03-06-2026 TE CHEMICAL SEM-V C SCHEME MTO-I QP CODE: 20014792

Time: 3 Hours **Total Marks: 80**

N.B.: (i) Question No.1. is compulsory.
(ii) Attempt any three questions out of remaining five questions.
(iii) Assume suitable data and justify the same.
(iv) Figures to the right indicate full marks

Q1 **Explain any Four.** **[20]**

(a) Minimum liquid to gas ratio in gas absorption

(b) Write a note on two film theory

(c) Fick's first law of molecular diffusion

(d) Compare tray tower with packed towers

(e) Write a note on humid heat and humid volume.

Q2 **(a)** If an O_2-N_2 gas mixture at 1 atm and 25°C, the concentration of O_2 at two planes,2 mm apart are 10% and 20%(v/v) respectively. Calculate the rate of diffusion of O_2 for the case where DAB=2.064 x10^{-5} m^2/sec. R=0.08206 m^3/kgmole. k **[10]**
1.The N_2 is non diffusing 2. There is equimolar counter diffusion of the gases.

(b) Derive study state flux equation for molecular diffusion of liquid, a nondiffusing liquid B **[10]**

Q3 **(a)** A mixture of acetone vapour and air containing 5% by volume of acetone is to be freed of its acetone content by scrubbing it with water in a packed bed absorber. The flow rate of the gas mixture is 700 m^3/hr of acetone free air measured at NTP and that of water is 1500 kg/hr. The absorber operates at an average temperature of 20 ^{0} C and a pressure of 101 kpa. The scrubber absorbs 98% acetone. The equilibrium relation for the acetone vapour-water system is given by **[10]**
Y*=1.68 x
Y= k mole acetone /k mole dry air.
X= k mole acetone /k mole of water.
Calculate 1) Mean driving force for absorption
2)Mass Transfer area if the overall mass transfer coefficient is
K_G=0.4K mole of acetone/m^2.hr(k.mole acetone/per k mole dry air)

(b) Give criteria for the choice of solvent for Absorption And explain term Absorption Factor **[10]**

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Q4 **(a)** Derive an equation between overall and individual mass transfer coefficient in interface must transfer between gas and liquid **[10]**

(b) Air flow through cylindrical tube made of Naphthalene at velocity 5 m/s. The diameter of tube is 0.1 m and temperature of air is 293 Kelvin using correlation proposed by Gilliand and Sherwood. Calculate mass transfer coefficient for transfer of Naphthalene of air. **[10]**
Viscosity of air $=1.8\times 10^{-5}$ kg/ms
Density of air $=1.2$ kg/m^3
Diffusivity DAB $= 4.24\times 10^{-6}$ m^2/s

Q5 **(a)** It is desired to dry a batch of 160 kg of wet material from 30% to 5 % moisture content under constant rate and falling rate period. The falling rate is assumed to be linear. Calculate the total drying time considering an available drying surface of 1 m^2 /40 kg of dry solid. **[10]**
A constant drying flux of $3*10^{-4}$ kg/m^2 is given
Xc=Critical moisture content=0.2 kg moisture/kg solid
X*= Equillibrium moisture content =0.05

(b) Draw and explain typical drawing curve under constant dry condition, showing different regions of drying **[10]**

Q6 **Write Short notes (Any four)** **[20]**

(a) Write a note on packing used in absorption column.

(b) Write a note on F type and K type mass transfer coefficients.

(c) Differentiate between eddy diffusion and molecular diffusion.

(d)Venturi Scrubber

(e) Write a note on cooling towers.

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