Electrochemical Storage and Conversion

Course Information

Instructor: Hailong Chen (hailong.chen@me.gatech.edu)
Course Prefix and Number: ME 4759 HCH
Term: Fall 2026

Course Description

Energy is a fundamental issue facing society world-wide. Electrochemical devices play an important role in energy storage and conversion, especially at certain power-levels. The scope of applications include: (i) small, mobile electronic systems (e.g. phones and computers), (ii) large power sources for transportation (e.g. electric vehicles), and (iii) very large, grid-storage devices. Evolving renewable energy sources have a critical dependence on electrochemical energy storage. The course is appropriate for students interested in the general topic of energy and more specifically electrochemical devices used to store or convert energy from one for to another. Senior-level engineering students with a background in thermodynamics and transport are qualified to take the course.

Course Learning Outcomes

Upon completion of this course, the students are expected to have the following knowledge.

1. Understand how thermodynamics, kinetics and mass transport apply to electrochemical devices.
2. Understand the effect of temperature on Gibbs energy and entropy, and how that applies to electrochemical systems.
3. Understand the nature of the energized electrode and double layers.
4. Understand the two-electrode/electrolyte nature of electrochemical devices.
5. Understand the specific construction of several battery and fuel cell systems.
6. Understand how the performance of specific battery and fuel cell systems derives from fundamental thermodynamic, kinetic, and transport principles.
7. Understand battery and fuel cell charge/discharge and efficiency characteristics.
8. Understand the fundamental issues and practical outcomes of safety in battery, fuel cell and electrochemical systems.

Required Course Materials

No textbooks or materials are required. Resources for research are determined in consultation with the thesis advisor.

Grading Policy

Midterm exam-20%, final exam-30%, homework-20%, independent study project-15%, popup quizzes-15%.

Attendance Policy

Attendance is required in this course and is measured via popup quizzes, which comprises 15% of the overall grade.

Academic and Research Honesty/Integrity Statement

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. Review the Student Code of Conduct and the Academic Honor Code, especially Appendix A: Graduate Addendum to the Academic Honor Code.
Students are expected to perform research in an ethical and responsible manner.
Any student suspected of cheating or plagiarizing on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.
Allegations of scientific or scholarly misconduct are handled in accordance with the procedures outlined by the Policy for Responding to Allegations of Scientific or Other Scholarly Misconduct.

Core IMPACTS

Core IMPACTS is the University System of Georgia's General Education curriculum. If you are teaching a course that counts towards Core IMPACTS, you should include a syllabus statement about the Core area and associated career competencies. This resource developed by the Center for Excellence in Teaching and Learning and Online Education at Georgia State University includes template syllabus statements for each of the Core IMPACTS areas that you may adapt for your course.

Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services as soon as possible to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

Student-Faculty Expectations Agreement

At Georgia Tech, we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. The Student-Faculty Expectations articulate some basic expectations that you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to
the ideals of Georgia Tech while in this class.