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SE-6731

B. E. - III (Sem - V) (Chemical) Examination

May / June – 2011

Mass Transfer - I

Time : Hours] [Total Marks : **100**

Instructions :

(1)

નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fillup strictly the details of ☛ signs on your answer book.

Name of the Examination :

☛ **B. E. - III (Sem - V) (Chem.)**

Name of the Subject :

☛ **Mass Transfer - I**

☛ Subject Code No. : **6 7 3 1** ☛ Section No. (1, 2,.....) : **1, 2**

Seat No. :

Student's Signature

(2) Figure to the right indicate full marks.
(3) All notations carry their usual meanings.
(4) Make suitable assumptions whenever necessary and mention them clearly.
(5) Illustrate your answers with neat sketches wherever necessary.
(6) Assume suitable additional data if necessary.

SECTION - I

1 Attempt the following. **18**

(i) How diffusivity is determined with the help of Gilliland's equation ? **2**

(ii) On what factors cloes the mass transfer rate between two fluid phase depend ? **2**

(iii) Stefan's law gives a relation which describe transfer of mass by. **1**
- (a) bulk flow
- (b) diffusion
- (c) diffusion and bulk flow.

(iv) The dimension less group in heat transfer identical to that of schmidt number in mass transfer is _____. **1**

(v) Diffusivities of vapors are determined in a laboratory by **1**
- (a) Gilliland's method
- (b) Wilke's method
- (c) Winkelmann's method.

(vi) JD-factor mass transfer is a function of _____. **1**

(vii) The expression for sherwood number is, **1**

(a) $\mu/\rho D$

(b) hL/D

(c) $u\rho L/\mu$.

(viii) Temperature dependence of diffusivity is described by _____. **1**

(ix) When Henry's law constant is very small mass transfer rate is controlled by, **1**
(a) liquid film resistance
(b) gas film resistance
(c) Both (a) and (b).

(x) Measurement of interfacial area of mass transfer is easier and accurate in case of a, **1**
(a) packed tower
(b) bubble cap tower
(c) watted wall column.

(xi) In a binary system total flux of one component consists of two parts. What are they ? Express total flux of one component mathematically. **1**

(xii) Write down application of molecular diffusion. **2**

(xiii) Write down unit of molar flux. **1**

(xiv) Write Fick's first law. **1**

2 Attempt any **two**. **8×2=16**

(i) Derive continuity equation.

(ii) Oxygen (A) is diffusing through Carbon Monoxide (B) under steady state conditions with the carbon monoxide non diffusing. The total pressure is $1\times10^5\ N/m^2$ and the temperature $0°C$. The partial pressure of oxygen at two planes 2.0 mm a part is respectively, 13000 and 6500 N/m^2. The diffusivity for the mixture is $1.87\times10^{-5}\ m^2/s$. Calculate the amount of oxygen diffused in one hour in kg.mol through each square meter of two planes.

$$R = 8.314\left(\frac{N\cdot m}{kmol\cdot k}\right)$$

(iii) Explain in details the diffusion through porours solids and diffusion through polymers.

3 Write short notes on any **four**. **4×4=16**

(i) Classification of mass transefer operations.

(ii) Write down equations for

(a) Stedy state diffusion of A through non-diffusing B.

(b) Steady state equimolal counter diffusion.

(c) Steady state diffusion in multicomponent mixtures. Explain each term.

(iii) Penetration theory.

(iv) Analogies between mass transfer and Heat transfer.

(v) Diffusion through crystalline solids.

SECTION - II

4 (a) Attempt the following. **12**

(Question no. 1&2 carries 2 marks each)

(i) Define relative volatility.

(ii) State any four equipments for gas-liquid operations.

(iii) Give the names of the impellers frequently used in for mass transfer operations.

(iv) Most important factor for the choice of separating agent for extrative distillation is _____.

(a) toxicity

(b) availiability

(c) selectivity

(d) recoverbility.

(v) Separating agents for extractive and azeotropic distillation are hormany.

(a) polar organic compounds

(b) non-polar organic compounds

(c) inorganic electrolytes.

(vi) When steam distillation is applicable ?

(vii) The system cs_2 -acetone is an example of _____ azeotrope.

(viii) Which increase in total pressure on a binary system, the boiling points of the pure components.

(a) increase

(b) decrease

(c) remains unchanged.

(ix) Why liquid redistributars are used in tau packed towers ?

(x) For transfer operation involving liquids with dispersed solids, best performance is obtained in _____ column.

(b) Diffrentiate Azeotropic and extractive distillation. **7**

5 Attempt the following. **8×2=16**

(a) Define diffrential distillation and derive Royleigh's equation.

(b) A liquid mixture containing 50% moleheptane (A) and 50% mole octane (B) is to be continuously flash vaporised at a standard atm. pressure to vaporise 60% mol of the feed. What will be the composition of the vapour and liquid in the separator for an equilibrium stage ?
Data :

t°c	98.5	105	110	115	120	125.5
v.p.ofA in mmHg	760	940	1050	1200	1350	1540
v.p.of B in mmHg	333	417	484	561	650	790

(c) A mixture of Benzene and Toluene containing 40 mole percent benzene is to be separated to give a porduct of 90 mole percent of benzene at top and a bottom product with not moer than 10 mole percent benzene. Using an average value of 2.4 for the volatility of benzene relative to tolueue, calculate the number of theoretical plates required at total reflux. Also calculate the minimum reflux ratio, if the feed is liquid and at its boilling point.

6 Attempt the following. (any **three**) **5×3=15**

(a) Explain constraction and working of venturi scrubber.

(b) Write note : Reboilers arrangements.

(c) Write assumptions of Mccabe-Thicle methods with proper justifications and arguments.

(d) Service of Mass Transfer to mankind. Justify the statement.