

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

CLASS: M.TECH
BRANCH: BIOTECHNOLOGY

SEMESTER : I
SESSION : MO/19

SUBJECT: BE501 ADVANCED BIOPROCESS ENGINEERING

TIME: 3:00 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. Before attempting the question paper, be sure that you have got the correct question paper.
 5. Tables/Data handbook/Graph paper etc. to be supplied to the candidates in the examination hall.
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Q.1(a) What do you mean by allosteric enzyme? Describe a method for determination K_m value of an allosteric enzyme. [5]

Q.1(b) Calculate for an enzyme catalyzed reaction V_{max} and K_m . Given $[E_0] = 0.015$ g/l. [5]

V_o (g/l-min)	1.18	1.11	0.98	0.85	0.71	0.58	0.47	0.32
S_o (g/l)	20	10	6.7	5.0	4.0	3.3	2.9	2.5

Q.2(a) Following initial data were obtained for production of gluconic acid by a bacterial isolate. Design the steps for optimization of Carbon and Nitrogen components of medium. [5]

Name of Components of medium	Starch	NaNO ₃	Yeast Extract	FeSO ₄ .7H ₂ O	K ₂ HPO ₄
Components of medium (g/l)	6	1.2	1	0.008	0.2

Q.2(b) Describe the technique of simplex search method for optimization of medium. Propose the simplex plot for a lab optimized medium containing starch 6 g/L and NaNO₃ g/L. [5]

Q.3(a) Examine the factors affecting *in situ* sterilization of fermentation medium in a batch bioreactor. [5]

Q.3(b) A bacterial culture was growing in a 5 L fermenter. Calculate K_{1a} by using following data. When this process initiated CSTR was maintained at 52% of O₂ saturation. [5]

Equilibrium DO level	Aeration Stopped					Aeration resumed			
DO (%)	52	37	29	22	23	32	40	47	51
Time (min)	0	1.5	3	4.5	6	7.5	9	10.5	12

Q.4(a) Scale up a bioreactor from 5 L to 5000L. Draw a labelled diagram of STR and propose rpm, if it was initially operated at 400 rpm. Medium and other geometrical ratio were kept constant. Tank diameter to impellor diameter ratio was 3 in 5L fermenter. [5]

Q.4(b) Describe in detail about steps involved in scale up based on maintaining constant power per unit volume. Geometrical similarity at two level could be assumed. [5]

Q.5(a) Describe the components of a bioprocess industry for which cash flow is required. Describe in detail about cash flow for industrial operation. [5]

Q.5(b) Mention the components of bioprocess plant. Describe the factors affecting investment and production cost of a biotech product. [5]

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