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: 90033

M.E. / M.Tech. DEGREE END-SEMESTER EXAMINATIONS – JAN. / FEB. 2026
First Semester
Biotechnology
P23BT103 – ADVANCED BIOPROCESS 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.	Humid air enriched with oxygen is prepared for a gluconic acid fermentation. The air is prepared in a special humidifying chamber. 1.5 l/ h liquid water enters the chamber at the same time as dry air and 15 gmol/ min dry oxygen gas. All the water is evaporated. The outflowing gas is found to contain 1% (w/w) water. Draw and label the flow sheet for this process.	2	K2	CO1
2.	Mention any two specific medium formulation used for mammalian cell culture.	2	K2	CO1
3.	Sketch the flow sheet for a continuous perfusion reactor with internal biomass feedback and add a note on it.	2	K2	CO2
4.	Define critical dilution rate.	2	K1	CO2
5.	Compare the operating characteristics of stirred and air-driven reactors.	2	K2	CO3
6.	Write short note on trickle bed reactor with suitable diagram.	2	K2	CO3
7.	Schematically represent the “scale-up” window defining the operating boundaries for aeration and agitation in scale-up of fermentation.	2	K2	CO4
8.	Comment on profitability analysis.	2	K2	CO4
9.	Express the significance of simulation software used in bioprocess.	2	K2	CO5
10.	Narrate the key strategies to be followed in simulation analysis.	2	K2	CO5

PART – B

(5 x 13 = 65 Marks)

Q.No.		Questions	Marks	KL	CO
11.	a)	Discuss in detail about the optimization of medium components using Response Surface Methodology and add a note on its advantages over Plackett-Burman method.	13	K2	CO1
		(OR)			
	b)	*Acetobacter aceti* bacteria convert ethanol to acetic acid under aerobic conditions. A continuous fermentation process for vinegar production is proposed using non-viable *A. aceti* cells immobilized on the surface of gelatin beads. The production target is 2 kg/h acetic acid; however the maximum acetic acid concentration tolerated by the cells is 12%. Air is pumped into the fermenter at a rate of 200 gmol/ h. a. What minimum amount of ethanol is required? b. What minimum amount of water must be used to dilute the ethanol to avoid acid inhibition? c. What is the composition of the fermenter off-gas?	13	K2	CO1
12.	a)	Derive the expressions for a chemostat operation at D_{opt} to achieve μ_{max} in the reactor.	13	K3	CO2
		(OR)			
	b)	Mushroom tyrosinase is immobilized in 2-mm spherical beads for conversion of tyrosine to DOPA in a continuous, well-mixed bubble column. The Michaelis constant for the immobilized enzyme is 2 gmol m^{-3}. A solution containing 15 gmol m^{-3} tyrosine is fed into the reactor; because of the high cost of the substrate, the desired conversion is 99%. The reactor is loaded with beads at a density of 0.25 m 3 m^{-3}; all enzyme is retained within the reactor. The intrinsic V_{max} for the immobilized enzyme is 1.5 x 10^{-2} gmol s^{-1} per m^3 beads. The effective diffusivity of tyrosine in the beads is 7 x 10^{-10} m^2 s^{-1}; external mass-transfer effects are negligible. Immobilization stabilizes the enzyme so that deactivation is minimal over the operating period. Determine the reactor volume needed to treat $18 m^3$ tyrosine solution per day.	13	K3	CO2
13.	a)	With suitable diagram, explain in detail about the design and operation of fluidized bed reactor with its merits and demerits.	13	K3	CO3
		(OR)			
	b)	Discuss about the design and operation of Membrane bioreactor.	13	K3	CO3

			Marks	KL	CO
14.	a)	Consider the scale-up of fermentation from a 10L to 10,000 L vessel. The small fermenter has an aspect ratio of 3. The impeller diameter is 30% of the tank diameter. Agitator speed is 50 rpm and three Rushton impellers are used. Determine the dimensions of the large fermenter and agitator speed by: (i) Constant P/V, (ii) Constant impeller tip speed and (iii) Constant Reynolds number.	13	K3	CO4
		(OR)			
	b)	Explain in detail about the general cost considerations and preliminary economic evaluation of a project for manufacturing a biological product.	13	K3	CO4
15.	a)	Discuss about the simulation strategies involved in bioethanol production from lignocellulosic biomass using "Design Pro" software.	13	K4	CO5
		(OR)			
	b)	Express the steps involved in flow sheet creation for integrated bioprocessing.	13	K4	CO5

PART – C

(1 x 15 = 15 Marks)

Q.No.		Questions	Marks	KL	CO
16.	a)	A genetically engineering strain of yeast is cultured in a bioreactor at 30°C for the production of a protein. The oxygen requirement is 68 mmol/L hr. The critical oxygen concentration is 0.005mmol/L and the solubility of the O_2 in the fermentation broth is estimated to be 2% less than in water due to solute effects. i. What is the mass transfer coefficient necessary to sustain the culture if reactor is sparged with air at 1 atm? and ii. What is the mass transfer coefficient necessary to sustain the culture if reactor is sparged with pure O_2 instead of air?	15	K3	CO4
		(OR)			
	b)	Elaborate on the techno-economic analysis of insulin production from recombinant *E.coli*.	15	K3	CO4