22609

12425

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

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.

(8) Use of Steam tables, logarithmic, Mollier's chart is permitted.

Marks

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

a) State an expression for flux equation equimolar counter current diffusion with meaning of each term.

b) Write the material balance for absorption tower for one component.

c) Draw a neat sketch of Mixer settler.

d) Define Henry's Law and Raoult's Law.

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

f) Define saturated solution and super saturated solution.

g) Give two applications of extraction.

P.T.O.

Marks

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

a) State the equation for Fick's first law of diffusion. Give mathematical expression and explain the terms involved.

b) Define the terms :

i) free moisture content

ii) bound moisture content

iii) critical moisture content

iv) equilibrium moisture content

c) Write the factors that should be considered for selecting solvent in gas absorption. (any four)

d) Draw a neat sketch of Swenson - Walker crystalliser and label it.

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

a) Describe Rotating disc contactor with a neat sketch.

b) Derive the expression for time of drying under constant rate period.

c) Define minimum boiling azeotrope and draw a neat boiling point and equilibrium diagram for it.

d) Compare packed column and plate column on the following points :

i) Pressure drop

ii) Cost

iii) Handling corrosive fluids

iv) Handling volume of liquid.

Marks

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

a) Describe drying rate curve with graphical presentation.

b) Draw triangular diagram and describe its use in extraction.

c) Draw a neat sketch of mechanically agitated vessel for gas absorption and explain its working.

d) Show that for equimolar counter diffusion, $D_{AB} = D_{BA}$

e) Derive Rayleigh's equation for differential distillation.

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

a) Calculate the yield of $MgSO_4 \cdot 7H_2O$ crystals when 1000 Kg saturated solution of $MgSO_4$ at 353 K is cooled to 303 K assuming 10% of water is lost by evaporation during cooling

Data :

Solubility of $MgSO_4$ at 353 K = 64.2 Kg per 100 Kg water.

Solubility of $MgSO_4$ at 303 K = 40.8 Kg per 100 Kg water [At wt. of Mg = 24, S = 32, O = 16, H = 1]

b) A large tank filled with a mixture of gases 'A' and 'B' at 101 Kpa and 298 K is concentrated to another large tank filled with a mixture of 'A' and 'B' of different compositions at 101 Kpa and 298 K. The tanks are connected with a tube of inner diameter of 50 mm and 150 mm long. Calculate the steady state rate of transport of 'A' through the tube when concentration of 'A' in one tank is 90 mole% and other 5 mole% assuming uniformity in composition in each tank and transfer takes by molecular diffusion. The diffusivity of 'A' in 'B' is 4.3×10^{-3} m^2/sec.

c) Explain the stepwise procedure to obtain the number of theoretical plates by McCabe - Thiele method.

Marks

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

a) Solids are to be dried under 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^2-hr, calculate the drying time. (Drying surface = 0.5 $\frac{m^2}{Kg}$ of dry solid)

b) Calculate the yield of $Na_2S_2O_3.5H_2O$ crystals when 100 Kg of 48% $Na_2S_2O_3$ solution is cooled to 293 K. Also calculate percentage yield of hydrated crystals.

Data :

Solubility of $Na_2S_2O_3$ = 70 parts per 100 parts water at 293 K.

Atomic weights : Na = 23, S = 32, O = 16, H = 1

c) Methanol - water solution containing 50% by weight methanol at 300 K is to be continuously rectified at 101 Kpa at the rate of 5000 Kg/hr to provide a distillate containing 95% methanol and a residue containing 1.0% methanol by weight. Calculate the flow rates of distillate and residue on –

i) weight basis

ii) mole basis
