NJIT New Jersey Institute of Technology

THE COLLEGE OF SCIENCE AND LIBERAL ARTS

THE DEPARTMENT OF CHEMISTRY AND ENVIRONMENTAL SCIENCE

Fall 2025 Course Syllabus
CHEM 702-101 – Special Topics: Spectrometric Identification of Organic Compounds

NJIT Academic Integrity Code: The shift to remote and converged teaching due to the COVID-19 pandemic has necessitated adjustments to instructors' and students' standard working protocols for courses. Students are asked to exercise extra care and attention regarding academic honesty, understanding that all instances of plagiarism, cheating, multiple submissions, and unauthorized collaboration are subject to penalty. Students must properly cite and attribute all sources used for papers and assignments. Students may not collaborate directly or through virtual consultation on exams or projects without the instructor's specific permission. In addition to consulting posted materials, posting an exam, assignment, or answers to them on an online forum (before, during, or after the due date) 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 considered a violation of the honesty policy. All students should be familiar with the NJIT Academic Integrity Code.

All students should understand that the Department of Chemistry & Environmental Science (CES) takes the NJIT Academic Integrity Code very seriously and enforces it strictly. This means there must be no plagiarism, including copying homework, class projects, lab assignments, or cheating on quizzes and exams. According to the University Code on Academic Integrity, students are required to report such activities to the instructor.

COURSE INFORMATION

Course Description: Spectroscopic methods for structural analysis centered on Nuclear Magnetic Resonance Spectroscopy (NMR). Additional techniques, such as Mass Spectrometry (MS), Fourier Transform Infrared/Raman (FTIR, Raman), and Ultraviolet-Visible (UV-VIS) spectroscopy, are included as supplementary analytical methods. The course covers the fundamentals of the NMR phenomenon and explains how NMR spectra relate to molecular structure. Students will learn to record routine spectra (^{1}H and ^{13}C) and perform essential data processing tasks, such as applying weighting functions. 1D-NMR techniques include Decoupling, DEPT, Relaxation measurements, magnetization transfer (INEPT), NOE difference spectra, and selective experiments (NOESY-1D, ROESY-1D). 2D-NMR methods encompass homo- and heteronuclear correlation techniques (COSY, TOCSY, HSQC, HMBC), utilizing the nuclear Overhauser effect (nOe) through NOESY and ROESY to determine stereochemistry. A primary goal is to provide hands-on experience with NMR instruments. The course aims to develop the ability to interpret spectroscopic data accurately to determine plausible molecular structures,

Number of Credits: 3
Prerequisites: Knowledge of organic chemistry and basic laboratorytechniques.

Course-Section and Instructor

Course-Section	Instructor
Fall 2025-CHEM702-101	Carlos Pacheco, Ph.D.
FMH 412; Mondays, 6 PM - 8:50 PM	Email: carlos.n.pacheco@njit.edu
Office Hours: Mondays, 4 PM-6 PM **Virtual: https://njit-edu.zoom.us/launch/chat?src=direct_chat_link&email=pacheco@njit.edu	Office: B006; NMR laboratory: B008

Email: All emails should include **'CHEM702-101'** in the subject so they can be sorted appropriately. Delivery of instruction: face-to-face.

Textbooks

Title	Spectrometric Identification of Organic Compounds
Author	Robert M. Silverstein, Francis X. Webster, David J. Kiemle, David L. Bryce
Edition	$_8$th
Publisher	John Wiley & Sons
ISBN #	978-0-470-61637-6

Title	Spectroscopic Methods in Organic Chemistry
Author	Stefan Bienz, Laurent Bigler, Thomas Fox, Herbert Meier
Edition	$_3$rd
Publisher	Thieme Chemistry
ISBN #	978-3132434080

University-wide Withdrawal Date: The last day to withdraw is Monday, November 10, 2025; this deadline is strictly enforced.

Learning Outcomes:

1) Use NMR spectrometers.
2) Identify organic compounds through analysis and interpretation of spectral data.
3) Explain basic terms in NMR spectroscopy, such as chemical shift, coupling constant, and anisotropy, and describe how molecular structure influences them.
4) Analyze and interpret 1D and 2D NMR spectra.
5) Gain the ability to investigate and identify common organic compounds (molecular weight up to about 500 Da) using appropriate NMR experiments.
6) Perform the most frequently used NMR experiments and interpret and document the results.
7) Understand the concepts of Mass Spectrometry (MS), Infrared/Raman (FTIR, Raman), and Ultraviolet-Visible (UV-Vis) spectroscopies.

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.

SAFETY -- Proper observation and use of an NMR instrument require following a critical set of safety procedures and guidelines (which can be found here). Students should read and accept safety procedures and policies before their participation in the class is confirmed.

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

Homework/Pre-Quizzes/Quizzes	20%
Midterm Exam	30%
Presentation(s)	20%
Final	30%

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

A	90-100%	C	70-74.5%
B+	85-89.5%	D	60-69.5%
B	80-84.5%	F	<60%
C+	75-79.5%		

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

Homework Policy: Homework is an expectation of the course. The homework problems set by the instructor will be handed in for grading and used to determine the final letter grade as described above.

Exams: One midterm exam during the semester and one comprehensive final exam. The following exam periods are tentative and, therefore, possibly subject to change:

Midterm Exam	October 27, 2025
Final Exam Period	December 14 - 20, 2025

Makeup Exam Policy: There will typically be NO MAKEUP QUIZZES OR EXAMS during the semester. If a student has a legitimate reason for missing a quiz or exam, the student should contact the Dean of Students' Office. The student should present written, valid proof of the reason for missing the exam, such as a doctor's note, police report, or court notice, 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 for the missed grade.

Using mobile phones and AI tools responsibly in the classroom to enhance learning is essential. However, these devices should be kept in bags during exams or quizzes. Additionally, using AI tools is encouraged because learning new technologies is important for professional development.

ADDITIONAL RESOURCES

Accommodations for Disabilities: The Office of Accessibility Resources and Services (formerly Disability Support Services) offers long-term and temporary accommodations for undergraduate, graduate, and visiting students at NJIT. If you require accommodations due to a disability, please 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 in Fenster Hall, Room 260. A Letter of Accommodation Eligibility from the Office of Accessibility Resources Services authorizing your accommodations is required. For further information regarding self-identification, submission of medical documentation, and additional support services, please visit the Accessibility Resources and Services (OARS) website at https://www.njit.edu/accessibility/.

Important Dates (See: Fall 2025 Academic Calendar, Registrar)

Class Participation - In this course, participation is essential and involves engaging in discussions, attending classes, and responding to questions. The learning approach is discussion-based and student-centered. To have productive conversations, active participation is essential, including completing assignments on time and actively engaging in class discussions and quizzes. Recording four or more unexcused absences results in zero points for class participation. In the event of an emergency, please contact me through all available means if you need to miss class. It is essential to catch up on any material discussed in missed classes.

Literature Research/Group Learning - In this course, we will explore the benefits of group learning. The aim is to improve creative problem-solving skills and relate chemistry concepts to real-life situations. Students will be organized into teams and work together to identify problems during class, providing solutions as a group. These activities will require analytical, evaluative, and creative thinking. Students will also be expected to explain familiar phenomena using the concepts taught in the course.

Course Outline

Lecture	Section	Topic	Assignment
		Before the class starts on 9/8	Watching videos: 1) https://www.youtube.com/watch?v=cd2Ua9dKEl8 2) https://www.youtube.com/watch?v=Uu1i-s1mhk8 Reading: Silverstein - Chapter 3.1 to 3.7
1	9/08	Introduction to NMR ^{1}H: Chemical Shift, Couplings, spectra interpretation	
2	9/15	^{1}H: Chemical Equivalence, Magnetic Equivalence, Chirality, case studies	**Pre-Quiz 1** Reading: Silverstein - Chapter 3.8 to 3.16
3	9/22	^{13}C: Chemical Shift, Couplings, spectra interpretation	**Pre-Quiz 2** Reading: Silverstein - Chapter 4
4	9/29	^{13}C: ^{1}H Decoupling, Nuclear Overhauser Effect, Polarization Transfer, DEPT, INEPT, APT	**Pre-Quiz 3** Reading: Silverstein -Chapter 4

5	10/6	Multinuclear NMR (nuclei other than ^{1}H and ^{13}C)	**Pre-Quiz 4** Reading: Silverstein - Chapter 6
6	10/13	2D NMR: through-bond correlation Spectroscopy - **Homonuclear** shift correlation- COSY, TOCSY, INADEQUATE. 2D NMR: through-space correlation Spectroscopy, NOESY, ROESY -	**Pre-Quiz 5** Reading: Silverstein – Chapter 5.1 to 5.4.
7	10/20	2D NMR: **Heteronuclear** shift correlation – HSQC, HMBC	**Pre-Quiz 6** Reading: Silverstein – 5.5 to 5.11
8	10/27	**MIDTERM**	
9	11/03	Practical NMR laboratory (1D and 2D NMR)	Reading: Operational Guide, material under https://research.njit.edu/nmrl/training
10	11/10	Infrared Spectroscopy (IR), Raman	**Pre-Quiz 7** Reading: Silverstein - Chapter 2, video Stefan Bienz - Chapter 2
11	11/17	Infrared Spectroscopy (IR), Raman (cont.) UV-VIS	**Pre-Quiz 8** Reading: Silverstein -Chapter 2, UV-VIS material uploaded on CANVAS Stefan Bienz - Chapter 1
12	11/24	Mass Spectrometry (MS)	**Pre-Quiz 9** Reading: Silverstein - Chapter 1. Stefan Bienz – Chapter 4.
13	12/01	Mass Spectrometry (MS)	**Pre-Quiz 10** Reading: Silverstein - Chapter 1. Stefan Bienz – Chapter 4
14	12/08	**Presentations of acquired NMR data (1D and 2D)** .	
Updated by Carlos Pacheco – August 2025 Department of Chemistry & Environmental Sciences (CES) Course Syllabus, Fall 2025			