17648

11718

3 Hours / 100 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.

Marks

1. (A) Attempt any THREE : **4 × 3 = 12**

(a) State salient features of Higbie's penetration theory (any four).

(b) Explain Boiling Point diagram in distillation.

(c) Explain briefly the selection criteria of solvent to be used in gas absorption.

(d) Describe working of rotating disc contactor with neat diagram.

(B) Attempt any ONE : **6 × 1 = 6**

(a) Derive the equation for time of drying under constant rate period.

(b) Explain Mier's super saturation theory of Crystallization.

2. Attempt any FOUR: **4 × 4 = 16**

(a) List the four methods by which supersaturation can be generated.

(b) Wet solids are to be dried from 80% to 5% moisture (on weight basis). Calculate the amount of moisture to be evaporated per 100 kg of the dried product.

(c) Define :

(i) Extract phase

(ii) Raffinate phase

(iii) Distribution coefficient

(iv) Selectivity in Extraction.

(d) Ammonia from a ammonia-air mixture is to be absorbed in an absorption tower using water as a solvent. Data for the absorption system is as follows – Air flow rate – 200 kg/h.

Liquid phase composition – Top – 0.000013 kg NH_3/kg H_2O

– Bottom – 0.0006 kg NH_3/kg H_2O

Gas-phase composition – Top – 0.0044 kg NH_3/kg inert gas

– Bottom – 0.0084 kg NH_3/kg inert gas

Calculate flow rate of water entering the absorption tower.

(e) State and explain Fick's law of diffusion.

(f) Draw the feed line at different feed condition for distillation.

3. Attempt any TWO : 8 × 2 = 16

(a) The vapour pressures of n-hexane & n-octane are given below. Obtain an empirical relation between y and x for this system at a constant pressure of 101.325 kPa.

T °C	68.7	79.4	93.3	107.2	121.1	125.6
$P_A°$ kPa	101.3	136.6	197.3	283.9	399.9	455.9
$P_B°$ kPa	16.1	23.1	37.1	57.8	87.2	101.3

With the help of empirical equation generate VLE data and construct a plot of x v/s y.

(b) A liquid mixture containing 40 mole % methanol & 60 mole% water is fed to a differential distillation at atmospheric pressure, with 60 mole% of the liquid is distilled. Find the composition of the composited distillate of the residue. Equilibrium data :

x	0.05	0.1	0.2	0.3	0.4	0.5
y	0.27	0.42	0.57	0.66	0.73	0.78

(c) A feed containing 50 mole% hexane & 50 mole% octane is fed to a pipe still through a pressure reducing valve and then 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 & bottom products. The equilibrium data for the system is given below :

x	1	0.69	0.4	0.192	0.045	0
y	1	0.932	0.78	0.538	0.1775	0

4. (A) Attempt any THREE : **4 × 3 = 12**

(a) Write down the equations for steady state equimolar counter diffusion for gases.

(b) Distinguish between Distillation & Extraction.

(c) Draw 3 stage mixes-settles arrangement in Extraction.

(d) What are the different factors on which rate of drying depends ?

(B) Attempt any ONE : **6 × 1 = 6**

(a) Explain in brief with neat sketch – Swenson Walker Crystallizer.

(b) Draw rate of drying curve and state significance of each curve segment.

5. Attempt any FOUR : **4 × 4 = 16**

(a) Draw the Tray Dryer and write its working.

(b) Draw any four type of packings which are used in packed column.

(c) Write down the selection criterion of solvent used in Extraction.

(d) "Optimum Reflux Ratio for distillation is an economic approach". Discuss.

(e) Compare Bubble cap plate, sieve plate and valve plate.

(f) Compute x-y data when $\alpha = 2.5$.

6. Attempt any TWO : **8 × 2 = 16**

(a) Write down steps involved in McCabe-Thiele method for calculating no. of theoretical plates.

(b) Suggest with reason, suitable dryer of drying.

(i) Milk Powder

(ii) Wet Lumpy Solids

(iii) Free flowing material

(iv) Pharmaceutical Products.

(c) Explain in detail – Hydrodynamics of packed column.