

Group – E

8. (a) Define dry bulb temperature and wet bulb temperature. Which one is higher and why?
 (b) Explain operating principle of freeze dryer and compare between freeze dryer and spray dryer.

4 + (3 + 5) = 12

9. (a) Define super-saturation and secondary nucleation.
 (b) It is desire to scale up a batch crystallizer of an antibiotic based on experiments with a 1.0 Lit crystallizer. The use of a 3.0 cm diameter impeller at a speed of 800 rpm led to good crystallization results. For maintaining power per volume constant upon scale-up to 300 liters. what should be the diameter and speed of the large-scale impeller ? The solvent has the same density and viscosity as water.

(2 + 3) + 7 = 12

B.TECH/BT/7TH SEM/BIOT 4102/2019
BIOSEPARATION TECHNOLOGY
(BIOT 4102)

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) In Freundlich adsorption isotherm, the value of $1/n$ is
 (a) 1 in case of physical adsorption
 (b) 1 in case of chemisorption
 (c) between 0 and 1 in all cases
 (d) between 2 and 4 in all case.
- (ii) Which one of the following should be used for the first step of purification of a protein from a complex mixture?
 (a) Precipitation
 (b) Ion exchange chromatography
 (c) Affinity chromatography
 (d) Hydrophobic interaction chromatography.
- (iii) Membrane materials used in U F is of the type –
 (a) symmetric
 (b) isotropic
 (c) anisotropic
 (d) asymmetric.
- (iv) The unit of the transmembrane flux is defined by –
 (a) lit./m² (b) lit./m² hr. (c) lit./m hr (d) lit./hr.
- (v) When particle density and solvent density will be equal, the sedimentation velocity will be
 (a) one (b) less than zero (c) greater than zero (d) zero.

- (vi) G , the ratio of the centrifugal to gravitational acceleration for a particular centrifuge is
 (a) $\omega^2 R^2/g$ (b) $\omega^2 R/g$ (c) $\omega^2 R/g^2$ (d) $\omega^2 R^2/g^2$.
- (vii) The rate of primary Nucleation is $B = dN/dt = K_n (C - C^*)^n$
 The exponent 'n' is in the range of
 (a) 1 to 2 (b) 2 to 3 (c) 3 to 4 (d) 4 to 5.
- (viii) Impeller Reynolds number is given by
 (a) $Re = [d_i^2 N_i \rho] / \mu$ (b) $Re = [d_i^2 N_i \mu] / \rho$
 (c) $Re = [d_i^2 N_i^2 \rho] / \mu$ (d) $Re = [d_i^2 N_i] / \mu \rho$.
 Where, N_i is the impeller rotation rate and d_i is the impeller diameter.
- (ix) Ultrafiltration (U F) is used for separation with molecular weight range from
 (a) 0.1 – 10 μm (b) 10 – 100 μm
 (c) 100 – 200 μm (d) 200 – 500 μm .
- (x) A protein can precipitate when its PI is
 (a) equal to the pH (b) greater than the pH
 (c) less than the pH (d) no relation.

Group – B

2. (a) Explain operating principles of rotary vacuum filter.
 (b) It is desire to filter a cell broth at a rate of 2000 liters/hr on a rotary vacuum filter at a vacuum pressure of 70 K Pa. The cycle time for the drum will be 60 sec, and the cake formation time will be 15 sec. The broth to be filtered has a viscosity of 2.0 c p and a cake solids (dry basis) per volume of filtrate of 10 gm/liter. Specific cake resistance 9×10^{10} cm/gm. Determine the area of the filter. The resistance of the filter medium is neglected.
3. (a) A pilot plant scale tubular centrifuge was used to achieve complete recovery of bacterial cells from a fermentation broth. Bacterial cells are spherical with a radius of 0.5 μm and have a density of 1.10 gm/cm³. The bowl diameter is 10 cm, the bowl length is 100 cm, and the outlet opening of the bowl has a diameter of 4 cm. Estimate the R P M of the centrifuge and flow rate of fermentation broth.
 Given data : $\Sigma = 2.01 \times 10^6$ cm²
- (b) What do you understand by the term sedimentation velocity?

9 + 3 = 12

Group – C

4. (a) What are the factors utilized for precipitation?
 (b) Discuss the principle and application of the following chromatographic techniques:
 i) Reversed phase chromatography
 ii) Hydrophobic interaction chromatography
5. (a) Equilibrium adsorption data for benzene vapour on silica gel at different temperatures are given below.
 Fit the data to
 i) Langmuir and
 ii) Freundlich isotherm and obtain the isotherm equation.

$p \times 10^3$, atm	0.5	1.0	2.0	5.0	10.0	20
$q \times 10^2$ mmol/g	14.0	22.0	34.0	68.0	88.0	-
	70°C	70°C	70°C	70°C	70°C	70°C
	90°C	90°C	90°C	90°C	90°C	90°C

- (b) What are the assumptions of Langmuir adsorption isotherm?

10 + 2 = 12

Group – D

6. (a) What do you understand by modification of habit for crystal growth?
 (b) Explain nucleation with the help of suitable equations.
 (c) Discuss the basic concept of scale-up calculations of a crystallizer.
7. (a) 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 equilibrium through regeneration. You want a throughput of 10 gm/hr. What are the new column's dimensions if linear velocity is held constant? (column height constant).
 (b) Explain "Kolmogoroff length" with the help of a proper equation.
 (c) Define nucleation.

6 + 3 + 3 = 12