PVP 14

Code: ME3T2

II B.Tech - I Semester–Regular/Supplementary Examinations – November 2017

BASIC THERMODYNAMICS
(MECHANICAL ENGINEERING)

Duration: 3 hours Max. Marks: 70

PART – A

Answer ***all*** the questions. All questions carry equal marks

11x 2 = 22 M

1. a) Differentiate closed and open system.
   b) Define: Specific heat capacity at constant pressure.
   c) How do you classify the properties?
   d) Define: PMM of first kind.
   e) What is meant by steady flow process?
   f) State Clausius statement of second law of thermodynamics.
   g) What is the difference between a heat pump and a refrigerator?
   h) Define latent heat of evaporation.
   i) Explain Dalton's law of partial pressure.
   j) Define mean effective pressure as applied to gas power cycles.
   k) What is the effect of cut-off ratio on the efficiency of diesel cycle, when the compression ratio is kept constant?

PART – B

Answer any ***THREE*** questions. All questions carry equal marks. 3 x 16 = 48 M

2. a) Distinguish between reversibility and irreversibility.

8 M

b) A mass of 8 kg gas expands within a flexible container so that the p–v relationship is $pv^{1.2}$ = constant. The initial pressure is 1000 kPa and the initial volume is 1 m^3. The final pressure is 5 kPa. If specific internal energy of the gas decreases by 40 kJ/kg, find the heat transfer in magnitude and direction. 8 M

3. a) A gas undergoes a thermodynamic cycle consisting of three processes beginning at an initial state where p_1 = 1 bar, V_1 = 1.5 m^3 and U_1 = 512 kJ. The processes are as follows:

(i) Process 1–2: Compression with pV = constant. p_2 = 2 bar, U_2 = 690 kJ

(ii) Process 2–3: W_{23} = 0, Q_{23} = –150 kJ, and

(iii) Process 3–1: W_{31} = +50 kJ. Neglecting KE and PE changes, determine the heat interactions Q_{12} and Q_{31}.

8 M

b) A turbine operates under steady flow conditions, receiving steam at the following state: Pressure 1.2 MPa, temperature 188°C, enthalpy 2785 kJ/kg, velocity 33.3 m/s and elevation 3 m. The steam leaves the turbine at the following state: Pressure 20 kPa, enthalpy 2512 kJ/kg, velocity 100 m/s, and elevation 0 m. Heat is lost to the surroundings at the rate of 0.29 kJ/s. If the rate of steam flow through the turbine is 0.42 kg/s, what is the power output of the turbine in kW? 8 M

4. a) Why Carnot cycle cannot be realized in practice? 8 M

b) A household refrigerator is maintained at a temperature of 2°C. Every time the door is opened, warm material is placed inside, introducing an average of 420 kJ, but making only a small change in the temperature of the refrigerator. The door is opened 20 times a day, and the refrigerator operates at 15% of the ideal COP. The cost of work is Rs. 2.50 per kWh. What is the monthly bill for this refrigerator? The atmosphere is at 30°C. 8 M

5. a) Derive Clausius Clapeyron equation. 8 M

b) The gravimetric analysis of dry air is approximately: oxygen = 23%, nitrogen = 77%. Calculate:
(i) The volumetric analysis, (ii) The gas constant, (iii) The molecular weight, (iv) the respective partial pressures, (v) The specific volume at 1 atm, 15°C, and (vi) How much oxygen must be added to 2.3 kg air to produce. A mixture which is 50% oxygen by volume? 8 M

6. a) Derive air standard efficiency for diesel cycle with PV and TS diagrams. 8 M

b) The compression ratio of an air standard dual cycle is 12 and the maximum pressure on the cycle is limited to 70bar. The pressure and temperature of the cycle at the beginning of compression process are 1bar and 300K. Calculate the thermal efficiency and Mean Effective Pressure. Assume cylinder bore = 250mm, Stroke length = 300mm, C_p=1.005KJ/Kg K, C_v=0.718KJ/Kg K. 8 M