

**GUJARAT TECHNOLOGICAL UNIVERSITY**  
**BE - SEMESTER-V EXAMINATION – WINTER 2015**

**Subject Code: 150501****Date: 15/12/2015****Subject Name: Mass Transfer-I****Time: 10:30am to 1:00pm****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) Define molecular diffusion. Derive the equation of  $N_A$  for steady state equimolar counter diffusion. **07**
- (b) Calculate the rate of diffusion of acetic acid (A) across a film of non-diffusing water (B) solution 1 mm thick at 17 °C when the concentrations on opposite sides of the film are respectively, 9 and 3 wt% acid. The diffusivity of acetic acid in the solution is  $0.95 \times 10^{-9} \text{ m}^2/\text{sec}$ . Take the density of 9% and 3% solution of acetic acid as  $1012 \text{ kg/m}^3$  and  $1003.2 \text{ kg/m}^3$  respectively. **07**
- Q.2** (a) Discuss Film theory for mass transfer co-efficient. **07**
- (b) Explain selection criteria for choice of solvent for absorption. **07**
- OR**
- (b) Discuss Penetration theory for mass transfer co-efficient. **07**
- Q.3** (a) Explain different types of packing materials and their selection criteria. **07**
- (b) Discuss tray towers and internals with application. **07**
- OR**
- Q.3** (a) Discuss about Heat, Mass and Momentum transfer analogies. **07**
- (b) Discuss different types of liquid distributor, redistributor and packing supports. **07**
- Q.4** (a) Define liquid extraction giving typical example. Explain equilateral – triangular co-ordinate and the mixture rule. **07**
- (b) Explain counter current multiple contact, Shanks system. **07**

**OR**

- Q.4** If 100 kg of a solution of acetic acid (C) and water (A) containing 30% acid is to be extracted three times with isopropyl ether (B) at 20 °C, using 40 kg of solvent in each stage, determine the quantities and compositions of the various streams. How much solvent would be required if the same final raffinate concentration were to be obtained with one stage? The equilibrium data at 20 °C are listed below: **14**

Wt% acetic acid, 100x	Water layer		Isopropyl ether layer		
	Water	Isopropyl ether	Acetic acid 100y*	Water	Isopropyl ether
0.69	98.1	1.2	0.18	0.5	99.3
1.41	97.1	1.5	0.37	0.7	98.9
2.89	95.5	1.6	0.79	0.8	98.4
6.42	91.7	1.9	1.93	1.0	97.1
13.3	84.4	2.3	4.82	1.9	93.3
25.5	71.1	3.4	11.4	3.9	84.7
36.7	58.9	4.4	21.6	6.9	71.5
44.3	45.1	10.6	31.1	10.8	58.1
46.4	37.1	16.5	36.2	15.1	48.7

- Q.5** (a) Discuss the criteria for choice of solvent for liquid-liquid extraction. **07**  
 (b) Explain working of Ballman Extractor. **07**

**OR**

- Q.5** (a) What is crystallization? Discuss effect of temperature on solubility. **07**  
 (b) With a neat sketch explain the working of Swenson Walker Crystallizer. **07**

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