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

*Total number of printed pages – 2*

B. Tech

PCCH 4302

# Fifth Semester (Back / Special) Examination – 2013

## MASS TRANSFER – I

**BRANCH : CHEM**

**QUESTION CODE : D 257**

**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.*
*answer all parts of a question at a place.*

1. Answer the following questions : 2×10

   (a) Write and explain Fick's first law of diffusion.

   (b) On what factors does the mass transfer rate between two fluid phases depend ?

   (c) Write the Gilliland's equation.

   (d) For what value of relative volatility, the separation becomes uneconomical ?

   (e) Discuss the importance of minimum reflux ratio.

   (f) When steam distillation is used ?

   (g) Mention the characteristics of a good absorbent.

   (h) Write the expressions used for the estimation of packed height based on gas film and liquid film.

   (i) Define dry bulb, wet bulb, dew point, and adiabatic saturation temperatures.

   (j) Write the Lewis relation for air-water system.

2. In an $O_2$ - $N_2$ mixture at 10 atm and 25°C, the concentrations of $O_2$ at two places of 0.18 cm apart are 11 and 22vol % respectively. Calculate the rate of diffusion of $O_2$ in gm/cm$^2$.hr for the case of unicomponent diffusion ($N_2$ is non-diffusing). Value of diffusivity is 0.18 cm$^2$/s. 10

3. Discuss the concept of VLE for binary systems with a neat PTxy diagram. Also discuss the effect of T on Pxy diagram. 10

4. (a) Write the assumptions made in McCabe Thiele's method. 4

   (b) Derive the equation of q-line. 6

5. A liquid mixture containing 50 mol % heptane (A) and 50 mol % octane (B), is to be continuously flash vaporized at 1 atm pressure to vaporize 60 mol % of the feed. What will be the composition of the vapour and liquid in the separator for an equilibrium stage ? 10

   Data :

| T (°C) | 98.5 | 105 | 110 | 115 | 120 | 125.5 |
|---|---|---|---|---|---|---|
| Vapour pressure of A (mm Hg) | 760 | 940 | 1050 | 1200 | 1350 | 1540 |
| Vapour pressure of B (mm Hg) | 333 | 417 | 484 | 561 | 650 | 760 |

6. 5500 kg/hr of a $SO_2$-air mixture containing 5 % by volume $SO_2$ is to be scrubbed with $2 \times 10^5$ kg/hr of water in a packed tower. The exit concentration of $SO_2$ is reduced to 0.20 %. The tower operates at 1 atm.

   The equilibrium relationship is given by: $Y = 30\ X$

   where, Y = mole $SO_2$/mole air, and X = mole $SO_2$/mole water.

   If the packed height of the tower is 450 cm, estimate the height of transfer unit (HTU). 10



7. (a) Discuss in detail the construction and working of a spray tower. 5

   (b) Discuss in detail the construction and working of a sling psychrometer. 5

8. Write short notes on any **two** of the following : 5×2

   (a) Stefan's method for determination of diffusivity

   (b) Minimum irrigation rate

   (c) Optimum reflux ratio

   (d) Spray pond.

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