

SYLLABUS
CHEM 121, Fall 2021

<u>Course Description</u>	Theory and practice of volumetric and gravimetric analysis. Theoretical discussion of indicators, buffers, pH, etc. Introduction to data analysis, spectrophotometry, and chromatography.
<u>Modality Description</u>	This course will be held in-person unless otherwise specified. Students attending lecture must obey the on-campus mask mandate and other UVM policies as stipulated by the university's <u>Green and Gold Promise</u> . I will give students instructions on how to proceed in the event that the course switches to a remote or mixed format due to COVID-19 concerns.
<u>Learning Outcomes</u>	Quantitative analysis involves gravimetric, volumetric, and introduction to instrumental analysis. A good student will leave this class with the ability to perform these analyses for select sample types, accumulated significant hands-on laboratory experience with their mechanics, and can express the certainty of their measurements.
<u>Instructor</u>	Yangguang Ou
<u>Office</u>	E341 Innovation Hall
<u>Instructor email</u>	Yangguang.Ou@uvm.edu
<u>Office hours</u>	<u>Instructor and TA office hours:</u> By appointment only. Maddie Hatch: Madeline.Hatch@uvm.edu Francesca Milazzo: Francesca.Milazzo@uvm.edu
<u>Credit</u>	CHEM121 is worth 4 credit hours.
<u>Pre-requisites</u>	CHEM 032 or CHEM 036 or CHEM 052.
<u>Lecture</u>	MWF 08:30 – 09:20 Innovation Hall E430 Lecture begins at 8:30. Late arrivals should be <u>rare and quiet</u> . Enter the room with your phone off at all times.
<u>Lab</u>	(In Discovery Building W407) L01: M 12:00- 16:00; TA: Francesca Milazzo L02: M 17:05 – 21:05; TA: Maddie Hatch L03: T 14:50 – 18:50; TA: Maddie Hatch L04: T 08:30 – 12:30; TA: Francesca Milazzo

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Recitation/Review

W 18:40 – 21:40 via MS Teams

This time block will be used primarily as review sessions prior to exams and will be virtual via Microsoft Teams. It will be strictly a Q&A session (meaning, I will not prepare any materials in advance). Attendance will **not** be mandatory.

Student Learning Accommodations

In keeping with University policy, any student with a documented disability interested in utilizing accommodations should contact SAS, the Student Accessibility Services on campus. SAS works with students and faculty in an interactive process to explore reasonable and appropriate accommodations, which are communicated to faculty in an accommodation letter. All students are strongly encouraged to meet with their faculty discuss the accommodations they plan to use in each course.

Contact SAS:

A170 Living/Learning Center
802-656-7753
access@uvm.edu
<https://www.uvm.edu/access>

Calculators

Calculators with STAT and Log functions are **required**; calculators with the SOLVE function to solve polynomial equations are **preferred but not required**. Calculators with keyboards are prohibited from examinations. **Bring your own calculator to class everyday to work on problems.** Make sure you have an operator's manual for your calculator. Please also bring spare batteries for your calculator. A phone is not a calculator.

Blackboard, MS Teams

Blackboard will be used for course announcements, lecture materials (i.e. slides), lab manuals, worksheets, homework and other assessments, and grading. The instructor and TAs will use MS Teams for virtual office hours.

Technical Support

Students, please read this technology checklist to make sure you are ready for classes:
<https://www.uvm.edu/it/kb/student-technology-resources/>

Students should contact Helpline (802-656-2604) for support with technical issues.

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Homework

Required. Homework problems will be assigned weekly or biweekly. Problem sets will be posted through Bb and will be graded on a complete/incomplete scale. No late homework will be accepted. Keys will be posted after the due date.

In-class problems

You will be expected to solve problems, under my guidance, in class almost every week. This is critical practice that you should partake in and this is why it is important to bring your calculator. It will be helpful if you print out slides before each class (or pull it up on your device(s)) and fill in notes and example problems during class.

Attendance

Required. The best way to learn is to attend the lectures and work on problems. Attendance will be 5% (50 pts) of your overall grade. You can have 2 unexcused absence freebies but any more than that, I will deduct 5 pts per absence. Attendance will be conducted through Poll Everywhere using a 'word of the day.'

<http://catalogue.uvm.edu/>

The University of Vermont reserves the right to make changes in the course offerings, mode of delivery, degree requirements, charges, regulations, and procedures contained herein as educational, financial, and health, safety, and welfare considerations require, or as necessary to be compliant with governmental, accreditation, or public health directives.

The Green and Gold Promise clearly articulates the expectations that UVM has for students, faculty, and staff to remain compliant with all COVID-19 recommendations from the federal CDC, the State of Vermont, and the City of Burlington. This include following all rules regarding facial coverings when attending class. If you do not follow these guidelines, I will ask you to leave the class. If you forget your mask, you cannot enter the class and should go back and retrieve your mask. The Code of Student Conduct outlines policies related to violations of the Green and Gold Promise. Sanctions for violations include fines, educational sanctions, parent notification, probation, and suspension.

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Attendance and illness/isolation/quarantine:

If you need to isolate or quarantine, please contact Student Health Services (802) 656-3350), who will inform the Dean's office, who will then inform me. Please contact me and your TA via email directly to make arrangements to discuss missed work. In these cases, arrangements will be made so you can continue your studies remotely.

Recordings

Our class sessions may be audiovisually recorded for students in the class to refer back to, and for enrolled students who are unable to attend live. Students who participate with their camera engaged or utilize a profile image are agreeing to have their video or image recorded. If you are unwilling to consent to have your profile or video image recorded, be sure to keep your camera off and do not use a profile image. Likewise, students who un-mute during class and participate verbally are agreeing to have their voices recorded. If you are not willing to consent to have your voice recorded during class, you will need to keep your mute button activated and communicate exclusively using the "chat" feature, which allows students to type questions and comments live.

Quizzes

I will administer quizzes throughout the semester via Blackboard and you will be notified when they are up a few days in advance. You will have 24 hours to complete them.

Exams

In-class exams will be given during the lecture period. The final exam will include questions from each of the first three sections and a new fourth section devoted to the new materials covered since Exam 3. All exams will be closed-book written tests, and may include practical vocabulary, short-answer, and problem-solving questions. The 4th exam will be administered during finals week (***Dec 13, 2021 07:30 – 10:15 in Innovation Hall E430***) and will have four sections. I will replace your *lowest scoring* exam (from Exams 1-3) with the respective section score on the Final Exam *if you get a better percentage score*. If you feel confident with any of the first three exam scores, you do not have to take those respective sections on the final. Only section 4 of the final is mandatory for everyone. **There will be no makeup exams. If you know ahead of time that you will be missing an exam, please make sure to talk to me as soon as possible so that I can make arrangements for you to take the exam ahead of time.**

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Textbook

Fundamentals of Analytical Chemistry 9th Edition by Skoog, West, Holler, and Crouch.

Recommended not required. I understand that times are tough and not everyone can afford all of the course materials. My lecture notes will cover all the content for exams. The textbook will be helpful if you want more examples and practice problems.

I have requested copies of the textbook to be stocked at the UVM bookstore. You can rent a physical or electronic copy on Amazon for a much lower price. They are also available for purchase on Amazon as well, in both hardcover, paperback, and etextbook formats.

I have asked the library to hold a few copies of the textbook in case anyone would like to use it as a reference but do not wish to or cannot purchase it. You can check it out for up to 24 hours each time.

Lab Manual

CHEM121 Lab Manual (**Required**)

- Will be posted on Blackboard as a pdf.

CHEM121 Excel cover sheet for calculations (**Required**)

- Will be posted on Blackboard.

Intellectual Property

Students are prohibited from publicly sharing or selling academic materials that they did not author (for example: class syllabus, outlines or class presentations authored by the professor, practice questions, text from the textbook or other copyrighted class materials, lab manual, etc.); and students are prohibited from sharing assessments (for example homework or a take-home examination). Violations will be handled under UVM's Intellectual Property policy and Code of Academic Integrity.

Diversity, Equity, and Inclusion Resources

The Division of Diversity, Equity, and Inclusion believes excellence should be inclusive of the entire University of Vermont (UVM) community and is steadfastly committed to this belief. Every day, our Division strives to make our work accessible, affirming, and action-oriented to help ensure excellence is inclusive of everyone.

<https://www.uvm.edu/diversity>

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UVM Prism Center

The Prism Center serves the diverse queer and trans communities at the University of Vermont. We support and empower lesbian, gay, bisexual, transgender and queer students, as well as students whose identities fall in between or expand beyond those categories, and work to create a campus community where people of all sexual and gender identities can thrive.

<https://www.uvm.edu/prism>

Interfaith Center

Each of us engages those questions differently, perhaps through a religious tradition, philosophy, or spiritual practice. No matter how you make meaning of your life, you are welcome at the Interfaith Center for reflection, spiritual practice, education, and community building.

<https://www.uvm.edu/interfaithcenter>

Mosaic Center for Students of Color

The Mosaic Center for Students of Color (MCSC) Vision is to create a diverse and rich community of empowered, engaged, and enthusiastic students of color at UVM. We fully support the holistic development of self-identified students of color so that they can obtain their goals for academic achievement, personal growth, identity formation, and cultural development.

<https://www.uvm.edu/mcsc>

Women & Gender Equity Center

The UVM Women & Gender Equity Center cultivates joyful community while advancing gender equity across identities. We envision a brave, diverse, and equitable learning environment for all members of the UVM community. We provide advocacy services for those in our community who have experienced sexual or intimate partner violence, and strive to provide programming, education, and events that ask our community to explore the intersections of their gender and other identities.

<https://www.uvm.edu/wagecenter>

Tips for Success

Students are encourage to attend class, do homework, come to office hours, work with peers, and ask questions to help them succeed in class. In case the course goes fully online, here are a few resources for students on remote/online learning:

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- Checklist for success in <https://learn.uvm.edu/about/support-for-students/checklist-online-credit-courses/>
- Academic support for online courses: <https://www.uvm.edu/academicsuccess/online-learning-student-resources-remote-instruction>

Helpful resources other than the instructor include the Undergraduate/Graduate Writing Center, Supplemental Instruction, Learning Co-op tutors, and supplemental course materials.)

Important University Policies

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 and Standards for further investigation. Violations of the Code of Academic Integrity – including any inappropriate collaboration, collusion, cheating, corroboration, plagiarism, or any other related offense–will be fully investigated according to the rules set by the UVM Academic Integrity Office and may be punishable with a score of zero for the assignment in question. Details can be found at <http://www.uvm.edu/policies/student/acadintegrity.pdf>.

Grade Appeals

If you would like to contest a grade, please follow the procedures outlined in this policy: <https://www.uvm.edu/policies/student/gradeappeals.pdf>

Code of Student Conduct

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

FERPA Rights Disclosure

The purpose of this policy is to communicate the rights of students regarding access to, and privacy of their student educational records as provided for in the Family Educational Rights and Privacy Act (FERPA) of 1974. <http://catalogue.uvm.edu/undergraduate/academicinfo/ferparightsdisclosure/>

Promoting Health and Safety

The University of Vermont's number one priority is to support a healthy and safe community:

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Center for Health and Wellbeing:

<https://www.uvm.edu/health>

Counseling & Psychiatry Services (CAPS): Please call 802-656-3340 for assistance.

C.A.R.E. If you are concerned about a UVM community member or are concerned about a specific event, we encourage you to contact the Dean of Students Office (802-656-3380). If you would like to remain anonymous, you can report your concerns online by visiting the Dean of Students website at <https://www.uvm.edu/studentaffairs>

Alcohol and Cannabis Statement

As a faculty member, I want you to get the most you can out of this course. You play a crucial role in your education and in your readiness to learn and fully engage with the course material. It is important to note that alcohol and cannabis have no place in an academic environment. They can seriously impair your ability to learn and retain information not only in the moment you may be using, but up to 48 hours or more afterwards. In addition, alcohol and cannabis can:

- Cause issues with attention, memory and concentration
- Negatively impact the quality of how information is processed and ultimately stored
- Affect sleep patterns, which interferes with long-term memory formation

It is my expectation that you will do everything you can to optimize your learning and to fully participate in this course.

Final Exam Policy

The University final exam policy outlines expectations during final exams and explains timing and process of examination period. <https://www.uvm.edu/registrar/final-exams>

Course evaluation

All students are expected to complete an evaluation of the course at the end of the semester. Evaluations will be anonymous and confidential, and the information gained, including constructive criticisms, will be used to improve the course.

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Lecture and Exam Schedule (subject to change)

Mon	Aug 30	First day of class.
Fri	Sept 3	Last day to add class without instructor permission
Mon	Sept 6	<i>Labor Day Holiday (no classes)</i>
Mon	Sept 13	Add/drop, pass/no pass, audit deadline
Fri	Sept 17	Exam 1
Fri	Oct 08	<i>Fall Recess</i>
Mon		Exam 2
Wed	Nov 1	Exam 3
Thurs	Nov 1	Last day to withdraw
Mon-Fri	Nov 22-26	<i>Thanksgiving Day (no classes)</i>
Fri	Dec 10	Last day of classes
Sat, Sun, Wed	Dec 11, 12, 15	Reading days
Mon	Dec 13	Final Exam (@ 07:30 – 10:15, Innovation E430)

Laboratory Schedule (subject to change)

Lab Dates	Lab Dates	Lab Activity
08/30	08/31	No labs.
09/06	09/07	Labor Day week – no labs.
09/13	09/14	<i>Expt 1 part 1. Mass analysis and calibration.</i>
09/20	09/21	<i>Expt 1 part 2. Mass analysis and calibration.</i>
09/27	09/28	<i>Expt 2. Standardization of EDTA and NaOH solutions.</i>
10/04	10/05	<i>Expt 3. Calcium by ion exchange.</i>
10/11	10/12	<i>Expt 4. Calcium by EDTA titration.</i>
10/18	10/19	<i>Expt 5. Calcium by ion selective electrode.</i>
10/25	10/26	<i>Expt 6. Iron by dichromate oxidation.</i>
11/01	11/02	<i>Expt 7. Iron by UV-Vis.</i>
11/08	11/09	<i>Expt 8. Copper by UV-Vis titration.</i>
11/15	11/16	Lab check out.

GRADING

Participation (class attendance)	5%
Exams I, II, III, IV	15% each
Homework	10%
Quizzes	5%
Laboratory	20%
TOTAL	100%

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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 and no more than TWO excused absences from the laboratory, and (ii) you must have an overall laboratory grade of $\geq 60\%$. Hands-on learning is an integral part of this course.

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. If you make a mistake, put a single ~~strikethrough~~ to indicate the error.
- You must take pictures or scans of your lab notebook to be included in your final report to be uploaded to Blackboard.
- All pages must be dated.
- All entries must 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.

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- 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 blackboard). Your submission should be in the form of a single pdf, which includes pictures or scans of your notebook. Please make sure the pages are in order and all pages (including scans/pictures) are legible. TAs will take off points if any of these rules are violated.
- 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 cause you lose 2% of your lab report grade for each 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

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.

Health

Any students showing signs of illness (coughing, sneezing, shortness of breath, general malaise, fever) are required to stay home based on the UVM Green and Gold Promise. This is true even if the student thinks they just have allergies. TAs should not be put in a

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position to evaluate student health. If a student comes to lab sick, the TA should send them home immediately with instructions to contact the instructor of the course to make arrangements for completing an alternative assignment.

Cleaning

All students are required to wash their hands upon arrival. Students are required to wipe down their work area with ethanol or isopropanol before and after each lab session. The TA will be responsible for wiping down communal areas in the laboratory (reagent bottles, waste area, etc.) before and after each lab session.

PPE

All students must wear masks that cover the nose and mouth as well as eye protection while in the laboratory. Any student who arrives without a mask or eye protection will be sent home, no exceptions. Students who remove masks, or wear them inappropriately, will lose points from their technique grade (quantity to be determined for each course) upon the first warning. A second infraction during the same lab period will result in dismissal from the laboratory for that day (2 strikes and you're out). Disposable gloves, which are in short supply, should only be worn when the chemistry necessitates it (caustic or toxic chemicals in use). Gloves should not be stored in the open due to the high likelihood of theft.

Lab Report Collection

Students will submit prelabs and lab reports as electronic files (PDF format) via Blackboard. TAs should not accept hard copies. TAs will be given guidance from their instructors as to how grading should be done, and what materials will need to be returned to the students.

**Tentative Detailed Schedule (subject to change)
(we will move quickly, so keep up with your homework!)**

Lecture	Day	Date	Subject	Chapter(s)
1	Mon	08/30	Syllabus review, intro to analytical chemistry	1
2	Wed	09/01	Tools, spreadsheets, calculations	2,3,4
3	Fri	09/03	Calculations, errors	4,5
<i>No class</i>	<i>Mon</i>	<i>09/06</i>	<i>Labor day</i>	
4	Wed	09/08	Calculations, errors	4,5
5	Fri	09/10	Random Errors	6
6	Mon	09/13	Statistical analysis	6, 7
7	Wed	09/15	Statistical analysis	7
Exam day	Fri	09/17	EXAM 1	Lectures 1-7
8	Mon	09/20	Finish statistical analysis, start sampling	7,8
9	Wed	09/22	Sampling and calibration	8
10	Fri	09/24	Standardization, aqueous solutions	8, 9

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11	Mon	09/27	Aqueous solutions and chemical equilibria	9
12	Wed	09/29	Effect of electrolytes on equilibria	9,10
13	Fri	10/01	Solving equilibrium problems for complex systems	10,11
14	Mon	10/04	Equilibrium continued...	11
15	Wed	10/06	Gravimetric methods of analysis	12
<i>No class</i>	<i>Fri</i>	<i>10/08</i>	<i>Fall Recess</i>	
Exam day	Mon	10/11	Exam 2	Lectures 8-15
16	Wed	10/13	Separations – ion exchange	31
17	Fri	10/15	Separations – gas chromatography	31, 32
18	Mon	10/18	Separations – GC, HPLC	32, 33
19	Wed	10/20	Separations - HPLC	33
20	Fri	10/22	Miscellaneous separation methods	34
21	Mon	10/25	Titrations	13
22	Wed	10/27	Neutralization Titrations	14
23	Fri	10/29	Complexation Reactions	17
Exam day	Mon	11/01	EXAM 3	Lectures 16-23
24	Wed	11/03	Introduction to spectrochemical methods	24
25	Fri	11/05	Introduction to spectrochemical methods	24
26	Mon	11/08	Instruments for optical spectroscopy	25
27	Wed	11/10	Atomic spectroscopy	28
28	Fri	11/12	Raman spectroscopy	notes
29	Mon	11/15	Introduction to electrochemistry	18
30	Wed	11/17	Potentiometry	21
31	Fri	11/19	Voltammetry	23
<i>No class</i>	<i>Mon</i>	<i>11/22</i>	<i>Thanksgiving</i>	
<i>No class</i>	<i>Wed</i>	<i>11/24</i>	<i>Thanksgiving</i>	
<i>No class</i>	<i>Fri</i>	<i>11/26</i>	<i>Thanksgiving</i>	
32	Mon	11/29	Mass spectrometry I	29
33	Wed	12/01	Mass spectrometry II	29
34	Fri	12/03	Real-world applications: guest lecture	
35	Mon	12/06	Real-world applications: guest lecture	
36	Wed	12/08	Real-world applications: guest lecture	
<i>No class</i>	<i>Fri</i>	<i>12/10</i>	<i>Instructor out of town.</i>	
Exam day	Mon	12/13	FINAL EXAM @07:30-10:15 Innovation Hall E430	All