MAE 110A
Thermodynamics

Designation: Required Course for ME and AE

Catalog Data:
MAE 110A Thermodynamics (4)

Fundamentals of engineering thermodynamics: energy, work, heat, properties of pure substances, first and second laws for closed systems and control volumes, gas mixtures. Application to engineering systems, power and refrigeration cycles, combustion.

Prerequisites: Grades of C- or better in Phys. 2C and Chem. 6A (or equivalent). Enrollment restricted to engineering majors.

Prerequisites by topic: Calculus, elementary physics and chemistry.

Textbook, Required Materials:
Moran, M.J. and H. N. Shapiro, Fundamentals of Engineering Thermodynamics, Fifth Edition, John Wiley & Sons, Inc., 2004.

Class/Laboratory Schedule: 4 lecture hours per week

Course Topics:
1. Basic concepts: energy, work, heat
2. Conservation of mass and energy
3. Properties of pure substances, ideal gas, incompressible substances
4. First law analysis of closed systems, control volumes, cycles
5. Second Law concepts, irreversibility
6. Carnot cycle, thermodynamic temperature scale, entropy
7. Second law analysis of closed systems, control volumes, cycles
8. Applications to power and refrigeration cycles
9. Ideal gas mixtures
10. Chemical reaction and combustion

Course Objectives:
(Numbers in parenthesis refer to MAE Program Outcomes)

Objective 1: To teach students the basic principles of classical thermodynamics (1a, AE12, ME12).

Objective 2: To train students to apply principles in analysis of thermodynamic systems (1a, 5e, ME15).

Objective 3: To teach good problem solving skills and written analysis (5e).

Objective 4: To introduce students to engineering applications in energy conversion, refrigeration, and combustion systems, to teach use of thermodynamics in engineering practice, and to promote awareness of impact of engineering solutions (8h, 9i, 10j).

Objective 5: To provide students a sound basis for subsequent courses in fluid mechanics, heat transfer, energy technologies and propulsion (1a, 5e, AE12, ME12).

Methods of Evaluation:

1. Weekly homework assignments.
2. Weekly quizzes to emphasize most important concepts.
3. Midterm and final exams.

Performance Criteria:
(Numbers in parentheses refer to the methods of evaluation used to assess student performance.)

Objective 1
1.1 Students will demonstrate understanding of basic thermodynamic principles (1,2,3).

Objective 2
2.1 Students will demonstrate ability to apply thermodynamics principles to engineering systems (1,2,3).

Objective 3
3.1 Students will demonstrate ability to formulate a thermodynamic problem and use an orderly and systematic approach in the analysis and solution (1,3). This includes:
3.2 Selection of appropriate systems for analysis and identification of relevant interactions with surroundings.
3.3 Identification of known and unknown data.
3.4 Effective use of system sketch to indicate two previous items.
3.5 Use of property diagrams to indicate equilibrium states and processes.
3.6 Formulation of simplifying assumptions and idealizations.
3.7 Identification of relevant physical laws and relationships.
3.8 Reduction of governing equations and appropriate relationships using simplifying assumptions and manipulation to forms giving desired results use of tables, charts, and relations to evaluate thermodynamic properties.
3.9 Numerical calculations and unit conversions.

Objective 4
4.1 Students will demonstrate familiarity and basic understanding of thermodynamic applications and engineering systems (1,2,3).
4.2 Students will demonstrate ability to apply principles and perform thermodynamic analyses of more complex systems (1,3).
4.3 Students will demonstrate understanding of various design aspects, constraints, and impact in practical systems (1,3).

Objective 5
5.1 Students will demonstrate an understanding of basic thermodynamics principles (1,2,3).

Contribution of Course to Professional Component:
Engineering Science

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Revised: S.G. Llewellyn-Smith, April 2008, via Teaching Work Group meeting.