Name : ……………………………………………………

Roll No. : …………………………………………………

Invigilator's Signature : …………………………………

CS/B.Tech(CHE)/SEPARATE SUPPLE/SEM-8/CHE-802/2011

2011

BIOTECHNOLOGY AND BIO-MEDICAL 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)   Immobilization of enzyme can retain its activity

   a)   longer than enzyme in solution

   b)   shorter than enzyme in solution

   c)   equal to enzyme in solution

   d)   any one of the three situations can happen.

   ii)   The reactor using external loop for fluid circulation is

   a)   Bubble column reactor

   b)   Fluidized bed reactor

   c)   CSTR

   d)   Air lift fermenter.

SS-265   [Turn over

iii) Gradient of catalyst concentration exists in

    a) Fluidized bed reactor

    b) CSTR

    c) Bubble column reactor

    d) Air lift fermenter.

iv) The typical concentration of microbes in air is

    a) 10^5 to 10^6 /m^3 b) 10 to 10^2 /m^3

    c) 10^3 to 10^4 /m^3 d) 10^7 to 10^9 /m^3 .

v) Liquid recycle is required for continuous inoculation in case of

    a) CSTR

    b) PFR

    c) Fluidized bed reactor

    d) Bubble column reactor.

vi) Tracer pulse at the exit will be exactly same as that in the entrance in case of

    a) Ideal PFR   b) Ideal CSTR

    c) Both of these   d) None of these.

vii) Mg^{2+} is

    a) Cofactor   b) Coenzyme

    c) Prosthetic group   d) None of these.

viii) ATP stands for

    a) Adenosine tri phosphate

    b) Adenine tri phosphate

    c) Adenosyl tri phosphate

    d) None of these.

ix) Hexokinase belongs to

    a) Oxidoreductases   b) Transferases

    c) Lyases   d) Ligases.

x) Identify the Macronutrient

    a) Ca^{2+} b) Zn^{2+}

    c) Mo^{2+} d) Mg^{2+} .

xi) Hemoglobin contains

    a) Mg^{2+} b) Fe^{2+}

    c) Cu^{2+} d) Zn^{2+} .

xii) Pyruvate $\varnothing$ Lactate is an example of

    a) Alcoholic fermentation

    b) Homolactic fermentation

    c) Both of these

    d) None of these.

GROUP – B
(Short Answer Type Questions)
Answer any *three* of the following.   3 × 5 = 15

2. What is substrate saturation limit ? Explain how the rate of an enzymatic reaction is depending on pH and temperature.   1 + 2 + 2

3. Outline the application of biotechnology in the field of agricultural processes very briefly.

4. What is isoenzyme ? Give the international classification of enymes.   2 + 3

5. What is Reverse Osmosis (RO) ? How does industrial reverse osmosis work ?   2 + 3

6. What are the major types of bioreactors used in industry as fermenter ?

7. Define specific growth rate (μ) of microbial growth. What is the difference between the specific growth rate (μ) and the rate of cell increase (dX/dt) ?   3 + 2

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following.   3 × 15 = 45

8. Discuss the essential characteristics of mono and poly saccharides. What is steroid ? How can ethanol be produced using immobilized yeast cells ?   4 + 1 + 10

9. 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

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

$$R = \frac{B\,(\,\Delta P - \Delta\pi\,)}{1 + B\,(\,\Delta P - \Delta\pi\,)}$$ 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 ∞ 10 $^{-2}$ kg/s.m ^{2} . atm. Neglecting the effects of concentration polarization, if any, calculate the final amount of solution and the time to perfrom this using a pressure difference of 0.50 atm.   6 + 9

11. a) What is the difference between chemostat and turbiostat ?

 b) Writing a material balance on the cell concentration around chemostat prove that

 μ_g (specific growth rate) = D (dilution rate of the reactor).

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

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

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

    a)   Apoenzyme

    b)   Cofactor

    c)   Induced fit model

    d)   Classification of enzymes.