# BIOSEPARATION TECHNOLOGY
## (BIOT 3234)

**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) Rate of filtration depends on
(a) Pressure drop
(b) Viscosity of filtrate
(c) Cake resistance
(d) All the above

(ii) Performance of a centrifuge is measured by
(a) Sigma factor
(b) Effectiveness factor
(c) Thiele Modulus
(d) None of the above

(iii) Reflection coefficient of a membrane separation process should be
(a) Less than 100
(b)Greater than 1
(c) Between 0 and 1
(d) None of the above

(iv) What is an ideal fluid?
(a) A fluid which has no viscosity
(b) A fluid which is incompressible
(c) A fluid which has no surface tension
(d) All of the above

(v) Which of the following is a pressure driven membrane separation process
(a) Dialysis
(b) Electrodialysis
(c) Osmosis
(d) Reverse osmosis

(vi) Which chromatographic technique depends on the highly specific interaction between pairs of biological molecules such as enzyme-substrate
(a) adsorption chromatography
(b) ion exchange chromatography
(c) affinity chromatography
(d) gel permeation chromatography

(vii) What happens during the 'elution from the column' phase in chromatography?
(a) Components with greatest affinity elute first
(b) Components with least affinity elute first
(c) Components elute in a random manner
(d) Components elute according to their concentration in the mixture

(viii) Salting out process involves
(a) precipitation of protein using ammonium sulphate
(b) precipitation of protein using copper sulphate
(c) precipitation of protein using sodium chloride
(d) none of these

(ix) Which of the following is not used to promote the formation of proteins crystals?
(a) PEG
(b) Ammonium sulfate
(c) Tris-HCL
(d) Ammonium nitrate

(x) Which of the following is not true about High pressure liquid chromatography (HPLC)?
(a) It requires high pressure for the separation of the specious
(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) To isolate insulin receptor, _____ can be used as a ligand molecule in an affinity chromatography.

(xii) One of the agent applicable for the precipitation of biological macromolecules is_____.

(xiii) The most important application of reverse osmosis is _____.

(xiv) The final unit operation in separation and purification of intracellular enzymes is _____.

(xv) In liquid-liquid extraction the heavy phase is the _____

## Group - B

2. (a) Yeast cells are recovered from a fermentation broth by using a tubular centrifuge. Sixty percent of the cells are recovered at a flow rate of 12l/min with a rotational speed of 4000rpm. Recovery is inversely proportional to flow rate.

(i) To increase the recovery of the cells to 95% at the same flow rate, what should be the rpm of the centrifuge?

(ii) At a constant rpm of 4000rpm, what should be the flow rate to result in 95% cell recoveryCompare the role of centralized control in traditional and distributed databases. *[(CO2)(Analyse/HOCQ)]*

(b) Derive Ruth's equation for constant pressure filtration. *[(CO2)(Remember/LOCQ)]*

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

3. (a) Illustrate the downstream processing of an extracellular enzyme in a chart form. *[(CO1)(Apply/IOCQ)]*

(b) Define the following terms: osmotic shock, centrifugation, reverse osmosis. *[(CO2)(Remember/LOCQ)]*

**6 + 6 = 12**

## Group - C

4. (a) Streptomycin is extracted from the fermentation broth using an organic solvent in a counter current staged extraction unit. The distribution coefficient of streptomycinat pH 4 is $K_D = Y_i/X_i = 40$, and the flow rate of the aqueous phase (H) is H=150L/min. If only 5 extraction units are available to reduce the streptomycin concentration from10g/L in the aqueous phase to 0.2g/L, determine the required flow rateof the organic phase(L) in the extraction unit. *[(CO3)(Analyse/HOCQ)]*

(b) Define dialysis. What is concentration polarization? *[(CO4)(Remember/LOCQ)]*

**8 + (2 + 2) = 12**

5. (a) In a cross flow ultra filtration system for separation of protein from the fermentation broth, the flow rate of liquid through a tube of diameter d=2cm and length L= 50cm is Q= 2L/min. The flow regime is turbulent, f=0.0005, and $C_4 = 2[atm(s/cm)^2]$. The inlet pressure is $P_i = 2$ atm. Protein concentration in the solution and on gel film are $C_B = 30mg/L$ and $C_G = 100$ mg/L, respectively. Determine

(i) The transmembrane pressure drop.

(ii) If the mass transfer coefficient (k) for protein flux is k= 5cm/s, determine the flux of liquid through the UF membrane. *[(CO3)(Analyse/HOCQ)]*

(b) What is Reverse osmosis? *[(CO3)(Remember/LOCQ)]*

**(5 + 5) + 2 = 12**

## Group - D

6. (a) State the principle of HIC chromatography. *[(CO4)(Remember/HOCQ)]*

(b) Define the following with respect to chromatography : (i) stationary phase (ii) mobile phase (iii) retention time. *[(CO4)(Remember/LOCQ)]*

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

7. (a) State the principle of partition chromatography. What is meant by 'distribution coefficient'? *[(CO5)(Analyse/IOCQ)]*

(b) Explain the common methods for elution of bound protein from an ion exchange chromatography. *[(CO5)(Analyse/IOCQ)]*

**6 + 6 = 12**

## Group - E

8. (a) Explain the principle behind salting out of protein. *[(CO3)(Analyse/HOCQ)]*

(b) How does the removal hydration shell of protein is needed for protein precipitation? Why addition of methanol might cause protein precipitation? *[(CO4)(Remember/LOCQ)]*

**6 + 6 = 12**

9. (a) Explain the principle behind isoelectric precipitation of protein. *[(CO5)(Analyse/HOCQ)]*

(b) Describe the drying curve of a food material under constant drying condition. *[(CO6)(Analyse/HOCQ)]*

(c) Define 'free moisture'. *[(CO6)(Remember/LOCQ)]*

**6 + 4 + 2 = 12**

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| Cognition Level | LOCQ | IOCQ | HOCQ |
|---|---|---|---|
| Percentage distribution | 33.33 | 18.75 | 47.92 |