

Electrochemistry of Fuel Cells and Batteries (ME/MS 545)

Course Description: Electrochemistry of fuel cells, batteries, sensors, membrane separation and electrolytic methods are discussed. Thermodynamics and kinetics of electrode reactions and associated mass transport in electrochemical systems are covered. Measurements techniques (dc polarization, ac impedance spectroscopy, blocking electrodes, etc.) used in characterizing electrochemical systems are presented and discussed in a journal club setting. 4 Cr.

Instructor: Uday B. Pal

Contact information: Rm. 206, 730 Commonwealth Avenue

Office hours: Thursday 4-5 PM

Prerequisites: Undergraduate thermodynamics and transport phenomena

Course schedule – MW: 10-noon, Soc B59

Required textbook: "Electrochemical Methods-Fundamentals and Applications", by Allen J. Bard and Larry R. Faulkner, John Wiley.

Recommended/reference text: Fuel Cell Handbook 7, DOE-NETL Production

Course learning objectives – Learn about the fundamentals of electrode reactions and electrochemical cells. Should be able to design and analyze the performance of electrochemical systems such as those represented by fuel cells, batteries, and various sensors and electrolytic cells.

Exam schedule: May 7 (tentative).

Homework policy – One home work problem set every ten days

Quiz: Two surprise quizzes (20%)

Journal Club: Present a Research Article and Conduct Discussion in Class (40%)

Final Exam: (40%)

Lecture by lecture (or week by week)

1. Introduction and Overview of electrode Processes (1.5 weeks)
2. Thermodynamics of Electrochemical Cells (1 week)
3. Kinetics of Electrode Reactions (2 weeks)
4. Mass transfer by Migration and Diffusion (1 week)
5. Controlled Potential and Controlled Current Microelectrode Techniques (2 weeks)
6. Analytical Techniques based on Impedance Spectroscopy (1 week)
7. Introduction to Defect Structure for studying Solid State Electrochemistry (1.5 weeks)
8. Journal Club (3 weeks)