

**GUJARAT TECHNOLOGICAL UNIVERSITY****BE - SEMESTER-V • EXAMINATION – WINTER • 2014****Subject Code: 150501****Date: 26-11-2014****Subject Name: Mass Transfer Operation - I****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) Define “Diffusivity”. Derive equation for steady-state diffusion of A through non diffusing B starting from Fick’s law. **07**
- (b) Discuss the operating characteristics of sieve trays along with the plot of Liquid rate vs. Gas rate **07**
- Q.2** (a) 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 is  $0^\circ\text{C}$ . The partial pressure of oxygen at two planes 2.0 mm apart is, respectively, 13000 and 6500  $\text{N/m}^2$ . The diffusivity for the mixture is  $1.87 \times 10^{-5} \text{ m}^2/\text{s}$ . Calculate the rate of diffusion of oxygen in  $\text{kmol/s}$  through each square meter of the two planes. **07**
- (b) Define liquid extraction with an example and discuss the criteria for choosing solvent for extraction operation. **07**
- OR**
- (b) Discuss different types of packings used in packed towers with their applications. **07**
- Q.3** (a) Discuss Penetration theory and state how it is different from Film theory. **07**
- (b) Derive equation for height of packed tower for absorption of one component. **07**
- OR**
- Q.3** (a) Enlist different industrial liquid extractors and explain any one in detail with neat figure. **07**
- (b) Gas from petroleum distillation column has its concentration of  $\text{H}_2\text{S}$  reduced from 0.03  $\text{kmol H}_2\text{S}$  per  $\text{kmol-inert hydrocarbon gas}$  to 1% of this value by scrubbing with a triethanol amine water solvent in a counter current tower of height 7.79 metre operating at 300 k and atmospheric pressure. The equilibrium relation may be taken as,  $Y=2X$  **07**
- Where,  $Y = \frac{k \text{ mol H}_2\text{S}}{k \text{ mol inert gas}}$        $X = \frac{k \text{ mol H}_2\text{S}}{k \text{ mol solvent}}$
- Pure solvent enters the tower and leaves containing 0.013  $\text{k mol H}_2\text{S}$  per  $\text{k mol solvent}$ . If the flow of inert hydrocarbon gas is 0.015  $\text{k mol/m}^2\text{s}$  and gas phase resistance controls the process, calculate the overall coefficient for absorption  $K_G$  a.
- Q.4** (a) Discuss the working of venturi scrubber and state its applications. **07**
- (b) Define leaching and discuss Shank system in detail. **07**
- OR**
- Q.4** (a) Define supersaturation and explain stages for crystallization. **07**
- (b) Discuss the equipments used for leaching of vegetable seeds and explain any one in detail. **07**
- Q.5** (a) Discuss single stage cocurrent extraction along with ternary diagram. **07**
- (b) Define absorption factor and state properties of solvent required for absorption. **07**
- OR**
- Q.5** (a) Write a note on types of crystallizers used in industries. **07**
- (b) Differentiate between packed towers and tray towers. **07**

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