

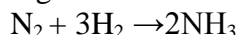
GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-V • EXAMINATION – WINTER • 2014****Subject Code: 150503****Date: 03-12-2014****Subject Name: Chemical Engineering Thermodynamics - II****Time: 10.30 am - 01.00 pm****Total Marks: 70****Instructions:**

- 1. Attempt all questions.**
- 2. Make suitable assumptions wherever necessary.**
- 3. Figures to the right indicate full marks.**

- Q.1** (a) Define partial molar properties. Explain analytical and graphical methods to determine partial molar properties of components in mixtures. **07**
- (b) Define chemical potential. Discuss the effect of temperature and pressure on chemical potential. **07**
- Q.2** (a) Define ideal solution. Discuss Henry's law for dilute solutions. **07**
- (b) Derive the relation between standard free energy change and equilibrium constant from first principle. **07**

OR

- (b) 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 2×10^{-4} . Determine the percent conversion of nitrogen to ammonia at 675 K & 20 bar.

- Q.3** (a) Write a note on T-x, y diagram for partially miscible system. **07**
- (b) Discuss the effect of temperature and pressure on equilibrium constant. **07**

OR

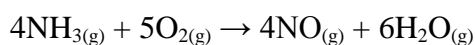
- Q.3** (a) Discuss the criteria of chemical equilibrium. **07**
- (b) Write a brief note on feasibility of chemical reaction. **07**

- Q.4** (a) Briefly discuss about thermodynamic consistency test of VLE data. **07**
- (b) The azeotrope of the ethanol – benzene system has a composition of 44.8 % (mol) ethanol with a boiling point of 341.4 K at 101.3 kPa. At this temperature, the vapour pressure of benzene is 68.9 kPa and the vapour pressure of ethanol is 67.4 kPa. What are the activity coefficients in a solution containing 10% alcohol (use van Laar equation) **07**

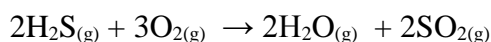
OR

- Q.4** (a) Stating the significance, discuss the various forms of Gibbs - Duhem equation in detail. **07**
- (b) Develop expressions for the mole fractions of reacting species as functions of the reaction coordinate for: **07**

- (i) A system initially containing 2 mol of NH_3 & 5 mol of O_2 and undergoing the reaction

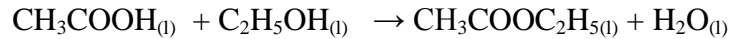


- (ii) A system initially containing 3 mol of H_2S & 5 mol of O_2 and undergoing the reaction



Q.5 (a) Show that the van Laar equation & Margules equation are consistent with Gibbs - Duhem equations. **07**

(b) Acetic acid is esterified in the liquid phase with ethanol at 100°C (373.15 K) and atmospheric pressure to produce ethyl acetate and water according to the reaction: **07**



If initially there is one mole of each acetic acid and ethanol, estimate the mole fraction of ethyl acetate in the reacting mixture at equilibrium. The value of ΔH°_{298} and ΔG°_{298} for the above reaction are – 3640 J and – 4650 J respectively. Assume that the heat of reaction is independent of temperature and the liquid mixture behaves as ideal solution.

OR

Q.5 (a) An equimolar solution of benzene and toluene is totally evaporated at a constant temperature of 363 K. At this temperature, the vapour pressures of benzene & toluene are 135.4 and 54 kPa respectively. What are pressures at the beginning & at the end of the vaporization process? **07**

(b) Write short notes on any two: **07**

(i) Bubble-point equilibria; (ii) Dew-point equilibria; (iii) Flash vaporization
