BIOSENSORS
(BIOT 4181)

Time Allotted : 3 hrs　　　　　　　　　　　**Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one from each group.

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

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following:　　　**10 × 1 = 10**

   (i) Out of the following, which electrode is used in piezoelectric biosensor?
   (a) Silver　　　(b) Gold　　　(c) Platinum　　(d) All of the above.

   (ii) The response of an ion-selective electrode is given by
   (a) $E = E_0 + (RT/zF)\ln[i]$　　　　　(b) $E = E_0 + (zF/RT)\ln[i]$
   (c) $E_0 = E + (RT/zF)\ln[i]$　　　　　(d) $E_0 = E + (zF/RT)\ln[i]$.

   (iii) Thermistors are used in
   (a) potentiometric biosensor　　　　(b) amperometric biosensor
   (c) calorimetric biosensor　　　　　(d) optical biosensor.

   (iv) Biosensors which measure movement of electrons is known as
   (a) potentiometric biosensor　　　　(b) amperometric biosensor
   (c) calorimetric biosensor　　　　　(d) optical biosensor.

   (v) The first and the most widely used commercial biosensor is a
   (a) penicillin biosensor　　　　　　(b) DNA biosensor
   (c) glucose biosensor　　　　　　　(d) none of these.

   (vi) To develop a biosensor, the biological component is immobilised most effectively on the surface of a transducer by
   (a) adsorption　　　　　　　　(b) microencapsulation
   (c) physical entrapment　　　　(d) covalent bonding.

   (vii) Response of an enzyme sensor depends on
   (a) rate of enzymatic reaction
   (b) diffusion through membrane
   (c) membrane thickness
   (d) both (b) and (c).

   (viii) In Piezo-electric biosensor, the resonant frequency changes as
   (a) $\Delta f = -K^2 f \Delta m / A$　　　　　(b) $\Delta f = Kf^2 \Delta m / A$
   (c) $\Delta f = -Kf \Delta m / A^2$　　　　　(d) $\Delta f = -Kf^2 \Delta m / A$.

   (ix) Optical sensor are based on the principle of
   (a) Snell's law　　　　　　　　(b) total internal refection
   (c) Beer-Lambert's law　　　　(d) light scattering technique.

   (x) When the physical change detected by transducer is the heat output by the reaction, then it is
   (a) potentiometric biosensor　　　(b) calorimetric biosensor
   (c) piezoelectric biosensor　　　　(d) amperometric biosensor.

Group - B

2.(a) Describe features of an ideal biosensor.

(b) What is the necessity of enzyme immobilization for constructing a biosensor?

(c) What is the response time of enzyme biosensor? How is it related with the thickness of enzyme layer?

　　　　　　　　　　　6 + 2 + (2 + 2) = 12

3.(a) Describe 3 different reaction sequences for the measurement of glucose using glucose oxidase with electrochemical detection (enzyme electrodes). At least one of these should not require the presence of oxygen.

(b) Draw a diagram to show how the above sensors are constructed.

(c) How does the pH influences the response of an enzyme biosensor.

　　　　　　　　　　　6 + 4 + 2 = 12

Group - C

4. (a) Explain how DNA can be used in a Biosensor.

(b) What are the different types of Bio-recognition elements found in a Biosensor?

　　　　　　　　　　　8 + 4 = 12

5. (a) Compare microbial biosensor with an enzyme biosensor.

(b) Explain how antibody can be used in an Optical biosensor.

　　　　　　　　　　　5 + 7 = 12

Group - D

6. (a) Explain the working principle of Immuno-FET.

   (b) What are the characteristics of an Ion-selective electrode?

8 + 4 = 12

7.(a) Describe the working principle of piezo-electric biosensor.

   (b) What is the role of thermistors in calorimetric biosensor?

8 + 4 = 12

Group - E

8. (a) Discuss in detail the application of biosensors in Environmental monitoring.

   (b) What is the application of potentiometric enzyme electrode for detection of urea in urine samples?

6 + 6 = 12

9. (a) Mention two application of biosensors in food industry.

   (b) How biosensor is used in COD removal process?

6 + 6 = 12