Registration No.

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B.TECH
PCCH4302

5th **Semester Regular / Back Examination 2016-17**
MASS TRANSFER - I
BRANCH : Chemical
Time : 3 Hours
Max Marks : 70
Question Code :Y237

Answer Question No. 1 which is compulsory and any FIVE from the rest.
The figures in the right-hand margin indicate marks.
Assume suitable notations and any missing data wherever necessary.
Answer all parts of a question at a place.

1. **Answer the following questions :** **2 x 10**

(a) In crystallization, solute diffuses through the _____ while in leaching, the solute diffuses through the _____.

(b) State the difference between molecular and eddy diffusion.

(c) What do you understand by permeability ?

(d) What is the effect of liquid flow rate on $K_G a$ values for liquid film controlled absorption processes ?

(e) What is the function of a downcomer ?

(f) What are the causes of flooding in a tray column ?

(g) What is effect of temperature on absorption equillibria ? Illustrate.

(h) What are the factors that influence HETP ?

(i) How would you characterize negative and positive deviations from Raoult'slaw ?

(j) What causes the formation of azeotropes ?

2. Two large vessels are connected by a tube 5 cm in diameter and 15 cm in length. Vessel 1 contains 80 % N_2 (A) and 20 % O_2 (B) while vessel 2 contains 20 % N_2 and 80 % O_2 initially at 20^0C and 2 atm total pressure. Calculate:(a) the steady-state flux and the rate of transport of N_2 from vessel 1 to 2; (b) the same quantities for O_2; (c) the partial pressures of N_2 and its gradient in the tube 0.05 m from vessel 1; and (d) the net mass flux with respect to a stationary observer.
Data: $D_{N_2-O_2}$ = 0.23 cm²/s at 316 K and 1 atm. **10**

3. **(a)** Discuss the different types of mass transfer coefficients. **05**
   (b) Determine the relation between gas phase mass transfer coefficients, K_G and K_Y. **05**

4. A bubble cap distillation column consisting of 12 plates working at an average efficiency of 75 % is being used to distill 1000 kg/hr of aqueous methanol at its bubble point entering the tower. The feed, overhead, and bottom streams contain 50, 90, and 10 mole % of methanol respectively. A total condenser is provided. The reflux is sent at its saturation temperature. If thereflux ratio is 1.7 times the minimum check whether the column available is satisfactory. The VLE data are:

x_1	8	10	20	30	40	50	70	80	95
y_1	36.5	41.8	57.9	66.5	72.9	77.9	87.0	95.8	97.9

   10

5. A packed tower with 0.5 cm Raschig rings of 12 m height is to be used for absorption of H_2S from natural gas, by using monoethanolamine as solvent. The operation is carried out at 30^0C, 1 atm, and counter-currently. The entering gas contains 18 % H_2S by volume. 90 % of this has to be absorbed. The gas flow rate is 2000 m^3/m^2.hr. Equilibrium line is straight in the operating limits and is given by : $Y = 1.1 X$. Operating line is also straight and parallel to equilibrium line. Find: (a) the liquid flow rate, (b) the number of stages, and (c) HETP. **10**

6. A moist air sample having a dry-bulb temperature of 27^0C and a humidity of 0.015 kg/kg dry air. Determine: (a) relative humidity, (b) dew point temperature, (c) adiabatic saturation temperature, (d) wet bulb temperature, (e) enthalpy, (f) humid volume, and (g) humid heat. The Antoine equation for water is: $\ln p_A^{sat} = 11.96 - \frac{3984.9}{T-39.72}$bar. The total pressure is 1 atm. **10**

7. Discuss briefly the construction and operation of the following equipments with their neat diagrams.
   i.   Natural draft towers **05**
   ii. Induced draft towers **05**

8. Write short notes on any **TWO**: **5 x 2**
   (a) Surface renewal theory
   (b) Steam distillation
   (c) Selection criteria of a solvent for absorption
   (d) McCabe-Thiele method