17648

16172

3 Hours / 100 Marks   Seat No. ☐☐☐☐☐☐☐☐

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

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

Marks

1. (A) **Attempt any THREE :**   **12**

(a) State salient features of two film theory.

(b) Draw the diagram of bubble captray and mark the parts.

(c) Which factors should be considered while selecting a solvent for extraction ?

(d) What are the factors and how it affects rate of drying ?

(B) **Attempt any ONE :**   **6**

(a) For a binary system, the relative volatility is 2.5. Compute x-y data and draw the equilibrium curve.

(b) With help of neat figure, explain construction and working of Swenson-Walker crystalizer.

2. **Attempt any FOUR :**   **16**

(a) Define supersaturation and give methods of supersaturation.

(b) Explain the working of fluidised bed dryer.

(c) Describe differential distillation with neat figure.

(d) Explain boiling point diagram with neat figure.

(e) Differentiate between Destination and Extraction.

3. **Attempt any TWO :** 16

(a) A feed containing 50 mole % hexane and 50 mole % octane is fed to a pipe still through a pressure reducing valve and then into flash disengaging chamber. The vapour and liquid leaving the chamber are assumed to be in equilibrium. If the fraction of feed converted to vapour is 0.5, find the composition of the top and bottom products. Equilibrium data for system is given below :

x	1	0.69	0.4	0.192	0.045	0
y	1	0.982	0.78	0.538	0.1775	0

(b) 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 containing 5% benzene. Feed is a 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.

(c) The vapour pressure of n-heptane (A) & n-octane (B) are given in the following table. Assume that Raoult's and Dalton's law apply, compute vapour-liquid equilibria at constant pressure of 101.325 kPa.

Boiling point of (A) = 371.4 K

Boiling point of (B) = 398.6 K

Data :

T, $\overset{o}{K}$	371.4	378	383	388	393	398.6
$P°_A$, kPa	101.325	125.323	139.988	159.987	179.99	205.32
$P°_B$, kPa	44.396	55.595	64.528	74.795	86.66	101.325

4. **(A) Attempt any THREE :** 12

    (a) With suitable figure explain spray column used for extraction.

    (b) Give mathematical expression and statement of Fick's law and mention the terms involved in it.

    (c) Describe steam distillation.

    (d) What factors should be considered while selecting solvent for gas absorption (any 4 points) ?

    (B) Attempt any ONE : 6

    (a) List various types of packings used in industry and state their material of construction and draw any two packings.

    (b) A 100 kg batch of granular solids containing 30% moisture is to be dried in a tray dryer to 16% moisture by passing a current of air at 350 K across its surface at a velocity of 1.8 m/s. If the constant rate of drying under these conditions is 0.7×10^{-3} kg/(m^2-s) and the critical moisture content is 15%, calculate the drying time.

    Drying surface $= 0.03$ m^2/kg dry weight.

5. **Attempt any FOUR :** 16

    (a) What is azeotrope ? Explain minimum and maximum boiling azeotrope.

    (b) Derive Rayleigh's equation for simple distillation.

    (c) Explain the hydrodynamics of packed column.

    (d) Draw the feed line for different conditions of feed. Give the values of 'q' in each case.

    (e) What is HETP ? How total height of packed column is calculated from HETP ?

6. **Attempt any TWO :** 16

    (a) Derive the expression for time required to dry the solids from moisture content $X_1 (> X_C)$ to moisture content $X_2 (< X_C)$.

    (b) Find out the rate of drying and moisture content from the following data :

Wt. of wet sawdust (g)	Wt. of sawdust after drying (g)	Time (h)
250	230	0.5
250	215	0.75

Dimension of tray = 10 cm × 10 cm.

Weight of dry sawdust on tray = 150 g

    (c) 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.H_2O

At. wt. Mg = 24, S = 32, H = 1, O = 16

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