Course Outline for: ENGR 2231 Thermodynamics

A. Course Description:

1. Number of credits: 3
2. Lecture hours per week: 3
3. Prerequisites: CHEM 1061 and MATH 1510
4. Corequisites: 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 reviewed/updated: October 2023

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:

Upon successful completion of the course, the student will be able to:

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

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

E. Methods for Assessing Student Learning:

Methods for assessment may include, but are not limited to, the following:

1. Exams
2. Problem sets
3. 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:

1. An ability to apply knowledge of mathematics, science, and engineering.
2. 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.
3. An ability to identify, formulate, and solve engineering problems.
4. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.