Question Paper

Exam Date & Time: 17-Nov-2022 (09:00 AM - 12:00 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

SEVENTH SEMESTER B.TECH END SEMESTER EXAMINATIONS, NOVEMBER 2022

BIOSENSORS [ICE 4072]

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

Program Elective

Answer all the questions.

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

1) Define the term '*biosensor*'. Can the term biosensor be used interchangeably with point of use diagnostics? Explain. [CO1, PO 1-3, BL 2] (3)

A)

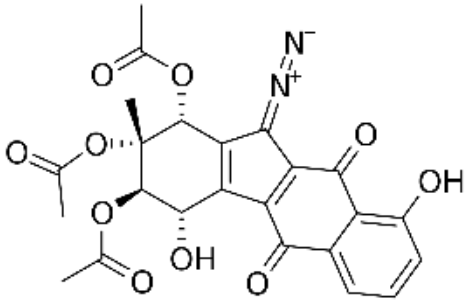
B) A point of use sensor for detection of blood glucose needs to be developed using the enzyme glucose oxidase as the bio recognition element. Choose a suitable bio conjugation strategy for the said enzyme assuming that your substrate is cellulose (paper/cloth/thread). [CO2, PO 1-4, BL 3] (3)

C) Describe in detail the considerations for the design of sensor (as above, for detection of blood glucose). Emphasize on the analyte interactions and transduction mechanisms. [CO3, PO1-4, BL3] (4)

2) Illustrate the layout of a Lateral Flow Assay (LFA) for detection of small molecules. Describe the major functional regions of the device. [CO5, PO1-3 BL3] (4)

A)

B) If the small molecule of interest were to be an antibiotic, kanamycin which has the given structure: (3)

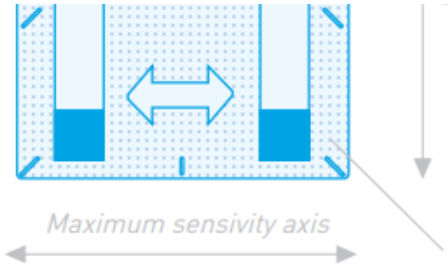


Choose a suitable bio recognition element and describe your choice of bio conjugation chemistries for use in the LFA. [CO2 PO1-4 BL3]

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. [CO 3 PO1-4 BL4] (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: (4)

A) [CO5 PO1-3 BL4]



Specifications

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 PO1-3 BL3] (4)

C) Come up with an application where you could use the designed transducer for bio sensing. [CO3, PO 1-2, BL 3] (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 given diagram may be of help:
[CO3 PO1-2 BL3]

B) When would you prefer the use of microencapsulation over covalent immobilization for biosensing. Illustrate with an example.[CO3 PO1-3 BL3] (4)

C) Design a biosensor using whole bacterial cells for detection of antibiotics. [CO3 PO 1-3 BL3] (3)

5) Describe the transduction platforms which use Faradaic and non-Faradaic currents. [CO3, PO1-3, BL2] (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. [CO3, PO1-3, BL3] (3)

C) Critique the findings of the attached paper for point of use. [CO5 PO 1-4,7 BL5] (5)

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