MEEM 4260/5990: Fuel Cell Technology
Fall 2009
10:05 to 10:55 AM, M, W, F
Room - 20:403

Instructor: Dr. A. Mukherjee; Office: 20-932; Ph: 487-1174; mukherje@mtu.edu

Office Hours: 4:00 to 5:00 pm, M, W & F

Prerequisite: Thermodynamics and any basic course on Chemistry


Course Content: Fuel cell technology is an emerging technology for electric power generation for stationary, mobile and portable power applications. Fuel cell, the heart of this technology, is an electrochemical device in which hydrogen and oxygen react in the presence of a catalyst and produces electricity, heat and water. The major advantages of fuel cell systems are higher energy conversion efficiencies, low emissions and negligible noise. In this course, fuel cell technology basics, operating principles and fuel cell performance will be discussed from energy and thermodynamic viewpoints. Major types of fuel cells will be described: Polymer Electrolyte Membrane Fuel Cell (PEMFC), Direct Methanol Fuel Cells (DMFC), Alkaline Fuel Cells (AFC), Phosphoric Acid fuel cell (PAFC), Molten Carbonate Fuel Cell (MCFC) and Solid Oxide Fuel Cell (SOFC). The emphasis will be on the construction features, performance behavior and analysis. The balance of fuel cell power plant and thermal system design and analysis that affect the power generation will be discussed. Finally, hydrogen infrastructure and issues related to delivering electrical power generated from the fuel cell would be covered.

Course Objectives: 1. Obtain thorough understanding and advancement of performance characteristics of fuel cell power plant and its components. 2. Understand the performance and design characteristics and operating issues for various fuel cells. 3. Discuss impact of fuels and fuel cell power plants on environment and society. 4. Learn design and analysis of fuel cells using thermodynamics and electrochemistry. 5. Learn to prepare a formal technical report and make presentations in the class. Thus, at the successful end of the course, the students will have sufficient knowledge for working in a fuel cell industry or R&D organization.
**Grading:** You will have two midterm exams and one final exam. Graduate students will have to do an additional project. There will be no make up exams. The breakdown of your final grade is as follows:

<table>
<thead>
<tr>
<th>Undergraduate Students</th>
<th>% of final grade</th>
<th>Graduate Students</th>
<th>% of final grade</th>
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</thead>
<tbody>
<tr>
<td>Homework</td>
<td>20%</td>
<td>Homework</td>
<td>10%</td>
</tr>
<tr>
<td>Midterm 1</td>
<td>25%</td>
<td>Midterm 1</td>
<td>20%</td>
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<tr>
<td>Midterm 2</td>
<td>25%</td>
<td>Midterm 2</td>
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<tr>
<td>Final</td>
<td>30%</td>
<td>Project</td>
<td>20%</td>
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**Homework:** Homework problems will be assigned every other Monday and they are due in the class the following Monday. No late HW will be accepted.

**Project:** During the assigned week individual graduate students will present their own perspectives on an article they select from the professional literature related to Fuel Cells.

“Presentation” does not mean a formal PowerPoint show – it just means a substantive post to the class discussion board about the article you read.

Contents of that substantive post should include:

- A review of what you read, since other students will not have read what you did
- Your opinions—agree? Disagree? Why?
- Some questions to guide discussion of your article by others

After starting discussion with your presentation, you should then revisit the bulletin board regularly to answer questions raised by others about your article, and finally present a summary guiding the discussion to its conclusion.

When it’s your turn to present on an article, I will need to receive a citation for the article via email by 11:59 PM on Sunday, the day before the new class week opens up. I will create a separate discussion board topic for each article discussed during the term.

**Course Policies:** Attendance is mandatory for all classes. Please bring your textbook, a notebook and a calculator to class. For any help on homework problems, you should have tried the problem on your own first.