ENG ME 430 Energy Conservation

2008 - 2009 Catalog Data:
ENG ME 430 Energy Conservation Prereq: ENG ME 304. Thermodynamic and mechanical aspects of modern conventional energy conversion systems, including steam electric power plants, gas turbine and internal combustion engines, and refrigeration systems. Combined cycle and cogeneration are also considered, as well as economic and environmental aspects of energy conversion. Includes design project. 4 cr.

Class/Lab Schedule: 4 lecture hours per week

Status in Curriculum: Elective

Textbook(s) and/or Other Required Material:
M. J. Moran and H. N. Shapiro, Fundamentals of Engineering Thermodynamics, 4th ed., Wiley, 1999

Coordinator: William M. Carey, Professor, Mechanical Engineering

Prerequisites by Topic:
1. Basic thermodynamics
2. Basic fluid mechanics

Goals:
This course is designed to provide a thorough understanding of both the thermodynamic and mechanical aspects of modern, conventional energy conversion systems, and the optimization of, and/or trade off between, their efficiency and performance in light of economic and societal factors.

Course Learning Outcomes:
As an outcome of completing this course, students will:

i. Become proficient in the application of fundamental engineering thermodynamics to the analysis of: 1) vapor power systems - Rankine Cylce-Superheat and Reheat-regenerative vapor cycles - feedwater heaters 2) Gas power systems - internal combustion - Otto cycle - diesel - Brayton - regenerative gas turbines - reheat and inter cooling 3) gas turbine vapor power cycle - nozzles and diffusers 4) refrigeration and heat pump systems - vapor compression refrigeration - absorption refrigeration - heat pumps (A, E, K, L, M)
ii. Become proficient with the application of engineering thermodynamics to: 1) energy accounting 2) gas mixtures 3) methods to determine equations of state for working fluids. (A, E, K, L, M)
iii. Gain knowledge and experience of the National and International Energy Research, Development and
Production by: 1) reviewing the Department of Energy Global Outlook, 2003 2) understanding the national laboratory system 3) the power industry institutes such as the Edison Power Research Institute and 4) industrial associations (F, H, I, J)

iv. Gain experience in design of energy conservation systems by: 1) proposing the conceptual design of an actual conversion system 2) determining the potential on a national and regional basis 3) performing a thermal analysis of the system 4) developing a system design 5) performing a cost and energy cost analysis 6) assessment of environmental impact 7) a concise presentation of the conceptual design (C, H, I, G, M)
v. Gain experience and confidence in teamwork by working in a small group to complete the project (D)

Course Learning Outcomes mapped to Program Outcomes:
(For Program Outcomes, please see attached page or Department Web Site)

Program:	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Course:	i, ii		iv	v	i, ii	iii	iv	iii, iv	iii, iv	iii	i, ii	i, ii	i, ii, iv	
Emphasis:	5	1	3	3	5	2	4	4	3	3	3	3	3	1

Topics (time spent in weeks):
1. Introduction to conventional and non-conventional energy conservation (1)
2. Applied thermodynamics review including Carnot cycle and availability analysis (2)
3. Rankine cycle; reheat, regeneration, superheat and thermal analysis of components: turbine, pumps, heat exchangers, nozzles diffusers and throttles including efficiencies (3)
4. Application of the Rankine cycle to steam power plants including availability and cost analysis (1)
5. Gas power cycles; ideal gas laws and standard air analysis to the Carnot, Otto, Diesel, Stirling and Brayton cycles including turbine and compressor efficiencies (2)
6. The Brayton cycle with regeneration, inter-cooling, reheat water injection and application to turbo jet propulsion (1)
7. Compressible fluid flow through nozzles and diffusers (1)
8. Refrigeration and heat pump systems (1)
9. Compressible substances and gaseous mixtures (1)
10. Project presentations (1)
11. Test and in-class discussions of exams (1)

Contribution of Course to Meeting the Professional Component:
Engineering Topics: 100%

Status of Continuous Improvement Review of this Course:
Date: April 1, 2008 **Reviewed by:** Thermal/Fluids Committee
Prepared by: William Carey **Date:** June 8, 2009