U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

August 2024 Supplementary Examinations

Programme: B.E. **Semester: IV**
Branch: Chemical Engineering **Duration: 3 hrs.**
Course Code: 19CH4DCTD2 **Max Marks: 100**
Course: Process Engineering Thermodynamics-II

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

			CO	PO	Marks
		UNIT - I			
1	a)	Starting from exact differential, derive Maxwell relations.	*CO1*	*PO1*	**08**
	b)	Show that $$C_P - C_V = \frac{TV \propto^2}{\beta}$$ Where, α = Volume of thermal expansion and β = Volume of thermal contraction	*CO2*	*PO2*	**12**
		OR			
2	a)	Explain the significance of Joule Thomson coefficient.	*CO1*	*PO1*	**04**
	b)	What are thermodynamic diagrams? Explain the T-S and H-S phase diagrams for a binary solution with a neat sketch.	*CO1*	*PO1*	**10**
	c)	Explain the Gibbs Helmholtz equation and list its applications.	*CO2*	*PO2*	**06**
		UNIT - II			
3	a)	Discuss the effect of pressure and temperature on fugacity.	*CO2*	*PO2*	**06**
	b)	For isopropanol vapour at 200°C, $$Z = 1 - 9.86\times10^{-3}\text{P} - 11.41\times10^{-5}P^2$$ Where P is pressure in bar. Estimate the fugacity coefficient and fugacity at 25 bars.	*CO3*	*PO2*	**06**
	c)	It is decided to prepare 0.1 m^3 of alcohol-water solution by mixing 0.03 m^3 alcohol with 0.07 m^3 pure water. How much volume should have been mixed in order to prepare a mixture of the same strength and of the required volume? Data: • Density of ethanol = 789 kg / m^3 • Density of water = 997 kg / m^3 • The partial molar volume of ethanol =53.6 × 10^{-6} m^3 /mol • The partial molar volume of water = 18 × 10^{-6} m^3 /mol.	*CO4*	*PO3*	**08**

			OR			
	4	a)	The volume of an aqueous solution of NaCl at 298 K was measured for a series of molalities (moles of solute per kg of solvent) and it was found that the volume varies with molality according to the following expression. $V = 1.003 \times 10^{-3} + 0.1662 \times 10^{-4} m + 0.177 \times 10^{-5} m^{1.5} + 0.12 \times 10^{-6} m^2$ Where m is the molality and V is in m^3. Calculate the partial molar volumes of the components at m = 0.1 mol/kg.	***CO4***	***PO3***	**10**
		b)	Derive Gibbs-Dehum equation in terms of fugacity.	***CO3***	***PO 2***	**10**
			UNIT - III			
	5	a)	Discuss Criteria of equilibrium for the following cases: i. System at constant U and V ii. System at constant T and V. iii. System at constant T and P	***CO4***	***PO3***	**10**
		b)	Discuss influence of temperature and pressure on chemical potential.	***CO4***	***PO3***	**10**
			UNIT – IV			
	6	a)	Using relevant mathematical correlation explain the significance of (i) Wilson equation and (ii) Margules equation.	***CO5***	***PO3***	**08**
		b)	The pure component vapour pressure of two organic liquids X and Y by Antoine equation are given by $\ln P_1^{Sat} = 14.35 - \frac{2942}{T+220}$ and $\ln P_2^{Sat} = 14.25 - \frac{2960}{T+210}$; Where, P_1^{Sat} and P_2^{Sat} are in kPa and T in °C. Calculate the composition of liquid and vapour in equilibrium at 77° C and 75 kPa.	***CO*** 6	***PO3***	**12**
			UNIT - V			
	7	a)	Discuss the factors affecting equilibrium conversion.	***CO3***	***PO3***	**06**
		b)	The standard heat of formation and the standard free energy of formation of ammonia at 298 K are - 46100 J/mol and -16500 J/mol respectively. Calculate the equilibrium constant for the reaction at 500K $N_2(g) + 3\,H_2(g) \rightarrow 2\,NH_3(g)$ Assuming standard heat of reaction is constant in the same temperature range of 298 K to 500 K.	***CO6***	***PO3***	**14**

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