Code No: 43141/43142 **R07** **Set No - 3**

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) Explain the air standard Otto cycle with the help P-V and T-S diagrams.
   (b) In an Otto cycle, the upper and lower limits for absolute temperatures are respectively T_3 and T_1. Show that for maximum work, the ratio of compression should have the value
   $r = (T_3 / T_1)^{1.25}$ Take $\gamma = 1.4$ [8+8]

2. (a) Write the unit of temperature and explain the International fixed points.
   (b) Explain in detail the ideal gas temperature scale. [8+8]

3. Two containers p and q with rigid walls contain two different monoatomic gases with masses m_p and m_q gas constants R_p and R_q, and initial temperatures T_p and T_q respectively, are brought in contact with each other and allowed to exchange energy until equilibrium is achieved. Determine:
   (a) the final temperature of the two gases and
   (b) the change of entropy due to this energy exchange. [16]

4. (a) Show that the adiabatic mixing of two fluids is irreversible.
   (b) Show that if two bodies of thermal capacities $C_1$and C_2 at temperatures T_1 and T_2 are brought to the same temperature, T by means of a reversible heat engine, then
   In T= $\frac{C_1 \ln T_1 + C_2 \ln T_2}{C_1 + C_2}$. [8+8]

5. (a) What are the advantages and disadvantages of air refrigeration systems over the other?
   (b) Determine the temperature ratio (T_2 / T_1) (where T_2 = source temperature and T_1 = sink temperature) for a Carnot refrigerator whose COP is 5. Also calculate the refrigeration capacity of the machine in tons of refrigeration if the power consumption is 8 kW. If the cycle is used as heat pump, find the COP for heating cycle and the quantity of heat pumped assuming same temperature range. [6+10]

6. (a) Show that the work done during a flow process is $-\int_{p_1}^{p_2} vdp$
   (b) A certain mass of sulphur dioxide ($S0_2$) is contained in a vessel of 0.145 m^3 capacity, at a pressure and temperature of 24.2 bar and 20^{o}C respectively. A

valve is opened momentarily and the pressure falls immediately to 7.8 bar. Sometime later the temperature is again 20^{o}C and the pressure is observed to be 10.2 bar. Estimate the value of specific heat ratio. [6+10]

7. (a) What is principle of operation of an electrial calorimeter?

   (b) A vessel of 0.04 m^3 contains a mixture of saturated water and saturated steam at a temperature of 250 ^{0}C. The mass of the liquid present is 9 Kg. Find the pressure, the mass, the specific volume, the enthalpy, the entropy and internal energy using steam table only. [6+10]

8. (a) Explain the work interaction between a system and the surroundings.

   (b) The pistion of an oil engine, of area 0.0045 m^2, moves downwards 75 mm, drawing in 0.0028 m^3 of fresh air from the atmosphere. The pressure in the cylinder is uniform during the process at 80 kPa, while the atmospheric pressure is 101.325 kPa, the difference being due to the flow resistance in the induction pipe and the inlet valve. Estimate the displacement work done by the air finally in the cylinder. [6+10]

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