ME 300
THERMODYNAMICS II

Course Outcomes [Related ME Program Outcomes in brackets]

1. Provide a thorough understanding of the applications of classical thermodynamics to practical problems. Applications include refrigeration and air conditioning, reciprocating engines, gas turbine engines, and power plants. [1, 2, 7]
2. Introduce the new concepts of transient energy analysis, availability analysis and generalized property relations. [1, 2, 7]
3. Provide an introductory treatment of thermodynamics for an expanded range of fluids including gas mixtures, real gases, and reacting flows. [1, 2, 7]
4. Provide limited design experiences for systems requiring significant consideration of thermodynamics. [2, 3]

Review (1 wk)

1. Properties
2. First and Second Law

First and Second Law Analyses (2 wks)

1. Transient Analysis
2. Irreversibility
3. Availability Analysis

Mixture Properties (2.7 wks)

1. Ideal Gas Mixtures
2. Mixture Properties
3. Gas–Vapor Mixtures
4. Air Conditioning Processes
5. Thermodynamic Relations

Combustion Analyses (3.3wks)

1. Stoichiometry of Reactions
2. Actual Combustion
3. Energy Analysis
4. Adiabatic Flame Temperature
5. Equilibrium Criteria
6. Chemical Potential
7. Equilibrium Constant
1. Equilibrium Composition
9. Equilibrium Calculations

Typical Special Problems (5 – 6 per semester)

- Psyometric Applications (e.g., Buildings, Swimming Pools, etc.)
- Design and Efficiencies of
  - Cogeneration Plants
  - Combined Power Plants
  - Industrial or Residential Furnaces
- Emission Analysis of Industrial or Residential Furnaces

Gas Power Cycles (3 wks)

1. Air Standard Cycles
2. Otto, Diesel, Dual Cycles
3. Brayton Cycle
4. Regeneration
5. Multi-Staging
6. Intercooling
7. Reheating
8. Aircraft Gas Turbines

Vapor Power Cycles (1.7 wks)

1. Rankine Cycle
2. Reheat Cycle
3. Regeneration
4. Co-generation

Vapor Compression Cycles (1.3 wks)

1. Vapor Compression Cooling
2. Heat Pumps
3. Multi-Staging
4. Alternative Refrigeration

COURSE NUMBER: ME 300

COURSE TITLE: Thermodynamics II

REQUIRED COURSE OR ELECTIVE COURSE: Restricted Elective

TERMS OFFERED: Fall and Spring

TEXTBOOK/REQUIRED MATERIAL:

M.J. Moran and H.M. Shapiro, Fundamentals of Engineering Thermodynamics, 9th ed, Wiley, 2018.

PRE-REQUISITIES:

ME 200 Thermodynamics II

ME 263 Introduction to Mechanical Engineering Design, Innovation and Entrepreneurship

COORDINATING FACULTY: E. A. Groll

COURSE DESCRIPTION: Properties of gas mixtures, air-vapor mixtures, applications. Thermodynamics of combustion processes, equilibrium. Energy conversion, power, and refrigeration systems.

COURSE OUTCOMES [Related ME Program Outcomes in brackets]:

1. Provide a thorough understanding of applications of classical thermodynamics to practical problems. Applications include refrigeration and air conditioning, reciprocating engines, gas turbine engines, and power plants. [1, 2, 7]
2. Introduce the new concepts of transient energy analysis, availability analysis and generalized property relations. [1, 2, 7]
3. Provide an introductory treatment of thermodynamics for an expanded range of fluids including gas mixtures, real gases, and reacting flows. [1, 2, 7]
4. Provide limited design experiences for systems requiring significant consideration of thermodynamics. [2, 3]

ASSESSMENTS TOOLS:

1. Weekly homework
2. Two 6-page design project reports.
3. Three 1-hour exams.
4. One comprehensive final exam.

NATURE OF DESIGN CONTENT: Open-ended problems are assigned for the purpose of conducting parameter studies and development of thermodynamic programming skills.

RELATED ME PROGRAM OUTCOMES:

1. Engineering fundamentals
2. Engineering design
3. Communication skills
4. Ethical/Prof. responsibilities
5. Teamwork skills
6. Experimental skills
7. Knowledge acquisition

PROFESSIONAL COMPONENT:

1. Engineering Topics: Engineering Science – 67%
   Engineering Design – 33%

COMPUTER USAGE: A non-linear equation solver with built-in thermodynamic property information is employed in this class to facilitate analysis and parametric design in applied problems. The computer tool, called Engineering Equation Solver (EES), is available to students for class and personal use.

COURSE STRUCTURE/SCHEDULE:

Lecture - 3 days per week at 50 minutes

PREPARED BY: E. A. Groll (Updated by R. P. Lucht, January 2019)

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