Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–VI EXAMINATION – WINTER 2025

Subject Code:3160512 Date:25-11-2025

Subject Name:Biochemical Engineering

Time:02:30 PM TO 05:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	State the function of following in Eukaryotic cell: 1. Golgi bodies 2. endoplasmic reticulum 3. Chloroplasts	**03**
	(b)	Justify the following statement: 'Agitator is important component for fermenter design'. Write the flow pattern for the following agitator: 1. Disc turbine 2. Pitched blade agitator	**04**
	(c)	Explain the biological process with a suitable block diagram. State the merit and demerit of biological process.	**07**
Q.2	**(a)**	Differentiate between Monosaccharides and Polysaccharides.	**03**
	(b)	Specify building blocks and bond formation for the following: (1) Protein, (2) Disaccharides, (3) Fat, and (4) Nucleotide.	**04**
	(c)	Define the quaternary structure of protein? Classify the following protein based on their structure: 1. Insulin 2. Hemoglobin 3. Glycine 4. Fibrous protein Discuss the three important characteristics of protein.	**07**
		OR	
	(c)	Discuss in brief about property of lipid, its variant and application.	**07**
Q.3	**(a)**	What is enzyme inhibition? List out the various type of enzyme inhabitation.	**03**
	(b)	List out the unit operations involved for separation of products based on the following criteria 1. Size 2. Solubility 3. Diffusivity 4. Vapour pressure	**04**
	(c)	Following sequence describes the reactions of two different substrates catalyzed by one enzyme: $E + S_1 \underset{k_2}{\overset{k_1}{\rightleftharpoons}} ES_1$ $ES_1 + S_2 \underset{k_4}{\overset{k_3}{\rightleftharpoons}} ES_1S_2$ $ES_1S_2 \xrightarrow{k_5} E + P$	**07**

a. Derive the rate equation by making the Michaelis-Menten assumption.
b. What is the rate equation if the concentration of S_1 is much higher than that of S_2 ?

OR

Q.3 **(a)** Sate the important points in designing and constructing a fermenter. **03**

(b) Discuss the following plots for estimation of kinetic parameters: **04**

1. Langmuir plot
2. Line weaver-Burk plot

(c) What is Enzyme immobilization? List out the methods used for enzyme immobilization. Explain the merit of enzyme immobilization over suspended cultures. **07**

Q.4 **(a)** Define the following: **03**

(1) Sterilization (2) Foaming in reactor (3) oxygen uptake rate

(b) State the mechanism and application of following chromatography: **04**

1. Adsorption chromatography
2. Gel-filtration chromatography

(c) The following data were obtained from enzymatic oxidation of phenol by phenol oxidase at different phenol concentrations. **07**

S (mg/l)	10	20	30	50	60	80	90	110	130	140	150
v (mg/l-h)	5	7.5	10	12.5	13.7	15	15	12.5	9.5	7.5	5.7

a. What type of inhibition is this?
b. Determine the constants Vm and Km.
c. Determine the oxidation rate at [S] = 70 mg/l.

OR

Q.4 **(a)** What is isoelectric focusing? State the mechanism and use of isoelectric focusing in biochemical processing. **03**

(b) Briefly Discuss the following: **04**

(1) cell death kinetics
(2) Monod Equation

(c) Aerobic degradation of an organic compound by a mixed culture of organisms in waste water can be represented by the following reaction. **07**

$C_3H_6O_3 + aO_2 + bNH_3 \rightarrow cC_5H_7NO_2 + dH_2O + eCO_2$

a. Determine a, b, c, d, and e, if $Y_{X/S} = 0.4$ g X/g S.
b. Determine the yield coefficients $Y_{X/O2}$ and $Y_{X/NH3}$.
c. Determine RQ (Respiratory Quotient) for the organisms.

Q.5 **(a)** List the methods available for product recovery. How cell disruption is useful in biochemical processes? **03**

(b) What is volumetric oxygen transfer coefficient? State the factor affecting it. **04**

(c) Discuss the plug flow reactor for biomass processing with a suitable diagram. **07**

OR

Q.5 **(a)** Differentiate between chemostat and turbidostat for biological process. **03**

(b) State the unique features of batch and continuous biomass culture. **04**

(c) Discuss the continuous stirred tank reactor biomass using a suitable diagram. **07**

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Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–VI (NEW) EXAMINATION – WINTER 2024

Subject Code:3160512 **Date:05-12-2024**

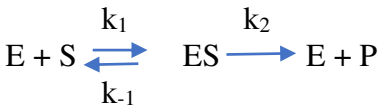
Subject Name:Biochemical Engineering

Time:02:30 PM TO 05:00 PM **Total Marks:70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Explain Polysaccharides with its examples.	**03**
	(b)	Discuss in detail about various unit operations involved in bioprocess.	**04**
	(c)	Give comparison of Chemical and Biochemical processes with advantages and limitations.	**07**
Q.2	**(a)**	Explain Allosteric enzymes.	**03**
	(b)	The following data have been obtained for initial enzyme concentration [E0] for an enzyme-catalysed reaction.	**04**



Rate of formation r([E0] = 0.015 g/l) (g/l-min)	Substrate Concentration [S] (g/l)
1.14	20.0
0.87	10.0
0.70	6.7
0.59	5.0
0.50	4.0
0.44	3.3
0.39	2.9
0.35	2.5

a. Find *Km*.
b. Find maximum forward velocity of the reaction *Vm* for [E0] = 0.015 g/l.
c. Find rate constant k_2.

	(c)	Give comparison of Eukaryotic and Prokaryotic cells using suitable labelled images.	**07**
		OR	
	(c)	Explain types of proteins in detail.	**07**
Q.3	**(a)**	Explain: 1) Proximity effect of enzyme 2) Orientation effect of enzyme 3) specific activity	**03**
	(b)	Derive Michaelis and Menten rate equation assuming rapid equilibrium between Enzyme and substrate to form [ES] complex.	**04**
	(c)	Discuss ‘Entrapment’ for immobilization of Enzymes with its types.	**07**
		OR	

Q.3	**(a)**	What is Damkohler number? Give its significance.	**03**
	(b)	Explain the effect of pH and temperature on enzyme activity.	**04**
	(c)	Describe reactions for competitive inhibitors and derive rate equation for the same.	**07**
Q.4	**(a)**	Explain Monod growth kinetics using equation.	**03**
	(b)	Draw schematic diagram for growth of microorganism in batch culture.	**04**
	(c)	Discuss types of sterilization of media in detail.	**07**

OR

Q.4	**(a)**	Discuss 'Chemostat continuous culture' with dilution rate.	**03**
	(b)	Why aeration and agitation is required for fermentation process.	**04**
	(c)	Explain static method of gassing out for determination of mass transfer coefficient K_La value.	**07**
Q.5	**(a)**	Explain Ultrasonication technique for cell disruption.	**03**
	(b)	Discuss the method of media preparation	**04**
	(c)	Discuss various parts and controls of fermenter using suitable diagram.	**07**

OR

Q.5	**(a)**	Describe environmental factors affecting microbial growth of microorganisms.	**03**
	(b)	Name various industrial importance enzymes and mention their applications.	**04**
	(c)	Discuss adsorption chromatography for separation and purification of products.	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI (NEW) EXAMINATION – WINTER 2023

Subject Code:3160512 Date:13-12-2023

Subject Name: Biochemical Engineering

Time:02:30 PM TO 05:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

Q.1	(a)	State the important differences between prokaryotes and eukaryotes.	03
	(b)	Outline the method of the graphical evaluation of kinetic parameters derived from the Michaels-Menten equation?	04
	(c)	Explain 'Lock and Key' and 'Induced fit Model' of enzyme-substrate complex formation hypothesis	07
Q.2	(a)	List the various unit operation involved in bio-processing operation	03
	(b)	You as a chemical engineer will decide on which general requirements of Fermentation process.	04
	(c)	State the advantages and disadvantages of the continuous culture.	07
		OR	
	(c)	Differentiate between competitive, uncompetitive and non-competitive enzyme inhibition.	07
Q.3	(a)	Enlist various techniques of Enzyme/Cell immobilization.	03
	(b)	Write in brief on different types of sterilization	04
	(c)	Explain the phenomenon of thermal-death kinetics of cells and spores	07
		OR	
Q.3	(a)	List three industrially important enzymes with their uses	03
	(b)	Outline the different methods used for measurement of microbial growth?	04
	(c)	Explain growth of a typical microbial culture in batch conditions.	07
Q.4	(a)	Explain 'critical dilution rate' and 'wash out' in context with continuous culture	03
	(b)	Discuss various problems that may arise if DO level falls down in an aerobic process	04
	(c)	Explain the methods for determination of K_{La} value	07
		OR	
Q.4	(a)	Write down Monod equation of microbial growth and explain the terms therein	03
	(b)	State the names of mediums for bio processing operations and discuss them.	04
	(c)	Describe various methods of product separation and purification operations in bioprocess industries in brief.	07
Q.5	(a)	How is fed-batch process carried out for fermentation.	03
	(b)	Explain any method of membrane separation used for product recovery?	04
	(c)	Explain the method of manufacturing of industrial alcohols using biotechnology route?	07
		OR	
Q.5	(a)	Define aerobic and anaerobic fermentation process with an example of each.	03
	(b)	Outline the various challenges faced during the scale-up process at different level.	04
	(c)	Discuss the different types of fermenter used in batch and continuous process.	07

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