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CS/B.TECH(BT)/SEM-7/BT-703E/2012-13

2012

BIOSENSORS AND DIAGNOSTICS

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) To develop a biosensor, the biological components are immobilized most effectively on the surface of a transducer by
      a) Adsorption
      b) Micro-encapsulation
      c) Physical entrapment
      d) Covalent bonding.

   ii) The antibody as a bioreceptor is suitable for a biosensor based on
      a) Electrochemical process
      b) Thermistor
      c) Piezoelectric crystal
      d) CHEMFET.

iii) Enzyme present in banana used in as an enzyme electrode is suitable for the detection of

a) Alcohol b) Dopamine

c) Phenol d) Benzene.

iv) Nernst equation is used for quantitative determination of an analyst in a biosensor of the type

a) Voltametric b) Impedimetric

c) Potentiometric d) FET based sensor.

v) Optical sensors are based on the principle of

a) Snell's law

b) Total internal reflection

c) Beer Lambert's law

d) Light scattering technique.

vi) Sensors based on piezoelectric properties of some crystals depend on

a) Mass of the crystals

b) Frequency of vibration

c) Total mass of crystals with the deposit mass

d) Surface vibration.

vii) Sensors using the surface acoustic waves are used for the detection of

a) Human IgG b) Organophosphorus

c) Formaldehyde d) Sulphurdioxide.

viii) Response time of an enzyme sensor depends on

a) the rate of enzymatic reaction

b) diffusion through the membrane

c) membrane thickness

d) both (b) & (c).

ix) Insulin can be detected by a sensor of the type

a) Conductometric

b) Potentiometric

c) Optical biosensor

d) Piezoelectric biosensor.

x) Movement of electrons due to redox reactions can be measured by

a) Calorimetric biosensors

b) Optical biosensors

c) Piezoelectric biosensors.

xi) Most extensively studied biosensor is

a) Urea Biosensor b) Thermistor

c) Glucose Biosensor d) Optical Biosensor.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. How do you classify biological receptors ? How do these receptors respond to specific transducers ? 2 + 3

3. What is the mechanism of Glucose Biosensor using glucose oxidase ?

4. What are the potentiometric biosensors ? How is the electrical signal in the form of potential difference given by Nernst equation ? 3 + 2

5. Write down the principles of bio-affinity based biosensor.

GROUP – C

(Long Answer Type Questions)

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

6. a) What is the third generation of direct enzyme electrode coupling using organic conducting salt electrodes. Illustrate with an example.

   b) What is cyclic voltametry ? Illustrate with glucose, glucose oxidase and ferrocene as a mediator.

   $7 + (1 + 7)$

7. In amperometric sensor using banana tissue to detect catechol beer, the following data are given in terms of peak current (*ip*) and concentration of catechol (ΔC).

Catechol Concentration 10^{-5} *M* (ΔC)	0	1.0	1.99	2.98	3.95	4.93
ip, μA	1.45	1.8	2.0	2.3	2.7	2.8

   ip is related to catechol concentration (ΔC) as

   $ip = mC (ox) + Co$ (a constant)

   a) Give the mechanism of the system with respect to analyte, enzyme and the transfer of electrons.

   b) Fit the data to the linear model and determine the slope. $5 + 10$

8. Write short notes on any *two* : $7\frac{1}{2} + 7\frac{1}{2}$

   a) Optical biosensors
   b) ENFET
   c) Thermal biosensors
   d) Microbial sensors.

9. Discuss in detail the application of biosensors in the following : 3×5

   i) Environmental monitoring
   ii) Defense
   iii) Food industry.