Chemical Analysis I, CHEM 253
Fall 2024

Instructor: Dr. Sarah Smith
Office: Jepson Science Center 440
Email: ssmith23@umw.edu
Phone: (540) 654-1409
Lecture: MWF 1:00 pm - 1:50 pm Jepson 454
Lab: M 2:00 pm - 4:45 pm, Jepson 210

Office Hours:

Tuesday: 8:00 pm – 9:00 pm on Zoom only
Wednesday: 10:00 am – 11:00 am Jepson 440
2:00 pm – 3:00 pm Jepson 440
Friday: 10:00 am – 11:00 am Jepson 440
2:00 pm – 3:00 pm Jepson 440

Required Materials:

- Quantitative Chemical Analysis, 9th or 10th edition, Harris D.C
  - There is a copy of the textbook in the chemistry pod.
- 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 ed or 10th edition. I have both copies 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:

Quantitative chemical analysis is an essential part of modern life. It is required for industrial and pharmaceutical quality control, governmental regulation of industry, and environmental monitoring, as but a few examples. Practicing chemists must understand proper sampling methodology and the fundamental chemistry underlying various

analytical methods. Through both lab and lecture, this course introduces basic theory and techniques of wet analysis.

Topics we will investigate include experimental error and statistics, sampling and sample preparation, advanced principles of chemical equilibrium and their application to quantitative analysis, and electrochemical analysis.

Students successfully completing this course will demonstrate comprehension of or competency in:

- standard laboratory and data analysis techniques
- the components of analysis from sampling to statistical analysis
- applying advanced equilibrium and stoichiometric principles to chemical analysis
- understanding of electrochemical methods of analysis

Grading: Grades will be based on the following:

	Points	**Total**
Hourly Examinations (4)	75 each	300
Laboratory		250
Quizzes (best 5 of 6)	18 each	90
Excel Assignments (3)		80
Problem Sets (best 8 of 10)	10 each	80
Cumulative Final Exam	200	200
		1000

Students with an exam grade average of 70 or less 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. Please, discuss difficulties with the homework problems or lecture material with me.

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.

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 EXTREMELY 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. Each student will be given one no questions asked 1-week extension that can be used on a lab report, spreadsheet assignment. It cannot be used for quizzes, exams, or problem sets. When you want to use the extension, you must turn in a sheet of paper that includes your name, date, and the assignment you are using the extension on.

Exams

There will be four 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: **December 13th, 12:00 pm – 2:30 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.

Quizzes:

Throughout the semester, there will be six 15-20 minutes quizzes. Quiz questions will be similar to problems in the text or come from the assigned reading or lecture material. The lowest quiz grade will be dropped. **There will be no make-up quizzes without prior arrangements with me.**

Problem Sets:

Problem sets will consist of questions taken either from your text, literature, or material covered in lecture. These problem sets will be collected at the start of the class the day they are due. **Late work will not be accepted.** These assignments are for your benefit as they will help you master the course material and prepare you for quizzes and exams. You are allowed to work on the problem sets with other students, but you may not copy or plagiarize. Please write the names of those you worked with or received help from on the front page of your problem set. Remember that you must work alone on quizzes and exams, so it is in your best interest to be sure *you* understand the material.

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.*

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.

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 UMW's Title IX website to view UMW's policy and to find further information on support and resources.

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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for this course (in the coursepack, during class or lab, or posted on Canvas or YouTube) without permission is a violation of copyright law.

****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.

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.

Laboratory

Expectations of Students:

1) Students may not work on experiments outside of laboratory time (2:00 pm until 4:45 pm on Monday) *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 and are on the first page of each laboratory handout. If you have not completed the pre-laboratory exercise you will not be able to complete the lab and it will count as an unexcused absence.

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 students must upload their data to the class spreadsheet linked on Canvas by the Wednesday after lab by 2:00 pm. If you miss this or upload your data late, you will receive a 10 point deduction on the lab report.

5) 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.

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 an individual is repeatedly tardy, a **five-point deduction** will occur for each instance or the student will not be permitted to perform the experiment. If you are late and miss the prelab lecture, you may be dismissed from participating in lab that day.

In-lab Behavior:
It is 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, laboratory coats, and closed toed shoes for each experiment. Failure to bring the appropriate materials to the laboratory may result in a penalty to your grade.

You will be working alone in most of the labs. We will be compiling the classes data for you to use when writing your lab reports. Students must write the pre-laboratory assignment, analyze the data individually, and write an independent lab notebook.

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 (last page of the syllabus) 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.

Lab Reports:
Unless specified, all reports must be completed *individually*. They must be double-spaced, have numbered pages, be between 3 to 7 pages (not including notebook 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 and discussion***: 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)
- ***Excel file.*** This can be uploaded to Canvas
- **Notebook pages:** These will be collected before you leave the lab.

Calculations:
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.

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 or turned in during lab.

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.

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.

End-of-Chapter Exercises and Problems
9th edition

Chapter	*Exercises*	*Problems*
1	A, B	4, 12, 14, 15, 24, 23, 30, 31, 36
2	E	5, 10, 15, 18, 24
3	A, B, C	1, 10, 12, 17, 16, 20(b), 22
4	**A (using Excel), E**	1, 5, 9, 12, 14, 15, 24, 25
28	A, B	3, 6, 8, 9, 13
6	A, F, H	4, 8, 15, 17, 22, 30, 35, 36, 46, 50
8	A, C, G	3, 8, 13, 21 (27 is extra credit on exam 3)
7	C	5, 10, 11, 13, 15, 17, 19, 23, 31, 32
9	B, E, F, J	1, 5, 8, 15, 24, 26, 28, 29, 30, 31, 32, 34, 38, 42, 43
10	A, B	5, 13, 15, 19, 24, 27, 30, 37, 40
11	A, D, F, I, J	7, 12, 13, 18, 19, 26, 40, 49, 50, 55
12	E, F	3,6, 14, 15, 23, 36
14	B(a&b), C, D, H	3, 4, 8, 10, 17(a,b,c), 21, 25, 29
15	-	1, 3, 4, 8, 13, 24, 25, 31
16	A	5(a,b,c), 8, 15, 19, 23, 24, 26
17	-	1, 4, 10, 14, 17, 27, 33, 34(a,b), 37

10th edition

Chapter	*Exercises*	*Problems*
1	A, B	4, 11, 12, 13, 14, 20, 22, 23, 28, 29, 34
2	E	5, 10, 15, 19, 25
3	A, B, C	1, 6, 8, 10, 16, 17, 20, 21
4	**A, D**	1, 6, 9, 12, 14, 15, 21, 23, 24, 26
28	A, B	3, 6, 8, 9, 14

6	A, F, H	4, 8, 15, 17, 22, 31, 35, 36, 46, 50
8	A, C, G	3, 8, 13, 21 (27 is extra credit on exam 3)
7	C	5, 10, 11, 13, 15, 17, 19, 23, 31, 32
9	B, E, F, J	1, 5, 9, 14, 23, 25, 26, 27, 28, 29, 31, 35, 39, 40
10	A, B	5, 13, 15, 19, 24, 27, 30, 37, 40
11	A, D, F, I, J	7, 12, 13, 18, 19,26, 40, 49, 50, 54
12	E, F	3, 6, 14, 15, 22, 34
14	B(a&b), C, D, H	3, 4, 8, 10, 18(a,b,c), 21, 25, 28
15	-	1, 3, 4, 8, 13, 24, 25, 31
16	A	5(a,b,c), 8, 15, 19, 23, 24, 26
17	-	1, 4, 10, 14, 17, 27, 36, 37(a,b), 40

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.

8/26 Introduction Chapter 1	8/28 Chapter 2	8/30 Chapter 3
9/02 Labor Day NO CLASS	9/04 Chapter 4 **Spreadsheet #1**	9/06 Chapter 4 **Problem set #1** **Quiz #1**
9/09 Chapter 4	9/11 Chapter 4	9/13 **Chapter 28**
9/16 Chapter 28	9/18 **Exam 1** **Chapters 1-4** **Problem set #2**	9/20 Chapter 6
9/23 Chapter 6	9/25 Chapter 8	9/27 Chapter 8 **Quiz #2** **Problem set 3**
9/30 Chapter 8	10/02 Chapter 7	10/04 **Exam 2** **Chapters 28, 6, and 8** **Problem set 4**
10/07 Chapter 7	10/09 Chapter 7	10/11 Chapter 9 **Quiz #3**
10/14 Fall Break NO CLASS	10/16 Chapter 9 **Problem set 5**	10/18 Chapter 9 **Spreadsheet #2**
10/21 Chapter 10	10/23 Chapter 10	10/25 Chapter 11 **Quiz #4** **Problem set 6**

10/28 Chapter 11	10/30 Chapter 11	11/01 **Exam 3** **Chapters 9 – 11** **Problem set 7**
11/04 Chapter 12	11/06 Chapter 14	11/08 Chapter 14
11/11 Chapter 15	11/13 Chapter 15 **Problem set 8**	11/15 Chapter 15 **Quiz #5**
11/18 Chapter 16	11/20 Chapter 16 **Problem set 9**	11/22 Chapter 17 **Quiz #6**
11/25 Chapter 17	11/27 **Thanksgiving**	11/29 **Break**
12/02 Chapter 17	12/04 **Exam 4** **Chapters 12 -17** **Problem set 10**	12/06 Selected Topics **Spreadsheet #3**

Final Exam: December 13th, 12:00 pm – 2:30 pm.

Last day to drop a course without a W: September 13th, 2024
Last day to withdraw from a course: November 1st, 2024
Last day to change to pass/fail grading: November 1st, 2024

Chem 253 Lab Schedule

Throughout this semester, we will complete the following labs. Information about what each assignment details will be available on canvas.

	Lab	Assignments
8/26	Safety, Lab Check-in	
9/2	No Lab – Labor Day	
9/9	Water Density	prelab water density
9/16	Pipette performance	prelab pipette performance Water density due 9/18
9/23	Solution preparation	prelab solution preparation Pipette performance due 9/25
9/30	Standardization/Sampling	prelab standardization/sampling Solution Prep due 10/02
10/7	Carbonate mixture	prelab carbonate mixture Standardization due 10/09
10/14	**Fall break No lab**	**Carbonate mixture lab due 10/18**
10/21	KSP	prelab KSP
10/28	Indicators	prelab indicators KSP due 10/30
11/4	Gran plots	Prelab gran plots Indicators due 11/06
11/11	Zinc in a cough drop	Pre lab Zinc Gran plots due 11/13
11/18	Faraday's constant	prelab Faraday's constant Zinc due 11/20
11/25	Electrochemistry lab	Prelab electrochemistry Faraday's constant **due 11/26**
12/2	TBD	Turn in electrochemistry lab 12/4