Scheme – G

Sample Test Paper - I

Course Name : Diploma in Chemical Engineering

Course Code: CH

Semester : Sixth **17648**

Subject Title : Mass Transfer Operation

Marks : 25 **Time: 1 Hour**

Instructions:

1. All questions are compulsory
2. Illustrate your answers with neat sketches wherever necessary
3. Figures to the right indicate full marks.
4. Assume suitable data if necessary
5. Preferably, write the answers in sequential order.

Q1. Attempt any THREE of the following **09 Marks**

a. Define relative Volatility. How it is related with equilibrium data?
b. Give the values of "q" for different thermal conditions with neat figure.
c. Give mathematical statement of Ficks law of diffusion and give the meaning of each term involved in it.
d. Show that for equimolar counter diffusion $D_{AB} = D_{BA.}$

Q2. Attempt any TWO of the following. **08 Marks**

a. Describe with sketch working of bubble cap plate for distillation.
b. Explain briefly boiling point diagram.
c. 100 kmol/hr of a feed containing 35 mole% methanol is to be continuously distilled in a fractionating column to get 96.5 mole% methanol as a distillate and 10 mole % methanol as a bottom product .Find the molal flow rates of distillate and bottoms.

Q3. Attempt any ONE of the following. **08 Marks**

a. A liquid mixture containing 40 mole % benzyl and 60 mole % toluene is subjected to flash distillation at a separator pressure of 101.325 kPa to vaporize 50 mole % of feed. What will be the equilibrium composition of vapour and liquid?

x	0	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
y	0	0.13	0.21	0.375	0.5	0.6	0.7	0.77	0.83	0.9	0.95	1.0

b. A mixture of benzene and toluene containing 60 mole % benzene is to be separated to give a product of 95 mole % benzene and bottom product containing 10 mole % benzene. The feed enters a column at its bubble point. It is proposed to operate the column with reflux ratio of 2.5.it is required to find the number of the theoretical plates needed and position of feed plate. The vapour liquid equilibrium data are given as below:

x	0	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
y	0	0.13	0.21	0.375	0.5	0.6	0.7	0.77	0.83	0.9	0.95	1.0

Scheme – G

Sample Test Paper - II

Course Name : Diploma in Chemical Engineering

Course Code: CH

Semester : Sixth **17648**

Subject Title : Mass Transfer Operation

Marks : 25 **Time: 1 Hour**

Instructions:

1. All questions are compulsory.
2. Illustrate your answers with neat sketches wherever necessary
3. Figures to the right indicate full marks.
4. Assume suitable data if necessary.
5. Preferably, write the answers in sequential order.

Q1. Attempt any THREE of the following **09 Marks**

a) Define Gas absorption. State its industrial application with suitable example.

b) Define liquid extraction. State its industrial application with suitable example.

c) Define i) Moisture content on wet basis ii) Moisture content on dry basis and iii) Equilibrium moisture content.

d) What do you mean by caking of crystals and why it occurs?

Q2. Attempt any TWO of the following. **08 Marks**

a) Compare plate and packed columns for merits and demerits.

b) Differentiate between distillation and Extraction. (Any 4 points)

c) Write in brief on classification of the dryers.

Q3. Attempt any ONE of the following. **08 Marks**

a) A wet solid is to be dried from 35% to 10% moisture under the constant drying conditions in 5 hours. If the Equilibrium moisture content is 4% and the critical moisture content is 14%, how long it will take to dry solids to 6% moisture under the same conditions?

b) Give the classification of crystallizer based on the method of achieving super saturation and explains briefly agitated tank crystallizer.

Scheme – G

Sample Question Paper

Course Name : Diploma in Chemical Engineering

Course Code: CH

Semester : Sixth **17648**

Subject Title : Mass Transfer Operation

Marks : 100 **Time: 3 Hours**

Instructions:

1. All questions are compulsory.
2. Illustrate your answers with neat sketches wherever necessary
3. Figures to the right indicate full marks.
4. Assume suitable data if necessary.
5. Preferably, write the answers in sequential order.

Q1(A). Attempt any THREE **12 Marks**

a) State salient features of two film theory.
b) Define reflux ratio. What is optimum reflux ratio and state its significance?
c) Explain briefly the selection criteria for solvent to be used for liquid extraction.
d) State the principle of Gas absorption. What for it is carried out industrially? Explain with example.

Q1(B). Attempt any ONE **06 Marks**

a) Derive the equation of 'q' line $y = -q/(1-q)\, x + x_{F}/(1-q)$.
b) Explain briefly hydrodynamics / pressure drop characteristics of packed column.

Q2. Attempt any FOUR **16 Marks**

a) Define equilibrium moisture content and critical moisture content. State the meaning of the term constant rate period and constant drying condition?
b) Describe various methods of generating super saturation.
c) Explain triangular diagram for system with one pair partially miscible.
d) In case of differential distillation derive Rayleigh's equation.
e) Define azeotropes and describe the process of azeotropic distillation?

Q3. Attempt any TWO **16 Marks**

a) The vapour pressure of n-heptane (A) and n-octane (B) are given in the following table at 101.325 kPa pressure .Assume that Raoult's and Dalton's laws apply, calculate the value of average relative volatility , generate x-y* data and construct x-y plot(equilibrium/distribution diagram)

T,K	371.4	378	383	388	393	398.6
P^0_A , KPa	101.325	125.323	139.988	159.987	179.985	205.316
P^0_B , KPa	44.396	55.595	64.528	74.795	86.659	101.325

Boiling point of n-heptane (A) =371.4K
Boiling point of n-octane (B) =398.6K

b) 100 Kmol of a mixture containing 50 mol % n-heptane (more volatile) and 50 mole % n-octane is subjected to a differential distillation at atmospheric pressure with 60 mole % of liquid distilled. Compute the composition of the composited distillate and the residue using Rayleigh equation.

Equilibrium data:

X	0.5	0.46	0.42	0.38	0.34	0.32
Y	0.689	0.608	0.608	0.567	0.523	0.497

c) Differentiate between distillation and extraction considering following points
   i. Phases involved
   ii. Temperature conditions
   iii. Quality of product
   iv. Operating cost.

Q4 (A) Attempt any THREE **12 Marks**

a) Explain briefly analogy between heat, mass and momentum.
b) What factors should be considered while selecting solvent for Gas absorption. (Any 4 points).
c) Suggest with reasonssuitable dryer for drying
   i) Milk powder
   ii) Wet lumpy solids
   iii) Free flowing material
   iv) Pharmaceutical products.

d) Calculate the equilibrium composition of the liquid and the vapour phases for a mixture of methyl alcohol and water at a temperature of 323 K and under a pressure of 40 kPa. Assume that both liquid and vapour behave ideally.
   Data: V.P. of methanol at 323 K = 53.32 kPa.
   V.P. of methanol at 323 K = 53.32 kPa.

Q4 (B) Attempt any ONE **06 Marks**

a) Explain in brief with neat sketch Swenson Walker crystallizer.
b) Draw rate of drying curve and state significance of each curve segment.

Q5. Attempt any FOUR **16 Marks**

a) Describe the process of Steam distillation.
b) State any fourdesirable characteristics of packings used in packed column.
c) Draw a neat sketch of Rotating disk contactor and explain its working.
d) Explain the process of liquid liquid extraction and state its field application.
e) Methane diffuses at a steady state through the tube containing helium. At point 1 the partial pressure of methane is 55 kPa and at point 2 it is 15 kPa. The points 1 and 2 are 30 mm apart. The total pressure is 101.3 kPa and temperature is 298 K. Calculate the flux of methane for equimolar counter diffusion. Take value of diffusivity as 6.75×10^{-6} m^2/s.

Q6. Attempt any TWO **16 Marks**

a) Calculate the yield of $MgSo_4.7H_2O$ crystals when 1000 kg saturated solution of $MgSo_4$ at 353 K is cooled to 303 K assuming 10% of the water is lost by evaporation during cooling.
   Data: Solubility of $MgSO_4$ at 353 K = 64.2 kg/100 kg water.
   Solubility of $MgSO_4$ at 353 K = 64.2 kg/100 kg water.
   At.Wt: Mg = 24, S = 32, H = 1and O = 16.

b) Solidsare to be dried under the constant drying conditions from 67 % to 25 % moisture. The value of equilibrium moisture for material is 1 %. If the critical moisture content is 40 % and rate of drying in constant rate period is 1.5 kg/ (m^2h), calculate the drying time.
Drying surface = 0.5 m^3/kg dry solid.

c) Draw the neat labeled diagram of Spray dryer and explain its working.