

**SPECIAL SUPPLE B.TECH/CHE/7<sup>TH</sup> SEM/CHEN 4143/2018**

**ADVANCED SEPARATION PROCESS  
(CHEN 4143)**

**Time Allotted : 3 hrs**

**Full Marks : 70**

*Figures out of the right margin indicate full marks.*

*Candidates are required to answer Group A and  
any 5 (five) from Group B to E, taking at least one from each group.*

*Candidates are required to give answer in their own words as far as practicable.*

**Group - A  
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) The pore size of RO membrane is  
(a) 1-10<sup>0</sup>A (b) 10-100<sup>0</sup>A  
(c) 10-1000<sup>0</sup>A (d) > 1000<sup>0</sup>A.
- (ii) The required pressure difference for ultrafiltration is  
(a) 1-10 bar (b) 10-35 bar  
(c) 10-70 bar (d) 35-70 bar.
- (iii) In membrane distillation the membrane pore size is of \_\_\_\_\_ range.  
(a) ultrafiltration (b) microfiltration  
(c) nanofiltration (d) both (a) and (b).
- (iv) Electrodialysis might be an alternative to  
(a) ultrafiltration (b) microfiltration  
(c) nanofiltration (d) reverse osmosis.
- (v) The temperature difference between the hot feed and cold sweep in direct contact membrane distillation for desalination operation should be equal to or more than  
(a) 2 K (b) 3 K (c) 2.5 K (d) 6 K.
- (vi) Surfactant molecules are of \_\_\_\_\_ nature.  
(a) amphiphilic (b) hydrophilic  
(c) lipophilic (d) isotropic.
- (vii) \_\_\_\_\_ with increasing surfactant concentration.  
(a) Micellization is less likely (b) Surface tension increases  
(c) Surface viscosity is unaffected (d) Surface tension decreases.

- (viii) According to the rate theory in chromatography the non-equilibrium parameter tells us that the ratio between solute concentration at stationary phase and mobile phase at the trailing edge of the column will be \_\_\_\_\_ the equilibrium constant  
 (a) more than (b) equal to  
 (c) less than (d) either (a) or (b).
- (ix) In Gouy-Chapman double layer the \_\_\_\_\_ ions are populated.  
 (a) co (b) counter  
 (c) neutral (d) both (a) and (b)
- (x) If pH is \_\_\_\_\_ pI, the protein becomes positively charged  
 (a) more than (b) less than  
 (c) either (a) or (b) (d) equal to.

### Group - B

2. (a) "Molecular weight cut off (MWCO) of a selected nanofiltration membrane is 1 kDa." – Is it possible to specify a nanofiltration membrane with MWCO? If yes, what is meant by the statement regarding separation of the solutes? Write down two applications of nanofiltration processes along with the specification of the membrane.
- (b) A macromolecular solution (mol.wt. = 6000; concentration 1.2 wt %) is passed through a tubular UF membrane of 1 cm internal diameter and 1 m long at 28°C. Pure water permeability of  $1.46 \times 10^{-5} \text{ m}^3/\text{m}^2 \cdot \text{s} \cdot \text{atm}$  is obtained using this membrane. Calculate the flow velocity to be maintained in the tube in order to prevent formation of a gel layer on the membrane surface.  
 [Data given: Rejection coefficient = 0.98; Applied Pressure difference = 1.5 bar; Diffusivity of solute, =  $8 \times 10^{-7} \text{ cm}^2/\text{s}$ ; Viscosity of the solution = 3 cp; Concentration at which the solute forms a gel,  $C_g = 10.5\%$ . Pore blockage and fouling may be ignored].
- (1 + 2 + 4) + 5 = 12**
3. (a) What do you understand by composite membrane? Give example.
- (b) Write down the causes of flux decline in case of pressure driven membrane processes. What are the advantages and disadvantages of membrane separation technology over conventional separation processes?
- (c) Discuss one of the manufacturing processes for symmetric microporous membrane.
- 2 + (3 + 4) + 3 = 12**

**Group – C**

4. (a) “Pervaporation can be used along with the distillation unit to achieve 99% of ethanol from ethanol-water mixture” – Justify the correctness of the statement along with a flow-diagram of a yeast fermentation process.
- (b) Estimate membrane area and electrical-energy requirements for an electrodialysis process to reduce the salt (NaCl) content of 24,000m<sup>3</sup>/day of brackish water from 1,500 mg/L to 300 mg/L with a 50% conversion. Assume each membrane has a surface area of 0.5 m<sup>2</sup> and each stack contains 300 cell pairs. A reasonable current density is 5 mA/cm<sup>2</sup> and the current efficiency is 0.8 (80%).

**5 + 7 = 12**

5. (a) Show that for a column chromatography the average linear rate of solute migration ( $u_s$ ) is given by the product of average linear rate of solvent migration ( $u$ ) and fraction of the solute in the mobile phase at a particular retention time.
- (b) Show that for a column chromatography the number of transfer units  $(N) = 16 \left( \frac{t_R}{W} \right)^2$ , where  $t_R$  is the retention time and  $W$  the base width of the peak.

**6 + 6 = 12****Group – D**

6. (a) What are the Kopp’s guidelines for emulsion liquid membrane preparation?
- (b) What are the properties of support and organic solvent in case with the supported liquid membrane?
7. (a) What is aggregation number during micellization? How does it change with addition of electrolytes in micellized system?
- (b) What is meant by HLB? In a mixed surfactant system 35% (w/v) of surfactant A (HLB = 11) is mixed with 65% (w/v) of surfactant B (HLB = 3). What is the combined HLB of the surfactant system? Comment on the type of the emulsion formed with this surfactant system.

**6 + (3 + 3) = 12****(2 + 3) + (2 + 2 + 3) = 12**

**Group - E**

8. (a) What is the purpose of adding glycine in running buffer during SDS PAGE electrophoresis? At pH 8.3 is how the charge on glycine is affected? The second acid dissociation constant for this amino acid is 9.6.
- (b) The relative mobility values of a 30-kDa and a 92-kDa protein during SDS polyacrylamide gel electrophoresis are 0.80 and 0.41, respectively. What is the molecular mass of a protein that has a relative mobility of 0.62 in this gel?

**(3 + 4) + 5 = 12**

9. (a) A drop of a solution containing a mixture of glycine (pKa's = 2.34 and 9.6), alanine (pKa's = 2.34 and 9.69), glutamic acid (pKa's = 2.19, 9.67 and 4.25), lysine (pKa's = 2.18, 8.95 and 10.53) and histidine (pKa's = 1.82, 9.17 and 6.0) was placed in the center of a paper strip and dried. The paper was moistened with a buffer of pH 6.0 and an electric current was applied to the ends of the strip. What should be the profile of separation of these amino acids after applying the electric field?
- (b) What are the amounts of bisacrylamide and acrylamide must be given in 1 L of the solution to prepare a gel cast of 40%T and 3%C, if 100 ml of the solution contains 40 gm of bisacrylamide and acrylamide?

**7 + 5 = 12**