

03/06/2025 TE CHEMICAL SEM-V C-SCHEME MTO-I QP CODE: 10084263

Duration: 3 hours

Total Marks: 80

- N. B. (i) Question number one is compulsory.
 (ii) Answer any three questions from the rest.
 (ii) Assume suitable data wherever necessary.

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| Q 1 Answer the following | |
| a. Differentiate between molecular diffusion and eddy diffusion. | 5 |
| b. Explain film theory with suitable diagram showing concentration profile showing concentration-distance curve. | 5 |
| c. Explain the concept of equilibrium with the help of equilibrium distribution of solute between gas and liquid phase at constant temperature. | 5 |
| d. Write a short note on properties of ideal solvent for gas absorption. | 5 |
| Q2 a. Ammonia is diffusing through a stagnant gas film mixture of 33 %Nitrogen and 67% Hydrogen by volume. The total pressure is 205 KN/m ² abs. temperature is 55 °C. Calculate rate of diffusion of ammonia per m ² through 0.5 mm thick film when concentration changes across the film from 10 % to 5% by volume ammonia.
$D_{\text{NH}_3\text{-N}_2} = 0.196 \text{ cm}^2/\text{sec.}$, $D_{\text{NH}_3\text{-H}_2} = 0.63 \text{ cm}^2/\text{sec.}$ | 10 |
| b. Derive the equations for steady state molecular diffusion of A into non-diffusing B and equimolar counter diffusion of A and B for laminar flow. | 10 |
| Q 3. a. Compare Penetration theory and surface renewal theory of mass transfer. | 10 |
| b. A large volume of pure gas B at 2 atm is flowing over the surface from which pure A is vaporizing. Liquid A completely wets the surface which is a blotting paper. Hence the partial pressure of A at the surface is vapour pressure of A at 298 K which is 0.2 atm. The ky' has been estimated to be $6.78 \times 10^{-5} \text{ kmol/m}^2\text{sec}$ mole fraction. Calculate N_A and ky . | 10 |
| Q 4 a. A countercurrent plate absorber is to be installed for scrubbing an air mixture containing 5 % ammonia by volume. The scrubber is fed with water containing 0.002 mole ammonia per mole of water. The scrubbing water rate is 1 mole water per mole ammonia. It is required to absorb 85% of ammonia present in the gas by operating the absorber at 20 °C. $Y=0.8X$. Calculate the concentration of ammonia in the outgoing liquid and number of stages required. | 10 |
| b. With suitable diagram explain the calculation for minimum liquid gas ratio in absorption | 10 |

- Q 5 a. In laboratory test, the rate of drying was found to be $0.5 \times 10^{-3} \text{ kg/m}^2\text{s}$ when the moisture content reduced from 0.4 to 0.1 on dry basis. Critical moisture on dry basis is 0.08. A tray dryer is used for drying 100 kg of the same material on dry basis under identical conditions. The area of the material is $0.04 \text{ m}^2/\text{kg}$ of solid. Calculate the time required to reduce the moisture content from 0.3 to 0.2 on dry basis. 10
- b. Draw and explain typical rate of drying curve under constant drying conditions showing different regions of drying. 10
- Q 6 Write short notes on any 4: 5 each
- A. adiabatic saturation temperature.
 - B. comparison of packed and tray towers.
 - C. Adiabatic saturation curve
 - D. Diffusion through porous solid.
 - E. Drum dryer
