Q.P. Code: 26251

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.

Q1 A: Explain the factors affecting choice of solvent in gas absorption. [5]

B: What is diffusivity? Explain FICK's law of diffusion. [5]

C: What is molecular diffusion? [5]

D: Explain the concept of equilibrium in inter phase mass transfer. [5]

Q2:A : Derive equation for molar flux for steady state equimolar counter diffusion for gases. [10]

B: Calculate the rate of diffusion of butanol across a film of nondiffusing water(B) solution, 0.1 cm thick at 20 deg.C when the concentration on opposite sides of the film are respectively 10 and 4 percent acid. The diffusivity of butanol in the solution is 5.9 X 10^{-6} cm^2/s. At 20 deg.C, the density of 10 % solution is 0.971 g/cc, and that of 4 % solution is 0.992 g/cc. Mol. wt. of butanol is 74. [10]

Q3: A: Explain diffusion through porous solid. [10]

B: Ammonia is absorbed at 1 bar from an ammonia air stream by passing it a vertical tube down which dilute H_2SO_4 is flowing. The following laboratory test data are available:
Length of the tube=825 mm, Diameter of tube=15 mm, Partial pressure of ammonia at inlet= 7.5 kN/m^2, Partial pressure of ammonia at out let= 2 kN/m^2.
The amount of ammonia absorbed at this condition is 1.12x10^{-6} kmol/sec. Determine the overall transfer coefficient k_G based on gas phase. [10]

Q3 A: In a typical chemical process, component A is desorped from an aqueous solution into an air stream in a mass transfer tower at a certain operating temperature and pressure. At a particular point in the tower, analysis report shows that $P_{A,G}$ = 12 mm Hg, C_{AL} = 4 $kmol/m^3$
The overall mass transfer coefficient K_G=0.269 Kmol A/ (m^2.hr.atm.). If Henry's law is applicable to this system and if 56 % of total mass transfer resistance is in gas film. Calculate

(a) Gas film coefficient k_g (b) Liquid film coefficient (k_l) (c) Molar flux of component A, N_A. [10]

B: Explain following terms

(a) Equilibrium stage(b) Stage efficiency (c) Murphee stage efficiency(d)Stage(e)Cascades [10]

Q4: A: Carbon disulphide is to be absorbed from a dilute gas mixture of CS_2-N_2 into a pure non volatile oil at atm.pressure in a counter-current absorber. The mole fraction of CS_2 in inlet gas stream is 0.05 and the flow rate of gas stream, G is 1500 kmol/hr. The equilibrium relation is given by y= 0.5 x where x is mole fraction of CS_2 in liquid stream. It is desired to reduce the mole fraction of CS_2 in exit gas stream to 0.005. (a) Calculate the minimum L/G where L is the liquid flow rate in kmol/hr (b) Derive the equation for the operating line if L/G is equal to 1.5 times minimum value. [10]

B: Compare packed tower and tray tower. [10]

Q5:A:Explain (i) Saturated vapour gas mixture(ii)Relative humidity(iii)Humid volume(iv)Dew point(v)Humid heat [10]

B: Explain adiabatic saturation process. Derive equation for adiabatic saturation temperature. [10]

Q6: A: With neat diagram, explain various types of moisture. [5]

B: With neat diagram explain fluidized bed dryers [5]

C: A batch of wet solid was dried on a tray dryer using constant drying conditions and a thickness of material on the tray of 25.4 mm. Only the top surface was exposed. The drying rate during constant rate period was R=2.05 kg/ (kg hr m^2). The ratio used was 24.4 dry solids / m^2 exposed surface. The initial free moisture content was W=0.55 and critical moisture content W_c = 0.22 kg moisture/kg dry solid. Calculate the time to dry a batch of this material from W_1 =0.45 to W_2= 0.30 using the same drying conditions but thickness of 50.8 mm, with drying from the top and bottom surfaces. [5]

D: Write applications of spray dryer. [5]

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