15-06-2026 SE MECHANICAL SEM-III C SCHEME THERMO. QP CODE:20015182

Time: 3 hrs **Marks: 80**

Note:

1. Question No. 1 is compulsory.
2. Attempt any **THREE** questions out of the remaining **FIVE** questions.
3. Assume suitable data wherever necessary.
4. Use of Steam Table and Mollier chart permitted.

			Marks
Q. 1		Answer the following (Any **FOUR**)	
	a)	Define a thermodynamic system. Differentiate between point and path function	**5**
	b)	Show that internal energy is property of system.	**5**
	c)	What is Joule –Thomson coefficient? Explain inversion point and inversion curve.	**5**
	d)	Define the refrigerator, heat pump. Prove the (COP)heat pump =1+(COP)ref.	**5**
	e)	What is cut off ratio? What are assumptions of air standard cycle?	**5**
	f)	Define the terms a) Sonic Velocity and Mach Number b) Stagnation temperature and Stagnation pressure.	**5**
Q.2	a)	Develop the following expression for the heat transfer from a mass of gas undergoing reversible expansion process obeying the polytrophic law $PV^n = C$ $Q_{1-2} = \frac{\gamma - \eta}{\gamma - 1}$ X Polytropic work done	**08**
	b)	A quantity of gas occupies a volume of 0.28 m^3 at a pressure of 1.03 bar and temperature of 21°C.The gas is compressed isothermally to a pressure of 5.15 bar and then expanded adiabatically to its initial volume. Determine for this quantity of gas. a) Heat received or rejected during compression in KJ. b) Change of internal energy of gas during expansion in KJ. c) The mass of gas in kg. Take C_P= 0.921 KJ/kg-K C_V = 0.5678 KJ/kg-K. Draw P-V diagram	**12**
Q.3	a)	A reversible heat engine operates between two reservoirs at temperatures of 875 K and 310 K the engine drives the reversible refrigerator which operates between the reservoirs at temperature of 310 K and 255 K. The heat transfer to the engine is 2000 KJ and the network output of the combined engine and refrigerator plant is 350 KJ. Make calculation for cooling effect.	**12**
	b)	Write the statements of second law of thermodynamics,	**08**

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Q.4 a) In a steady flow system, fluid flow at the rate of 5 kg/s. It enters at a pressure of 620 KPa, a velocity of 300 m/s, Internal energy 2100kJ/kg and specific volume 0.37 m^3/kg. It leaves the system at a pressure of 130kpa, a velocity of 150m/s, Internal energy 1500kJ/kg and specific volume 1.2m^3/kg. During its flow through system there is a heat loss of 30kJ/kg. Determine the power capacity of the system in KW .State whether it is from or to the system. Neglect P.E. **10**

b) Explain the steady flow energy equation with neat sketch. Apply to it condenser, compressor **10**

Q.5 a) Define a) wet steam b) Superheated steam c) Dryness fraction d) Saturation temperature. Draw schematic of Rankine cycle, also sketch on p-v and T-s plots. **10**

b) In a thermal power plant operating on an ideal Rankin cycle, superheated steam produced at 1.5 MPa and 300°C is feed to a turbine where it expands to the condenser pressure of 80 KPa. The saturated liquid coming out of the condenser is pumped back to the boiler by a feed pump. Assuming ideal Processes, determine a) The condition of steam after isentropic expansion, b) Rankine cycle efficiency, c) The mean effective pressure, d) The ideal steam consumption per kW hour e) The actual steam consumption per kW hour.
Take relative efficiency = 60% and neglect pump work **10**

Q.6 a) Derive an expression for the air standard efficiency of an Otto cycle. **08**

b) In an air standard diesel cycle air a 0.1 MPa and 300 K is compressed adiabatically until the pressure rise to 5 MPa. If 700 kJ/kg of energy in the form of heat is supplied at constant pressure, determine the compression ratio, cut off ratio, thermal efficiency and mean effective pressure. **12**

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