Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER– VI EXAMINATION – SUMMER 2026

Subject Code:3160512 Date:01-06-2026

Subject Name:Biochemical Engineering

Time:10:30 AM TO 01:00 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)**	List out the process in Biochemical engineering, which required knowledge of other engineering field.	**03**
	(b)	List out the product of industrial importance involved the use of fermenter. How the fermenter is operated under controlled conditions in industry?	**04**
	(c)	Explain the reason behind higher selectivity of enzyme catalyzed reaction over conventional chemical reaction. List out factor affecting activity of enzymatic reaction.	**07**
Q.2	**(a)**	What are major sources of carbon, nitrogen, and phosphorus in industrial fermentations?	**03**
	(b)	Compare between Monosaccharides, Disaccharides and Polysaccharides.	**04**
	(c)	What is a major constituent of lipid? Are steroid and fat considered in lipid? What is the role of steroid and fat in living organism?	**07**
		OR	
	(c)	What is denaturation of protein? List out the five major biological functions of proteins.	**07**
Q.3	**(a)**	List out three industrial enzymes, its source and its application.	**03**
	(b)	What is the effect of temperature, pH and concentration of substrate on enzyme activity?	**04**
	(c)	Explain the following plots for evaluation of parameters (1) Lineweaver–Burk plot (2) Eadie–Hofstee plot (3) Hanes–Woolf plot.	**07**
		OR	
Q.3	**(a)**	Write assumption involved in enzyme kinetics for the Michaelis-Menten approach.	**03**
	(b)	List out merit of immobilization techniques for enzymatic reaction.	**04**
	(c)	Differentiate between competitive and non-competitive inhibition.	**07**
Q.4	**(a)**	Define the product and substrate inhibition with a suitable example?	**03**

	(b)	Briefly discuss the following: (1) Cell death kinetics (2) Oxygen demand	**04**
	(c)	Explain with a neat diagram the characteristics equation of continuous culture.	**07**

OR

Q.4	**(a)**	List out the types of agitator used and its application in fermenter.	**03**
	(b)	Explain the importance of product recovery in biochemical synthesis? List out the important product recovery operation.	**04**
	(c)	List out the utilities of fermenter plant. Explain the importance of media preparation in fermenter?	**07**
Q.5	**(a)**	Define the following: (1) Oxygen uptake rate (2) Fluid rheology.	**03**
	(b)	Give the merit and demerit of continuous culture over batch culture.	**04**
	(c)	Discuss the various methods to determine the KLa value? List out the factor affecting it.	**07**

OR

Q.5	**(a)**	Discuss the use of valve and steam trap in fermentation unit.	**03**
	(b)	What is electrophoresis? Explain principal involved in electrophoresis.	**04**
	(c)	What is cell disruption. Discuss the Chemical and biological methods involved in it.	**07**

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Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI EXAMINATION – SUMMER 2025

Subject Code:3160512 Date:30-05-2025

Subject Name:Biochemical Engineering

Time:10:30 AM TO 01:00 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)**	Distinguish between bioprocess engineering and biochemical engineering.	**03**
	(b)	For animal and plant cells, mention the following differences: 1. Cell wall 2. Chloroplast 3. Vacuoles 4. Endoplasmic reticulum	**04**
	(c)	List out procedures involved in the separation and purification of intracellular enzymes. Tabulate the unit operations and their range for recovery and purification of products based on: 1. Size 2. Diffusivity 3. Surface activity 4. Density.	**07**
Q.2	**(a)**	State the role of chelator, buffer and antifoam in the microbiological process.	**03**
	(b)	Classify protein based on its structure. What is the function of transport protein?	**04**
	(c)	Define and write chemical reactions for the synthesis of: 1. Fat 2. Sucrose 3. Amylose	**07**
		OR	
	(c)	What is the denaturation of protein? List out the five major biological functions of proteins.	**07**
Q.3	**(a)**	List out physical methods adopted for immobilization of enzymes. What are the advantages and disadvantages of it compared to free enzyme?	**03**
	(b)	What is the effect of temperature, pH and concentration of substrate on enzyme activity?	**04**
	(c)	A substrate is converted to a product by the catalytic action of an enzyme. Assume that the Michaelis-Menten kinetic parameters for this enzyme reaction are: K_M = 0.03 mol/L r_{max} = 13 mol/L.min a. What should be the size of a steady-state CSTR to convert 95% of incoming substrate C_{S0}=10 mol/L) with a flow rate of 10L/hr? b. What should be the size of the reactor if a plug flow reactor is used instead of the CSTR in part (a)?	**07**
		OR	
Q.3	**(a)**	Write assumptions involved in enzyme kinetics for the Michaelis-Menten approach.	**03**
	(b)	Differentiate between competitive and noncompetitive inhibition of enzymes.	**04**

(c) The initial reaction rate of hydrolysis of acetylcholine (substrate) by dog serum (source of enzyme) and obtained the following data: **07**

Substate Concentration, mol/L	Initial Reaction Rate, mol/L.min
0.0032	0.111
0.0049	0.148
0.0062	0.143
0.0080	0.166
0.0095	0.200

Evaluate the Michaelis-Menten kinetic parameters by employing
(a) the Langmuir plot
(b) the Lineweaver-Burk plot
(c) the Eadie-Hofstee plot

Q.4 **(a)** Define the following: **03**
1. Cultivation
2. Inoculation
3. Sterilization

(b) Discuss the use of a valve and steam trap in the fermentation unit. **04**

(c) Aerobic degradation of benzoic acid by a mixed culture of microorganisms can be represented by **07**

$$\underset{\text{(substrate)}}{C_6H_5COOH} + a\,O_2 + b\,NH_3 \longrightarrow \underset{\text{(bacteria)}}{c\,C_5H_7NO_2} + d\,H_2O + e\,CO_2$$

a. Determine *a, b, c, d,* and *e* if respiratory quotient RQ = 0.9.
b. Determine the yield coefficients, $Y_{X/S}$ and $Y_{X/O2}$.

OR

Q.4 **(a)** How mass transfer limitations in bioreactors are prevented? List out the variant of it. **03**

(b) What are the limitations of batch reactors for microbial growth? How fed-batch reactor is advantageous for it? **04**

(c) Disuses sodium sulfite method for oxygen absorption rate. A fermenter was filled with 10 L of 0.5 M sodium sulfite solution containing 0.003 M Cu^{++} ion and the air sparger was turned on. After 10 minutes, the airflow stopped and a 10 mL sample was taken and titrated. The concentration of the sodium sulfite in the sample was found to be 0.21 mol/L. The experiment was carried out at 25°C and 1 atm. Calculate the oxygen uptake and K_La. **07**

Q.5 **(a)** What is foaming in a bioreactor? What are the adverse impacts of it? How it can be prevented? **03**

(b) List out the source of probable contamination generation in a bioreactor. How can it be prevented? **04**

(c) Sketch a single stirred tank reactor and write a cell and substrate mass balance. Derive an expression for dilution rate. **07**

OR

Q.5 **(a)** List out the methods used for the separation of soluble products. **03**

(b) Write about ultrafiltration and microfiltration methods. **04**

(c) What is Chromatography? Discuss the various types of chromatography methods used for product separation and recovery. **07**

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Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3160512 Date:24-05-2024

Subject Name:Biochemical Engineering

Time:10:30 AM TO 01:00 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)**	List various unit operation encountered in bioprocessing operation.	**03**
	(b)	Discuss the role of impellers used for agitation in fermentor in brief.	**04**
	(c)	Write in brief notes on various steps involved in integrated bioprocessing.	**07**
Q.2	**(a)**	Discuss any two techniques used to extract intracellular product via Cell Disruption.	**03**
	(b)	Explain different methods for the determination of kLa	**04**
	(c)	State and briefly explain various steps, either sequential or concurrent of an integrated bioprocess in general.	**07**
		OR	
	(c)	What is carbohydrate? Explain the types and function of carbohydrates.	**07**
Q.3	**(a)**	Explain why oxygen needs to be supplied at a sufficient rate during aerobic fermentation.	**03**
	(b)	Explain various methods used for immobilization of enzymes.	**04**
	(c)	Explain the Lock and Key model with diagram for enzymatic reactions	**07**
		OR	
Q.3	**(a)**	List various types of valves used in biochemical process industry.	**03**
	(b)	Discuss the asceptic condition. State important considerations for maintenance of aseptic conditions.	**04**
	(c)	Discuss the air sterilization process for a large scale aerobic fermentor with a schematic diagram. Name a few materials used as air filters.	**07**
Q.4	**(a)**	Explain range of fermentation process	**03**
	(b)	Discuss briefly various constituents of a liquid media used for growth of yeast and give examples.	**04**
	(c)	What is a fed-batch reactor? Explain with diagram various configurations of fed-batch bioreactor.	**07**
		OR	
Q.4	**(a)**	Explain the importance of pH in fermentation or enzymatic process for product formation.	**03**
	(b)	Classify enzymes with examples. How does an enzyme work?	**04**
	(c)	Draw a schematic of a fermentation vessel. Label the major components and briefly explain their functions.	**07**

Q.5	**(a)**	Name different types of solid media used for growth.	**03**
	(b)	Define crystallization and state its application in biochemical industry.	**04**
	(c)	Explain growth of a typical microbial culture in a batch conditions.	**07**

OR

Q.5	**(a)**	Discuss the limitation of bio-catalyzed reaction.	**03**
	(b)	Discuss various developments that took place in history for biochemical engineering and its products.	**04**
	(c)	Explain the types of protein with a suitable example? Discuss the factor affecting protein denaturation.	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3160512 Date:14-07-2023

Subject Name:Biochemical Engineering

Time:10:30 AM TO 01:00 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)**	Differentiate between Chemical and Biochemical process with a suitable example.	**03**
	(b)	Justify the statement "Biochemical engineering is an interdisciplinary course."	**04**
	(c)	List out the unit operations involved in biochemical processes. Elaborate the Integrated bioprocess system with suitable example.	**07**
Q.2	**(a)**	Define the following: (1) carbohydrates, (2) Protein, and (3) Lipid	**03**
	(b)	For the fermentation, write the importance of (1) Nutriant, (2) Agitator, (3) Areation , and (4) Steam.	**04**
	(c)	Differentiate between primay, secondary and tertiary protein ? List out the characteristics of protein.	**07**
		OR	
	(c)	Classify Lipid based on its structure. Discuss the important functions of lipid.	**07**
Q.3	**(a)**	List out the techniques used for sterilization. Explain the need of sterilization ?	**03**
	(b)	Justify the statement, "Media preparation is essential part of biochemical process."	**04**
	(c)	Draw the various phases for microbial growth. Explain the need of deriving methametical model for enzyme kinetics? List out the various enzyme kinetics approachs.	**07**
		OR	
Q.3	**(a)**	How the enzymes are classified? Discuss the importance of Industrial enzymes.	**03**
	(b)	Discuss the merit and demerit of Enzyme immobilization in biochemical process.	**04**
	(c)	List out the factor affecting enzymatic activity. Derive an expression for non-competitive inhibition with a suitable diagram.	**07**
Q.4	**(a)**	Explain the importance of centrifugation operation role in product recovery.	**03**
	(b)	Define the following: (1) Monod growth rate, (2) Yield coefficient, (3) Respiratory Quotients, and (4) Fluid rheology	**04**
	(c)	Compare between batch and continuous biomass culture with suitable example.	**07**
		OR	
Q.4	**(a)**	Discuss the briefly factor affecting K_La value in design of fermentor.	**03**

	(b)	List out the various confurigations for fermentation process. Draw the Fed batch reactor showing important components.	**04**
	(c)	Explain the role of maintaining the aseptic conditions and control of parameters in ferementation process.	**07**
Q.5	**(a)**	What is the importance of product recovery in biochemical unit ?	**03**
	(b)	Differentiate between microfiltration and ultra filtration method.	**04**
	(c)	State the imporatant characteristics of Stirred tank reactor in series and stirred tank reactor with recycle of biomass.	**07**

OR

Q.5	**(a)**	Define the following in context to continuous reactor: (1) critical dilution rate, (2) wash out and , (3) Residence time.	**03**
	(b)	List the product recovery method? Discuss in brief single stage and multistage extraction for biochemical process.	**04**
	(c)	Explain the variant of cell disruption method with merit and demirt of each.	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI (NEW) EXAMINATION – SUMMER 2022

Subject Code:3160512 Date:10/06/2022

Subject Name:Biochemical Engineering

Time:10:30 AM TO 01:00 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)**	Differentiate between Prokaryotic and Eukaryotic cells with a suitable example.	**03**
	(b)	Suggest the role of Aeration and Agitation in the fermentation unit. List out the various agitation units used in a typical fermenter.	**04**
	(c)	Compare the chemical processes with the biochemical process. Specify the characteristic of biochemical processes.	**07**
Q.2	**(a)**	What are carbohydrates? List out the functions of carbohydrates.	**03**
	(b)	Specify the application of the following in fermentation: (1) Sterile air, (2) Stem trap, (3) Controller, and (4) valve.	**04**
	(c)	Explain the types of protein with a suitable example? Discuss the factor affecting protein denaturation.	**07**
		OR	
	(c)	Define polysaccharides. Differentiate between amylose and amylopectin in terms of their structure, composition, and function.	**07**
Q.3	**(a)**	List out the unit operations involved in bioprocesses. Explain the need for unit operations with appropriate examples.	**03**
	(b)	Explain the effect of pH and temperature on enzyme activity.	**04**
	(c)	Derive an expression for enzyme kinetics using the Michaelis-Menten approach. State the assumption made in this approach.	**07**
		OR	
Q.3	**(a)**	Control of process parameters is essential in the fermentation unit. Please explain how the controlled conditions are kept fermentation.	**03**
	(b)	Define the term ‘Enzyme immobilization’. How the function of an enzyme is altered due to immobilization.	**04**
	(c)	What is enzyme inhibition? List out the various type of enzyme inhabitation. Derive an expression for competitive inhibition with a suitable diagram.	**07**
Q.4	**(a)**	List the types of chromatography methods. Explain its role in product recovery.	**03**
	(b)	Define the following: (1) Sterilization (2) Yield coefficient, (3) oxygen uptake rate (4) Substrate	**04**
	(c)	Discuss the following (1) cell death kinetics (2) Microbial growth phases	**07**

OR

Q.4	**(a)**	Discuss the electrophoresis process in biochemical processing.	**03**
	(b)	State the Monod Equation and suggests the techniques to determine its parameters.	**04**
	(c)	List out various methods for the determination of KLa value. Explain any one in detail.	**07**
Q.5	**(a)**	List the methods available for product recovery. What is the difference between micro and ultrafiltration?	**03**
	(b)	State the similarity and difference between batch and continuous biomass culture.	**04**
	(c)	What is a fed-batch reactor? Explain with diagram various configurations of fed-batch bioreactor.	**07**

OR

Q.5	**(a)**	What is cell disruption? Explain its importance in biochemical processes.	**03**
	(b)	Explain the term 'critical dilution rate' and 'wash out' in context with a continuous culture.	**04**
	(c)	Discuss the stirred tank reactor in series and stirred tank reactor with recycling of biomass using a suitable diagram.	**07**

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