

Chemistry: *Spring 2025 Course Syllabus*

[NJIT Academic Integrity Code](#): All Students should be aware that the Department of Chemistry & Environmental Science (CES) takes the University Code on Academic Integrity at NJIT very seriously and enforces it strictly. This means that there must not be any forms of plagiarism, i.e., copying of homework, class projects, or lab assignments, or any form of cheating in quizzes and exams. Under the University Code on Academic Integrity, students are obligated to report any such activities to the Instructor.

COURSE INFORMATION

Course Description: This course is designed to introduce students to the fundamentals of Analytical Chemistry, a sub-discipline of chemistry. Analytical Chemistry deals with identifying and assaying materials and their components. Quantitative Analysis deals with the latter of these processes, i.e., how much of a specific substance is in the material to be analyzed. Chem 222 introduces the theory and applications of quantitative chemical analysis developed from threshold topics of statistics, molecular interactions, and equilibrium. Other topics include wet chemistry, electrochemistry, spectroscopy, and separation. Students will work in teams to build their knowledge in these areas and then apply this knowledge to a new situation.

Number of Credits: 3

Prerequisites: 2

Course-Section	Instructor
CHM 222-002	Dr. Gregory Edens email: gregory.edens@njit.edu tel: 973-642-7938 Office Hours: Monday 3:00 PM - 4:30 PM Tier 323a (across from 309)

Class time: Mon & Thur 10:00 AM - 11:20 AM at FMH 306

E-Mail: All E-mail to me should start with CHEM 222 in the subject so that it can be filtered appropriately. Any e-mail pertaining to your academic standing (i.e., grades) must be sent from your NJIT account. Anonymous e-mail will not be read.

Suggested References

Recommended Text	Quantitative Chemical Analysis, DC Harris & CA Lucy, Macmillan Pub.
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(Lecture slides based on this)	ISBN-13: 978-1319164300
Suggested Streamlined Text	Exploring Chemical Analysis, DC Harris, Macmillan Publisher
Suggested Open Education Resource (OER)	<p>Analytical Chemistry 2.0, David Harvey, https://chem.libretexts.org/Courses/Los_Angeles_Trade_Technical_College/Analytical_Chemistry/2%3A_Analytical_Chemistry_2.0_(Harvey) https://chromedia.org/chromedia?waxtrapp=qoxojfEsHonOvmOIIcEcxBgCVhB&subNav=mtxojfEsHonOvmOIIcEcxBgCVhBP</p>

University-wide Withdrawal Date: The last day to withdraw with a **W** is Monday, April 7, 2025. It will be strictly enforced.

Learning Outcomes:

1. List the steps of the analytical approach
2. Perform calculations with propagation of experimental error and significant figures
3. Critically evaluate sample preparation.
4. Identify possible sources of error in measurements of mass and volume
5. Display data in various formats and summarize data using statistics
6. Report confidence interval for results and explain its meaning
7. Use t-test to decide if two results represent the same population.
8. Use sampling variance and analysis variance to optimize the number of replicates for sampling and analysis
9. Construct and characterize a straight-line calibration curve including slope, intercept, and their standard deviations
10. Calculate the Limit of Detection (LOD) and limit of quantitation (LOQ) using appropriate measures of blank and sample signal
11. Prepare a control chart and draw conclusions regarding indeterminate and determinate error
12. Explain the Quality Assurance process as applied to a case study
13. Perform spike and spike-recovery calculations in method validation scenarios
14. Use method of standard additions to determine concentration of analyte in a matrix
15. Use method of internal standard to determine concentration of analyte where loss or instability occurs
16. Use pH and pK_a to give a qualitative estimate and quantitative calculation of speciation
17. Use pH and auxiliary reagent concentration in calculation of K_f for formation of Metal-EDTA complex
18. Set up equations for multiple equilibria and make suitable approximations.
19. Interpret data from direct, indirect, and back titrations
20. Calculate equilibrium concentrations for aqueous reactions of all types
21. Calculate ionic strength, activity coefficient, and activity
22. Construct ladder diagram (qualitative) and fractional composition diagram (quantitative) for weak acid
23. Employ systematic equilibrium approach when multiple equilibria are present
24. Construct a titration curve
25. Process data from measurements at electrodes for pH, ion selective electrodes, and coulometric titrations
26. Interpret qualitative and quantitative information from polarography
27. Describe molecular interactions underlying ion selective electrodes and the glass pH electrode
28. Calculate Galvanic cell potential under standard conditions and nonstandard conditions.
29. Convert cell potential among various reference electrodes
30. Explain relaxation pathways of an electron excited by UV-VIS radiation
31. Identify sources of error in atomic spectroscopy and provide for their mitigation
32. Use Beer's Law to calculate the concentration of an analyte.
33. Calculate diffraction angle and efficiency of a grating
34. Explain "stray light error" in molecular UV-VIS spectroscopy and how to minimize its effect
35. Determine liquid-liquid extraction efficiency for single and/or sequential extractions
36. Calculate resolution R , plate height H , and efficiency N from chromatographic data

37. Demonstrate critical thinking in GC sampling technique; and injection and detection selection
38. Use chromatographic data quantitatively to determine the concentration of a species

POLICIES

All CES students must familiarize themselves with, and adhere to, all official university-wide student policies. CES takes these policies very seriously and enforces them strictly. In addition, obtaining course materials such as past exams or solutions to homework and/or class assignments from external sources constitutes cheating. The official Student's Solutions Guide is exempt. Posting of course materials on external websites without the approval of the instructor violates intellectual property laws and hence strictly forbidden. Any student caught cheating on an assignment will be assessed a penalty of 20 points, in addition to a grade of zero for the given assignment.

Grading Policy: The final grade in this course will be determined as follows:

In Class Work	100 points
Homework	150 points
Worksheets	150 points
Midterm Exams 1 & 2 & 3	300 points
Cumulative Final Exam	300 points
Total	1000 points

Your final letter grade in this course will be based on the following tentative curve:

A	900 - 1000	C	700 - 749
B+	850 - 899	D	600 - 699
B	800 - 849	F	< 600
C+	750 - 799		

Participation Policy: In-Class points cannot be made up if lecture is missed. Each class is a learning experience that cannot be replicated through simply “getting the notes.”

For Success: Buy a textbook. Read a chapter ahead. Do end-of-chapter problems and check your answer against the back of the book. Watch the slides / video before coming to lecture; put slide# in left margin of your notebook and record any questions or understandings. Do the same in lecture. This will guide your study. Bring a calculator to lecture and use it for in-class problems. A calculator is more efficient than your phone; it was designed for calculating. This will give you practice using it for exams.

In Class Work includes (a) individual example problems and (b) small-group work & presentation, such as selecting the most appropriate approach to analyze a mixture, or making a multiple choice question on a given concept. *These points cannot be made up if you miss class.*

Homework includes JoVE videos to be watched outside of class and an associated canvas quiz that must be completed before class. JoVE homework will be assigned Saturday and due at 11:59 PM Sunday, and again 12:01 AM Wednesday and due 9:55AM on Thursday.

Worksheets includes problem sets that you will work on in groups and upload to canvas as a group. Worksheet quiz will be on an individual basis with different numbers. Worksheets will be distributed in Monday's recitation and class time will be given to work in groups on the problems. The work is to be uploaded as a group by 11:59PM

Tuesday. Each student is encouraged to know how to do each problem. A worksheet quiz *with different* numbers will be made available after Thursday lecture and will be due *individually* as a Canvas Quiz at 11:59 PM Friday.

Homework Policy: Homework and Worksheets is an expectation of the course and will be used in the determination of the final letter grade as described above. You must do your own work on Homework and Worksheet assignments. To make up missed homework or worksheets requires a note from the dean of students.

Coursework Timeline

Sun	Mon	Tue	Wed	Thu	Fri	Sat
						12:01 AM HW opens
11:59PM JoVE HW closes	Recitation Worksheet begins	11:59PM Worksheet upload closes	12:01 AM JoVE HW opens	9:55 AM JoVE HW Closes 11:30 AM Wks quiz opens	11:59 PM Wks quiz closes	etc.

Midterms and Final Exam: There will be three midterms. An entire period will be used for each midterm exam. The final exam will test your knowledge of all the course material taught in the entire course. You must bring ID to the exam. Come on time, put away cell phones (turn to silent or off), headphones / air buds of any kind, smart watches/smart glasses, and electronics of any kind, notes, and put your bag far away from you such as in the front of the room. No head coverings (unless for religious reasons). You will be provided with an equation sheet and necessary tables. Bring a calculator, pencils, eraser. No talking or communicating is allowed during the exam. Anyone caught with an unapproved electronic device will receive a zero for the assignment and be reported to the Dean of Students. Tentative exam dates:

Exam 1	Thursday February 20
Exam 2	Thursday April 3
Exam 3	Thursday May 1
Cumulative Final Exam	TBA May 10 - 16

Makeup Exam Policy: There will normally be **NO MAKE-UP QUIZZES OR EXAMS** during the semester. In the event that a student has a legitimate reason for missing a quiz or exam, the student should contact the Dean of Students office and present written verifiable proof of the reason for missing the exam, e.g., a doctor's note, police report, court notice, etc. clearly stating the date AND time of the mitigating problem. The student must also notify the CES Department Office/Instructor that the exam will be missed so that appropriate steps can be taken to make up the grade.

Cellular Phones: All cellular phones and other electronic devices must be switched off during all class times. During exams or quizzes, Smart Devices including all cell phones, smart glasses, smart watches, tablets, laptops and the like must be stowed in bags.

Course Conduct: A business-like environment is expected in the classroom. Arrive on time and be ready to begin class promptly. Come to class having completed assigned readings or homework. Treat the professor and classmates with respect. Avoid interrupting others, and listen attentively when someone is speaking. Avoid side conversations, phone use, or other distractions during class. Engage in discussions, ask relevant questions, and contribute thoughtfully. Collaborate professionally during group activities or projects. Meet deadlines for assignments and exams. Take accountability for your own learning, such as seeking help when needed. Treat class time as you would a meeting or task at work, with full attention to the subject matter.

ADDITIONAL RESOURCES

Mental Health and Well-being: NJIT is committed to the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of mental health support, services are available.

For help, such individuals should contact Center for Counseling and Psychological Services (c-CAPS) at <https://www.njit.edu/counseling/> or by calling the c CAPS office at 973-596-3414. If you need support and information about options and resources, please also reach out to the Office of the Dean of Students at <https://www.njit.edu/dos/>

IST Service Desk: Students may contact the IST Service Desk with any questions. Questions or problems can be submitted via web form by going to: <https://servicedesk.njit.edu> and clicking on the "Report your issue online" link. You may also call the IST Service Desk with any questions at 973-596-2900

AI: "Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at: NJIT Academic Integrity Code.

Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu

This course expects students to work without artificial intelligence (AI) assistance in order to better develop their skills in this content area. As such, AI usage is not permitted throughout this course under any circumstance. "

Chemistry Tutoring Center: Located in the Central King Building, Lower Level, Rm. G12. Hours of operation are Monday - Friday 10:00 am - 6:00 pm. For further information please click [here](#).

Accommodation of Disabilities: Office of Accessibility Resources and Services (*formerly known as Disability Support Services*) offers long term and temporary accommodations for undergraduate, graduate and visiting students at NJIT.

If you are in need of accommodations due to a disability please contact Marsha Williams-Nicholas, Accessibility and Resources and Services Manager at 973-596-2994 or via email at marsha.williamsnicholas@njit.edu. The office is located in Fenster Hall Room 260. A Letter of Accommodation Eligibility from the Office of Accessibility Resources Services office authorizing your accommodations will be required.

For further information regarding self-identification, the submission of medical documentation and additional support services provided please visit the Accessibility Resources and Services (OARS) website at:

- <http://www.njit.edu/accessibility/>

Important Dates See: Spring 2025 Academic Calendar, Registrar
<https://www.njit.edu/registrar/spring-2025-academic-calendar>

January	20	Monday	Martin Luther King, Jr. Day
January	21	Tuesday	First Day of Classes
January	25	Saturday	Saturday Classes Begin
January	27	Monday	Last Day to Add/Drop a Class
January	27	Monday	Last Day for 100% Refund, Full or Partial Withdrawal
January	28	Tuesday	W Grades Posted for Course Withdrawals

February	3	Monday	Last Day for 90% Refund, Full or Partial Withdrawal, No Refund for Partial Withdrawal after this date
February	17	Monday	Last Day for 50% Refund, Full Withdrawal
March	10	Monday	Last Day for 25% Refund, Full Withdrawal
March	16	Sunday	Spring Recess Begins - No Classes Scheduled - University Open
March	22	Saturday	Spring Recess Ends
April	3	Thursday	Wellness Day - No Classes Scheduled - University Open
April	7	Monday	Last Day to Withdraw
April	18	Friday	Good Friday - No Classes Scheduled - University Closed
April	20	Sunday	Easter Sunday - No Classes Scheduled - University Closed
May	6	Tuesday	Thursday Classes Meet
May	7	Wednesday	Friday Classes Meet
May	7	Wednesday	Last Day of Classes
May	8	Thursday	Reading Day 1
May	9	Friday	Reading Day 2
May	10	Saturday	Final Exams Begin
May	16	Friday	Final Exams End
May	18	Sunday	Final Grades Due
May	19	Monday	Master's and PhD Candidate Commencement - Bloom Wellness and Events Center

May	21	Wednesday	Undergraduate Candidate Commencement – Prudentia Center
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Tentative Course Outline

Week	Outcome	Topic	Homework JoVE video & quiz	Worksheet
1-2	1,2,3,4	Chapter 0 - The Analytical Process Chapter 1 - Chemical Measurements Chapter 2 - Tools of the Trade Chapter 3 - Experimental Error	Sample Prep Experimental Error	Analytical Process
2-3	5,6,7,8	Chapter 4 - Statistics	Statistics	Statistics
4	9,10,11,12, 13,14,15	Chapter 5 - Quality Assurance and Calibration Methods	Calibration Curves	QC & Calibration
5		Exam 1		
5,6,7,8	16,17,18,19, 20,21,22,23,24	Chapters 6 - 12 - Wet Chemistry	Equilibria Precipitation Acid-Base Complexometric	Wet Chemistry A Wet Chemistry B Wet Chemistry C
9,10	25,26,27,28,29	Chapters 14 - 17 - Electrochemistry	Electrodes	Electrochemistry

			Potentiometry Coulometry Redox Titration	
11		Exam 2		
11,12	30,31,32,33,34	Chapters 18 - 21 - Spectrophotometry	Spectrophotometry	Spectro- photometry
13	35,36	Chapter 23 - Introduction to Analytical Separations	Extraction: Partition and Distribution Coefficients Effects of pH Advanced Methods Chromatography: Introduction	Analytical Separations A
14	37,38	Chapter 24 - Gas Chromatography Chapter 25 - High Performance Liquid Chromatography	Chromatography: Principles GC HPLC	Analytical Separations B
15		Exam 3		
16		Final Review		
		May 9 - 16 ... Cumulative Final		

Updated by Gregory Edens, Ph.D. January 09, 2025
Department of Chemistry & Environmental Sciences (CES)
Course Syllabus, Spring 2025
