Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V • EXAMINATION – SUMMER • 2014

Subject Code: 150503 **Date: 19-06-2014**

Subject Name: Chemical Engineering Thermodynamics -II

Time: 10.30 am - 01.00 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)** What is Chemical Potential? Derive necessary equation for criteria for phase equilibrium in multi component system. **07**

(b) Define partial molar properties. Discuss various methods for evaluation of partial molar properties. **07**

Q.2 **(a)** Discuss the various forms of Gibbs-Duhem equation in detail. **07**

(b) Discuss in detail: ideal solutions and non-ideal solutions. **07**

OR

(b) List out various methods for evaluation of fugacity coefficient of pure component. Discuss any two in detail. **07**

Q.3 **(a)** Prove that $\Delta G^0 = -\ R\ T\ \text{In}K$ **07**

(b) At 300 K and 1 bar ,the volumetric data for a liquid mixture of benzene and cyclohexane are represented by **07**
$V=109.4 \times 10^{-6} - 16.8 \times 10^{-6}\ x - 2.64 \times 10^{-6}\ x^2$, where x is the mole fraction of benzene and V has the units of m^3/mol. Find expressions for the partial molar volumes of benzene and cyclohexane.

OR

Q.3 **(a)** Discuss the effect of pressure and temperature on equilibrium constant for chemical reaction equilibrium. **07**

(b) Mixtures of n-Pentane (1) and n-Heptane (2) confirm to ideal solution behavior. Prepare P-x-y diagram at 70^0C. **07**
Use Antoine equation: $\log_{10}P = A - (B / (T + C))$ where pressure P is in Torr and temperature T is in ^{0}C.

	A	B	C
n-Pentane	6.87632	1075.780	233.205
n-Heptane	6.89386	1264.370	216.640

Q.4 **(a)** Discuss various methods for checking the consistency of experimental VLE data. **07**

(b) Calculate the equilibrium constant at 298 K of the reaction **07**

$$N2O4\ (g) \rightarrow 2NO2\ (g)$$

Given that the standard free energies of formation at 298 K are 97,540 J/mol for N2O4 and 51,310 J/mol for NO2.

OR

Q.4 **(a)** Write a brief note on multi reaction equilibria. **07**

(b) The azeotrope of the ethanol-benzene system has a composition of 44.8 mole percent ethanol with a boiling point of 68.24^{o}C at 760 mmHg. At 68.24^{o}C, the vapor pressure of pure benzene is 517 mmHg and that of ethanol is 506 mmHg. Calculate the van Laar constants for the system and determine the activity coefficients for a solution containing 10 mole percent ethanol. **07**

Q.5	**(a)**	Discuss any two group contribution methods to determine Activity coefficients.	**07**
	(b)	Discuss retrograde condensation and its application.	**07**
		OR	
Q.5	**(a)**	Write short note on "Phase diagrams for completely immiscible systems."	**07**
	(b)	Discuss factors affecting equilibrium conversion.	**07**

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