



Name :

Roll No. :

Invigilator's Signature :

CS/B.TECH(CHE)/SEM-8/CHE-802/2013

2013

BIOTECHNOLOGY AND BIOCHEMICAL ENGINEERING

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following :

10 × 1 = 10

- i) The rate versus substrate concentration plot using Michaelis-Menten equation gives a
- a) section of a rectangular hyperbola
 - b) section of a parabola
 - c) straight line
 - d) none of these.



- ii) Damkohler number is defined by the ratio of
- a) Maximum rate of reaction / Maximum rate of diffusion
 - b) Maximum rate of diffusion / Maximum rate of reaction
 - c) Maximum rate of production / Maximum rate of diffusion
 - d) none of these.
- iii) The net effect of competition inhibition
- a) is an increase in the maximum velocity
 - b) is a decrease in the maximum velocity
 - c) is an increase in the apparent Michaelis-Menten constant
 - d) is a decrease in the apparent Michaelis-Menten constant.
- iv) The Hanse-Woolf plot gives slope equal to
- a) V_m
 - b) $1/V_m$
 - c) $-K_m$
 - d) K_m/V_m .



- v) The Michaelis-Menten theory is based on the assumption that is used in
- a) homogeneous catalysis
 - b) heterogeneous catalysis
 - c) both homogeneous and heterogeneous catalysis
 - d) none of these.
- vi) Monod model is a kind of
- a) structured & segregated model
 - b) unstructured & segregated model
 - c) structured & nonsegregated model
 - d) unstructured & nonsegregated model.
- vii) The reaction involved in glycolysis includes
- a) carbonization b) oxidation
 - c) phosphorylation d) dehydration.
- viii) Gel chromatography is based on
- a) solubility b) density
 - c) size d) surface activity.



ix) The best combination of reactors to achieve the substrate concentration at the maximum cell growth rate is

- a) MFR followed by PFR b) PFR followed by MFR
c) two MFRs in series d) two PFRs in series.

x) Hormones are examples of which type of proteins ?

- a) Structural b) Catalytic
c) Transport d) None of these.

xi) The terms 'stationary phase' and 'mobile phase' refer to

- a) Filtration b) Chromatography
c) Membrane separation d) Centrifugation.

xii) In order to avoid wash-out of cells from a chemostat,

$k\tau_m$ should be

- a) equal to unity b) greater than unity
c) less than unity d) none of these

where k = maximum specific cell growth rate and

τ_m = residence time.



GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following $3 \times 5 = 15$

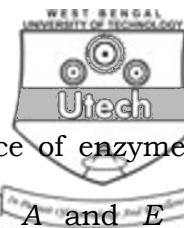
2. Describe the zwitterionic structure of amino acids. Define iso-electric point and state its utility. $2 + 3$
3. Explain how the rate of an enzymatic reaction depends on pH and temperature.
4. Define macronutrients and micronutrients with examples. Explain catabolic and anabolic processes. $3 + 2$
5. Derive the rate equation of a substrate uninhibited enzymatic reaction using Michealis-Menten theory.
6. Define turn-over number of an enzyme. How is it related to K_{cat} of an enzyme ? $3 + 2$

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) Discuss the drawback of Michaelis-Menten theory. How it has been rectified in Briggs-Halden theory ? Deduce the rate equation of an uninhibited enzymatic reaction using Briggs-Halden theory. $2 + 2 + 4$

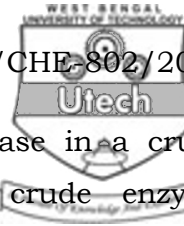


- b) Substrate A decomposes in the presence of enzyme E . To study the action of this enzyme, A and E are introduced into a batch reactor and the concentration of A is measured at various times (The initial concentration of enzyme $(C_{E0}) = 10 \text{ gm/m}^3$). The data are given below :

Time (t), hr.	0	1	4	5
Concentration of A (C_A), mol/m^3	1200	840	100	30

Find the intrinsic kinetic parameters of Michaelis -
Menten equation. 7

8. a) Describe the TCA cycle of glucose metabolism with detailed diagram. 10
- b) What are fats ? Give the reaction for formation of fats from fatty acid and glycerol. 5
9. a) What are the main features of an allosteric enzyme ? Compare graphically the behaviour of allosteric enzymes with the enzymes following Michaelis-Menten equation. 3 + 3
- b) Define specific activity of an enzyme. What is the unit of specific activity ? 2 + 2



- c) To measure the amount of glucoamylase in a crude enzyme preparation, 1 ml of the crude enzyme preparation containing 8 mg protein is added to 9 ml of a 4.4% starch solution. One unit of activity of glucoamylase is defined as the amount of enzyme which produces 1 μ mol of glucose per minute in a 4% solution of Lintner starch at pH 4.5 and at 60°C. Initial rate of experiments shows that the reaction produces 0.6 μ mol of glucose/ml.min. What is the specific activity of the crude enzyme ? 5

10. a) Derive the performance equation of Chemostat in terms of substrate concentration and residence time used for carrying out a microbial fermentation reaction following substrate uninhibited Monod equation. 7

- b) A specific bacterium lives and grows on lactose. In order to study the kinetic of this reaction, the following experimental data (in consistent units) were obtained from a batch reactor :

Time (t)	0	0.54	0.90	1.23	1.58	1.95	2.33	2.70
Concentration of substrate (C_A)	147	125	104	70	38	18	3	1
Concentration of cell (C_C)	15.5	23	30	38.8	48.5	58.3	61.3	62.5

Find the intrinsic kinetic parameters of Monod's equation. 8



11. a) The following data were obtained in a constant pressure filtration unit for Yeast suspension :

T min	4	20	48	76	120
V filtrate(l)	115	365	680	850	1130

Characteristics of the filter are as follows :

$A = 2.28 \text{ m}^2$, $C = 1920 \text{ kg/m}^3$, $\mu = 2.9 \times 10^{-3} \text{ kg/ms}$,
 $\alpha = 4 \text{ m/kg}$.

- i) Determine the pressure drop across the filter
 - ii) Determine the filter medium resistance r_m
 - iii) Determine the size of the filter for same pressure drop to process 4000 L cell suspension in 20 min. 9
- b) Write short notes on any *two* of the following : $2 \times 3 = 6$
- i) Reverse osmosis
 - ii) Concentration polarization
 - iii) Regulatory enzyme.

=====