GUJARAT TECHNOLOGICAL UNIVERSITY
BE- SEMESTER–V (NEW) EXAMINATION – WINTER 2020
Subject Code:3150501   **Date:27/01/2021**
Subject Name:Mass Transfer Operations I
Time:10:30 AM TO 12:30 PM   **Total Marks: 56**

Instructions:
1. Attempt any FOUR questions out of EIGHT questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

Q.1	**(a)**	Discuss the factors affecting choice of separation method.	**03**
	(b)	Differentiate between packed towers/tray towers.	**04**
	(c)	Discuss in detail classification of mass transfer operations with examples.	**07**
Q.2	**(a)**	Explain mass transfer operation between two immiscible phases.	**03**
	(b)	Explain material balance for single stage leaching.	**04**
	(c)	Methane diffuses at steady state through a tube containing helium for the case equimolar counter diffusion. At point 1, the partial pressure of methane is 55 kPa and at point 2, 0.03 m apart is 15 kPa. The total pressure is 101.325 kPa and temperature is 298 k, at this temperature and pressure the value of diffusivity is 6.75×10^{-5} m^2/s. Calculate the partial pressure of methane at point 0.02 m apart from point 1 for the above case.	**07**
Q.3	**(a)**	Define selectivity, absorption factor and ideal stage.	**03**
	(b)	Explain mass, heat and momentum transfer analogies.	**04**
	(c)	Explain the following terms with respect to tray towers: (i) Flooding (ii)Priming (iii) Coning (iv)Weeping (v) Dumping (vi)Tray Spacing (vii)Theoretical Tray	**07**
Q.4	**(a)**	Differentiate between random and regular packing.	**03**
	(b)	Define liquid extraction giving typical example. Explain equilateral–triangular co-ordinate and the mixture rule.	**04**
	(c)	Explain selection criteria for choice of solvent for gas absorption.	**07**
Q.5	**(a)**	With neat diagram discuss Venturi Scrubber.	**03**
	(b)	Discuss local and overall mass transfer coefficients.	**04**
	(c)	Derive equations to calculate rate of steady state diffusion of 'A' through non-diffusing 'B' and also for steady state equimolal counter diffusion in case of gases.	**07**
Q.6	**(a)**	Explain counter current multiple contact, Shanks system for leaching.	**03**
	(b)	Discuss in detail about Film theory for mass transfer coefficient.	**04**
	(c)	Enlist different industrial liquid extractors and explain any one in detail with neat figure.	**07**
Q.7	**(a)**	Explain preparation of solids for leaching.	**03**
	(b)	Discuss agitated batch crystallizer with neat sketch.	**04**

(c) A hot solution containing 2000kg of $MgSO_4$ and water at 57^OC and with a concentration of 30 weight% $MgSO_4$ is cooled to 30^0C and $MgSO_4.7H_2O$ crystals are removed. The solubility at 30^0C is 35.5 kg $MgSO_4$ per100 kg water. Calculate the yield of crystals and % yield of crystallization. Assume that no water is vaporized. Atomic weight: Mg=24, S=32, O=16, H=1 **07**

Q.8 **(a)** Explain caking of crystals and methods to prevent it. **03**

(b) Define super saturation and explain Meir's super saturation theory. Explain stages of crystallization. Explain stages or mechanism of crystallization. **04**

(c) Discuss the system of three liquids- one pair partially soluble and the effect of temperature on ternary equilibria. **07**

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