

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-V (NEW) - EXAMINATION – SUMMER 2016****Subject Code:2150501****Date:21/05/2016****Subject Name:Mass Transfer Operation - 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) Derive the relation for steady state molecular diffusion in fluids at rest and in laminar flow. **07**
- (b) CO₂ is diffusing at steady state through a straight tube of 0.5m long with an inside diameter of 0.05m containing N₂ at 300K & 1atm pressure. The partial pressure of CO₂ at one end is 15KPa and 5KPa at other end. Given that at 300K and 1 atm pressure $D_{\text{CO}_2\text{-N}_2} = 4 \times 10^{-5} \text{ m}^2/\text{s}$. Calculate following for steady state equimolar counter diffusion. (a) molar flow rate of CO₂ (b) molar flow rate of N₂ **07**
- Q.2** (a) Distinguish between diffusion of A through non diffusing B vs. equimolar counter diffusion for mass transfer coefficient and Explain F- type Mass transfer Coefficient. **07**
- (b) (1) Explain phases separated by membrane. **07**
(2) What are the choices of separation method?
- OR**
- (b) Explain local overall mass transfer coefficients and how to correlate between local overall mass transfer coefficient and individual phase transfer coefficients. **07**
- Q.3** (a) Explain equilibrium solubility of gases in liquid for two component and multi component systems. **07**
- (b) Derive equation for height of packed tower for absorption of one component. **07**
- OR**
- Q.3** (a) Discuss various operation characteristics of sieve trays **07**
- (b) List out the devices in which liquid is dispersed into thin film or drops and describe any one in details with neat diagram. **07**
- Q.4** (a) Describe briefly no. of theoretical stages through continuous countercurrent multistage extraction. **07**
- (b) Define: (1) Tie line (2) Solutropic solution (3) Diffusivity (4) Extract (5) Operating line (6) Selectivity (7) Permeation **07**

OR

- Q.4** If 100kg 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 40kg of solvent in each stage, determine the quantities and compositions of the various streams. How much solvent would be required if same final raffinate concentration were to be obtained with one stage? **14**

Water layer			Isopropyl ether layer		
Wt% acetic acid 100x	Water	Isopropyl ether	Wt% 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
13.30	84.4	2.3	4.82	1.9	93.3
25.50	71.1	3.4	11.40	3.9	84.7
36.70	58.9	4.4	21.60	6.9	71.5
44.30	45.1	10.6	31.10	10.8	58.1
46.40	37.1	16.5	36.20	15.1	48.7

- Q.5** (a) What is Leaching? Explain unsteady state operations in Leaching. **07**
 (b) Discuss the equipments used for leaching of vegetable seeds and explain any one in detail. **07**

OR

- Q.5** (a) Discuss agitated batch crystallizer with neat sketch. **07**
 (b) Explain analogies between Mass and Heat transfer operations **07**
