B.TECH SEM - V (2007 COURSE) (CHEMICAL ENGG.) : SUMMER - 2018
SUBJECT: MASS TRANSFER-I

Day : **Thursday** | **S-2018-2651** | Time : **10.00 AM TO 01.00 PM**
Date : **24/05/2018** | | Max. Marks: 80

N. B.:

1) **Q.No.1** and **Q.No.5** are **COMPULSORY**. Out of remaining attempt **ANY TWO** questions from each section.
2) Figures to the right indicate **FULL** Marks.
3) Answer to both the sections should be written in **SEPARATE** answer book.
4) Assume suitable data, if necessary.

SECTION-I

Q.1 a) Describe Chilton-Colburn analogy for heat and mass transfer. **(05)**

b) What is two resistance concept in interphase mass transfer? **(05)**

c) Write the material balances for countercurrent flow absorption process. **(04)**

Q.2 a) Modify the Fick's law of diffusion for the case of diffusion in solids. **(06)**

b) In an oxygen-nitrogen gas mixture at 1 atm and 25°C, the concentrations of oxygen at two planes 0.2 cm apart are 10% and 20% (by volume) respectively. Calculate the flux of oxygen when nitrogen is non-diffusing. Diffusivity of oxygen in nitrogen is $0.215 cm^2/s$. **(07)**

Q.3 a) What are the assumptions of Film theory? Explain the mechanism of mass transfer across the phase boundary using Film theory. **(07)**

b) During absorption of carbon tetra chloride from a mixture of air-CCl_4 by an organic oil, the gas and the liquid phase mass transfer coefficients have been estimated to be 0.32 and 5.26 kmol/h m^2 mole fraction respectively. The equilibrium relation under the operating condition is given by $y^* = 20\ x$ where y and x are mole fractions of CCl_4 in gas and liquid phase respectively. Estimate the overall mass transfer coefficient. **(06)**

Q.4 a) What is the criteria for choice of solvent in absorption operation? **(05)**

b) Design a packed column absorber to obtain the Height of transfer unit (HTU) and Number of transfer unit (NTU). **(08)**

SECTION-II

Q.5 a) What is super saturation? What are the different methods of supersaturating? **(06)**

b) What is leaching? What are the different factors controlling leaching operation. **(04)**

c) What is meant by entrainment? How does it affect tray efficiency? **(04)**

Q.6 a) Discuss various types of packing used in gas-liquid operations. **(07)**

b) Describe the working principle of venturi scrubber and state its advantages. **(06)**

P.T.O.

Q.7 **a)** How crystallizer can be classified? With a neat sketch describe Swenson Walker crystallizer. **(07)**

b) A saturated Solution of $MgSO_4$ at 353K is cooled to 303K in a crystallizer. During cooling 4% solution is lost by evaporation of water. Estimate the quantity of the original saturated solution to be fed to the crystallizer per 1000 kg of $MgSO_4$. $7H_2O$ crystals. Data given: **(06)**
Solubility of $MgSO_4$ at 303K= 40.8kg/100kg water.
Solubility of $MgSO_4$ at 353K = 64.2 kg/100kg water.
Atomic weight Mg = 24, S = 32, O = 16 and H =1.

Q.8 **a)** Describe typical equilibrium diagrams in leaching operation. **(07)**

b) With the help of material balance equation and graphical representation, describe multistage crosscurrent leaching operation. Explain all the terms involved. **(06)**

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