

## Chemical Analysis I Chemistry 253

University of Mary Washington  
Fall 2019

**Lecture** TR, 11:00 – 12:15 (Jepson 454)

**Laboratory** R 2:00 – 4:45 (Jepson 210)

**Instructor** Dr. Charles Sharpless Jepson 441 (654-1405) [csharp@umw.edu](mailto:csharp@umw.edu)

**Office Hours** Walk-in: W (10-12 & 1-3), F (10-11) Appointments also welcome!

**Course Websites** Lecture notes, prelab powerpoints, and grades (<https://canvas.umw.edu/login>)

### Required Course Materials

Textbook: Quantitative Chemical Analysis, 9<sup>th</sup> ed., Harris, D.C.

Lab notebook (carbonless copy), lab coat, lab goggles, non-programmable scientific calculator

**Course Objectives:** 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:**

35%	Laboratory Reports
25%	Quizzes
40%	Four 50 min. exams

*\* No late assignments will be accepted without my prior consent.*

*\* Missed laboratories and exams may not be made-up without my prior consent.*

**Class Attendance** Attendance at lecture is highly recommended and is mandatory for lab. The material covered in lecture will differ in emphasis from the textbook. Also, lecture time will be used to discuss example problems and address any questions you have with them. Should you miss a class, you are responsible for the material covered. **IMPORTANT:** Any student with unexcused absences for more than two labs will automatically fail the entire course.

**Laboratory Reports:** Your laboratory work will count as 35% of your overall grade. Care and attention to detail in notebook records and experimental technique will pay off richly here. Sloppy work will lead to unfortunate consequences. Some labs will require full written reports and some are "spreadsheet labs" in which the report is simply a spreadsheet assignment. Your lab grade will be the determined as the average of all the spreadsheet labs and the best 6 out of 8 reports.

**Notebooks:** Your lab notebook serves as a journal record of your experimental methods and data. Someone else looking at it should have no difficulty understanding what you did and should be able to follow your methods and duplicate your results. *Each experiment should start on a new page, have a descriptive title, begin with a brief statement of purpose and a procedural outline, and clearly present the raw data as it was collected.* There should also be a summary of results that makes clear what calculations were performed on the data and what conclusions were drawn. Notebook pages must be submitted with written reports, and their quality constitutes 25% of the report grade.

**Lab reports:** Reports must be double-spaced. All lab reports consist of three sections in the following order: i) a brief abstract; ii) a summary of the experimental procedure; iii) presentation of experimental results and data analysis (i.e., relevant graphs, tables, and sample calculations). Some labs will require you to submit a spreadsheet data analysis, and this will be made explicit in the lab information. You must also submit copies of your lab notebook pages.

**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 lab period of the semester, the safety rules will be presented and reviewed. To participate in this course, each student must sign a statement in which he or she acknowledges the risks associated with the course and agrees to follow all safety rules and to assume responsibility for his or her actions in the laboratory.

**Quizzes:** Quizzes in this course are not really quizzes. Each time we conclude a chapter of lecture material, in the following class period I will collect answers to selected homework problems from that chapter. Many “practice” problems from the textbook have been assigned and are listed on page 3 of this syllabus. On the day of a “quiz”, you will simply be asked to submit your answers to three of the problems from that chapter. These are graded as 75% for completion and 25% for correct answers (no partial credit). You will not know which problems they are before coming to class on quiz day. After these have been submitted, answer keys for all homework problems will be made available.

**Note:** If you are struggling with “quiz” problems, please come see me with questions. Do not do these problems in groups: that would be a violation of the Honor Code.

**Classroom Etiquette** If you arrive late to class, please enter quietly and seat yourself with minimal disturbance to your fellow students. Please refrain from eating in the classroom. Please turn off cell phones in class. Cell phones are prohibited from examinations. Please do not distract yourself and others by reading newspapers or browsing the web during class time, either on a laptop or a PDA.

**Disability Resources** Students who require or feel they may require accommodations due to a disability should visit the Office of Disability Resources online (<http://academics.umw.edu/disability/>). A detailed course-specific accessibility statement can be found here (<https://tinyurl.com/csumwbpolicy>)

**Honor System** In accordance with the University’s Honor Code, all work submitted for grading must be your own and be pledged as such by writing at the end of the work, “*I hereby declare upon my word of honor that I have neither given nor received any unauthorized help on this work. (your signature)*” It is your duty as students and mine as faculty to uphold the Honor Code, which is described in detail in the Guidebook & Constitution (<https://academics.umw.edu/academicintegrity/academic-integrity/guidebook-and-constitution/>). Suspected violations of the Honor Code will be addressed according to the policy established by the Honor Council.

**Classroom Recordings** Classroom activities in this course may be recorded by students enrolled in the course for the personal, educational use of that student or for all students presently enrolled in the class only. More policy details can be found at <https://tinyurl.com/csumwbpolicy>.

**Title IX Statement** UMW is 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. You may talk to me, but understand that as a “Responsible Employee” of the University, I must report to UMW’s Title IX Coordinator what you share. More information can be found at <https://tinyurl.com/cmsumpolicy>.

### End-of-Chapter Exercises and Problems (in order of topics covered in lecture)

Target dates are dates on which you can likely expect problems to be due for “quizzes”.

<i>Chapter</i>	<i>Exercises</i>	<i>Problems</i>	<i>Target Dates</i>
1	A, B	4, 12, 14, 15, 24, 23, 30, 31, 36	8/29
2	E	5, 10, 15, 18, 24	9/3
3	A, B, C	1, 10, 12, 17, 16, 20(b), 22	9/5
4	A (using Excel), E	1, 5, 9, 12, 14, 15, 24, 25	9/12
28	A, B	3, 6, 8, 9, 13	9/19
6	A, F, H	4, 8, 15, 17, 22, 30, 35, 36, 46, 50	9/26
8	A, C, G	3, 8, 13, 21 (27 is 10 pts extra credit on exam 2)	10/3
7	C	5, 10, 11, 13, 15, 17, 19, 23, 31, 32	10/10
9	B, E, F, J	1, 5, 8, 15, 24, 26, 28, 29, 30, 31, 32, 34, 38, 42, 43	10/24
10	A, B	5, 13, 15, 19, 24, 27, 30, 37, 40	10/31
11	A, D, F, I, J	12, 13, 18, 19, 49, 50, 55	11/7
12	E, F	3, 14, 15, 23, 36	11/12
14	B(a&b), C, D, H	3, 4, 8, 10, 17(a,b,c), 40, 41	11/21
15	-	1, 3, 4, 8, 13, 24, 25	11/26
16	A	5(a,b,c), 19, 23, 24, 26	12/3
17	-	1, 4, 14, 17, 27, 33, 34(a,b), 37	“12/6”

## Fall 2019 Weekly Schedule (subject to change)

Labs indicated with \* are "spreadsheet labs"

Week Of	Chapters & Topics	LAB
Aug. 26 <sup>th</sup>	Ch 1: Review of fundamentals Ch 2: Fundamental techniques Ch 3: Error in measurements and propagation of error	water density & temperature*
Sep. 2 <sup>nd</sup>	Ch 3: Error in measurements and propagation of error Ch 4.1 to 4.6: Fundamental statistics for chemical analysis	solution preparation
Sep. 9 <sup>th</sup>	Ch 4.1 to 4.6: Fundamental statistics for chemical analysis Ch 28: Sampling error and sample preparation methods <i>Friday, 9/14: drop period ends</i>	pipette performance evaluation*
Sep. 16 <sup>th</sup>	<i>Exam 1, Sept 17<sup>th</sup>: Ch. 1 through 4</i> Ch 6: Fundamentals of solubility and acid-base equilibria	standardization
Sep. 23 <sup>rd</sup>	Ch 6: Fundamentals of solubility and acid-base equilibria Ch 8: Activity corrections, systematic approach to equilibrium problems	KHP/sucrose
Sep. 30 <sup>th</sup>	Ch 8: Activity corrections, systematic approach to equilibrium problems Ch 7: Fundamentals of titration chemistry and mathematics	spreadsheet assignment*
Oct. 7 <sup>th</sup>	Ch 7: Fundamentals of titration chemistry and mathematics Ch 9: Monoprotic acid-base equilibrium	carbonate mixture
Oct. 14 <sup>th</sup>	<i>No Class Tuesday – Fall Break</i> Thursday: TBA (exam Q&A?)	<i>Exam 2</i> <i>Ch. 28, 6, 8</i>
Oct. 21 <sup>st</sup>	Ch 9: Monoprotic acid-base equilibrium <i>Friday, 10/25: last day to declare P/F or withdraw from courses</i>	$K_{sp}$ of $\text{Cu}(\text{IO}_3)_2$
Oct. 28 <sup>th</sup>	Ch 10: Polyprotic acid-base equilibrium Ch 11.1 to 11.6: Acid-base titrations and streamlined calculations	spreadsheet assignment*
Nov. 4 <sup>th</sup>	Ch 11.1 to 11.6: Acid-base titrations and streamlined calculations Ch 12: EDTA titrations	titration & data analysis
Nov. 11 <sup>th</sup>	Ch 14: Electrochemistry fundamentals	Fe in a vitamin
Nov. 18 <sup>th</sup>	<i>Exam 3, Nov 19<sup>th</sup>: Ch. 9 through 12</i> Ch 15.1 to 15.3 and 15.5: Introduction to electrodes and potentiometry	cyclic voltammetry
Nov. 25 <sup>th</sup>	Ch 16: Introduction to redox titrations Begin Ch 17: Electrochemical methods of analysis <i>No class Thursday – Thanksgiving Break</i>	<i>no lab</i> <i>(Thanksgiving)</i>
Dec. 2 <sup>nd</sup>	Ch 17: Electrochemical methods of analysis	cyclic voltammetry
Dec. 9 <sup>th</sup>	<i>Exam 4, Dec 12<sup>th</sup>, 12pm: Ch 14 through 17 (Jepson 454)</i>	

## RELEASE FORM FOR CHEMISTRY LABORATORY STUDENTS

Please read carefully before signing.

I, \_\_\_\_\_, fully understand that there are hazards associated with performing new and unfamiliar procedures in a chemistry laboratory. I further understand that by signing up for CHEM \_\_\_\_\_ I must be especially careful to follow all safety rules and procedures while working in the laboratory. In addition to abiding by the Departmental safety rules, I agree that...

- (1) I will receive appropriate safety training, and afterwards I will follow all proper safety guidelines for working in the chemistry laboratory;
- (2) I will not work alone in the laboratory, and I will always have at least one other person, who has also had appropriate safety training, present with me in the laboratory when I am performing any procedure:
- (3) I will not perform unauthorized experiments, meaning that all experimental procedures will be approved before I perform them and that the quantities of reagents used will be no greater than the amounts delineated in the approved procedure (but they may be scaled down to lesser amounts);
- (4) I take full responsibility for my actions and for any injuries that I may incur as a result of performing the approved experimental procedures, and I will not hold the University of Mary Washington, the Chemistry Department, or my instructor responsible should an injury occur;
- (5) If I take any action that puts me or anybody else at unnecessary risk of injury, I will immediately be dismissed from the laboratory and lose the privilege of participating in the laboratory portion of the course;
- (6) If I lose my right to work in the laboratory, I am solely responsible for lost time and any subsequent loss of grade points resulting from deadlines that cannot be met;
- (7) I will not remove anything from the laboratory;
- (8) I will report any accidents immediately to my instructor and the departmental safety officer, Dr. Oldham;
- (9) I will report any damaged or malfunctioning equipment or safety violations to my instructor, to the departmental safety officer, Dr. Oldham, and to the department chair, Dr. Sharpless.

Signed: \_\_\_\_\_

Date: \_\_\_\_\_