Spring 2010 **MAE-226** Y. Wang
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Hydrogen Transport and Conversion SYLLABUS

Catalog Data:

MAE226: Hydrogen Transport and Conversion (Credit Units: 4). This course serves as an in-depth introduction to hydrogen fuel and associated hydrogen economy as well as fuel cell technology. Through this course, we will examine hydrogen as a renewable energy source and the barriers to the hydrogen economy. Hydrogen's long term viability will be evaluated on various criteria: hydrogen's properties, drivers for market penetration, and safety and environmental aspects. Fundamental and modeling aspects of solid-state hydrogen storage and conversion (in fuel cell and combustors) will be emphasized, such as mass transport and heat transfer. Prerequisite: MAE115.

Textbooks:

- Introduction to hydrogen technology, Roman J. Press, John Wiley, c2009.

References:

- Hydrogen Fuel: Production, Transport, and Storage, Ram B. Gupta, CRC; 1 edition, 2008.
- Materials for the Hydrogen Economy, Russell H. Jones, CRC; 1 edition (2007).
- Fuel cell fundamentals, R O'Hayre, S. Cha, W. Colella, and F.B. Prinz, John Wiley & Sons, 2006.
- Handbook of fuel cells: fundamentals, technology, and applications / editors, Wolf Vielstich, Arnold Lamm, Hubert A. Gasteiger. V3 and V4.

Instructor:

Prof. Wang (4231EG) email: yunw@uci.edu
Office hour: 1:00-1:40 Pm T T

Course Outcomes:

Students will be able to:
(1) understand the state-of-the-art methods of hydrogen production, storage, and conversion; (2) and apply the fundamentals of mass transport, thermodynamics, fluid mechanics and heat transfer in hydrogen technology, particularly,

a.) Learn technology of hydrogen production from hydroncardon, coal, solar energy, and biomass;
b.) Learn technology of hydrogen storage in metal hydrides and carbon;
c.) Learn hydrogen sensors, code and standard;
d.) Understand hydrogen transport and absorption in metal hydride bed;
e.) Understand hydrogen transport and conversion in PEM fuel cells.

Prerequisites By Topic:

Thermodynamics (MAE 115)

Lecture Topics:

1. Introduction to the hydrogen economy
2. Fundamental properties and use of hydrogen as a fuel
3. Examples of hydrogen energy conversion (internal combustion engines and fuel cells)
4. Production of hydrogen (hydrocarbons/coal/solar/biomass)
5. Fundamentals of hydrogen heat and mass transport

6. Applications of hydrogen heat and mass transport
- Storage in metal hydrides and carbon
- Electrochemical conversion in fuel cell
- Combustion conversion in internal combustion engines (gas turbine, rotary)
- Tropospheric and stratospheric conversion*

7. Summary
- Technical challenges and opportunities

** may not be covered by the lecture.*

Class Schedule: Each class meets ~3 hours per week for 10 weeks.

Computer Usage: Data analysis (Excel, Matlab, Mathcad), and report writing (Word, LaTex).

Professional Component: Contributes toward the Mechanical Engineering Topics courses.

Relationship to Program Outcomes:

This course relates to the MAE Graduate Program as stated at:
http://mae.eng.uci.edu/grad/graduate_program.html
The course provides practical engineering issues related to energy generation which reinforce, amplify, and extend the concepts of thermodynamics, fluid flow, mass transport, and heat transfer.

This course also contributes to students' abilities to demonstrate the following ME Program Outcomes:

(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to function in multi-disciplinary teams.
(c) an ability to identify, formulate, and solve engineering problems, and particularly to conceptualize objectives and constraints, identify governing principles, apply fundamental analytical tools, and predict performance.
(d) an understanding of professional and ethical responsibility
(e) a knowledge of contemporary issues.
(f) the broad education necessary to understand the impact of engineering solutions in a global and societal context

Design Content Description

Grading Criteria:

HWs:	30%
Project:	40%
Exam:	30%
	100%

Prepared by Prof. Yun Wang
Mar. 2010