

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

**Course Description:** Fundamental 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. 4 Cr.

**Instructor:** Uday B. Pal

**Contact information:** Rm. 206, 730 Commonwealth Avenue

**Office hours:** Friday 4-5 PM

**Prerequisites:** Undergraduate thermodynamics and transport phenomena

**Course schedule** – TR: 2-4 PM, EPC 206

**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 and list of related publications

**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.

**Homework policy** – Home work problem set will be assigned once in two weeks; will be solved in class

**Open Book Quiz 1** (20% of the grade)-TBD.

**Open Book Quiz 2** (20% of the grade)-TBD

**Open Book Final** (60 % of the grade)-Last Class

### **Lecture topics**

1. Introduction and Overview of electrode Processes (2 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 (2 weeks)