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Question Paper Code: 53703

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2023

Third Semester

Mechanical Engineering

15UME303 - ENGINEERING THERMODYNAMICS

(Regulation 2015)

(Steam table Mollier chart and Psychrometric chart Permitted)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

- Which of the following is an intensive property of a thermodynamic system CO1- R
(a) Volume (b) Temperature (c) Mass (d) Energy
- The absolute zero temperature is taken as CO1- R
(a) -273°C (b) 273 K (c) 237°C (d) -237 K
- Carnot cycle has maximum efficiency CO2- R
(a) Petrol engine (b) Diesel engine (c) Reversible engine (d) Irreversible engine
- The increase in entropy of a system represent CO2- R
(a) Increase in availability of energy (c) Decrease in temperature
(b) Increase in temperature (d) Degradation of energy
- Cycle used in thermal power plants is CO3- R
(a) Carnot cycle (b) Reversed Carnot cycle (c) Rankine cycle (d) Brayton cycle
- Dryness fraction of dry steam is CO3- R
(a) 0 (b) 1 (c) 2 (d) 3
- Following relationship defines the Gibb's free energy G CO4- R
(a) $G=H+TS$ (b) $G=H-TS$ (c) $G=U+TS$ (d) $G=U+PV$

8. Internal energy and enthalpy of an ideal gas are function of CO4- R
- (a) Temperature only (b) Pressure only
- (c) Temperature and pressure (d) Pressure, temperature and specific volume

9. During sensible cooling, CO5- R
- (a) Relative humidity remains constant
- (b) Wet bulb temperature increases
- (c) Specific humidity remains constant
- (d) Partial pressure of water vapour remains constant

10. The difference between dry bulb temperature and dew point temperature is called CO5- R
- (a) Dry bulb temperature (b) Wet bulb temperature
- (c) Dew point depression (d) Wet bulb depression

PART – B (5 x 2= 10 Marks)

11. What are the assumptions made while deriving steady flow energy equation? CO1 R
12. State Clausius inequality. CO2 R
13. Define dryness fraction of system. CO3 R
14. Define Joule – Thomson coefficient. CO4 R
15. Name any four psychrometric properties. CO5 R

PART – C (5 x 16= 80Marks)

16. (a) 5 kg of air at 40°C and 1 bar is heated in a reversible non flow constant pressure process until the volume is doubled. Find CO1- App (16)
- (i) Change in volume
- (ii) Work done
- (iii) Change in internal energy
- (iv) Change in enthalpy

Or

- (b) Steam enters a turbine at a velocity of 12 m/s and specific enthalpy is 2900 KJ/Kg. At the exit of the turbine, the steam velocity is 30 m/s, and specific enthalpy is 2400 KJ/kg. The heat lost during the flow through the turbine is 20 KJ/Kg, and the steam flow rate is 85 Kg/s. Determine the work output from the turbine. CO1- App (16)

17. (a) Two Carnot engine A and B are operated in series. The first one A receives heat at 870 k and rejects to a reservoir at temperature T. The second engine B receives the heat rejected by the first engine and in turn rejects to a heat reservoir at 300k. Calculate the temperature T in $^{\circ}\text{C}$ for the following cases:
(i) The work output of the two engines are equal
(ii) The efficiencies of the two engines are equal.

Or

- (b) A reversible heat engine operating between two reservoirs at 900 k and 300 k the engine drives a reversible refrigerator operating between reservoirs 300 k and 250 k the heat engine receives 1800 KJ from 900 K reservoir the net output from combined engine refrigerator 360 KJ find the heat transfer to the refrigerator and the net heat rejected to the reservoir at 300 K.

18. (a) A cylinder contains 150 liters of steam at 400 Kpa and 0.5 dry. The steam is compressed hyperbolically to 0.06 m^3 . Find: mass of vapour, the final dryness fraction and the heat transferred.

Or

- (b) In a steam power plant steam at 20 bar, 350°C is expanded in a steam turbine to 0.1 bar. It then enters a condenser, where it is condensed to saturated liquid water. neglect pump work find the cycle efficiency.

19. (a) A mixture of ideal gases consists of 2.5 kg of N_2 and 4.5 kg of CO_2 at a pressure of 4 bar and a temperature of 25°C . Determine
(i) Mole fraction of each constituent
(ii) Equivalent molecular weight of the mixture
(iii) Equivalent gas constant of the mixture
(iv) The partial pressure and partial volume
(v) The volume and density of the mixture.

Or

- (b) Obtain expressions of Maxwell equations.

20. (a) Atmospheric air at a dry bulb temperature of 16°C and 25 % RH CO5- U (16)
passes through a furnace and then through a humidifier, in such a
way that the final dry bulb temperature is 30°C and 50% RH.
Find the heat and moisture added to the air.

Or

- (b) Explain the various psychrometric process in detail. CO5- U (16)