



## Chemistry 327: Fundamentals of Analytical Sciences

**Semester and Year:** Spring 2020

**Credits:** 4 credit hours

**Course URL:** <https://learnuw.wisc.edu/>

**Course Designations and Attributes:** Breadth - Physical Science; counts toward the Natural Science requirement; Level – Intermediate; L&S Credit - Counts as Liberal Arts and Science credit in L&S

### Meeting Times and Locations:

Lecture: MW 2:25-3:15 pm in B371 Chemistry

Disc	Time	Room	Lab		Laboratory Room
301	W 7:45-8:35 am	STERLING 2339	601	TuTh 7:45-10:45 am	MED SC CTR 5385
302	W 7:45-8:35 am	STERLING 2319	602	TuTh 7:45-10:45 am	MED SC CTR 5385
303	W 7:45-8:35 am	STERLING 2329	603	TuTh 7:45-10:45 am	MED SC CTR 5385
305	F 2:25-3:15 pm	CHEM 2381	605	MW 7:45-10:45 am	MED SC CTR 5385
306	F 2:25-3:15 pm	CHEM B387	606	MW 7:45-10:45 am	MED SC CTR 5385

**Instructional Mode:** All face-to-face

**How Credit Hours Are Met:** CHEM 327 is a 4-credit class that meets each week for two 50-minute lectures, one 50-minute discussion, and two 3-hour laboratories. Over the course of the semester, students are expected to engage in at least 180 hours of learning activities, which includes class attendance, reading, studying, preparation, problem sets, laboratory reports, and other learning activities.

### INSTRUCTORS AND TEACHING ASSISTANTS

**Lecturer:** Dr. Linda Zelewski

**Office:** Chem 1325

**Email/Preferred Contact:** [zelewski@wisc.edu](mailto:zelewski@wisc.edu) (Please include “Chem 327” in the subject line.)

**Office Hours:** See Canvas.

**Laboratory Director:** Dr. Pamela Doolittle

**Office:** 535 Service Memorial Institute (SMI)

**Email/Preferred Contact:** [pam.doolittle@wisc.edu](mailto:pam.doolittle@wisc.edu)

**Office Hours:** Dr. Doolittle has an open door policy for meeting with students. Feel free to stop by her office, or email to set up an appointment when seeking help related to the laboratory portion of the course.

### Teaching Assistants:

Section	TA	Email
301/601	Matthew Hautzinger	hautzinger@wisc.edu
302/602	Jiabao Gao	jguo245@wisc.edu
303/603	Ann Lindberg	aelindberg@wisc.edu
305/605	Surajadeen Omalabake	omalabake@wisc.edu
306/606	Emily Reasoner	ereasoner@wisc.edu

**TA Office Hours:** See Canvas.

### 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.

**Requisites:** Chem 104 or 109

### Course Learning Outcomes

Students will be able to

- Apply statistical methods for the evaluation of laboratory data
- Use calibration and sampling methods important to quantitative analysis
- Model chemical systems and experimental data using relevant quantitative, mathematical, and computational methods.
- Learn analytical methods based on titrations, separations, electrochemical measurements, and spectroscopy and interpret the results for chemical analysis
- Identify, formulate, and solve integrative problems using appropriate information and approaches.
- Develop skills in working collaboratively with others, both chemists and those from other disciplines, to solve problems and create new knowledge.

### GRADING

Below are the point values of items that will be graded. Adjustments to graded items and point values may be made during the semester if needed.

3 Midterm Exams	450 points
9 Homework Assignments	90 points
TopHat	30 points
Discussion Participation	15 points
14 Pre-lab Quizzes	84 points
13 Laboratory Reports	182 points
Laboratory Project	150 points

Grading will be based on the following scale: A 90.0%, AB 88.0%, B 80.0%, BC 78.0%, C 70.0%, D 60.0%. This scale may be adjusted downward at the end of the semester, depending on the overall class average. It will never be adjusted upward.

## DISCUSSION SESSIONS

Attendance is required. Your TA will provide important pre-lab information as well as answer any questions you may have about labs, homework, or lecture material. To get the most from discussion section, you need to be prepared. It is your responsibility to communicate to your TA the concepts you do not understand and the skills you need to practice. You should ask your TA specific questions and make sure you understand the questions and the answers given by your TA and by fellow students. Bring your lab notebook and manual with you to discussion.

## LABORATORY SESSIONS

The laboratory sessions are a significant and inseparable part of this course.

**You must complete all of the labs and earn a minimum score of 60% on all laboratory assignments (combined prelab, lab report and project grades) in order to receive a passing grade in the course.**

**Laboratory Project:** For the laboratory project, you will be working in small groups to investigate the content of alpha and beta acids present in beer. More information regarding the project will be provided later during the semester.

**Standard Labs:** 13 standard laboratory sessions related to the course content are designed to help you practice and gain proficiency in mastering course concepts, as well as develop specific laboratory techniques important to the field of analytical chemistry. Each of the standard labs is worth 20 points and has three graded components. You must take the online Pre-lab Quiz on Learn@UW prior to coming to lab (6 points). You will be graded on the accuracy of your lab results (10 points), and your lab notebook will be graded for completeness and clarity (4 points). ***Please note that for some weeks each lab section has a different lab schedule.*** Be sure to check the schedule at the end of this syllabus so that you prepare for the appropriate lab and take the appropriate online Prelab Quiz.

**Pre-lab Quiz:** The primary goal of the pre-lab quiz is to prompt you to prepare for the lab beforehand and to test your knowledge and understanding of the concepts behind the standard experiments. Prior to taking the pre-lab quiz, read about the experiment in the lab manual and prepare your notebook pages. You should be familiar with the overall concepts of the experiment and the methods used in the experiment. You should also understand the procedure and how to do the calculations you will need to do with the raw data.

You may attempt the quiz twice and your highest score will appear in the grade book. Note that there is a time limit (usually 30 minutes) for each attempt. The clock begins timing once you start the quiz and you cannot stop and come back later in the day to finish, so be prepared to complete the entire quiz once you begin. Most quizzes have questions that involve calculations, so you should have a calculator, scratch paper, pencil, and your lab manual available when you attempt a quiz.

Check your lab schedule to make sure you are attempting the correct quiz. Quiz ending dates and times have been set-up by section and are set to end at 7:45 am the day you are scheduled to do a lab. ***Quizzes must be completed before this time or you will receive zero points for the quiz.***

When taking a quiz, ***do not include units when entering numbers for computational questions.*** The auto-grade feature will not recognize the units and it will mark your answer wrong. In all other parts of the course (lab notebook, homework, exams, etc.) you should always include units. Also be sure to enter the correct number of significant figures for a calculated answer. ***An error in***

*the number of significant figures will result in an incorrect answer and zero points for your answer.*

### **Laboratory Notebook**

Your lab notebook should include the following:

- Overview of the experiment or purpose statement
- Experimental procedure
- Relevant chemical reactions
- Raw data from all measurements
- One complete sample calculation including units and proper significant figures
- Results and summary section

The first three items and tables for the raw data should be prepared ahead of time. Sample calculations should be outlined ahead of time and doing so may help you with the prelab quiz. Your results and summary section should be brief. In addition to your final results, it should include comments on whether your data are reasonable and/or any problems that occurred that could affect your results. Someone else should be able to repeat the experiment based on what you've written in the notebook. For more guidelines on proper record keeping, consult the lab manual and section 2-2 of the textbook.

**Laboratory Reports:** Your laboratory report will consist of the carbonless copies of the relevant pages from your laboratory notebook and the completed (yellow) summary sheet from your lab manual. ***Laboratory reports are due to your TA the following laboratory period after you have completed the experiment.*** A penalty of 2 points per day will be deducted if you submit your report late. Late lab reports placed in your TA's mailbox must be accompanied by an email message sent prior to submitting the report. Failure to email your TA may result in additional points lost if your TA does not know to look for your report in his/her mailbox.

**Laboratory Conduct:** Safety goggles and proper attire must be worn at all times in the laboratory. Your lab begins at 7:45 am, and it is essential that you arrive on time so that you do not miss important information. Points will be deducted from your lab score for unsafe or inadequate conduct including, arriving late, not wearing goggles, not cleaning up spills promptly, and not cleaning your lab area before leaving the lab.

**Special Laboratory Accommodations:** Students requiring special accommodations in lab should contact the laboratory director, Dr. Pam Doolittle ([pam.doolittle@wisc.edu](mailto:pam.doolittle@wisc.edu)) before the first lab meets.

### **REQUIRED TEXTBOOK, SOFTWARE & OTHER COURSE MATERIALS**

- **Textbook:** Quantitative Chemical Analysis, Ninth Edition, by Daniel C. Harris, W.H. Freeman and Company, 2016.
- **Lab Manual:** A Manual of Experiments for Analytical Chemistry – Spring 2020, Department of Chemistry, UW-Madison. Lab manuals will be sold in Chemistry room 1375 Tuesday, January 21 through Friday, January 31 from 8:00 am to 4:30 pm. The cost for the manual is \$20. Payment is by WiscCard only.
- **Lab Notebook:** Carbonless laboratory notebook with numbered, duplicate pages. Alpha Chi Sigma (AXE), a professional co-ed chemistry fraternity founded here at UW-Madison, will be selling suitable lab notebooks in chem 1375.

- **Calculator:** A scientific or graphing calculator is required. Only calculators that are permitted on SAT or ACT tests may be used on exams. You may NOT use any stored information, programs, or applications on exams unless given explicit permission.
- **Personal Protection Equipment:** Industrial quality eye protection is required at all times when you are in the lab. Indirectly vented safety goggles that completely seal around the eyes and fit over regular glasses can either be purchased from local bookstores or from Alpha Chi Sigma in chem 1375. You're also required to wear a laboratory coat at all times in lab; lab coats will be available for WiscCard purchase in chem 1375 if you need one. You should transport your lab coat in a sealed plastic bag, such as a 1-gallon Ziploc.
- **Top Hat Software:** We will be using the Top Hat classroom response system in class. You will be able to submit answers to in-class questions using Apple or Android smartphones or tablets (via the Top Hat app), laptops (via their website), or through text message. For directions on how to set up a TopHat account go to <https://kb.wisc.edu/59937>. TopHat registration is \$16 for one semester, \$20 for one year or \$54 for life. Our Chemistry 329 course join code is 948508.
- **USB Drive:** A USB flash drive that will hold at least 2 GB is required for laboratory.

## EXAMS, QUIZZES, PAPERS & OTHER MAJOR GRADED WORK

Exam 1: Wednesday, March 4, 7:15-9:15 pm (room TBA)

Exam 2: Wednesday, April 8, 7:15-9:15 pm (room TBA)

Exam 3: Monday, May 4, 5:05-7:05 pm (room TBA)

Exams are cumulative in the sense that many of the concepts covered in this course build on one another and a good understanding of earlier material is required for mastering later material.

If you have a conflict with either evening exam, please meet with Dr. Zelewski no later than Friday, February 7.

## HOMEWORK & OTHER ASSIGNMENTS

Homework is critical to success in this class and on the exams. When doing homework assignments, you may work independently or collaborate with others, but you must work out and turn in your own solutions. If you cannot work out the problems yourself after completion of the homework, you will not gain the proficiency required to solve the problems on the exams within the timeframe of the exam. In all homework assignments, you must explain your thinking and show your work to receive full credit. Homework is graded based on completion. It is your responsibility to check the key to determine if your answer is correct. Homework assignments will usually be due at the beginning of lecture. ***No late assignments are accepted. This is a strict deadline.***

## ATTENDANCE POLICY

Your attendance at all scheduled classes (lecture, discussion and lab) is mandatory and essential for success in the course. However, circumstances occasionally occur where you may need to miss a class.

**Planned Absences:** If you need to miss class for a religious observance, a UW athletic commitment, graduate school interview or some other legitimate reason, you must make

arrangements to make up the missed work *a minimum of one week before the absence occurs*, otherwise, the absence will be unexcused and you will receive a zero on the missed work.

***Homework must be turned in before the deadline if you will be absent on the day it is due.***

**Serious Illness/ Family Emergency:** If you are seriously ill or experiencing a family emergency and are unable to attend lab, inform your TA via email and copy Dr. Zelewski. If you need an extension on your homework due to a serious illness or family emergency, arrangements must be made with Dr. Zelewski *before* the homework due date.

## **RULES, RIGHTS & RESPONSIBILITIES**

See the Guide to [Rules, Rights and Responsibilities](#).

## **ACADEMIC INTEGRITY**

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 [studentconduct.wiscweb.wisc.edu/academic-integrity/](http://studentconduct.wiscweb.wisc.edu/academic-integrity/).

## **ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES**

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 Dr. Zelewski and their TA of their need for instructional accommodations by the end of the third week of the semester, or as soon as possible after a disability has been incurred or recognized. We will work either directly with 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/>

## CHEMISTRY 327 LECTURE OVERVIEW\*

WEEK	DAY & DATE	TOPIC
1	W Jan 22	Introduction/ The Analytical Process
2	M Jan 27	Chemical Measurements
	W Jan 29	Experimental Error
3	M Feb 3	Volumetric Analyses
	W Feb 5	Statistics
4	M Feb 10	Statistics
	W Feb 12	Quality Assurance
5	M Feb 17	Spectrophotometry
	W Feb 19	Spectrophotometry
6	M Feb 24	Calibration Methods
	W Feb 26	Ionic Strength & Activity
7	M Mar 2	Chemical Equilibrium & Solubility
	W Mar 4	Chemical Equilibrium & Solubility <b>EXAM 1 (Wednesday, March 4, 7:15-9:15 pm)</b>
8	M Mar 9	Acid-Base Equilibria
	W Mar 11	Acid-Base Equilibria
9	Mar 16-20	<b><i>Spring Break</i></b>
10	M Mar 23	Acid-Base Equilibria
	W Mar 25	Acid-Base Titrations
11	M Mar 30	Acid-Base Titrations
	W Apr 1	Systematic Treatment of Equilibria
12	M Apr 6	Systematic Treatment of Equilibria
	W Apr 8	Electrochemistry <b>EXAM 2 (Wednesday, April 8, 7:15-9:15 pm)</b>
13	M Apr 13	Electrochemistry
	W Apr 15	Electrodes and Potentiometry
14	M Apr 20	Electrodes and Potentiometry
	W Apr 22	Chromatography
15	M Apr 27	Chromatography
	W Apr 29	Chromatography
FINALS	M May 4	<b>EXAM 3 (Monday, May 4, 5:05-7:05 pm)</b>

\*See Canvas for specific reading, homework, and laboratory assignments and due dates.

## CHEMISTRY 327

## LABORATORY SCHEDULE

SPRING 2020

			Section 601: Matt Hautzinger				
			Section 605: Surajadeen Omalabake	Section 606: Emily Reasoner	Section 602: Jiabao Guo	Section 603: Ann Lindberg	
Week	Date (MW)	Date (TR)	605 (MW)	601 (TR) and 606 (MW)	602 (TR)	603 (TR)	
1	20-Jan	21-Jan	<i>No Lab</i>	<i>No Lab</i>	<i>No Lab</i>	<i>No Lab</i>	
	22-Jan	23-Jan	Check-in/ Weighing Experiment	Check-in/ Weighing Experiment	Check-in/ Weighing Experiment	Check-in/ Weighing Experiment	
2	27-Jan	28-Jan	Glass Volumetric Apparatus	Glass Volumetric Apparatus	Glass Volumetric Apparatus	Glass Volumetric Apparatus	
	29-Jan	30-Jan	Prep. of Standard HCl & NaOH Solutions	Prep. of Standard HCl & NaOH Solutions	Prep. of Standard HCl & NaOH Solutions	Prep. of Standard HCl & NaOH Solutions	
3	3-Feb	4-Feb	Prep. of Standard HCl & NaOH Solutions	Prep. of Standard HCl & NaOH Solutions	Prep. of Standard HCl & NaOH Solutions	Prep. of Standard HCl & NaOH Solutions	
	5-Feb	6-Feb	Determination of % KHP in a Mixture	Determination of % KHP in a Mixture	Determination of % KHP in a Mixture	Determination of % KHP in a Mixture	
4	10-Feb	11-Feb	High Pressure Liquid Chromatography	Electrophotometric Determination of a Mixture	High Pressure Liquid Chromatography	Spectroscopic Determination of a Mixture	
	12-Feb	13-Feb	Spectroscopic Determination of a Mixture	High Pressure Liquid Chromatography	Spectroscopic Determination of a Mixture	Ascorbic Acid Method	
5	17-Feb	18-Feb	Ascorbic Acid Method	Ascorbic Acid Method	Ascorbic Acid Method	High Pressure Liquid Chromatography	
	19-Feb	20-Feb	Spike Recovery and MDL	Spike Recovery and MDL	Spike Recovery and MDL	Spike Recovery and MDL	
6	24-Feb	25-Feb	A Study of Fluorescein	A Study of Fluorescein	A Study of Fluorescein	A Study of Fluorescein	
	26-Feb	27-Feb	Project Day	Project Day	Project Day	Project Day	
7	2-Mar	3-Mar	<i>Finish Labs</i>	<i>Finish Labs</i>	<i>Finish Labs</i>	<i>Finish Labs</i>	
	4-Mar	5-Mar	<b>No Lab – EXAM 1 is WEDNESDAY, MARCH 4 from 7:15-9:15 p.m. (room TBA)</b>				
8	9-Mar	10-Mar	Project Day	Project Day	Project Day	Project Day	
	11-Mar	12-Mar	Project Day	Project Day	Project Day	Project Day	
9	16-Mar	17-Mar	<b>SPRING BREAK</b>				
	18-Mar	19-Mar	<b>SPRING BREAK</b>				
10	23-Mar	24-Mar	Chemical Oxygen Demand	Chemical Oxygen Demand	Chemical Oxygen Demand	Chemical Oxygen Demand	
	25-Mar	26-Mar	Adventures with Buffers	Adventures with Buffers	Adventures with Buffers	Adventures with Buffers	
11	30-Mar	31-Mar	ID of an Unknown Weak Acid	ID of an Unknown Weak Acid	ID of an Unknown Weak Acid	ID of an Unknown Weak Acid	
	1-Apr	2-Apr	Study of Bromocresol Green	Study of Bromocresol Green	Study of Bromocresol Green	Study of Bromocresol Green	
12	6-Apr	7-Apr	<i>Finish Labs</i>	<i>Finish Labs</i>	<i>Finish Labs</i>	<i>Finish Labs</i>	
	8-Apr	9-Apr	<b>No Lab – EXAM 2 is WEDNESDAY, APRIL 8 from 7:15-9:15 p.m. (room TBA)</b>				
13	13-Apr	14-Apr	Project Day	Project Day	Project Day	Project Day	
	15-Apr	16-Apr	Project Day	Project Day	Project Day	Project Day	
14	20-Apr	21-Apr	Project Day	Project Day	Project Day	Project Day	
	22-Apr	23-Apr	Silver Electrode Study of Equilibria	Fluoride Ion Electrode	Silver Electrode Study of Equilibria	Fluoride Ion Electrode	
15	27-Apr	28-Apr	Fluoride Ion Electrode	Silver Electrode Study of Equilibria	Fluoride Ion Electrode	Silver Electrode Study of Equilibria	
	29-Apr	30-Apr	<i>Finish labs/ Checkout</i>	<i>Finish labs/ Checkout</i>	<i>Finish labs/ Checkout</i>	<i>Finish labs/ Checkout</i>	