P P SAVANI UNIVERSITY

Fifth Semester of B. Tech. Examination
December 2021
SECH3021 Mass Transfer Operations-II

06.12.2021, Monday   Time: 09:00 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	Discuss choice of solvents used in Liquid-Liquid Extraction.	[05]
Q - 2 (a)	Explain with sketch the material balance continuous multistage countercurrent extraction with and without reflux.	[05]
Q - 2 (b)	Explain the equilateral triangular diagram.	[05]

OR

Q - 2 (a)	Explain with sketch the material balance multistage cross-current extraction with partially miscible solvent.	[05]
Q - 2 (b)	Discuss the mixture rule with diagram	[05]
Q - 3 (a)	Derive the expression for differential distillation. Also discuss the concept of hold-up, reflux ratio.	[05]
Q - 3 (b)	Describe the poncho-savarit method for calculating number of theoretical plates in the column.	[05]

OR

Q - 3 (a)	Write short note on Flash Distillation with diagram and VLE equilibrium curve.	[05]
Q - 3 (b)	Derive the expression for differential distillation. Also discuss the concept of hold-up, reflux ratio.	[05]
Q - 4	What is meant by Plate Efficiency and their practical types?	[05]

SECTION – II

Q - 1	Answer the Following: Any five	
(i)	Freundlich Adsorption Isotherm is given by	
	(i) $q = ky^n$ ii) $q = ky^{n-1}$ iii) $n = ky^q$ iv) $q = yk^n$	
(ii)	Adsorption is preferred at	
	i) High temp. & low press. ii) Low temp & high press. ii) Low temp & low press. iv) High press. & high temp.	
(iii)	Define weeping and dumping in tray tower.	
(iv)	State any two industrial applications of leaching.	
(v)	Name any two commercial adsorbents used in industry.	
(vi)	State the types of packings.	
(vii)	Name the equipments used in gas liquid contact for the case of liquid dispersed.	
Q - 2 (a)	Write a short note on principles of ion exchange with suitable examples.	[05]
Q - 2 (b)	State and discuss in detail the types of adsorption	[05]

OR

Q - 2 (a)	Derive the relation for two stage cross current adsorption using Freundlich isotherm.	[05]
Q - 2 (b)	Write a short note on Adsorption wave with neat schematic diagram	[05]
Q - 3 (a)	Describe with neat sketch the construction and working of tray tower with all internal components.	[05]
Q - 3 (b)	Discuss in detail the comparison between tray and packed towers.	[05]

OR

Q - 3 (a)	Discuss in detail with neat sketch the working of Rotocel	[05]
Q - 3 (b)	Explain with neat sketch the working of rotating fixed bed adsorber.	[05]
Q - 4	Attempt any one.	[05]
	Write a short note on preparation of solid in leaching.	
	Explain with schematic diagram the shank's system.	

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SECTION – I

Q - 1	Answer the Following: Any five	[05]
(i)	Define plate efficiency.	
(ii)	State any two industrial applications of Extraction.	
(iii)	Define selectivity.	
(iv)	The relative volatility of a binary mixture at azeotropic composition is i) Zero ii) Infinity iii) Unity iv) Either less than or more than unity	
(v)	A binary feed mixture containing 2/3 vapors, calculate the slope of Feed line.	
(vi)	Define absorption factor.	
(vii)	Calculate the relative volatility of a binary mixture, when vapour pressure of more volatile component is 940 mmHg and that of low volatile component is 417 mm Hg.	
Q - 2 (a)	For an ideal binary mixture and its associated ideal vapors; show that separation factor is the ratio of vapor pressure of more volatile component to that of low volatile component.	[05]
Q - 2 (b)	Write a short note on azeotrope.	[05]

OR

Q - 2 (a)	For flash distillation prove that $x = x_f = y$	[05]
Q - 2 (b)	Discuss the importance of minimum liquid-gas ratio for absorbers.	[05]
Q - 3 (a)	A 30 mole % of component A in a mixture of A and B is to be distilled in a batch operation to obtain a product having an average composition of 45 mole % A. Calculate the amount of residue per 100 kmol of charge when $\alpha = 2.45$.	[05]
Q - 3 (b)	Discuss in detail the selection criteria for solvent in extraction.	[05]

OR

Q - 3 (a)	Describe the concept of equilibrium solubility of various gases in a liquid.	[05]
Q - 3 (b)	Describe vapour-liquid Equilibria for a binary mixture at constant pressure and temperature.	[05]
Q - 4	Attempt any one	[05]
(i)	A solution containing 5 % acetaldehyde and 95 % toluene is to be extracted with water in a five stage crosscurrent extraction unit to extract acetaldehyde. Toluene and water are essentially insoluble. If 25 kg of water each time are used per 100 kg of feed, calculate the amount of acetaldehyde extracted and final concentration of the exit solution.	
(ii)	A packed tower is designed to recover 98% CO_2 from a gas mixture containing 10% CO_2 and 90% by volume air using water. A relation $y' = 14 x'$ can be used for the equilibrium condition. The water to gas rate is kept 30% more than the minimum value. Calculate the actual mole ratio of water to solute free gas (Inert gas), where y'= kg CO_2/kg dry air and x' = kg CO_2/kg water.	

SECTION – II

Q - 1	Describe VLE at constant pressure and temperature.	[05]
Q - 2 (a)	Describe different operating problems in a tray tower.	[05]
Q - 2 (b)	Discuss Ideal and Non-ideal solutions and explain the characteristics of ideal solutions.	[05]

OR

Q - 2 (a)	Differentiate between Physical and Chemical adsorption.	[05]
Q - 2 (b)	Describe multistage cross current leaching operations with the sketch.	[05]
Q - 3 (a)	Explain various internal components involved in packed tower.	[05]
Q - 3 (b)	Explain HETP, HTU and NTU in details.	[05]

OR

Q - 3 (a)	Write the names of equipment used for Extraction purpose. Explain any one in details.	[05]
Q - 3 (b)	Explain the system of three liquids which one pair partially miscible with diagram.	[05]
Q - 4	What do you understand by Leaching operation? Explain the application of leaching.	[05]

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