B.Tech. SEM -V (Chemical 2014 Course (CBCS) : SUMMER - 2019
SUBJECT: MASS TRANSFER OPERATION

Day: Thursday
Date: 09/05/2019

S-2019-2639

Time: 10.00 AM TO 01.00 PM
Max Marks. : 60

N.B. :

1) All questions are **COMPULSORY**.
2) Figures to the right indicate **FULL** marks.
3) Assume suitable data, if necessary.
4) Draw neat diagrams wherever necessary.

Q. 1 Oxygen (A) is diffusing through carbon monoxide (B) under steady state conditions with carbon monoxide non-diffusing. The total pressure is 1×10^5 N/m^2 and the temperature 0^0C. The partial pressure of oxygen at two planes 2.0 mm apart is 13000 and 6500 N/m^2 respectively. The diffusivity for the mixture is 1.87×10^{-5} m^2/s. Calculate the amount of oxygen diffused in one hour in kg mol/hr m^2 **(10)**

OR

Q. 1 Calculate the rate of diffusion of acetic acid (A) across a film of non diffusing (B) solution 1 mm thick at 17^0C when the concentrations on opposite sides of the film are 9 and 3 % respectively. The diffusivity of acetic acid in the solution is 0.95×10^{-9} m^2/sec. **(10)**

Q. 2 a) What are the assumptions of film theory? Draw the concentration profile and explain the theory in brief. **(05)**

b) Describe Colburn analogy in brief. **(05)**

OR

Q. 2 a) Define mass transfer coefficient and derive the relationship between individual and overall mass transfer coefficient. **(05)**

b) Describe mass transfer coefficients in turbulent flow. **(05)**

Q. 3 5000 kg/hr of a SO_2 – air mixture containing 5% kg volume SO_2 is to be scrubbed with 200,000 kg/hr of water in a packed tower. **(10)**
The exit concentration of SO_2 is reduced to 0.15 %. The tower operates at 1 atm. The equilibrium relationship is given by

$$Y = 30X. \quad \text{where } Y = \frac{moles\ of\ SO_2}{mole\ of\ air}$$

$$X = \frac{moles\ of\ SO_2}{mole\ of\ water}$$

If the packed height of tower is 420 cm, estimate the height of transfer unit.

OR

Q. 3 a) Draw a schematic diagram of countercurrent flow absorption column and state the balances. Also show graphically the operating lines and equilibrium curve for absorber and stripper. **(05)**

b) What is absorption and stripping factor? Explain its significance. **(05)**

P.T.O.

Q. 4 **a)** Explain the typical enthalpy temperature diagram for a pure substance in a humidification process. **(05)**

b) Derive the equation for wet bulb depression (t_G - t_w). **(05)**

OR

Q. 4 Air has a dry bulb temperature of 30^0C and a dew point of 20^0C. The total pressure is 760 mm Hg calculate **(10)**

a) Molal humidity
b) Absolute humidity
c) Percent RH,
d) Percent Saturation
e) Humid volume.

Q. 5 **a)** Explain the rate of drying curve. **(05)**

b) Give the classification of dryers. **(05)**

OR

Q. 5 It is desired to dry a certain type of fiberboard in sheets 0.131 m by 0.162 m by 0.071 m from 58% to 5 % moisture on wet basis. The data for this board shows a constant drying rate of 8.9 kg/m^2 hr. The critical moisture content was 24.9% and equilibrium moisture content was 1 %. The board is dried from one side only and has a done dry density of 210 kg/m^3. Determine the time required for drying. The falling rate period may be assumed to be linear. **(10)**

Q. 6 **a)** Explain the Mier's super saturation theory with diagram. **(05)**

b) Describe the functioning of Swenson Walker crystallizer. **(05)**

OR

Q. 6 **a)** A crystallizer is charged with 5000 kg of an aqueous solution of sodium sulfate containing 29.6% of Na_2SO_4. The solution is cooled when Na_2SO_4. 10 H_2O is crystallized. 10% by weight of water is lost by evaporation. If the mother liquor contains 18.3 % Na_2SO_4 calculate (a) weight of salt crystallized (b) weight of mother liquor left. **(07)**

b) What is primary and secondary nucleation? **(03)**

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