B.E./B.TECH. Degree Examination, December 2020

Third Semester

ME16301-Engineering Thermodynamics

(Regulation 2016)

Time: Three hours Maximum : 80 Marks

Answer **ALL** questions

PART A - (8 X 2 = 16 marks)

1. Select the odd one from the list below

   (a)Pressure (b)temperature (c) specific volume (d) Volume

2. Thermal efficiency of a carnot engine for the given temperature limits will be

   (a) maximum (b)minimum (c) 100 % (d) Zero

3. Maximum moisture content at the turbine exhaust is not allowed to exceed

   (a)10% (b)15% (c) 85% (d) 20%

4. One ton of refrigeration is equivalent to

   (a)1 kW (b)2.5 kW (c) 5 kW (d) 3.5 kW

5. When an open system will be called as closed system and isolated system?
6. Two adiabatic lines never intersect each other. Justify
7. In a T-S diagram show the effect of increasing steam temperature at a given boiler pressure on dryness fraction of seam at turbine exhaust.
8. When a real gas behaves like an ideal gas?

PART B - (4 X16 = 64 marks)

09. (a) A stone of 20 kg mass and a tank containing 200 kg water comprise a system. The stone is 15 m above the water level initially. The stone and water are at the same temperature initially. If the stone falls into the water, the determine change in internal energy, potential energy and kinetic energy, heat and work transfer for the following conditions. **(16)**

   (i) When the stone is about to enter the water

   (ii) When the stone has come to rest in the tank

   (iii) When the stone and water come to their initial temperature

(OR)

(b) A heat pump working on a reversed Carnot cycle takes in energy from a reservoir maintained at 5^0C and delivers it to another reservoir where temperature is 77^0C. The heat pump derives power for its operation from a reversible engine operating within the higher and lower temperatures of 1077^0C and 77^0C. **(16)**

For 100 kJ/kg of energy supplied to reservoir at 77^0C, estimate the energy taken from the reservoir at 1077^0C

10. (a) 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 (i) pump work (ii) the turbine work (iii) The Rankine efficiency (iv) The Carnot efficiency (v) The condensate heat flow (vi) the dryness at the end of expansion. Assume flow rate of 9.5 kg/s **(16)**

(OR)

(b) Steam is supplied to a turbine at 30 bar and 350 ^{0}C. the turbine exhaust pressure is 0.08 bar. The main condensate is heated regeneratively in two stages by steam bled from the turbine at 5 bar and 1.0 bar respectively. Calculate masses of steam bled off at each pressure per kg of steam entering the turbine and the theoretical thermal efficiency of the cycle. **(16)**

11. (a) Prove that

$$du = C_V dT + \left[T\left(\frac{\beta}{K}\right)_V - p \right] dv$$

$$dh = C_p dT + v\left[1 - T\beta\right] dp$$

(16)

(OR)

(b) One kg of CO_2 has a volume of 1 m^3 at 100 ^{0}C. Compute the pressure by
(a)Vander walls equation (b) ideal gas equation **(16)**
(c) compressibility chart

12. (a) It is required to design an air conditioning plant for a small office room for the following winter conditions
Outdoor condition = 14°C DBT, 10°C WBT
Required comfort condition = 20°C DBT, 60% RH
Seating capacity of office = 60
Amount of air supplied = 0.3 m^3/min per person **(16)**
If the required condition is achieved first by heating and then by adiabatic humidifying, estimate
(a) heating capacity of the coil and the surface temperature required if the by-pass factor of the coil is 0.4 (b) the capacity of the humidifier.

(OR)

(b) A mixture of hydrogen and oxygen is to be made so that the ratio of hydrogen to oxygen is 2:1 by volume. If the pressure and temperature are 1 bar and 25^{0}C respectively, calculate(a)Mass of oxygen required (b) the volume of the container **(16)**