

- N.B.: 1. Question No.1.iscompulsory.
2. Attempt any **three** questions out of the remaining **five** questions.
3. Assume **suitable** data wherever **required**.
4. **Figures** to the **right** indicates **full** marks.

1]. Solve any Four.

- (a) Discuss Minimum boiling Azeotropes [5]
(b) Explain the concept of leaching [5]
(c) Explain the process of nucleation in crystallization. [5]
(d) Write the characteristics of adsorbents [5]
(e) Classify the membrane separation processes. [5]
(f) Explain principle of liquid-liquid extraction. [5]

2. a. Derive the equation for operating line of Rectifying section and Stripping Section in a Fractioning column. [10]

b. A mixture of benzene and toluene containing 40 mole percent of benzene is to be separated to give a product of 90 mole percent benzene at top and a bottom product with not more than 10 mole percent benzene. Using an average value of 2.4 for the volatility of benzene relative to toluene, calculate the number of theoretical plates required at total reflux. Also calculate the minimum reflux ratio, if the feed is liquid and at its boiling point. [10]

3. a. Derive an equation for calculating the No. of stages required for multistage cross current Extraction. [10]

b. Vegetable oil seeds containing 100gms of insoluble solid and 10gm of oil are contacted with 200gm of organic solvent in a single stage leaching operation.The solvent used is fresh.Determine the amount of oil left in the oil seeds after the leaching.The equilibrium data can be expressed as,

$$N = -4y + 8$$

Where, $N = \text{gm insoluble}/(\text{gm solvent} + \text{gm oil})$

$y = \text{gm oil}/(\text{gm solvent} + \text{gm oil})$

in the solvent phase.

The tie line data is,

y	0.26	0.28	0.31	0.34
x	0.02	0.04	0.06	0.08

[10]

4. a. For multistage cross-current adsorption, explain material balance and explain the procedure to estimate minimum amount of adsorbent. [10]
b. Experiments on decolourisation of oil yielded the following equilibrium relationship

$$Y = 0.004 X^2$$

Where, $Y = \text{g colour/g colour-free oil}$ and $X = \text{g colour/g adsorbent}$

100 kg oil containing 1 part of colour to 3 parts of oil is agitated with 25 kg of adsorbent. Calculate the percentage colour removed if

- i) All 25 kg of adsorbent is used in one step
ii) 12.5 kg of adsorbent is used initially, followed by another 12.5 kg of adsorbent. [10]

5 a. Derive the Fenske's equation or finding minimum number of stages. [10]

- b. P-dioxane [C] can be separated from water [A] by using benzene [B] as a liquid-liquid extraction solvent. The distribution coefficient for this system is 1.2, independent of composition at 25°C and 101 kPa, the process conditions. Water and benzene may be assumed to be completely immiscible. 10000 kg/hr of a 25 wt % solution of C in water is to be extracted with 15000kg/hr of B. What percent extraction is achieved in

- i) One single stage
ii) In two cross-flow stages with 7500 kg/hr of solvent used in each stage [10]

6 Write short notes on (any **four**) [20]

- (a) Rotating Disc contactor for extraction.
(b) Need of membrane separation, and its advantages
(c) Factors involved in choice of solvent in extraction
(d) physical adsorption and chemisorption
(e) Forced circulation evaporative crystallizer.
(f) Steam Distillation
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