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

Autonomous Institute Affiliated to VTU

January / February 2025 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Chemical Engineering **Duration: 3 hrs.**
Course Code: 19CH5PCMT2 **Max Marks: 100**
Course: Mass Transfer-II

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

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	*CO*	*PO*	Marks
1	a)	Compare and contrast between the tray and packed towers for liquid-gas contact operations.	*CO2*	*PO3*	**10**
	b)	Carbon disulfide (CS_2) is to be recovered from the CS_2-nitrogen mixture by scrubbing it with solvent oil in a multi-stage counter-current absorber. The gas mixture entering the system has a partial pressure of CS_2 equal to 50 mmHg. The feed mixture is at 20 °C and 101.3 kPa and flows at a rate of 500 m^3/h. It is required to recover 93% of CS_2 present in the feed gas. The solvent oil has a molecular weight of 180 kg/kmol and is free of CS_2 and forms an ideal solution with it. The vapour pressure of CS_2 at 20°C is 346 mmHg. The Murphree stage efficiency is 80% based on gas composition. Generate the equilibrium data and plot the equilibrium curve for this system.	*CO3*	*PO4*	**10**
		OR			
2	a)	What are HETP and HTU in gas-liquid contact equipment? Explain their significance.	*CO1*	*PO2*	**04**
	b)	What are flooding, weeping, and priming?	*CO2*	*PO3*	**06**
	c)	It is desired to absorb 90% of acetone in a gas containing 1 mol % acetone in the air in a counter-current stage tower. The total inlet gas flow to the tower is 30 kmol/h and the total inlet pure water flow to be used to absorb the acetone is 90 kmol/h. The process is to operate isothermally at 300 K and a total pressure of 101.3 kPa. The equilibrium relation for acetone in gas-liquid is $y_A = 2.53\ x_A$. Determine the number of theoretical stages required for the separation.	*CO3*	*PO4*	**10**
		UNIT - II			
3	a)	What is simple distillation? Derive Rayleigh equation.	*CO1*	*PO2*	**08**
	b)	Elucidate the importance of VLE data in distillation.	*CO1*	*PO2*	**06**

		c)	What are the differences between flash distillation and steam distillation?	*CO4*	*PO2*	**06**
			OR			
	4	a)	State the assumption of the McCabe-Thiele method for the determination of the number of stages in a distillation column.	*CO3*	*PO4*	**05**
		b)	What is reflux ratio? Based on the feed conditions, locate the slope of the q-line on an x-y plot.	*CO2*	*PO3*	**05**
		c)	2000 kg/h of a mixture of CS_2 and CCl_4 containing 67 mole % CS_2 is to be fractionated in a bubble cap column to give a distillate containing 97 mole % and a residue containing 9.6 mole % mole volatile component, respectively. The feed enters the column at its bubble point. The reflux ratio is 2.5 times the minimum reflux ratio suggested. The average molecular weight of feed is 101.74 kg/kmol. Determine the number of plates required using the data given below. Mole fraction of CS_2 in liquid, x: 0, 0.16, 0.44, 0.83, 1.0 Mole fraction of CS_2 in vapour, y: 0, 0.3, 0.68, 0.93, 1.0	*CO3*	*PO4*	**10**
			UNIT - III			
	5	a)	Explain the azeotropic and extractive distillation with an example.	*CO4*	*PO2*	**10**
		b)	Discuss different types of reboiler arrangements for the distillation columns with figures.	*CO4*	*PO2*	**10**
			OR			
	6	a)	Describe the Ponchon Savarit method to determine number of stages with a neat graphical diagram.	*CO 2*	*PO 3*	**10**
		b)	Explain the vacuum and molecular distillation processes.	*CO 2*	*PO3*	**10**
			UNIT - IV			
	7	a)	A multi-stage cross-flow extraction system is used to extract dioxane from a binary mixture of dioxane and water using benzene as a solvent. The aqueous feed is available at 150 kg/h containing 20 wt. % dioxane. The system has three stages, and 120 kg/h of fresh solvent is to be used in each stage. The solvent feed contains 2 wt. % dioxane. Considering each stage to be an ideal stage, determine the final content of dioxane in water. The miscibility of benzene in water may be neglected. The solubility of dioxane in water and benzene at equilibrium is given below. Wt. % dioxane in water: 5.1, 18.9, 25.0 Wt. % dioxane in benzene: 5.2, 22.5, 32	*CO3*	*PO4*	**10**
		b)	With the help of a neat sketch, explain the working principle of a rotating disc extractor.	*CO4*	*PO2*	**10**
			OR			
	8	a)	What are the desirable characteristics of an industrial solvent used for liquid-liquid extraction?	*CO2*	*PO3*	**10**
		b)	Explain the working of a three-stage counter current mixer settler cascade for extraction.	*CO2*	*PO3*	**10**

			UNIT - V			
	9	a)	With the help of neat diagrams, explain the typical equilibrium diagrams for leaching operation.	*CO4*	*PO2*	**10**
		b)	Explain the working and construction of any two industrial leaching equipment with a diagram.	*CO2*	*PO3*	**10**
			OR			
	10	a)	Develop the design calculation for multistage crosscurrent leaching. Present its graphical representation.	*CO3*	*PO4*	**10**
		b)	Outline the operations of Bollman extractor with a neat diagram. Enlist its advantages.	*CO4*	*PO2*	**10**

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