King Saud University
Department of Mechanical Engineering

ME 372 Thermodynamics II

Summary of ABET course information for BSME degree

Course Description

ME 372 Thermodynamics II
Availability; Thermodynamic relations; Ideal and real gas mixtures; Gas vapor mixtures; Thermodynamics of reciprocating gas compressors; Combustion; Ideal Power cycles, Introduction to internal combustion engine.

Number of Credits

3(3, 1, 1)

Prerequisites by Course

ME 371 (Thermodynamics I)

Prerequisites by Topic

1. Properties of pure substances.
2. First and second law of Thermodynamics.
3. Thermodynamic processes and cycles

Textbook

1. Thermodynamics an Engineering Approach, Cengel & Boles, McGraw Hill, Latest edition.

Reference Books

1. Applied Thermodynamics for Engineering Technologists, T. D. Eastop and A. McConkey, Longman Scientific & Technical, Ch. 12.
2. Internal Combustion Engine Fundamentals, John B. Heywood, McGraw Hill. Ch1, 2 and 5.

Course Topics

1. Second law analysis (availability or exergy)
   for open and closed systems. ------------------------------------(3 weeks, 9 classes)
2. Reciprocating air compressor,
   single and multi-stage with intercooling. ----------------------(2 weeks, 6 classes)
3. Generalized thermodynamic relations for internal energy;
   enthalpy; entropy; Joule Thomson; and specific heats. ------(2 weeks, 6 classes)
4. Basic laws of ideal and real gas mixtures;
   properties of gas-vapor mixtures. -------------------------------(2 weeks, 6 classes)

5. Combustion stoichiometric,
   first law application to a reacting system. ----------------------(3 weeks, 9 classes)
6. Ideal gas power cycles. ---(1 week, 3 classes)
7. Introduction to internal combustion engines. ------------------(2 weeks, 6 classes)

Course Objectives

(Entries in brackets are links to program educational objectives.)

1. Provide an introduction to second law analysis involving availability (exergy), lost work and second low efficiency. [A]
2. Students will demonstrate an understanding of the construction of thermodynamic property tables and the capability to determine changes in enthalpy, entropy and internal energy using a suitable equation of stat. [A]
3. Students will demonstrate the ability to perform analysis of thermodynamic system and to perform appropriate calculations where ideal /real gas mixtures are the working fluid. [A]
4. Students will demonstrate the ability to apply the first and second laws to combustion processes. [A]
5. Applying the first and second laws to the reciprocating gas compressors with intercooling. [A]
6. Students will demonstrate the ability to differentiate between the real and ideal internal combustion engines and do the thermal analysis for the ideal gas model cycles. [A]
7. Students will do experiments in the lab related to the subject studied. [A], [B], [C].

Course Outcomes

(Entries in brackets are links to program educational objectives.)

Tthe students will be able to:

1) Calculate the useful work potential (exergy) for a pure substance for a specified state. [e]
2) Calculate the exergy destruction and the entropy generation for any process. [e].
3) Calculate the second law efficiency of steady flow devices, such as a turbine, compressor, etc. [e]
4) Calculate the changes in internal energy, enthalpy, entropy, Joule-Thomson coefficient for any substance using a suitable equation of state. [e]
5) Use the Generalized thermodynamic property charts for real gases. [e]
6) Determine the behavior of ideal/ real gas mixtures using Dalton's law and Amagat's law. [e]
7) Determine heat, work, entropy change, or exergy destruction associated with a process undertaken by a mixture of ideal/ real gases. [e, k]
8) Apply the first law to calculate heat released during a steady flow combustion process for a known quantity of fuel and oxidizer at specified temperature and pressure of reactants and products. [e, k]
9) Calculate the adiabatic flame temperature for a known quantity of fuel and oxidizer. [e, k].

10) Apply the energy equation to calculate the power required for the reciprocating compressor with or without intercooling. [e]
11) Determine the heat lost through the intercooler and comprehend the definition of complete intercooling. [e]
12) Calculate the power required for the compressor for one stage or for various stages. [e]
13) Apply knowledge of subject covered in class to differentiate between two and four stroke engines, classification of engines, etc.. [e]
14) Calculate the performance and power developed by the ICE using the ideal gas models of engine cycles. [e].
15) Apply knowledge of subjects covered in class to understand class tours. [e, g, k]
16) Write a lab report and solve a design problem. [e, g, k]

Individually each student will be able to:

1. Work in a team. [d]

Class/Laboratory Schedule
Three 50-minute lecture sessions and two 50 minutes lab session per week.

Computer Applications
The computer is used to calculate the thermodynamic properties of gas mixtures and to analyze combustion systems.

Laboratory Projects
Student will submit lab report for the following experiments

1. Performance test for multi-stage reciprocating air compressor.
2. Measurement of heating value of a gaseous fuel.
3. Exhaust gas analysis
4. Performance of spark ignition engine.
5. Performance of compression ignition engine.

Contribution to Meeting the Professional Component
Engineering Topics

Science/Design Contents
3/0

Assessment Tools:

1. 10% Homework + quizzes
2. 10% Lab report + Oral lab test
3. **20% Midterm I, 04:00-05:30 PM 1/4/1429- 7/4/2008**
4. **20% Midterm II, 04:00-05:30 PM 14/5/1429- 19/5/2008**
5. 40% Final exam.
6. Course Evaluation by Students

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