P P SAVANI UNIVERSITY

Fifth Semester of B. Tech. Examination

December 2021

SECH3041 Chemical Engineering Thermodynamics II

13.12.2021, Monday **Time: 9:00 a.m. To 11:30 a.m.** **Maximum Marks: 60**

Instructions:

1. The question paper comprises of two sections.
2. Section I and II must be attempted in separate answer sheets.
3. Make suitable assumptions and draw neat figures wherever required.
4. Use of scientific calculator is allowed.

SECTION – I

Q - 1	Answer the Following	**[05]**
(i)	Chemical potential	
(ii)	Relative volatility	
Q - 2	Define fugacity coefficient. Discuss any two methods to evaluate the fugacity coefficient in detail.	**[10]**
	OR	
Q - 2	Two components A and B form a maximum boiling azeotrope at 90 ^{0}C and 760 mmHg. The composition of azeotrope is 60% A (mol). The vapor pressure of A and B at 600 and 300 mmHg respectively. Calculate the Margules constant and plot ln γ_A vs. x_A.	**[10]**
Q - 3 (a)	Discuss the Gibbs–Duhem equation and its various forms. What are the major fields of application of the Gibb's Duhem equations?	**[05]**
Q - 3 (b)	Discuss Margules equations. Give it significance.	**[05]**
	OR	
Q - 3 (a)	Define partial molar properties and explain various methods for the evaluation of partial molar properties.	**[05]**
Q - 3 (b)	Discuss the various correlation equations used for VLE calculations.	**[05]**
Q - 4	Attempt any one	**[05]**
(i)	Discuss the "Flash Vaporization" with neat sketch.	
(ii)	Prove that for an ideal gas mixture, the fugacity of component (i) is equal to its partial pressure in the gas mixture.	

SECTION – II

Q - 1	Answer the Following: (Any FIVE)	**[05]**
(i)	Define osmotic pressure	
(ii)	Define bubble point	
(iii)	Define dew point	
(iv)	What is excess Gibbs free energy	
(v)	Define phase rule for reacting system	
(vi)	Define vapor liquid equilibria	
(vii)	Define activity coefficient	
Q - 2 (a)	What do you mean by property change of mixing? Derive an expression for volume change of mixing and enthalpy change of mixing.	**[05]**
Q - 2 (b)	Discuss the criteria of chemical reaction equilibrium	**[05]**
	OR	
Q - 2 (a)	Sketch the diagrams for minimum boiling azeotrope.	**[05]**
Q - 2 (b)	A gas mixture containing 3 mol CO_2, 5 mol H_2 and 1 mol water is undergoing the following reactions: $CO_2 + 3H_2 \rightarrow CH_3OH + H_2O$ $CO_2 + H_2 \rightarrow CO + H_2O$	**[05]**

	Develop expressions for the mole fraction of the species in terms of the extent of reaction.	
Q - 3 (a)	Discuss and derive Lewis-Randall Rule.	**[05]**
Q - 3 (b)	Derive the equation relating equilibrium constant and standard free energy change.	**[05]**
	OR	
Q - 3 (a)	Liquid A and B form an azeotrope containing 46.1 mole percent at 1 atm and 72 C. At 72 °C, the vapor pressure of A is 0.837 atm and that of B is 0.772 atm. Generate VLE data for the above system using Van Laar equation and plot y vs x.	**[05]**
Q - 3 (b)	Derive a Clausius-Clapeyron and Antoine equation.	**[05]**
Q - 4	Attempt any one.	**[05]**
(i)	Write a short note on feasibility of a reaction.	
(ii)	Discuss the effect of temperature, pressure and inert on equilibrium conversion in detail.	

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