

**M.E. CHEMICAL ENGINEERING
FIRST YEAR FIRST SEMESTER EXAM 2025**

MEMBRANE SCIENCE & ENGINEERING

Time 3hr

Full Marks 100

Answer question no. 1 and any four from the rest

All symbols have their usual meaning

Assume any missing Data

1. a) Write the distinguishing features of membrane separation process and filtration process
b) Write down the distinctive features of isotropic and anisotropic membrane.
c) Write down application of gas separation membrane.
d) Mention characteristic features of affinity ultrafiltration.
e) Mention selection criteria for a membrane for fruit juice clarification.

4×5=20
2. a) How does size of membrane pore affects its selection for a particular separation process? Explain with appropriate example.

b) What are the main applications of the ultrafiltration process? Which model predicts the permeate flux behavior of ultrafiltration process.

10+10 = 20
3. a) Explain the factors controlling the rejection profile of membrane separation process.

c) Mention in brief about experimental procedure to determine pore diameter, porosity and pore density of a synthesized membrane.

10+10= 20
4. a) Briefly mention the steps of membrane sheet casting from its precursor material.
b) Write a comparative note on cellulose acetate and polyether sulfone membrane.
c) A membrane with a surface area of 0.55 m² produces a permeate flow rate of 0.25 L/min. Calculate the permeate flux.

8+8+4=20
5. a) Calculate the percentage recovery of a 5% protein feed solution with permeate flow rate of 5.5 l/s. The feed flow rate was maintained at 15.3 l/s.
b) Explain the term concentration polarization and gel layer. Explain in brief about the effect of concentration polarization and gel layer formation on membrane permeate flux.

8+12=20
6. a) Write a comparative note on tubular membrane module and spiral-wound membrane module.
b) A feed solution of whey protein is to be concentrated from 0.05 (M) to 0.5 (M) by UF at 25°C. The solute rejection is 90%. If the upstream pressure is 5 atm (gauge) and

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Ref. No.: Ex/PG/CHE/PE/T/114B/2025

downstream pressure is atmospheric, find out the effective pressure driving force at the start and at the end of the operation. Calculate % reduction of solvent flux at the end of the operation. Take necessary assumptions if any. .

10+10=20

7. a) A feed with bovin serum protein is being purified in a cross flow UF. The liquid phase mass transfer coefficient at the membrane surface is estimated to be 5.0×10^{-5} cm/sec. The bulk concentration of solute is 0.55 mass%. If the solvent water flux across the membrane is $0.35 \text{ m}^3/\text{m}^2 \cdot \text{h}$, calculate Polarisation modulus and concentration of the enzyme in the liquid at the membrane surface.

The membrane has a distribution of pore size and solute rejection is 95%. If the diffusivity of enzyme is $6.7 \times 10^{-7} \text{ cm}^2/\text{sec}$, calculate the film thickness.

- b) Explain the performance of cross flow membrane module and dead end membrane module.

10+10= 20