Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

B. E. Sem. - V - Examination – June- 2011

Subject code: 150501

Subject Name: Mass Transfer Operations- I

Date:20/06/2011 **Time: 10:30 am – 01:00 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)** 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**

(b) Oxygen (A) is diffusing through carbon monoxide (B) under steady state condition with the carbon monoxide nondiffusing. The total pressure is 1 x 10^5 N/m^2, and the temperature 0°C. The partial pressure of oxygen at two planes 2 mm apart is, respectively 13000 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)** Explain selection criteria for choice of solvent for absorption. **07**

(b) Discuss in detail about Film theory for mass transfer coefficient. **07**

OR

(b) Discuss in detail about Penetration theory for mass transfer coefficient. **07**

Q.3 **(a)** Different types of packing materials and their selection criterion. **07**

(b) Differentiate between packed tower v/s tray tower. **07**

OR

Q.3 A packed tower is to be designed to absorb sulfur dioxide from air by scrubbing the gas with water. The entering gas is 18.6% SO_2 by volume. The water flow is to be 2.3 times the minimum. The air flow rate (SO_2 free basis) is 1100 m^3/hr. The temperature is 30 ^{0}C and the total pressure is 2 atm. The equilibrium data is governed by y=21.8x where y and x are in mole fractions units. Compute the number of overall gas phase transfer units. **14**

Q.4 **(a)** Define liquid extraction giving typical example. Explain equilateral – triangular co-ordinate and the mixture rule. **07**

(b) Explain selection criteria for choice of solvent for liquid extraction. **07**

OR

Q.4 **(a)** Discuss the system of three liquids- one pair partially soluble and the effect of temperature on ternary equilibria. **07**

(b) Explain with a sketch the material balance for single stage liquid liquid extraction. **07**

Q.5 **(a)** Explain counter current multiple contact, Shanks system for leaching. **07**

(b) Write short note on Bollman extractor **07**

OR

Q.5 Nicotine (C) in a water (A) solution containing 1.2% nicotine is to be extracted with kerosene (B) at 200 C. Water and kerosene are essentially insoluble. (a) Determine the percentage extraction of nicotine if 100 kg of feed solution is to be extracted once with 120 kg solvent. (b) Repeat for three theoretical extractions using 40 kg solvent each. **14**

Equilibrium data :

x’	0	0.001011	0.00246	0.00502	0.00751	0.00998	0.0204
y’*	0	0.000807	0.00196	0.00456	0.00686	0.00913	0.0187

where, x’ = kg nicotine/kg water y’*= kg nicotine/kg kerosene.

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