Question Paper

Exam Date & Time: 27-Dec-2022 (02:30 PM - 05:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

SEVENTH SEMESTER B.TECH END SEMESTER EXAMINATIONS, DEC 2022

BIOSENSORS [ICE 4072]

Marks: 50 **Duration: 180 mins.**

A

Answer all the questions.

Instructions to Candidates: Answer ALL questions Missing data may be suitably assumed

1) Is a point of care diagnostic same as a biosensor? Illustrate with the help of an application. [CO1, PO1-4, BL3] (4)

A)

B) A point of use sensor for detection of blood glucose needs to be developed using glucose oxidase as the bio recognition element. Choose a suitable bio conjugation strategy for the said enzyme assuming that your substrate is a screen printed electrode. [CO2, PO 1-4, BL3] (3)

C) Illustrate the layout of a Lateral Flow Assay (LFA) for detection of SARS-CoV-2 antigen. Describe the major functional regions of the device. [CO5, PO 1-4, BL3] (3)

2) Design a sensor for detection of total bacterial load in drinking water. Your design considerations should elaborate on the substrate, bioconjugation chemistries, biorecognition element, transduction and correlation of the result with analyte concentration. [CO3, PO 1-4, BL4] (4)

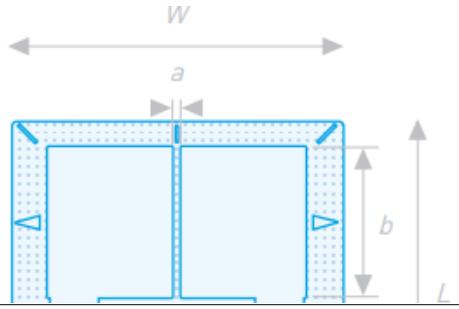
A)

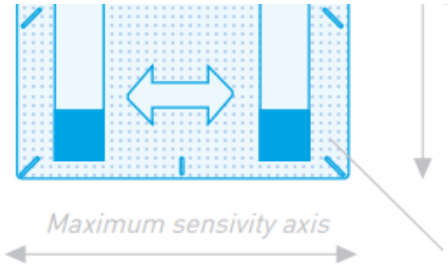
B) Illustrate the use of any one bioconjugation protocol for immobilization of an aptamer as a biorecognition element, for design of a biosensor. Explain your choice in a use case scenario. [CO2, PO1-3, BL3] (3)

C) Usually an LFA such as the Rapid Antigen Test (RAT) kit or pregnancy test kit provides a qualitative readout. If you were to convert this into quantitative readout, design the instrumentation. [CO3, PO1-4, BL 3] (3)

3) You are required to design a strain gauge for measurement of surface stress due to an affinity driven biological interaction. Design the masks that you shall use and the mode of taking the contacts out. A few details are as follows: [CO5, PO1-4, BL4] (4)

A)





Scheme of a nano strain gauge.

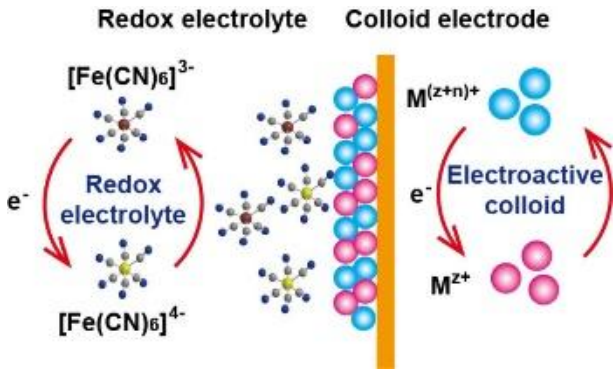
Nano strain gauge (ref.)	a – Length of the active area mm (in)	L – Length of the substrate mm (in)	b – Width of the active area mm (in)	w – Width of the substrate mm (in)	Resistance
NG-UNI-V3-200K	**0.1** (0.004)	**7** (0.277)	**3** (0.118)	**6.5** (0.118)	**200** kΩ
NG-UNI-V3-1M					**1 M** kΩ

B) Describe the various microfabrication protocols that you would use for the designs mentioned in question 3a. [CO4, PO1-4, BL4] (4)

C) Come up with an application where you could use the designed transducer for bio sensing. [CO3, PO1-4, BL4] (2)

4) (3)

A)



Describe the use of a redox probe in cyclic voltammetry based bio sensing with the help of suitable diagrams and reactions illustrating an electrochemical setup and input output waveforms. The following diagram may be of help:

[CO4, PO1-4, BL3]

B) When would you prefer the use of microencapsulation over covalent immobilization for biosensing. Illustrate with an example. [CO2, PO1-4, BL3] (4)

C) Design a biosensor using whole bacterial cells for detection of antibiotics. [CO1, PO1-4, BL4] (3)

5) Describe the transduction platforms which use Faradaic and non-Faradaic currents. [CO3, PO1-4, BL4] (2)

A)

B) Illustrate the use of reference electrodes in a cyclic voltammetry based electrochemical cell with the help of suitable diagrams. Illustrate the design considerations therein with the help of necessary circuits and expressions. [CO5, PO1-4, BL4] (3)

C) Critique the findings of the attached paper for point of use. [CO4, PO1-4, BL5] (5)

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