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

Total number of printed pages – 2

B. Tech

BENG 1103 (Old)

Second Semester (Back) Examination – 2013

THERMODYNAMICS

QUESTION CODE : B493

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) Differentiate between open system and closed system.

   (b) Convert 40 cm H_20 to absolute pressure in kPa, when the atmospheric pressure is 100 kPa.

   (c) Draw p-v and T-s diagram for Carnot cycle.

   (d) Write down whether followings are point function or path function (i) volume, (ii) temperature, (iii) heat, (iv) entropy.

   (e) Name the different types thermocouples used for measuring temperatures.

   (f) What is compressor ? How is it different from a turbine ?

   (g) What is the function of a heat exchanger ? Write down SFEE for it.

   (h) What is universal gas constant ? How to find characteristic gas constant ?

   (i) A system contains air at 1 bar and 45°C. Find the density of air in the system.

   (j) State the zeroth law of thermodynamics.

2. (a) What is thermodynamic equilibrium ? 4

   (b) In an ideal constant volume cycle the pressure and temperature at the beginning of compression are 97 kN/m^2 and 40°C, respectively. The volume ratio of compression is 7:1. The heat supplied during cycle is 1200 kJ/kg of working fluid. Determine (i) the maximum temperature attained in the cycle, (ii) the thermal efficiency, (iii) the work done during the cycle/kg of working fluid. 6

3. (a) State first law of thermodynamics for a system and a cycle. 4

(b) A piston-cylinder device operates 1 kg of fluid at 20bar pressure. The initial volume is 0.04 m^3. the fluid is allowed to expand reversibly following a process $pV^{1.45}$ = constant so that the volume becomes double. The fluid is then cooled at a constant pressure until the piston comes back to the original position. Keeping the piston unaltered, heat is added reversibly to restore it to the initial pressure. Calculate the work done in the cycle. 6

4. (a) Derive the expression for finding the work done during an isothermal process. 4

(b) 680 kg of fish at 5°C are to be frozen and stored at –12°C. the specific heat of fish above freezing point is –2°C, and the latent heat of fusion is 234.5 kJ/kg. how much heat must be removed to cool fish, and what percentage of this heat is latent heat. 6

5. (a) Derive the SFEE for a control volume. 4

(b) A blower handles 1kg/s of air at 20°C and consumes a power of 15 kW. The inlet and outlet velocities of air are 100 m/s and 150m/s respectively. Find the exit air temperature, assuming adiabatic conditions. Take Cp of air is 1005 J/kg-K. 6

6. (a) State the second law of thermodynamics (both K-P and Clausius statement). 4

(b) A heat engine is used to drive a heat pump. The heat transfers from the heat engine and from the heat pump are used to heat the water circulating through the radiators of a building. The efficiency of the heat engine is 27% and the COP of the heat pump is 4. Evaluate the ratio of the heat transfer to the circulating water to the heat transfer to the engine. 6

7. (a) Define the following terms : (i) wet steam, (ii) dry steam, (iii) super heated steam. 4

(b) A vessel of volume 0.04 m^3 contains a mixture of saturated water and steam at a temperature of 250°C. The mass of the liquid present is 9 kg. find the pressure, the specific volume, the enthalpy, the entropy, and the internal energy. 6

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

(a) Throttling calorimeter

(b) Refrigerator and Heat pump

(c) Flow work and displacement work

(d) The inequality of Clausius.
