Reg.No.:												

VIVEKANANDHA COLLEGE OF ENGINEERING FOR WOMEN
[AUTONOMOUS INSTITUTION AFFILIATED TO ANNA UNIVERSITY, CHENNAI]
Elayampalayam – 637 205, Tiruchengode, Namakkal Dt., Tamil Nadu.

Question Paper Code: 9020

M.E. / M.Tech. DEGREE END-SEMESTER EXAMINATIONS – JUNE / JULY 2024
Second Semester
Biotechnology
P23BT205 – ADVANCED BIOSEPARATION TECHNOLOGY
(Regulation 2023)

Time: Three Hours | Maximum: 100 Marks

Answer ALL the questions

Knowledge Levels (KL)	K1 – Remembering	K3 – Applying	K5 - Evaluating
	K2 – Understanding	K4 – Analyzing	K6 - Creating

PART – A

(10 x 2 = 20 Marks)

Q.No.	Questions	Marks	KL	CO
1.	List out any four advent emerging techniques to avoid the conventional RIPP scheme.	2	K1	CO1
2.	A type of animal derived tissue is being ground in a bead mill to recover a pharmaceutical enzyme. It was estimated that 3000 joules of energy was used to reduce the average particle size of the tissue from 1 mm to 0.5 mm. Predict the amount of energy required to further reduce the particle size to 0.1 mm. Assume that this grinding process follows Rittinger's law.	2	K3	CO1
3.	Compare the features of microfiltration membrane with other conventional filter methods.	2	K2	CO2
4.	Mention the significance of reflection coefficient in ultrafiltration.	2	K2	CO2
5.	Outline the role of synthetic resins as adsorbent.	2	K1	CO3
6.	Recall the concept of breakthrough curve in fixed beds.	2	K2	CO3
7.	Give a short note on the dispersion effects of chromatography.	2	K2	CO4
8.	State the principle behind size exclusion chromatography.	2	K1	CO4
9.	Enlist the steps involved in standardization of milk proteins.	2	K1	CO5
10.	Schematically represent the process of sewage treatment using trickling filter.	2	K1	CO5

PART – B

(5 x 13 = 65 Marks)

Q.No.			Questions	Marks	KL	CO
11.	a)	i.	Describe in detail about the mechanical methods of cell disruption with suitable diagram.	7	K2	CO1
		ii.	You plan to concentrate an *E. coli* suspension by centrifugation prior to cell disruption. The suspension has the following physical properties: cell diameter- 1 μm; density - 50 kg/m^3; viscosity – 2 x 10^{-3} kg/m s. The centrifuge diameter is 5 inch.	6	K3	
			a. If the maximum allowable cake thickness in the bowl is 1.5 inch, predict the throughput (Q) for the proposed operation. Assume that the centrifuge will be operated at 16000 rpm and it will deliver 90% of the theoretical capacity.			CO1
			b. After disruption, the diameter of the cell debris has been reduced to an average of 0.5 μm and the viscosity of the suspension has been increased to 8 x 10^{-3} kg/m s. Estimate the new capacity of the centrifuge for this operation. Assume that the centrifuge is operated at the same speed and efficiency.			
			(OR)			
	b)	i.	Derive the expressions to estimate [Σ] factor for tubular bowl centrifuge.	7	K2	CO1
		ii.	You are filtering a beer containing 6% citric acid on a continuous rotary vacuum filter. The filter has an area of 18.1 m^2, a negligible medium resistance, a cycle time of 75 s, and a pressure difference of close to 1 atm. The cake which forms has a washing efficiency of 60%, but it is incompressible and permeable: $\left(\frac{\mu\alpha\rho}{2\Delta P} = \frac{86\,s}{cm^2}\right)$ The cake retains 7% of filtrate leaving and should be washed until the cake contains only 10% citric acid originally entrained. Calculate the filtration time and the washing time required to process 3000 L/h.	6	K3	CO1
12.	a)	i.	Clarified fermentation broth contains a polysaccharide product with a gelation concentration of 25 g/l. The fluid density is 1020 kg m^{-3}, the viscosity is 1.8 cP, and the polysaccharide diffusivity is 5.63 x 10^{-11} m^2 s^{-1}. The product is harvested from	7	K3	CO2

			the broth using ultrafiltration at a fluid velocity of 0.34 ms-1 in open membrane tubes of diameter 2.4 cm and length 2.0 m. Estimate the permeate flux if the filter is operated under gel polarization conditions and the polysaccharide concentration in the feed is 12 $g.l^{-1}$.			
		ii.	Compute the necessary equations for determining filtration time in ultrafiltration.	6	K2	CO2
			(OR)			
	b)	i.	Brief about the principle and application of Reverse osmosis and dialysis.	6	K2	CO2
		ii.	With suitable diagram, explain in detail about integrated membrane reactor.	7	K2	CO2
13.	a)	i.	Phosphoglycerate kinase isolated from yeast can be adsorbed on cellulose. The adsorption follows Langmuir isotherm. The maximum uptake is 70 mg/cm^3 adsorbent; half of this maximum occurs when the solution contains 50 mg/L of the enzyme. We have 1.5 litres of feed containing 220 mg/L of this enzyme. How much cellulose should we add to get a 90% recovery of this solute?	8	K3	CO3
		ii.	Explain the common adsorption isotherms that occur in bioseparations with suitable expressions.	5	K2	CO3
			(OR)			
	b)	i.	Outline the performance characteristics and engineering analysis of a fixed bed adsorber.	6	K2	CO3
		ii.	Explain in detail about the separation of proteins using aqueous two phase liquid extraction. How it differs from supercritical fluid extraction?	7	K2	CO3
14.	a)	i.	In a gel chromatography column packed with particles of average radius 22μm at an interstitial velocity of 1.2 cm min^{-1} of the mobile phase, two peaks show poor separation characteristics, that is, RS = 0.85.	8	K3	CO4
			a. What velocity of the mobile phase should be applied to attain good separation (RS above 1.2) with the same column length?			
			b. What length of a column should be used to obtain RS = 1.2 at the same velocity? The linear correlation of $h = Hs/2r_0$ versus ν shown in Figure can be applied to this system, and the diffusivities of these solutes of 7×10^{-7} cm^2s^{-1} can be used.			

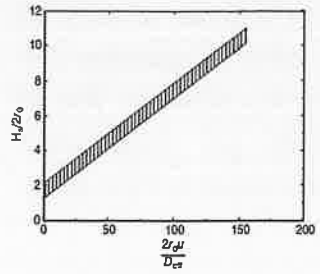

Figure: $Hs/2r_0$ plotted against $2r_0$ $u/D_{eff}.r_0$:17–37μm; solute: myoglobin, ovalbumin, bovine serum albumin. Temperature: 10, 20, 40°C.

	ii.	Describe the factors affecting the performance of chromatography columns.	5	K2	CO4
		(OR)			
b)	i.	Sketch neatly and explain the principle and application behind Ion exclusion chromatography.	7	K2	CO4
	ii.	Brief about the design, operation and application of spray drier.	6	K2	CO4
15. a)		Elaborate on the process involved in separation and fractionation of milk fat globules.	13	K2	CO5
		(OR)			
b)		With suitable diagram, discuss about the sewage treatment processes using membrane bioreactors.	13	K2	CO5

PART – C

(1 x 15 = 15 Marks)

Q.No.		Questions	Marks	KL	CO
16.	a)	Explain in detail about the membrane processes involved in the production of functional whey components.	15	K4	CO5
		(OR)			
	b)	Elaborate on desalination of seawater using RO and electrodialysis.	15	K4	CO5