Registration No. : | | | | | | | | | | |

Total number of printed pages – 3

B.Tech
BE 2103

Second Semester Examination – 2011

THERMODYNAMICS

Full Marks – 70

Time : 3 Hours

*Answer Question No. **1** which is compulsory and any **five** from the rest.*
The figures in the right-hand margin indicate marks.
(Use of Steam Table is allowed.)

1. Answer in brief : 2 ×10

(a) State the criteria which a system should satisfy for it to be in a state of thermodynamic equilibrium.

(b) State zeroth law of thermodynamics and how is it used ?

(c) Define absolute pressure and explain with a sketch under which circumstances it is equal to gauge pressure in a simple U-tube manometer.

(d) In what respects are heat and work transfers are similar ?

(e) What does the principle of entropy increase specify ?

(f) What are the two basic types of internal combustion engines ? What are the fundamental differences between the two ?

(g) How the quality of wet steam is determined ? Represent the constant quality line for wet steam at different pressures on a P-V diagram.

(h) How the entropy change in an irreversible process can be calculated ?

(i) Represent a constant pressure cooling process from super-heated region to wet region on a T-S plot.

P.T.O.

(j) Give the example of a process or system where all the three modes of heat transfer occurs in combination.

2. (a) Explain the salient features of triple point and critical point for a pure substance with water as example. Draw a P-T diagram representing these points. 4

(b) A rigid enclosure, 55 cm on each side, contains a wet mixture of water vapour at 95°C and 30 percent quality. Heat is added until the pressure is raised to 600 kPa. Determine the final state and the quantity of heat added. 6

3. (a) Define absolute zero temperature and Prove that it is not achievable in practice. 4

(b) During winter the inside temperature of a house is maintained at 21°C by a heat pump consuming a power of 6.0 kW. The heat loss rate from the house is 5000kJ/hr/°C. Determine the lowest outside temperature for which the heat pump can maintain the house temperature at 21°C. 6

4. (a) State second T-dS relation and derive from it change in entropy of an ideal gas for any process. 4

(b) A 0.5 kg block of copper initially at 80°C is cooled by immersion in an insulated tank containing 5 kg of liquid water at 23°C. The heat transfer process continues till thermal equilibrium of water and copper. Determine the entropy change for copper and water during the process. 6

5. (a) Define work thermodynamically. Show that in a reversible flow process work transfer is $\int v.dp$. 4

(b) 0.063 m^3 Air initially at pressure and temperature of 0.87 MPa and 237°C expands reversibly to 1.9 bar following the law $Pv^{1.3} = C$. Determine the following : 6

(a) Change in internal energy

(b) Work transfer

(c) Heat transfer.

6. (a) Explain briefly control volume approach of energy analysis. State the assumptions made during the control volume analysis. 4

(b) Air enters a compressor operating at steady state at a pressure of 1 bar, a temperature of 290K and a velocity of 6 m/s through an inlet with area 0.1 m^2. At the exit, the pressure is 7 bar, the temperature is 450 K and the velocity is 2 m/s. Heat transfer from the compressor to its surroundings occurs at a rate of 180 kJ/min. Employing the ideal gas model, calculate the power input to the compressor. 6

7. (a) Explain different methods for temperature calibration with their limitations. 4

(b) Liquid water at 1 MPa and 20°C is mixed with steam at 1 MPa and 100 percent quality to produce hot water to produce hot water at 120°C. The mixing occurs in a steady flow process inside an insulating box. If the inlet water flow at 20°C is 7.2 kg. Calculate the quantity of steam required. 6

8. (a) Draw a neat line diagram and explain working principle of a thermal power plant. 4

(b) What is the basic difference between refrigeration and air conditioning ? Draw the schematic diagram and discuss the function of each component of a vapour compression refrigeration system. 4

(c) What are the limitations of first law of thermodynamics? How these are being addressed in second law of thermodynamics? 2