Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V • EXAMINATION – SUMMER • 2015

Subject Code: 150503 **Date: 11-05-2015**

Subject Name: Chemical Engineering Thermodynamics - II

Time: 02.30 pm - 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 various methods for determination of partial molar properties. **07**

(b) Derive the relation between standard free energy change and equilibrium constant from the first principle. **07**

Q.2 **(a)** Discuss various methods to determine equilibrium constant. **07**

(b) Estimate the fugacity of iso-butane at 15 atm and 87°C using the compressibility factor correlation Z= 1+ (BP/RT), given that the second virial coefficient B = -4.28 *10^{-4} m^{3}/mol. **07**

OR

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

Q.3 **(a)** Write in brief on the effect of pressure on equilibrium constant **07**

(b) Discuss the criteria of chemical equilibrium. **07**

OR

Q.3 **(a)** Prepare T-x,y diagram at temperature of pressure of 101.33 kPa for a binary system Benzene(1) and Ethyl benzene(2). Assume that Raoult's law is valid and use the following Antonie equation. **07**

$\ln P_i^{sat} = A - B/(T + C)$, where P_i^{sat} in kPa and T is in ^{0}C.

	Value of constant		
Component	A	B	C
Benzene	13.8594	2773.78	220.07
Ethyl benzene	14.0045	3279.47	213.20

(b) For a binary system, if the activity coefficient for component '1' is $\ln\gamma_1 = \beta x_2^2$, then derive the expression for component '2'. **07**

Q.4 **(a)** Write a brief note on Area tests **07**

(b) Write in brief on Equilibrium conversion charts **07**

OR

Q.4 An equimolar mixture of CO(g) and H_2O(g) enters a reactor which is maintained at 10 bar and1000 K. the reaction involved is **14**

$$CO(g) + H_2O(g) \rightarrow CO_2(g) + H_2(g)$$

Given that the equilibrium constant for this reaction is 1.5 at 1000 K, Calculate the degree of conversion and the composition of the gas mixtures that leaves the reactor. The reaction mixture can be considered

to behave as ideal gas mixture.

Q.5		The azeotrope of the benzene- cyclohexane system has a composition of 53.2 mole percent benzene with a boiling point of 350.6 K at 101.3 kPa. At 350.6 K, the vapor pressure of pure benzene is 100.59 kPa and that of cyclohexane is 99.27 kPa Calculate the Vanlaar constants for the system and determine the activity coefficients for a solution containing 10 mole percent benzene.	**14**

OR

Q.5	**(a)**	Write a brief note on Excess properties.	**07**
	(b)	In case of flash vaporization, explain the methodology adopted to calculate the flash?	**07**

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