

ESM 288 – Energy, Technology, and the Environment

Fall 2016

Course Instructor:

Brandon Kuczenski, PhD

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Course Meetings: Tuesdays and Thursdays; 2:30–3:45 PM; BH 1424

Office Hours: Tuesdays 3:45–5:00 PM;
Thursdays 1:00–2:30 PM;
other times by appointment.

Textbook: There is no required textbook.

Recommended reference:

Energy Science, by John Andrews and Nick Jelley. Oxford, 2nd edition (2013).

Other recommended resources (free online):

Energy and Fuels in Society, edited by R. L. Radovic (2001, with revisions)

<http://www.ems.psu.edu/~radovic/matsc101.html>

Sustainable Energy – without the hot air, by David JC MacKay (2008)

<http://www.withouthotair.com/>

This course covers the main physical principles of energy conversion, the environmental impacts related to it, and the ways energy forms the foundation of the modern era. The class will include coverage of the theory and engineering principles behind energy systems, balanced with applications of the theory to answer practical questions. The course material connects naturally to daily life in the developed world, as well as questions of public policy and private decision making.

Course Performance and Grading

60% Homework (5 assignments)

10% Power Use Study (1 week over the quarter)

30% Course Project **Due December 9**

A 70% grade will be considered passing.

Homework

Homework will be due approximately every two weeks during the quarter. All homework assignments are due at 5pm on the date specified in either physical or electronic form. Physical homework can be placed in my mailbox in the 2nd floor *North* mailroom or submitted via email or Gauchospace.

Homework will be considered late if I have not received it by the time I begin grading. Assignments received after this time will be docked 20%. Assignments received after solutions are posted will be docked 50%.

Power Use Study

Students working alone or in groups of 2 will borrow one of two P3 International Kill-a-Watt™ P4400 power meters to perform measurements of power consumed by an electric device in their home (see separate assignment). At the end of the quarter, I will tabulate and present the results.

Course Project

The project will be an independent study of a product or energy system in contemporary use. Proposals and group selections are due **October 31, 2016** in class. The final project will be due on **December 9, 2016**, the last day of finals week.

Lecture Topics

The pacing of the course will vary based on student interest and challenges. Recommended reading assignments will be posted on Gauchospace and make reference to the textbooks above. Readings should be done as-needed to understand the material.

Week 0-1 Introduction to Energy

- Sep 22 – Course Overview
- Concepts of work and energy
- Units and unit conversions
- Orders of magnitude
- Sep 27-29 Dr. Kuczenski out; Reading and Homework #0 in-class
- Sep 30 **Homework #0 Due**
- Reading: Andrews & Jolley, Ch. 1; Radovic [Ch. 1](#), [Ch. 2](#); MacKay Chapters 1-2

Week 2-3 System Modeling; Laws of Thermodynamics

- Oct 4 – System Description, system boundaries; steady state
- Continuity and conservation
- First law of thermodynamics
- Oct 6 – Second law of thermodynamics
- Heat engines; Carnot efficiency
- Oct 11 **Class held in Bren 1414**
- More heat engines: Otto, Brayton
- Refrigeration
- Oct 13 Review and catch-up
- Oct 14 **Homework #1 Due**
- Reading: Andrews & Jolley, Ch. 2, Ch. 4; Radovic [Ch. 3](#), [Ch. 4](#)

Week 4-5 Sources and Conversion of Energy

Oct 18 – Non-renewable energy sources

Oct 20 – Principles of Electricity

Reading: TBA

Oct 25 – Generation, Distribution, and Energy Storage

Oct 27 – Renewable energy sources

Oct 28 **Homework #2 Due**

Reading: TBA

Week 6-7 Uses of Energy

Nov 1 – US Energy Use

Nov 3 – Transportation

Nov 8 **Election Day – Please Vote!**

– Transportation and biofuels

– Space heating and cooling

Nov 10 – Computing and Communication

– Manufacturing and Embodied Energy

Homework #3 Due (Nov 11 Holiday)

Reading: TBA

Week 8-9 Environmental Impacts of Energy

Nov 15 – Extraction Impacts

– Combustion Impacts

Nov 17 – Renewable power, land use and Wildlife

Nov 22 – Climate Change and Public Engagement

Nov 23 **Homework #4 “due”** (for people who do not wish to work over Thanksgiving)

Reading: TBA

Week 10 Energy Policy

Nov 28 **Homework #4 due** (per grading policy)

Nov 29 – Policy measures affecting energy production and consumption

Dec 1 – Renewable energy scenarios

– Outlook & Course completion

Week 11 Finals Week

– Work on Final Project

Dec 9 **Final Project Due**