

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

THERMODYNAMICS

(Mechanical Engineering)

Time: 3 hours

Max. Marks: 70

PART – A

(Compulsory Question)

- 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 $U = 1.5PV - 85 \text{ kJ/kg}$, 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 $P = 2.5 \text{ bar}$, $v_1 = 0.4 \text{ m}^3$, $W_{12} = 13 \text{ kJ}$
 - Process 2-3 compression $PV = \text{Constant}$, $U_3 = U_2$
 - Process 3-1 constant volume $U_1 - U_3 = -30 \text{ kJ}$
- 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 $0.187 \text{ m}^3/\text{kg}$, find the mass flow rate.
 - (iii) If the specific volume at nozzle exit is $0.498 \text{ m}^3/\text{kg}$, 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 $0.2 \text{ m}^3/\text{kg}$, 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 $0.5 \text{ m}^3/\text{kg}$, 90 kPa and 250 m/s.

Contd. in page 2

UNIT – III

- 6 (a) A food freezer maintains temperature of -13°C . 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°C .

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°C 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 steam if the steam is directly passed through the turbine without throttling.
- (b) Using Clausius clapeyron equation, estimate the enthalpy of vaporization at 220°C saturation temperature. Take the following data $T_s = 220^{\circ}\text{C}$, $v_g = 0.086 \text{ m}^3/\text{kg}$, $v_f = 0.001109 \text{ m}^3/\text{kg}$, $(dP/dT) = 52 \text{ kPa/K}$.

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°C 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.
