Exam.Code:0939
Sub. Code: 6701

2074

B.E. (Mechanical Engineering)
Third Semester
MEC-301: Thermodynamics

Time allowed: 3 Hours **Max. Marks: 50**

NOTE: ***Attempt five questions in all, including Question No. I which is compulsory and selecting two questions from each Part. Use of steam table allowed. Make suitable assumptions in case of any missing data.***

x-x-x

1. (a)What do you understand by system, surroundings and boundary.

(b) What is Control volume.

(c) What are macroscopic and microscopic forms of energy.

(d) What is difference between Path function and Point function.

(e) What is Saturation temperature and Saturation pressure.

(f) What is Polytropic process.

(g) Define Conservation of mass principle.

(h) Write differences between refrigerators and heat pump.

(i)What are internally and externally reversible processes.

(j) What is effect of superheating on Rankine efficiency.

(1*10=10)

PART-A (Attempt any two questions)

2. (a) A closed system of constant volume experiences a temperature rise of 25° C when a certain process occurs. The heat transferred in the process is 30 kJ. The specific heat at constant volume for the pure substance comprising the system is 1.2 kJ/g °C, and the system contains 2.5 g of this substance. Determine (i) The change in internal energy (ii) The work done (7)

(b) Determine the power required to accelerate a 900 kg car from rest to a velocity of 80 km/h in 20 s on a level road. (3)

3. (a) What are different mechanisms for transferring energy to and from a control volume. (6)

(b) A rigid tank contains 10 kg of water at 90° C. if 8 kg of water is in the liquid form and rest in in the vapor form, determine (i) the pressure in the tank (ii) volume of the tank. (4)

P.T.O.

4. (a) A piston-cylinder device initially contains 0.4 kg of nitrogen gas at 160 kPa and 140° C. The nitrogen is now expanded isothermally to a pressure of 100 kPa. Determine the boundary work done during this process. (5)

(b) Draw and explain T-v and P-v Diagram of a pure substance (5)

PART-B (Attempt any two questions)

5. (a) Sketch the Rankine cycle on p-v & T-s diagram and state in what respects it differs from the Carnot cycle working between the same temperature limits . (4)

(b) Steam flows steadily through an adiabatic turbine. The inlet conditions of the steam are 10 MPa, 450° C and 80 m/s and the exit conditions are 10 kPa, 92 percent quality and 50 m/s. The mass flow rate of steam is 12 kg/s. Determine (i) the change in kinetic energy (ii) the power output and (iii) the turbine inlet area. (6)

6. In a Rankine cycle, the steam at inlet to turbine is saturated at a pressure of 35 bar and the exhaust pressure is 0.2 bar. Determine the (i) pump and turbine work (ii) rankine efficiency (iii) condenser heat flow (iv) dryness fraction at the end of compression. Assume flow rate of 9.5 kg/s. (10)

7. (a) Turbine bleed system enters an open feedwater heater of a regenerative Rankine cycle at 200 kPa and 150° C while the cold feedwater enters at 40°C. Determine the ratio of the bleed steam mass flow rate to the inlet feedwater mass flow rate required to heat the feedwater to 110°C. (5)

(b) Determine the COP of a heat pump that supplies energy to a house at a rate of 8000 kJ/h for each KW of electric power it draws. Also, determine the rate of energy absorption from the outdoor air. (5)

x-x-x