PVP 19

Code: 19ME3302

II B.Tech - I Semester – Regular Examinations – MARCH 2021

ENGINEERING THERMODYNAMICS
(MECHANICAL ENGINEERING)

Duration: 3 hours Max. Marks: 70

Note: 1. This question paper contains two Parts A and B.
2. Part-A contains 5 short answer questions. Each Question carries 2 Marks.
3. Part-B contains 5 essay questions with an internal choice from each unit. Each question carries 12 marks.
4. All parts of Question paper must be answered in one place

PART – A

1. a) Specify clearly, following system can be treated as open/closed/isolated.
(i) Boiler (ii) Mixture of ice and water in a metal container (iii) heating of air in cycle tube, (iv) nozzle.
b) Explain PMM-2
c) Can entropy of universe ever decrease? Why?
d) Define dryness fraction of steam.
e) Write the expression for efficiency of Brayton cycle

PART – B

UNIT – I

2. a) What do you understand by Quasi-Static process? Explain its significance in thermodynamics. 6 M
b) A mass of gas is compressed in a quasi-static process from 80 kPa, $0.1m^3$ to 0.4MPa, $0.03m^3$. Assuming that the pressure and volume are related by pv^n= constant, find work done by the gas system. 6 M

OR

3. a) What do you understand by 'internal energy' of a system? Prove that it is property of a thermo dynamic system. 6 M

b) In a steady flow apparatus, 135 kJ of work is done by each kg of fluid. The specific volume of the fluid, pressure, and velocity at the inlet are 0.37 m^3/kg, 600 kPa, and 16 m/s. The inlet is 32 m above the floor, and the discharge pipe is at floor level. The discharge conditions are 0.62 m^3/kg, 100 kPa, and 270 m/s. the total heat loss between the inlet and discharge is 9 kJ/kg of fluid. In flowing through this apparatus, does the specific internal energy increases or decrease, and by how much? 6 M

UNIT – II

4. a) Why the COP of a heat pump is higher than that of a refrigerator, if both operate between the same temperature limits? 6 M

b) The interior of refrigerator is provided by incandescent lamps whose switches are actuated by the opening of the refrigerator door. Consider a refrigerator whose 40 W bulb remains on continuously as a result of malfunction of the switch. If the COP is 1.3 and cost of electricity is 8 Rs/kWh, determine the increase in the energy consumption and its cost. 6 M

OR

5. a) Why Carnot cycle cannot be realized in practical? 6 M

b) Two reversible heat engines A and B are arranged in series, A rejecting heat directly to B. Engine A receives 200KJ at 421^0C while B is in communication with a cold sink at 4.4^0C. If the work output of A is twice that of B. Find (i) the intermediate temperature between A and B (ii) efficiency of each engine (iii) heat rejected to cold sink. 6 M

UNIT-III

6. a) What do you mean by 'Clausius inequality'? Explain — 6 M

   b) 0.03 m^3 of nitrogen contained in a cylinder behind a piston is initially at 1.05 bar and 15°C. The gas is compressed isothermally and reversibly until the pressure is 4.2 bar. Calculate the change of entropy, the heat flow, and the work done, and sketch the process on a *p-v* and *T-s* diagrams. Assume nitrogen to act as a perfect gas. Molecular weight of nitrogen = 28. — 6 M

OR

7. a) Derive an expression for decrease in available energy when heat is transferred through a finite temperature difference — 6 M

   b) Calculate the decrease in available energy when 25 kg of water at 95° C mix with 35 kg of water at 35°C, the pressure being taken as constant and temperature of the surroundings being 15°C (C_p of water = 4.2 kJ/ kg.K) — 6 M

UNIT – IV

8. a) Draw the phase equilibrium diagram for a pure substance on T – S plot with relevant constant property lines and explain. — 6 M

   b) A vessel having a capacity of 0.05 m^3 contains a mixture of saturated water and saturated steam at a temperature of 245°C. The mass of the liquid present is 10 kg. Calculate the pressure, mass, specific volume, specific enthalpy, specific entropy, and specific internal energy. — 6 M

OR

9. a) Explain the terms: Degree of super heat, degree of sub-cooling and give the procedure to calculate the properties of superheated steam. — 6 M

b) A large insulated vessel is divided into two chambers, one containing 5Kg of dry saturated steam at 0.2 MPa and other 10kg of steam 0.8 quality at 0.5MPa. If the partition between the chambers is removed and the steam is mixed thoroughly and allowed to settle, find the final pressure, steam quality and entropy change in the process. 6 M

UNIT – V

10. a) Derive an expression for thermal efficiency of a 'Lenoir Cycle'. 6 M

b) An engine is to operate on Otto cycle with the following data: Maximum temperature 1400 K, exhaust temperature 700 K. State of air at the beginning of compression 0.1 MPa, 300 K. Estimate the compression ratios, the maximum pressures, efficiencies, and rate of work output (for 1 kg/min of air) of the respective cycle. 6 M

OR

11. a) Derive the expressions for efficiency and mean effective pressure of Diesel cycle. 6 M

b) An Ericsson cycle operating with an ideal regenerator works between 1100 K and 288 K. The pressure at the beginning of isothermal compression is 1.013 bar. Determine i) work per kg of air, and ii) the cycle efficiency. 6 M