

BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: M.TECH
BRANCH: BIOENGINEERING

SEMESTER : II
SESSION : SP/19

SUBJECT: BE507 ADVANCED BIOSEPARATION ENGINEERING

TIME: 3.00 Hrs.

FULL MARKS: 50

INSTRUCTIONS:

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
 2. Attempt all questions.
 3. The missing data, if any, may be assumed suitably.
 4. Before attempting the question paper, be sure that you have got the correct question paper.
 5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
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- Q.1(a) A suspension of spherical particles of 0.1 mm diameter was allowed to settle in a column of 50 cm length. The density difference between the solid and liquid was 1.1 g/cm^3 and viscosity is 1 cP. Calculate the settling time in centrifuge rotating at 400 rpm, if the distance between the axis of rotation at bottom of the centrifuge was 12 cm and distance between the axis and liquid surface was 3 cm. [5]
- (b) Calculate the settling velocity of limestone falling in water at 30°C . Given: $D_p = 0.161 \text{ mm}$, viscosity 0.8 cP, water density 1000 kg/m^3 , particle density 2800 kg/m^3 , $C_D = 7.9$. [5]
- Q.2(a) Explain the process and advantages of Super critical fluid extraction. [5]
- (b) Write adsorption isotherm equations. [2]
- (c) The solubility of a protein is 15 g/L at salt concentration of 2.2 M and 0.25 g/L at 3 M. calculate the solubility of the protein at 3.8 M of the salt. [3]
- Q.3(a) Write the basic principal and application of Ion exchange chromatography. [5]
- (b) Two analytes A and B are separated on a 25 cm column. The observed retention times were 7 min 20 sec and 8 min 20 sec respectively. A reference compound completely exhausted by stationary phase is eluted out at 1 min 20 sec. considering number of theoretical plates are 1764, what is the resolution of these two peaks? What should be the minimum length of column in cm if we want minimum good resolution? [5]
- Q.4(a) Explain the mechanism of transport in MF system. [5]
- (b) Dialysis is used to recover a certain solute from a dilute solution of $2 \times 10^{-2} \text{ kg mole/m}^3$ through a membrane to a solution having concentration of $0.3 \times 10^{-2} \text{ kg mole/m}^3$. The membrane is $1.6 \times 10^{-5} \text{ m}$ thick. Distribution coefficient is 0.75. Diffusivity is $3.5 \times 10^{-11} \text{ m}^2/\text{s}$. mass transfer coefficients are $3.5 \times 10^{-5} \text{ m/s}$ and $2.1 \times 10^{-5} \text{ m/s}$ respectively. Calculate (i) total resistance, (ii) flux at steady state and (iii) total area in m^2 for a transfer of 0.01 kg mol solute/h. [5]
- Q.5(a) Define various moisture contents with a suitable diagram. [5]
- (b) It is desired to scale up a batch crystallization based on experiment with a one litter crystallizer. The use of a 3 cm diameter impeller at a speed of 800 rpm led to good crystallization results. For maintaining power per volume const. upon scale-up to 300 litters, what should be the diameter and speed of large-scale impeller? Solvent has same viscosity and density of water. [5]

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