Printed page: 4 Subject Code: ABT0502

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NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech

SEM: V - THEORY EXAMINATION (2024-2025)

Subject: Bioprocess Engineering

Time: 3 Hours Max. Marks:100

General Instructions:

IMP: Verify that you have received question paper with correct course, code, branch etc.

1. *This Question paper comprises of three Sections -A, B, & C. It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.*
2. *Maximum marks for each question are indicated on right hand side of each question.*
3. *Illustrate your answers with neat sketches wherever necessary.*
4. *Assume suitable data if necessary.*
5. *Preferably, write the answers in sequential order.*
6. *No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.*

SECTION – A 20

1. Attempt all parts:-

1-a. Which phase has the condition of specific growth rate "$\mu = 0$"? (CO1, K2) 1

(a) Log Phase

(b) Death Phase

(c) Stationary Phase

(d) Lag Phase

1-b. Calculate the stoichiometric coefficients of the following biological reaction: 1

Glucose: $C_6H_{12}O_6 + aO_2 + bNH_3 = c\ (C_{4.4}H_{7.3}N_{0.86}O_{1.2}) + d\ H_2O + e\ CO_2$ (CO1, K2)

(a) a = 1.573, b = 0.685, c = 0.470, d = 2.564, e = 2

(b) a = 2.789, b = 1.896, c = 0.438, d = 1.395, e = 1

(c) a = 1.473, b = 0.782, c = 0.909, d = 3.854, e = 2

(d) a = 2.390, b = 1.295, c = 0.943, d = 2. 564, e = 1

1-c. The catalytic efficiency of two distinct enzymes can be compared based on which of the following factor? (CO2, K2) 1

(a) K_m

(b) Product formation

(c) Size of the enzymes

(d) pH of optimum value

1-d. Which of the following matrix is not used while immobilizing the enzyme by covalent binding? (CO2, K1) 1

(a) Agarose
(b) Cellulose
(c) Calcium alginate
(d) Glutaraldehyde

1-e. Impeller flooding signifies…….. (CO3, K1) 1

(a) The flooding of an impeller
(b) Gas handling is greater than the amount introduced
(c) Gas handling is smaller than the amount introduced
(d) None of the above

1-f. What do you mean by "k_La"? (CO3, K1) 1

(a) Volumetric mass transfer coefficient
(b) Henry's law coefficient
(c) Volumetric oxygen transfer coefficient
(d) None of these

1-g. Which type of fermenter and process does Penicillin production requires? (CO4, K1) 1

(a) Batch fermenter and fed-batch process
(b) Batch fermenter and batch process
(c) Continuous fermenter and fed-batch process
(d) Continuous fermenter and batch process

1-h. _____ species are used for acetone–butanol production. (CO4, K1) 1

(a) Clostridium
(b) Bacillus
(c) Streptomyces
(d) Acetobacter

1-i. Are these statements about the sterilization true? 1

Statement 1: Sterilization process consists of 3 phases.

Statement 2: Phase 2 in sterilization process is known as holding phase. (CO5, K1)

(a) True, False
(b) True, True
(c) False, True
(d) False, False

1-j. Which of the following is an advantage of continuous sterilization over batch sterilization? (CO5, K1) 1

(a) Solid matter can be used in media

(b) Reduction of fermenter corrosion

(c) Lower risk of contamination

(d) Easier control

2. Attempt all parts:-

2.a. What is bacterial growth rate? How it differs from specific growth rate? (CO1, K2) 2

2.b. State the advantages of fed-batch bioreactor over batch reactor. (CO2, K1) 2

2.c. Discuss why baffles are installed in the side wall of the bioreactor leaving a small gap. (CO3, K1) 2

2.d. What type of difficulties one can face during the downstream processing of proteins? (CO4, K1) 2

2.e. What do you understand by decimal reduction time in context to sterilization? (CO5, K1) 2

SECTION – B 30

3. Answer any <u>five</u> of the following-

3-a. Describe any two indirect methods of quantifying microbial growth. (CO1, K2) 6

3-b. The growth of *S. cerevisiae* on glucose under anaerobic conditions can be described by the following overall reaction: 6

$C_6H_{12}O_6 + b\ NH_3 \rightarrow 0.59\ CH_{1.74}N_{0.2}O_{0.45}$ (biomass) + $0.43\ C_3H_8O_3 + 1.54CO_2 + 1.3\ C_2H_5OH + 0.036\ H_2O$

a. Determine the biomass yield coefficient $Y_{X/S}$.

b. Determine the product yield coefficients $Y_{EtOH/S}$, $Y_{CO2/S}$, Y_{C3H8O3}. (CO1, K2)

3-c. Describe the significance of K_m, V_{max} and K_{cat} in enzyme kinetics. (CO2, K2, K3) 6

3-d. Explain any two enzyme immobilization method. What are the advantages and disadvantages of that method? (CO2, K1) 6

3-e. Using appropriate example discuss solid-state fermentation. (CO3, K1) 6

3-f. Discuss any case study involving the production of insulin. (CO4, K2) 6

3-g. Elaborate the advantages of continuous sterilization over batch sterilization. (CO5, K1) 6

SECTION – C 50

4. Answer any <u>one</u> of the following-

4-a. Discuss the kinetics of microbial growth and substrate utilization. (CO1, K2) 10

4-b. Using appropriate example elaborate the stoichiometry of microbial product formation. (CO1, K2) 10

5. Answer any <u>one</u> of the following-

5-a. Discuss in detail construction and working of a continuous bioreactor. (CO2, K1) 10

5-b. Explain the characteristic features of immobilized enzymes. What do you understand by cross-linked enzymes? (CO2, K2) 10

6. Answer any <u>one</u> of the following-

6-a.	Illustrate various parameters that need to be checked during scale up of a bioreactor and also give mathematical equations corresponding to them. (CO3, K1)	10
6-b.	Elaborate the operation and control of a bioreactor with respect to aeration and heat transfer. (CO3, K1)	10

7. Answer any <u>one</u> of the following-

7-a.	Describe the process for high fructose corn syrup production. (CO4, K1)	10
7-b.	With appropriate discussion elaborate the production process of bio-ethanol. (CO4, K1)	10

8. Answer any <u>one</u> of the following-

8-a.	Elaborate various heat based and radiation based methods of sterilization. (CO5, K1)	10
8-b.	Discuss mathematical modelling used in bioprocess engineering in context to dynamic mass balance equations. (CO5, K1)	10