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Manipal Institute of Technology, Manipal



(A Constituent Institute of Manipal University)

IV SEMESTER B.TECH (CHEMICAL ENGINEERING)

END SEMESTER EXAMINATIONS, MAY 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	Estimate the diffusivity of Acetone ((CH ₃) ₂ CO; MW=58, Boiling point is 56 0 C) through air (MW= 29) at STP condition. Data is provided below.						
1b	Calculate the rate of diffusion of acetic acid across a film of equi-molal counter current diffusing water solution (2 mm thick at 17 ⁰ C) when the mole fraction of acetic acid at two locations in solution are 0.0288 and 0.0092. The diffusivity of acetic acid in water at this conditions is $9.5 \times 10^{-10} \text{ m}^2/\text{s}$. The $\frac{P}{M_{equ}} = 53.6 \text{ kmol/m}^3$						
2 3a	It is desired to dry 20 kg of soap from 18% moisture (MW=18) by weight to a desirable value in three stages by contact with hot air (MW=29). The wet soap is placed in container of total volume of 9 m ³ out of which 2 m ³ is occupied by wet soap and rest is air at 350 K, 1 atm and water vapor partial pressure is 2 kPa. The system is allowed to reach equilibrium and then air is replaced with fresh air with original moisture content and same conditions. What is the final concentration of soap after three stages? Assume the change in soap volume due to loss of moisture is negligible in all stages. The equilibrium data of X and Y is given below. $\frac{X (mole ratio)}{V (mole ratio)} 0.025 0.05 0.085 0.145 0.182 0.235}{0.065 0.073}$ Estimate average mass transfer coefficient of pure oxygen at 10 atm and 25 °C into water flowing as film down a vertical wall of 1m high and 6 cm width at a Reynolds number of 60 without ringlog. The diffusivity of ovygen in water 2 5x10 ⁻⁹ m ² /g	20					
3b	 i) Define gas, liquid holdup ii) Draw a graph representing the liquid rate vs gas rate in gas liquid operations and explain the various mechanical difficulties arises in equipment due to gas and liquid 						
4a	Calculate the minimum steam rate for given stripper and compute the number of stages with 1.5 times of minimum steam rate. (counter current) The oil with a circulation rate of 3×10^{-3} kmol/s, is entering to stripper with 1% by volume against fresh steam to reduce the oil concentration to 0.5% by volume. The relation of liquid and gas mole ratios as follows $\frac{Y}{Y+1} = 3.16 \frac{X}{X+1}$						
4b	Hydrogen gas at 2 atm and 25 0 C flows through a pipe made of unvulcanised neoprene rubber.(I.D= 25 mm and O.D= 50 mm). The solubility of H ₂ is 0.053 cm ³ (STP)/cm ³ .atm and diffusivity is 1.8×10^{-10} m ² /s. Estimate the rate of loss of hydrogen diffusion per meter of pipe length.	5					

