

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 $\Delta G^0 = - R T \ln K$ **07**
- (b) At 300 K and 1 bar, the volumetric data for a liquid mixture of benzene and cyclohexane are represented by $V = 109.4 \times 10^{-6} - 16.8 \times 10^{-6} x - 2.64 \times 10^{-6} x^2$, 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. **07**

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°C. **07**
- Use Antoine equation: $\log_{10} P = A - (B / (T + C))$ where pressure P is in Torr and temperature T is in °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**
- $$\text{N}_2\text{O}_4 (\text{g}) \rightarrow 2\text{NO}_2 (\text{g})$$
- 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°C at 760 mmHg. At 68.24°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**

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| 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 |
