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V SEMESTER B.TECH (B. E. BIOTECHNOLOGY) END SEMESTER EXAMINATIONS, NOV/DEC 2015

SUBJECT: DOWNSTREAM PROCESSING TECHNOLOGY [BIO 305]

REVISED CREDIT SYSTEM

Time: 3 Hours

MAX. MARKS: 50

Instructions to Candidates:

✤ Answer ANY FIVE FULL the questions.

✤ Missing data may be suitable assumed.

For a batch adsorption process, derive the equations for the operating line and the equilibrium line which follows the following isotherm:

1A.

$$\mathbf{q} = \frac{q_m K_A C}{1 + K_A C}$$

Adsorption of a novel drug on activated carbon follows the Freundlich isotherm, q is in mg/cm³ and y is in mg/L and the value for the constant K is given as 25.1 and p is 0.41. About 0.01 liters of a batch of freeh advarbant is

- **1A** given as 35.1 and n is 0.41. About 0.01 liters of a batch of fresh adsorbent is added to 3 liters of fermentation beer containing 46 mg/liter of the drug. Determine the percent recovery for the process.
- **1C.** Illustrate and formulate the equations involved in multistage cross current and **3** counter current adsorption processes.
- **1D.**An 18cm long activated carbon bed gives 55% utilization at the breakthrough point; the length of the unused bed is 7 cm. Estimate the unused portion.2

12 g of amylase is eluted from a 75 litre chromatographic column, where the void fraction is 0.38. The C_{max} in the column peak after 470 litres are eluted

2A. void fraction is 0.38. The C_{max} in the column peak after 470 litres are eluted is 2% of the original. Estimate: (a) the value of the equilibrium constant K; and (b) the eluted concentration profile. (N=450)

A protein has a retention time of 9 minutes in an ion exchange chromatography column having a volume of 10 liter and a voidage fraction of 0.28. The distribution coefficient (K) of the protein is known to be equal to 2.

- Determine t_m and k' values for the protein.
- **2C.** What are the common types of detectors used in Gas chromatography technique to detect an organic substance?
- **3A.** Derive the following equation for the distance migrated by a charged solute molecule under the influence of an electric field and solve the problem.

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 $z = vt_R = (u\frac{V}{L} + u_{osm}\frac{V}{L})t_R$

20	In a batch electrophoresis, $u_{osm}=0$ and $u= 2 \times 10^{-5}$ cm ² /v.s. Determine the	2
3B.	location of the peak if the strength of the electric field is 130v/cm for 3 hours.	-
3C.	Propose two techniques that can be applied for the extraction of a highly temperature sensitive protein product from a large volume of cell lysate as feed.	3
3D.	Illustrate and describe the principle and working of pneumatic dryers.	2
4A.	Aqueous two phase extraction process is utilized for the extraction of a protein. The system is set up such that the concentration of protein in the top and bottom phase is 1.99 and 2.81 mg/ml respectively. The volume of the top and bottom phase is 3.2ml and 1.077ml respectively. After addition of 0.5M salt, the protein partitions in two phases as follows: Top and bottom phase volume 2.2 and 2.29 ml respectively; Top and bottom phase concentration 1.2 and 5.72 mg/ml respectively. Determine the phase ratio, partition coefficient and the yield of the system after adding 0.5M salt for protein extraction.	3
4B.	Analyze the situations that give rise to bad crystals and suggest the steps that can be taken to avoid them.	3
4C.	12 kg of gamma-globin is mixed in 15 kg water and heated for solubilization. Around 12% of water is lost during solubilization. Crystals were recovered after a cooling step at a lower temperature. The solubility of gamma globin at the lower temperature is 0.05 protein per kg water. Calculate the crystal weight that were recovered from the process.	4
5A.	A tunnel dryer is used to dry a wet protein slurry from 30 to 10 per cent moisture under constant drying conditions in 4.17 hours. Under these drying conditions, if the critical and the equilibrium moisture contents are 15% and 5% respectively, how long will it take to dry the solid from 40 to 12% moisture under the same conditions?	4
5B.	Derive the equation for determining the time of drying using the rate of drying curve.	2
	A mixture of cell surface bacterial proteins was obtained by cell lysis. This mixture has to be separated to individual protein components using the differences in their mobility, under an electric field in a pH gradient. Analyze the situation and design an appropriate process.	
5C.	Compare and contrast the techniques of ion exchange and affinity chromatography.	4

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Supercritical fluid is utilized for various extraction processes. What are the advantages of the use of supercritical fluid in extraction? If a supercritical fluid is used in the leaching process under the following set of conditions,

6A. determine the concentration of the solute in the overflow and underflow: 100 kg of solid containing 40 wt% solute of interest is leached with 100 kg of supercritical CO_2 as the solvent. The value of N for the slurry underflow is essentially constant at 3 kg insoluble solid/kg solution retained.

An aqueous solution of protein (concentration=1g/L) is contacted with an organic solvent (10L). The equilibrium relationship is given as $C_E=100C_R^2$,

- 6B. where C_E and C_R are the concentration of protein in the extract and in the initial feed at 100 liters. Calculate: (a) concentration of protein in the raffinate and the extract (b) fraction of protein extracted.
- Sketch and describe the principle working and of membrane 3 6C. chromatography.