Example Course Syllabus: ENG ME 304 Energy and Thermodynamics

Credits: 4
Number of Contact Hours: 4 lecture, 1 discussion hours per week; Two 2 hr labs per semester.

Instructor or Coordinator: James C. Bird

Textbook(s) and/or Other Required Material:
M.J. Moran and H.N. Shapiro, Fundamentals of Engineering Thermodynamics, 8th ed., John Wiley & Sons, 2014.

Prereq: CAS PY 211; coreq: CAS MA 225.
Macroscopic treatment of the fundamental concepts of thermodynamic 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.

Prerequisites by topic:
1. Basic calculus and differential equations
2. Calculus-based understanding of force, pressure, and energy

Co-requisites by topic: Multivariate calculus

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 humidity. (A, E,I)

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; refrigeration system 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)

v. Be able to use computational tools: The analysis of experimental data and a selection of homework problems require the use of computational programs such as Matlab or Excel. (K)

Course Learning Outcomes mapped to Program Outcomes:

Program:	a	b	c	d	e	f	g	h	i	j	k
Course:	i,ii	iii	i,ii	iii	i,ii,iii	-	iv	i,ii	i,ii	i,ii	v
Emphasis:	5	3	2	2	5	1	3	2	2	2	3

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)
1. Properties of pure substances, state diagrams, thermodynamic tables, ideal gas law (1.5)
2. Control volume analysis (0.5 weeks)
3. Second Law of Thermodynamics, Carnot cycle (1.5)
4. Entropy, TdS equations, entropy balance for closed systems and control volumes (1.5)
5. Isothermal, isobaric, isometric, isentropic, and polytropic processes; thermodynamic efficiencies (2.5)
6. Humidity (0.5)
7. Engine cycles, refrigeration cycles (2.5)
8. In-class exams and labs (1)

Example of Course-level to Program-level Outcome Emphasis Map for Mechanical Engineering BS Degree Program

	FRESH	SOPH				JUNIOR									SENIOR			
Outcome	EK127	EK301	EK307	EK102	EK156	ME302	ME303	ME304	ME305	ME306	ME359	ME360	ME366	ME419	ME310	ME460	ME461	Senior Year Outcome Achievement Target
A	3	5	5	5	4	5	5	5	5	5	3	5	5	5	4	4	4	4.7
B	3	2	5	2	3	3	3	3	3	4	1	3	1	3	5	1	4	4.0
C	1	3	4	1	2	2	3	2	3	3	3	5	1	4	3	5	5	4.0
D	3	4	2	1	1	1	2	2	1	3	3	5	1	2	4	5	5	3.5
E	3	5	3	2	3	5	5	5	5	5	3	5	5	5	4	5	5	4.7
F	1	3	1	1	3	1	1	1	1	1	3	2	1	1	2	1	3	3.0
G	3	3	2	1	3	3	4	3	3	3	4	5	1	3	4	4	5	4.0
H	2	2	1	1	3	2	2	2	2	4	1	2	1	1	2	4	3	3.0
I	3	2	1	1	5	2	2	1	2	3	2	1	1	1	3	4	4	3.5
J	3	2	1	1	1	2	2	2	1	2	1	3	1	2	3	5	3	3.0
K	5	3	4	1	4	3	3	3	3	3	5	5	3	3	5	5	5	4.7

The table above shows the emphases that each of program outcomes A – K receives in each required course, and the overall level of achievement of the outcome expected for our students at the program level for their entire curriculum at the end of the senior year. Emphasis levels go from 1 (no emphasis) to 5 (substantial emphasis). The senior year expected outcomes are also relative to a 1 to 5 scale, but signify expected level of achievement, rather than emphasis.