Printed Pages : 4

NCH403

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 151411

Roll No.

B. Tech.

(SEM. IV) THEORY EXAMINATION, 2014-15

MASS TRANSFER - I

Time : 3 Hours] [Total Marks : 100

Note : Attempt all questions. All questions carry equal marks. In case of numerical problems assume data wherever not provided

1 Attempt any four parts of the following: **5×4=20**

(a) Prove that for equimolecular counter diffusion from a sphere to a surrounding stationary, infinite medium, the Sherwood number based on the diameter of the sphere is equal to 2.

(b) What are the general principles underlying the two-film and penetration theories for mass transfer across the phase boundary? Give the basic difference equations with appropriate boundary conditions.

(c) The diffusivity of CO_2 in O_2 at 0°C is 1.39×10^{-5} m^2/s at atmosp heric pressure. Find the diffusivity at an elevated temperature and pressure of 100°C and 2 atm respectively.

(d) Obtain the relationship between overall mass transfer coefficient and individual mass-transfer coefficient.

(e) In many processes mass-transfer and heat transfer take place simultaneously. In what manner the governing equations, are related with each other? Comment on it.

(f) What is the effective thickness of the gas film for the evaporation of water into air in a 50mm diameter wetted wall column at a Reynolds number of 20,000 and temperature of 40°C. Kinematics viscosity for air at 40°C is 0.165 cm^2/s. diffusivity for water in air at 1 atm, is 0.288cm^2/s.

2 Attempt any two parts of the following : **10×2=20**

(a) (i) Write all the requirements of the packing to be used in a gas absorption packed-bed.

(ii) Write all the necessary requirement of a suitable solvent.

(b) (i) What is meant by number of transfer unit? Differentiate between HTU and HETP.

(ii) Derive the following relation with explanation of each term:--

$HTU_{OG} = HTU_g + (mG/L)\ (HTU_l)$

(c) (i) What are different types of gas-liquid contractors used for absorption?

(ii) What do you understand by limiting gas-liquid ratio in absorption column?

3 Attempt any Two parts of the following : **10×2=20**

(a) The dry bulb temperature and the wet bulb temperature of an air-water vapor sample is 90°C and 30°C, respectively . With the help of a humidity chart, determine the following :
   (i) Absolute humidity
   (ii) Saturation humidity
   (iii) Dew point temperature
   (iv) Humid volume.

(b) In a process in which benzene is used as a solvent, it is evaporated into dry nitrogen. At 24°C and 1 bar, the resulting mixture has a percentage relative humidity of 60. It is required to recover 80% of benzenepresent by cooling to 10°C and compressing to a suitable pressure. What should this pressure be? Vapour pressure of benzene at 24°C and 10°C are 12.2 and 6.0 kN/m^2 respectively.

(c) Give classification of different types of cooling towers with help of neat sketches. Explain the construction and operation of any one.

4 Attempt any Two parts of the following : **10×2=20**

(a) In certain batch drying operation we get the rate drying in constant drying period as 2.8 kg $H_2O/hr.m^2$ at a air inlet temperature of 60°C with a wet bulb temperature of 35°C. What will be the rate if same air is used at a inlet temperature of 80°C.

(b) Describe rate of drying curve. Mention the points at which it changes the shape.

(c) With the help of neat sketch, explain the construction and operation of a continuous rotary dryer. Also discuss its application.

5 Attempt any two parts of the following : **10×2=20**

(a) What do you understand by individual and overall growth coefficient in crystal growth?

(b) A saturation solution containing 1500 kg of KCl at 87°C is cooled in an open tank to 17°C. If the density of solution is 1200 kg/m^3, solubility of KCl per 100 parts of water is 53.55 at 87°C and 34.5 at 17°C, calculate :

(i) the capacity of tank required

(ii) the weight of crystal obtained.

(c) In some of the crystallizers the crystals are in fluidized state why? Describe the construction and operation of such crystallizer.