MET-2320: THERMAL DYNAMICS

Cuyahoga Community College

Viewing: MET-2320 : Thermal Dynamics

Board of Trustees:
March 2023

Academic Term:
Fall 2023

Subject Code
MET - Mech Eng/Manuf Ind Eng Tech

Course Number:
2320

Title:
Thermal Dynamics

Catalog Description:
Heat, work, kinetic theory of gases, equation of state, thermodynamics system, control volume, first and second laws of thermodynamics, reversible and irreversible processes, and introduction to basic thermodynamic cycles.

Credit Hour(s):
3

Lecture Hour(s):
3

Requisites

Prerequisite and Corequisite
MATH-1620 Calculus II and PHYS-2310 General Physics I.

Outcomes

Course Outcome(s):
Evaluate the properties of thermodynamics.

Essential Learning Outcome Mapping:
Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):
1. Discuss thermodynamic systems and boundaries.
2. Explain the basic laws of thermodynamics.
3. Discuss various forms of energy including heat transfer and work.
4. Identify various type of properties (e.g., extensive and intensive properties).
5. Use tables, equations, and charts, in evaluation of thermodynamic properties.
6. Demonstrate an understanding of thermodynamic properties through identification and computation.

Course Outcome(s):
Apply conservation of mass, first law, and second law in thermodynamic analysis of systems (e.g., turbines, pumps, compressors, heat exchangers, etc.).

Essential Learning Outcome Mapping:
Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):

1. Discuss the basic problems and laws of thermodynamics.
2. Explain the concept of conservation mass, first law, and second law of thermodynamics.
3. Determine appropriate calculations to solve for application with a thermo system.

Course Outcome(s):

Utilize problem-solving skills to select the appropriate calculations and laws for selected given real-life problems.

Objective(s):

1. Use their problem-solving skills.
2. Apply laws of thermodynamics in solving problems.
3. Demonstrate the proper use of tables and charts in solving problems with proper calculation processes to solve real-life problems.

Methods of Evaluation:

A. Tests

B. Assignments

C. Final Exam

Course Content Outline:

a. Introductory concepts and definitions of thermodynamic systems
   i. Measuring units
   ii. Systems of units
   iii. Properties
   iv. Specific volume
   v. Pressure
   vi. Temperature
   vii. Demonstration of open, closed, thermally-isolated, mechanically-isolated and isolate systems
   viii. Demonstration of surrounding, system, and boundary
b. The First Law of Thermodynamics
   i. Statements for First Law of Thermodynamics
   ii. Demonstration of First Law of Thermodynamics for closed systems
c. Energy of a system and energy transfer by work of heat
   i. Demonstration of the different statements for First Law of Thermodynamics
   ii. Demonstration of the First Law of Thermodynamics for closed systems
d. Energy balance for systems and cycles
   i. Conservation of energy
   ii. Steady-state
   iii. Heat exchangers
   iv. Valves
   v. Systems integration
e. Ideal gas model
   i. Internal energy
   ii. Enthalpy
   iii. Specific heats of ideal gases
   iv. Applying energy balance using ideal gas tables and specific heats
   v. Polytropic process
f. Thermodynamic properties of a pure, simple, compressible substance
   i. Phase and pure substance
   ii. pvT relation
   iii. pvT diagram
   iv. Phase change
   v. Thermodynamics properties
   vi. Evaluating pressure
   vii. Specific volume and temperature
   viii. Evaluating specific internal energy and enthalpy

   ix. Using property tables
   x. Evaluating properties of liquids using saturated liquid data
g. Second Law of Thermodynamics and definition of entropy change
   i. Statements of the Second Law; irreversibly
   ii. Applying the Second Law to power and refrigeration cycles
   iii. Evaluating the performance of cycles
h. Irreversible and reversible processes
   i. Second Law of Thermodynamics
i. Entropy of pure, simple compressible substance
   i. TdS Equation
   ii. Entropy change of incomprehensible substance
   iii. Entropy change of the ideal gas
   iv. Entropy rate balance for control volumes
   v. Isentropic efficiencies of turbines, nozzles, compressors, and pumps, heat transfer and work in internally reversible steady-state processes
j. Gas power cycles, vapor compression cycle, refrigeration and heat pump cycles
   i. Performance of ideal vapor compression systems
   ii. Refrigeration systems
   iii. Absorption refrigeration
   iv. Heat pumps
   v. Gas refrigeration system
k. Heat Transfer
   i. Conduction
   ii. Convection
   iii. Radiation
   iv. Advection
   v. Phase changes

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Resources

Granet, Irvine; Bluestein, Maurice. *Thermodynamics and Heat Power*. 9th ED. Upper Saddle River, NJ., 2020.

Rolle, Kurt C. *Thermodynamics and Heat Power.* 8th ed. Upper Saddle River, NJ., 2014.

Cengel, Yunus and Michael Boles. *Thermodynamics: An Engineering Approach*. 9th ed. NA: McGraw-Hill, 2019.

Moran, Michael J., Howard N. Shapiro, Daisie D. Boettner, and Margaret B. Bailey. *Fundamentals of Engineering Thermodynamics*. 9th ed. Hoboken, NJ: John Wiley & Sons, Inc., 2018.

Resources Other

Scientific Calculator

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