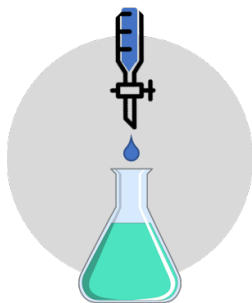
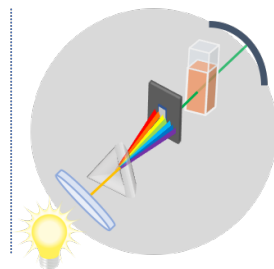


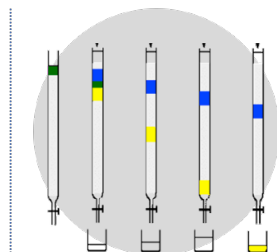
## CHEMISTRY 248: QUANTITATIVE ANALYSIS



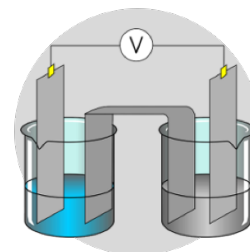
Titration



Spectrophotometry



Chromatography



Electrochemistry

### COURSE DESCRIPTION

Quantitative chemical analysis has become an important part of everyday life due to the rising concern for our environment and our well-being. Quantitative methods can be used to enforce quality control in consumables, analyze materials for the pharmaceutical industry, detect hazardous materials, and analyze tissue samples critical for diagnosing diseases. This course is intended to provide you with the basic principles of quantitative chemical analysis by introducing you to the fundamental theories and methods. Through a combination of lectures, laboratory experiments, and problem sets, you will learn how to apply the concepts of chemical equilibrium covered in General Chemistry quantitatively to the field of chemical analysis. Specifically, we will discuss: 1) the handling of analytical data including statistical analysis, 2) how chemical equilibrium affects quantitative separations, titration curves, polyprotic acid-base systems, and redox processes, and 3) analytical instrumentation. In addition, you will be given hands-on opportunities to work with analytical instrumentation—gas chromatograph/mass spectrometer (GC/MS), high-performance liquid chromatograph (HPLC), open-flame atomic absorption spectrometer (FAAS), along with more traditional analytical instrumentation and equipment—to analyze your samples.

### LEARNING OUTCOMES

At the end of this course, a successful student will be able to:

- **PREDICT** the results and identify errors associated with a chemical analysis based on the analytical technique and nature of the sample.
- **ANALYZE** and accurately determine the concentration of analyte in a given sample using conventional analytical laboratory techniques.
- **EVALUATE** experimental data using statistical and error analysis methods.
- **COMMUNICATE** results of chemical analyses and report the relative error associated with these results.

## CLASS SESSIONS

	Section	Day(s)	Time	Location	Instructor
LECTURE	Sec 1	M, T, W, R	9:00	A121	Riha
LAB	Sec 1	M, T, W, R	10:00	D114	Riha

## COURSE COMPONENTS

**Lecture** is designed to introduce you to the concepts that define quantitative chemical analysis. My lectures combine classic “chalk-talks”, lecture supplements and problem solving, clicker-like activities, real-world applications, and live demonstrations to appeal to the variety of learning styles students have. **Not all material will be covered during lecture times and must be supplemented by completing all assigned readings and homework.**

**Lab** is the “hands-on” experience essential to learning chemistry and critical to your success in this course. It gives you the experience of putting the key concepts you covered in lecture into practice, teaches you experimental techniques, and helps you better learn how to problem solve. During lab, you will work individually and at your own pace to analyze unknown samples. Your lab grade will be based on how close your experimental value matches the true value.

## REQUIRED MATERIALS

- **Course text**
  - Exploring Chemical Analysis, 5<sup>th</sup> Ed.* Harris
  - Available at text rental in the Campus Bookstore
- **Laboratory manual**
  - Quantitative Analysis Experiments, Summer 2018*
  - Available for purchase in the Campus Bookstore
- **Laboratory notebook**
  - Permanently bound notebook(s), preferably quadrille ruled.
  - Available for purchase in the Campus Bookstore
- **Calculator**
  - Any scientific calculator that can perform logarithms and exponentials.
  - Available for purchase in the Campus Bookstore or at any office supply store
- **Sapling**
  - On-line activity homework system.
  - Go to [www.saplinglearning.com/login](http://www.saplinglearning.com/login) to log in or create an account. The following link includes detailed instructions on how to register for the course: <https://community.macmillan.com/docs/DOC-5972-sapling-learning-registering-for-courses>
  - If you have any issues during sign up or throughout the semester, the technical support team is there to help. They can be reached by phone or by webform via the Student Support Community. (<https://community.macmillan.com/docs/DOC-6915-students-still-need-help>)
- **Time**
  - Lecture readings, homework, and lab preparation/reporting.
  - You must be willing (and able) to invest a significant amount of time and effort to successfully complete this course.

## GRADING

The grade you receive for the course will be based on the following:

Exams (4 @ 150 pts each)	600
Homework (10 @ 10 pts each)	100
Lab Quizzes (3 @ 5 pts each)	15
Lab Results (10 @ 50 pts each)	500
Lab Notebook (10 @ 5 pts each)	50
<b>TOTAL</b>	<b>1265</b>

Tentative grading scale cut-offs:

<b>A</b>	100 – 93%	<b>C+</b>	<80 – 77%
<b>A-</b>	<93 – 90%	<b>C</b>	<77 – 73%
<b>B+</b>	<90 – 87%	<b>C-</b>	<73 – 70%
<b>B</b>	<87 – 83%	<b>D+</b>	<70 – 66%
<b>B-</b>	<83 – 80%	<b>D</b>	<66 – 60%
		<b>F</b>	<60%

**Note:** The cut-off percentages may be adjusted at the end of the semester; however, I will never adjust the cut-off percentages higher. This means if you get an 83% you will not receive any lower than a B for the final grade. *I do not provide extra credit opportunities or “bump” students up to a higher grade*, however, if I have made a mistake in grading an assignment or exam, let me know right away so I can fix it. I welcome you to discuss your grade with me at any point in the semester and am happy to provide you with study strategies to help you earn a solid grade in this course.

## HELP & RESOURCES

If you are feeling lost or overwhelmed, there are many resources to get help in this class to maximize your learning experience. Seek help early and often!

- **D2L.** Course information, including the syllabus, lecture notes and supplements, lab quizzes, and other supporting material will be posted on the course D2L site. You can also find a running total of your points for the course.
- **Come see me.** I am dedicated to help you learn. You can e-mail me to set up an appointment. Don't ever feel like you are bothering me when you come see me—you are the reason I am here 😊!
- **Disability Services.** UWSP is committed to providing students with disabilities the academic accommodations and auxiliary aids necessary to ensure access to all university services, programs, and activities. Disability and Assistive Technology Center (DATC) is responsible for determining these accommodations. Visit the DATC website to find out more: <http://www.uwsp.edu/disability/Pages/default.aspx>

## ASSESSMENT

Your progress in this course will be assessed based on both in-class and lab performance.

**Exams** are designed for you to demonstrate what you have learned in lecture and lab. The exams will cover lecture material AND material from completed lab experiments. Three exams will be given during the course of the semester and the fourth exam will be given during the Final exam time. Exam dates will not change.

**Homework** is designed to help you learn material covered in lecture and in lab. Homework assignments will be administered through Sapling On-line homework system. The on-line homework system is designed to provide you, the student, immediate feedback as well as useful hints and suggestions to solve problems. Tentative due dates are listed in the Lecture Schedule.

## ASSESSMENT CONTINUED

**Lab Results** will help build confidence in your laboratory skills. You will be graded on the accuracy of your results for each experiment. The scoring details for each experiment is found on page 149 in the lab manual. It is possible to recalculate experiment results or redo any experiment (see below).

**Lab Notebook and Report** will hone your ability to communicate your data. Your lab notebook is an important record of the work you have performed and all lab results must be accompanied by a complete notebook entry. The grading rubric for your lab notebook can be found on D2L.

**\*Redo:** Only one of the experiments may be repeated with a new unknown, if time permits. A new report must be submitted and the grade for the experiment will be the average of the two scores.

**\*Recalculate:** In the case of a calculation error, recalculations must be submitted within one week after the lab has been graded and returned to you. A new report must be submitted along with an indication in your lab notebook of where the error occurred and a new set of calculations. Errors in judgement may not be used to recalculate a result. For example, you may not change your result to a median value from a mean or vice versa. You should discuss recalculations with your lab instructor. *Your new score will be determined by subtracting up to five points from your "recalculated" score.*

## ADVICE FOR SUCCEEDING IN THIS CLASS: Lecture

This class is fast-paced and to do well will require you to put forth a constant effort.

- **Form study groups.** Working with other students in the course is a great way to build off each other's strengths and see how to approach problems in different ways. Additionally, compare notes from class with study partner(s).
- **Scan topics to be covered in class ahead of time.** You will be much more prepared to learn new material by having an idea of what is ahead. Don't feel you need to learn and understand everything right away. Completing reading assignments before they are covered in lecture will allow you to be an active participant in class and enhance your learning experience.
- **Work the suggested/assigned problems.** I cannot stress this point enough! Chemistry is not a course that can simply be memorized right before the exam. Chemistry is a complex subject and can seem, at times, very overwhelming. Working through suggested/assigned problems means writing complete solutions and including explanations for your solutions where appropriate. This approach will not only help you understand and retain the material better, it will also prepare you for questions that may appear on exams.
- **Take notes.** Taking notes in lecture not only keeps you informed on what was covered that day but also provides you with information that may be applicable to the laboratory portion of this course. This will also help you know what material is most likely to make it on an exam.
- **Read the topics carefully.** After covering the material in lecture, go back and read through the key topics. Look over the sample exercises to make sure you understand the key concepts. Then test your skills by trying some of the end of chapter exercises.
- **Ask questions.** No question is a dumb question. If you are struggling with material or are just curious about something, don't hesitate to ask. Chances are there is someone else in the room with the same question.
- **Don't fall behind.** The materials presented in this course build on what was presented previously. Therefore, if you do not keep up with your reading and problem sets you will find it much harder to follow the lectures and discussions on current topics.

## ADVICE FOR SUCCEEDING IN THIS CLASS: Lab

Success in lab requires being prepared and organized.

- **Plan Ahead.** Know which experiment you will be working on at least two lab periods in advance. This will help you gather and prepare necessary reagents and unknowns.
- **Read the experimental procedure thoroughly before coming to lab.** This will allow you to plan out your lab period and make a to-do list. Some experiments may have long wait times, which is a great time to gather materials for the next steps in the procedure or the next experiment.
- **Prepare your lab notebook before coming to lab.** Update the TOC, write out the purpose and procedure, and create data tables ahead of time. This will ensure you are prepared for the day's experiments and will save you time on the back end when submitting your results. Be sure to leave plenty of space for additional data and calculations!
- **Use lab time for experimental work only.** The summer will go by fast and it is extremely important to stay on schedule in lab. Save calculations and write-ups for outside the lab to stay on, or ahead of, the lab schedule. Lab time should be used for doing experiments!
- **Work efficiently.** Do not rush through experiments; this only leads to error and frustration. Rather work carefully, keep your station clean and organized, label solutions/containers, and ask questions.
- **Multitask** (when possible). Some experiments will require you to boil water or to heat a solution. This is a great opportunity to multitask by working on another part of the experiment or starting a new experiment. Of course, being able to efficiently multitask requires you to plan ahead!

## INSTRUCTOR INFORMATION

Office: Science Building D140

Phone: 715-346-2172 (on campus dial x2172)

E-mail: sriha@uwsp.edu

**\*\*Email is the preferred way to reach me\*\***

### My Fall 2017 Schedule

	Monday	Tuesday	Wednesday	Thursday	Friday
8:00 am	Prep	Prep	Prep	Prep	
9:00 am	Lecture (A121)	Lecture (A121)	Lecture (A121)	Lecture (A121)	
10:00 am	Lab (D114)	Lab (D114)	Lab (D114)	Lab (D114)	R, P, G, and moving
11:00 am					
12:00 pm					
1:00 pm	R, P, G, and moving	R, P, G, and moving	R, P, G, and moving	R, P, G, and moving	
2:00 pm					
3:00 pm					
4:00 pm					

Office Hours are available by appointment.

R, P, G = Research (D105), Prep, and Grade

**How Am I Doing?** If there are any particular aspects of my instructing that you find helpful or not useful, please let me know. In addition, I welcome any suggestions and ideas you have on creating an inclusive learning environment.

## THE FINE PRINT

- **Late Homework/Late Reports:** Meeting deadlines and staying on track with your work are not only useful life and career skills, but also help reduce stress. For this course, you are expected to complete assignments, quizzes, and exams on schedule. If you have a personal situation that prevents you from completing your work on time, you will need to discuss this with me before the due date. Extensions are granted at my discretion.
  - **Late Homework:** A 5% point deduction from the remaining points will be assessed each day the assignment is late.
  - **Late Reports:** If you are not able to meet the deadline for a lab report, speak with your instructor about an extension. Together, you and your instructor will set a new due date. Late lab reports will incur a 5-point penalty for each lab period it is late if an extension is not discussed in advance.
- **Attendance, Absences and Make-ups**
  - Chemistry is a very exciting, yet challenging and complex subject. It is, therefore, essential to attend all course lectures and labs to achieve the course learning objectives. If you miss a lecture it is your responsibility to obtain the material covered. Any unexcused absence from a lab or exam will not be tolerated. ***Make-up labs or exams for unexcused absences will NOT be given.***
  - **Excused Absences.** An excused absence from an exam must be presented in writing (ahead of time). Make-up exams will be scheduled under the following circumstances: UWSP scheduled athletic event (written authorization from coach), family emergency (documentation such as an obituary), medical emergency (written authorization from physician), armed forces training/drills (written authorization from supervising officer), or the like. ***No make-up labs will be scheduled during the summer session regardless if an absence is considered an excused absence.***
- **Etiquette.** Be respectful of your fellow classmates!
  - Students in my classroom may have diverse racial, ethnic, cultural, and religious backgrounds, sexual orientations and gender identities. Each and every voice in the classroom brings with it a wealth of experiences, values, and beliefs. Please respect your fellow classmates and refrain from personal attacks or demeaning comments of any kind.
  - Whispering and talking to your neighbor during class is disruptive and annoying to those around you trying to listen to the lecture. If there is something you do not understand or have a question about, please raise your hand. If you are uncomfortable asking the question in front of the class, you can e-mail me, talk to me after class, or see me during office hours.
  - Cell phones must be turned off and put away during class. This means no texting/tweeting/social networking during class.
  - No iPods, radios, MP3 players or other recording and transmitting devices may be used during quizzes or exams. Hats with bills must be turned backwards during an exam.
  - It is your responsibility to check D2L for the points you have earned in the class. If you find that an error has been made, you must inform me within *one week* of the posting grade for it to be considered.
- **Academic Misconduct.** As stated in the Student Academic Standards and Disciplinary Procedures:

“The Board of Regents, administrators, faculty, academic staff and students of the University of Wisconsin System believe that academic honesty and integrity are fundamental to the mission of higher education and of the university of Wisconsin system. The university has a responsibility to promote academic honesty and integrity and to develop procedures to deal effectively with instances of academic dishonesty.”

Therefore, students caught cheating on quizzes/exams or in the laboratory are subject to a grade of F for the course and a report being placed in their judicial file. More information can be found at: <http://www.uwsp.edu/dos/Pages/Academic-Misconduct.aspx>

## SCHEDULES

### Tentative Lecture Schedule

- Please note that this is a *tentative* schedule and may be adjusted depending on the pace of the class. The exam dates, however, will not change.

Date	Topic(s)	Reading	Noteworthy
5/29	Course Intro	Syllabus	
5/30	Chemical Measurements	Ch. 0, 1, 2	
5/31	Statistics: Error in Analysis	Ch. 3	HW #1 due
6/4	Statistics: Data Analysis	Ch. 4	
6/5	Data Analysis and QA/QC	Ch. 4, 5	
6/6	Titrations	Ch. 6	HW #2 due
6/7	Gravimetric Analysis	Ch. 7	
6/11	<b>EXAM 1</b>		HW #3 <u>due 6/10</u>
6/12	Acid-Base Equilibria	Ch. 8	
6/13	Buffers	Ch. 9	
6/14	Acid-Base Titrations	Ch. 10	
6/18	Acid-Base Titrations	Ch. 10	HW #4 due
6/19	Polyprotic Acid-Base Equilibria	Ch. 11	
6/20	Polyprotic Acid-Base Titrations	Ch. 11	HW #5 due
6/21	Solubility, Ionic Strength, and Activity Coefficients	Ch. 12	
6/25	<b>EXAM 2</b>		HW #6 <u>due 6/24</u>
6/26	Complex Equilibria	Ch. 12	
6/27	Introduction to Electrochemistry	Ch. 14	
6/28	Electrode Potentials	Ch. 14	
7/2	Electrode Measurements	Ch. 15	HW #7 due
7/3	Redox Titrations	Ch. 16	
7/4	<b>Independence Day</b>		
7/5	Electrochemical Measurements	Ch. 17	HW # 8 due
7/9	<b>EXAM 3</b>		
7/10	Spectrophotometry	Ch. 18	
7/11	Spectrophotometric Analysis	Ch. 19	HW #9 due
7/12	Atomic Spectroscopy	Ch. 20	
7/16	Separation Methods	Ch. 21, 22	
7/17	Separation Methods	Ch. 21, 22	
7/18	Review and Catch-up		HW #10 due
7/19	<b>EXAM 4</b>		

**Lab Schedule**

Week	Date	Experiment	Pages in Lab Manual	Due Dates
1	5/29	Safety and Check In		
	5/30	Calibration of Buret and Pipets	41-42	
	5/31	Calibration of Buret and Pipets	41-42	
2	6/4	Finish Calibrations	41-42	
	6/5	Sodium Carbonate in Soda Ash	43-53	Soda Ash due 6/11
	6/6	Sodium Carbonate in Soda Ash	43-53	
	6/7	Nickel in Nickel Oxide	55-61	Nickel due 6/14
3	6/11	Nickel in Nickel Oxide	55-61	
	6/12	Nickel in Nickel Oxide	55-61	
	6/13	Manganese in Steel	63-82	Manganese due 6/21
	6/14	Manganese in Steel	63-82	
4	6/18	Manganese in Steel	63-82	
	6/19	Manganese in Steel	63-82	
	6/20	Iron in Limestone	89-100	Fe in Limestone due 6/25
	6/21	Iron in Limestone	89-100	
5	6/25	Ca and Mg in Limestone	89-100	Ca/Mg in Limestone due 7/2
	6/26	Ca and Mg in Limestone	89-100	
	6/27	Ca and Mg in Limestone	89-100	
	6/28	Titration of an Acid Mixture	101-106	Acid Mix due 7/5
6	7/2	Titration of an Acid Mixture	101-106	
	7/3	Ethanol by Titration	107-114	Ethanol due 7/9
	7/4	Ethanol by Titration	107-114	
	7/5	Ethanol by Titration	107-114	
7	7/9	Ethanol by GC	115-122	GC due 7/12
	7/10	Ethanol by GC	115-122	
	7/11	Cu/Zn by Atomic Absorption	123-128	AA due 7/16
	7/12	Cu/Zn by Atomic Absorption	123-128	
8	7/16	Bleach by Coulometry	129-136	Coulometry due 7/18
	7/17	Bleach by Coulometry	129-136	
	7/18	Checkout		
	7/19	Final		

\*\*\*No late lab reports or recalculations will be accepted after Friday, July 20<sup>th</sup>\*\*\*