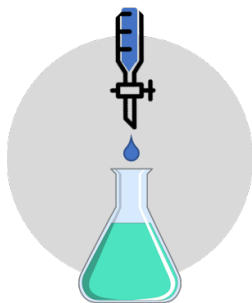
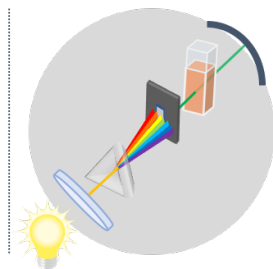


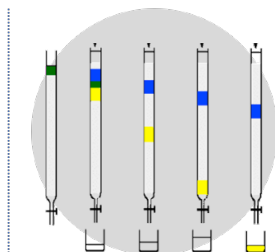
CHEMISTRY 248: QUANTITATIVE ANALYSIS



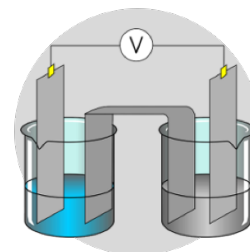
Titration



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 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.

INSTRUCTOR INFORMATION

Dr. Shannon C. Riha

Office: Chem/Bio Building 448

E-mail: sriha@uwsp.edu (I generally respond to email within 24 hours)

My Daily Schedule

	Monday	Tuesday	Wednesday	Thursday	Friday
8:00 am	Lab (CBB466/476)	R, P, G	Lab (CBB466/476)	R, P, G	R, P, G
9:00 am					
10:00 am	R, P, G	Prep	Prep		
11:00 am		CHEM248 Lecture (CBB105)	CHEM248 Lecture (CBB105)		
12:00 pm		Prep	Prep		
1:00 pm	R, P, G	Lab (CBB466/476)	R, P, G	Lab (CBB466/476)	Department meetings and seminars
2:00 pm					
3:00 pm					
4:00 pm					

Office Hours: If my office door is open, come on in. Otherwise, send me an email to set up a time to meet in person or virtually via Zoom. Don't ever feel like you are bothering me—you are the reason I am here ☺!

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.

CLASS SESSIONS

	Section	Day(s)	Time	Location	Instructor
LECTURE	All	T, R	12:00 pm	CBB105	Riha
LAB	Sec 1	M, W	8:00 am	CBB466/476	Riha
	Sec 2	T, R	2:00 pm	CBB466/476	Riha

COURSE COMPONENTS

Lecture is designed to introduce you to the concepts that define quantitative chemical analysis. My lecture style promotes active learning by introducing you to the theory and methods first through videos and assigned readings. You will then generate a deeper understanding of the concepts and apply your knowledge with activity sheets, lab activities, problem solving, and homework assignments.

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, 5th Ed.* Harris

- Available at text rental in the Campus Bookstore
- **Laboratory manual:** *Quantitative Analysis Experiments, Summer/Fall 2021*
 - Available for purchase in the Campus Bookstore
- **Laboratory notebook:** *Permanently bound notebook(s), preferably quadrille ruled*
 - Available for purchase in the Campus Bookstore
- **Achieve:** *On-line activity homework system*
 - Access cards available at the Campus Bookstore or purchase direct from Macmillan Learning. Note: there is a 14 day grace period
 - Use the Macmillan Learning tab in our Canvas page to access and register your account.
- **Calculator**
 - Any scientific calculator that can perform logarithms and exponentials
- **PPE**
 - Safety goggles and face mask
- **Time and Effort:** *Lecture recordings and 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:

Tentative grading scale cut-offs:

Exams (4 @ 100 pts each)	400	A	100 – 93%	C+	<80 – 77%
Homework (10 @ 10 pts each)	100	A-	<93 – 90%	C	<77 – 73%
Lab Quizzes (3 @ 5 pts each)	15	B+	<90 – 87%	C-	<73 – 70%
Lab Results (9 @ 50 pts each)	450	B	<87 – 83%	D+	<70 – 66%
Lab Notebook (9 @ 5 pts each)	45	B-	<83 – 80%	D	<66 – 60%
Lab report	50			F	<60%

TOTAL

1060

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.

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

Homework is designed to help you learn material covered in lecture and in lab. Homework assignments will be administered through Achieve on-line homework system. The on-line homework system is designed to provide you, the student, immediate feedback as well as useful hints and

given during the Final exam time. All exams will be virtual.

suggestions to solve problems. Tentative due dates are listed in the Lecture Schedule.

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 141 in the lab manual. It is possible to recalculate experimental results or redo any one experiment (see below).

Lab Notebook and Report will enhance 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 and example notebook entries can be found on Canvas.

***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.*

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!

- **Canvas.** Course information (syllabus, recorded lecture videos and worksheets, lab quizzes and report forms, due dates, study guides, and other supporting material), direct link to Achieve, Zoom lectures, and virtual office hours will be available on the course Canvas page. You can also find a running total of your points for the course.
- **Office Hours.** I am dedicated to help you learn; all you have to do is ask. You can e-mail me to set up an appointment or just drop by my office.
- **TIMS @ UWSP.** Tutors are UWSP students who have done well in their classes and who are here to share their successful study habits and chemistry content knowledge to help others succeed. Discussing chemistry concepts and processes together clarifies and solidifies knowledge, and the tutors are eager to study with you. Links to group and drop-in tutoring schedules can be found at: <http://www.uwsp.edu/tlc>
- **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>

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 virtual 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).

- **Seek help early and often.** I am here and ready to help you. I will be available prior to lab each day to answer any questions you have about worksheet problems, lecture content, and lab experiments and calculations.
- **Tutoring.** The Tutoring-Learning Center (TLC) offers FREE tutoring to support you in your STEM classes. The tutors are UWSP students who have done well in their classes and who are here to share their successful study habits and content knowledge to help others succeed. Discussing concepts and practicing problems together clarifies and solidifies knowledge, and the tutors are eager to study with you. If you have questions about the schedules or would like to make an appointment, please visit the TLC in ALB 018 (library basement), email (tlctutor@uwsp.edu), or call (715) 346-3568.
- **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 class 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!

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 lab instructor about an extension*. Late lab reports will incur a 5-point penalty for each lab period it is late if an extension is not discussed in advance.

**Note: Lab report extensions will not exceed 1 week past your experiment completion date. The absolute final date to submit reports is July 23rd.*
- **Attendance, Absences and Make-ups**
 - Chemistry is a very exciting, yet challenging and complex subject. It is, therefore, essential to engage in 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. Recorded lectures will be available on Canvas. Any unexcused absence from a lab 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 (via email preferably 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. ***Make-up labs for excused absences will only be available during regularly scheduled laboratory periods with instructor consent.***
- **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.
 - It is your responsibility to check Canvas 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.
- **Covid-19 Restriction Planning**
 - Face Coverings:
 - At all UW-Stevens Point campus locations, the wearing of face coverings is mandatory in all buildings, including classrooms, laboratories, studios, and other instructional spaces. Any student with a condition that impacts their use of a face covering should contact the Disability and Assistive Technology Center to discuss accommodations in classes. Please note that unless everyone is wearing a face covering, in-person classes cannot take place. This is university policy and not up to the discretion of individual instructors. Failure to adhere to this requirement could result in formal withdrawal from the course.
 - Other Guidance:
 - Please monitor your own health each day using this screening tool. If you are not feeling well or believe you have been exposed to COVID-19, do not come to class; email your instructor and contact Student Health Service (715-346-4646).

- As with any type of absence, students are expected to communicate their need to be absent and complete the course requirements as outlined in the syllabus.
 - Wash your hands or use appropriate hand sanitizer regularly and avoid touching your face.
 - Please maintain these same healthy practices outside the classroom
- **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>
- **Lecture Recordings.** Lecture materials and recordings for CHEM248 are protected intellectual property at UW-Stevens Point. Students in this course may use the material and recordings for their personal use related to participation in this class. Students may also take notes solely for their personal use. If a lecture is not already recorded, you are not authorized to record my lectures without my permission unless you are considered by the university to be a qualified student with a disability requiring accommodation. [Regent Policy Document 4-1] Students may not copy or share lecture materials and recordings outside of class, including posting on internet sites or selling to commercial entities. Students are also prohibited from providing or selling their personal notes to anyone else or being paid for taking notes by any person or commercial firm without the instructor’s express written permission. Unauthorized use of these copyrighted lecture materials and recordings constitutes copyright infringement and may be addressed under the university’s policies, UWS Chapters 14 and 17, governing student academic and non-academic misconduct.

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
9/2	Course Intro/Review	Syllabus	
9/7	Chemical Measurements	Ch. 0, 1, 2	
9/9	Statistics: Error in Analysis	Ch. 3	HW #1 due 9/12
9/14	Statistics: Data Analysis	Ch. 4	
9/16	Data Analysis and QA/QC	Ch. 4, 5	
9/21	Titrations	Ch. 6	HW #2 due 9/19
9/23	Gravimetric Analysis	Ch. 7	
9/28	EXAM 1		HW #3 due 9/26
9/30	Acid-Base Equilibria	Ch. 8	
10/5	Buffers	Ch. 9	
10/7	Acid-Base Titrations	Ch. 10	
10/12	Acid-Base Titrations	Ch. 10	HW #4 due 10/10
10/14	Polyprotic Acid-Base Equilibria	Ch. 11	
10/19	Polyprotic Acid-Base Titrations	Ch. 11	HW #5 due 10/17
10/21	Solubility, Ionic Strength, and Activity Coefficients	Ch. 12	
10/26	EXAM 2		HW #6 due 10/24
10/28	Complex Equilibria	Ch. 12	
11/2	Complex Equilibria	Ch. 12	
11/4	Introduction to Electrochemistry	Ch. 14	
11/9	Electrode Potentials	Ch. 14	HW #7 due 11/7
11/11	Electrode Measurements	Ch. 15	
11/16	Redox Titrations	Ch. 16	
11/18	Electrochemical Measurements	Ch. 17	
11/23	EXAM 3		HW # 8 due 11/21
11/25	<i>No Class – Happy Thanksgiving!</i>		
11/30	Spectrophotometry	Ch. 18	HW #9 due 11/28
12/2	Spectrophotometric Analysis	Ch. 19	
12/7	Atomic Spectroscopy	Ch. 20	
12/9	Separation Methods	Ch. 21, 22	
12/13	EXAM 4		HW #10 due 12/12

Lab Schedule

Week	Date	Experiment	Pages in Lab Manual	Due Dates
1	Sept 2	No lab		
2	Sept 7/8	Check-in and Calibration	39-40	
	Sept 9	Calibration of Buret and Pipets	39-40	
3	Sept 13/14	Finish Calibrations	39-40	
	Sept 15/16	Sodium Carbonate in Soda Ash	41-51	Soda Ash due 9/29&30
4	Sept 20/21	Sodium Carbonate in Soda Ash	41-51	
	Sept 22/23	Sodium Carbonate in Soda Ash	41-51	
5	Sept 27/28	Manganese in Steel	61-80	Manganese due 10/13&14
	Sept 29/30	Manganese in Steel	61-80	
6	Oct 4/5	Manganese in Steel	61-80	
	Oct 6/7	Manganese in Steel	61-80	
7	Oct 11/12	Vanillin	81-86	1 st draft of formal report due Oct 26 st
	Oct 13/14	Vanillin	81-86	
8	Oct 18/19	Iron in Limestone	87-98	Fe in Limestone due 10/27&28
	Oct 20/21	Iron in Limestone	87-98	
9	Oct 25/26	Ca and Mg in Limestone	87-98	Ca/Mg in Limestone due 11/3&4
	Oct 27/28	Ca and Mg in Limestone	87-98	
10	Nov 1/2	Titration of an Acid Mixture	99-104	Acid Mix due 11/10&11
	Nov 3/4	Titration of an Acid Mixture	99-104	
11	Nov 8/9	Ethanol by Titration	105-112	Ethanol due 11/22&23
	Nov 10/11	Ethanol by Titration	105-112	
12	Nov 15/16	Ethanol by Titration	105-112	
	Nov 17/18	Ethanol by GC	113-118	GC due 11/29&30
13	Nov 22/23	Ethanol by GC	113-118	
	Nov 24	Cu/Zn by Atomic Absorption	119-124	AA due 12/6&7
14	Nov 29/30	Cu/Zn by Atomic Absorption	119-124	
	Dec 1/2	Bleach by Coulometry	125-132	Coulometry due 12/13
15	Dec 6/7	Bleach by Coulometry	125-132	
	Dec 8/9	Checkout		

*** All laboratory work must be complete *before* your check-out day ***

*** The absolute last day to hand in lab reports for grading is Dec 15th ***