

GUJARAT TECHNOLOGICAL UNIVERSITY
BE – SEMESTER – VI (NEW).EXAMINATION – WINTER 2016

Subject Code: 2163508**Date: 25/10/2016****Subject Name: Basics of Thermodynamics & Kinetics****Time: 10:30 AM to 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) Explain Gibbs-Helmholtz equations **07**
 (b) Derive $\left(\frac{\partial T}{\partial V}\right)_s = -\left(\frac{\partial P}{\partial S}\right)_v$ using fundamental properties relations **07**
- Q.2** (a) Derive various forms of Gibbs-Duhem equation **07**
 (b) How are the partial molar volumes of the constituents of a binary solution related to their mole fractions of the constituents and the molar volume of the solution? Explain how these equations are useful for the determination of partial molar volumes by the tangent-intercept method. **07**
- OR**
- (b) The activity coefficient of component 1 in a binary solution is given by **07**
 $\ln \gamma_1 = ax_2^2 + bx_2^3 + cx_2^4$
 Where, a, b, c are constants independent of concentrations. Obtain an expression for γ_2 in terms of x_1 .
- Q.3** (a) Derive the equation for solving a general VLE problem. How does this equation get simplified for (a) ideal gas phase, ideal liquid solution (b) low pressure equilibrium **07**
 (b) Derive the equation for criteria for phase equilibrium in terms of chemical potential for a mixture of N components and π phases. **07**
- OR**
- Q.3** (a) Write a note on T-x,y diagram for binary system **07**
 (b) 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**
- Q.4** (a) Derive from first principle $G^0 = -RT \ln K$. **07**
 (b) Derive the criteria of chemical reaction equilibria **07**
- OR**
- Q.4** (a) Discuss the effect of pressure and temperature on equilibrium constant for chemical reaction equilibrium **07**
 (b) A gas mixture containing 3 mol CO_2 , 5 mol H_2 and 1 mol water is undergoing the following reactions: **07**

$$\text{CO}_2 + 3\text{H}_2 \rightarrow \text{CH}_3\text{OH} + \text{H}_2\text{O}$$

$$\text{CO}_2 + \text{H}_2 \rightarrow \text{CO} + \text{H}_2\text{O}$$
 Develop expressions for the mole fractions of the species in terms of the extent of the reactions.
- Q.5** (a) Write a short note on temperature dependency from Arrhenius' law. **07**

- (b) State the various methods of analysis of kinetic data and explain any one of them in brief **07**

OR

- Q.5** (a) Differentiate between (1) single reaction and multiple reaction (2) elementary and non elementary reaction **07**
- (b) n-butane is isomerised to i-butane by the action of catalyst at moderate temperature. It is found that the equilibrium is attained at the following compositions. **07**

Temperature, K	Mole %, n-Butane
317	31
391	43

Assuming that activities are equal to the mole fractions, calculate the standard free energy of the reaction at 317 K and 391 K and average value of heat of reaction over this temperature range.
