

COURSE OUTLINE

ENES-181

Thermodynamics

3 Credits

HOWARD COMMUNITY COLLEGE

Description

This course is designed for the student who plans to transfer to an engineering program. Topics covered include the following: introduction to thermodynamics, thermodynamic properties of matter, laws of thermodynamics, cycles, reactions, mixtures, automobile engines and turbines. Prerequisite: MATH-182 and PHYS-111. (2 hours lecture, 2 hours lab).

Overall Course Objectives

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

1. Discuss the thermodynamic properties of a substance.
2. Analyze the behavior of a gas undergoing thermodynamic changes.
3. Use thermodynamic tables to determine the state of a vapor sample.
4. Use the first law of thermodynamics to solve energy transfer problems.
5. Investigate steady-state, steady-flow processes.
6. Apply the second law of thermodynamics to analyze heat engines and refrigerators.
7. Determine the entropy generated in various processes.
8. Discuss the cycles in power systems.
9. Analyze various combustion processes.
10. Discuss the third law of thermodynamics.

Major Topics

I. Concepts and Definitions

- A. Thermodynamic Systems
- B. Properties and State of a Substance
- C. Processes and Cycles
- D. Thermodynamic Variables
- E. The Zeroth Law of Thermodynamics
- F. Temperature Scales

II. Properties of a Pure Substance

- A. The Pure Substance
- B. Equilibrium of Phases in Pure Substance
- C. Equations of State
- D. Thermodynamic Tables
- E. Thermodynamic Surfaces

III. Work and Heat

- A. Definitions of Work and Heat
- B. Units of Work and Heat
- C. Work Done by a Moving Boundary
- D. Heat Transfer Modes

IV. **The First Law of Thermodynamics**

- A. Internal Energy
- B. Control Mass Undergoing a Cycle
- C. Control Mass Undergoing a Change of State
- D. Enthalpy
- E. Specific Heats
- F. The First Law as a Rate Equation
- G. Conservation of Mass
- H. Steady-State, Steady-Flow Process

V. **The Second Law of Thermodynamics**

- A. Heat Engines and Refrigerators
- B. The Kelvin-Planck Statement
- C. The Clausius Statement
- D. The Reversible Process
- E. The Carnot Cycle and Engine Efficiency

VI. **Entropy**

- A. The Entropy of a Pure Substance
- B. The Inequality of Clausius
- C. Entropy Changes in Various Processes
- D. Principle of Entropy Increase

VII. **Power Systems**

- A. The Rankine Cycle
- B. The Reheat and the Regenerative Cycles
- C. Comparison between Actual Cycles and Ideal Power Cycles
- D. Gas-Turbine Power Cycles
- E. The Otto, Diesel and Stirling Cycles

VIII. **Refrigeration Systems**

- A. The Vapor-Compression Refrigeration Cycle
- B. Ammonia Absorption Refrigeration Cycles
- C. Comparison between Actual Cycles and Ideal Refrigeration Cycles
- D. The Air-Standard Refrigeration Cycle

IX. **Chemical Reactions**

- A. Fuels and the Combustion Process
- B. Enthalpy and Internal Energy of Combustion
- C. The Third Law of Thermodynamics
- D. Chemical Equilibrium

Course Requirements

Grading/exams: Grading procedures will be determined by the individual faculty member but will be based on classroom exercises, homework, quizzes, unit tests, and final exam.

Writing: Specific writing assignments will be determined by the individual faculty member.

Other Course Information

This course is an Arts and Sciences elective.