Registration No.										

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B.TECH
PCCH4302

5th Semester Regular / Back Examination 2015-16
MASS TRANSFER - I
BRANCH : Chemical
Time : 3 Hours
Max Marks : 70
Question Code : T250

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.
Use of Humidity Chart is permitted. Answer all parts of a question at a place.

1. Answer the following questions : 2 x 10
   (a) In case of molecular diffusion in gases, calculate N_{AF} for the chemical reaction: C_2H_6 (g) $\rightarrow$ 2 C (s) + 3 H_2 (g).
   (b) Differentiate between molecular and eddy diffusion.
   (c) In gas film controlled systems, the value of $K_G a$ is much greater than in liquid film controlled systems. Justify.
   (d) What is the effect of pressure on relative volatility ? Illustrate.
   (e) In a distillation column, temperatures are highest at the bottom and lowest at the top. Explain.
   (f) What causes formation of azeotropes ?
   (g) What are the advantages of absorption systems using packed and tray columns in pollution control ?
   (h) Mention the factors that influence HETP.
   (i) What are psychometric ratio and wet bulb depression ?
   (j) In a natural draft cooling tower, what causes air flow through the tower ?

2. A circular open tank of 6 m in diametercontains benzene at 25^0C is exposed to the atmosphere in such a way that the liquid is covered with a stagnant air film having a thickness of 5.0 mm. The concentration of benzene beyond the stagnant film is negligible. The vapour pressure of benzene at 25^0C is 100 mmHg. If the cost of benzene per liter isRs. 100/-, calculate the amount of benzene lost from this tank in rupees per day. Molar diffusivity of benzene in air at 25^0C and 1.0 atm is 280 cm^2/hr. $\rho_{benzene\ at\ 25^0C}$ = 0.9 gm/ml. 10

3. (a) Explain the Whitman's Two-film theory with a neat figure. 06

(b) Prove that: $\frac{1}{K_G} = \frac{1}{k_g} + \frac{H}{k_l}$, where K_G = overall mass transfer coefficient, k_g and k_l = gas film and liquid film mass transfer coefficients, and H = Henry's law constant. 04

4. A mixture of 30 mole % A and 70 mole % B is separated in a distillation column. The concentration of A in the distillate is 90 mole % and 95 % of all products A is in the distillate. The feed is half vapour, the reflux ratio is 4, and the relative volatility of A to B is 2.0. Calculate the number of theoretical plates in the column and locate the feed plate. 10

5. For a continuous binary distillation operation, derive the equation of feed-line. 10

6. A gas absorber handles 950 m^3/hr of a gas containing 3 % benzene by volume.The gas enters at 300 K and 810 mmHg. 95 % of benzene is to be recovered by the solvent. The solvent enters at 300 K containing 0.005 mole fraction of benzene and has an average MW of 260. Calculate the circulation rate of solvent per second, if the column is to be operated at 1.5 times the minimum L_s. The equilibrium data is: 10

$$\frac{y}{1+y} = 0.13\ \frac{x}{1+x}$$

where, y = mole ratio of benzene to dry gas and
x = mole ratio of benzene to solvent.

7. Air at 101.325kPa enters an adiabatic drier at 87.5^{0}C with a dew point of 20^{0}C andleaves at 70% humidity. Wet paper enters the drier with 25% moisture and leaves with 5% moisture.Determine: (a) the amount of water evaporated and (b) the finished product inkilograms per 100 m^3 of air entering. 10

8. Write short notes on any **TWO**: 5 x 2

(a) PTxy phase diagram
(b) Minimum irrigation rate
(c) Cooling towers
(d) Hygrometers
