Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE – SEMESTER V • EXAMINATION – WINTER - 2012

Subject code: 150501 **Date: 11-01-2013**

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.**

Q.1 **(a)** Explain molecular diffusion in gases in detail. Also discuss steady state diffusion of A through non diffusing B. **07**

(b) Oxygen (A) is diffusing through carbon monoxide (B) under steady state condition, with the carbon monoxide non diffusing. The total pressure is 1 x 10^5 N/m^2 , and the temperature 0^0 C. The partial pressure of oxygen at two planes 2.0 mm apart is respectively, 13 000 and 6500 N/m^2 . The diffusivity for the mixture is 1.87 x 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.2 **(a)** Discuss with neat sketch various packing materials used in Column. **07**

(b) A packed tower is designed to recover 98% CO_2 from a gas mixture containing 10% CO_2 and 90% air using water. A relation y = 14x can be used for equilibrium conditions where , y = kg CO_2/ kg dry air and x =kg CO_2/ kg water. **07**

The water to gas rate is kept 30% more than the minimum value. Calculate the height of the tower if $(HTU)_{OG}$ is 1 meter.

OR

(b) Discuss with examples the diffusion in solids. **07**

Q.3 **(a)** For given liquid flow rate give stepwise procedure to determine minimum liquid gas ratio for absorbers. **07**

(b) Discuss the criteria for choosing the solvent for absorption. **07**

OR

Q.3 **(a)** Discuss with neat diagram any one type of equipment used for extraction of oil from vegetable seeds. **07**

(b) Seeds containing 20 percent by weight of oil are extracted in a counter current plant and 90 percent of the oil is recovered in a solution containing 50 percent by weight of oil. If the seeds are extracted with fresh solvent and 1kg of solution is removed in the underflow in association with every 2 kg of insoluble matter, how many ideal stages are required? **07**

Q.4 **(a)** Discuss local and overall mass transfer coefficients. **07**

(b) If 1000 kg/h of a nicotine (C)-water (A) solution containing 1% nicotine is to be counter currently extracted with kerosene at 20^0 C to reduce the nicotine content to 0.1% , determine (a) the minimum kerosene rate and (b) the number of theoretical stage required if 1150 kg of kerosene is used per hour. **07**

Sr. No.	x’	y’	Sr. No.	x’	y’
1.	0	0	5.	0.00751	0.00686
2.	0.001011	0.000807	6.	0.00988	0.00913
3.	0.00246	0.001961	7.	0.0204	0.01870
4.	0.00502	0.00456			

x’ :kg nicotine/ kg water
y’: kg nicotine/ kg kerosene
Water and kerosene are essentially insoluble.

OR

Q.4	**(a)**	Give the comparison of tray and packed tower.	**07**
Q.4	**(b)**	Discuss with diagram equipment for Gas liquid operations for a batch system.	**07**
Q.5	**(a)**	Discuss preparation of the solids for leaching in detail	**07**
	(b)	Give comparison of Random packing and stacked packing.	**07**

OR

Q.5	**(a)**	Describe differential (continuous contact) extractor in detail.	**07**
	(b)	Discuss construction and working of sieve trays. Explain Tray efficiency.	**07**

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