

(3 Hours)

[Total Marks: 80]

N. B. (1) Question No. 1. is compulsory.

- (2) Attempt any **three (3)** questions from remaining **five (5)** questions.
 (3) Assume suitable data whenever required.
 (4) **Figures to right** indicate **full** marks.

Q.1 Answer the following (any **four**):

(20)

- (a) Write a note on Bonded Phase Chromatography.
 (b) Write a note on Molecular Sieves as adsorbent.
 (c) What is meant by membrane? Give its classification based on driving force.
 (d) Give methods of Foam Formation, Coalescence and Collapse.
 (e) Explain Tap Fill method of packing for rigid solids in LC columns.
 (f) Explain regeneration and activation of activated carbon.

Q.2

- (a) Explain Pressure Swing Adsorption (PSA) technology with appropriate examples. (10)
 (b) List different modules used in membrane processes and explain Plate and Frame module in detail. (10)

Q.3

- (a) Derive the relation for liquid permeation process in 'Dialysis' (10)

$$\text{i.e. } N_A = \frac{C_1 - C_2}{\left(\frac{1}{kC_1}\right) + \left(\frac{1}{kC_2}\right) + \left(\frac{1}{P_m}\right)}$$

- (b) Discuss the construction and working of any one type of flotation equipment used for mineral processing. (10)

Q.4

- (a) Explain Liquid-Liquid Chromatography in detail using following points:

- i. Advantages over other LC methods
- ii. Essential features
- iii. Column packing
- iv. Partitioning phases and other separation variables
- v. Applications

(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 3.5×10^{-5} m/s and 2.1×10^{-5} m/s respectively. (10)

Calculate

- i. The permeability when steady state flux is 2.492×10^{-8} kg mol solute /h.m²
- ii. Diffusivity of solute through membrane when distribution coefficient is 0.7
- iii. The individual resistances and total resistance.

Q.5

(a) Explain following methods to prepare Composite Membrane: (10)

- (i) Interfacial polymerization
- (ii) Dip Coating

(c) An industrial wastewater having a TOC of 200 mg/L will be treated by GAC for a flow rate of 200 m³/day. Allowable TOC in the effluent is 10 mg/L. Design an adsorption column using scale up approach with following Pilot Plant Data. (10)

Q = 50 L/hr

Column diameter = 95 mm

Column depth (packed bed) = 175 cm

Packed bed carbon density = 400 kg/m³

V_{breakthrough} = 8400 L

V_{exhaustion} = 9500 L

Q.6 Write short note on the following: (20)

- (a) Nano-Filtration
- (b) Ion Exchange Chromatography
- (c) Simulated Moving Bed Adsorber
- (d) Refractive Index detector in LC
