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ROLL No: | | | | | | | | | | |     Total number of pages:[2]

Total number of questions:06

B.Tech. || CHE || 5<sup>th</sup> Sem

# Mass Transfer-I

## Subject Code: BTCH-503A

Paper ID:     (for office use)

Max Marks: 60

Time allowed: 3 Hrs

**Important Instructions:**

- All questions are compulsory
- Assume any missing data

### PART A (2marks x 10)

Q. 1.  Short-Answer Questions:

(a) What is meant by diffusivity and mass transfer coefficient?

(b) Define relative humidity and wet bulb temperature.

(c) What is Fick's first law of mass transfer?

(d) Define the term ideal stage. Enumerate the various stage efficiencies.

(e) Differentiate between absorption and stripping.

(f) Enlist the various types of equipments for gas-liquid contact.

(g) Define Schmidt number and Lewis number.

(h) What is meant by flooding and loading?

(i) Define entrainment. How does it affect the stage efficiency?

(j) What is permeate flux and concentration polarization?

### PART B (8marks x 5)

Q. 2.  What do you mean by Local and Overall Mass Transfer coefficient? Derive the relation between these coefficients both for liquid and gas phase and what is the relative role of resistances?     CO1, CO2

OR

Derive the general mass transfer equation in Cartesian coordinates.     CO1, CO2

Q. 3.  Enlist the various mass transfer theories. Discuss the Penetration theory of mass transfer and derive the relevant expression. Compare the result with the result of surface renewal theory.     CO1, CO2

OR

Through an accidental opening of a valve, water has been split on the floor of an industrial plant. Determine the time required to evaporate the water into the surrounding air. The water layer is 15 mm thick and air may be assumed to remain at 25°C and 1 atm pressure with an absolute humidity of 0.001 kg water / kg dry air. Evaporation is assumed to take place by molecular diffusion through a gas film of 10 cm thickness. The mass diffusivity of water vapor in air is $2.6 \times 10^{-5}$ m²/sec. Vapor pressure of water at 25°C is 24 mm of Hg.     CO1, CO2

**Q. 4.**  a) What is meant by transfer unit? Derive the expressions for number of transfer units and the height of transfer unit.  CO3, CO4

b) What is meant by a stage? What is the difference between stage wise contactors and continuous contactors? How do you find the height of contactor in each case?

OR

Coal gas is to be freed of its benzene content by contact with wash oil. The wash oil forms ideal solution with benzene. Gas at flow rate $=0.5 m^3/s$ and 30°C enters the column with 3 vol% benzene vapours. Fresh wash oil is also at 30°C is to be used and the flow rate is 1.8 times the minimum required. 95% removal of benzene is desired. Find the number of stages required. The equilibrium data is  CO3, CO4

| X | 0 | 0.05 | 0.1 | 0.15 | 0.2 | 0.25 |
|---|---|------|-----|------|-----|------|
| Y | 0 | 0.006 | 0.0115 | 0.01657 | 0.0213 | 0.0256 |

**Q. 5.**  What are the desired characteristics of a solvent for absorption? Derive the equation of operating line for counter current absorption. How do you find the minimum solvent rate and the number of stages? Show graphically.  CO4

OR

a) Enlist various membrane separation processes. Elaborate any one of them.  CO4

b) Derive an expression for time of drying under constant and falling rate period and show how it can be determined graphically?

**Q. 6.**  What is adiabatic saturation and 'Adiabatic saturation curves'? Derive a general expression for these curves. Show graphically for case of saturated & unsaturated vapor-gas mixtures.  CO4

OR   CO4

Write in brief about:
   a) Psychrometric charts
   b) Through circulation drying
   c) Dimensionless numbers