

Birla Institute of Technology and Science Pilani (Rajasthan)

CHEM F414: BIO and CHEMICAL SENSORS

Mid Semester Test

Closed Book

II Semester 2022-23

Max. Marks: 60

Time: 90 minutes

Date: 13.03.2023

Q. 1 (a) Explain the following immobilization methods:

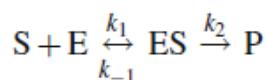
(i) Entrapment (ii) Covalent bonding by coupling via thiol groups. (6)

(b) How following parameters affect the performance of a sensor:

(i) Sensitivity (ii) Time (6)

(c) Write approximations suggested to develop different enzyme models. (4)

(d) Derive Michaelis-Menten equation from the scheme given below: (4)



Q. 2 (a) Write the characteristic features of aptamers. (3)

(b) What are limitations of fluoride ion selective electrodes and how these can be eliminated? (3)

(c) For immunochemical selectivity, write the binding equilibrium expression and explain why the expression is a gross oversimplification of the situation. (3)

(d) Why imprinted polymers do not match the affinities of natural stereospecific binding sites. (3)

(e) Discuss the significance of the dimensionless diffusion-reaction mechanism equation given below for chemical sensing:

$$\left(\frac{\delta C_S}{\delta t}\right)^* = D_S \left(\frac{\delta^2 C_S}{\delta x^2}\right)^* - \phi^2 \left(\frac{C_S}{1 + C_S}\right)^*$$

(4)

(f) Write similarities and differences between QCM and SAW devices. (3)

Q. 3 (a) Draw the schematic of multiple steps involved in performing modeling with equivalent electrical circuits for mass sensors. (3)

(b) Explain parameters that affect the performance of QCM as chemical sensors in liquids. (3)

(c) Write the advantages and disadvantages of plate mode oscillators (3)

(d) Explain the use of cantilevers in chemical sensing. (3)

(e) Explain the characteristic features of (i) Thermistor (ii) Pellistor. (6)

(f) Explain the principle used to maximize the overall performance of thermal sensors. (3)
