

( 3 Hours)

[Total Marks: 80]

**N. B.** (1) Question No. 1 is compulsory.(2) Attempt any **three** questions from remaining **five** questions.

(3) Assume suitable data whenever required.

(4) **Figures to right** indicate **full** marks.(5) Draw neat labeled **Diagrams** wherever required.**Q.1** Answer the following (any **four**):**(20)**

- Give methods of Foam Formation, Coalescence and collapse.
- Explain Retention time, Retention volume and Resolution in LC.
- Write a short note on Characteristics of modern adsorbents.
- Explain in brief different modes of operation of a foam fractionation column
- Write a short note on Silica gel as adsorbent.
- Describe membrane and give its classification based on driving forces.

**Q.2**

- Discuss the construction and working of any one type of flotation equipment used for mineral processing. **(10)**
- List different membrane modules used in membrane processes and explain spiral wound module in detail. **(10)**

**Q.3**

- Explain Modern Liquid-liquid chromatography in detail on the basis of following points: **(10)**
  - Advantages over other conventional chromatographic methods
  - Essential features
  - Column packings
  - Partitioning phases and other separation variables
  - Applications
- Discuss the application of adsorption process in drying of air or any process streams. **(10)**

**Q.4**

- Briefly describe chromatographic separation of Enzymes and Proteins. **(10)**

- (b) A dialysis process is being designed to recover a certain solute from dilute solution having solute concentration  $2.0 \times 10^{-2} \text{ kg mol/m}^3$  through a membrane to a solution having solute concentration  $0.3 \times 10^{-2} \text{ kg mol/m}^3$ . The membrane is  $1.59 \times 10^{-5} \text{ m}$  thick. The mass transfer coefficients in upstream and downstream are  $3.5 \times 10^{-5} \text{ m/s}$  and  $2.1 \times 10^{-5} \text{ m/s}$  respectively. Calculate (10)
- The permeability when steady state flux is  $2.492 \times 10^{-8} \text{ kg mol solute /h.m}^2$
  - Diffusivity of solute through membrane when distribution coefficient is 0.75
  - The individual resistances and total resistance.

## Q.5

- (a) i) What is Reverse Osmosis? Explain with process flow diagram, how seawater is desalinated by reverse osmosis? (10)
- (c) Chemical department wanted to treat outlet water from laboratories which content 10 mg/L chlorophenol, and is going to be treated by carbon adsorption. 95% removal is desired. The wastewater is discharged at a rate of 0.1 Million Gallons per Day (MGD). Calculate the carbon requirement for: (10)
- A single mixed contactor (CMFR).
  - Two mixed (CMFR) contactors in series with intermediate concentration

Freundlich isotherm  $q(\text{mg/g C}) = 6.74 \times C^{0.41} (\text{mg/L})$

Q.6 Write a short notes on any **four** of the following: (20)

- Ultra filtration
- Ion Exchange Chromatography
- Classification of Foam Fractionation techniques
- Membrane Fouling
- Pressure Swing Adsorption

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