ME 3322 Thermodynamics (Required)

Catalog Description: ME 3322 Thermodynamics (3-0-3)

Prerequisites: PHYS 2211 Introduction to Physics I and MATH 2403 Differential Equations (C or better)

Introduction to thermodynamics. Thermodynamic properties, energy and mass conservation, entropy and the second law, and second law analysis. Thermodynamic analysis of power, refrigeration, and heat pump systems; vapor cycles and gas cycles.

Textbook: Michael J. Moran, Howard N. Shapiro, Daisie D. Boettner, and Margaret B. Bailey, *Fundamentals of Engineering Thermodynamics*, 7th Edition, John Wiley & Sons, 2011.

Topics Covered:

1. Definitions: property, state, closed and open systems, temperature, pressure, work interactions, and heat transfer. State postulate.
2. Forms of energy: kinetic, potential, and internal.
3. Properties of pure substances, equilibrium diagrams, and quality; ideal gases and incompressible substances.
4. Conservation of mass: steady and transient processes.
5. Conservation of energy: closed and open systems, and steady and transient processes.
6. Introduction to the second law: Kelvin-Planck and Clausius statements; Clausius inequality; irreversibility and entropy; and the *Tds* equations.
7. Second law analysis of thermodynamic systems: exergy (availability); entropy production; and closed and open systems.
8. Power, refrigeration, and heat pump systems: vapor cycles (e.g., ideal, Rankine, and vapor-compression); and air standard analysis of gas cycles (e.g., ideal, Brayton, Otto, and diesel).

Course Outcomes:

Outcome 1: To teach students the basic principles of classical thermodynamics.

1.1 Students will demonstrate an understanding of the concepts of conservation of mass, conservation of energy, and the second law of thermodynamics.

1.2 Students will demonstrate an understanding of the concepts of work interaction and heat transfer.

1.3 Students will demonstrate an understanding of methods for determining thermodynamic properties of simple compressible substances, incompressible substances, and ideal gases.

Outcome 2: To train students to identify, formulate, and solve engineering problems in classical thermodynamics involving closed and open systems for both steady state and transient processes.

2.1 Students will demonstrate the ability to identify closed and open systems.

2.2 Students will demonstrate the ability to identify work interactions and heat transfer.

2.3 Students will demonstrate the ability to determine accurately the thermodynamic properties of simple compressible substances, incompressible substances, and ideal gases.

2.4 Students will demonstrate that they can apply the principles of conservation of mass and energy to the solution of problems.

Outcome 3: To train students in the application of a second law analysis to a thermodynamic system.

3.1 Students will demonstrate an understanding of the concepts of the second law including entropy, irreversibility, and the isentropic efficiency.

3.2 Students will demonstrate that they can apply a second law analysis to the solution of problems involving closed and open systems for both steady and transient processes.

Outcome 4: To train students to analyze the performance of power, refrigeration, and heat pump cycles.

4.1 Students will demonstrate that they can apply the principles of conservation of mass, conservation of energy, and the second law of thermodynamics to thermodynamic cycles.

4.2 Students will demonstrate the ability to analyze the performance of vapor and gas power cycles.

4.3 Students will demonstrate the ability to analyze the performance of vapor and gas refrigeration and heat pump cycles.

Correlation between Course Outcomes and Student Outcomes:

ME 3322											
	Mechanical Engineering Student Outcomes										
Course Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Outcome 1.1	X				X						X
Course Outcome 1.2	X				X						X
Course Outcome 1.3	X				X						X
Course Outcome 2.1	X				X						X
Course Outcome 2.2	X				X						X
Course Outcome 2.3	X				X						X
Course Outcome 2.4	X				X						X
Course Outcome 3.1	X				X						X
Course Outcome 3.2	X				X						X
Course Outcome 4.1	X				X						X
Course Outcome 4.2	X				X						X
Course Outcome 4.3	X				X						X

GWW School of Mechanical Engineering Student Outcomes:

(a) an ability to apply knowledge of mathematics, science and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multidisciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

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