BAKER COLLEGE
STUDENT LEARNING OUTCOMES

ME 3310 THERMODYNAMICS

3 Semester Hours

Student Learning Outcomes & Enabling Objectives

1. Explore thermodynamics concepts and definitions
   a. Explain several fundamental concepts including closed system, control volume, boundary and surroundings, property, state, process, the distinction between extensive and intensive properties, and equilibrium
   b. Define SI and English engineering units, including units for specific volume, pressure, and temperature
   c. Describe the relationship among Kelvin, Rankine, Celsius, and Fahrenheit temperature scales
2. Apply energy and the first law of thermodynamics
   a. Explain key concepts related to energy and the first law of thermodynamics . . . including internal, kinetic, and potential energy, work and power, heat transfer and heat transfer modes, heat transfer rate, power cycle, refrigeration cycle, and heat pump cycle
   b. Analyze closed systems including applying energy balances, appropriately modeling the case at hand, and correctly observing sign conventions for work and heat transfer.
   c. Examine energy analyses of systems undergoing thermodynamic cycles, evaluating as appropriate thermal efficiencies of power cycles and coefficients of performance of refrigeration and heat pump cycle
3. Evaluate properties
   a. Explain key concepts, including phase and pure substance, state principle for simple compressible systems, p-v-T surface, saturation temperature and saturation pressure, two-phase liquid–vapor mixture, quality, enthalpy, and specific heats.
   b. Analyze closed systems, including applying the energy balance with property data
   c. Sketch T–v, p–v, and phase diagrams, and locate states on these diagrams.
   d. Retrieve property data from Tables
   e. Apply the ideal gas model for thermodynamic analysis, including determining when use of the model is warranted
4. Explore control volume analysis using energy

    a. Describe key concepts related to control volume analysis, including distinguishing between steady state and transient analysis, distinguishing between mass flow rate and volumetric flow rate, and explaining the meanings of one-dimensional flow and flow work.
    b. Apply mass and energy balances to control volumes.
    c. Develop appropriate engineering models for control volumes, with particular attention to analyzing components commonly encountered in engineering practice such as nozzles, diffusers, turbines, compressors, heat exchangers, throttling devices, and integrated systems that incorporate two or more components
    d. Apply appropriate property data for control volume analyses.
5. Analyze reversible and irreversible processes using the second law of thermodynamics
    a. Explain key concepts related to the second law of thermodynamics, including alternative statements of the second law, the internally reversible process, and the Kelvin temperature scale
    b. list several important irreversibilities
    c. Calculate the performance of power cycles and refrigeration and heat pump cycles
    d. Describe the Carnot cycle
    e. Apply the Clausius inequality
6. Explore Entropy
    a. Explain key concepts related to entropy and the second law, including entropy transfer, entropy production, and the increase in entropy principle.
    b. Determine entropy, entropy change between two states, and analyze isentropic processes, using appropriate property data
    c. Express heat transfer in an internally reversible process as an area on a temperature–entropy diagram
    d. Analyze closed systems and control volumes, including applying entropy balances
    e. Employ isentropic efficiencies for turbines, nozzles, compressors, and pumps for second law analysis
7. Explain energy analysis
    a. Demonstrate understanding of key concepts related to exergy analysis, including the exergy reference environment, the dead state, exergy transfer, and exergy destruction
    b. Determine exergy at a state and exergy change between two states, using appropriate property data
    c. Apply exergy balances to closed systems and to control volumes at steady state
    d. Define and evaluate exergetic efficiencies
    e. Apply exergy costing to heat loss and simple cogeneration systems.
8. Explore vapor power systems

a. Explain the basic principles of vapor power plants
b. Develop and analyze thermodynamic models of vapor power plant based on the Rankine cycle and its modifications
c. Sketch schematic and accompanying T–s diagrams
d. Examine property data at principal states in the cycle
e. Apply mass, energy, and entropy balances for the basic processes
f. Determine power cycle performance, thermal efficiency, net power output, and mass flow rates
g. Describe the effects of varying key parameters on Rankine cycle performance
h. Discuss the principal sources of exergy destruction and loss in vapor power plants

9. Explain gas power systems
    a. Conduct air-standard analyses of internal combustion engines based on the Otto, Diesel, and dual cycles
    b. Conduct air-standard analyses of gas turbine power plants based on the Brayton cycle and its modifications
    c. Analyze subsonic and supersonic flows through nozzles and diffusers
10. Describe refrigeration and heat pump systems
    a. Demonstrate understanding of basic vapor-compression refrigeration and heat pump systems
    b. Develop and analyze thermodynamic models of vapor-compression systems and their modifications
    c. Explain the effects on vapor-compression system performance of varying key parameters
    d. Demonstrate understanding of the operating principles of absorption and gas refrigeration systems and perform thermodynamic analysis of gas systems

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These SLOs are not approved for experiential credit.

Effective: Spring 2020