Spring 2022

# CHEM 222-002: Analytical Chemistry

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NJIT New Jersey Institute of Technology

THE COLLEGE OF SCIENCE AND LIBERAL ARTS

THE DEPARTMENT OF CHEMISTRY AND ENVIRONMENTAL SCIENCE

**Chemistry:**
***Course CHEM 222-002***
***Spring 2022 Syllabus***

NJIT Academic Integrity Code: the shift to remote and converged teaching due to the COVID-19 pandemic has
required that both instructors and students make changes to their typical working protocols for courses. Students are asked to practice extra care and attention concerning academic honesty, understanding that all cases of plagiarism, cheating, multiple submission, and unauthorized collaboration are subject to penalty. Students must properly cite and attribute all sources used for papers and assignments. Students may not collaborate on exams or assignments directly or through virtual consultation unless the Instructor gives specific permission.
Posting an exam, assignment, or answers to them on an online forum (before, during, or after the due date), in addition to consulting posted materials, constitutes a violation of the university's Honesty policy. Likewise, unauthorized use of live assistance websites, including seeking "expert" help for specific questions during an exam, can be construed as violating the honesty policy. All students should be familiar with the NJIT Academic Integrity Code. All Students should be aware that the Department of Chemistry & Environmental Science (CES) takes the NJIT Academic Integrity Code very seriously and enforces it strictly. It means that there must not be any forms of plagiarism, *i.e.*, copying of homework, class projects, 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 various phenomena such as the law of mass action, the Nernst equation, conservation of mass, and charge, to mention just a few. Topics to be covered include data analysis, chemical equilibria, acid-base chemistry, titrimetric methods, electrochemistry, spectroscopy, and mass spectrometry and separation techniques. Classical techniques will be complemented with discussions on databases and statistical methods.

**Number of Credits**: 3

**Prerequisites**: 2

**Course-Section and Instructor**

| Course-Section | Instructor | Email/Office | Office Hours |
|---|---|---|---|
| CHEM 222-002 | Carlos Pacheco, Ph.D. | carlos.n.pacheco@njit.edu<br>Office: B006; Lab:B008 -- NMR laboratory | Wednesdays, 12 PM - 1PM* |
| *Virtual: https://njit.webex.com/meet/pacheconjit.edu | | | |

**Class time:** Mon & Th 10-11:20am

**Email:** All Emails should be prepended by **CHEM 222** in the subject line to be filtered appropriately.

**University-wide Withdrawal Date:** The last day to withdraw with a W is Monday, April 4, 2022. It will be strictly enforced.

**Required Textbook/e-textbook:**

| | |
|---|---|
| **Title** | Quantitative Chemical Analysis<br>(Achieve 1-Term Access Card) |
| **Author** | DC Harris & CA Lucy |
| **Edition** | 10th |
| **Publisher** | MPS (Macmillan Publishers) |
| **ISBN #** | 9781319384807 |

**Learning Outcomes:**

1. Develop a sound physical understanding of the principles of analytical chemistry
2. Show how these principles are applied through exercises and problem-solving assignments
3. Develop an understanding of the limitations and uncertainties of results using statistics and spreadsheets exercises.

**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, Quizzes, Clicker** | 15% |
| **Midterm Exam I** | 20% |
| **Midterm Exam II** | 20% |
| **Final Exam** | 25% |
| **Literature Research/Group Learning** | 20% |

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

| | | | |
|---|---|---|---|
| **A** | 90-100 | **C** | 70-75.5 |
| **B+** | 86-89.5 | **D** | 60-69.5 |
| **B** | 80-85.5 | **F** | <60 |
| **C+** | 76-79.5 | | |

**Attendance Policy**: Attendance at classes will be recorded and is **mandatory**. Each class is a learning experience that cannot be replicated through merely "getting the notes."

**Homework Policy**: Homework is an expectation of the course. The Instructor's homework problems are to be handed in for grading and used to determine the final letter grade as described above.

**Exams**: Two midterm exams will be held in class and one comprehensive final exam. The following exam periods are tentative and, therefore, possibly subject to change:

| | |
|---|---|
| Midterm Exam I | March 3 |
| Midterm Exam II | April 11 |
| Final Exam Period | May 6 – May 12 |

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

**Makeup Exam Policy**: There will typically be **NO MAKEUP QUIZZES OR EXAMS** during the semester. Suppose a student has a legitimate reason for missing a quiz or exam. In that case, 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 need accommodations due to a disability, don't hesitate to contact Chantonette Lyles, Associate Director at the Office of Accessibility Resources and Services, at 973-596-5417 or via email at lyles@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: https://www.njit.edu/studentsuccess/node/5

**Important Dates** See: Spring 2022 Academic Calendar, Registrar - https://www5.njit.edu/registrar/calendars/

**Course Outline**

| Lecture | Topic | Assignment |
|---|---|---|
| Week 1 | Welcome, introduction to Analytical Chemistry | |
| Week 2 | Methods & Operations of Analytical Chemistry | |
| Week 3 | Errors in Chemical Analyses | |
| Week 4 | Spreadsheets Statistical Manipulation of Analytical Data, **Midterm Exam I** | |
| Week 5 | Quality Assurance, Calibration Methods | |
| Week 6 | Chemical Equilibrium & Activity --- Titrations | |
| Week 7 | Systematic Treatment of Equilibrium | |
| Week 8 | Acid-base Equilibria; Buffers, Polyprotic Acids; | |
| Week 9 | **Midterm Exam II -** Fundamentals of Electrochemistry | |
| Week 10 | Introduction to Spectrometric Methods | |
| Week 11 | Introduction to Analytical Separations -- GC, HPLC; Chromatographic Methods, Capillary Electrophoresis | |
| Week 12 | Mass Spectrometry | |
| Week 13 | Literature Research/Group Learning: Presentations | |

*Updated by Carlos Pacheco, Ph.D. January 2022*
*Department of Chemistry & Environmental Sciences (CES)*
*Course Syllabus, Spring 2022*