Name: **Enrolment No:**	

UPES

End Semester Examination, December 2024

Course: Biosensors and Diagnostics

Semester:5th

Program: B.Tech Biomedical Engineering — **Duration: 3 Hours**

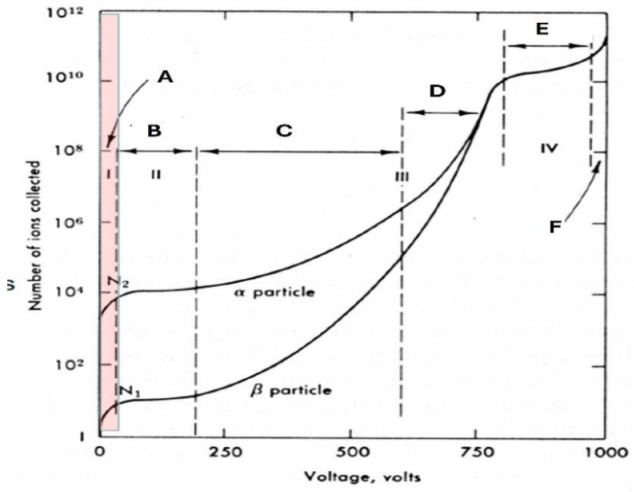
Course Code: HSBE3002 — **Max. Marks: 100**

Instructions: Attempt all questions

S. No.	Section A Short answer questions/ MCQ/T&F (20Qx1.5M= 30 Marks)	Marks	COs
Q 1	A nonpolarizable electrode is ideal for applications where stable long-term measurements are required. (True/False)	1.5	CO1
Q 2	Enzyme electrodes are used for the noninvasive measurement of parameters like glucose and oxygen. (True/False)	1.5	CO2
Q 3	Microelectrodes are primarily used for measuring large-scale bioelectric events such as ECG and EEG. (True/False)	1.5	CO2
Q 4	Electrode polarization is a phenomenon where a voltage develops at the electrode-electrolyte interface, affecting the measurement accuracy. (True/False)	1.5	CO2
Q 5	Which of the following best describes the purpose of the reference electrode in an electrochemical measurement setup? a) To measure the potential difference between two points b) To maintain a stable potential for accurate measurement c) To provide a signal for amplifying electrical activity d) To introduce a current into the system	1.5	CO2
Q 6	In which of the following cases is a blood glucose sensor typically used? a) Measurement of blood oxygen levels b) Monitoring pH in blood c) Monitoring blood glucose levels in diabetic patients d) Measurement of CO2 tension in blood	1.5	CO3

Q 7	**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**	**CO4**
Q 8	**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**	**CO3**
Q 9	**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**	**CO4**
Q 10	**Which type of electrode is most suitable for measuring the pO2 level in blood? a) Ion-Selective Field-Effect Transistor (ISFET) b) Blood glucose sensors c) pO2 electrodes d) Microelectrodes**	**1.5**	**CO1**
Q 11	**Define accuracy of a sensor.**	**1.5**	**CO1**
Q 12	**List two applications of fiber optic sensors.**	**1.5**	**CO1**
Q 13	**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**	**CO1**
Q 14	**Which of the following best describes the penetrating power of gamma rays? a) They can be stopped by skin and clothing b) They are absorbed easily by the human body c) They have the highest penetration power d) They cannot penetrate any solid barriers**	**1.5**	**CO1**
Q 15	**List how many sensors or senses do humans have?**	**1.5**	**CO1**
Q 16	**Give examples of sensors in robots that are similar to at least two human senses**	**1.5**	**CO1**
Q 17	**State different types of taste can your tongue detect.**	**1.5**	**CO3**
Q 18	**Briefly explain why most students had difficulty determining the flavor of the candy when their noses were closed?**	**1.5**	**CO3**

Q 19	**What is SU-8 primarily used for in microfabrication?** **a) Conductive material for electronic circuits** **b) A photoresist for patterning microstructures** **c) A substrate for growing cells** **d) A solvent for dissolving polymers**	**1.5**	**CO2**
Q 20	**What type of polymer is SU-8?** **a) Epoxy-based** **b) Polyester-based** **c) Polyimide-based** **d) Polyethylene-based**	**1.5**	**CO2**
	Section B **(4Qx5M=20 Marks)**		
Q 1	**What are the applications of Ion-Selective Field-Effect Transistors (ISFET) in biomedical instrumentation?** ***(3.5 marks)*** **Provide examples.** ***(1.5 marks)***	**5**	**CO1**
Q 2	**How do electrochemical sensors function?** ***(2.5 marks)*** **Discuss their role in measuring parameters such as blood pH and oxygen levels.** ***(2.5 marks)***	**5**	**CO3**
Q 3	**Describe the mechanism of avalanche multiplication in gas detector.**	**5**	**CO2**
Q 4	**Discuss physical fiber optic sensor with a suitable example.**	**5**	**CO3**
	Section C **(2Qx15M=30 Marks)**		
Q 1	**Explain the principles of electrode-electrolyte interactions and their impact on biopotential recording accuracy.** ***(10 marks)*** **Discuss the differences between polarizable and nonpolarizable electrodes in terms of their performance and applications.** ***(5 marks)***	**15**	**CO3**
Q2	**Explain the principle of gaseous ionization detector (with diagram) (*5 marks*). Discuss the basic characteristics of gas ionization chamber (*4 marks*). Label A, B, C, D, E and F in the below given diagram (*6 marks*):**	**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**