

**BIOSEPARATION TECHNOLOGY
(BTC3202)**

Time Allotted : 2½ hrs

Full Marks : 60

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 4 (four) from Group B to E, taking one from each group.*

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

Group – A

1. Answer any twelve:

12 × 1 = 12

Choose the correct alternative for the following

- (i) Ruth equation is used to describe
 - (a) Heat flow by conduction
 - (b) Heat flow by radiation
 - (c) Constant pressure filtration
 - (d) Setting of solids
- (ii) The following is/are observed in a membrane separation unit operation:
 - (a) Concentration polarization
 - (b) Back diffusion
 - (c) Solute rejection
 - (d) All of these
- (iii) Two most important properties of membranes for industrial separations are
 - (a) selectivity and permeability
 - (b) selectivity and volatility
 - (c) permeability and strength
 - (d) permeability and productivity
- (iv) An example of a membrane separation process is
 - (a) Absorption
 - (b) Reverse osmosis
 - (c) Diffusion
 - (d) Adsorption
- (v) An application of reverse osmosis is _____
 - (a) Desalination of water
 - (b) Dilution of concentrated solution
 - (c) Melting
 - (d) Formation of cell pellets
- (vi) Protein separation technique is often based on except
 - (a) charge of protein
 - (b) solubility of protein
 - (c) viscosity of protein
 - (d) specific binding affinity of protein
- (vii) In chromatography, the stationary phase can be _____ supported on a solid
 - (a) Solid or liquid
 - (b) Liquid or gas
 - (c) Solid only
 - (d) Liquid only
- (viii) Which of the following parameters does not influence the likelihood of protein crystallization?
 - (a) Concentration of protein
 - (b) Temperature
 - (c) viscosity
 - (d) Volume of sample

- (ix) Which of the following is the distance that the solute moves while undergoing one partition?
 (a) Retention distance (b) Distribution constant
 (c) Plate height (d) Column packing length
- (x) Which of the following is not true about High pressure liquid chromatography (HPLC)?
 (a) It requires high pressure for the separation of the species
 (b) There is no need to vaporise the samples
 (c) It is performed in columns
 (d) It has high sensitivity

Fill in the blanks with the correct word

- (xi) In Thin layer chromatography, the stationary phase is made of _____.
- (xii) In the case of anion exchange chromatography, what will be the charge of the column wall? _____
- (xiii) An example of a membrane separation process is _____.
- (xiv) The final unit operation in separation and purification of intracellular enzymes is _____.
- (xv) The charge equilibrium in dialysis is _____.

Group - B

2. (a) Write a note on non-mechanical methods of cell disruption mentioning its advantages and disadvantages. [[C02](Remember/LOCQ)]
 (b) Derive Ruth's equation for constant pressure filtration. [[C02](Remember/LOCQ)]
6 + 6 = 12
3. (a) What do you understand by downstream processing? [[C01](Comprehend/LOCQ)]
 (b) Write a note on how can cell be disrupted by different mechanical methods and their usefulness. [[C01](Remember/LOCQ)]
4 + 8 = 12

Group - C

4. (a) Penicillin is extracted from a fermentation broth using isoamylacetate as the organic solvent in a continuous counter current cascade extraction unit. The flow rates of organic (L) and aqueous (H) phases are $L=10\text{L/min}$ and $H=100\text{L/min}$ respectively. The distribution coefficient of penicillin between organic and aqueous phases at $\text{pH}=3$ is $K_D=Y_L/X_H=50$. If the penicillin concentration in the feed stream is 20g/L , determine the number of stages required to reduce the penicillin concentration to 0.1g/L in the effluent of the extraction unit. [[C03](Calculate/HOCQ)]

(b) What are the different factors affecting the selection of a membrane?

[[CO3](Remember/LOCQ)]

8 + 4 = 12

5. In a cross flow ultra filtration system used for filtration of proteins from a fermentation broth, gel resistance increases with protein concentration according to the following equation: $R_G = 0.5 + 0.01C$, where C is in mg/L. Pressure at the entrance system is $P_i = 6 \text{ atm}$ and at the exit is $P_0 = 2 \text{ atm}$. The shell side of the filter is open to the atmosphere, resulting in $P_f = 1 \text{ atm}$. The membrane resistance is $R_M = 0.5 \text{ atm}/(\text{mg}/\text{m}^2 \cdot \text{h})$, and the protein concentration in the broth is $C = 100 \text{ mg}/\text{L}$. Determine : i) The pressure drop across the membrane, ii) the filtration flux and iii) Rejection coefficient of the membrane for effluent protein concentration of $C_i = 5 \text{ mg}/\text{L}$.

[[CO3](Analyse/HOCQ)]

(4 + 4 + 4) = 12

Group - D

6. (a) Describe the principle of affinity chromatography. [[CO5](Analyse/IOCQ)]
(b) Two proteins of molecular weight 2.5×10^5 and 1×10^4 are eluted out of a gel filtration column at 220 ml and 300 ml respectively. Determine the molecular weight of protein which elutes out at 270 ml from the column under the same condition. [[CO4](Compute/HOCQ)]

6 + 6 = 12

7. (a) Describe the principle of paper chromatography. What is R_f factor? [[CO3](Understand/LOCQ)]
(b) Describe the principle of Gel filtration. [[CO5](Explain/IOCQ)]

6 + 6 = 12

Group - E

8. (a) Describe the principle behind HPLC. [[CO3](Analyse/HOCQ)]
(b) Define 'equilibrium moisture'. [[CO6](Remember/LOCQ)]
(c) Describe the drying curve of a food material under constant drying condition. [[CO6](Analyse/HOCQ)]

6 + 2 + 4 = 12

9. A solution of KNO_3 at 80°C contains 40% salt by weight. You have 500 kg of this solution. It is cooled to 20°C . During the cooling process, 5% of the total water present in the initial solution evaporates.

Calculate:

- (i) The weight of KNO_3 crystals obtained.
(ii) The percentage yield of the crystallization process

Given Solubilities:

At 80°C : 169 Kg KNO_3 /100 kg of water

At 20°C : 32 Kg KNO_3 /100 kg of water

[[CO6](Compute/HOCQ)]

(6 + 6) = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	37.5	12.5	50