QP CODE : 22710

(3 Hours) **Marks : 80**

NB : (1) Question **no.1** is **Compulsory.**
(2) Attempt **any three** quetions out of remaining **five** questions.
(3) Assume suitable data and justify the same.
(4) **Figures** to the **right** indicate full **marks**.

1. **20**
   (i) Distingusih between state and path function by giving three examples of each.
   (ii) Define compressibility factor. What is it's significance?
   (iii) How would you calculate entropy change of a irrerrsible process ?
   (iv) What is the purpose of doing exergy analysis? Give two examples where exergy analysis is done in a chemical manufacturing plant.
   (v) Define and explain Joule Thomson effect.

2. 1 Kmol of oxygen having average Cp of 32.33 KJ/kg.K undergoes the following changes successively. Find Q, W, Δ U and Δ H for each step and for entire process. The process is reversible and ideal gas behaviour is assumed. **20**
   (a) It is expanded iso thermally from 800K and 2.5 MPa to 0.5 MPa
   (b) It is cooled at constant volume to 400 K.
   (c) It is further cooled at constant pressure to 300K.
   (d) It is compressed adiabatically to 2.5 MPa.
   (e) It is heated at constant pressure to 800K.

3. (a) Derive an expression for fugacity cofficient for a gas obeying Redlich Kwong equation of state. Redlich Kwong equation of state is given by : **10**

$$P = \frac{RT}{V-b} - \frac{a}{V(v+b)}$$

   (b) Estimate the enthalpy and entropy departure of n-Hexane at 600K and 800kPa using Van der Waads equation of state. **10**
   Data : Tc = 507.4K ; Pc = 2969 KPa

4. (a) Prove that critical compressibility factor for a van der Waals gas is equal to $\frac{3}{8}$. **10**

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(b) Calculate the molar volume and compressibility factor of SO_2 at 100^0C. Assume that SO_2 follows the Redlich Kwong equation of state. **10**

Data : $P = \frac{RT}{V-b} - \frac{a}{V(v+b)}$

Tc = 430.8 K , Pc = 78.8 bar.

5. (a) Derive an expression for the thermal efficiency of a Carnot Engine. **10**

(b) A lump of steel of mass 10 kg at 630^0C is dropped in 100 kg of oil at 35^0C. The specific heat of steel and oil are 0.5 KJ/kg.K and 3.5 KJ.kg.K respectively. Calculate the entropy change of steel, oil and the universe. **10**

6. Write a short note on any four of the following : **10**
   (a) P-H diagram
   (b) Maxwell equations
   (c) Transient Process
   (d) Reduced equation of state
   (e) Heat Engine anf Heat Pump
