

GUJARAT TECHNOLOGICAL UNIVERSITY**B.E. Sem-Vth Examination December 2010****Subject code: 150503****Subject Name: Chemical Engineering Thermodynamics- II****Date: 16 /12 /2010****Time: 03.00 pm - 05.30 pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

Q.1 (a) Define fugacity and fugacity co efficient. **07****(b)** The enthalpy of a binary liquid mixture of species 1 and 2 at fixed T and P is represented by the equation: **07**

$$H = 400x_1 + 600x_2 + x_1x_2(40x_1 + 20x_2) \quad \text{Where } H \text{ is in J mol}^{-1}.$$

Calculate values of H_1 , H_2 , \bar{H}_1^∞ , \bar{H}_2^∞ .**Q.2 (a)** Derive the equation for the criteria for phase equilibrium in terms of fugacity for a mixture of N components and π phases. **07****(b)** Show that for a binary system, Henry's law is valid for component '1' then Lewis Randall rule is valid for component '2'. **07****OR****(b)** Construct Pxy diagram for the cyclohexane(1) - benzene(2) system at 40°C. Use the following expressions for the liquid-phase activity coefficients: **07**

$$\ln \gamma_1 = 0.458 x_2^2$$

$$\ln \gamma_2 = 0.458 x_1^2$$

At 40°C, $P_1^{\text{sat}} = 0.243 \text{ atm}$; and $P_2^{\text{sat}} = 0.241 \text{ atm}$.**Q.3 (a)** Write a brief note on retrograde condensation and its application. **07****(b)** Write a brief note on ideal solutions and non-ideal solutions **07****OR****Q.3** Assuming the validity of Raoult's law, do the following calculations for the benzene(1) / toluene(2) system: **14**a. Given $x_1 = 0.33$ and $T = 100^\circ\text{C}$, find y_1 and P.b. Given $y_1 = 0.33$ and $T = 100^\circ\text{C}$, find x_1 and P.c. Given $T=105^\circ\text{C}$ and $P=120 \text{ kPa}$, find x_1 and y_1 .d. For part (c), if the overall mole fraction of benzene is $z_1=0.33$, what molar fraction of the two-phase system is vapor? $\ln P^{\text{sat}} = A - [B \div (t + C)]$ where P^{sat} is in kPa and t is in °C

Component	A	B	C
Benzene	13.86	2,774	220.1
Toluene	14.00	3,103	219.80

Q.4 (a) Derive the relationship, $K = K_\phi K_v K_n (P/P_i)^{\Delta n}$ **07****(b)** Write in brief on various methods for evaluating the equilibrium constant **07****OR**

- Q.4** The azeotrope of the methanol-benzene system has a composition of 44.8 mole percent ethanol with a boiling point of 68.2°C at 760 mmHg. At 68.2°C, the vapor pressure of pure benzene is 517 mmHg and that of ethanol is 506 mmHg. Calculate the Margules constants for the system and determine the activity coefficients for a solution containing 20 mole percent ethanol **14**
- Q.5** (a) Write a brief note on Area tests **07**
(b) Explain T-xy diagram for partial miscible system. **07**
- OR**
- Q.5** (a) Write the effect of temperature on equilibrium constant **07**
(b) Write in brief on Equilibrium conversion charts **07**
