

ENGR 2010 / CHEN 2110 – ENGINEERING THERMODYNAMICS (3)

Required Core Course

Catalog Data **Lec (2) Lab (3).** Laws of thermodynamics; energy transformations; properties and relationship among properties; equations of state and single processes and cycles.

Prerequisites Pr: CHEM 1030 or CHEM 1110 or CHEM 1117, MATH 1620 or MATH 1627 or MATH 1720; P/C: PHYS 1600 or PHYS 1607

Schedule Two one-hour class session and two 75-minute lab sessions per week.

Course Objectives This is the first engineering-wide course in thermodynamics for providing a comprehensive treatment of thermodynamics including the first and second laws of thermodynamics, equations of state, simple processes and cycles, and their applications throughout engineering. The primary emphasis is the application of thermodynamic fundamentals to the analysis of processes and engineering equipment.

Textbooks

1. Cengel, Boles, *Thermodynamics: An Engineering Approach*, 9e, **2019**, 9781259822674, McGraw Hill
2. Smith, Van Ness, Abbott, Swihart, *Introduction to Chemical Engineering Thermodynamics*, 8e, **2018**, 9781259696527

Topics Covered

1. Concepts and definitions (1 week)
2. Pure substances (2 weeks)
3. First Law - closed system (work and heat) (2 weeks)
4. First Law of Thermodynamics - open systems (4 weeks)
5. Second Law of Thermodynamics (2 weeks)
6. Entropy (3 weeks)
7. Exams (1 week)

Course Outcomes:

1. Employ both the SI and American Engineering system of units when solving engineering problems.
2. Explain the concepts of heat, work, kinetic energy, potential energy, internal energy, enthalpy, entropy and availability.

3. Explain the concepts of closed and open systems, intensive and extensive properties, thermodynamic state, process path, state and path functions, reference state and heat capacity.
4. Explain the concepts of reversible and irreversible processes.
5. Explain and apply the first and second laws of thermodynamics for a closed system.
6. Use thermodynamic tables, charts and equations of state to obtain the properties of density, temperature, pressure, specific volume, internal energy, enthalpy, entropy and heat capacity for pure substances.
7. Employ single- and double-interpolation techniques to obtain thermodynamic data from steam and refrigerant tables.
8. Draw a process path on P-v, T-v and T-s diagrams as an aid to solving thermodynamic problems.
9. Explain the concepts of mass balances and control volumes for open systems.
10. Apply mass balances (mass rate equation) and the first and second laws to solve open-system engineering problems.
11. Describe and analyze cyclic processes as related to heat engines, heat pumps, power generation and refrigeration systems.
12. Design and evaluate thermodynamic processes that minimize entropic losses.
13. Calculate the efficiency of process equipment such as pumps, compressors, turbines and nozzles.