GE 3300 (SUMMER I 2020)
ENERGY SYSTEMS: SCIENCE, TECHNOLOGY & SUSTAINABILITY
- SYLLABUS -

INSTRUCTOR: Dr. Courtney Pfluger; c.pfluger@neu.edu

DESCRIPTION

This multidisciplinary introductory course in energy systems concentrates on providing students with a sound scientific, technology, and economic basis for understanding our modern energy system, as well as tools and policy context for analyzing real-world energy engineering challenges. The course begins with a presentation of the physics principles of energy and work, thermodynamics, and the first and second laws. Technologies across the full energy system from supply to demand will be explored, from extraction of primary energy, conversion into fuels and electricity, important energy end-uses, and losses. Fossil and nuclear power plants will be reviewed and renewable energy technologies (wind, solar, hydro, geothermal, biofuels) will be discussed in detail. Transmission and distribution will cover electricity and fossil fuel infrastructure. Energy demand by buildings, transportation, and industry will be discussed with an emphasis on second-law analysis and efficiency measures. Throughout the course, physics and chemistry concepts relevant to each topic will be introduced and quantitative analysis will be applied to understand the engineering and economic challenges that we face in energy. The energy system represents the single-largest impact of industry on the environment and public health, and yet there are enormous opportunities for improvement. Sustainability concepts will be discussed including net energy/exergy analysis and life cycle assessment, energy-related emissions, decentralized generation, smart grids, district heating, and net zero energy facilities.

PREREQUISITES: MATH 1241/1250/1341 AND PHYS 1151/1161/1171

TEXTBOOKS AND OTHER MATERIALS:

- D.J.C. MacKay, *Sustainable Energy: Without the Hot Air*, (free online, http://www.withouthotair.com/)
- **Referenc**e: Yasar Demirel, Energy: Production, Conversion, Storage, Conservation, and Coupling. Second Edition. Springer, 2016 (pdf posted on Blackboard)

CANVAS

The Canvas website for this course has been set up. The site will contain the syllabus, relevant handouts, course slides, homework assignments, and other supplemental material.

COURSE OBJECTIVES

This course is about becoming familiar with our energy system, from extraction to use, and understanding the physics behind the energy-related technologies that we use every day. Over the course of the semester, the desired learning objectives are for you to:

- Learn proper energy terminology and units
- Develop an intuition about energy quantities and related energy use at different scales
- Characterize energy resources and potential future transitions
- Evaluate energy proposals using energy/exergy/economic/life cycle assessment tools
- Explain and use the basic equations of electromagnetism and thermodynamics
- Provide the engineering basis for the main supply- and demand-side energy technologies
- Describe environmental and health effects of our energy system

PROBLEM SETS

There will be problem sets given, spread evenly throughout the semester. You are encouraged to work together on assignments, but each student must write up and submit the problem sets individually, *and note your*

collaborators. Problem sets must be turned in on time to receive full credit; late assignments will not be accepted.

COURSE PROJECT

During this course you will perform a project with global collaborators, Brazilian University students and the Brazilian company, Suzano.

GRADING

Problem Sets	30%
Project Part 1	10%
Project Part 2	10%
Final Project	30%
Participation	10%
Reflection	10%

The best kind of participation in the class is by asking questions you have about energy: where energy comes from, why the system looks the way it does, and how energy technologies work.

GENERAL POLICIES

The course will adhere to University policies on neatness and academic honesty: www.northeastern.edu/osccr/.

CLASS SCHEDULE – SUBJECT TO CHANGE