

[3 Hours]

[Total Marks: 80]

- (1) Q.1 is compulsory. (2) Attempt any 3 from the remaining 5 questions. (3) Use graph paper, if required. (4) Assume suitable data if required and justify the same.

- 1 a Derive operating line equation for flash distillation. **5**  
 b What you mean by super saturation **5**  
 c Differentiate between physical adsorption and chemisorptions. **5**  
 d Explain industrial applications of leaching. **5**

- 2 a Explain Ponchon Savarit method for multistage tray towers. **10**  
 b A feed consisting of 1200 gram moles of mixture containing 30 percent naphthalene and 70 percent dipropylene glycol is differentially distilled at 100 mm Hg pressure and final distilled contains 55 percent of feed solution. Determine the amount of distillate and concentration of naphthalene in residue and distillate. VLE data is given below in percent

X	8.4	11.6	28	50.6	68.7	80.6	88
y	22.3	41.1	62.9	74.8	80.2	84.4	88

- 3 a Explain factors involved in choice of solvent in extraction **10**  
 b Acetone is to be recovered from an aqueous solution containing 20 percent acetone by means of kerosene as solvent. The distribution of acetone in water and kerosene follows relationship  $X = 6.45Y$ .  $X = \text{kg acetone/kg water}$ ,  $Y = \text{Kg acetone/kg kerosene}$ . If 6 kg/kg solution of kerosene is used in tower, Find number of equilibrium stages required to reduce the concentration from 0.20 to 0.040 in aqueous flow. Kerosene and water are nearly immiscible. All compositions are by weight. **10**

4. a) Nitrogen gas contaminated with water at 926 mg/kg  $N_2$  is continuously fed to pilot scale adsorption column that contains a 0.268 m high bed packed with molecular sieve. Out let data given below **10**

Time hrs	0	9	9.2	9.6	10	10.4	10.8	11.25	11.5	12	12.5	12.8
Water conc. (mg/kg $N_2$ )	0	0.6	2.6	21	91	235	418	630	717	855	906	926

If the breakthrough curve is defined here as being when  $C/C_0$  reaches 0.02, (a) Find breakthrough time (b) Fraction of total sieve capacity used by breakthrough time.

- b) Draw and explain breakthrough concentration profile in fluid at outlet of the adsorption bed. Describe the method for determination of capacity of column from breakthrough curve. **10**
- 5 a) Explain various properties of a membrane that affect separation. **5**  
 b) Explain various methods of super saturation. **5**  
 c) A salt solution weighing 10,000 kg with 30 wt. percent  $Na_2CO_3$  is cooled to 293K. The salt crystallizes the decahydrate. What will be the yield of  $Na_2CO_3 \cdot 10H_2O$  crystals if the solubility is 21.5 kg unhydrous  $Na_2CO_3$  per 100 kg water. For (a) No water evaporated (b) 3 percent of total weight of solution is lost by evaporation of water in cooling. **10**

6. Write short notes **20**  
 a Tray efficiency  
 b Principles of leaching operation  
 c Pressure swing adsorption  
 d Osmotic equilibrium in reverse osmosis processes

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