

Syllabus: CHEM 2310A Quantitative Analysis – Fall 2023

Course Description:

UVM catalogue description: *CHEM 2310 Quantitative Analysis:* “Theory and practice of volumetric and gravimetric analysis. Theoretical discussion of indicators, buffers, pH, etc. Introduction to data analysis, spectrophotometry, and chromatography. Prerequisite: CHEM 032 (1450) or CHEM 036 (1455) or CHEM 052 (1460).”

Learning Goals:

- To apply knowledge of chemical and physical principles to the solution of qualitative and quantitative chemical problems
- To understand the interplay of observational data, hypotheses, and hypothesis-driven experimentation through application of the scientific method
- To become proficient in chemical laboratory techniques and apply these techniques to practical and current problems in research
- To learn to present scientific data clearly and effectively through both written and verbal communication

What you are expected to get from of this course:

- Develop a theoretical foundation for variety of methods of analytical chemistry, including volumetric, gravimetric and electrochemical analysis, spectrophotometry, ion exchange and complexation
- Apply a subset of the analytical methods in the laboratory that were discussed in lecture
- Develop good practices of experimental observation, keeping a laboratory notebook and experimental technique
- Build a foundation in statistical data evaluation, data interpretation, and reporting of results

Lecture:

Class: Mon, Wed, Fri 8:30 - 9:20 am in Innovation Hall E430
Recitation/review/exams: Wed 6:40 - 9:40 pm in Innovation Hall E430

Laboratory sections (STEM W407):

L02: Mon 5:05 - 9:05 pm TA: TBA
L03: Tues 8:30am – 12:30pm TA: TBA
L04: Tues 2:50 - 6:50 pm TA: TBA

Course Instructor:

Giuseppe A. Petrucci

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Room: Innovation E354

Phone: 656-0957

<http://www.uvm.edu/%7Egpetrucc/>

Office hours: *Posted on Brightspace.*

- I am available at other times as well, and you are welcome to set up an appointment via email.
- Also, I am also available via email for questions; I check my email several times every day.

Teaching Assistants:

Maddie Hatch, Rusul Mustafa

Textbook:

Quantitative Chemical Analysis, 10th Edition by Daniel C. Harris (REQUIRED)

- You won't find the text at the UVM Bookstore, so order it on-line. Search by ISBN number, and you should go to one of several suppliers, including Amazon.
 - ISBN-10: 1319164307
 - ISBN-13: 978-1319164300

Lab Manual:

Chem2310 Laboratory Manual (REQUIRED)

- Posted as a PDF on Brightspace

Chem2310 Introduction to Excel in the Laboratory – a Tutorial

- Posted as a PDF on Brightspace
- An Excel worksheet accompanies this tutorial

UVM Policy on Absences:

- **Religious Holidays:** Students have the right to practice the religion of their choice. Students should submit in writing by the end of the 2nd full week of classes their documented religious holiday schedule for the semester if there are any conflicts with the class or laboratory schedule.
- **Inter-collegiate Athletics:** Members of UVM varsity and junior varsity teams are responsible for documenting in writing any conflicts between their planned athletic schedule and the class (& laboratory) schedule by the end of the 2nd full week of classes.

UVM Policy on Academic Integrity:

Offenses against the Code of Academic Integrity are deemed serious and insult the integrity of the entire academic community. Any suspected violations of the code are taken very seriously and will be forwarded to the Center for Student Ethics & Standards for further investigation. Details:

<http://www.uvm.edu/policies/student/acadintegrity.pdf>.

How the course grade is determined:

Activity	Weight
Laboratory	30%
Quizzes	10%
Exam 1	15%
Exam 2	15%
Exam 3	15%
Final Exam	15%
TOTAL:	100%

- See below for more information about grading of the **laboratory assignments**. The TAs will go over laboratory expectations your first meeting.
- **Quizzes:**
 - At least one quiz will be given each week. Quiz questions will be exclusively based on the previous weeks lecture material.
- **Exams:**
 - There will be **3 exams** during the semester given during the evening recitation/review/exam period (see BrightSpace for the schedule).
 - **The final exam is scheduled for Monday 12/14/2023 from 7:30 am – 10:15 am** in Innovation E430.
 - Your exam grade (60% of the total) will be *the average of the top 3 exam scores*. The lowest exam score will be excluded. For example, if you are comfortable with your first 3 exam scores, you may skip the final.

NOTE: You will receive an automatic F for the course if you do not have a passing grade in the laboratory. To receive a passing grade, (i) you cannot have more than ONE unexcused absence from a laboratory experiment, and (ii) you must have an overall laboratory grade of $\geq 60\%$.

Laboratory:

Practical quantitative analysis is a skill that is acquired only via meticulous practice in the laboratory. The purpose of this course is not only to acquaint you with specific methods of analysis, but also to instill in you good quantitative lab habits. The quantitative lab skills that you learn will help you regardless of the area of laboratory science you may end up in and are a common part of many research laboratories or commercial laboratories.

You must come to lab prepared to work. Each experiment has been allotted a sufficient number of periods for its completion. You may not work on an experiment longer than the allotted number of periods. Before coming to the lab, you should have read the materials associated with the lab and be sure that you understand the experiment and the outline of the experimental procedure that you will follow. You cannot “wing” these labs. If you're not prepared, you will likely make mistakes, not collect good data and/or will not have enough time to finish in the allotted periods. We reserve the right to inspect your outlined experimental procedure before allowing you to begin the experiment.

Lab Notebook:

A BOUND lab notebook is REQUIRED

- However, “bound” means nothing more than an inexpensive *composition book* purchased in the UVM Bookstore. The composition book comes as ruled and as quadrille versions; either works, just be sure to put your name and contact information on the front.
- Your notebook entries must be organized and all data (e.g. weights and measures) must be recorded directly into it in pen.
- All pages must be dated.
- All entries will be readable! *Points will be deducted for bad hand-writing and ambiguous numbers.*
- You will not be allowed to begin a laboratory or work in the laboratory without your lab notebook.
- You should also purchase an indelible marker or "Sharpie" (also available at the bookstore) for marking your name on weighing bottles and crucibles that will be dried in the lab ovens.

Lab Reports:

- Lab reports should follow the format shown in the sample lab report (see BrightSpace).
- All reports are due at the beginning of the lab period one week following the end of the assigned experiment.
- Lab reports turned in late will be docked 2% of your lab report grade for each weekday-day that you are late.
- If it is obvious to us at first glance that you have made a serious error in your calculations, the lab report will be handed back to you without a grade, and you will be given 24 hours to rectify the error(s).

Lab Grading:

- Your lab grade is based on the accuracy of your results, your laboratory technique, pre-lab quizzes, your lab write up, and a subjective TA component (which includes, but is not limited to, preparedness, arriving to lab on time, pre-lab write-ups).
- Take special care in drawing graphs and making calculations. If we need to redo calculations for you, you'll lose points. Your lab grade will be negatively affected if incorrectly performed calculations result in inaccurate final answers.

Lab Safety:

See detailed information on *Brightspace*. It goes without saying that your safety in the lab is of prime importance.

- We will be using a number of truly hazardous substances in the lab. Please heed all warnings and handle these substances as directed! For example strong oxidants and acids (e.g. concentrated H_2SO_4) WILL CAUSE SEVERE BURNS IF IT CONTACTS YOUR SKIN and will eat through your clothes. Lab coats are not required but suggested (available at the bookstore).
- **Safety Glasses/Goggles** are required IN THE LAB AT ALL TIMES! They're available in the bookstore as safety glasses and as goggles. You will not be allowed in lab without safety glasses/goggles. If you wear prescription glasses, you must still wear goggles over them.
- **Closed-toe shoes.** Another OSHA rule: no sandals, flip-flops or any shoe that is open in any way.

Subject Matter to be Covered in CHEM 2310:

Topic (Chapters in Harris 10th Ed.)

- Tools of the trade (0-5)
 - Critical concepts of analytical chemistry
 - Statistics
 - Use of Excel
 - Quality assurance and setting up an analytical method
- Chemical equilibria (6)
- Acids, bases, & buffers (8-10)
- Titrations (7, 11, 12, 16)
- Electrochemistry & redox titrations (14-15)
- Spectrophotometry & applications (18-20)
- Chromatography (23-25)