

Drop-In Energy Modules for the ChE Curriculum

CACHE Energy Task Force

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For the past several years, a CACHE task force has been developing modules to introduce concepts of hydrogen and hydrogen fuel cells into the chemical engineering undergraduate curriculum. To date, about two dozen modules have been developed for the following ChE courses:

- Material and Energy Balances
- Thermodynamics
- Fluid Mechanics
- Heat and Mass Transport
- Kinetics and Reaction Engineering
- Separations
- Process Safety and Process Design
- Materials Science and Engineering

Each module contains a background on the technology as it applies to the core course. This is followed by an example problem statement and a solution to the example problems. Finally, a homework problem is provided. Homework solutions are available on a password protected website. Instructors can distribute the modules "as is" for homework, or give the background information and example problem as an in-class problem.

The modules are available at the following website:
http://www.che.msstate.edu/pdfs/fuel_cell_curriculum/index.html.

These efforts were expanded in 2010 to include general energy modules for alternative energy. The modules are presented in the same format as the fuel cell modules, and a list of the modules is provided below.

General Energy Analysis (<http://www.che.msstate.edu/pdfs/energy/generalenergy.html>)

Biodiesel Calculator

Stoichiometric Analysis of Fuel Combustion

Energy Value of Fuels

Hydrogen Production Cost

Fuel Energy Cost and Energy Density

Hydrogen Flammability

Theoretical Fuel Consumption and Power

Energy Consumption Analysis

Energy Efficiency Analysis

Energy Emissions Analysis

Battery Energy Analysis

Battery / Fuel Cell Vehicle Range

Solar Energy Analysis

Wind Energy Analysis

Power and Energy Analysis of Transient Driving Schedules

Coal Energy (<http://www.che.msstate.edu/pdfs/energy/coal.html>)

Material Balances on CO₂ Absorption / Stripping Process

Solar Energy (<http://www.che.msstate.edu/pdfs/energy/coal.html>)

The Power of Solar Energy

Solar Water Heating

The modules were used in several required and elective chemical engineering courses during the 2011-2012 academic year at Mississippi State University. Most notably, a module was used as the homework assignment after most of the presentations in the course CHE 4990 Hydrogen Energy Fundamentals. Topics in this course included:

- History of Energy Production
- Energy Sources, Emissions, Capacity
- Electric / Hybrid Electric Vehicles
- Fuel Cells and Fuel Cell Vehicles – General Concepts
- Fuel Cells and Fuel Cell Vehicles – Mass Balances
- Hydrogen from Natural Gas – Steam Reforming
- Hydrogen from Natural Gas – Hydrogen Purification
- Hydrogen from Coal
- Hydrogen from Biomass
- Hydrogen from Electrolysis
- Hydrogen from Wind
- Hydrogen from Solar Energy
- Hydrogen from Nuclear Energy
- Hydrogen Public and Government Policy
- Hydrogen Economy

For any questions, comments, or ideas for new modules, please contact energy modules task force chair Jason Keith at keith@che.msstate.edu.