

13/12/2024 CHEMICAL SEM-IV C SCHEME CET-II QP CODE: 10069060

Time: 3hour

MaxMarks: 80

- N.B.** (1) Question No 1 is compulsory
 (2) Attempt any three questions out of remaining five questions
 (3) Assumption made, if any should be clearly stated

Q.1 Solve any Four

20

- UNIFAC Method
- Excess properties
- Explain criteria for reaction Equilibria
- State Raoult's law. Show that it is a simplified form of the Lewis-Randall rule
- Properties of refrigerant

Q.2

- The volume of an aqueous solution of NaCl at 298K was measured for a series of molalities (moles of solute per kg of solvent) and it was found that the volume varies with molality according to the following expression. 10

$$V = 1.003 \times 10^{-3} + 0.1662 \times 10^{-4}m + 0.117 \times 10^{-5}m^{1.5} + 0.12 \times 10^{-6}m^2$$

Where m is the molality and V is in m^3 ; calculate the partial molar volumes of the components at $m = 0.1$ mol/kg

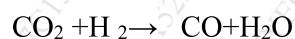
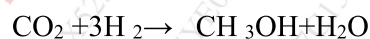
- Derive different forms of Gibbs Duhem Equations 10

Q.3

- A container is divided into two compartments. One contains 3.0 moles hydrogen at 298K and 1.0 bar and the other contains 1.0 mol nitrogen at 298K and 3.0 bar. Calculate the free energy of mixing when the partition is removed. 10
- Derive the expression for effect of temperature on chemical potential 10

Q.4

- A gas mixture containing 3 moles of CO_2 , 5 moles of H_2 and 1 mole water is undergoing the following reaction. 10



Develop expressions for the mole fractions of the species in terms of extent of reaction.

- b) Explain the criteria for phase equilibria. 10

Q.5

- a) Determine the degree of freedom in a gaseous system consisting of CO, CO₂, H₂, H₂O, and CH₄ in chemical equilibrium. 10
b) Sketch and label vapour compression refrigeration system with P-H and T-S diagram 10

Q.6

- a) Construct the P-x-y diagram for the cyclohexane(1) - benzene(2) system at 313K given that at 313K the vapour pressures are $P_1^{sat} = 24.62 \text{ kPa}$ and $P_2^{sat} = 24.41 \text{ kPa}$. The liquid phase activity coefficients are given by $\ln \gamma_1 = 0.458 x_2^2$, $\ln \gamma_2 = 0.458 x_1^2$ 10
b) Derive the expression for effect of temperature on equilibrium constant. 10
