Registration No. : | | | | | | | | | | |

Total number of printed pages – 2

B. Tech

PCCH 4302

Fifth Semester Regular Examination – 2014

MASS TRANSFER - I

BRANCH : CHEM

QUESTION CODE : H 143

Full Marks – 70

Time : 3 Hours

*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.

1. Answer the following questions : 2×10

   (a) The driving force for mass transfer by molecular diffusion is the difference in molar concentration. (True/False). Justify your answer.

   (b) What is equimolar counter-diffusion ?

   (c) Write the Stanton numbers for heat and mass transfer.

   (d) Discuss the effect of pressure on relative volatility and the effect of relative volatility on xy-diagrams.

   (e) Explain why in distillation columns, temperatures are lowest at the top and highest at the bottom.

   (f) What causes the formation of azeotropes ?

   (g) What is reactive absorption ? Give one example.

   (h) Define HETP. How does HETP vary with the size of packing ?

   (i) What is psychrometricratio ? Mention its value for air-water vapour mixtures.

   (j) What is wet bulb depression ?

2. (a) With a neat plot, explain the Whitman's two-film theory. 6

   (b) A tube of small diameter was filled with acetone (ρ = 0.8 gm/cm^3) upto 1.18 cm from top and maintained at a temperature of 20 ^{0}C in a gentle current of atmospheric air. After 4.5 hours the level of the liquid fell to 2.25 cm from the top. Calculate the diffusivity of acetone in air if the

barometric pressure was 755 mm Hg. Vapour pressure of acetone at 20 ^{0}C is 200 mm Hg. R = 82.06 cm^3.atm/gmol.K. 4

3. Discuss in detail the Ponchon-Savarit method for finding the number of equilibrium stages on the enthalpy composition diagram. 10

4. An ethanol-water mixture containing 35% by weight of ethanol is differentially distilled at 1 atm pressure and the mixture is reduced to a maximum ethanol composition of 5mol %. Determine the composition of the distillate. The VLE data are as follows : 10

Mole fraction of ethanol in liquid, x :	0.18	0.16	0.14	0.12	0.10	0.08	0.06
Mole fraction of ethanol in vapour, y :	0.52	0.50	0.48	0.46	0.44	0.42	0.40

5. Describe briefly the graphically and analytical procedures involved in finding number of trays in the design of tray absorbers. 10

6. A gas absorber has to be designed to handle 1115 m^3/h of coal gas containing 2.6% by volume of benzene. Coal gas enters at 300 K and 800 mm Hg. 84 % of benzene should 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 minimum L_s. Equilibrium data is : 10

$$\frac{Y}{1+Y} = 0.125\frac{X}{1+X}$$

where, Y = mole ratio of benzene to dry gas

X = mole ratio of benzene to solvent.

7. Discuss the construction and operation of the following equipment with a neat diagram :
   (a) Sling hygrometer. 5
   (b) Mechanical draft cooling tower. 5

8. Write short notes on any **two** : 5×2
   (a) Mass transfer coefficients
   (b) Optimum reflux ratio
   (c) Minimum liquid rate
   (d) Direct chemical method for humidity measurement.