Printed Pages: 4 **ECH-609**

(Following Paper ID and Roll No. to be filled in your Answer Books)	
Paper ID : 182603	**Roll No.**

B.TECH.

Theory Examination (Semester-VI) 2015-16

MASS TRANSFER OPREATIONS

Time : 3 Hours ***Max. Marks : 100***

Note: Attempt all Sections. Assume suitable data, if required. All questions carry equal marks.

Section-A

1. Attempt all the parts. All parts carry equal marks. (2×10=20)

(a) What is the difference between molecular diffusion and turbulent diffusion?

(b) Define the mass transfer coefficient and overall mass transfer coefficients.

(c) Difference between physical and chemical Adsorption?

(d) What are the criteria for selecting solvent in Gas Absorption?

(e) What are the industrial applications of mass transfer operations?

(f) Define Bound and unbound moisture content.

(g) Define Ficks law of diffusion.

(h) What are the characteristics to be possessed by industrial adsorbents?

(i) What are the Comparison of Gas Absorption and Distillation?

(j) Define Absolute and relative humidity.

Section-B

2. Attempt any five parts of the following. (10×5=50)

(a) A volatile organic compound benzene costing Rs 45 per kg, is stored in a tank 10m diameter and open at top. A stagnant air film 10mm thick is covering the surface of the compound beyond which the compound is absent. If the atmospheric temperature is 25C.Vapour pressure of the compound is 150mm Hg and its molar diffusivity is $0.02 m^2/h$, calculate the loss of benzene in Rs/day.

(b) Derive an expression for the steady state diffusion of A through non diffusing B for the gases system?

(c) Explain the penetration and film theory of mass transfer?

(d) An ammonia air mixture containing 2% by volume ammonia is to be scrubbed with water at 20C in a tower packed with 1.27 cm Raschig rings. The water and gas rates are 1170 kg/hr m^2 each, based on empty tower cross section. Estimate the height of the tower required if 98% of the ammonia in the entering gas is to be absorbed. The tower operates at 1atm pressure. The equilibrium relationship is given by the following equation.

i. $y_e = 0.746x$

ii. y_e = Mole traction of ammonia in air

iii. x = Mole fraction of ammonia in solution with water.

iv. The height of transfer unit may be taken as equal to 2 meter.

(e) Classify the various types of dryer and explain the construction and working of a Spray dryer?

(f) A mixture of 35 mole % A and 65 mole %B is to be separated in distillation column. The concentration of A in the distillate is 93 mole % and 96 mole % of component A is recovered in distillate. The feed is half vapor and reflux ratio is 4:1. The relative volatility is α_{AB} = 2.5. Calculate the number of theoretical plates in the column?

(g) Compare the several adsorption isotherms you know of and discuss their importance in adsorption steps in a chemical engineering operation.

(h) Discuss the process of adsorption in detail and its applications in chemical industries.

Section-C

Note: Attempt any two parts of the following. (15×2=30)

3. For dilute mixture and case where Henrys law applies, prove that the number of overall gas phase transfer units for counter current gas absorption in packed towers is given by

$$NTU = \ln \frac{[y_1 - mx_2 / y_1 - mx_2 / (1 - 1/A)]}{(1 - 1/A)} + 1/A$$

Where subscript 1 indicates bottom, subscript 2 indicates top of the tower and A is absorption factor.

4. Derive the equations for the operating lines of rectifying and stripping sections Used according to the ponchon-savarit method for the design of distillation column. State the assumptions clearly.

5. Derive the Rayleigh equation and mention the assumption involved during derivation and also derive the equation of feed line in Mc Cabe Thiele method