-credit class that meets each week of the 8-week summer term for four 75-minute lectures and four 3-hour laboratories. Approximately 25 minutes of each lecture session is dedicated to discussion the laboratory activities and help on homework or other course issues, and will be led by the TAs in discussion format. Over the course of the semester, students are expected to do at least 180 hours of learning activities, which includes class attendance, reading, studying, preparation, problem sets, laboratory reports, and other learning activities.

Official Course Description: Fundamentals of chemical measurement in chemistry, biology, engineering, geology, and the medical sciences. Topics include equilibria of complex systems, spectroscopy, electrochemistry, separations, and quantitative laboratory technique. Lecture, lab, and discussion.

Course Designations: Intermediate level; physical science breadth; counts as L&S credit.

Instructional Mode: Face-to-face

Requisites:

CHEM 104 or CHEM 109

Lecture time: MTWR 10:40 – 11:55 AM

Lab time: MTWR 7:30 – 10:30 AM

Lecture location: Chem 2373

Lab location: MSC 5385

Instructor:

Prof. R. Claude Woods

office: Chem 4337

phone: 608-262-2892

e-mail: rcwoods@wisc.edu (Please include "Chem 327" in the subject line.)

Course webpage: <https://learnuw.wisc.edu>

Office hours: By appointment

Teaching Assistants:

Section 301

Lida Khalafi

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Section 302

Lisa George

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Yumin Lian

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TA Office hours will be announced during the first week of classes and posted on the course website.

Textbook: Harris, Daniel C. *“Quantitative Chemical Analysis”* 9th Ed.

Other Required Material: Lab manual (available for purchase at the analytical stockroom counter, room 3380 in the Medical Sciences Center), bound laboratory notebook with carbon copy, safety goggles, a USB or flash drive, and a lab coat.

Learning Objectives for Chem 327:

Students will be able to

- a) Apply the statistical methods for the evaluation of laboratory data
- b) Use calibration and sampling methods important to quantitative analysis
- c) Model chemical systems and experimental data using relevant quantitative, mathematical, and computational methods.
- d) Learn analytical methods based on titrations, separations, electrochemical measurements, and spectroscopy and interpret the results for chemical analysis
- e) Identify, formulate, and solve integrative problems using appropriate information and approaches.
- f) Develop skills in working collaboratively with others, both chemists and those from other disciplines, to solve problems and create new knowledge.
- g) Communicate chemical knowledge effectively through written reports, oral presentations, and visual aids.
- h) Locate, evaluate, and use information in the chemical literature.

Grades:

The point distribution is as follows:

Exams:	3 exams (150 points each)	450 points
Homework:	Approximately 7 assignments	150
Laboratory:	12 labs	400
	12 pre-lab quizzes	
	1 project	
	lab exit survey	
	TA evaluation	
<i>Total:</i>		<i>1000 points</i>

Final term letter grades will be assigned in the same order as term numerical point totals in all cases. Cut-offs for letter grades will be determined at by the staff at the end of the term bases of several factors, one of which will be consistency with previously assigned letter grades. We will provide updates to the accumulated points earned in the course with a very tentatively estimated letter grade twice during the term. All course grades will be documented on the course webpage.

Exams:

There will be three exams this semester. The exams are not cumulative; however, most of the material is inherently connected. Therefore, in general you must have a firm

understanding of previous material in order to fully comprehend new material. Exams will be given during scheduled laboratory periods.

Exam I: July 5
Exam II: July 26
Exam III August 9

Homework:

You may work on these assignments as a group, but you must turn in your own homework. Be sure to note that the homework assignments directly reflect exam material. If you cannot work out the problems yourself after the completion of the homework, you will not gain the *proficiency* required to solve the problems on the exams within the timeframe of the exams. **No late assignments are accepted except with permission from Professor Woods. This is a strict deadline.**

Course Outline:

The very tentative course schedule is as follows:

Week	Lecture Topics	Book Chapters
1 (June 18)	Units, Errors, Statistics	0-4
2 (June 25)	Solubility, Systematic Equilibrium	6-8
3 (July 2)	Modeling Chemical Equilibrium, Spectrophotometry, Acid-Base Chemistry	9, 18, 19 (primarily lecture material)
4 (July 9)	Acid-Base Chemistry, Fractional Composition	10,13
6 (July 16)	Buffering, Modeling Acid-Base Titrations, Transition Metal Hydroxide Complexes	11
7 (July 23)	Complexation Equilibria, EDTA Titration Chemistry	12
8 (July 30)	Oxidation-Reduction Chemistry, Potential Buffers, Red-Ox titrations	14-16

This schedule will change as we go along, depending on how we do in these lectures. You should also note that textbook chapters 0, 2, and 28 are devoted to analytical laboratory practices. Although you will not be directly tested on these chapters, you will find information in these chapters that will boost your performance in the laboratory.

ACADEMIC INTEGRITY

Each student is expected to submit homework assignments that are their own work. Students may work together on homework, but the final submitted assignment must be that of an individual. By enrolling in this course, each student assumes the responsibilities of an active participant in UW-Madison's community of scholars in which everyone's academic work and behavior are held to the highest academic integrity standards. Academic misconduct compromises the integrity of the university. Cheating, fabrication, plagiarism, unauthorized collaboration, and helping others commit these acts are examples of

academic misconduct, which can result in disciplinary action. This includes but is not limited to failure on the assignment/course, disciplinary probation, or suspension. Substantial or repeated cases of misconduct will be forwarded to the Office of Student Conduct & Community Standards for additional review. For more information, refer to student conduct.wiscweb.wisc.edu/academic-integrity/.

ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES

McBurney Disability Resource Center syllabus statement: “The University of Wisconsin-Madison supports the right of all enrolled students to a full and equal educational opportunity. The Americans with Disabilities Act (ADA), Wisconsin State Statute (36.12), and UW-Madison policy (Faculty Document 1071) require that students with disabilities be reasonably accommodated in instruction and campus life. Reasonable accommodations for students with disabilities is a shared faculty and student responsibility. Students are expected to inform faculty [me] of their need for instructional accommodations by the end of the second week of the term, or as soon as possible after a disability has been incurred or recognized. Faculty [I], will work either directly with the student [you] or in coordination with the McBurney Center to identify and provide reasonable instructional accommodations. Disability information, including instructional accommodations as part of a student's educational record, is confidential and protected under FERPA.”

DIVERSITY & INCLUSION

Institutional statement on diversity: “Diversity is a source of strength, creativity, and innovation for UW-Madison. We value the contributions of each person and respect the profound ways their identity, culture, background, experience, status, abilities, and opinion enrich the university community. We commit ourselves to the pursuit of excellence in teaching, research, outreach, and diversity as inextricably linked goals.

The University of Wisconsin-Madison fulfills its public mission by creating a welcoming and inclusive community for people from every background – people who as students, faculty, and staff serve Wisconsin and the world.” <https://diversity.wisc.edu/>

Laboratory:

The laboratory counts for a total of 40% towards your final grade and is divided into three main categories: standard experiments, lab quizzes, and project.

- There will be 14 graded standard experiments, and your grade will be based on the accuracy and precision of your results. **The results from these experiments are to be turned in no later than the start of the laboratory period following the completion of the experiment.** You will lose 2 pts/day if the result is turned in late.
- The primary goal of the pre-lab quizzes is to prompt you to prepare for the labs beforehand and to test your knowledge and understanding of the concepts behind the standard experiments. Overall, being “prepared” for a lab means you are familiar with the: overall concepts and goals of the experiment, methods used in the experiment to accomplish the goals, procedure (enough so that you understand the impact of each step on the chemistry and the calculations, e.g. dilutions, stoichiometry, etc), and calculations (enough so that you understand how to perform the calculation required for the experiment given a set of raw data). You can have two attempts at each quiz, the higher grade will be the final grade. It is advised that you make your first attempt for each quiz at least 1 day before the lab so that you have time to ask questions before your second attempt, in case you encounter any difficulties. **The quiz for each lab becomes unavailable when that lab starts.**
- The lab project could be the most challenging and also most rewarding part of this course. We will discuss the project in more details as we go into the semester.

Week	Date	301 Lida Khalafi/John Pavek	302 Lisa George/Yumin Lian
1	18-Jun	Check in/ Weighing Experiment	Check in/ Weighing Experiment
	19-Jun	Glass Volumetric Apparatus	Glass Volumetric Apparatus
	20-Jun	Glass Volumetric Apparatus	Glass Volumetric Apparatus
	21-Jun	Preparation of Standard HCl and NaOH Solutions	Preparation of Standard HCl and NaOH Solutions
2	25-Jun	Preparation of Standard HCl and NaOH Solutions	Preparation of Standard HCl and NaOH Solutions
	26-Jun	Det. of % KHP in a Mixture	Det. of % KHP in a Mixture
	27-Jun	Soluble Oxalate Titration	Soluble Oxalate Titration
	28-Jun	Spectroscopic Determination of a Mixture	Spectroscopic Determination of a Mixture
3	2-Jul	Ascorbic Acid Method	Ascorbic Acid Method
	3-Jul	<i>Study Day/Finish Labs</i>	<i>Study Day/Finish Labs</i>
	4-Jul	Happy Independence Day!	
	5-Jul	EXAM 1	
4	9-Jul	Gas Chromatographic Analysis of a Mixture	High Pressure Liquid Chromatography
	10-Jul	High Performance Liquid Chromatography	Gas Chromatographic Analysis of a Mixture
	11-Jul	Spike Recovery and Determining a Method Detection Limit	Spike Recovery and Determining a Method Detection Limit
	12-Jul	A Spectrophotometric Study of Fluorescein	A Spectrophotometric Study of Fluorescein
5	16-Jul	<i>Study Day/Finish Labs</i>	
	17-Jul	Study and Identification of an Unknown Weak Acid	Study and Identification of an Unknown Weak Acid
	18-Jul	Adventures with Buffers	Adventures with Buffers
	19-Jul	A Study of Bromocresol Green	A Study of Bromocresol Green
6	23-Jul	Hardness of Water	Hardness of Water
	24-Jul	Hardness of Water	Hardness of Water
	25-Jul	<i>Study Day/Finish Labs</i>	<i>Study Day/Finish Labs</i>
	26-Jul	EXAM 2	
7	30-Jul	Fluoride Ion Electrode	Fluoride Ion Electrode
	31-Jul	Project Planning Day	Project Planning Day
	1-Aug	Project	Project
	2-Aug	Project	Project
8	6-Aug	Project	Project
	7-Aug	Project/Check out	Project/Check out
	8-Aug	<i>Study Day</i>	<i>Study Day</i>
	9-Aug	EXAM 3	