(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)

a) Define ideal solution.

b) Differentiate between residual property and excess property.

c) What is activity and activity coefficient?

d) What is enthalpy concentration diagram?

e) Define chemical potential.

f) Define heat of solution.

g) What is Lewis/Randall rule?

h) Define property change of mixing.

i) What is reaction co-ordinate?

j) Calculate the Equilibrium constant K at 3000 C for A $\rightarrow$ B+C if Gibbs free energy of the reaction at this temperature is $\Delta G^o = -2750\ J/mole$.

Section - B

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

2. For the ammonia synthesis reaction written as

$$1/2\,N_2 + 3/2\,H_2 \rightarrow NH_3$$

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

$$CO_2 + 3H_2 \rightarrow CH_3OH + H_2O$$

$$CO_{2+} H_2 \rightarrow CO + H_2O$$

If there are present initially 4 mole CO_2, 6 mole H_2 & 3 mole H_2O, determine expressions for yi 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 $G^E/RT = (1.42x_1+0.59x_2)x_1 x_2$

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

b) What is the change in entropy when 0.7 m^3 of CO_2 and 0.3 m^3 of N_2 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 $II\left(Y_i\ \Phi_i\right)^{vi} = KP^{-v}$

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 x_1=0.06

b) Make DEW P Calculation for T = 343.15K and y_1=0.06

c) What is the azeotrope composition and pressure.

$G^E/RT = 0.75\ x_1.x_2$

P^{Isaf}= 79.50 KPa; P^{2saf}=40.20Kpa

11. a) In a binary mixture the activity coefficient of component (2) is given by $\ln \gamma 2 = Ax12$. 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 -21.13×10^{-6} m^3/mol and 1054×10^{-12} m6/mol^2.

12. Write notes on

a) Vapour-Liquid-Liquid Equilibrium

b) Solid-Liquid Equilibrium

c) Equilibrium and Stability.

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