EEL 4930/5930 Introductory Energy Storage Fall 2012

Instructor: Dr. Jim P. Zheng Room 346

Lecture Hours: MW: 9:40-10:55am
Office Hours: MF: 3:00-4:00pm
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Prerequisites: EEL3300, or equivalent (grading C or better)

Textbook: Energy Storage for Power Systems, Andrei G. Ter-Gazarian, the Institution of Engineering and Technology, United Kingdom, 2008.

Course Topics:

This course is intended to provide students an overview on energy storage schemes/devices with major focus on electrochemical storages including advanced rechargeable batteries, electrochemical capacitors, and fuel cells. The course will cover operating principles, electrochemical mechanisms, physics behind them, characterization methods, and applications. Other energy storage technologies such as thermal energy storage, flywheel storage, pumped hydro storage, compressed air energy storage, hydrogen storage, and superconducting magnetic energy storage will also been briefly discussed.

Instructional Objectives:

After completing the course the student will

- Understand the necessity and usage of different energy storage schemes for different purposes
- Have a technological overview of various energy storage schemes
- Understand the operational mechanisms of each energy storage system
- Understand preliminary thermodynamics and electrochemistry
- Be able to characterize and analyze electrochemical energy storages

Grading:

Attendance:	10%
Lab:	50%
Projects/Presentation:	40%

Grading scale: A: >90%, B: 80-89%, C: 60-79%, D: 45-59%, F: <45%

These breakpoints may be lowered slightly depending on overall class performance.

Attendance:

No attendance credit will be awarded if you have more than 3 unexcused absences.

Laboratorial Assignment:

In the assignment you'll determine some basic parameters of one of energy storage devices. These parameters are defined below for clarity. A final brief experimental report is required to summarize the following parameters:

- Power Capacity: is the maximum instantaneous output that an energy storage device can provide, usually measured in watts.
- Energy Storage Capacity: is the amount of electrical energy the device can store usually measured in kilowatt-hours (kWh).
- Efficiency: indicates the quantity of electricity which can be recovered as a percentage of the electricity used to charge the device.
- Response Time: is the length of time it takes the storage device to start releasing power.
- Round-Trip Efficiency: indicates the quantity of electricity which can be recovered as a percentage of the electricity used to charge and discharge the device.

Due Date: November 21 (Wednesday), 2012

Project Assignment:

In the assignment you'll review a commercial application of one energy storage device. It should be a product or technology that is being prepared for market, but it doesn't have to be on the market yet. You'll review the technology, the product, how the energy storage device is addressing a specific need. Your assignment should focus on four key areas; first the company, second, the technology, third, the device or product itself, and fourth, the size of the market. Think of these four perspectives as corners of a square, and tell your story from the middle of the square. All four corners are important. The goal of this assignment is to learn about the most current energy storage device that is closest to the market, and to understand how young companies are approaching the needs of the market with the most current technologies available.

Your assignment should be about 1,000 to 1,500 words, meaning from three to five pages in length. Write an executive summary if you wish. Start your assignment by picking a product or application of interest, then researching the technology, with an emphasis on the problem that is being solved. Take time to understand the size of the market, the magnitude of the problem, and some rough estimate of the value of the technology. There are qualitative and quantitative measures of technology value, including the value of having 'first mover advantage'.

Due date: Title: September 10 (Monday), 2012
Project: December 5 (Wednesday), 2012

Presentation:

Each graduate student will present an assigned project (one of energy storage devices) to the class and to lead a discussion and critique of the issue(s) presented. PowerPoint/Handouts are expected, videos, dialogues/debates, etc. are welcome (anything goes as long as it is relevant to the issue being presented). The class presentation and ensuing discussion should take about 75 minutes. You should:

- Present the project
- Explain the operational principle
- Provide characteristics of the device
- Propose applications and market

The date for the presentation will be assigned by instructor.

Policy Statements:

- Attendance is mandatory.
- Coming late (5 minutes) or leaving early (5 minutes) will be considered as the absence from class.
- Cellular phones must be turned off in the classroom.
- There is renewed emphasis on the Honor Code. Violation of this code can result in course failure and/or dismissal from the College of Engineering.

Americans with Disabilities Act:

Students with disabilities needing academic accommodation should: (1) register with and provide documentation to the Student Disability Resource Center; and (2) bring a letter to the instructor indicating the need for accommodation and what type. This should be done during the first week of class.