Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V EXAMINATION – SUMMER 2025

Subject Code:3150501 Date:15-05-2025

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)**	Discuss Fick's law of diffusion.	**03**
	(b)	Differentiate between N flux and J flux.	**04**
	(c)	Derive the equation of N flux for steady state diffusion of A through non-diffusing B for gases.	**07**
Q-2	**(a)**	Define the following terms with respect to packed tower a) Flooding b) loading c) liquid hold up	**03**
	(b)	Discuss Random packing	**04**
	(c)	In an Oxygen-Nitrogen gas mixture at 1 atm, 25 ºC, the concentrations of oxygen at two planes of the film 3mm apart are 10% and 20% by volume. Calculate the Rate of diffusion of oxygen in kmol/ m^2s for the case where there is an equimolar counter diffusion of the two gases. The diffusivity of the system is 0.206 m^2/s.	**07**
		OR	
	(c)	Benzene is stored in a tank of 10.0 m diameter and open at the top. A stagnant air film 10 mm thick is covering the surface of Benzene Beyond which the benzene is not present. Atmospheric temperature is 25 ºC and vapor pressure of Benzene is 150 mm Hg and its molar diffusivity is 0.02 m^2/hr. Calculate the Rate of diffusion in kmol/ m^2hr.	
Q-3	**(a)**	Discuss how solvent solubility affects the extraction process.	**03**
	(b)	Classify gas-liquid mass transfer operations.	**04**
	(c)	A tower packed with 0.5 cm Raschig rings of 12 m height is to be used for absorption of H_2S from natural gas by using mono ethanolamine as a solvent. The operation is counter currently carried out at temperature 30 ºC and pressure 1 atm. The entering gas contains 18% H_2S by volume, 90% of which has to be absorbed. The gas flow rate is 2000 m^3/m^2 hr.The equilibrium data is governed by y= 1.1x. Operating line is straight and parallel to the equilibrium line. Calculate liquid flow rate.	**07**
		OR	
Q-3	**(a)**	Briefly explain diffusivity of liquids.	**03**
	(b)	Discuss the principle of inter phase mass transfer with neat sketch.	**04**

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(c) A packed tower is to be designed to absorb sulfur dioxide from air by scrubbing the gas with water. The entry and exit gas concentrations are 20% and 0.5% SO_2 by volume respectively. The entering water is SO_2 free. The actual water flow is twice the minimum. The air flow rate (on SO_2 free basis) is 975 kg/hr m^2.The temperature is 30 ^oC and pressure is 2 atm. The equilibrium data is governed by y = 21.8x. Compute the number of gas transfer units. **07**

Q-4 **(a)** Discuss characteristics of a good solvent for extraction process. **03**

(b) Discuss the method to determine minimum gas liquid ratio for absorber with neat sketch **04**

(c) Discuss single stage extraction and develop equations to determine the quantity of extract and raffinate. **07**

OR

Q-4 **(a)** Explain the function of following: **03**
a) Down spout b) Weir c) Entrainment eliminator

(b) Discuss material balance over a counter current absorber. **04**

(c) Discuss working of Agitated vessels for leaching batch process. **07**

Q.5 **(a)** Define: a) Absorption factor b) tray efficiency c) selectivity **03**

(b) Explain working of Venturi scrubber. **04**

(c) Explain construction and working of Rotocell with neat sketch. **07**

OR

Q.5 **(a)** Discuss bubble cap trays briefly. **03**

(b) Describe Swenson-Walker crystallizer. **04**

(c) Explain equilibrium diagrams in leaching operation with neat sketch. **07**

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