

BIOSENSORS
(BIOT 4124)

Time Allotted : 2½ hrs

Full Marks : 60

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

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

Group – A

1. Answer any twelve:

12 × 1 = 12

Choose the correct alternative for the following

- (i) Bananatrode is suitable for detection of
(a) Alcohol (b) Dopamine (c) Phenol (d) Benzene.
- (ii) 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) $\Delta f = - K f^2 \Delta m / A$.
- (iii) Biosensors which measures the light generation is known as
(a) Amperometric biosensor (b) Electrochemical biosensor
(c) Optical biosensor (d) Piezoelectric.
- (iv) Biosensors which measures the mass change is known as
(a) Amperometric biosensor (b) Electrochemical biosensor
(c) Calorimetric biosensor (d) Piezoelectric biosensor.
- (v) The component of a biosensor which binds with the analyte is known as
(a) bio-recognition element (b) transducer
(c) signal processor (d) reading device.
- (vi) The selection of immobilization process of cell or enzyme depends on
(a) number of step in the process (b) cost
(c) stability and catalytic specificity (d) all of (a), (b) & (c).
- (vii) 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) $E_0 = E + (zF/RT) \ln[i]$
- (viii) In which of the technique enzyme and polymer are bridged by the use of bi-functional reagent
(a) Covalent cross-linking (b) Adsorption
(c) Physical entrapment (d) Microencapsulation.

- (ix) Which one of the following is a bio-recognition element?
 (a) DNA (b) Enzyme
 (c) Antibody (d) All of (a), (b) & (c).
- (x) The genetic monitoring and disease diagnosis are examples for _____ sensor?
 (a) DNA sensors (b) Cell-based sensors
 (c) Point of care sensors (d) All of (a), (b) & (c)

Fill in the blanks with the correct word

- (xi) The first widely used commercial biosensor is known as _____.
- (xii) Chemiluminescent used in an optical biosensor is _____.
- (xiii) For competitive enzyme immobilization, Km value _____.
- (xiv) One enzyme immobilisation technique which is a surface phenomenon is named as _____.
- (xv) Biosensor where microbe is used as bio-recognition element is called as _____.

Group - B

2. (a) How many major components are there in a biosensor? Illustrate on them. [[CO2](Remember/LOCQ)]
 (b) What are the 7s rule of an ideal biosensor? [[CO1](Understand/IOCQ)]
6 + 6 = 12
3. (a) What is activation of support matrix for enzyme immobilisation? Give two examples of this process. [[CO2](Analyse/IOCQ)]
 (b) Explain the reaction mechanism of competitive inhibition of enzyme. Draw the double reciprocal plot of competitive inhibition in comparison to a non inhibited enzyme. [[CO2](Critical/HOCQ)]
(2 + 4) + (3 + 3) = 12

Group - C

4. (a) Explain how DNA can be used as a Bio-recognition element in an Optical Biosensor. [[CO3](Explain/IOCQ)]
 (b) Write notes on wearable biosensors. [[CO5](Remember/LOCQ)]
6 + 6 = 12
5. (a) Explain how glucose can be detected by GOD in a Calorimetric Biosensor. [[CO3](Explain/IOCQ)]
 (b) Enumerate with an example the use of microbes as a Biosensor. [[CO5](Enumerate/IOCQ)]
6 + 6 = 12

Group - D

6. (a) Describe with an example the working principle of Piezo-electric Biosensor. [[CO4](Design/IOCQ)]

- (b) Discuss the role of carbon nanotubes in Biosensors. [[CO4](Discuss/IOCQ)]
6 + 6 = 12
7. (a) Design the process of detecting DNA with the help of Potentiometric biosensor. [[CO4](Design/IOCQ)]
- (b) Examine the role of Ionophore in ion selective electrodes. [[CO4](Examine/IOCQ)]
7 + 5 = 12

Group - E

8. (a) State the principle of nitrate determination in water using biosensor. [[CO6](Analyse/IOCQ)]
- (b) Explain with an example how esophagus cancer can be detected by biosensor [[CO4](Apply/HOCQ)]
6 + 6 = 12
9. (a) How is biosensor used in fingerprint analysis. [[CO5](Analyse/IOCQ)]
- (b) Write short note on E-Nose. [[CO4](Apply/IOCQ)]
6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	12.50	75.00	12.50

Course Outcome (CO):

After completing this course, students will be able to:

1. State types of bio-recognition elements and describe the fundamental components required to make a viable biosensor.
2. Illustrate types of enzyme immobilization methods used to make a biosensor and immobilize it to a transducer for the construction of biosensor.
3. Describe each types of biosensing element in relation to their uses in biosensors.
4. Understand the classification, construction and working principle of various transducers.
5. Understand the concepts, types, working principles and practical applications of important biosensors.
6. Explain the working principle of different types of inhibition based biosensors.

**LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.*

