Course Outline for: ENGR 2231 Thermodynamics

A. Course Description:

1. Number of credits: 3
2. Lecture hours per week: 3
3. Prerequisites: CHEM 1061 (C or higher) and MATH 1510 (C or higher)
4. Corequisites: None
5. MnTC Goals: None

An introductory course in engineering thermodynamics focusing on the principles of mass and energy conservation, entropy balance, and thermodynamic cycles, including power, refrigeration, and heat pump systems. These principles are applied to the analysis of modern engineering systems.

B. Date last reviewed/updated: January 2025

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. Convert between extensive and intensive representations of material properties.
2. Identify the phase of a simple compressible substance based on its location on a pvT surface or one of its projections.
3. Apply linear interpolation to material property table entries, both at and away from saturation states.
4. Calculate material properties using incompressible and ideal gas assumptions when applicable.
5. Solve the first law of thermodynamics to calculate relationships between physical properties, both for control volumes and closed systems.

6. Incorporate heat transfer calculations into problems using the differential form of the first law of thermodynamics.
7. Apply the Kelvin-Planck statement of the second law of thermodynamics to calculate performance metrics for power, refrigeration, and heat pump cycles.
8. Apply the entropy statement of the second law of thermodynamics to calculate entropy production for processes.

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:

None