

Course Title: EST 11 – Introduction to Energy Technology

Description: Introduced energy concepts and resources, energy conversion systems, institutions and global implications. Infrastructure and technology at micro-scale (household and personal electrification) and at macro-scale (transportation, electricity). Societal use patterns. Evolution of and alternatives to present dominant energy systems. Exercises in recognizing and evaluating energy infrastructure, use, waste and costs in everyday life.

Afternoon project based learning activities (approximate budgets):

- Biodiesel synthesis and analysis (\$350)
- Automotive Technology shop tour
- Build your own solar phone charger (\$350)
- Exploring wind turbines and wind energy
- Physical realization of work and energy – Bicycle generator (\$250)
- Movie Screening “An Inconvenient Truth” and group discussion (\$15)
- Yonkers Science Barge tour
- Quantifying nutrient and sewage levels in the Harlem, Hudson, and Bronx Rivers with the LSAMP SIFI program

Format and Credit: 2 Credits, 1 Lecture, 1 Recitation hour

Co-Requisites: Eng 02 and RDL 02, if required.

Texts: Joseph Priest, Energy: Principles, Problems, Alternatives

Publication date: August 2006 Edition #: 6 [Required]

David Nye, Consuming Power: A Social History of American Energies

Publication date: February 1999 [Recommended]

Requirements and Grading:

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|---------------------|-----|
| Mid-term Exam       | 20% |
| Two Short papers    | 40% |
| Class Participation | 10% |
| Final Exam          | 30% |

Learning Objectives:

- Use abstract reasoning, including the ability to analyze, interpret, evaluate and integrate information; apply the results; and formulate and solve problems
- Use reading, writing, listening and speaking to find, interpret and communicate information in various modes, including aesthetic, statistical, symbolic and graphic
- Understand energy resources and conservation
- Ability to read and analyze an electric bill
- Basic ability to recognize and quantify energy use and efficiency
- Awareness of global patterns and problems of energy use
- Understand basics of electrical system infrastructure

- Understand transportation drivers, planning and implications
- Awareness of career options related to energy

Syllabus [COMPASS math concepts covered]

1. Energy & Global Issues [ratios]
  - a. Energy and Society
  - b. Energy Use in the United States
  - c. Energy Production and Consumption
  - d. Environmental Challenges
  - e. The Future
2. Energy Principles
  - a. Units [decimals, scientific notation]
  - b. Models [setting up equations]
  - c. Rates [graphing linear equations with two variable]
  - d. Speed, Velocity, and Acceleration [signed numbers]
  - e. Newton's laws [solving linear equations]
  - f. Energy and Work [distance and slope formulas]
  - g. Household energy use
3. Resources
  - a. Coal
  - b. Petroleum
  - c. Oil
  - d. Renewables
  - e. Batteries
  - f. Energy Density [fractions, proportions]
  - g. Energy Consumption [scientific notation]
4. Principles of Electricity
  - a. Electric force and charge
  - b. Atomic structure
  - c. Electricity
  - d. Electric Power and Energy
  - e. Electric Generators [percentages]
  - f. Transformers
  - g. Transmission
  - h. Customer Demand
5. Energy Conversion: Principles of Thermodynamics
  - a. Ideal gas law
  - b. Internal energy
  - c. Heat
  - d. First law of Thermodynamics
  - e. Steam Turbine
  - f. Second Law of thermodynamics
6. Environmental Impacts & Policies
  - a. Electromagnetic radiation
  - b. Green house gasses
  - c. Particulate matter

- d. Global warming
- e. Regulation
- 7. Settlement Patterns, Food & Transportation
  - a. Global soil quality
  - b. Fresh water
  - c. Food production
  - d. Population density
  - e. Population growth [exponentials, substitution]
- 8. Vehicle Design
  - a. Engine fundamentals
  - b. Octane rating
  - c. Emissions
  - d. Crankcase blowby
  - e. Catalytic converter
  - f. Alternative fuels
  - g. Diesel
  - h. Electric vehicles
- 9. Alternative Technologies: Fuel Cells and Hydrogen
  - a. Principles of redox chemistry
  - b. Electrolysis
  - c. Membranes
  - d. Hydrogen storage
- 10. Alternative Technologies: Wind & Solar
  - a. Terrestrial abundance of wind and solar resources
  - b. Solar thermal
  - c. The photoelectric effect
  - d. PN-junctions
  - e. Solar panel morphologies
  - f. Wind turbines
  - g. Blade design and size scaling
  - h. Inverters
  - i. Micro-grids
- 11. Alternative Technologies: Biofuels
  - a. Basic plant biology
  - b. Wood & bagasse
  - c. Fermentation – bioethanol
  - d. Food vs. Fuel
  - e. Lignocellulosic
- 12. Alternative Technologies: Nuclear
  - a. Nuclear physics principles
  - b. Radioactivity
  - c. First generation reactors
  - d. Accidents
  - e. Waste production and storage
  - f. Second generation reactors and beyond
- 13. Careers in Energy

