NJIT New Jersey Institute of Technology

THE COLLEGE OF SCIENCE AND LIBERAL ARTS

THE DEPARTMENT OF CHEMISTRY AND ENVIRONMENTAL SCIENCE

Chemistry:
Fall 2024 Course
Syllabus

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 to achieve. 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:* *http://www5.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf*.

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 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*

Generative AI: *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.*

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 and Instructors

Course-Section	Instructor
CHM 222-001	Gregory Edens, Ph.D. email: gregory.edens@njit.edu tel: 973-642-7938 Office Hours: TBA

Class time: Tue & Thur 8:30 AM – 9:50 AM at Kupf 107

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.

Recommended Text (Lectures based on this)	Quantitative Chemical Analysis, DC Harris & CA Lucy, Macmillan Pub.
Suggested condensed book	Exploring Chemical Analysis, DC Harris, Macmillan Publisher
Suggested Open Education Resource (OER)	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)

University-wide Withdrawal Date: The last day to withdraw with a **W** is Monday, November 11, 2024. 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. Use pH and pK_a to give a qualitative estimate and quantitative calculation of speciation
14. Use pH and auxiliary reagent concentration in calculation of K_f" for formation of Metal-EDTA complex
15. Set up equations for multiple equilibria and make suitable approximations.
16. Interpret data from direct, indirect, and back titrations
17. Process data from measurements at electrodes for pH, ion selective electrodes, and coulometric titrations
18. interpret qualitative and quantitative information from polarography
19. Describe molecular interactions underlying ion selective electrodes and the glass pH electrode
20. Calculate Galvanic cell potential under standard conditions and nonstandard conditions.
21. Convert cell potential among various reference electrodes
22. Explain relaxation pathways of an electron excited by UV-VIS radiation
23. Identify sources of error in atomic spectroscopy and provide for their mitigation
24. Use Beer's Law to calculate the concentration of an analyte.
25. Calculate diffraction angle and efficiency of a grating
26. Explain "stray light error" in molecular UV-VIS spectroscopy and how to minimize its effect
27. Determine liquid-liquid extraction efficiency for single and/or sequential extractions
28. Calculate resolution R, plate height H, and efficiency N from chromatographic data
29. Demonstrate critical thinking in GC sampling technique; and injection and detection selection
30. Use chromatographic data quantitatively to determine the concentration of a species

31. Perform spike and spike-recovery calculations in method validation scenarios
32. Use method of standard additions to determine concentration of analyte in a matrix
33. Use method of internal standard to determine concentration of analyte where loss or instability occurs
34. Calculate equilibrium concentrations for aqueous reactions of all types
35. Calculate ionic strength, activity coefficient, and activity
36. Construct ladder diagram (qualitative) and fractional composition diagram (quantitative) for weak acid
37. Employ systematic equilibrium approach when multiple equilibria are present
38. Construct a titration curve

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.

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

Homework	160 points
Group work (POGILs = 80; Presentation = 160)	240 points
Midterm Exams 1 & 2	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		

Attendance Policy: Attendance at classes will be recorded and is **mandatory**. 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.

Group Work including POGIL and work pertaining to Group Presentation will be graded as a group. You must be present in class and actively working in the group to receive these points. *These points cannot be made up if you miss class.*

Each POGIL will be worth up to 10 points as a group; additionally, up to 5 points will be available through a Canvas quiz pertaining to the POGIL. During POGIL, if you understand the problems, explain it to your group members; if you do not understand it, ask for an explanation. It is to your advantage to understand the material, you will be more likely to get the points on the Canvas quiz. The Canvas quiz will be due the same day as the POGIL, by 11:59PM. Late work will not receive points. It is to your advantage if your classmates understand the material. If all team members score above 70% on an exam, each receives 10 bonus points; if three of four team members score above 70%, those three receive 10 bonus points; and if two of four score above 70%, those to receive 5 bonus points. (This pertains to midterm exams that occur subsequent to POGIL activities.)

Group work pertaining to the presentation will be graded as a group. Topic selection will receive up to 28 points and will be due by 11:59PM on the day it is worked on in lecture. Project summary will receive up to 40

points and is due by 11:59PM on the day it is worked on in lecture. Presentation will receive up to 60 points. Quiz on other groups' presentations will receive up to 36 points and will be due immediately upon completion of those presentations. (There will be a Grading Rubric for each phase of the Presentation Project group work.) Late work will not be accepted; missing work will not receive a grade.

Homework Policy: Homework is an expectation of the course. The homework problems set by the instructor are to be handed in for grading and will be used in the determination of the final letter grade as described above. Worksheets will be distributed in the first class of the week and will be due Sunday night at 11:59 PM. The written work must be uploaded to Canvas and there will be a Canvas Quiz to assess your understanding, also due at 11:59 PM on Sunday. This must be your own work, and it is to your advantage to thoroughly understand the worksheet problems for success on the canvas Quiz (with different numbers) and on the exams.

Midterms and Final Exam: There will be two midterms. An entire period will be used for each midterm exam. Come on time, put away cell phones (turn to silent of 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. Violation of one of these regulations may result in zero on the exam. Tentative dates:

Exam 1	Tuesday October 1
Exam 2	Tuesday November 12
Cumulative Final Exam	TBA December 15 – 21

The final exam will test your knowledge of all the course material taught in the entire course.

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. Such devices must be stowed in bags during exams or quizzes.

ADDITIONAL RESOURCES

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: **O**ffice of **A**ccessibility **R**esources and **S**ervices (***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: Fall 2024 Academic Calendar, Registrar
https://www.njit.edu/registrar/fall-2024-academic-calendar

Sept	2	Labor Day. University Closed
Sept	3	First Day of Classes
Sept	9	Last Day to Add/Drop a Class
Sept	9	Last Day for 100% Refund, Full or Partial Withdrawal
Sept	10	W Grades Posted for Course Withdrawals
Sept	16	Last Day for 90% Refund, Full or Partial Withdrawal - No Refund for Partial Withdr after this date
Sept	30	Last Day for 50% Refund, Full Withdrawal
Oct	21	Last Day for 25% Refund, Full Withdrawal
Nov	11	Last Day to Withdraw from Classes
Nov	26	Thursday Classes Meet
Nov	27	Friday Classes Meet
Nov	28	Thanksgiving Recess Begins. No Classes
Dec	1	Thanksgiving Recess Ends
Dec	11	Last Day of Classes
Dec	12	Reading Day 1
Dec	13	Reading Day 2
Dec	14	Saturday Classes Meet
Dec	15	Final Exams Begin
Dec	21	Final Exams End
Dec	23	Final Grades Due

Tentative Course Outline

Week	Outcome	Topic	Homework
1	1,2,3,4	Chapter 0 – The Analytical Process Chapter 1 – Chemical Measurements Chapter 2 – Tools of the Trade Chapter 3 – Experimental Error	Chapters 0 – 3 homework
2	5,6,7,8	Chapter 4 – Statistics	Chapter 4 homework
3	9,10,11,12, 31,32,33	Chapter 5 – Quality Assurance and Calibration Methods	Chapter 5 homework
4		Exam 1	
4, 5, 6	13,14,15,16, 34,35,36,37,38	Chapters 6 – 12 – Wet Chemistry POGIL – Multiple Equilibria: When Reactions Compete	Wet Chemistry homework Recorder submit team's work
7, 8	17,18,19,20,21	Chapters 14 – 17 – Electrochemistry POGIL – Electrochemistry: Calculating Cell Potentials	Electrochemistry Homework Recorder submit team's work
9, 10	22,23,24,25,26	Chapters 18 – 21 – Spectrophotometry POGIL – The Beer Lambert Law	Spectrophotometry Homework Recorder submit team's work
11		Exam 2	
11	27,28	Chapter 23 – Introduction to Analytical Separations POGIL – Sample Techniques in Gas Chromatography	Chapter 23 homework Recorder submit team's work
12	29,30	Chapter 24 – Gas Chromatography Chapter 25 – High Performance Liquid Chromatography	Chapters 24 – 25 homework
13		Group – Preparation Thanksgiving – No Class Thursday November 28	Submit Topic selection
14		Group – Preparation Group Presentations	Submit Project Summary Submit Peer Evaluations
15*		Group Presentations	Submit Peer Evaluations
16		Cumulative Final will be scheduled by registrar's office	

** Week 15 the class meets only on Tuesday*

Updated by Gregory Edens, Ph.D. August 15, 2024
Department of Chemistry & Environmental Sciences (CES)
Course Syllabus, Fall 2024