

# 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: **04**
1. Cell wall
  2. Chloroplast
  3. Vacuoles
  4. Endoplasmic reticulum
- (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: **07**
1. Size
  2. Diffusivity
  3. Surface activity
  4. Density.

- 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: **07**
1. Fat
  2. Sucrose
  3. Amylose

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. **03**  
What are the advantages and disadvantages of it compared to free enzyme?
- (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: **07**
- $K_M = 0.03 \text{ mol/L}$   
 $r_{\max} = 13 \text{ mol/L.min}$
- a. What should be the size of a steady-state CSTR to convert 95% of incoming substrate ( $C_{S0}=10 \text{ mol/L}$ ) 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)?

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

Substrate 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

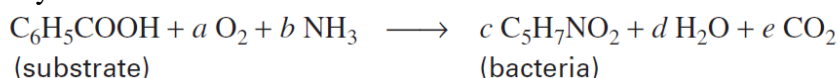
- (a) the Langmuir plot  
(b) the Lineweaver-Burk plot  
(c) the Eadie-Hofstee plot

- 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



- a. Determine  $a$ ,  $b$ ,  $c$ ,  $d$ , and  $e$  if respiratory quotient  $\text{RQ} = 0.9$ .  
b. Determine the yield coefficients,  $Y_{X/S}$  and  $Y_{X/\text{O}_2}$ .

**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  $\text{Cu}^{++}$  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  $K_{\text{La}}$ . 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

\*\*\*\*\*