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Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)



IV SEMESTER B.TECH (CHEMICAL ENGINEERING)

END SEMESTER EXAMINATIONS, June/July 2016

SUBJECT: MASS TRANSFER -I (CHE 2203)

REVISED CREDIT SYSTEM

Time: 3 Hours

MAX. MARKS: 100

Instructions to Candidates:

❖ Answer **FIVE FULL** questions. Missing data may be suitably assumed.

1a	<p>Porous Alumina spheres, 10 mm diameter, 25 % voids, were thoroughly impregnated with an aqueous potassium chloride, KCl solution, concentration 0.25 g/cm^3. When immersed in pure running water, the spheres lost 75% of their salt content in 6 hrs The diffusivity of KCl in water is $1.84 \times 10^{-9} \text{ m}^2/\text{s}$.</p> <p>Estimate the time for removal of 85% of dissolved solute if the spheres had been impregnated with potassium chromate, K_2CrO_4 sol. at a con. 0.28 g/cm^3, when immersed in a running water containing 0.02 g/cm^3. The average diffusivity of K_2CrO_4 in water is $1.14 \times 10^{-9} \text{ m}^2/\text{s}$.</p>	15
1b	Give the equations for Diffusion in porous solids (three cases)	5
2	<p>Derive the flux equation for the following cases starting from the this $N_A = N x_A + J_A$ for gases and liquids :</p> <p>A) Steady state diffusion of A through non diffusing B</p> <p>B) Steady state diffusion of Equimolal counter current (assume fluids are in laminar or rest in both cases)</p>	20
3a	Estimate mass transfer coefficient of air flowing with a velocity of 5 m/s through cylindrical tube which is made up of Naphthalene. The diameter of pipe is 25 mm (I.D.). $D_{AB} = 2.5 \times 10^{-6} \text{ m}^2/\text{s}$, density of air is 1.2 kg/m^3 and viscosity is $1.8 \times 10^{-5} \text{ Pa.s}$ (Use three methods)	8
3b	Prove that the $k \propto D^n$ (mass transfer coefficient is proportional to diffusivity) where n ranges between 0.5 to 1 using four theories .	12
4a	<p>Calculate the minimum liquid rate for given absorber and compute the number of stages with 1.5 times of minimum liquid rate. (counter-current) with following data.</p> <p>The gas in $0.5 \text{ m}^3/\text{s}$ at 26°C and pressure of $1.09 \times 10^5 \text{ N/m}^2$ containing 3% by volume of benzene oil vapors. The removal of benzene is 95% is expected with wash oil which is entering the absorber with 0.005 mole fraction benzene. The relation of liquid and gas mole ratios as follows $Y/(1+Y) = 0.125 * X/(1+X)$</p>	15
4b	Explain the properties of solvent gas absorption	5
5a	Explain the preparation and use of following adsorbents: Fullers earths, Activated clays, Bauxites, Alumina, Bone char Silica gel, Gas adsorbent carbon and synthetic polymer adsorbents	10
5b	What are the major parameters considered for choosing tray and packed towers.	10