Code No: 43141/43142 **R07** **Set No - 4**

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. Two tanks are connected by a valve. One tank contains 1.5 kg of CO gas at 75 ^oC and 0.9 bar. The other tank holds 7.5 kg of the same gas at 25^{o}C and 1.4 bar. The valve is opened and the gases are allowed to mix while receiving energy by heat transfer from the surroundings. The final equilibrium temperature is 45^{o}C. Using the ideal gas model, determine
   (a) the final equilibrium pressure,
   (b) the heat transfer for the process. [16]

2. (a) Define the specific heats at constant volume and at constant pressure.
   (b) 1.5 Kg of liquid having a constant specific heat of 2.5 KJ/kg K is stirred in a well insulated chamber causing the termerature to rise by 15^{0}C. Find the change in the internal energy and wotk done for the process. [6+10]

3. (a) What do you understand by the terms refrigeration effect and ton of refrigeration?
   (b) An ideal refrigeration system working on Carnot cycle operates between the temperature limits of -25 ^{o}C and 30^{o}C. Find the ideal COP and the power required from an external source to absorb 4 kW at low temperature. If the system operates as a heat pump, determine the COP and the power required to discharge 4 kW at high temperature. [6+10]

4. The usual cooking gas (mostly methane) cyclinder is about 20 cm in diameter and 100 cm in height. It is charged to 11.5 MPa at room temperature of 25 ^{o}C.
   (a) Assuming the ideal gas law, find the mass of gas filled in the cyclinder.
   (b) Explain how the actual cyclinder contains nearly 15 kg of gas.
   (c) If the cylinder is to be protected against excessive pressure by means of a fusible plug, at what temperature should the plug melt to limit the maximum pressure to 15 MPa? [16]

5. (a) Distiguish between open system and closed system.
   (b) A gas at a pressure of 138 kN/m^2 is having volume of 0.112 m^3. It is compressed to 690 kN/m^2 according to the law pv$^{1.4}$=constant.
   Calcuate the final volume of the gas. [6+10]

6. (a) Explain with the help of a line diagram the cyclic refrigeration palnt.

(b) Prove the equivalence of Kelvin planck and clausius statement. [8+8]

7. Two streams of steam one at 2 Mpa, 300^0 C and the other at 2 Mpa, 400^0 C mix in a stedy flow adiabatic process. The rates of flow of the two streams are 3 Kg/min, 2kg/min respectively. Evaluate the final temperature of the emerging stream, if there is no pressure drop due to the mixing process. What would be the rate of increase in the entropy of the universe? This stream with a negligible velocity now expands adiabatically in a nozzle to a pressure of 1Kpa. Calculate the exit velocity of the stream and the exit area of the nozzle. [16]

8. For an air standard Otto cycle with fixed intake and maximum temperatures, T_1 and T_3, find the compression ratio that renders the net work per cycle a maximum. Derive the expression for cycle efficiency at this compression ratio. If the air intake temperature, T_1, is 305 K and the maximum cycle temperature, T_3, is 1300 K, compute the compression ratio for maximum net work, maximum work output per kg in a cycle, and the corresponding cycle efficiency. Find the changes in work output and cycle efficiency when the compression ratio is increased from this optimum value to 8. Take C_v = 0.718 kJ/kg K. [16]

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