

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 $1 \times 10^5 \text{ N/m}^2$, and the temperature 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 $1.87 \times 10^{-5} \text{ m}^2/\text{s}$. 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, $y = \text{kg CO}_2/\text{kg dry air}$ and $x = \text{kg CO}_2/\text{kg water}$. The water to gas rate is kept 30% more than the minimum value. Calculate the height of the tower if $(\text{HTU})_{\text{OG}}$ is 1 meter. **07**
- 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°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**
