Code No: 43141/43142 **R07** **Set No - 2**

II B.Tech I Semester Regular Examinations,Nov/Dec 2009
THERMODYNAMICS
Common to Mechanical Engineering, Aeronautical Engineering, Automobile Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. A slow-speed reciprocating air compressor with a water jacket for cooling approximates a quasi-static compression process following a path $pv^{1.35}$ = constant. If air enters at a temperature of 23^{o}C and a pressure of 1.1 bar, and is compressed to 6.5 bar at a rate of 1050 kg/h, determine the discharge temperature of air, the power required and the heat transferred per kg. [16]

2. (a) Demonstrate, using the second law, that free expansion is irreversible.
   (b) A domestic food freezer maintains a temperature of -15^0 C with ambient temperature of 30^{0}C. If heat leaks into he freezer at the continuous rate of 1.75 kJ/s, What is the least power necessary to pump this heat out continuously. [8+8]

3. (a) What is an air standard cycle? Why are such cycles conceived?
   (b) Find the air standard efficiencies for Otto cycles with a compression ratio of 6 using ideal gases having specific heat ratios 1.35, 1.43 and 1.62. What are the advantages and disadvantages of using helium as the working fluid? [6+10]

4. (a) Explain microscopic and macroscopic approach with examples.
   (b) A pump forces 1.2m/min of water horizontally from an open well to a closed tank where the pressure is 0.9 Mpa. Compute the work the pump must do upon the water in an hour just to force the water into the tank against the pressure. [6+10]

5. Air at 28 ^{o}C, 78% RH is cooled by spraying in water at 10 ^{o}C. This causes saturation, followed by condensation, the mixing being assumed to take place adiabatically and the condensate being drained off at 17.5^{o}C. The resulting saturated mixture is then heated to produce the required conditions of 55% RH at 23^{o}C. The total pressure is constant at 101 kPa. Determine the mass of water supplied to the sprays to provide 12 m^3/h of conditioned air. What is the heater power required? [16]

6. A 6 ton ideal vapour compression refrigerator works between the condensing pressure of 12 bar and evaporating pressure of 3.3 bar. The refrigerant is dry saturated vapour before it enters the compressor. Saturated liquid refrigerant enters into the expansion valve from the condenser. The average specific heat of the superheated refrigerant vapour at constant pressure is 1.7 kJ /kg K. Compute the temperature of the refrigerant before it enters the condenser, the refrigerating effect per kg of refrigerant, the COP, the mass flow rate of the refrigerant per minute and power

input into the compressor.

The properties of the refrigerants are:

Pressure bar	Sat. Temperature ^{0}C	Enthalpy kJ/kg	Entropy kj/kg K	
		Sat. liquid (h_f)	Sat. liquid (S_f)	Sat. vapour (S_g)
12	30	84.5	0.312	0.9
3.3	-12	31	0.125	0.95

[16]

7. A rigid vessel contains 1 Kg of a mixture of saturated water and saturated steam at a pressure of 0.15 Mpa. When the mixture is heated, the state passes through the critical point. Determine the volume of the vessel, the mass of the liquid and vapour in the vessel initially, the temperature of the mixture when the pressure has risen to 3Mpa, and the heat transfer required to produce the final state. [16]

8. (a) Explain what is PMMI?

   (b) Steam enters a steam turbine with a volocity of 16 m/s and specific enthalpy 2990 kJ/kg. The steam leaves the turbine with a velocity of 37 m/s and specific ethalpy of 2530 kJ/kg. The heat lost to the surroundings is 25 kJ/kg with the steam flow rate of 3,60,000 kg/w. Calculate the turbine work output in kW. [4+12]

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