ENERGY TECHNOLOGY AND POLICY

Spring Semester 2010
Cross-Listed as EG 40401 and AME 40401

COURSE DESCRIPTION

INSTRUCTOR:	F. P. Incropera H. Clifford and Evelyn A. Brosey Professor of Mechanical Engineering
CREDIT HOURS:	Three
PREREQUISITES:	Junior or senior-level standing in the College of Engineering.
ENROLLMENT:	Capped at twenty-five students.
DESCRIPTION:	This course provides a comprehensive treatment of the science and technology of energy production and conversion options, as well as the role of energy in society. After reviewing the benefits and problems associated with today's dependence on fossil fuels, attention is directed to the opportunities and challenges of transitioning to a sustainable energy future. Course content is developed along two tracks, one scientific/technical, the other socio/economic/political/ethical.

LEARNING OBJECTIVES: Upon completion of the course, students will

- understand and be able to quantify the different forms of energy;
- understand and be able to apply the fundamental laws governing conversion from one form of energy to another (*First and Second Laws of Thermodynamics*);
- understand the basic principles and be able to quantify related performance parameters underlying traditional and emerging technologies based on fossil-fuels, nuclear energy, and renewable energies such as solar, wind, and biofuels;
- understand and be able to quantify the environmental consequences (*pollution* and *climate change*) of energy technologies;
- understand the influence of the following *non-technical issues* on the nation's and the world's energy future:
    - geopolitics,
    - economics, and
    - public policy;

- understand linkages between *ethics* and energy consumption, with special attention given to the implications of *energy poverty* in the developing world and *over-consumption* in developed nations.

Among the serious problems to be faced by this generation of college students *throughout their lives*, shaping a sustainable energy future ranks with, and is, in fact, coupled to those of environmental degradation, war, hunger, poverty and disease. This course is offered in recognition of the need to develop and implement thoughtful and comprehensive visions of humanity's energy future. Its main objective is to provide students with the ability to synthesize diverse technical and non-technical issues in making informed decisions concerning this future.

LEARNING ACTIVITIES: Class time involves a mix of

- lectures on scientific/technical matters,
- group discussions of reading materials,
- student presentations, and
- invited speakers from the energy industry, academe, and/or government.

STUDENT EVALUATION: Grades will be based on

- solutions to homework problems,
- short essays and oral presentations on selected topics,
- a mid-term examination, and
- a final (team-based) project involving a comprehensive engineering/economic/environmental analysis of a prospective sustainable energy system.

READINGS:

- Instructor Notes.
- Selected articles from
  - *Scientific American,*
  - *Science*,
  - non-governmental organizations, and
  - the U.S. Government.

PROJECT DESCRIPTION: This year's project involves assessment of the role to be played by solar energy in achieving California's goal of deriving a third of its electricity from renewable sources by 2020. Issues to be considered include, but are not restricted to:

- current status of California's power generation and distribution system, including existing sources of renewable energy,

- projections of growth in demand for electricity and the extent to which growth can be reduced by energy efficiency measures,
- role to be played by solar energy in meeting projected demand for 2020; issues to be considered include, but are not restricted to:
    - assessment of technology options (solar thermal and photovoltaic) and trade-offs related to efficiency and cost,
    - relative contributions to be made by distributed (roof-top units) and central (solar farms) sources of power,
    - means of dealing with intermittent generation, particularly by central power stations, including options for energy storage and/or auxiliary power,
    - inadequacies of the existing grid: need for expansion to transmit power from remote sites to locations of large demand and role to be played by a *smart grid*, in maximizing benefits from distributed sources, and
    - land and water requirements and related environmental concerns.