Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech (BT-NEW)/SEM-6/BT-602/2010

2010

BIOSEPARATION TECHNOLOGY

Time Allotted : 3 Hours Full Marks : 70

The figures in the margin indicate full marks.

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

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

   i) Non-mechanical methods of cell disruption include

      a) Osmotic shock

      b) Homogenizer

      c) Ball Mill

      d) None of these.

   ii) Micro filtration (μF) remove particulate material ranging from size

      a) Microns

      b) < 0·001 microns

      c) < 0·01 microns

      d) < 0·0001 microns.

iii) Electrophoresis is used for the separation of

a) Charged biomolecules

b) Neutral biomolecules

c) Organic molecules

d) Inorganic molecules.

iv) Liquid-liquid extraction depends on

a) Distribution coefficient

b) Volatility

c) Solubility

d) Partition coefficient.

v) In gel filtration chromatographic separation, biomolecules are separated based on what property of biomecules ?

a) Size

b) Charge

c) Hydrophobic interaction

d) Metal ion affinity.

vi) Molecular weight of a protein can be determined by

a) Size exclusion chromatography

b) Ion exchange chromatography

c) Pseudo-affinity chromatography

d) Affinity chromatography.

vii) Basic principle of centrifugation depends on

a) Concentration b) Polarization

c) Centripetal force d) Pressure gradient.

viii) In reverse osmosis the deposition of solute molecules on membrane surface results in large resistance for solvent flow. This phenomenon is known as

a) Reflection coefficient

b) Rejection coefficient

c) Break through point

d) Concentration polarization.

ix) Cell disruption homogenizer is based on

a) Applied voltage

b) Operation pressure

c) Salt concentration

d) Osmosis.

x) Dialysis is a membrane operation used for the removal of low molecular weight solutes such as organic ions of mol. wt. range (MW)

a) $10 < MW < 100$ b) $MW > 10$

c) $MW < 10$ d) $MW > 100$.

xi) Which method is commonly used to separate inhibitory fermentation product such as ethanol from fermentation broth ?

a) Aqueous two phase extraction

b) Liquid-liquid extraction

c) Adsorption

d) Ultrafiltration.

xii) Chromatofocusing depends on which one of the following properties of a protein ?

a) Molecular weight of protein

b) Hydrophobic residues of the protein

c) Isoelectric point of the protein

d) Affinity to the resin.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. What are the characteristic features of solvent precipitation and isoelectric precipitation ? 5

3. Discuss non-mechanical methods of cell disruption. 5

4. Briefly comment on aqueous two phase extraction process used for the separation of biomolecules. 5

5. What are the primary uses of reverse osmosis ? Give examples of membranes used in the process. 4 + 1

6. Write short notes on principle and application of Native-PAGE & SDS-PAGE. 5

GROUP – C
(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. a) Describe different types chromatographic separation technique available for the separation of metabolic product presents in fermentation broth.

   b) What are the basic principles exploited for the separation of biomolecules by chromatographic process ? 8 + 7

8. A tubular ultrafiltration unit with diameter of 2 cm and water permeability of 250 l/(m^2) (hr) is used for filtration of cheese whey. The protein has the diffusivity of 4×10^{-7} cm^2/s and the osmotic pressure (π) in the bar is given as $\pi = (4{\cdot}4 \times 10^{-3})C - (1{\cdot}7 \times 10^{-6})C^2$, where C is the protein concentration in gm/L.

   a) Calculate the mass transfer co-efficient unit, Re from the following co-relation $Sh = 0{\cdot}0096\ (Re)^{0.9}\ (Sc)^{0.35}$ where $Sh = K_C d/De$.

   b) Calculate ΔP if the solution velocity is 1·5 m/s and the concentration of protein in the bulk (C_B) is 40 gm/L and that of Gel is 400 gm/L (C_G). The rejection is 100%. The density and viscosity of protein solution are the same as those of water. 6 + 9

9. a) What are the major advantages for recovering bioproducts using membrane based separation processes ?

   b) What are the operating conditions that affect performance in membrane based separation process ?

   c) Draw a plot of flux and rejection versus pressure for ultrafiltration.

   d) Which membrane process has been utilized the most for downstream biotechnology applications ? What are the general categories of such applications and elaborate on one *specific* example. [4 + 3 + 3 + (1 + 2 + 2)]

10. Write short notes on any *two* of the following : $2 \times 7\frac{1}{2}$

a) Isopycnic ultracentrifugation

b) Dialysis

c) Gel filtration

d) SDS - PAGE.

11. Give a complete flow diagram of isolation and purification of penicillin in a commercial plan. Briefly describe the major operations involved in this process. 15