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RN-6731

B. E. III (Sem. V) (Chem.) Examination

May / June – 2010

Mass Transfer - I

Time : **3** 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. 3 (Sem. 5) (Chem.)**

Name of the Subject :

☛ **Mass Transfer - 1**

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

Seat No. :

Student's Signature

(2) Answers to each section must be written in **separate** answer book.

(3) Figures to the **right** indicate full marks.

(4) All notations carry their usual meanings.

(5) Make suitable assumptions wherever **necessary** and mention them clearly and draw neat sketches wherever necessary.

SECTION - I

1 (a) For mass transfer operations involving gas-liquid phases with gas containing dispersed solid particles, the best performance is obtained by _____ column. (Fill in the blank) **1**

(b) _____ column can be used an experimental equipment for estimating mass transfer coefficient when mass transfer is from gas phase to liquid phase. (Fill in the blank) **1**

(c) Write down the equation for mass transfer coefficient predicted by surface renewal theory explaining each term. **2**

(d) Write down the equation for total flux for steady-state diffusion of component 'A' through non-diffusing 'B' for binary gaseous system explaining each term. **2**

(e) Define molecular diffusion in one sentence. **1**

(f) Write down the equation which correlates diffusivity, viscosity and temperature for diffusion in liquids. Explain each term. **2**

(g) Write down the Knudsen's law explaining each term. **2**

(h) The operating line would be a straight line when material balance will be done in terms of _____ for steady-state countercurrent process. (fill in the blank) **1**

(i) Derive an equation for steady-state molecular diffusion of component A through non diffusing component B for liquids from basic equation for total flux of component A. **6**

2 (a) Attempt any **two** : **8×2=16**

(i) Ethane is cracked on a catalyst : **3**

$C_2H_6 \rightarrow 2\,C + 3H_2$

C_2H_6 (A) diffuses to cracking surface and H_2 (B) diffuses back. Obtain an equation for N_A.

(ii) Discuss the unsteady-state diffusion through a rectangular slab along with necessary equations and diagrams. **5**

(b) (i) Discuss the choice of methods for separation of components. **4**

(ii) Show the method for calculating column diameter for a tray column and that for a packed column. **4**

(c) (i) Derive overall mass transfer coefficient in terms of individual mass transfer co-efficients. Show all the details. **5**

(ii) Discuss the penetration theory. **3**

3 Write short notes on any **four** : **16**

(a) Relationships between mass transfer co-efficients.

(b) Classification of mass transfer operations.

(c) Outline for calculating diffusivity in gases from theoretical considerations.

(d) Comparison of dimensionless groups for analogy between heat transfer and mass transfer.

(e) Diffusion through polymers.

SECTION - II

4 (a) Attempt the following : **10**

(i) Define Relative Volatility with mathematical expression.

(ii) State three industrial application of distillation.

(iii) State any four equipments for gas liquid contact equipments.

(iv) State any three types of impellers used in agitated vessels.

(b) (i) Describe construction, working and industrial application of agitated vessels for gas liquid operation. **5**

(ii) Explain in brief Vortex formation and prevention in agitated vessel. **5**

5 Attempt the following : **8×2=16**

(a) A liquid mixture containing 60 mole % acetone (1), 40 max % water (2) at 1 atm pressure is differentially distilled to vaporize 30 mole % of feed. Compute the composition of the composite distillate and residue. The VLE data are :

X_e	0.010	0.050	0.100	0.200	0.400	0.50
Y_e	0.253	0.624	0.755	0.815	0.839	0.849
X_e	0.600	0.700	0.800	0.900	0.950	
Y_e	0.859	0.874	0.898	0.935	0.963	

(b) A liquid mixture containing 50% mol heptane (A) and 50% mole octane (B) is to be continuously flash vaporised at 1 Std. atm pressure to vaporise 60 mol % of feed. What will be the composition of the vapour and liquid in the spectator for an equilibrium stage?

Data :

t°C	98.5	105	110	115	120	125.5
V.P. of A mm Hg	760	940	1050	1200	1350	1540
V.P. of B mm Hg	333	417	484	561	650	760

(c) Write assumptions for Mc. cabe – Thile method and derive equation for enriching section operating line.

6 Attempt the following : **7×2=14**

(a) What is total reflux? How distillation column works in such condition?

(b) Being a chemical engineer write importance of Mass Transfer technically.

(c) Differentiate packed tower and tray tower. Write in brief operational difficulties in tower operation.
