

17648

15116

3 Hours / 100 Marks

Seat No.

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

Marks

- 1. a) Attempt any THREE of the following: **12****
- (i) Give the mathematical statement of Fick's law of diffusion and give the meaning of each term involved in it.
- (ii) Define azeotrope and azeotropic distillation.
- (iii) Explain briefly the selection criteria for solvent to be used for liquid extraction.
- (iv) Give the classification of dryers.

P.T.O.

b) Attempt any ONE of the following:

(i) Derive the equation of 'q' line.

$$y = \frac{-q}{1-q}x + \frac{x_f}{1-q}$$

(ii) State various methods of generating supersaturation.

2. Attempt any FOUR of the following: 16

- Explain in brief solubility curves.
- State the factors on which the rate of drying depends.
- Give the equation of operating line for flash distillation and explain the terms involved.
- Derive Rayleigh's equations for differential distillation.
- Differentiate between distillation and extraction.

3. Attempt any TWO of the following: 16

- The vapour pressures of n-heptane (A) and n-octane (B) are given in the following table. Assume that Raoult's and Dalton's laws apply, compute vapour - liquid equilibria at constant pressure of 101.325 kPa. Boiling point of n-heptane (A) = 371.4K [98.4°C]
Boiling point of n-octane (B) = 398.6 K [125.6°C]

T°C	98.4	105	110	115	120	125.6
T°K	371.4	378	383	388	393	398.6
P _A ^o , kPa	101.325	125.323	139.988	159.987	179.985	205.316
P _B ^o , kPa	44.396	55.595	64.528	74.795	86.659	101.325

- b) A mixture of benzene and toluene containing 60 mole % benzene is to be separated to give a product of 95 mole % benzene and a 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 theoretical plates needed and the position of feed plate.

Equilibrium data:

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

- c) Explain Lewis-Sorel method used to obtain theoretical plates required for a given degree of separation by distillation.

4. a) Attempt any THREE of the following: 12

- (i) Give any four applications of extraction.
- (ii) Show that for equimolar counter diffusion $D_{AB} = D_{BA}$.
- (iii) Suggest with reason suitable dryer for drying:
 - (1) Milk powder
 - (2) Free flowing material
 - (3) Wet lumpy solids
 - (4) Pharmaceutical products.
- (iv) 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 (50°C) and under a pressure of 40 kPa. Assume that both the liquid and vapour behave ideally.

Data : V.P. of methanol at 323 k [50°C] = 53.32 kPa

V.P. of water at 323 k [50°C] = 12.33 kPa.

- b) **Attempt any ONE of the following:** **6**
- (i) Explain construction and working of Oslo cooling crystalliser with neat sketch.
 - (ii) Draw rate of drying curve and state significance of each curve segment.
- 5. Attempt any FOUR of the following:** **16**
- a) Explain Bubble cap plate used for phase contacting.
 - b) Explain in brief rectification on an ideal plate.
 - c) State the situations in which packed columns are well suited.
 - d) Draw a feed line on the equilibrium diagram for various values of 'q'. $q = 0$, $q = 1$, $q > 1$ and $0 < q < 1$ and $q < 0$.
 - e) State the advantages and disadvantages of a packed column [two of each]
- 6. Attempt any TWO of the following:** **16**
- a) Solids are to be dried under constant drying conditions from 67% to 25% moisture. The value of equilibrium moisture for the material is 1%. If the critical moisture content is 40% and rate of drying in the constant rate period is $1.5 \text{ kg/cm}^2 \cdot \text{h}$, Calculate the drying time.
Drying surface = $0.5 \text{ m}^2/\text{kg}$ dry solid.
 - b) With a neat sketch explain the construction and working of drum dryer.
 - c) Explain Mier's supersaturation theory for crystallisation.
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