Code No: 153BZ

R18

Time: 3 hours   **Max. Marks: 75**

Answer any five questions
All questions carry equal marks
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1.a)   During one cycle the working fluid in an engine engages in two work interactions: 15 kJ to the fluid and 44 kJ from the fluid, and three heat interactions, two of which are known: 75 kJ to the fluid and 40 kJ from the fluid. Evaluate the magnitude and direction of the third heat transfer.

  b)   Explain the significance of absolute scale of temperature.   [8+7]

2.a)   Using an engine of 30% thermal efficiency to drive a refrigerator having a COP of 5, what is the heat input into the engine for each MJ removed from the cold body by the refrigerator? If this system is used as a heat pump, how many MJ of heat would be available for heating for each MJ of heat input to the engine?

  b)   Describe the corollaries of first law of thermodynamics.   [8+7]

3.   Water at 150 kPa and 10 ^{0}C enters a mixing chamber at a rate of 136 kg/min where it is mixed steadily with steam entering at 140 kPa and 115 ^{0}C. The mixture leaves the chamber at 140 kPa and 55 ^{0}C and heat loss to the surrounding air at 22 ^{0}C at a rate of 190 kJ/min. Neglecting KE and PE, determine the entropy generation, available energy and irreversibility.   [15]

4.a)   0.45 kg of air undergoes two processes that are in series. The first process consists of an isothermal expansion during which the air is supplied with 23.2 KJ at a temperature of 187^{0}C this process is then followed by a reversible adiabatic process that takes the gas to a temperature of 50^{0}C, determine the change in entropy for these combined processes.

  b)   Differentiate between unavailable energy and irreversibility.   [8+7]

5.a)   Steam having a quality of 0.80 is contained in a rigid vessel at a pressure of 20.7 bar. Heat is added until the temperature reaches to 260^{0}C. Determine the final pressure.

  b)   Explain in detail about a typical P – V – T diagram for a substance that expands on freezing.   [8+7]

6.a)   Two Carnot engines are operated in a series with the exhaust of the first engine being the input of the second engine. The upper temperature of this combination is 700 ^{0}C, and the lower temperature is 200^{0}C if each engine has the same thermal efficiency, determine the exhaust temperature of the first engine and the inlet temperature to second engine.

  b)   How to measure the dry bulb temperature and wet bulb temperature? Explain.   [8+7]

7.a)   Derive the Vander Waals equation for real gases.

  b)   Explain the steps involved in the construction of Psychrometric chart at 2 bar pressure and also explain the process of adiabatic saturation.   [7+8]

8.a)   Derive on expression for the thermal efficiency of a dual cycle.

  b)   Determine the mean effective pressure of a four cycle, six cylinder engine that has a 75 kW output at 4000 rpm. The cylinder bore is 75 mm and the stroke is 102 mm.   [7+8]

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