7.5+1/10

+

[redacted] **Roll no.:** [redacted]

BT-308 BIOENGINEERING: QUIZ-I Date: 07.02.2025

Instructions: *Total marks: 10. Each of the 09 questions carries 01 mark. The additional 01 mark will be awarded to the students submitting the answer sheet within 3.30 pm (Sharp).Marking more than the required number of answer per question leads to zero mark.*

1. Identify two performance factors for biosensors that attribute to their functional traits from the following list:

(A) Selectivity
(B) Cost
(C) Portability
(D) Design
(E) Market
(F) Sensitivity

1

2. Write the word/phrase against each acronym letter of "ASSURED", the criteria World Health Organization has suggested. Zero mark will be awarded for an incomplete or incorrect answer against any acronyms.

A: ~~Affordable~~ S: Specific S: Sensitive U: User Friendly
R: Rapid & Robust E: Equipment free D: Deliverable to-end users

1

3. Fill the gaps in the following sentence using the words: oxidative, reductive.
The redox potential of the mediator, E^0_M, should be more positive and more negative than the redox potential of the enzyme active site E^0_E in the case of oxidative $E^0_M > E^0_E$ and reductive $E^0_M < E^0_E$ bioelectrocatalysis, respectively.

1

4. Do metals or non-metals exhibit surface plasmon resonance (SPR)? Justify your answer. Metals ~~ex~~ like Ag, Au, Pt exhibit SPR due to the formation / presence of rigid lattice structures & the presence of low energy Fermi-level electrons.

1

5. Identify the correct relations among the amount of charge(C) developed, piezoelectric coefficient (d), force applied along the x-direction (F_x), the number of stacked elements (n), and crystal dimensions a, b for a longitudinal effect in piezoelectric materials from the following equations:

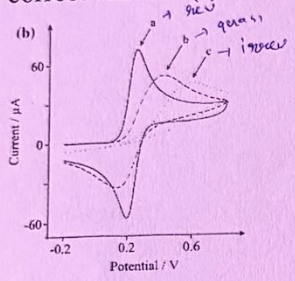
(A) $C_x=d_{xy}F_xn\ a/b$
(B) $C_x=d_{xx}F_xn\ b/a$
(C) $C_x=2d_{xx}F_xn\ a/b$
(D) $C_x=d_{xx}F_xn$
(E) $C_x=2d_{xy}F_xn$
(F) $C_x=d_{xy}F_xn$

1

6. Identify two correct answers without making any assumption from the following statements:
For oxidation of a target analyte on the electrode surface, the
(A) $E_F >$ E of LUMO of the target
(B) $E_F >$ E of HOMO and LUMO of the target.
(C) $E_F <$ E of LUMO of the target
(D) $E_F =$ E of LUMO of the target
(E) None of the above.
The terminology/symbols follow the usual meaning as discussed in the classes.

CORRECT ANSWER :- (C)

7. From the cyclic voltammogram below, correlate the pattern of the graphs with the correct reaction(s):



(A) a → quasi-reversible
(B) a → non-reversible
(C) a → reversible
(D) b → reversible
(E) b → irreversible
(F) b → quasi-reversible
(G) c → reversible
(H) c → quasi-reversible

8. If the enthalpy change of an enzymatic reaction associated with the conversion of 2000 g of a target analyte substrate to 1 mol of the product is -100 kj/mol, the heat capacity of the system is 1 kj/K.Kg, Seebeck coefficient is 0.01 V/K, then estimate the output potential difference (ΔV) of a thermopile, with one pair number of the thermocouple (Units must be shown, otherwise zero mark will be awarded).

$q = -n_p \Delta H = mC_p \Delta T$ $\quad \Delta V = \eta \varepsilon \Delta T$

$\Delta T = \frac{-n_p \Delta H}{mC_p} = \frac{-(1)(-100)\,[\text{mol kJ/mol}]}{2 \times 1\,[\text{kJ/K.kg} \times \text{kg}]} = 50\ \text{K}$

$\Delta V = 0.01 \times 1 \times 50\ \left[\frac{V}{K} \times K \times 1\right] = 0.5\ V$

9. Fill the gaps each with one appropriate word: The threshold voltage in ISFET is the minimum gate-to-source voltage that is needed to create a current path between the sources and drain terminals. The words to be filled up must be according to the text in the lecture note.

0.5

**********END**********