Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) - EXAMINATION – SUMMER 2016

Subject Code:2150503 **Date:09/05/2016**

Subject Name:Chemical Engineering Thermodynamics - II

Time:02:30 PM to 05:00 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)** Discuss the consistency tests for VLE data by using Gibbs-Duhem equation. **07**

(b) The following table gives composition v/s total pressure data for the system chloroform (1)/ethanol (2) at 328 K: **07**

x_1	0.0331	0.9652
P, kPa	40.84	84.88

Vapour pressures of chloroform and ethanol at 328 K are 82.35 kPa and 37.30 kPa respectively. Estimate the constants in the Margules equation.

Q.2 **(a)** Show that for a binary system, Henry's law is valid for component '1' then Lewis Randall rule is valid for component '2'. **07**

(b) The azeotrope of the ethanol-benzene system has a composition of 44.8 mol% ethanol with boiling point of 341.4 K at 101.3 kPa. At this temperature, the vapor pressure of benzene is 68.9 kPa and the vapor pressure of ethanol is 67.4 kPa. What are the activity coefficients in a solution containing 10% ethanol. (Use VanLaar equations). **07**

OR

(b) Write a brief note on retrograde condensation and its application. **07**

Q.3 **(a)** Define fugacity and fugacity coefficient. Discuss any two methods to evaluate fugacity coefficient. **07**

(b) Define azeotropes and explain minimum boiling and maximum boiling azeotropes with suitable examples and neat diagrams. **07**

OR

Q.3 **(a)** Mixtures of n-Pentane (1) and n-Heptane (2) conform to ideal solution behaviour. The vapour pressures of pure components are adequately described by Antoine equations. Prepare P-x-y diagram at 70^0C. **07**

Compound	A	B	C
n-Pentane	6.8763	1075.78	233.2
n-Heptane	6.8939	1264.37	216.64

Use Antoine equation: $\log_{10} p_i^{sat} = A_i - B_i/(t + C_i)$ where pressure p_i^{sat} is in torr and temperature t is in ^{0}C.

(b) What is gamma-phi formulation of VLE? Draw block diagrams for the BUBL P and DEW P calculations. Write all necessary equations. **07**

Q.4 **(a)** Define partial molar properties and explain various methods for evaluation of partial molar properties. **07**

	(b)	The enthalpy of a binary liquid system of species 1 and 2 at fixed T and P is represented by the equation: $H = 400\, x_1 + 600\, x_2 + x_1\, x_2\, (40x_1 + 20x_2)$ where H is in J mol^{-1} Determine expressions for $\overline{H}_1$ and $\overline{H}_2$ as functions of x_1, numerical values for the pure-species enthalpies H_1 and H_2, and numerical values for the partial enthalpies at infinite dilution $\overline{H}_1^{\infty}$ and $\overline{H}_2^{\infty}$.	**07**
		OR	
Q.4	**(a)**	Derive Margules equations from the following expression: $\frac{G^E}{x_1 x_2 RT} = A_{21}x_1 + A_{12}x_2$	**07**
	(b)	Explain T-x-y diagram for partial miscible system.	**07**
Q.5	**(a)**	Explain the effect of temperature and pressure on equilibrium constant.	**07**
	(b)	Derive from the first principles, $\Delta G^0 = -RT \ln K$.	**07**
		OR	
Q.5	**(a)**	Discuss the criteria of chemical equilibrium.	**07**
	(b)	Write in brief a note on feasibility of chemical reactions.	**07**

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