'I' Scheme

Sample Question Paper

Program Name : **Diploma in Chemical Engineering**
Program Code : **CH**
Semester : **Sixth**
Course Title : **Mass Transfer operation**
Marks : **70**

22609

Time: 3 Hrs.

1. Answer any FIVE **(10 Marks)**

a) State Ficks law of diffusion.

b) Define relative Volatility.

c) Define HETP.

d) Define bound and unbound moisture content.

e) Define azeotropic distillation.

f) Define Gas absorption.

g) Define distribution coefficient of extraction.

2. Answer any THREE **(12 Marks)**

a) Explain various methods of generating super saturation.

b) Describe the concept of optimum reflux ratio.

c) Explain briefly the selection criteria for solvent to be used for liquid extraction.

d) Explain hydrodynamics of packed column in detail.

3. Answer any THREE **(12 Marks)**

a) Derive an equation for operating line of rectifying section.

b) Explain Rotating Disc Contactor with neat diagram.

c) Derive Rayleigh's equation differential distillation.

d) Write down the characteristics of packings.

4. Answer any THREE **(12 Marks)**

a) Write down the equations for Steady state diffusion of A through non-diffusing B & Equimolar counter diffusion.

b) Suggest suitable dryer for drying

i) Milk powder, ii) Wet lumpy solids, iii) Free flowing material, iv) Pharmaceutical products.

c) 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.

d) Draw neat sketch of the Swenson-Walker Crystalliser and label it.

e) Differentiate between Distillation and Extraction. (Any 4 Points).

5. Answer any TWO **(12 Marks)**

a) A mixture of benzene and Toluene containing 40% Benzene and 60 % toluene is to be separated in a fractionating column to give a product containing 96 % benzene and bottom product containing 5 % benzene. Feed is mixture of two third vapour and one third liquid. find out the number of theoretical stages required if reflux ratio of 1.5 times the minimum is used and if relative volatility is 2.5.

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) A solution of sodim nintrate in water contents 48% NaNO3 by weight at 313 K temperatre. Calculate the % yield of NaNO3 crystals that may be obtained when the temperature is reduced to 283 K. Also calculate the quantity of NaNO3 crystals obtained from 100 Kg of solution. Data: Solubility of NaNO3 in water at 283 K is 80.18 Kg NaNO3 / 100 Kg water.

6. Answer any TWO **(12 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.

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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.

Scheme - I
Sample Test Paper - I

ProgramName :**Diploma in Chemical Engineering**

ProgramCode :**CH**

Semester :**Sixth**

22609

CourseTitle : **Mass Transfer Operation**

Marks : **20** **Time: 1Hour.**

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.

Q.1 Attempt any FOUR. **(08 Marks)**

a) Define relative Volatility.

b) Give the values of "q" for different thermal conditions.

c) State Ficks law of diffusion.

d) Define Mass fraction, Mole fraction.

e) Define Mass flux and Molar flux.

f) Define Distillation and Extraction.

Q.2 Attempt any THREE. **(12 Marks)**

a) Show that for equimolar counter diffusion $D_{AB} = D_{BA.}$

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.

d) 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

e) Generate x,y data and plot equilibrium diagram for binary system having relative volatility $\alpha = 2.5$. Using formula $y = \alpha.x / [1+x(\alpha-1)]$.

f) Methane diffuses at 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 point 1 and 2 are 40 mm apart. The total pressure is 101.3 kPa and temperature is 298 K. Calculate the flux of methane at s. state for equimolar counter diffusion. Valve of diffusivity is 6.75×10^{-5} m^2/s.

Scheme - I
Sample Test Paper – II

Program Name :**Diploma in Chemical Engineering**
Program Code :**CH**
Semester :**Sixth**

22609

Course Title : **Mass Transfer Operation**

Marks : **20** **Time: 1Hour.**

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.

Q.1 Attempt any FOUR. **(08 Marks)**

a) Define Gas absorption.

b) Define liquid-liquid extraction.

c) Define Critical moisture content.

d) State and define the mechanism of crystal growth.

e) Describe caking of crystals.

f) Define Equilibrium moisture content.

Q.2 Attempt any THREE. **(12 Marks)**

a) Compare plate and packed columns for merits and demerits. (Any 4 points)

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

c) Write in brief on classification of the dryers.

d) 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?

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

f) 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 303 K = 40.8 Kg/100 Kg water.

Atomic weight

Mg = 24, S = 32, H = 1 and O = 16