Common Course Outline for: ENGR 2231 Thermodynamics

A. Course Description

1. Number of credits: 3
2. Lecture hours per week: 3
   Lab hours per week: 0
3. Prerequisites: PHYS 1121, CHEM 1061
4. Co-requisites: None
5. MnTC Goals: None

This course will cover the conservation of mass and energy and entropy balance; the properties, equations of state, and the processes and cycles for reversible and irreversible thermodynamic systems; and modes of energy transfer. Thermodynamic principles will be applied to modern engineering systems.

B. Date last revised: April 2017

C. Outline of major content areas:

1. Introductory concepts and definitions: Defining and describing systems and their behavior; measurement units; volume, pressure, temperature.
2. Energy and the first law of thermodynamics: Energy, work, and heat; energy balance in closed systems; analysis of cycles; energy storage.
3. Evaluating properties of matter: Equations of state; ideal gas law; ideal gas properties.
4. First law Analysis for a control volume: Development of equations for conservation of mass and energy; steady state applications; transient analysis.
5. Second law of thermodynamics: Introduction; irreversible and reversible processes; application to thermodynamic cycles.
6. Entropy: Introduction; incompressible substances; ideal gas; reversible and irreversible processes; adiabatic reversible processes; entropy of mixing
7. Applications: One or more of the following—vapor power systems, gas power systems, refrigeration, heat pumps, etc.

D. Course Learning Outcomes:

(Note: Two-year pre-engineering programs are not eligible for accreditation by ABET, the engineering accreditation agency. Nevertheless, the learning outcomes below are linked to ABET's program outcomes, of which there are eleven, labeled a-k. See Special Information (below) for a summary of the outcomes that are addressed.

Upon successful completion of this course, students will be able to:

1. Demonstrate an understanding of the thermodynamic properties and equations of state. [a, e]
2. Demonstrate knowledge of the first law of thermodynamics. [a, e]
3. Demonstrate an ability to apply the first law of thermodynamics to engineering processes. [a, c, e]
4. Demonstrate an understanding of entropy and the second law of thermodynamics. [a, e]
5. Demonstrate an ability to apply the second law of thermodynamics to real systems. [a, c, e, k]
6. Demonstrate an ability to analyze reversible and irreversible systems. [a, c, e]

7. Demonstrate an ability to apply the laws of thermodynamics to steady state open systems. [a, c, e]
8. Demonstrate an ability to apply the laws of thermodynamics to unsteady open systems. [a, c, e]
9. Demonstrate an ability to analyze one or more applications such as vapor power systems, gas power systems, refrigeration, heat pumps, etc. [a, c, e, k]

E. Methods for Assessing Student Learning:

Student evaluation is at the discretion of the instructor and may include exams, problem sets, and group projects.

F. Special Information:

Relationship to ABET Accreditation Criteria: To assist our transfer partner engineering programs in their ABET accreditation evaluations, this course teaches skills that help students achieve the following ABET outcomes:

[a] an ability to apply knowledge of mathematics, science, and engineering

[c] an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

[e] an ability to identify, formulate, and solve engineering problems

[k] an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

See Course Learning Outcomes above for how the ABET Outcomes are tied to the Course Learning Outcomes.