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

CLASS: M.TECH **SEMESTER: 1st**
BRANCH: BIOENGINEERING & BIOTECHNOLOGY **SESSION: MO/24**

SUBJECT: BE501 ADVANCED BIOPROCESS ENGINEERING

TIME: 3 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

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Q.1(a)	Define enzyme activity (IU). Derive immobilized enzyme kinetic equation indicating Dam Kohler Number.	[5]	1	3
(b)	An enzyme has a Km value of 4.7×10^{-5} M, and Vmax value of 25 mole/L. min. What will be the velocity in the presence of substrate concentration of 2.5×10^{-4} M and competitive inhibitor concentration of 3.5×10^{-4} M ($K_i = 3\times10^{-4}$ M)? Calculate the degree of inhibition in this case.	[5]	1	5
Q.2(a)	Write the steps for media optimization (OFAT and multi-factor) for any bioprocess.	[5]	2	3
(b)	Prove that in a chemostat at steady state and for sterile feed, D = μ; Where, D = dilution rate and μ = specific growth rate.	[5]	2	4
Q.3(a)	Explain the different mechanisms or modes of air sterilization.	[5]	3	3
(b)	A fed-batch culture operates with the intermittent addition of glucose solution. The values of the following parameters are given at t = 2 h. Considering the system is at a quasi-steady state, calculate V_0, S and X. Given, V = 1000 mL; S_0 = 100 g/L; K_s = 0.1 g/L; X_0 = 30 g; F = 200 mL/h; μ_{max} = 0.3 h^{-1}; $Y_{x/s}$ = 0.5 g/g.	[5]	3	5
Q.4(a)	Describe any one physical and one chemical sensor used in the Bioreactor.	[5]	4	3
(b)	Consider scaling up fermentation from a 10 L to a 10000 L vessel (scale-up ratio 3:1). The small fermenter has a height-to-diameter ratio of 2. The impeller diameter is 20% of the tank diameter. The agitator speed is 600 rpm, and three impellers are used. Determine the dimensions of the large fermenter and agitator speed for constant P/V and constant impeller tip speed.	[5]	4	5
Q.5(a)	With the help of a flow diagram, illustrate the citric acid production and purification process.	[5]	5	3
(b)	An organism is used in chemostat culture in a 750 L fermenter. The feed contains 10 g/L glucose and μ_{max} and K_s of the organism is 0.5 h^{-1} and 1.5 g/L respectively. Dilution rate is 0.1 h^{-1}. What will be the final cell density in g/L? $Y_{x/s}$ = 0.8 g/g	[5]	5	5

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