

## Chem698-ST: Chemistry, Sustainability and Circular Economy *Fall 2025 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:

The Earth is in the era of the “Anthropocene.” Chemistry has been a driving force behind many of today’s “grand challenges,” including climate change, energy security, and resource depletion. Achieving the United Nations Sustainable Development Goals (SDGs) requires a transformational change in the chemical enterprise. This graduate-level course substantiates students' knowledge of chemistry from broad **societal, economic, environmental, and governance (SEEG)** perspectives.

The course explores the essential principles of sustainable chemistry and the circular economy, using the **end-of-life (EOL) management of electric vehicle (EV) lithium-ion batteries** as a semester-long case study. A unique aspect of this course is the integration of advanced AI tools, such as Google's Gemini, as a fundamental component of the learning process. Students will learn to leverage AI for literature analysis, data interpretation, and hypothesis generation, preparing them to become leaders who can address the critical needs for a sustainable future.

**Number of Credits:** 3

**Prerequisites:** Graduate standing

#### Course-Section and Instructors

Course-Section	Instructor
CHEM698-101	Dr. Zeyuan Qiu; <a href="mailto:zeyuan.qiu@njit">zeyuan.qiu@njit</a> ; 973-596-5357

**Office Hours:** Mondays 4-5pm or by appointment through email

**Required Textbook:** There is no textbook required. All teaching materials including the readings are provided in the Canvas course website or obtained through the NJIT Library.

**University-wide Withdrawal Date:** The last day to withdraw with a **W** is Monday, November 10, 2025. It will be strictly enforced.

## Learning Outcomes:

Upon successful completion of this course, students will be able to:

1. **Expand** the understanding of sustainability and circular economy and their fundamental linkages to chemistry.
2. **Identify and articulate** the contemporary sustainability challenges of chemistry from broad SEEG perspectives.
3. **Analyze** the complex chemical and material challenges associated with the EV battery life cycle.
4. **Critically evaluate** the techno-economic, environmental, social, and policy trade-offs of different material management strategies.
5. **Formulate** innovative research questions and strategies on chemical development following the principles of sustainability.
6. **Utilize** AI tools (e.g., Gemini) effectively and ethically for interdisciplinary research and problem-solving.
7. **Develop and apply** sustainability ethics and social responsibility in pursuing a career in chemistry.

## 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:

Class Participation & AI workshops	20%
Weekly Assignments	20%
Midterm Case Study Analysis	25%
Final Project Report	25%
Final Project Presentation	10%

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

A	90% above	C	70-75%
B+	85-90%	D	60-70%
B	80-85%	F	Below 60%
C+	75-80%		

**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.” Any one missed class beyond the first one due to any reasons will result in a “one” point loss in your final weighted grade.

**Class Activity Participation (20%):** This course is taught using a problem-based learning strategy. There are significant amounts of activities that are arranged for the students to engage and learn. The attendance and participation are critical to achieving the learning outcomes.

**Weekly Assignments (20%):** There are weekly assignments on the topics being discussed weekly before the midterm case study analysis. The assignment will be submitted online on time. Any late submission will be penalized at the rate of 5% per day until the total deduction of 50%.

**Midterm Case Study Analysis (25%):** Apply the foundational concepts and knowledge from the first part of the course and write a report to critically identify a chemistry issue relevant to today’s “grand challenges”, develop a comprehensive understanding of the issue from societal, environmental, economic and governance perspectives and identify the multi-level solutions to the issue by apply the fundamental principles in sustainability and circular economy.

**Final Project (35%):** Apply the knowledge learned on the concepts and EV battery EOL management to identify the specific needs to implement the potential EOL management measures as proposed in New Jersey Hybrid and Electric Vehicle Battery Management Act (N.J.S.A. 13:1E-99.81 et seq.). The final project will be evaluated through a sequence of class activities and interactions with the course instructor and project mentors throughout the second half of the semester such as topic identification and assessment, peer review, project draft report, project presentation and final group project report.

The Midterm Case Study Analysis is tentatively due on Monday, **October 13, 2025**. The Final Project presentation is scheduled on Monday, December 8, 2025, and the Final Project Report on Monday, December 15, 2025.

**Late Submission:** The score for late submission will be deducted 5% a day until the maximum deduction of 50%. All missing assignments will be given a score of zero.

**Makeup Assignment/Exam Policy:** There will normally be **NO MAKE-UP Assignments OR EXAM** during the semester. In the event that a student has a legitimate reason for missing an assignment 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 assignment or 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 unless instructed by instructors to use for class activities during all class times.

## ADDITIONAL RESOURCES

**Accommodation of Disabilities:** Office of Accessibility Resources and 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, M.S., E.D.M., Accessibility Resources and Services Manager at the Office of Accessibility Resources and Services at **973-596-2994** or via email at [marsha.williamsnicholas@njit.edu](mailto:marsha.williamsnicholas@njit.edu). The office is in Kupfrian Hall 201. 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/accessibility/>

**Important Dates** See: Fall 2023 Academic Calendar, Registrar

<https://www.njit.edu/registrar/fall-2023-academic-calendar>

Date	Day	Event
Sept	1	Labor Day. University Closed
Sept	2	First Day of Classes
Sept	8	Last Day to Add/Drop a Class
Sept	8	Last Day for 100% Refund, Full or Partial Withdrawal
Sept	9	W Grades Posted for Course Withdrawals
Sept	15	Last Day for 90% Refund, Full or Partial Withdrawal - No Refund for Partial Withdrawal after this date

Sept	29	Last Day for 50% Refund, Full Withdrawal
Oct	2	Wellness Day
Oct	20	Last Day for 25% Refund, Full Withdrawal
Nov	10	Last Day to Withdraw from Classes
Nov	25	Thursday Classes Meet
Nov	26	Friday Classes Meet
Nov	27	Thanksgiving Recess Begins. No Classes
Nov	30	Thanksgiving Recess Ends
Dec	11	Last Day of Classes
Dec	12	Reading Day
Dec	13	Saturday Classes Meet
Dec	14	Final Exams Begin
Dec	20	Final Exams End
Dec	22	Final Grades Due

## Course Outline

**(Topic and Order Are Subject to Change, and Follow the Schedule in Cavas)**

Session	Date	T	Assignment
1	9/8	Introduction to Chemistry and sustainability	Assignment 1
2	9/15	Life Cycle Assessment (LCA) and Social Impacts	Assignment 2
3	9/22	Introduction to Circular Economy	Assignment 3
4	9/29	The Role of AI in Accelerating the Circular Economy	Assignment 4
5	10/6	Chemistry of Lithium-Ion Batteries	Assignment 5
6	10/13	EV Battery Supply Chain and Its Challenges	Midterm Case Study Analysis Report
7	10/20	Policy, Regulations and Economics	Final Project: Topic Exploration
8	10/27	EOL Pathways: Reuse and Second Life	Final Project: Research Objectives
9	11/3	EOL Pathways: Pyrometallurgical Recycling	Final Project: Refined Objectives
10	11/10	EOL Pathways: Hydrometallurgical Recycling	Final Project: Progress Review
11	11/17	EOL Pathways: Direct Recycling	Final Project: Draft
12	11/24	Damaged EV Battery Storage, Handling and Transport	Final Project: Peer Review
13	12/1	Designing for Sustainability: The Next Generation of Batteries	Final Project: Refinement
14	12/8	Final Project Presentation	
15	12/15	Final Project Report Submission	

*Updated by Zeyuan Qiu - August 2025  
Department of Chemistry & Environmental Sciences (CES)  
Course Syllabus, Fall 2025*