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GANDHI INSTITUTE OF ENGINEERING AND TECHNOLOGY UNIVERSITY, ODISHA, GUNUPUR

(GIET UNIVERSITY)

M.Tech. (First Semester) Regular Examinations, February – 2025

24MCHPC11002– Advanced Separation Processes

(Chemical)

Time: 3 hrs Maximum: 60 Marks

Answer ALL questions

(The figures in the right hand margin indicate marks)

PART – A **(2 x 5 = 10 Marks)**

Q.1. Answer ***ALL*** questions

		CO #	Blooms Level
a.	Define Membrane Casting. Write the common polymeric membrane materials is used for the casting process.	CO1	K1
b.	Differentiate between Homogeneous barrier and Micro porous Barrier.	CO2	K2
c.	List the different types of motion of molecules through barrier.	CO2	K1
d.	Write the transport mechanism, Pressure, Pore size, Molecular weight is maintained for Small solute particles to be separated by Reverse Osmosis.	CO1	K2
e.	Write the transport mechanism, Pressure, Pore size, Molecular weight is maintained for Red blood cells to be separated by Ultrafiltartion.	CO2	K1

PART – B **(10 x 5=50 Marks)**

Answer ***ALL*** the questions

		Marks	CO #	Blooms Level
2. a.	Explain the contribution of various steps to the overall preparation of composite membranes.	5	CO1	K2
b.	How to modify the membrane surface, aimed at prevention of contaminant deposition and maintenance of high flux?	5	CO2	K2
	(OR)			
c.	Explain the critical parameters affecting each stage of composite membrane preparation.	5	CO2	K3
d.	Enumerate about the detail steps for Phase Inversion Technique for Preparation of Integrally Skinned Asymmetric Membranes.	5	CO1	K2
3.a.	How do the two primary geometries influence the structure and function of synthetic membranes?	5	CO2	K2
b.	Enumerate the description of transport process by phenomenological equation.	5	CO3	K2
	(OR)			
c.	What are the key differences and interrelations between the various driving forces in species transport?	4	CO3	K4
d.	Describe the working mechanism, design and characteristics of (i) plate and frame module, (ii) hollow fiber module, (iii) spiral wound and (iv) tubular Modules in order to provide maximum membrane area in relatively smaller volume to get maximum permeate flux.	6	CO2	K2
4.a.	Design the solution diffusion model for RO/NF where the solute flux through the membrane is considered in realistic situation.	4	CO3	K4
b.	Demonstrate the Modified solution diffusion model for RO/NF.	6	CO4	K5

(OR)

c.	Design the Kedem-Katchalsky equation for Ultra Filtration in case of imperfect retention of the solutes by the membrane by a reflection coefficient.	5	CO4	K4
d.	Demonstrate the Modified solution diffusion model for Ultra Filtration.	5	CO3	K5
5.a.	Consider separation of 10kg/m3 concentration of a protein solution using ultra filtration. Filtration is gel layer controlled, with gel concentration 300 kg/m^3. Filtration takes place in a thin channel with equivalent diameter 2 mm and width 4 cm. The cross flow velocity is 0.5 m/s and protein diffusivity is 2×10^{-11} m^2/s. If the filtrate rate is 100 L/day, find the length required of the membrane module. Use the following correlations to estimate mass transfer coefficient: $Sh = 1.86 \left(Re\ Sc\ \frac{d_e}{L} \right)^{\frac{1}{3}}$ for laminar flow	6	CO4	K4
b.	Explain the fundamental principles of nanofiltration, including the role of membrane structure and selective permeability.	4	CO3	K1
	(OR)			
c.	Water is flowing through a rectangular channel of half height 1 mm and width 8 cm. The inlet flow rate is 40 L/h. Inlet transmembrane pressure of 500 kPa results in a constant permeate flux of 2×10^{-5} $m^3/m^2 \cdot s$. The length of the channel is 2m. (a) Find the axial pressure drop across the module. (b) What is the transmembrane pressure drop at the module exit? (c) Find out the fractional recovery of the feed. (d) What is the flow rate at the channel exit? (e) For a fractional recovery of 0.92 what is the length of the module is required? What is the axial pressure drop and flow rate at the module exit?	10	CO3	K4
6.a.	In a steady state, counter current dialyzer of rectangular cross section, urea is removed by pure water as dialysate. Inlet feed concentration is 1500 mg/L. Feed and dialysate flow rates are 18 L/h and 90 L/h, respectively. D_{Urea} in the membrane is 10^{-12} m^2/s and in the bulk is 10^{-10} m^2/s. membrane thickness is 1 micron. Feed and dialysate chambers are identical in shape. Width of each channel is 5 mm and height 5 mm. In the feed side, the urea concentration has to be reduced from 1500 (inlet) to 300 mg/L (outlet). Find the membrane area required. Neglect mass transfer resistances on both sides.	6	CO4	K4
b.	Discuss recent advancements in membrane technology for pervaporation and predict potential future applications in emerging industries	4	CO2	K2
	(OR)			
c.	Explain the principle of pervaporation and describe how it differs from other membrane separation processes.	5	CO3	K1
d.	Identify the key factors affecting the efficiency of pervaporation, such as membrane selectivity and feed temperature. Analyze how each factor influences the separation performance.	5	CO3	K3

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