22609

21222

3 Hours / 70 Marks Seat No. | | | | | | | | |

15 minutes extra for each hour

Instructions – (1) All Questions are *Compulsory.*

(2) Answer each next main Question on a new page.

(3) Illustrate your answers with neat sketches wherever necessary.

(4) Figures to the right indicate full marks.

(5) Assume suitable data, if necessary.

(6) Use of Non-programmable Electronic Pocket Calculator is permissible.

(7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

Marks

1. Attempt any FIVE of the following: **10**

a) Define molecular diffusion and eddy diffusion.

b) State types of gas absorption and give one example each.

c) Define volatility.

d) Name any two types of packing used in packed column for gas absorption.

e) Define moisture content on wet basis and dry basis.

f) Define selectivity in liquid - liquid extraction.

g) Define supersaturation.

Marks

2. Attempt any THREE of the following: **12**

a) Derive an equation of flux for steady state equimolar counter diffusion.

b) Derive Rayleigh's equation for simple distillation.

c) Explain the situation where liquid - liquid extraction is preferred over distillation.

d) Explain selection criteria for solvent in gas absorption. (Any four points)

3. Attempt any THREE of the following: **12**

a) Explain the purpose of drying operation carried out in industry. (Any four points)

b) Explain Mier's supersaturation theory.

c) Describe rotating disc contactor with neat sketch.

d) Draw and explain the graph showing effect of feed conditions on q-line. Also write the equation of q-line.

4. Attempt any THREE of the following: **12**

a) Explain triangular diagram for a ternary system.

b) Differentiate between packed column and plate column. (Any four points)

c) Wet solids are to be dried from 80% to 5% moisture (wet basis). Calculate the amount of moisture to be evaporated per 100 Kg of the dried product.

d) Describe azeotropie distillation in brief.

e) Explain construction of Swenson - Walker crystallizer with a neat sketch.

Marks

5. Attempt any TWO of the following: **12**

a) Ammonia gas (A) diffuses through a non-diffusing nitrogen gas (B) under steady state conditions. The partial pressure of 'A' at location 1 is 1.5×10^4 Pa and that at location 2 is 5×10^3 Pa. The locations 1 and 2 are 0.15 m apart. The total pressure is 1.103×10^5 Pa and temperature is 298 K. Calculate the flux of diffusion of ammonia. Also calculate the flux of diffusion for equimolar counter diffusion considering that nitrogen is also diffusing. The diffusivity of ammonia at the prevailing conditions is 2.30×10^{-5} m^2/s.

b) Explain Drum dryer with a neat sketch.

c) A saturated solution of $MgSO_4$ at 353 K is cooled to 303 K in a crystalliser. During cooling, 4% solution is lost by evaporation of water. Estimate the quantity of original saturated solution to be fed to the crystalliser per 1000 Kg of $MgSO_4 . 7H_2O$ crystals.

Data :-

Solubility of $MgSO_4$ at 303 K = $\frac{40.8 \text{ Kg}}{100 \text{ Kg Water}}$

Solubility of $MgSO_4$ at 353 K = $\frac{64.2 \text{ Kg}}{100 \text{ Kg Water}}$

At. wt : Mg = 24, S = 32, O = 16 and H = 1.0

Marks

6. Attempt any TWO of the following: **12**

a) A rectification column is fed with 100 kmol/h of a mixture containing 50 mole % hexane and 50 mole % octane at 101.325 kPa absolute pressure. The feed is at its boiling point. The distillate is to contain 90 mole % hexane and the bottoms 10 mole % hexane. The reflux ratio is 3:1. Calculate the Kmol/h distillate and Kmol/h bottoms, and the number of theoretical trays needed for this separation. The equilibrium data is given below :

Mole fraction of hexane in liquid, x	Mole fraction of hexane in vapour, y
1.0	1.0
0.69	0.932
0.4	0.78
0.192	0.538
0.045	0.1775
0	0

b) A feed containing 60 mole% hexane and 40 mole % octane is fed to a pipe still through a pressure reducing valve into a flash separator. The vapour and liquid leaving the separator are assumed to be in equilibrium. If 50 mole % of the feed is vapourised, find the composition of the top and bottom products. The equilibrium data is given below:

x	1.0	0.69	0.40	0.192	0.045	0
y	1.0	0.932	0.78	0.538	0.1775	0

c) Slabs of paper pulp 100 cm × 100 cm × 1.5 cm is to be dried under constant drying conditions from 67% to 30% moisture. The equilibrium moisture for the material is 0.5%. If the critical moisture content is 60% and rate of drying at the critical point is 1.5 Kg/(m^2.h), calculate the drying time. The dry weight of each slab is 2.5 Kg. All moisture contents are on weight basis.