AQ–2754

Faculty of Engineering & Technology

M.Tech. (Chemical Engg.) Second Semester (CBS) Examination

ADVANCED SEPARATION TECHNIQUES

Paper—2 CE 2

Time—Three Hours] [Maximum Marks—80

INSTRUCTIONS TO CANDIDATES

(1) All questions carry marks as indicated.

(2) Answer any **SIX** questions.

(3) Due credit will be given to neatness and adequate dimensions.

(4) Assume suitable data wherever necessary.

(5) Diagrams and Chemical equations should be given wherever necessary.

(6) Use pen of Blue/Black ink/refill only for writing the answer book.

1. Describe the membranae transport and separation techniques with the transport equation, physico-chemical criteria with surface force pore model and prediction of membrane performance for either RO or UF membrane module with neat sketches. 13

2. What are the different materials used for (UF) Ultra Filtration membrane techniques ? Discuss one industry of your choice for the application of UF with neat sketches. 13

3. An Ultra Filtration (UF) plant is required to treat 50 m³/day of a protein containing waste stream. The waste contains 0.5 kg/m³ of protein which has to be concentrated to 20 kg/m³ so as to allow recycling to the main process stream. The tubular membranes to be used are available as 30 m²

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modules. Pilot plant studies show that the flux J through these membranes is given by ;

$$J = 0.02 / n \left(\frac{30}{c_f} \right) m / n,$$

where — c_f is the concentrated of protein in kg/m^3.

Due to fouling, the flux never exceeds 0.04 m/h. Estimate the minimum number of membrane modules required for the operation of this process : (a) as a single feed and (b) as two feed and bleed stages in series operation for 20 h/day may be assumed.   14

4. What are the components and criteria for selection of Reverse Osmosis (RO) membrane techniques used domestically for water treatment ? Explain the functions and application of each component of this technique.   13

5. Discuss the transfer of solute through membrane in dialysis. A stack of an electrodialysis unit having 100 cells is to be used to partially demineralize 100,000 l/day of water from a casein plant. The salt content is 4000 mg/l and the cation and anion content is 0.066 g equivalent weights per litre. Pilot scale studies using a multicellular stack have been made. It was found that the current efficiency was 0.9, the efficiency of salt removal was 0.5, the resistance was 4.5 ohms, and the current density/normality ratio was 500.

   Determine :

   (i)   The current I required.

   (ii) The area of the membrane, and

   (iii) The power requirement.   14

6 Design and develop membrane module for AIR and WATER pollution control for your choice of industrial unit and elaborate the analytical techniques to validate the same.   13

7. Discuss the membrane bio-reactor and pre evaporation techniques applied in alcohol concentration. How does the membrane's chemistry affects the performance ?   13

8. Describe osmosis and osmotic pressure for the semipermeable membrane. Calculate the osmotic pressure of an aqueous solution containing 2 gm of a protein (M2 = 69,000 g/mole) per 100 ml at 27° C in centimeters of mercury and in centimeters of water, taking density of solution as 1 gm/cm² and 1 atms 1013250 dynes/cm².   13

9. Describe the membrane fouling and compaction for a liquid membrane, containing dilute solute (A) with neat sketch for the flux and the concentration at the membrane's interfaces. 13

10. Discuss the different parameters required to be considered for various membrane modules design with suitable examples of your choice. 13