

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

CLASS: MTECH
BRANCH: BIOTECHNOLOGY

SEMESTER : I
SESSION : MO/18

SUBJECT: BE501-ADVANCED BIOPROCESS ENGINEERING

TIME: 03:00 HRS.

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 hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
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Q.1(a) Propose assumption associated with mechanistic model of enzyme kinetics. Derive the simple expressions for hydrolysis of cellulose. [5]

(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 | 0.91 | 0.78 | 0.65 | 0.51 | 0.44 | 0.37 | 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 |

(b) Yeast grown on glucose is described by [5]



Calculate total oxygen required and $Y_{x/s}$ for a design requiring 50 g/L of yeast in a batch reactor of 100,000L.

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

(b) Calculate K_La by using following data. When this process initiated CSTR was maintained at 55% of O₂ saturation. [5]

| | | | | | | | | | |
|----------------------|------------------|-----|----|-----|----|------------------|----|------|----|
| Equilibrium DO level | Aeration Stopped | | | | | Aeration resumed | | | |
| Time (min) | 55 | 37 | 29 | 22 | 23 | 32 | 40 | 47 | 51 |
| DO (%) | 0 | 1.5 | 3 | 4.5 | 6 | 7.5 | 9 | 10.5 | 12 |

Q.4(a) Calculate the rpm of an impellor for a CSTR scaled to 5000L from 50L. Medium and other geometrical ratio were kept constant. Tank diameter to impellor diameter ratio was 3 in 50L fermenter. [5]

(b) Describe in detail about steps involved in scale up based on maintaining constant tip speed. Geometrical similarity at two level could be assumed. [5]

Q.5(a) Describe in detail about process of costing of a bioprocess. [5]

(b) How will you justify that "the role of net profit on cash flow over the full life cycle of an industrial operation is critical". [5]