Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) EXAMINATION – WINTER 2021

Subject Code:3150501 Date:01/01/2022

Subject Name:Mass Transfer Operations I

Time:02:30 PM TO 05:00 PM Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Define: Plait point, selectivity and distribution coefficient in liquid-liquid extraction.	**03**
	(b)	Explain design principles of mass transfer equipments.	**04**
	(c)	A coal gas 0.01075 kmol/s at 26ºC, and $1.07*10^5$ N/m^2 containing 2% by volume of light oil vapors is to be freed of its light oil(Benzene) by scrubbing with wash oil as an absorbent and a 95% removal is required. The wash oil is to enter at 26 ºC, containing 0.005 mole fraction benzene, and has an average molecular weight 260. An oil circulation rate of wash oil is 0.001787 kmol/sec. Take vapor pressure of benzene at 26ºC is 13330 N/m^2. Assume ideal solution of wash oil-benzene. Calculate number of ideal stages.	**07**
Q.2	**(a)**	Explain the influence of solvent solubility on extraction.	**03**
	(b)	Explain the stage wise construction for insoluble liquids in liquid-liquid extraction.	**04**
	(c)	Oxygen is diffusing through a stagnant layer of methane 5 mm thick. The temperature is 20ºC and the pressure 100 kN/m^2. The concentrations of oxygen on the two sides of the film are 15% and 5% by volume. The diffusivity of oxygen in methane at 20ºC and 100 kN/m^2 is 2.046 x 10-5 m^2/s. Calculate: (a) Rate of diffusion of oxygen in kmol/ m^{2}s. (b) What will be the rate of diffusion if total pressure is raised to 200 kN/m^2, other conditions remaining unaltered?	**07**
		OR	
	(c)	Oxygen (A) is diffusing through carbon monoxide (B) under steady state condition with carbon monoxide non-diffusing. The total pressure is 1×10^5 N/m^{2}and temperature is 0^0C. The partial pressure of oxygen at two planes 2.0 mm apart is respectively 13000 and 6500 N/m^2. The diffusivity for the mixture is 1.87×10^{-5} m^2/s. Calculate the rate of diffusion of oxygen in kmol/s through each square meter of the two planes.	**07**
Q.3	**(a)**	Compare N type flux and J type flux.	**03**
	(b)	Classify gas-liquid mass transfer operations with principle.	**04**
	(c)	Derive the equation of N flux for steady state diffusion of A through non-diffusing B for gases.	**07**
		OR	
Q.3	**(a)**	Compare diffusivity of gases and diffusivity of liquids.	**03**
	(b)	Compare Penetration theory with Film theory with reference to molecular diffusion.	**04**
	(c)	Derive the equation of N flux for equimolal counter diffusion for gases	**07**

Q.4	**(a)**	Define the following terms with respect to tray tower a) Priming b) Coning c) Weeping	**03**
	(b)	Explain the prevention of vortex formation in mechanically agitated vessel.	**04**
	(c)	Explain "two resistance theory" briefly.	**07**
		OR	
Q.4	**(a)**	Define the following terms with respect to tray tower a) Flooding b) Dumping c) Tray Spacing	**03**
	(b)	Explain the characteristics of fill for packed tower.	**04**
	(c)	Explain use of local overall coefficients.	**07**
Q.5	**(a)**	Define: a) Absorption factor b) Crystallization c) selectivity of solvent	**03**
	(b)	Explain Meir's super saturation theory of crystallization.	**04**
	(c)	Explain construction and working of Ballman Extractor with neat sketch.	**07**
		OR	
Q.5	**(a)**	Define: a) Recoverability of solvent b) absorption c) striping	**03**
	(b)	Describe Swenson-Walker crystallizer.	**04**
	(c)	Explain typical equilibrium diagrams in leaching operation briefly	**07**

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