Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV(NEW) EXAMINATION – WINTER 2022

Subject Code:3140507 Date:20-12-2022

Subject Name:Chemical Engineering Thermodynamics II

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.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Explain the significance of phase equilibria.	**03**
	(b)	Discuss Lewis-Randall rule along with its limitations.	**04**
	(c)	Define azeotrope and explain the minimum boiling and maximum boiling azeotropes with suitable examples.	**07**
Q.2	**(a)**	Discuss: ideal solutions and non-ideal solutions.	**03**
	(b)	For a closed system consisting two phases in equilibrium, explain Chemical Potential and Phase Equliibria.	**04**
	(c)	Explain in brief about fundamental property relation. Derive Gibbs/Duhem equations relating molar and partial molar properties.	**07**
		OR	
	(c)	At 300 K and 1 bar ,the volumetric data for a liquid mixture of benzene and cyclohexane are represented by V=109.4 × 10-6 − 16.8 ×10-6 x − 2.64 ×10-6 x2, where x is the mole fraction of benzene and V has the units of m3/mol. Find expressions for the partial molar volumes of benzene and cyclohexane.	**07**
Q.3	**(a)**	Discuss about liquid – liquid equilibrium (LLE).	**03**
	(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?	**04**
	(c)	Write a short note on flash vaporization.	**07**
		OR	
Q.3	**(a)**	Explain gamma-phi formulation of VLE.	**03**
	(b)	A mixture of A and B confirms closely to Raoult's law. At 373 K, the vapour pressure of A and B are 106 and 74 kPa respectively. Determine the composition of the vapour and liquid in equilibrium at 173 K and 101.3 kPa.	**04**
	(c)	Write a brief note on retrograde condensation and its application.	**07**
Q.4	**(a)**	Define activity and activity co efficient	**03**
	(b)	Liquid A and B form an azeotrope containing 46.1 mole percent A at 101.3 kPa and 345 K, the vapour pressure of A is 84.8.kPa and that of B is 78.2 kPa. Calculate the Van Laar Constants.	**04**
	(c)	List out various methods for evaluation of fugacity coefficient of pure component. Discuss any two in detail.	**07**
		OR	
Q.4	**(a)**	Define fugacity and fugacity co efficient	**03**
	(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'.	**04**

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

Q.5 **(a)** Explain the different factors affecting equilibrium conversions. **03**

(b) Discuss various methods to determine equilibrium constant. **04**

(c) Using the fundamental properties relation for single phase reaction, show that **07**

$$\Delta G^0 = - RT \ln K$$

OR

Q.5 **(a)** Write a brief note on multi reaction equilibria. **03**

(b) Develop expressions for the mole fractions (y_i) of reacting species as functions of the reaction coordinates for a system initially contains 2-mol CH_4 and 3-mol H_2O undergoing the reaction: **04**

$CH_4 + H_2O \rightarrow CO + 3H_2$……(1)

$CH_4 + 2H_2O \rightarrow CO_2 + 4H_2$……(2)

(c) Explain effect of temperature, pressure and total stoichiometric number on equilibrium constant. **07**

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