BIOSENSORS AND DIAGNOSTICS
(BIOT 3243)

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

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
<u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> 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)   The analyte and the co-reactant are chemically altered by which of the following principles?
      (a) Bioaffinity   (b) Biometabolic
      (c) Arrhenious   (d) Physical adsorption.

  (ii)   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.

  (iii)   Time required to return the sensor to working state after interaction with the sample is known as
      (a) response time   (b) regeneration time
      (c) specificity   (d) none of the above.

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

  (v)   Selectivity coefficient of an ion –selective electrode should be
      (a) less than 1   (b) greater than 1
      (c) equal to 1   (d) none of the above.

  (vi)   Which type of transducer is used by the enzyme Bio-recognition element?
      (a) Amperometric   (b) Optical
      (c) Piezoelectric   (d) All of the above.

  (vii)   Biosensor measures glucose concentration between which of the following range?
      (a) 10^{-1} to 10^{-2}M   (b) 10^{-2} to 10^{-4}M
      (c) 10^{-1} to 10^{-4}M   (d) 10^{-1} to 10^{-7}M.

  (viii)   Which of the following electrode is used by the Urea biosensor?
      (a) Carbon di-oxide electrode   (b) Ammonia electrode
      (c) Fluoride electrode   (d) Ammonium electrode.

  (ix)   Which of the following is used as gel for constructing the Glucose Biosensor?
      (a) Urea   (b) Urease   (c) Acrylamide   (d) Polyacrylamide.

  (x)   Which part of a BIO-FET binds with the charged molecules?
      (a) Source   (b) GATE   (c) Drain   (d) Substrate

Group – B

2.(a) Explain the method of immobilization of enzyme by cross-linking method with one example.

 (b) State the basic working principle of biosensor.

 (c) Illustrate variations of biological /biochemical components and transducer components of a biosensor.

                            3 + 3 + (3 + 3) = 12

3. (a) For immobilized enzyme, what should be range of Damkohler number when the overall rate of product formation is limited by diffusion of substrate through the solid matrix? Justify mathematically.

 (b) What do you mean by activation of support material for enzyme immobilisation?

 (c) Explain how the support material for immobilization of enzyme for enzyme biosensor can be activated using ethyl chloroformate and cyanogen bromide.

                          (1 + 3) + 2 + (3 +3) = 12

Group – C

4.(a) Explain how DNA can be used as a Bio-recognition element in an optical biosensor.

 (b) Explain the working principle of ENFET.

                             6 + 6 = 12

5.(a) Explain the working principle of Immuno-potentiometer.

 (b) How can you detect alcohol with the help of Non-invasive biosensor?

                              7 + 5 = 12

Group – D

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

(b) Discuss the role of carbon nanotubes in biosensors.

6 + 6 = 12

7.(a) A 10 KΩ NTC thermistors has a B value of 3455 between the temperature range of 25°C to 100°C. Calculate its resistive value at 100°C. Data Given: B=3455, R1=10 KΩ at 25°C.

(b) What do you mean by the selectivity coefficient of an ion selective electrode?

(c) Explain how bacteria can be determined in a clinical sample with the help of optical biosensor.

3 + 3 + 6 = 12

Group – E

8. (a) How will you determine BOD value of wastewater using biosensor?

(b) Explain the method of on- line determination of lactose concentration in milk.

6 + 6 = 12

9.(a) Explain the principle of detection of pesticide in environmental sample using acetyl cholin esterase.

(b) How does biosensor help to monitor a scarification process during fermentation?

8 + 4= 12