ENG ME 304 Energy and Thermodynamics

2008 - 2009 Catalog Data:
ENG ME 304 Energy and Thermodynamics Prereq: CAS PY 211; coreq: CAS MA 225. Macroscopic treatment of the fundamental concepts of thermo-dynamic systems. Zeroth, first, and second laws; properties of simple compressible substances; entropy; energy availability; ideal gas mixtures and psychometrics; and thermodynamic cycles. Application to engines, refrigeration systems, and energy conversion. Includes lab. Cannot be taken for credit in addition to ENG EK 424. 4 cr.

Class/Lab Schedule: 4 lecture hours per week, Two 2 hour labs per semester

Status in the Curriculum: Required

Textbook(s) and/or Other Required Material:
M.J. Moran and H.N. Shapiro, Fundamentals of Engineering Thermodynamics, 6th ed., John Wiley & Sons, 2008.

Coordinator: Xi Lin, Assistant Professor, Mechanical Engineering

Prerequisites by Topic:
1. Differential and integral calculus, multi-variate calculus
2. 1st semester college physics (calculus based)

Goals:
To provide a broad introduction to classical thermodynamics, with sufficient coverage of cycles as a prerequisite for more focused studies of energy conversion and propulsion.

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

i. Understand underlying principles of engineering thermodynamics: properties of simple compressible fluids, use of "steam tables" for fluids, use of closed-form expressions for gasses, first and second laws of thermodynamics for closed and open systems, concept of entropy, thermodynamic temperature scale, concept of exergy (availability). (A, E,)

ii. Understand and be able to analyze simple gas and vapor cycles: Carnot cycle, Rankine cycle, Brayton cycle, Refrigeration cycle, Otto and Diesel cycles. (A, E)

iii. Be able to carry out experiments involving thermal systems: application of 1st law to open and closed systems; jet engine performance. (B, E, D)

iv. Be able to write clear, concise, technical reports: Individual reports are required for each laboratory exercise. Students are expected to succinctly describe the experimental system, present the measured results, and compare results to the theory developed in class. (G, L)

v. Be able to develop computational tools: The analysis of experimental data and a selection of homework problems require the development of computational programs using Excel. (K)

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	iii	i, ii	iii	i, ii, iii	-	iv	i, ii	-	i, ii	v	iv	i, ii	-
Emphasis:	5	3	2	2	5	1	3	2	1	2	3	4	2	1

Topics (time spent in weeks):
1. Introductory concepts and definitions (1)
2. Energy, energy transfer, work, first law of thermodynamics for open and closed systems, zeroth law of thermodynamics (1.5)
3. Properties of pure substances, state diagrams, thermodynamic tables, ideal gas law (1.5)
4. Control volume analysis (0.5 weeks)
5. Second Law of Thermodynamics, Carnot cycle (1.5)
6. Entropy, TdS equations, entropy balance for closed systems and control volumes (1.5)
7. Isothermal, isobaric, isometric, isentropic, and polytropic processes; thermodynamic efficiencies (2.5)
8. Availability, second law efficiency (0.5)
9. Engine cycles, refrigeration cycles (2.5)
10. In-class exams and labs (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:** Fluids-Thermal Committee
Prepared by: Xi Lin **Date**: January 29, 2009