Code: 13A03302 **R13**

B.Tech II Year I Semester (R13) Supplementary Examinations June 2017

THERMODYNAMICS

(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

PART – A

(Compulsory Question)

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1 Answer the following: (10 X 02 = 20 Marks)

(a) Convert 35°C into K and 60°F into R.
(b) What is meant by quasi static process?
(c) What is meant by pmm1?
(d) Mention some applications in which steady flow equations are used.
(e) Define the term entropy.
(f) State Clausius theorem.
(g) What is the important vapour process?
(h) What is meant by joule Thomson coefficient?
(i) Define Avogadro's law.
(j) State Dalton's law of mixtures.

PART – B

(Answer all five units, 5 X 10 = 50 Marks)

UNIT – I

2 A gas undergoes a quasi static expansion which follows P = a+ bV, where a and b are constants. The initial and final volumes are 0.2 m^3 and 1.2 m^3. The initial and final pressures are 1000 kPa and 200 kPa respectively. The specific internal energy of the gas is given by the equation U = 1.5PV – 85 kJ/kg, where P is in kPa and U is in m^3/kg. Calculate the net heat transfer.

OR

3 The various process of a gas undergoing following thermodynamic cycle:

Process 1-2 constant pressure P = 2.5 bar, v_1 = 0.4 m^3, W_{12} = 13 kJ
Process 2-3 compression PV = Constant, $U_3 = U_2$
Process 3-1 constant volume $U_1 - U_3$ = - 30 kJ

Calculate the net work for the cycle in kJ, heat transfer for process 1-2.

UNIT – II

4 A nozzle is a device for increasing the velocity of a steadily flowing stream. At the inlet to a certain nozzle, then the enthalpy of fluid passing is 3000 kJ/kg and velocity is 60 m/s. at the discharge end, the enthalpy is 2762 kJ/kg. the nozzle is horizontal and there is negligible heat loss from it.

(i) Find the velocity at the exit from the nozzle.
(ii) If the inlet area is 0.1 m^2 and the specific volume at inlet is 0.187 m^3/kg, find the mass flow rate.
(iii) If the specific volume at nozzle exit is 0.498 m^3/kg, find the exit area of the nozzle.

OR

5 In a steady flow apparatus, 120 kJ of work is done by each kg of fluid. The specific volume of the fluid, pressure and velocity at the inlet are 0.2 m^3/kg, 550 kPa and 13 m/s. The inlet is 28 m above the floor, and the discharge pipe is at the floor level. The total heat loss between the inlet and discharge is 5 kJ/kg of fluid. In flowing through this apparatus, how much does the internal energy increases or decreases. The discharge condition are 0.5 m^3/kg, 90 kPa and 250 m/s.

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UNIT – III

6 (a) A food freezer maintains temperature of -13℃. If heat leaks into the freezer at the continuous rate of 1.65 kJ/s. What is the power necessary to pump out heat continuously?

(b) 3 kg of air is expanded at constant pressure to three times its initial volume. Calculate the change in entropy if the initial temperature of the air is 300℃.

OR

7 (a) 2 kg of air at pressure P_1 and temperature 978 K is mixed with 2 kg of air at the same pressure but at 486 K. Determine the loss in availability if the atmospheric temperature is 310 K.

(b) 2 kg of air is compressed polytropically from pressure 2 bar and temperature 350 K to a pressure of 8 bar and 400 K. Determine the irreversibility and reversibility measure assuming the sink temperature of 348 K.

UNIT – IV

8 (a) Find the condition of the steam leaving the turbine and the work done/kg of the steam passing through the turbine if the steam is at 12 bar and 300℃ is throttled till its pressure becomes 7 bar and it expands isentropically passing through a turbine until pressure falls to 1 bar. Also find the work done/kg of stem if the steam is directly passed through the turbine without throttling.

(b) Using Clausius clapeyron equation, estimate the enthalpy of vaporization at 220 ℃ saturation temperature. Take the following data T_s = 220°c, v_g = 0.086 m^3/kg, v_f = 0.001109 m^3/kg, (dP/dT) = 52 kPa/K.

OR

9 (a) Derive Clausius clapeyron equation.

(b) 8 kg of steam at 8 bar and 0.8 dry is heated at constant pressure till the volume is doubled. Determine final quality of steam, heat added and change in internal energy.

UNIT – V

10 (a) 4 kg of O_2 at a pressure 100 kPa and 75℃ are mixed with 7 kg of N_2 at the same pressure and temperature. Find the increase in entropy.

(b) A vessel of 0.5 m^3 capacity contains 3 kg of CO_2 and 2 kg of N_2 at 320 K. Determine: (i) Pressure in the vessel. (ii) Mole fraction. (iii) R and M of the mixture.

OR

11 In an air standard Otto cycle the pressure at the beginning and end of compression are 1 bar, 15 bar the maximum pressure is 30 bar. Determine: (i) Compression ratio. (ii) Thermal efficiency. (iii) Mean effective pressure.

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