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Printed Page:-4 **Subject Code:- ABT0502**

Roll. No:

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA
(An Autonomous Institute Affiliated to AKTU, Lucknow)
B.Tech
SEM: V - THEORY EXAMINATION (2025 - 2026)
Subject: Bioprocess Engineering

Time: 3 Hours **Max. Marks: 100**

General Instructions:

IMP: *Verify that you have received the question paper with the 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. Degree of reduction of carbon dioxide is (CO1, K2) 1

(a) 6
(b) 8
(c) 4
(d) 0

1-b. The organism which obtain their energy from chemicals are designated as (CO1, K2) 1

(a) prototrophs
(b) chemotrophs
(c) organotrophs
(d) autotrophs

1-c. An uncatalyzed reaction involved: (CO2, K2) 1

(a) High activation energy
(b) Low activation energy
(c) Balanced activation energy
(d) All of these

1-d. Which of the the following is mandatory for all metabolic reactions? (CO2, K2) 1

(a) Breakdown of biomolecules
(b) Synthesis of biomolecules
(c) Presence of inhibitor
(d) Presence of catalyst

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1-e. The agitator is required to _____ (CO3, K2) 1

(a) Provide air
(b) Mixing objectives
(c) Purify the product
(d) Sterilize the media

1-f. The output of the feedback control system must be a function of _____ (CO3, K2) 1

(a) Output and feedback signal
(b) Input and feedback signal
(c) Reference input
(d) Reference output

1-g. The bio ethanol is subjected to rectification to remove _____ (CO4, K2) 1

(a) Sugar
(b) Enzymes
(c) Yeast
(d) Impurities

1-h. Which process is also called product recovery? (CO4, K1) 1

(a) Upstream processing
(b) Mid-stream processing
(c) Downstream processing
(d) Biological processing

1-i. What do you mean by sterilization? (CO5, K2) 1

(a) Purification of products
(b) Recovery of products
(c) Elimination of contamination
(d) Formulation of media

1-j. How long does it take for the autoclave to complete its cycle? (CO5, K1) 1

(a) 30-35 minutes
(b) 50 min to 1 hr
(c) 15-20 minutes
(d) 10-15 minutes

2. Attempt all parts:-

2.a. What is doubling time? (CO1, K2) 2

2.b. What do you mean by allosteric site? (CO2, K2) 2

2.c. What is the importance of Reynold's number? (CO3, K2) 2

2.d. What is the alternative of gasoline for flexifuel vehicles? (CO4, K2) 2

2.e. When is RSM employed for optimization of media components?(CO5, K2) 2

SECTION-B 30

3. Attempt all parts:-

3.a. Answer any one of the following:-

3.a.(i)	With the help of labelled diagram explain the working mechanism of particle counter for the determination cell number density? (CO1, K2)	6
3.a.(ii)	Classify microbial products into different categories? (CO1, K3)	6
3.b. Answer any one of the following:-		
3.b.(i)	Differentiate between enzyme catalysts and chemical catalysts?(CO2, K3)	6
3.b.(ii)	Diagrammatically explain in detail about the principle of enzyme action? (CO2, K2)	6
3.c. Answer any one of the following:-		
3.c.(i)	Discuss about the different components of control system in a bioreactor? (CO3, K2)	6
3.c.(ii)	Discuss about the PID controllers highlighting their advantages? (CO3, K2)	6
3.d. Answer any one of the following:-		
3.d.(i)	Describe the industrial process for penicillin production, highlighting the roles of the microorganism (*Penicillium chrysogenum*), the type of fermentation used, and the specific physiological conditions required for optimal yield. (CO4, K3)	6
3.d.(ii)	Describe the key parameters (temperature, pH, aeration rate, agitation strength) that need to be monitored and controlled during the industrial fermentation of a Xanthan Gum and their impact on yield and product quality (CO4, K3)	6
3.e. Answer any one of the following:-		
3.e.(i)	Describe various kinds of sensors for monitoring key parameters such as temperature, pressure, flow, dissolved oxygen (DO) concentration, pH, and cell concentration. (CO5, K3)	6
3.e.(ii)	Explain the principles and operation of a foam control system in a bioreactor. Why is mechanical foam breaking often preferred over the use of antifoam agents? (CO5, K2)	6

SECTION-C 50

4. Answer any one of the following:-

4-a.	Explain in detail about yield coefficients of biomass and product formation? Give suitable examples (CO1, K3)	10
4-b.	Discuss about microbial growth curve in detail with diagram (CO1, K3)	10

5. Answer any one of the following:-

5-a.	Briefly explain the principles of enzyme catalysis and detail the four main types of enzyme immobilization techniques. Discuss the key advantages of using immobilized enzymes over free enzymes in an industrial setting (CO2, K3)	10
5-b.	Discuss and derive the equation for chemostat with Immobilized cells and discuss the significance of washout conditions and D(Optimum) (CO2, K3)	10

6. Answer any one of the following:-

6-a.	Discuss and derive the energy-balance equation for heat exchanger? How this can be utilized for developing novel heat exchangers (CO3, K3)	10
6-b.	With the help of labelled diagram, explain the steps for oxygen transfer from gas bubble to cell clumps? (CO3, K3)	10

7. Answer any one of the following:-

7-a.	Discuss the importance of feedstocks. Also discuss about the different crops used in	10

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bioethanol production? (CO4, K3)

7-b.	Explain the process of producing human insulin using rDNA technology, highlighting the key steps involved and biological rationale for this method over traditional methods. (CO4, K3)	10

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

8-a.	Explain the fundamental principle of sterilization in bioprocess engineering and compare the design and operational differences between batch and continuous sterilization methods (CO5, K3)	10
8-b.	Briefly discuss how optimization techniques are applied in bioprocesses to enhance product formation. How do mathematical models assist in this optimization process? (CO5, K3)	10