BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION MO/2023)

CLASS: M. TECH **SEMESTER: I**
BRANCH: BIOTECH **SESSION: MO/2023**

SUBJECT: BE501 ADVANCED BIOPROCESS ENGINEERING

TIME: 03 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates**

			CO	BL
Q.1(a)	i) What are the diffusion limitations of immobilized enzymes? ii) What is the principle of diffusion? What is the significance of it in immobilised enzymes? iii) What is the Michaelis-Menten kinetic scheme and how does this explain generally the observed kinetics?	[2x3=6]	1	3,4
Q.1(b)	Given the value of [S]=0.00032, and K_M= 3.5x10^{-5}, find the ratio between V_0 and V_{max}	[4]		4
Q.2(a)	Discuss the difference between batch and continuous fermentation w.r.t. the following factors: i) Type of fermentation- Batch, Continuous ii) Nutrient addition iii) Product extraction iv) Turnover rate v) Type of product vi) Growth conditions inside the fermenter vii) Chances of contamination viii) Microbial phases ix) Nutrient consumption	[5]	2	3,4
Q.2(b)	Discuss the substrate effect on fermentation kinetics.	[5]	2	3,4
Q.3(a)	Discuss the oxygen transfer in microbial process	[5]		
Q.3(b)	Calculate the power required for agitation of non-aerated medium in fermentation whose operating conditions are as follows: Fermenter diameter = 3 m; Number of impellers = 1; Mixing speed = 300 rpm; Diameter of the Rushton turbine = 1 m; Viscosity of the broth = 0.001 pa.S; Density of the broth = 1000 kg.M^{-3}; Power number = 5	[5]		
Q.4(a)	Discuss the factors depending on the scale up process of fermentation?	[4]	4	3
Q.4(b)	A pilot-scale fermenter of diameter and liquid height 0.5 m is fitted with four baffles of width one-tenth the tank diameter. Stirring is provided using a Scaba 6SRGT curved-blade disc turbine with diameter one-third the tank diameter. The density of the culture broth is 1000 kg m^{-3} and the viscosity is 5 cP. Optimum culture conditions are provided in the pilot-scale fermenter when the stirrer speed is 185 rpm. Following completion of the pilot studies, a larger production-scale fermenter is constructed. The large fermenter has a capacity of 6 m^3, is geometrically similar to the pilot-scale vessel, and is also equipped with a Scaba 6SRGT impeller of diameter one-third the tank diameter. (a) What is the power consumption in the pilot-scale fermenter? (b) If the production-scale fermenter is operated so that the power consumed per unit volume is the same as in the pilot-scale vessel, what is the power requirement after scale-up? *Use the following data:* $Re_i = N_i D_i^2 \rho / \mu$ $P = N_P \rho N_i^3 D_i^5$ N_P = 1.5 for Scaba 6SRGT turbine 1W = 1kgm^{2}s^{-3}	[3x2=6]	4	3,4

PTO

Q.5(a)	What is the bottleneck for cellulosic bioethanol commercialization in terms of economics?	[3]	3,4
Q.5(b)	What are the general cost considerations of fermentation industry? How economics of a fermentation process can be assessed?	[3]	3, 4
Q.5(c)	Evaluate the product recovery cost in fermentation industry.	[4]	4,5

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