Department of Mechanical Engineering
Mechanical Engineering Department

ME311– Thermodynamics I

(Required)

Catalog Description: **ME 311 (3-0-3)**

Thermodynamic Fundamentals. Topics are the first and second laws of thermodynamics, physical properties of pure substances, entropy, ideal and real gases, and gaseous mixtures.

Prerequisites: Math 211- Calculus III
Phys 111-Physics I

Textbook(s) Materials Required:

1. Y.Cengel and M.Boles, Thermodynamics, An Engineering Approach, 5th Ed, McGroow, 2006,
2. Software: EES, McGraw-Hill.

Reference(s) (Not Required):

1. P.Shmidt et.al,Thermodynamics, an Integrated Approach J. Wiley, 2006.

Course Supervisor: Dr. E.S.Geskin

Pre-requisite by topic

1. Partial derivatives
2. Scalar and vector quantities
3. Newton's laws of motion;
4. Work, energy, momentum;
5. The conservation laws.

Course Objectives[1]:

1. To provide the students the basic knowledge about the thermodynamic systems (A, B, C, D,E)
2. To develop students skill in numerical description of the state of the thermodynamic systems. (A, B, C, D)
3. To develop the students skill in numerical description of the processes in the thermodynamic systems. (A, B, C, D)
4. To develop the students skill in the applications of the conservation laws to the systems description.(A, B, C, D)
5. To provide the students with the basic understanding of the entropy function . (A, B, C, D,E)
6. To provide the students with knowledge of basics of the Second Law (A,B,C,D,E)
7. To develop students skill in evaluation and optimization of the energy conversion

Topics[2]:

1. Basic concepts. (3 hrs)

2. Energy analysis. (3 hrs)
3. Properties of a pure substance (6 hrs)
4. Energy analysis of closed systems (3 hrs)
5. Analysis of open systems (6 hrs)
6 Entropy function (9 hrs)
7 The Second law (6 hrs)
8. Exergy function (3 hrs)
9. Review (3 hrs)

Evaluation Method:
1. Quizzes
2. Exam
3. Homework
4. Project

Schedule: Lecture Recitation: 3 hours, per week

Professional Component: Engineering Science

Program Objectives Addressed: A, B, C, D, E

Course Outcomes[3] :

Objective 1

a. Students will demonstrate an ability to decompose industrial and environmental objects in a set of thermodynamic systems determine surface forces and pressure difference for a static fluid. (1,2,3) (a,b,c,e,k)
b. Students will demonstrate an ability to identify properties of a system. (1,2,3) (a,b,c,e,k)
c. Students will demonstrate an ability to identify processes in a systems. (1,2,3) (a,b,c,e,k)
d. Students will demonstrate an ability to apply thermodynamic, state and process (constitutive) equations to a system (1,2,3) (a,b,c,e)
e. Students will demonstrate understanding an ability to use basic thermodynamic variables (1,2,3) (a,b,c,e)

Objective 2

2.1. Students will demonstrate an ability to apply the state postulate to identification of the available and required information about a system. (1,2,3) (a,b,c,e)
2. 2. Students will apply the ideal gas equation to determination the properties of a gas (1,2,3) (a,b,c,e)
2. 3. Students will apply data bases to determination the properties of a gas and a mixture(1,2,3)(a,b,c,e)

Objective 3

3.1. Students will demonstrate an ability to identify a process equation for a given change in a system. (1,2,3) (a,b,c,e)
3.2. Students will demonstrate an ability to determine the work of a process (1,2,3) (a,b,c,e)
3.3. Students will demonstrate an ability to determine the heat of a process (1,2,3) (a,b,c,e)
3.4.Students will demonstrate an ability to construct process representation on a phase diagram (1,2,3) (a,b,c,e)

Objective 4

4.1. Students will demonstrate an ability to apply the First law to close systems (1,2,3) (a,c,e)
4.2. Students will demonstrate an ability to apply the conservation laws to open systems (1,2,3) (a,b,c,e)
4.3. Students will demonstrate an ability to apply the conservation laws to major energy conversion devices (1,2,3) (a,b,c,e)
4.4. Students will demonstrate an ability to apply the conservation laws to unsteady processes (1,2,3) (a,b,c,e)

Objective 5

5.1. Students will demonstrate understanding of statistical and phenomenological definitions of the entropy functions . (3) (j)
5.2. Students will demonstrate an ability to determine the entropy change in various systems (1,2,3) (a,b,c,e)
5.3. Students will demonstrate an ability to construct the entropy balance(1,2,3) (a,b,c,e)
5.4. Students will demonstrate an ability to apply the entropy function to description of the isentropic and irreversible processes. (1,2,3) (a,b,c,e)

Objective 6

6.2. Students will demonstrate understanding of the Second law (3) (j)
6.1. Students will demonstrate an ability to classify the processes in a system (1,2,3) (a,b,c,e)

Objective 7

7.1. Students will demonstrate an ability to apply the I and II Laws efficiencies to improvement of energy utilization (1,2,3,4) (a,b,c,e,h,k)
7.2 Students will demonstrate an ability to apply the Carnot theorem to design of the energy conversion system (1,2,3) (a,b,c,e,h,k)
7.3. Students will demonstrate an ability to apply the exergy function to evaluation of the energy quality (1,2,3) (a,b,c,e,h,k)
7.4. Students will demonstrate an ability to apply the exergy destruction and process irreversibility toevaluation of the energy utilizationfunction to evaluation of the energy quality (1,2,3) (a,b,c,e,h,k)

Prepared by Ernest S. Geskin Date: September 29, 2006

[1] Capital Letters in parenthesis refer to the Program Objectives of the Mechanical Engineering
Department. Listed in Sec 2 d Tables B-2-9, B-2-12. Table B-2-8 links Program Objectives with the ABET a-k Criterion.

[2] Topi**c** numbers in parenthesis refer to lecture hours. (three hours is equivalent to 1 week)

[3] Outcome numbers in parenthesis refer to evaluation methods used to assess the student performance. Lower case letters in parenthesis refer to ABET a-k outcomes.