

M.TECH/BT/3RD SEM/BIOT 6101/2017
DOWNSTREAM PROCESSING
(BIOT 6101)

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) Micro-filtration membranes have pore sizes in the range
(a) 0.1 to 10 μm (b) 2 to 20 μm
(c) 10 to 20 μm (d) 30 to 50 μm.
- (ii) The adsorption of proteins is best described by
(a) the linear adsorption isotherm (b) the Freundlich isotherm
(c) the Langmuir isotherm (d) none of these.
- (iii) In ion-exchange adsorption the dominant mechanism that causes the adsorption of solutes from liquid media onto solids is
(a) van der Waals forces
(b) utilization of strong ionic bonds
(c) none of the above
(d) both (a) and (b).
- (iv) Cuprophane is a material used in the construction of membrane in the process of
(a) dialysis (b) hyper filtration
(c) cross flow filtration (d) ultra filtration.
- (v) Non-mechanical methods of cell disruption include
(a) French press (b) bead mill
(c) ball mill (d) osmotic shock
- (vi) Medical oxygen is best prepared by a packed bed of adsorbent of the type
(a) activated carbon (b) sintered alumina
(c) molecular sieve (d) ZSM -5.

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- (vii) In liquid-liquid extraction, the distribution coefficient K_D for a pair of solvents depend on
(a) temperature of operation (b) pressure
(c) both (a) & (b) (d) none of these.
- (viii) In the method of cell lysis by sonication the frequency of sound waves used is
(a) greater than 20kHz (b) less than 20kHz
(c) less than 10kHz (d) any frequency.
- (ix) Penicillin is more soluble in organic phase at pH
(a) 2 to 3 (b) 4 to 5
(c) 6 to 7 (d) 8 to 9.
- (x) The most common ion-exchange resin used in aqueous two-phase extraction is
(a) Polyvinylidene (b) polyethylene glycol
(c) polysulfone (d) polytetrafluoroethylene.

Group - B

2. (a) Derive an expression for settling velocity of a globular biomass in a sedimentation tank under gravity settling.
- (b) The centrifugal separation of a biomass of 80 μm sized cells of density 1.04 gm/cc was carried out in a tubular centrifuge having a diameter of 15 cm and rotating at 1200 r.p.m.
(i) Calculate the residence time if the distance between the liquid surface and the axis of rotation is 0.8 cm.
(ii) what would be the volumetric capacity of the centrifuge if its length is 40 cm?
(Given the liquid density 1 gm/cc and viscosity 0.013 gm/cm.sec)
5 + 7 = 12
3. (a) Define sedimentation coefficient, how do you express Svedberg units.
- (b) It is desired to use a cross flow filtration system to desalt 1000 liters of a protein solution containing NaCl. The system is capable of operating at a transmembrane flux of 30 liters/m² hr. To remove 99.96 % of the salt, determine the time required and the volume of water required using a cross flow filtration unit with a membrane area of 98.55 m².
4 + 8 = 12

Group - C

4. (a) What do you understand by the term sedimentation velocity.
 (b) Estimate how long it would take to completely clarify a suspension of ribosomes in a high speed centrifuge operating at 10,000 R P M with a tube containing the ribosome suspension in which the maximum distance of travel of particles radially outward is 1 cm and the initial distance from the center of rotation to the particles nearest the center of rotation is 4.5 cm.
- 4 + 8 = 12**
5. (a) What is partition coefficient and equilibrium curve
 (b) A column 20 cm long, with an internal diameter of 5 cm, gives sufficient purification to merit scale-up. The column produces 3.2 gm of purified protein per cycle, and a cycle takes 6 hr., from equilibration through regeneration. You want a throughput of 10 gm/hr. What are the new column's dimensions if linear velocity is held constant?
- 4 + 8 = 12**

Group - D

6. Write notes on ---- any four :
- (a) Silica based resins.
 (b) Polymer based resins.
 (c) Ion-exchange resins.
 (d) Reversed phase Chromatography.
 (e) Size exclusion Chromatography.
- 4 × 3 = 12**
- 7 (a) Explain the basic principle of gel filtration and give an account on the applications of the same.
 (b) A chromatographic separation of a two component sample on a 50cm column gave the retention times for the solutes A and B as 2.5 and 3.1 minutes with base widths of the two chromatographic peaks being 0.24 and 0.3 minutes respectively. Calculate the (a) number of theoretical plates (b) plate height (c) resolution of the two peaks.
- 6 + 6 = 12**

Group - E

8. (a) Define nucleation and crystal growth for crystallization operation with the help of most useful relationship.
 (b) Explain basic understanding of scale-up calculations for the design of a crystallizer.
- 6 + 6 = 12**
9. In a cross-flow ultrafiltration unit a protein of MW=3x 10⁵ da is separated from the fermentation broth using a UF membrane. The flow rate of liquid through a tube of diameter d=2 cm and length L=50 cm is Q=2 litres/min. The flow regime is turbulent, f=0.0005 and C₄=2 atm(s/cm)². The inlet pressure is 2atm. Protein concentration in the solution and on gel film are 30mg/litre and 100 gm/litre respectively.
- (i) Determine the exit pressure.
 (ii) Determine the trans membrane pressure drop.
 (iii) If the mass transfer coefficient for protein flux is 5cm/s, determine the flux of liquid through the UF membrane.
 (iv) If resistance of the filter is 0.002 atm.cm².s/cm³ determine the cake resistance.

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