



Name :

Roll No. :

Invigilator's Signature :

CS / B.TECH(CHE-NEW) / SEM-8 / CHE-802 / 2010

2010

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.

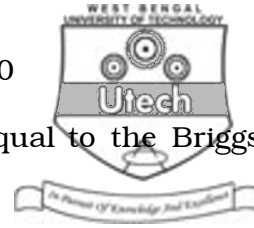
GROUP – A

(Multiple Choice Type Questions)

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

$$10 \times 1 = 10$$

- i) The rate of an enzyme-catalyzed reaction is
than that of the same reaction when directed by non-
biological catalysts.
- a) usually not much alter
 - b) usually much slower
 - c) usually much faster
 - d) none of these.



- ii) Michaelis-Menten Equation can be equal to the Briggs-Haldane equation when
- a) the product releasing step is much slower than the enzyme-substrate complex dissociation step
 - b) the product releasing step is much faster than the enzyme-substrate complex dissociation step
 - c) both (a) and (b)
 - d) none of these.
- iii) An enzyme containing a non-protein group is known as
- a) apoenzyme
 - b) holoenzyme
 - c) isoenzyme
 - d) none of these.
- iv) The molecules which can be separated by ultrafiltration process have the size range
- a) 10 - 100 nm
 - b) 2 - 10 nm
 - c) 0.1 - 10 μm
 - d) 0.1 - 1 nm.
- v) Fermentation broths of mold exhibit
- a) Newtonian behavior
 - b) non-Newtonian behavior
 - c) Ideal behavior
 - d) none of these.



- vi) At steady state dilution rate (D) in chemostat is
- a) greater than growth rate
 - b) less than growth rate
 - c) equal to growth rate
 - d) may be both (a) and (b).
- vii) When filtration is not a satisfactory separation method for microbial cells or other similar sized particles it may be replaced by the method of
- a) Evaporation
 - b) Solvent extraction
 - c) Centrifugation
 - d) Chromatography.
- viii) Allosteric enzymes have substrate binding site.
- a) only one
 - b) more than one
 - c) no
 - d) inhibited.
- ix) HPLC stands for
- a) High performance liquid chromatography
 - b) High propensity liquid chromatography
 - c) High purity liquid chromatography
 - d) High prospect liquid chromatography.



- x) Gel chromatography is based on
- a) solubility
 - b) density
 - c) size
 - d) surface activity.
- xi) Dextran can be separated from milk whey by
- a) Microfiltration
 - b) Ultrafiltration
 - c) Pervaporation
 - d) Reverse osmosis.
- xii) Globular protein contains mainly
- a) α -helix
 - b) β -helix
 - c) γ -helix
 - d) none of these.

GROUP – B

(Short Answer Type Questions)

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

2. Discuss the various methods to determine the Michaelis-Menten constant (k_m).
3. Discuss the nature of primary and secondary structures of protein.
4. State Briggs-Haldane assumptions. What are its limitations ?
5. Enumerate the important types of Chromatographic separations.
6. What do you mean by Micronutrients ? What are their Physiological functions ?

**GROUP – C****(Long Answer Type Questions)**Answer any *three* of the following. $3 \times 15 = 45$

7. Discuss the essential characteristics of mono and poly saccharides. What is steroid ? How can ethanol be produced using immobilized yeast cells ? $4 + 1 + 10$
8. The bioconversion of sucrose by the enzyme sucrase at room temperature resulted in the batch reaction data given in the table below :

Cs	m moles/l	1.0	0.84	0.68	0.53	0.38	0.27
t	hr	0	1	2	3	4	5
		0.16	0.09	0.04	0.018	0.006	0.0025
		6	7	8	9	10	11

The initial concentration used was 0.01 m.moles/l. Determine whether these data can reasonably fit the Michaelis-Menten kinetics.

$$-r_A = \frac{k_3 C_3 C_E}{C_s + k_m}$$

where k_m = is the Michaelis-Menten constant. If the fit is reasonable, determine the constants k_3 and k_m . Use integral methods of analysis. 15



9. Prove that for Reverse Osmosis using diffusion type model, the rejection co-efficient,

$$R = \frac{B (\Delta P - \Delta \pi)}{1 + B (\Delta P - \Delta \pi)} \quad \text{where symbols stand for usual notations.}$$

It is desired to use Ultrafiltration for 800 kg of a solution containing 0.05 wt% of a protein to obtain a solution of 1.10 wt%. The feed is re-circulated by the membrane with a surface area of 0.90 m^2 . The permeability of the membrane is $2.50 \times 10^{-2} \text{ kg/s.m}^2 \cdot \text{atm}$. Neglecting the effects of concentration polarization, if any, calculate the final amount of solution and the time to perform this using a pressure difference of 0.50 atm.

6 + 9

10. a) What is the difference between chemostat and turbidostat ?
- b) Writing a material balance on the cell concentration around chemostat prove that

$$\mu_g (\text{specific growth rate}) = D (\text{dilution rate of the reactor}).$$

- c) Writing down the material balance on the limiting substrate S in absence of endogenous metabolism, prove that

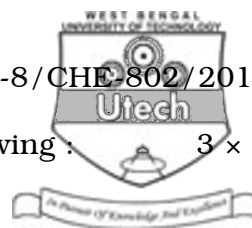
$$X = Y_{x/s} (S_o - S) \text{ at steady state i.e., } ds/dt = 0 \text{ and } \mu_g = D$$

Where, X = cell concentration, g/L

S_o , S = feed and effluent concentration, g/L

$Y_{x/s}$ = Yield coefficient, gm cell / gm substrate S .

2 + 6 + 7



11. Write short notes on any *three* of the following : 3×5

- a) Apoenzyme
 - b) Cofactor
 - c) Induced fit model
 - d) Classification of enzymes.
-