

**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. **07**

Use the following expressions for the liquid-phase activity coefficients:

$$\ln \gamma_1 = 0.458 x_2^2, \ln \gamma_2 = 0.458 x_1^2$$

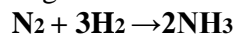
At 313 K,  $P_1^S = 24.62$  KPa and  $P_2^S = 24.41$  KPa.

- 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**



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

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

- 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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