MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

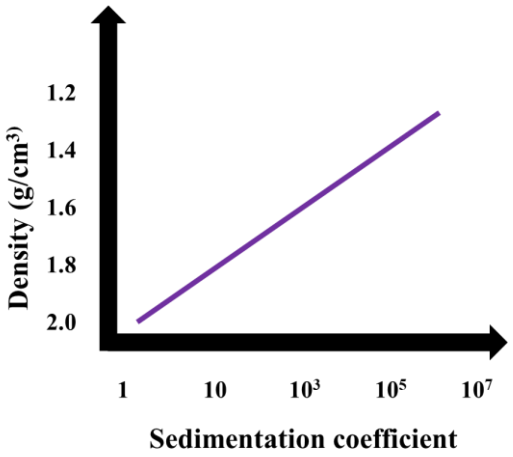
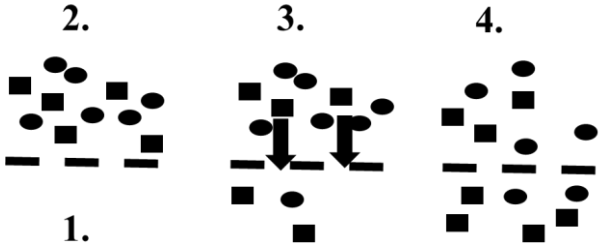
M.TECH. End semester – Regular

SUBJECT: ADVANCED BIOSEPARATION PROCESSES [BIO 5124]

Date of Exam: **23/11/2019** Time of Exam: **2.00 PM to 5.00 PM** Max. Marks: **50**

Instructions to Candidates:

- Answer ALL the questions & missing data may be suitable assumed

1A	Given below is the diagrammatic representation of density vs sedimentation coefficient. Suitably, place these components (Virus, Soluble protein, DNA, RNA, Mitochondria, Virus, Glycogen, Ribosomes, Microscomes) in the given chart.  	**3**
1B	How does the knowledge on electro-kinetic phenomena contribute to flocculation?	**2**
1C	Data was obtained on the precipitation of a protein by the addition of ammonium sulfate. The initial concentration of the protein was 15 g/liter. At ammonium sulfate concentrations of 0.5 and 1.0 M, the concentrations of the protein remaining in the mother liquor at equilibrium were 13.5 and 5.0 g/liter, respectively. From this information, estimate the ammonium sulfate concentration to give 95% recovery of the protein as precipitate.	**5**
2A	Picture given below shows the partitioning of biomolecules in a two-phase system. Two components are represented by circles and squares, respectively. Fill out the marked regions (1, 2, 3, 4).  	**2**

<table>
<tr><td>2B</td><td>The following data was obtained from a constant pressure cake filtration experiment:
<table><tr><td>Time (s)</td><td>5</td><td>10</td><td>20</td><td>30</td></tr><tr><td>V (t) (litres)</td><td>0.040</td><td>0.055</td><td>0.080</td><td>0.095</td></tr></table>
The following additional information is given: A = 0.1 ft2, ρ_c = 0.015 kg/ l, μ = 1.1 centipoise, ▲P = 10 N/m^2.
a) Determine R_m
b) Determine the specific cake resistance</td><td>4</td></tr>
<tr><td>2C</td><td>What would happen, if a protein sample of a single component is applied to a chromatography system in a small volume? Can we expect it to be eluted in a very sharp peak of similar volume?</td><td>4</td></tr>
<tr><td>3A</td><td>Aqueous two-phase extraction is used to extract xylanase from a solution. A PEG-dextran system is used for the same. The partition coefficient is 6. Calculate the maximum possible enzyme recovery when the volume ratio of upper to lower phase is 4.</td><td>2</td></tr>
<tr><td>3B</td><td>What are the advantages and disadvantages of Aqueous two phase extraction process</td><td>3</td></tr>
<tr><td>3C</td><td>Outline the design criteria for high-value low volume products. (Each step 0.5 mark)</td><td>5</td></tr>
<tr><td>4A</td><td>In an experiment 43 L/hr of streptomycin extract is to be stripped with water at pH 6. The value of K is 0.11. We want to use three stages and have 95% recovery. How much water should we use?</td><td>4</td></tr>
<tr><td>4B</td><td>100 litres of an aqueous solution of citric acid (concentration = 1 g/1) is contacted with 10 litres of an organic solvent. The equilibrium relationship is given by$C_E = 100\ C_R^2$, where C_R and C_E are the citric acid concentrations in the raffinate and extract respectively and are expressed in g/1. Calculate:
a) The concentration of citric acid in the raffinate and the extract.
b) The fraction of citric acid extracted.
If the extract thus obtained is then contacted with a further 100 litres of aqueous solution of citric acid (concentration = 1 g/1) calculate:
c) The concentration of citric acid in the raffinate and extract phases of the second extraction. Comment on these results.</td><td>6</td></tr>
<tr><td>5A</td><td>Briefly explain the steps involved in reverse Micellar Extraction process</td><td>3</td></tr>
<tr><td>5B</td><td>The intrinsic and apparent rejection coefficients for a solute in an ultrafiltration process were found to be 0.95 and 0.63 respectively at a permeate flux value of 6 x 10^{-3} cm/s. What is the solute mass transfer coefficient?</td><td>2</td></tr>
<tr><td>5C</td><td>Cell free fermentation liquor contains 8x10^{-5} moll^{-1} immunoglobulin G. It is proposed to recover at least 90% of this antibody by adsorption on</td><td>5</td></tr>
</table>

	synthetic, non-polar resin. Experimental equilibrium data are correlated as follows: $C^*_{AS} = 5.5 \times 10^{-5} (C^*_A)^{0.35}$ where C^*_{AS} is mol solute adsorbed per cm^3 adsorbent and C^*_A is liquid phase solute concentration in mol/ L. What minimum quantity of resin to treat $2m^3$ fermentation liquor in a single stage mixed tank?	