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

Total number of printed pages – 3

B. Tech
BE 2103

First Semester Back Examination – 2014

THERMODYNAMICS

BRANCH(S) : AEIE, AERO, AUTO, BIOMED, BIOTECH, CHEM, CIVIL, CSE, EC, EEE, EIE, ELECTRICAL, ENV, ETC, FASHION, FAT, IEE, IT, MANUTECH, MECH, MM, MME, PLASTIC, TEXTILE

QUESTION CODE : L 352

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 do you mean by property and process ?

   (b) Differentiate between intensive and extensive properties.

   (c) Differentiate between open system and closed system.

   (d) Mention different modes of heat transfer.

   (e) What is pdV work ?

   (f) Differentiate between adiabatic process and isothermal process

   (g) Draw the reversed Carnot cycle on p-v and T-s plot.

   (h) What do you mean by superheated steam? How it differs from dry steam ?

   (i) What is refrigerator ? How it differs from heat pump ?

   (j) Explain the terms :

      (i) Internal energy

      (ii) Enthalpy

2. (a) Derive the expression for displacement work in a polytropic process. 5

P.T.O.

(b) An engine cylinder has a piston of area $0.2m^2$ and contains gas at pressure of 15 bar. The gas expands according to a process which is represented by a straight line on a pressure-volume diagram. The final pressure is 1.5 bar. Calculate the work done by the piston if the stroke is 0.4m. 5

3. (a) State the first law of thermodynamics for a process and a cycle. 3

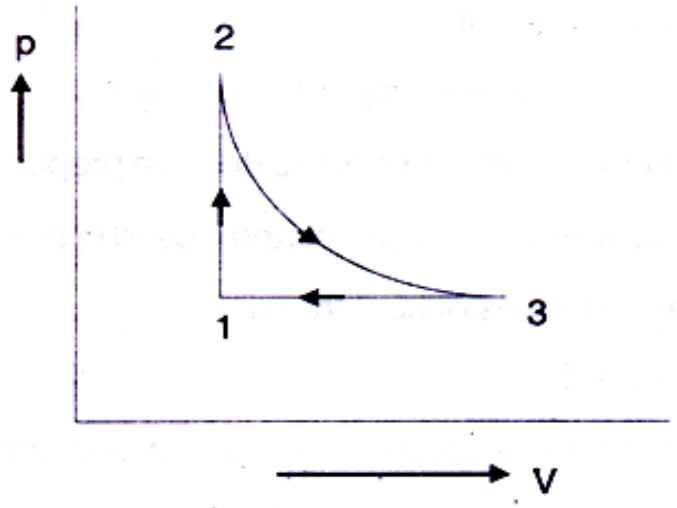
(b) A stationary fluid system goes through a cycle as shown in figure comprising the following processes.

(i) Process 1-2 isochoric heat addition of 235 kJ/kg

(ii) Process 2-3 adiabatic expansion to its original pressure with loss of 70 kJ/kg in internal energy

(iii) Process 3-1 isobaric compression to its original volume with heat rejection of 200 kJ/kg.

Prepare the balance sheet of energy quantities and find the overall changes during the cycle. 7



4. (a) Write down the mass conservation equation and steady flow energy equation for open system. 4

(b) In a gas turbine the gas enters at the rate of 5 kg/s with a velocity of 50 m/s and enthalpy of 900 kJ/kg and leaves the turbine with a velocity of 150 m/s and enthalpy of 400 kJ/kg. The loss of heat from the gases to the surroundings is 25 kJ/kg. Assume for gas R= 287 J/kg K and c_p=1005 J/kgK and the inlet conditions to be at 100 kPa and 30°C. Determine the turbine power output and the diameter of the inlet pipe. 6

5. (a) State the second law of thermodynamics (K-P and Clausius statements). 4

(b) Two reversible heat engines A and B are connected in series. A rejecting heat directly to B. Engine A receives 200 kJ at a temperature of 421°C from a hot source while engine B is in communication with a cold sink at 5°C. If the work output of A is twice that of B, find 6

(a) the intermediate temperature between A and B

(b) the efficiency of each engine

(c) the heat rejected to the cold sink.

6. (a) State Clausisus inequality. 5

(b) 0.01 kg of water at 20°C is converted into ice –10°C at constant atmospheric pressure. Assuming the specific heat of liquid water and ice to remain constant at 4.2 J/kg 2.1 J/kg respectively and latent heat of fusion of ice at 0°C to be 335 J/kg, Calculate the total entropy change of the system. 5

7. (a) Draw the phase equilibrium diagram for water-steam on T-s and h-s plot with relevant property lines. 5

(b) A vessel of volume 0.003155 m^3 contains a mixture of saturated water and saturated steam at a temperature 111.37°C. The mass of the liquid present is 1 kg. Find the pressure, the mass of liquid and vapor, the enthalpy, the entropy, and the internal energy. 5

8. Write short notes on any **two** of the following : 5×2

(a) Steam power plant

(b) Internal combustion engines

(c) Air compressor.