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: 90002

B.E. / B.Tech. DEGREE END-SEMESTER EXAMINATIONS – NOV. / DEC. 2024
Seventh Semester
Biotechnology
U19BT725 – DOWNSTREAM PROCESSING
(Regulation 2019)

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.	Name any two cell disruption methods useful for separation of DNA.	2	K2	CO1
2.	How concentration of amphiphiles affects the lipid solubility and surface tension of the cell suspension. Give few examples of cationic detergents?	2	K1	CO1
3.	A centrifuge is operated in a fixed angle rotor with the radius of 8cm at 22938g. Calculate the speed in rpm.	2	K5	CO2
4.	Write down the various pre-treatment methods available before the initial filtration step?	2	K2	CO2
5.	A clarified fermentation broth H containing 260 mg/l of antibiotic is to be extracted using methyl acetate L. The equilibrium constant K =57. You plan to let H =450 lit/hr & L=37 lit/hr. You hope to recover 99% of the antibiotic in the feed. How many stages will you need to accomplish the separation?	2	K4	CO3
6.	Aqueous two-phase extraction is used to recover α-amylase from solution. A PEG – Dextran mixture is added and solution separates into two phases. The Partition coefficient is 4.2. Calculate the maximum possible enzyme recovery when the volume ratio of upper to lower phase is 5.0.	2	K4	CO3

7.	A chromatographic separation of a two component samples on a 50 cm column gave the retention times for the solutes A and B as 2.5 and 3.1 minutes with base widths of the two chromatographic peaks being 0.24 and 0.3 minutes respectively. Calculate the i. number of theoretical plates ii. plate height iii. resolution of the two peaks.	2	K4	CO4
8.	Calculate the amount of gentamycin adsorbed per unit weight of activated carbon that adsorbs 9.8 x 10-6 mol/cm3. This process follows Langmuir isotherm with constant K of 2x 10-5 mol/l and the concentration of the solute in the solution = 4x10-8 mol/cm^3.	2	K4	CO4
9.	Write about the lyophilization process?	2	K3	CO5
10.	Define the term degree of super saturation.	2	K3	CO5

PART – B

(5 x 13 = 65 Marks)

Q.No.		Questions	Marks	KL	CO
11.	a)	Elucidate the generalized block diagram of various stages of downstream processing of Bioproducts and explain briefly the unit operations involved in primary, intermediate and final purification stages.	13	K4	CO1
		(OR)			
	b)	Illustrate a detailed note on the chemical and mechanical methods of cell disruption with suitable diagram.	13	K3	CO1
12.	a)	Using a test filter, we find the following data for the broth containing antibiotic erythromycin and added filter aids. The filter leaf has a total area of 0.1 ft^2 and filtrate has a viscosity of 1.1 cp. The pressure drop is 20 mm Hg and the feed contains 0.05 kg dry cake / liter. Determine the specific cake resistance (α) and medium resistance (Rm)	13	K4	CO2

Filtration Time (s)	5	10	20	30
Volume of filtrate (lit)	0.04	0.055	0.08	0.095

(OR)

	b)		The centrifuge contains 35 discs with an inner and outer diameter of 3 cm and 11 cm respectively. The half-cone angle is 30^{o}. When operated at a speed of 3000 rpm with a feed rate of 3.1 lit/min, 80% of the cells are recovered. If a bigger centrifuge is to be used for industrial treatment of 70 lit/min, what operating speed is required to achieve the same sedimentation performance if the larger centrifuge contains 55 discs with an inner and outer diameter of 4.2 cm and 14 cm and half-cone angle is 40^{o}?	13	K4	CO2
13.	a)		You are living in an apartment which is not having the facility to provide drinking water. Water available contains high concentration of salt. Design a single/ multi stage membrane processing unit for this purification process. Select the membrane type, modules and operating condition suitable for the operation. Explain your selection.	13	K4	CO3
			(OR)			
	b)	i.	Give an account of different solvent extraction methods with suitable diagrams.	5	K3	CO3
		ii.	An organic acid dissolved in 47 liters of organic solvent is to be washed with 10 liters of water. From the past extractions, we expect that $x^2 = 0.001y$ where both concentrations x and y are in mg/litres. The initial concentration of x is 1mg/liter: What is the fraction extracted?	8	K4	
14.	a)	i.	Describe the practice of Hydrophobic interaction chromatography with suitable examples.	13	K3	CO4
		ii.	Write a note on the different operating modes of ion-exchange chromatography.			
			(OR)			
	b)	i.	List out various methods employed in the separation of bioproducts by precipitation method. Explain any three methods in detail.	13	K4	CO4
		ii.	Describe the principle and practice of affinity chromatography with suitable examples.			
15.	a)	i.	Describe the theory of drying with suitable diagram.	13	K3	CO5
		ii.	Explain the working principle and operation of any one industrial important dryer with neat diagram.			
			(OR)			
	b)	i.	Write in detail about various stages of crystallization.	13	K3	CO5
		ii.	Give an account of circulating magma vacuum - type crystallizer with neat diagram.			

PART – C

(1 x 15 = 15 Marks)

Q.No.		Questions	Marks	KL	CO
16.	a)	A tubular bowl centrifuge is used to concentrate a suspension of E.coli prior to cell disruption. The bowl of this unit has an inside radius of 12.7cm and a length of 73cm. The speed of the bowl is 16000 rad/min and the volumetric capacity is 200 l/h. Under these conditions this centrifuge works well. i. Calculate the settling velocity for the cells. ii. After disruption the diameter of debris is about one-half of the original diameter and the viscosity is increased four times. Estimate the volumetric capacity of this same centrifuge and operating under these new conditions.	15	K5	CO2
		(OR)			
	b)	Protein X has to be isolated and purified from fermentation broth. The facilities for solvent extraction, aqueous two-phase extraction, adsorption and salt induced precipitation are available. Design a single/ multi stage purification process based on the facilities available to purify Protein X. Explain your design with proper reasons.	15	K6	CO5