
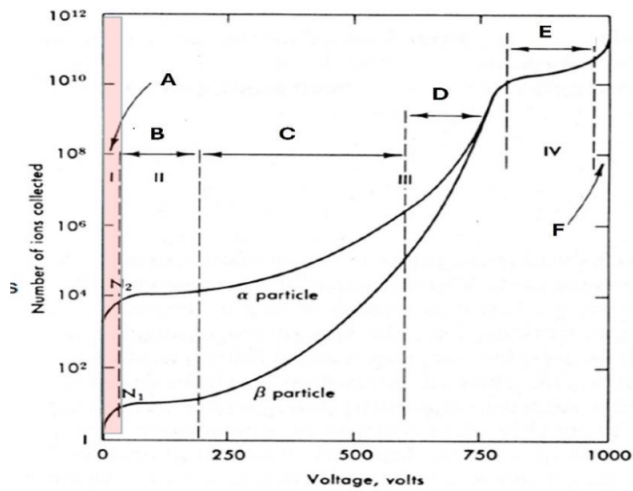


Name:			
Enrolment No:			
UPES			
End Semester Examination, December 2024			
Course: Biosensors and Diagnostics			
Semester: 5 th			
Program: B.Tech Biomedical Engineering			Duration: 3 Hours
Course Code: HSBE3002			Max. Marks: 100
Instructions: Attempt all questions			
S. No.	Section A Short answer questions/ MCQ/T&F (20Qx1.5M= 30 Marks)	Marks	COs
Q 1	Which of the following electrodes are used for measuring biopotentials like ECG, EMG, and EEG? a) Reference electrodes b) Microelectrodes c) Body-surface recording electrodes d) pH electrodes	1.5	CO1
Q 2	Which type of electrode is most suitable for measuring the pO ₂ level in blood? a) Ion-Selective Field-Effect Transistor (ISFET) b) Blood glucose sensors c) pO ₂ electrodes d) Microelectrodes	1.5	CO2
Q 3	Which electrode is typically used for blood gas monitoring? a) Microelectrode b) Enzyme electrode c) Reference electrode d) Ion-Selective Field-Effect Transistor (ISFET)	1.5	CO2
Q 4	What is the primary function of a reference electrode in electrochemical measurements? a) To provide a stable potential b) To measure the ion concentration c) To act as a measuring electrode d) To record the voltage across tissues	1.5	CO2

Q 5	Polarizable electrodes do not show a potential difference when a current is passed through them. (True/False)	1.5	CO2
Q 6	Microelectrodes are typically used for high precision measurements in smaller tissue areas. (True/False)	1.5	CO3
Q 7	The skin-electrode interface does not contribute to noise or signal distortion in body-surface recordings. (True/False)	1.5	CO4
Q 8	Ion-Selective Field-Effect Transistor (ISFET) electrodes are commonly used for noninvasive glucose monitoring. (True/False)	1.5	CO3
Q 9	Which of the following electrodes is most commonly used for the measurement of the electrical activity of the brain (EEG)? a) Microelectrode b) Body-surface recording electrode c) Needle electrode d) Reference electrode	1.5	CO4
Q 10	Which of the following is the main advantage of using microelectrodes over conventional electrodes? a) They have higher impedance b) They are suitable for high precision measurements in small tissues c) They require more invasive procedures d) They are less affected by motion artifacts	1.5	CO1
Q 11	Repeatability in a sensor refers to: a) The sensor's ability to detect the smallest input change b) The deviation in repeated measurements of the same object from the same direction c) The upper limit of measurements a sensor can record d) The time taken for the sensor to respond	1.5	CO1
Q 12	What does "Reproducibility" in sensor characteristics indicate? a) Repeatability over long-time lapses between measurements b) The ability to detect a range of inputs accurately c) The smallest detectable change in input d) The ability to calibrate accurately	1.5	CO2
Q 13	Define precision in a sensor.	1.5	CO1
Q 14	What type of material is PDMS? a) Metal alloy b) Ceramic c) Silicone-based elastomer d) Polyethylene derivative	1.5	CO2
Q 15	What is the most common way to expose SU-8 to light during photolithography? a) Using an electron beam b) Using X-rays c) Using UV light through a mask d) Using a laser beam	1.5	CO2

Q 16	How do gamma rays differ from alpha and beta particles? a) They are heavier than alpha and beta particles b) They carry both energy and mass c) They are pure energy without mass d) They are charged particles	1.5	CO3
Q 17	Briefly explain why most students had difficulty determining the flavor of the candy when their noses were closed?	1.5	CO2
Q 18	List how many sensors or senses do humans have?	1.5	CO2
Q 19	Give examples of sensors in robots that are similar to at least two human senses	1.5	CO2
Q 20	State different types of taste can your tongue detect.	1.5	CO3
Section B (4Qx5M=20 Marks)			
Q 1	Discuss the different types of electrodes used in biopotential recordings (ECG, EMG, EEG). <i>(2.5 marks)</i> Explain the design, function, and applications of body-surface recording electrodes, and internal electrodes like needle and wire electrodes. <i>(2.5 marks)</i>	5	CO1
Q 2	What is the significance of the electrode-skin interface in biopotential recording systems? <i>(2.5 marks)</i> How does skin impedance affect the quality of the recorded signal? <i>(2.5 marks)</i>	5	CO3
Q 3	Discuss PDMS pattern formation by micromolding <i>(3 marks)</i> and its various attributes. <i>(2 marks)</i> .	5	CO3
Q 4	Discuss physical fiber optic sensor with a suitable example.	5	CO
Section C (2Qx15M=30 Marks)			
Q 1	Explain the role of electrochemical sensors in monitoring blood gas and acid-base physiology. <i>(5 marks)</i> Discuss the principles and applications of pH, pO ₂ , and pCO ₂ electrodes, and how they contribute to patient diagnostics in clinical settings. <i>(10 marks)</i>	15	CO3
Q2	Describe the principle of proportional counter (with diagram <i>5 marks</i>). Discuss basic characteristics of proportional chamber (<i>4 marks</i>) Label A, B, C, D, E and F in the below given diagram (<i>6 marks</i>):	15	CO4



Section D
(2Qx10M=20 Marks)

Q 1	Describe the working principle of an Ion-Selective Field-Effect Transistor (ISFET). (5 marks) How is it used in noninvasive blood-gas monitoring and other biomedical applications? (5 marks)	10	CO2
Q2	Define BioMEMS (2 marks). Discuss various characteristics of BioMEMS (2 marks). Describe the principle of lithography and application of BioMEMS in drug delivery system with example (3+3 marks).	10	CO2