Syllabus

ENME 3661 Mechanical Energy Systems Engineering
Winter 2016

University of Denver
Mechanical and Materials Engineering Department

Meets: 205 CMK, 2:00-3:50 TR
(4.0 Credit hours), Satisfies Undergraduate Technical Elective or Graduate Course

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Course Description:
This course covers energy systems engineering analysis from a mechanical and materials engineering perspective. This courses covers energy production from traditional energy systems that use fossil fuel combustion such as internal combustion engines, coal-fired power plants, and natural gas turbines, to nuclear energy and renewable energy methods such as wind, solar, hydraulic and geothermal. Lastly, the course will survey emerging technologies for future (21st century) energy systems.

Prerequisites: ENME 2720, Engineering Thermodynamics II, ENME 2510, Engineering Dynamics I, ENME 2651, Fluids I or Equivalent.

Textbooks (Required):
Vanek, F.M., Albright, L.D., Angenent, L.T., Energy Systems Engineering: Evaluation and Implementation, 2nd Edition McGraw Hill, 2012. ISBN#:978-0-07-178778-9.

Supplementary Resource (not Required):
Goswami, D.Y., Kreith, F., Energy Conversion, CRC Press, 2008.

Some Journals available through the DU Library that Feature Emerging Topics:
Renewable Energy, Energy, Energy and Environmental Science, Applied Energy, Renewable and Sustainable Energy Reviews, Solar Energy, Journal of Energy, International Journal of Energy Research, BioEnergy Research, Atomic Research, Applied Solar Energy; Energy, Sustainability, and Society; Materials for Renewable and Sustainable Energy, Journal of Renewable & Sustainable Energy, The International Journal of Energy and Environmental Engineering, Journal of Energy Resources Technology, Journal of Energy Engineering, International Journal of Green Energy, Geothermal Energy

Course Learning Objectives: The student should be able to
- Perform engineering calculations to determine the performance and preliminary design of various energy conversion systems.
- Understand the physics of the environmental issues related to energy conversion, including air pollution, the greenhouse effect, global climate change.
- Perform comparative analysis of various energy conversion systems. The comparisons will include cost, social acceptability as well as environmental consequences.
- Survey and apply engineering analysis techniques to the emerging energy technologies of the 21st century.

- Research the scientific literature for emerging technologies in this field.

Approximate Course Schedule and Topics:

Units	Approximate Topics Covered and Sequence
1	Overview of Energy Conversion
2	Fossil Fuels (oil, natural gas, and coal)
3	Fossil Fuel Power Plant Cycles (Rankine and Brayton Cycle and Cogeneration)
4	Fossil Fuel Internal Combustion Engines (Otto and Diesel) and Jet Engine Cycles
5	Fossil Fuel potential for Air Pollution, Greenhouse Effect, and Climate Change
6	Nuclear Power: nuclear reaction physics, current reactor designs, breeder reactors, nuclear fusion.
7	Nuclear waste disposal and Nuclear Reactor Disasters
8	Solar-thermal energy: solar radiation physics, solar radiation geometry, solar energy collection and conversion for heating systems.
9	Concentrating solar thermal power and the Stirling cycle.
10	Photovoltaic technology. P-n junctions. Materials. Photovoltaic cells. Solar towers/heliostats.
11	Environmental Impacts of Solar Energy
12	Wind Energy: Wind turbine design. Turbine capacity factor. Tip speed ratio, Betz limit. Blade element theory.
13	Wind Energy: Operating conditions (siting, height, wind speed variation, site density). Land requirements.
14	Environmental Impacts of Wind Energy
15	Hydraulic Turbines/Power: Hydropower plants, Turbine Types, Performance Analysis.
16	Environmental Impacts of Hydropower
17	21st Century Technologies and Advances: Biomass, Clean Coal, Ocean Generation, Off-shore Wind, Transportation Technology, Hybrid Energy Systems, Geothermal Energy, Carbon Sequestration.

**Book and Supplemental Material will be used to cover this material.

Grading:

Homework 40%
Projects 60%

***Homework*:** Problems will be assigned from the required textbooks and/or given out in a handout and will be due at the beginning of class on the due dates--these will be assigned approximately weekly. The homework should be done in the required format which was shown on the first day of class. These problems are meant for you to hone your analytical skills and broaden your conceptual knowledge of Energy Systems. These homework problems are only required for graduate students, but undergraduate students may do them for extra credit.

In-Class "Homework": There will be some in-class participatory exercises that will count towards your homework grade. These types of exercises might include watching videos on a topic and filling out a viewing guide as well completing analytical problems relevant to the most recent material. These will be typically graded such that legitimate attempts and participation will give you most of the credit. These exercise will help me gage your progress and understanding of the topics along with encouraging you to attend and participate in class.

Projects: Three projects will be assigned to help you synthesize your understanding of Energy Systems topics and its practical applications to everyday engineering practice. These projects will require a level of analysis beyond what is required in the homework, and will likely involve independent reports, presentations, and using computational tools such as Matlab, MS Excel, CFD tools, or programming or similar. The projects will be spaced to be due approximately every 2-3 weeks. On every project there will be problems that are marked as "G" for graduate students. These projects are only required for graduate students, but undergraduate students may do them for extra credit.

***Late Policy on Projects and Homework*:** 10% penalty if not turned in during class period, 25% one calendar day late, 50% two calendar days late, no late work after three calendar days.