Name : ....

Roll No. : ....

Invigilator's Signature : ....

CS/B.Tech-(BT-OLD)/SEM-6/BT-602/2013

2013

BIO-SEPARATION 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)   Affinity chromatography is based on the highly specific

         interaction between

         a)   solute molecules and ligands

         b)   solute molecules

         c)   ligands

         d)   solute molecules and ceramic beads.

6113 (O)   [Turn over

ii)   Electrodialysis is a membrane separation method used for the separation of

    a)   charged molecules

    b)   neutral molecules

    c)   organic molecules

    d)   inorganic molecules.

iii)   Non-mechnical methods of cell disruption include

    a)   Osmotic shock

    b)   Ultrasound

    c)   Ball mill

    d)   Homogenizer.

iv)   Liquid-liquid extraction depends on

    a)   distribution coefficient

    b)   volatility

    c)   solubility

    d)   partition coefficient.

v) Dialysis is a membrane separation operation used for the removal of low molecular weight solutes such as organic ions of MW range at

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

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

vi) Micro-filtration (MF) is used to separate species that range from

    a)   0.1 to 10 μm   b)   1.0 to 10 μm

    c)   10 to 20 μm   d)   20 to 50 μm.

vii) UF is used for macromolecules with a molecular weight range of

    a)   2,000 to 5,00,000   b)   2,000 to 10,000

    c)   5,000 to 50,000   d)   1,00,000 to 5,00,000.

viii) Electrophoresis is used for the separation of

    a)   Charged biomolecules

    b)   Neutral biomolecules

    c)   Organic molecules

    d)   Inorganic molecules.

ix) Filtration rate depends on

    a)   pressure difference   b)   area of filter

    c)   visosity of medium   d)   all of these.

x) The most common exchange resin used in aqueous two phase extraction is

    a)   polyvinyl difluoride

    b)   polyethylene glycol

    c)   polysulfone

    d)   polytetrafluoroethylene.

xi) The method used to determine the relative molecular mass of protein is

    a)   Ion exchange chromotography

    b)   Gel filtration chromotography

    c)   Affinity chromotography

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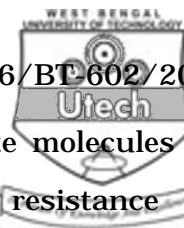
xii) In reverse osmosis, deposition of solute molecules on membrane surface results in large resistance for solvent flow. This phenomenon is known as

    a) reflection coefficient

    b) rejection coefficient

    c) breakthrough point

    d) concentration polarization.

GROUP – B
(Short Answer Type Questions)
Answer any *three* of the following.   3 × 5 = 15

2. Discuss non-mechanical methods of cell disruption.

3. Explain the difference between distribution coefficient and partition coefficient.

4. Differentiate between UF and MF.

5. Crystallization is a final state of purification. Justify with example.

6. Define affinity chromatography. Explain basic operating principle of affinity chromatography.

7. What do you understand by the term 'isoelectric point'. What is 2D gel electrophoresis ?   2 + 3

8. Write the adsorption isotherm equations. What is affinity adsorption ?   2 + 3

GROUP – C
(Long Answer Type Questions)
Answer any *three* of the following.   3 × 15 = 45

9. a) Write the principle of the salting out process.

    b) Write the name of a most common salt used in salting out method.

    c) A broth of 80 L contains lipase of 12.8 g/L and some contaminant of 1.8 g/L. Calculate the salt required to recover 98% of lipase if the value of β and k for lipase are 9.33 and 1.1 and that of contaminant are 8.8 and 0.95 respectively. What will be the purity of the lipase at 98% recovery ?

    d) Write the mass balance equation of a batch adsorption process.   3 + 1 + 8 + 3

10. a) What is reverse phase chromatography ? How is it advantageous over normal phase chromatographic technique ?

    b) Write a brief note on gel filtration, affinity and ion-exchange chromatography.

    c) Write the mode of operation of an HPLC system.

    2 + 2 + (3 × 3) + 2

11. Write notes on (with the help of a Schematic diagram) on any *three* of the following :   3 × 5

    a) Ultra-filtration

    b) Micro-filtration

    c) Reverse osmosis

    d) Concentration polarization.

12. a) A counter-current extractor with four equilibrium stages is available for separating desired bio-product from a contaminating impurity, which is 10% of the weight of the bio-product in a feed stream. For the extraction solvent being used, which is immiscible with the feed stream, the bio-product has a partition coefficient K of 10, while the impurity has $K = 1$. For an S/F ratio of 0.2, what will be the ratio of impurity to product in the extract phase at the outlet of the extractor ?

b) The operation of a pilot scale reciprocating plate extractor column has been optimized for the extraction of an antibiotic from whole fermentation broth using amyl acetate as solvent. The antibiotic has a partition coefficient K of 7.5. The optimal operating conditions are as follows :

solvent flow rate of 105 ml/min, flow rate of fermentation broth of 70 ml/min, and ratio of antibiotic in raffinate to antibiotic in feed is 0.07.

The column was 2.54 cm in diameter and the height of the extractor was 1.83 m. What column size is required to give a ratio of antibiotic in the raffinate to antibiotic in the feed of 0.03 and to handle fermentation broth at the rate of 1,50,000 litres in every 12 hrs. $2 \times 7\frac{1}{2}$