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

CLASS: **B. TECH** **SEMESTER : 7th**
BRANCH: **BIOENGINEERING & BIOTECHNOLOGY** **SESSION : MO/24**

SUBJECT: BE402 BIOREACTOR AND BIOPROCESS DESIGN

TIME:3 hour **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)	Describe the dynamic method of determination of K_La for aerobic fermentation.	[5]	1	3
(b)	An organism is used in chemostat culture in a 60 m^3 fermenter. The feed contains 12 g/L glucose, and μmax and Ks of the organism is 0.3 h^{-1} and 0.2 g/L, respectively. What flow rate is required for steady-state substrate concentration to reach 1.5 g/L? What will the cell density be at that flow rate? $Y_{x/s}$ = 0.06 g/g	[5]	1	5
Q.2(a)	Draw the E curve for i) Ideal PFR; ii) Ideal MFR; iii) Short-circuiting in PFR; iv) Channeling in PFR; v) Internal recirculation in PFR	[5]	2	3
(b)	A 12 m length pipe is packed with 1 m of 2 mm, 9 m of 1 cm, and 2 m of 4 mm particles. Estimate the variance (σ^2) in the output C curve for a pulse input into this packed bed if the fluid takes 2 min to flow through the bed. Assume a constant bed void and a constant intensity of dispersion given by D/ud_p = 2.	[5]	2	4
Q.3(a)	Derive the performance equation for an ideal batch reactor. Why scale down is needed?	[5]	3	2
(b)	A specific enzyme acts as catalyst in the fermentation of reactant A. At a given enzyme concentration in the aqueous feed stream (25 L/min) find the volume of plug flow reactor needed for 95% conversion of reactant A (C_{A0} = 2 mol/L). The kinetics of the fermentation at this enzyme concentration is given by $$-r_A = \frac{0.1C_A}{1+0.5C_A}$$	[5]	3	5
Q.4(a)	Describe the pH and Temperature sensor used in the Bioreactor.	[5]	4	3
(b)	Explain with a diagram the principle, advantages, and disadvantages of the 'P' type, 'I' type and 'D' type controllers.	[5]	4	3
Q.5(a)	With the help of a flow diagram, illustrate the penicillin production and purification process.	[5]	5	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]	5	5

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