

**M. TECH FOOD TECHNOLOGY AND BIO-CHEMICAL ENGINEERING
FIRST YEAR SECOND SEMESTER EXAM 2025**

MODERN SEPARATION AND PURIFICATION PROCESSES

Time: 3 hrs.

Full Marks : 100

(Use separate answer scripts for each Part.)

Part – A

[Answer question no. 6 and any three from the rest., (5 + 15 x 3) = 50]

1. (a) What is the principle of the process of dialysis? How is hemodialysis done? 1+4
 (b) Calculate the flux and the rate of removal of urea at steady state in g/hr from blood in a cellophane membrane dialyzer at 30°C. The membrane is of 0.027 mm thickness and has an area of 2.5 m². The mass transfer coefficient on the blood side is estimated as $k_{c1} = 1.32 \times 10^{-5}$ m/s and that on the aqueous side is 3.47×10^{-5} m/s. The permeance of the membrane is 8.82×10^{-6} m/s. The concentration of urea in the blood is 0.04 g urea/ 100 ml and that in the dialyzing fluid can be assumed to be zero. 10

2. (a) What are equations for solvent and solute fluxes through a reverse osmosis (RO) membrane? By using these equations deduce an expression for rejection coefficient of the membrane. 10
 (b) What is meant by osmotic pressure of a Solution? What is the equation used for its calculation? 5

3. What are the different stages that led to the development of modern day membranes for RO and UF? 15

4. Deduce a flux equation for the process of ultrafiltration(UF). What is gel polarization? How fruit juice is processed using UF? 10+1+4

5. Determine the flux rate in kg/s expected in a tubular ultrafiltration system being used to concentrate milk. The following conditions apply: density of milk= 1.04 g/c.c, viscosity= 0.75 cp, diffusivity= 7.2×10^{-7} cm²/s, $C_b = 3.1\%$ mass per unit volume, $C_g = 23\%$ mass per unit volume, diameter of the tube= 1.5 cm, length =225 cm, no. of tubes= 15 and fluid velocity= 1.6 m/s. 15

6. Answer any one. 5
 - (a) Spiral wound module
 - (b) Tubular modules
 - (c) Application of RO where concentrate is of interest
 - (d) Calculation of concentration polarization factor.

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Part - II

FM-100

Answer questions no 1 and 2 and 3 or 4 from the following

1. Dye is extracted using Tx-100 at 70°C. Dye concentration needs to be reduced from 4.1×10^{-4} (m) to 3.9×10^{-6} (m). Calculate the surfactant concentration required for reducing the dye using the following data.

$$m = 2.4 \times 10^{-1} - 5.9 \times 10^{-3} T + 3.7 \times 10^{-5} T^2$$

$$n = -5 \times 10^4 + 1.3 \times 10^3 T - 5.9 \times T^2$$

$$P = 5.9 - 200 C_o - 1.9 \times 10^{-8} C_o^{-2}$$

$$R = 0.39 + 6.9 C_o + 4 \times 10^{-9} C_o^{-2}$$

$$Q = -0.051, \quad S = 0.09$$

All notations carry their usual meaning.

Discuss the mechanism of cloud point separation?

(15+5=20)

2. How electrolytic concentration, pH and temperature effects the extraction process using surfactant. Discuss the working principle of separation by using HPTLC. (4+3+3+10=20)
3. Derive the functional relationship between flow rate and the dimension of the filter for centrifugal filtration process. 10
4. Discuss the working principle of cyclone separator. 10