

(Following Paper ID and Roll No. to be filled in your Answer Books)

Paper ID : 2289937

Roll No.

B.TECH

Regular Theory Examination (Odd Sem - V), 2016-17

THERMODYNAMICS-II

Time : 3 Hours

Max. Marks : 100

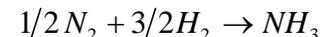
Section - A

1. Attempt all parts. All parts carry equal marks. Write answer of each part in short. (10×2=20)
- Define ideal solution.
 - Differentiate between residual property and excess property.
 - What is activity and activity coefficient?
 - What is enthalpy concentration diagram?
 - Define chemical potential.
 - Define heat of solution.
 - What is Lewis/Randall rule?
 - Define property change of mixing.
 - What is reaction co-ordinate?
 - Calculate the Equilibrium constant K at 3000 C for $A \rightarrow B+C$ if Gibbs free energy of the reaction at this temperature is $\Delta G^\circ = -2750 \text{ J / mole}$.

Section - B

Note : Attempt any five questions from this section. (5×10=50)

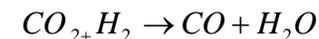
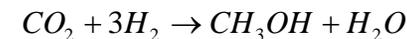
2. For the ammonia synthesis reaction written as



With 1/2 mole N_2 and 3/2 mole H_2 as the initial amount of reactants with the assumption that the equilibrium mixture is an ideal gas, show that

$$\epsilon = 1 - (1 + 1.299KP/P^0)^{-1/2}$$

3. a) Consider a system in which the following reaction occur



If there are present initially 4 mole CO_2 , 6 mole H_2 & 3 mole H_2O , determine expressions for y_i as functions of ϵ_1 & ϵ_2

- b) With the help of fundamental property relation, show that multiple phases at the same T and P in equilibrium when the chemical potential of each constituent species is same in all phases.

4. a) If $G^E/RT = (1.42x_1 + 0.59x_2)x_1x_2$

Find expressions for $\ln \gamma_1$ & $\ln \gamma_2$

- b) What is the change in entropy when 0.7 m³ of CO₂ and 0.3 m³ of N₂ each at 1 bar and 25°C is blended to form a gas mixture at the same conditions? Assume ideal gases.
5. a) Discuss the equilibrium criteria to chemical reaction.
b) Derive fundamental property relation.
6. Derive various forms of Gibbs-Duhem equation.
7. Derive $\ln(Y_i \Phi_i)^{vi} = KP^{-v}$
8. a) Discuss the effect of temperature on equilibrium constant.
b) Derive an equation for partial molar properties from an equation of solution property as a function of composition.
9. The molar enthalpy (J/mole) of a binary liquid mixture at T & P is given $H = 120x_1 + 70x_2 + x_1x_2(15x_1 + 8x_2)$ for the given T&P.
i) Find expression for partial molar enthalpies of species 1 & 2
ii) Show that these expressions satisfy the Gibbs/Duhem equation.
iii) Show that when these expressions are combined in according to summability equation, the equation for H is recovered.

Section - C

Note : Attempt any two questions from this section.
(2×15=30)

10. For the system ethyl ethanoate (1)/n-heptane (2) at 3.43.15K
a) Make BUBL P calculation for T = 343.15 K and x₁=0.06
b) Make DEW P Calculation for T = 343.15K and y₁=0.06
c) What is the azeotrope composition and pressure.
 $G^E/RT = 0.75 x_1.x_2$
 $P^{Isaf} = 79.50 \text{ KPa}; P^{2saf} = 40.20 \text{ Kpa}$
11. a) In a binary mixture the activity coefficient of component (2) is given by $\ln \gamma_2 = Ax_{12}$. Derive an expression for activity coefficient of component (1).
b) Find an expression for the fugacity coefficient of a gas that obeys the equation of state $PV/RT = 1+B/V+C/V^2$ And also estimate the fugacity of Argon at 1bar & 280K, if the constants B&C are $-21.13 \times 10^{-6} \text{ m}^3/\text{mol}$ and $1054 \times 10^{-12} \text{ m}^6/\text{mol}^2$.
12. Write notes on
a) Vapour-Liquid-Liquid Equilibrium
b) Solid-Liquid Equilibrium
c) Equilibrium and Stability.