Paper Code: ECH-051 **Roll No.** | | | | | | | | | | |

B.Tech.
(SEM VIII) EVEN SEMESTER EXAMINATION, 2015-16
ADVANCE SEPARATION TECHNOLOGY

[Time: 3 hrs.] **[Max. Marks: 100]**

Note: - Attempt all questions. Any data if missing may be assumed.

1. Attempt any four parts of the following:- **[5x4=20]**
   (a) Discuss the factors influencing the separation process.
   (b) Give classification of synthetic membrane. Explain every type in brief.
   (c) Discuss the characteristics of membrane processes?
   (d) Write the approaches to decrease Energy consumption in separation processes.
   (e) Why the membranes separation process is used in single stage only?
   (f) Write the classification of multistage separation processes.

2. Attempt any four parts of the followings:- **[5x4=20]**
   (a) Describe the cascade arrangement for membrane processing.
   (b) Give the advantages of cascade management.
   (c) Discuss the 'Squared off cascades'.
   (d) On which principle does the reverse osmosis work? Give the advantages and disadvantage of reverse osmosis.
   (e) What is membrane module? Explain different types of module with diagram
   (f) What is membrane? Differentiate between equilibrium and rate governed separation processes with a suitable example.

3. Attempt any two parts of the followings: - **[10x2=20]**
   (a) Describe the diffusion type model membrane processes with complete equations.
   (b) In a cross flow ultra filtration unit, a protein of molecular weight $3x10^5$ Da is separated from the fermentation broth by using a UF membrane. The flow rate of a liquid through a tube of diameter 2 cm and length 50 cm is 2 l/min. The flow regime is turbulent, f= 0.0005, and C_4=2[atm (s/cm]^2). The inlet pressure is Pi= 2atm. Protein concentration in the solution and on gel is 30 mg/l and 100 mg/l respectively.
      (i) Determine the exit pressure (P_0)
      (ii) Determine the trans membrane pressure drop(ΔPm)
      (iii) If the mass transfer coefficient (k) for Protein flux is 5cm/s, determine the flux of liquid through UF membrane.
   (c) A solution containing 0.9 wt% protein is undergoes ultafiltration using a pressure of 5 psi. The membrane permeability is A_w=$1.37x10^{-2}$ kg/s.M^2 atm. Calculate the flux for ultrafiltration process. Assuming no effect of polarization.

4. Attempt any two parts of the following: - **[10x2=20]**
   (a) A 75 μm thick polysulphone micro porous membrane has an average porosity of 0.35. Pure water flux through the membrane is 25 m^3/m^2 h at a pressure drop of 1.2 bar at 25^0 C. The average pore size is estimated to be 1 μm. Calculate the tortuosity factor of the pores, the resistance to flow offered by the membrane and its water permeability. The viscosity of water at 25^0C is 0.9cp.
   (b) Describe the electrodialysis with its advantages and disadvantages.
   (c) Give the various advantages and their limitations of membrane separation processes. Also discuss the applications of membrane separation.

5. Attempt any two parts of the following: - **[10x2=20]**
   (a) Write short notes on the following:
      (i) Liquid chromatography
      (ii) Gas chromatography
      (iii) Paper chromatography
      (iv) Thin-Layer chromatography
   (b) Describe the phenomena of Molecular Seive separations with suitable example.
   (c) A reverse osmosis membrane to be used at 25^0C for a NaCl feed solution containing 2.5 g NaCl/L (2.5 kg NaCl/M^3, P=999kg/m^3) has a water permeability constant A_w=$4.81x10^{-4}$ kg/s.M^2 atm and a solute (NaCl) permeability constant A_s=$4.42x10^{-7}$ M/s(Al). Calculate the water flux and solute flux through the membrane using ΔP=27.20 atm and solute rejection R. Also calculate C_2 of product solution.