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

Total number of printed pages – 3

B.Tech
BE 2103

Second Semester Examination – 2012

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.

1. Answer the following questions : 2 ×10

   (a) What are the parameters needed to define a thermodynamic system ?

   (b) A certain mass of ideal gas is heated from 325 K to 355 K at constant pressure of (i) 1 atm and (ii) 3 atm. In which case the energy requirement will be more ?

   (c) State two limitations of first law of thermodynamics.

   (d) "The internal energy of an isolated system remains constant". Justify.

   (e) Throttling occurs adiabatically or isentropically. Justify your answer.

   (f) What is the working principle of a thermocouple ?

   (g) Is it possible that a cyclic process can be irreversible ? Justify.

   (h) Heat rejections to the surroundings by a heat engine is more than that of a refrigerator when both are operating between same temperature limits, reversibly. True or false. Justify.

   (i) Under which condition the perfect gas laws can be applied to real gases.

   (j) Define the critical point of a pure substance.

P.T.O.

2. (a) Steam at 1.4 MPa expands through an expansion valve and is discharged to a condenser maintained at 710 mm of Hg. If the barometer reads 772 mm of Hg, determine the steam pressure, upstream and downstream of the expansion valve. 5

(b) Explain the principle of heat by different modes. Write the mathematical expression for amount of heat transferred in each mode. Give one example for each mode. 5

3. A gas held in a cylinder-piston assembly expands quasi-statically from 0.2 m^3/1000 kPa to 1.2 m^3/200 kPa, while its internal energy changes in accordance with

$U = 1.5\,Pv - 85$ KJ/kg

and the pressure P changes according to

$P = a + bv$ kPa, where v is the specific volume m^3/kg.

Evaluate the net heat transfer and maximum internal energy change during expansion. 10

4. (a) One kg of water at 373 k is converted to 373 k at 101 kPa. Determine the change in the internal energy during the process. 4

(b) A centrifugal air compressor delivers 900 kg/hr of air. Compute (i) the motor power required to drive the compressor (ii) the ratio of inlet to outlet pipe ID. 6

Given : air velocity at inlet = 5 m/s and at outlet = 7.5 m/s

Specific volume of air at inlet = 0.5 M^3/kg and at outlet = 15 M^3/kg

Enthalpy of compressed air = 20 kJ/kg

Heat loss to inter stage cooling = 75.6 KW

5. Three carnot engines HE1, HE2 and HE3 are lined up in a series. They are operating between two end temperature limits of 1000k and 300k. They produce the work output in the ratio of $W_1 : W_2 : W_3 = 4 : 3 : 2$. Determine the two intermediate temperatures. 10

6. In a steam locomotive, steam at 16 bar/0.98 dry is supplied to the steam header. However, as the steam flow through the pipeline, 25 kJ/kg of steam heat is lost to surroundings. What would be the steam conditions (temperature and quality) at header outlet ? Neglect the pressure drop. 10

7. With a neat sketch, explain the working principle of a thermal power plant. Write at least two methods to increase the efficiency of a power plant. 10

8. Write short notes on : 2.5×4

   (a) Pyrometer

   (b) Mollier's diagram

   (c) Heat pump

   (d) Carnot engine.