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

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (OLD) - EXAMINATION – SUMMER 2018

Subject Code:150503 Date:30/04/2018

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

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

Q.2 **(a)** Explain Retrograde condensation in detail with figure. **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) The enthalpy at 300 K and 1 bar of a binary liquid mixture is: **07**

$$H = 400X_1 + 600X_2 + X_1X_2(40X_1 + 20X_2)$$

where H is in J/mol for the stated temperature and pressure, determine:

(i) Expression for partial molar enthalpies of both components 1 and 2,

(ii) Numerical value for pure component enthalpies H_1 and H_2,

(iii) Numerical values for the partial molar enthalpies for both the components at infinite dilution.

Q.3 **(a)** Discuss various methods for checking the consistency of experimental VLE data. **07**

(b) Explain T-x,y diagram for partially miscible system. **07**

OR

Q.3 **(a)** 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.

(b) Construct P-x-y diagram for the cyclohexane (1) / benzene (2) system at 313 K. 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 313 K, $P_1^S = 24.62$ KPa and $P_2^S = 24.41$ KPa.

Q.4 **(a)** Discuss the criteria of chemical reaction equilibrium. **07**

(b) Discuss about the effect of temperature on equilibrium constant. **07**

OR

Q.4 **(a)** Write short note on Van Laar equation and Margules equation. **07**

(b) Discuss minimum and maximum boiling azeotropes giving examples for each with neat diagrams. **07**

Q.5 **(a)** In the synthesis of ammonia, stoichiometric amounts of nitrogen and hydrogen are sent to a reactor where the following reaction occurs. **07**

$$N_2 + 3H_2 \rightarrow 2NH_3$$

The equilibrium constant for the reaction at 675 K is 2×10^{-4}. Determine the percent conversion of nitrogen to ammonia at 675 K & 20 bar.

(b) Prove that $\Delta G^0 = -RT \ln K$ **07**

OR

Q.5	**(a)**	Write a brief note on Excess Properties.	**07**
	(b)	Discuss in detail: Ideal solutions and Non-ideal solutions.	**07**

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