GUJARAT TECHNOLOGICAL UNIVERSITY BE - SEMESTER-V • EXAMINATION – SUMMER • 2015

Subject Code: 150501 Subject Name: Mass Transfer Operations-I Time: 02.30pm-05.00pm Instructions:

- 1. Attempt all questions.
- 2. Make suitable assumptions wherever necessary.
- 3. Figures to the right indicate full marks.

Q.1 a) State Fick's law of diffusion and prove that $D_{AB} = D_{BA}$

- b) Derive the relation for steady state diffusion of A through non diffusing B in liquid 07
- Q.2 a) Expound briefly with neat sketch the working of tray tower and problems associated with 07 its working.
 - b) Ammonia is diffusing through a stagnant gas mixture consisting of 1/3 N₂ and 2/3 H₂ by 07 volume. The total pressure is 206.8 kN/m² and temperature 54⁰C. Calculate the rate of diffusion of ammonia through a film of gas 0.5 mm thick, when concentration change across the film is 10 % to 5% by volume. The diffusivity of ammonia in gas mixture is $2.45 \times 10^{-5} \text{ m}^2/\text{s}$.

OR

- b) State the assumptions of film theory and derive the relation for mass transfer coefficient. 07
- Q.3 a) Define ideal and non-ideal solutions with reference to multi-component absorption and state 07 the characteristics of ideal solution.
 - b) An air ammonia mixture containing 5% ammonia by volume is absorbed in water in a 07 packed column operated at 293 K and 101.325 kPa so as to recover 98% ammonia. If the inert gas mass velocity to column is 1200 kg / (m² h). Calculate the mass velocity of water to this column if column is operated at 1.25 times the minimum liquid rate to column. Also calculate the composition of liquid leaving column corresponding to this condition. The Equilibrium relationship to this condition is y = 1.154 x. where x and y are mole fraction of solute.

OR

Q.3	a)	Explain with neat sketch the working of packed tower and state the characteristics of packing.	07
	b)	State the selection criteria between tray tower and packed tower.	07
Q.4	a)	Discuss in brief the selection criteria for solvent in extraction.	07

b) Explain briefly the system of three liquids one pair partially soluble in extraction and state 07

Date: 02/05/ 2015

Total Marks: 70

07

the effect of temperature on its ternary diagram.

OR

- A solution of nicotine in water containing 1% nicotine is to be extracted with kerosene at Q.4 08 a) 293 k. Water and kerosene is essentially insoluble. The equilibrium relation is y' = 0.9 x', where y' and x' are mole ratio. 1) Determine the % extraction of nicotine if 100 kg of feed solution is extracted with 150 kg solvent. 2) Repeat for three theoretical stages using 50 kg solvent each. Discuss with neat sketch the working of Rotocel extractor for leaching of oil. 06 b) Q.5 Discuss in detail the equilibrium diagrams in leaching. 07 a)
 - b) Define supersaturation and state the methods of achieving supersaturation in brief. 07

OR

- Q.5 a) Explain briefly the construction, working and industrial applications of Swenson-Walker 07 crystallizer.
 - b) Calculate the yield of MgSO₄.7H₂O crystals when 1000 kg saturated solution of MgSO₄ at 07 353 k is cooled to 303 k assuming 10 % of the water is lost by evaporation during cooling. Data: Solubility of MgSO₄ at 353 k = 64.2 kg/100 kg water. Solubility of MgSO₄ at 303 k = 40.8 kg/100 kg water. At. Wt.: Mg = 24, S = 32.
