Seat No.: ________   *Enrolment No.*___________

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – I • EXAMINATION – WINTER • 2014

Subject code: 2713011   **Date: 12-01-2015**

Subject Name: Membrane Separation Processes

Time: 02:30 pm - 05:00 pm   **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	State various methods of manufacturing of polymeric membranes and discuss any one in details.	**07**
	(b)	For practical applications membranes are installed in a suitable device, which is referred to as membrane module. Discuss various membrane modules compare their characteristics, advantages and disadvantages, if any, with schematic.	**07**
Q.2	**(a)**	Discuss Kedem-Katchalsky and Solution-diffusion models of solute transport in reverse osmosis.	**07**
	(b)	Explain concentration polarization with a schematic diagram. How can the effect of concentration polarization be reduced in pressure driven membrane processes?	**07**
		OR	
	(b)	Discuss the effect of various parameters on the performance of nanofiltration process. State few industrial applications of nanofiltration	**07**
Q.3	**(a)**	Write a short note on any one of the following: (i) Micellear enhanced ultrafiltration (ii) Affinity Ultrafiltration	**07**
	(b)	Discuss fundamental mechanisms of gas transport with special mention of dual sorption model.	**07**
		OR	
Q.3	**(a)**	Derive the design equation for the separation of binary gas mixture using a complete mixing model. State the assumptions clearly.	**07**
	(b)	A well mixed membrane permeator has 20% CO_2 (A) and 80% CH_4 (B) at a total pressure of 12.5 atm. The permeate side is continuously flushed with pure CH_4 at 1.5 atm so that the CO_2 concentration in it is virtually zero. A 300 μm thick PDMS film is used as the membrane. The following data are given: the ideal separation factor = 3.15, Permeability of CO_2 in PDMS at given conditions P'_A = 4570 barrer, solubility coefficient of CH_4 in PDMS S_B = 0.0059 cm^3 (STP)/cm^3 (polymer)-mm. Hg. Calculate the flux of CO_2 and of CH4 through the film and the permeance of CO_2 in PDMS.	**07**

Q.4 **(a)** State the basic principle of pervaporation. Discuss critically the phenomenon of temperature-drop at the membrane surface during pervaporation. **14**

State various industrial applications of pervaporation and discuss any one application with a schematic diagram.

OR

(b) Derive various mass transfer resistances in a dialysis process with a schematic diagram. **14**

A dialysis process is being designed to recover a certain solute from a dilute solution having solute concentration 2.0×10^{-2} kg mol/m^3 through a membrane to a solution having solute concentration 0.3×10^{-2} kg mol/m^3. The membrane is 1.59×10^{-5} m thick. The distribution coefficient is 0.75; diffusivity of solute through membrane is 3.5×10^{-11} m^2/s. The mass transfer coefficients in the upstream and downstream are 3.5×10^{-5} m/s and 2.1×10^{-5} m/s respectively. Calculate

(i) The individual resistances, total resistance and the total percent resistance of the two films.

(ii) The flux at steady state and the total area in m^2 for a transfer of 0.01 kg mol solute/h.

Q.5 **(a)** Explain the working principles of various types of liquid membranes with schematic diagrams. **07**

(b) What are the applications of liquid membrane technology? **07**

OR

Q.5 **(a)** Discuss briefly the mechanism of facilitated transport in membranes. **07**

(b) State some of the potential applications of facilitated transport. **07**

****