Chemical Analysis II, CHEM 254 Spring 2025

Instructor: Dr. Sarah Smith
Office: Jepson Science Center 440
Email: ssmith23@umw.edu
Phone: (540) 654-1409
Lecture: MWF 2:00 pm – 2:50 am Jepson 219
Lab: Section 1: Thursday 9:30 am – 12:15 pm
Section 2: Thursday 2:00 pm – 4:45 pm

Office Hours: Monday: 9:00 – 10:00 am
Tuesday: 8:00 pm – 9:00 pm on Zoom
Wednesday 9:00 – 10:00 am
Wednesday 3:00 – 4:00 pm
Friday 3:00 – 4:00 pm

I have an open-door policy. If my office door is open, come on in!

Required Materials:

- Quantitative Chemical Analysis, 9th or 10th edition., Harris D.C
- Lab Notebook with carbonless duplicate pages
- Laboratory goggles and lab coat
- Access to Canvas
- Access to a printer or money on your eagle one card
- calculator with scientific notation and exponential functions – you will only be able to use non-graphing calculators on all quizzes and exams. TI-30X calculators are available in the Bookstore

Recommended Materials:

- Solutions Manual for Quantitative Chemical Analysis, 9th or 10th ed. I have a copy in my office.

Website:
This course will make use of the Canvas course management system. Please check here frequently as materials posted will include course announcements, assignments, and other course materials as necessary. There will be a weekly page with a list of all assignments and information you will need for the week.

Course Description:
Chem254 provides a theoretical and hands-on introduction to some of the most common spectroscopic and chromatographic instrumentation used in chemical analyses. Our major goals are to:

- understand the basic theory underlying the construction of several common instruments
- become familiar with the operation of spectroscopic and chromatographic instruments and the influence of instrumental settings
- apply proper data analysis to evaluate the accuracy of your quantitative technique
- gain familiarity with identifying and correcting common errors and interferences

Grading: Grades will be based on the following

	Points	Total
Literature assignments (3)	variable	50
Quizzes (best 4 of 5)	15 each	60
Hourly Examinations (3)	100 each	300
Lab Reports		200
Group Project		110
Instrument Video	80	80
Cumulative Final Exam	200	200
		1000 points total

Students with a C average or lower will receive a midsemester report of unsatisfactory.

Points to overall grade conversions:

Points accumulated	Letter Grade	Points accumulated	Letter Grade
≥ 930 points	A	929 – 900 points	A-
899 – 870 points	B+	869 – 830 points	B
829 – 800 points	B-	799 – 770 points	C+
769 – 730 points	C	729 – 700 points	C-
699 – 650 points	D+	649 – 600 points	D
below 600 points	F		

Honor System:

All graded work (hourly exams, online exercises, extra credit assignments, *graded* assignments, final exam) must be your own. Online submission constitutes you abiding by the Honor System and pledging as such. All written work must have the Honor Pledge written in full and your signature. You must use **these** words and sign the pledge: I hereby declare upon my word of honor that I have neither given nor received any unauthorized help on this work.

It is recommended that the *suggested* problems (i.e., not submitted for a grade) be done individually and then with a study group when questions arise.

In-Class Behavior:

Please act respectfully in class of other students and myself. This includes turning your cell phone, etc. off during class time, using electronic devices only for note taking purposes, and arriving to class on time. You are expected to participate in all activities and discussions. I reserve the right to dismiss you from class if I feel you are acting disrespectfully or are disrupting the class.

When meeting online using Zoom or other software, please be mindful of distracting audio or video backgrounds. You will never be required to share your video.

Class Attendance:

Class attendance is highly recommended. Attendance in laboratory is mandatory. The material discussed in lecture frequently has a different emphasis from that provided by the textbook. Also, time has been set aside in the course schedule to discuss example problems and practice problem-solving with your peers with instructor guidance. Students are responsible for all covered materials during a missed class. Missed exams **will not** be made up except in the event of an excused absence due to an emergency. (Immediate notification of the instructor is

mandatory). Lateness to lecture is distracting, and students should attempt to be on time. Lateness to an exam will result in less time allowed for completion of the exam. You may stay virtual for class lectures. You need to be present in person during exams, quizzes, and lab.

Absences:

You should notify me of an expected absence as early as possible. Make-up exams will not be given except in the event of extenuating circumstances. If you must miss a quiz, see me as soon as possible *prior* to the quiz to arrange a time for a make-up quiz.

Late Work Policy:

No late work will be accepted without prior arrangements **before** the assignment is due and is up to the instructors discretion. Each student will be given one no questions asked 1-week extension that can be used on an individual lab report or literature assignment. It cannot be used for quizzes, exams, any component of the final project, or the instrument video. When you want to use this, you must send an email or turn in a piece of paper with the name of the assignment you want to use the extension on. The new date will be 1 week after it was originally due.

Exams:

There will be three in-class exams during the semester which will emphasize material introduced since the last exam. There will be no make-up exams without **prior** arrangements with me. Exams will be given in class and must be completed within the class time.

The final exam will be a comprehensive and must be taken at the time scheduled by the University **Monday April 28th at 3:30 – 6:00 pm.** According to University policy, any student who does not take the final exam will fail the course.

Exam Policies:

No cell phones or other personal electronic communication devices (including Smart watches) will be permitted in the classroom during exams. You may only use approved non-graphing calculators for **ALL** quizzes and examinations.

If you feel a mistake has been made in the grading of your exam, you must write out what you wish to be re-graded and why (your reasoning is critical) on a separate sheet of paper. This must be turned in to me with the exam no later than one week after the graded exam is returned. Please note that the *entire* exam will be re-graded, and the new score (higher or lower) will be recorded.

If you feel there has been a numerical error in calculating your exam score, please bring this to my attention no later than one week after the graded exam is returned.

Literature Assignments:

Being able to read and understand chemical literature is important for all areas of chemistry. There will be a total of three literature assignments that will help develop skills needed to find and read chemical literature. More information will be given closer to the assignment due dates.

Quizzes:

Throughout the semester, there will be five 15-20 minutes quizzes. Quiz questions will be similar to problems in the text or come from the assigned reading or lecture material.

Your lowest quiz grade will be dropped. **There will be no make-up quizzes without prior arrangements with me.**

Projects:

Throughout the semester you will complete a self-directed project in teams. This will count as 11 % of your OVERALL grade. Graded portions of the projects include a "white paper" proposal, a team oral presentation of the proposed experimental design, and a team poster presentation at research and creativity day. Experimental work will occur during the final three weeks at the end of the semester. Serious planning must occur well before the work begins. This means paying careful attention to detail in the areas of sampling, sample preparation, instrumental method validation, and obtaining high quality data. The oral presentation should include detail in the areas of sampling, sample preparation, instrumental method validation, how obtaining high quality data, and what you expect to find.

***Project Topics*:** Topics may be drawn from several sources including: a) recent chemistry literature (i.e., any ACS journal); b) chemical education literature (i.e., the Journal of Chemical Education); or c) an independently planned experiment. You may want to develop a teaching lab, verify or adapt a published analytical technique, or perhaps assemble and demonstrate a novel instrumental device. Key dates to note are:

2/28: Team one page proposals due- two possible projects must be selected and submitted in 1 page following NSF one page proposal guidelines. More details will be available closer to the date.

Week of 3/10: discussion of possible topics with Dr. Smith, proposal development outside of class in office hours or scheduled meeting time.

3/21: Oral presentation about your proposed project during class and turn in a detailed written procedure with a list of materials needed for the project. More to come in class.

4/10-4/24: experimental work in lab

4/11: Abstract due

4/24: poster due by end of your lab period.

4/265: Oral presentation of final projects

Reading:

Reading of the appropriate sections of the textbook should be done *before* coming to class. You will be responsible for this material, *even if it is not covered in lecture.*

Weather Policy

To determine if classes will be held during inclement weather check the school website or call campus safety. If the campus is closed due to weather or other conditions on a day when an exam is scheduled, the exam will take place during the next class period when campus is open. If an assignment is due in class on a day when campus is closed due to weather or other conditions, it will be due at the next scheduled class meeting. Check Canvas for announcements. If campus is open but I am unable to come to campus, we will still have class but only online through the class Zoom link.

Basic Needs Security:

Learning effectively and engaging wholly in class is dependent upon our basic security and having our fundamental needs met: having a safe place to sleep at night, regular access to nutritious food, and some assurance of safety. If you have difficulty affording groceries or accessing sufficient food to eat every day, or if you lack a safe and stable place to live, please contact Chris Porter, Assistant Dean of Students, at cjporter@umw.edu. Additionally, the Gwen Hale Resource Center is a free resource on campus, providing food, toiletries and clothing to any member of our community. It is open Monday, Tuesday and Friday from 1pm-6pm, on the 5th floor (floor A for Attic) of Lee Hall, or resource@umw.edu . Finally, you are always welcome to talk with me about needs, if you are comfortable doing so. This will enable me to provide any resources I may possess.

Disability Resources:

The Office of Disability Resources has been designated by the University as the primary office to guide, counsel, and assist students with disabilities. You will need to request appropriate accommodations through this office as soon as possible, and then make an appointment with me to discuss your approved accommodation needs. I will hold any information you share with me in the strictest confidence unless you give me permission otherwise.

If you have allergies to any chemicals or other emergency medical information, please notify me as soon as possible.

Title IX Statement:

University of Mary Washington faculty are committed to supporting students and upholding the University's *Policy on Sexual and Gender Based Harassment and Other Forms of Interpersonal Violence.* Under Title IX and this Policy, discrimination based upon sex or gender is prohibited. If you experience an incident of sex or gender based discrimination, we encourage you to report it. ***While you may talk to me, understand that as a "Responsible Employee" of the University, I MUST report to UMW's Title IX Coordinator what you share***. If you wish to speak to someone confidentially, please contact the below confidential resources. They can connect you with support services and help you explore your options. You may also seek assistance from UMW's Title IX Coordinator. Please visit http://diversity.umw.edu/title-ix/ to view UMW's *Policy on Sexual and Gender Based Harassment and Other Forms of Interpersonal Violence* and to find further information on support and resources.

AI statement:

Use of AI technology (e.g. ChatGPT, Dall E, Google's Bard, etc.) in academic coursework is at the discretion of the course instructor and may encompass all submitted coursework or be limited to individual assignments. Use of AI technology on coursework when it is not permitted is a violation of the UMW Honor Code and as such, instructors may refer students to the Honor Council for a suspected violation. Beginning in Fall 2023 all course syllabi must include a version of one of the following statements to address the use of AI/ChatGPT.

AI is permitted in a limited capacity in this course. Students should refer to individual assignments for details as well as how/when appropriate citation for the tool should be used

Class Recordings and Materials:

Classroom activities in this course may be recorded by students enrolled in the course for the personal, educational use of that student only, and may not be further copied, distributed, published, or otherwise used for any other purpose without the express written consent of the course instructor. All students are advised that classroom activities may be taped by students for this purpose.

Distribution or sale of class recordings or recorded lecture videos is prohibited without the written permission of the instructor and other students who are recorded.

Any class materials (any document or other item provided by or made available by the instructor to students enrolled, including but not limited to coursepacks, lecture videos, annotated lectures, handouts, laboratory experiments, quizzes, exams, review sheets or past exams) provided for this course (in the coursepack, during class or lab, or posted on Canvas or YouTube) are for the personal, educational use of that student only, and may not be further copied, distributed, published, or otherwise used for any other purpose without the express written consent of the course instructor.

Distribution or sale of any and all class materials (any document or other item provided by or made available by the instructor to students enrolled, including but not limited to coursepacks, lecture videos, annotated lectures, handouts, laboratory experiments, quizzes, exams, review sheets or past exams) provided for this course (in the coursepack, during class or lab, or posted on Canvas or YouTube) is prohibited without the written permission of the instructor.

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****Students in violation of any part of this policy are subject to disciplinary action through the Office of Judicial Affairs and Community Standards.****

This policy is consistent with UMW's Policy on Recording Class and Distribution of Course Materials.

Laboratory

Expectations of Students:

1) Students may not work on experiments outside of laboratory time *without the explicit permission of the instructor* and may not work in the laboratory alone.

2) Each student is required to complete a pre-laboratory exercise for each experiment. Details of these assignments follow in this syllabus. If you have not completed the pre-laboratory exercise you will not be able to complete the lab.

3) Besides unknown samples and any solutions already prepared and available, the students will prepare all solutions themselves. You will need to include descriptions of how the solutions will be prepared, amounts needed, etc. in your pre-laboratory plan.

4) All experimentation, laboratory planning, data discussion must be completed *individually*. You may consult the literature or Dr. Smith, but you may not seek assistance from any other faculty member (including other disciplines) or student.

5) You will bring a printed copy of the lab procedure and instrument manual with you to lab.

Attendance:

Attendance in the laboratory is mandatory. **Unexcused absences from laboratory cannot be made up**. **MORE THAN ONE UNEXCUSED LABORATORY ABSENCE WILL RESULT IN FAILURE OF THE COURSE.** Excused absences may be made-up, if possible, at the discretion of the instructor. If you have to miss a laboratory due to an **emergency** or if you expect to be absent due to an interview, intercollegiate athletic event, etc., you should inform the instructor as soon as possible to schedule a make-up.

It is also imperative that you be on time for the laboratory. The pre-lab lectures cover important safety and procedural information. If a student is tardy to lab, the student will not be permitted to perform the experiment.

In-lab Behavior:

It is absolutely critical that you respect the dangers inherent in laboratory space**. If I feel your behavior is seriously unsafe to either you or your classmates, you will be asked to leave immediately and will receive a zero for that day's effort.**

Be sure to bring the Laboratory Experiment Reading (posted on Canvas), scientific duplication notebook, a blue or black pen, and calculator to each experiment. You are required to have goggles and laboratory coats for each experiment. Failure to bring the appropriate materials to the laboratory may result in a penalty to your grade.

You will be working in pairs to complete the experiments. Your group assignments will rotate for each experiment and will be announced at the start of the laboratory period. This work is solely to carry out the procedures and collect the data. Students must write the pre-laboratory assignment, analyze the data individually, and write an independent lab notebook and lab report.

Lab Safety:

Safe lab practices are expected of you. There are potential risks, such as exposure to hazardous chemicals and minor injuries (e.g., cuts and burns). During the first week of the semester, the safety rules will be presented and reviewed. To participate in this course, each student must sign a statement in which they acknowledge the risks associated with the course and agree to follow all safety rules and to assume responsibility for their actions in the laboratory.

Honor System:

Although you will be working as groups to complete the experiments, all assignments must be completed individually. You may not collaborate on the data analysis, pre-laboratory assignments, or notebook write-ups. Any assignment for which you will receive a grade must be completed individually and pledged as your own work. This includes notebook pages, literature assignments, etc. The honor pledge must be written in full: I *hereby declare upon my word of honor that I have neither given nor received unauthorized help on this work. (Signature)*

Alteration of data or copying data from another individual is an honor offense. You may discuss how to do the calculations with other students or get help from the instructor, but your final report must be your own work.

Lab Experiments:

There is no lab manual for this course. Experimental procedures and readings will be posted on Canvas. You must download these before lab to properly prepare for the exercise. Furthermore, the labs will frequently cover material not yet introduced in lecture. It is therefore essential that you do the assigned readings prior to performing labs. You may not use your phone during lab for the lab procedure.

Lab Reports:

Unless specified, all reports must be completed *individually*. Lab reports will be turned in on canvas and are due before the start of your scheduled lab period. They must be double-spaced with 1.25 in. margins, have numbered pages, and follow the format below.

- ***Attribution***: including your name, your partners' names, dates of work, and title
- ***Abstract*****:** one brief paragraph describing your major results.
- ***Results***: a brief discussion accompanying your results, data presented in tabular or graphic format as appropriate. This section must begin with prose, not data/figures.
- ***Discussion Questions***: answers to assigned questions (provided with lab)
- **Notebook pages:** These will be collected before you leave the lab.

Each report requires slightly different content, which will be discussed in class or made explicit in the lab assignment. Many labs require a spreadsheet data analysis, which is graded as analysis & calculations. Lab reports will be turned in electronically on canvas. You can upload your word document and any spreadsheets to Canvas. Any calculations completed by hand can be scanned or you can take a picture of the work and upload it to canvas.

Notebook and Calculations:

Your lab notebook serves as a record of your experimental methods and data. Anyone reading it should be able to understand your purpose, your methods, and your data analysis. *Each experiment must start on a new page and have (1) a descriptive title, (2) a brief statement of purpose, (3) a safety statement and how to mitigate the risk (4) a procedural outline including any changes made to the procedures DURING the lab period, (5) a clear presentation of the raw data, and (6) a well-organized collection of all calculations performed in lab and post-lab*. In cases where there are repetitive calculations done via spreadsheet, the notebook should show an example calculation.

Calculations will be turned in with your lab. These can be done by hand on a separate piece of paper. Each report requires slightly different content, which will be discussed in class or made explicit in the lab assignment. Many labs require a spreadsheet data analysis, which is graded as analysis & calculations.

Notebooks will be checked before lab and must already contain the title, purpose, safety, and procedural outline. *If your notebook is not ready, you will not be allowed in lab and will receive a failing grade for that lab*. Carbon copies of your lab pages will be collected at the end of each lab period.

Instrument Video Assignment:

Students will be assigned a group and will be responsible for making a video with closed captioning about one of the instruments used in lab. There will be more details about this later in the semester.

End-of-Chapter Exercises and Problems 9th edition

Unit 1: Ch 5: Ex. A, B; Prob. 6, 7, 9, 12, 26, 29, 30
Ch 18: Ex. B, C; Prob. 3, 4, 6, 7, 8, 10, 11, 12, 23, 24, 28
Ch 20: Ex. A, C; Prob. 1, 2, 3, 5, 6, 9, 11, 12, 28, 29, 33, 35

Unit 2: Ch 21: Ex. C, D; Prob. 1, 5, 6, 7, 11, 14, 15, 21
Ch 22: Ex. A; Prob. 1, 2, 5, 6, 19, 20, 21, (22 for fun)

Unit 3: Ch 23: Ex. B, F; Prob. 2, 3, 5, 8, 11, 16, 18, 22, 25, 28, 30, 32, 35, 38, 43
Ch 24: Ex. B, C; Prob. 2, 3, 4, 5, 6, 7, 9, 11, 13, 18, 21, 26, AND Ch 22-20 and 22-26
Ch 25: Ex. B, C; Prob. 1, 4, 5, 7, 8, 10, 11, 13, 19, 24, 27, 36, 37, 39, 40a
Ch 22: Prob. 31, 32

For final: Ch 26: Ex. C; Prob. 1, 3, 4, 8, 12, 13a, 14, 23, 24, 29, 34, 35, 36

End-of-Chapter Exercises and Problems 10th edition

Unit 1: Ch 5: Ex. A, B; Prob. 7, 8, 10, 14, 27, 32, 33
Ch 18: Ex. B, C; Prob. 3, 4, 6, 7, 9, 10, 11, 24, 25, 30
Ch 20: Ex. A, C; Prob. 1, 2, 5, 7, 8, 9, 11, 13, 31, 32, 35, 37

Unit 2: Ch 21: Ex. D, E; Prob. 2, 7, 8, 9, 17, 26
Ch 22: Ex. A; Prob. 1, 3, 6, 7, 22, 24, 25

Unit 3: Ch 23: Ex. B, F; Prob. 2, 3, 5, 8, 11, 16, 19, 23, 24, 27, 29, 31, 34, 37, 42
Ch 24: Ex. B, C; Prob. 2, 3, 4, 5, 6, 7, 9, 11, 13, 18, 22, 29, AND Ch 22-20 and 22-26
Ch 25: Ex. B, C; Prob. 1, 4, 5, 7, 8, 10, 11, 13, 20, 25, 28, 37, 38, 41, 42a
Ch 22: Prob. 32. 33

For final: Ch 26: Ex. C; Prob. 1, 3, 4, 8, 11, 12a, 13, 24, 25, 31, 36, 37, 38

Course Schedule: The tentative schedule that follows is how I see the course arranged. It is not concrete. If there is material that you, as a class, find confusing, we will spend more time on that topic. The exam dates will remain set according to the schedule. If all of the "scheduled" material has not been presented prior to the exam, the exam will include only what has been covered.

1/13 Introduction Chapter 4/5	1/15 Chapter 5	1/17 Chapter 5
1/20 Martin Luther King Jr. Day No Class	1/22 Chapter 18 **Literature assignment #1**	1/24 Chapter 18 **Quiz #1**
1/27 Chapter 18	1/29 Chapter 18	1/31 Chapter 20 **Literature assignment #2**
2/3 Chapter 20	2/5 Chapter 20	2/7 Chapter 20 **Quiz #2**
2/10 Chapter 20 **Literature assignment #3**	2/12 Chapter 21	2/14 **Exam 1 (chapters 5, 18, and 20**)
2/17 Chapter 21	2/19 Chapter 21	2/21 Chapter 22 **Quiz #3**
2/24 Chapter 22	2/26 Chapter 22	2/28 Chapter 22 **Group proposals due**
3/3 Spring	3/5 Break	3/7 Vacation
3/10 Chapter 23	3/12 Chapter 23	3/13 Chapter 23 **Quiz #4**
3/17 Chapter 23	3/19 Chapter 23	3/21 Proposal presentations

3/24 **Exam 2** **(chapter 21, 22, 23)**	3/26 TBD	3/28 Chapter 24
3/31 Chapter 25	4/2 Chapter 25	4/4 Chapter 25
4/7 Chapter 25	4/9 Chapter 26	4/11 Chapter 26 **Abstract due** **Quiz #5**
4/14 Chapter 26	4/16 Chapter 26	4/18 **Exam 3** **(chapter 24, 25, and 26)**
4/21 Chapter 26	4/23 Special topics	**4/25** Research and Creativity Day

Final Exam: Monday April 28th, 3:30-6:00 pm

Last day to drop a course without a W: 1/31/25

Last day to withdraw from a course or change to pass/fail grading: 3/21/25

Last day to withdraw from a course with a grade of W: 3/21/25

Lab Schedule:

Throughout this semester, we will complete the following labs. Most instrument labs are 2 weeks long. I will let you know which lab we will be doing on the Friday the week before and let you know which prelab assignment you will need to complete.

	Lab	
Date	**Group A/B**	**Group C/D**
1/16	Safety, Lab Check-in	Safety, Lab Check-in
1/23	UV-VIS	UV-VIS
1/30	ICP	Fluorescence
2/6	ICP	Fluorescence
2/13	Fluorescence	ICP
2/20	Fluorescence	ICP
2/27	HPLC	GC
3/6	Spring Break	Spring Break
3/13	HPLC	GC
3/20	GC	HPLC
3/27	TBD	TBD
4/3	GC	HPLC
4/10	Projects	Projects
4/17	Projects	Projects
4/24	Projects	Projects