BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

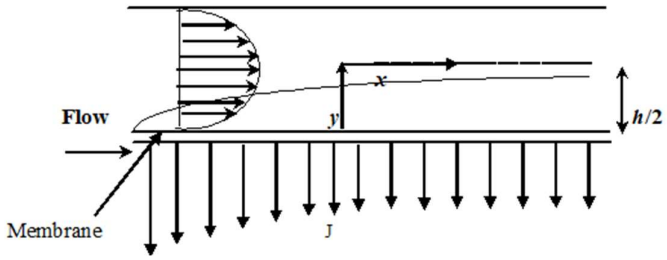
CLASS: BTECH **SEMESTER : VI**
BRANCH: CHEMICAL ENGINEERING **SESSION : SP/2025**

SUBJECT: CL359 MEMBRANE SCIENCE AND TECHNOLOGY

TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

			CO	BL
Q.1	A mass transfer boundary layer is growing on a membrane surface, a laminar fully developed flow is happening through the membrane channel as given in the following figure, taking	[10]		4



Expression of the velocity profile is given as $u(y) = \frac{3}{2}u_0\left[1 - \left(\frac{y-h}{h}\right)^2\right]$; where, $u(y)$ is the x directional velocity; h is the half height of the channel; u_0 is the centerline velocity. The CD equation of mass transport within the mass transfer boundary layer is given as

$$u\frac{\partial c}{\partial x} + J\frac{\partial c}{\partial y} = D\frac{\partial^2 c}{\partial y^2}$$

Where *D* is the solute diffusivity and *v* the *y* directional velocity. *With proper assumptions and boundary conditions* derive an expression of concentration profile within the membrane channel (take $\delta(x)$as the thickness of the mass transfer boundary layer .

Q.2(a)	How flat sheet polymeric membranes are fabricated; depict step by step	[5]		1
Q.2(b)	Define the following terms (a) active; (b) passive and (c) facilitated transport	[5]		1
Q.3	A Macromolecular solution of diffusivity D=6x10^{-11} m^2/s flows through a rectangular channel of length 1m, width 5cm, half height 1mm at a flow rate of 40L/h and transmembrane pressure drop 500kPa. Permeability of the membrane is 2.5x10^{-11} N.s/m^3. The feed concentration of the membrane is 10 kg/m^3 and real retention Rr=1.0. Membrane is placed at the bottom only. Π=1.5x10^{4}C, Π is in Pa and C in kg/m^3. Calculate the value of mass transfer coefficient	[15]		4
Q.4	Write with a proper diagram, different flow schemes in gas separation membrane modules	[10]		2
Q.5	Explain with a neat diagram the central idea behind dialysis	[5]		1

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