PHY 137S: Energy in the 21st Century and Beyond

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"A seminar course covering the fundamentals of energy science and related emerging technologies, presented at a level that is accessible to students from all undergraduate majors."

Bulletin description:

Concepts of energy from a scientific perspective for understanding problems of energy conversion, storage, and transmission in modern society. Topics include fundamental concepts (kinetic and potential energy, heat, basic thermodynamics, mass-energy equivalence), established power generation methods and their environmental impacts, emerging and proposed technologies (solar, wind, tidal, advanced fusion concepts). Final team project. Sophomores, juniors, and seniors from non-science majors are particularly encouraged to attend; no previous knowledge of physics is assumed.

Course Structure:

Seminar - Course meets every Wed. and Fri., 4.40 pm – 5.55 pm, in Physics Room 154. Each meeting consists of a mix of lecture, discussion, and occasional guest presentations.
Lab experience – One laboratory meeting during the semester designed to give students hands-on insight concerning the nature of energy technology. This will be held during the second half of October at a time to be determined.
Project – For the last third of the semester, students will work in groups of 3 or 4 and prepare a written report and oral presentation on a topic pertaining to the course, such as, a novel energy source, improvements over current practice in an existing energy technology, or the viability of a start-up company in the energy sector. Oral presentations and associated question/answer period will take place during the last two class meetings. Additionally, each student will prepare a written "review" of 2 assigned presentations other than their own.

Grading:

- Homework (approx. 5 assignments) = 20 %
- Mini-reports on weekly articles = 15 %
- In-class participation = 15 %
- Midterm Exam (Friday, Nov. 11) = 20 %
- Team project = 25 %
- Reviews of team projects = 5 %

Textbooks:

- *Energy Science – Principles, Technologies, and Impacts*, 2nd ed., by John Andrews and Nick Jelley (Oxford UP, 2013).
- *Sustainable Energy – without the hot air*, by David MacKay (UIT Cambridge, 2009); available for download at https://www.withouthotair.com/ .

Draft schedule (v 26 AUG 2016):

Aug. 29– Sept. 12: Introductory remarks; motivations - climate change, fossil fuels, and Hubbert's peak; fundamental physical concepts - energy, heat, efficiency, Faraday's Law of electromagnetic induction, energy conversion (generators and motors), and the 1st Law of Thermodynamics.

Sept. 12 - 19: Heat engines, heat pumps, refrigerators, and power plants; the 2nd Law of Thermodynamics.

Sept. 19 – 28: Hydrodynamics and aerodynamics; turbines; hydroelectric power, wind power.

Sept. 28 – Oct. 7: Light and photons; solar energy and photovoltaic cells.

Oct. 7 - 14: *Fall Break*; mass-energy equivalence and basic nuclear physics; power generation from nuclear fission.

Oct. 14 – 21: Advanced and speculative fission power approaches; nuclear fusion.

Oct. 21 – 28: Energy storage and battery technology.

Oct. 28 – Nov. 9 : Energy transmission and the grid; energy for transportation.

Nov. 11: In-class exam.

Nov. 11 - 18: A physicist's perspective on global effects: pollution, population, and climate dynamics.

Nov. 18 - 27: *Thanksgiving Break*.

Nov. 28 – Dec. 5: Special topics; may include, for example, additional renewables (tidal, hydrokinetic, wave, geothermal), organic solar cells, emerging energy-related ventures.

Dec. 2: Review draft written and oral presentations with individual groups.

Dec. 5: Written group project reports are due for SAKAI submission.

Dec. 7 and Dec. 9: In-class group oral presentations.

Dec. 12: Written reviews of group project presentations are due via SAKAI.