U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

September / October 2023 Semester End Main Examinations

Programme: B.E. **Semester: III**
Branch: Medical Electronics Engineering **Duration: 3 hrs.**
Course Code: 22MD3PCBSM **Max Marks: 100**
Course: Biomedical Sensors and Measurements

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

REAPPEAR EXAMS 2022-23

UNIT - I

1 a) Define the term Measurement and discuss its importance. **04**

b) Define the following static characteristics of measuring instruments: Threshold, Resolution, Sensitivity, Accuracy and Precision. **06**

c) Discuss the Step Responses of Zero, First and Second order instruments, with the help of their governing Input-Output relations and illustrations.. **10**

UNIT - II

2 a) "Electrical Sensors exhibit several advantages" to render themselves more suitable for modern measurement systems. Justify this statement, briefly explain their any FOUR specific advantages. **04**

b) Differentiate between Active and Passive sensors with an example for each type. **06**

c) Four Resistance strain gauges (R= 250 Ω, GF = 2.68) are bonded (two each) on either sides of a Steel cantilever (Young's modulus = 210 GPa) at its fixed end. When a tensile force of 500 MPa is applied, **10**

(i) Determine the Strain created and the %change in gauge resistances

(ii) Calculate the output voltages, when one of the gauges is connected to a Potentiometer circuit, and when both the gauges are connected in Half-bridge and Full bridge configurations. **NOTE:-** Assume V_{dc} = 5V, Fixed resistors = 1kΩ. Also show the circuit connections.

UNIT - III

3 a) Compare the RT characteristics, material selection for RTDs and Thermistors. **08**

b) With relevant governing equations, discuss the principle of a semiconducting P-N junction that provides a body temperature dependent linear output voltage. **06**

c) Illustrate the working principle of Radiation thermometers used for skin temperature, highlighting the total radiation entering the Radiometer. **06**

OR

4	a)	Determine the changes in resistance values when an RTD (with $\alpha = 0.00392$ / 0^oC and $R_o = 110\Omega$ at 25^oC) and a Thermistor (with $\beta = 2800K$ and $R_o = 12k\Omega$ at 25^oC) are simultaneously subjected to a new temperature of 100^oC.	**08**
	b)	Discuss the technique of realizing an electronic insulator for zero-heat flow condition, for the purpose of measuring skin temperature that is approximated to deep-tissue temperature.	**08**
	c)	Explain how the sensitivity of thermocouples can be enhanced.	**04**

UNIT - IV

5	a)	Explain the origin of biopotential and the generation of Action potentials in the human body cells.	**08**
	b)	Illustrate how, a Standard hydrogen electrode is used to measure the electrode potential with reference to zero potential.	**04**
	c)	Briefly explain the reversible electrochemical reaction at the surface of a Silver–Silver Chloride Electrode, and the electrode's application as surface electrode for ECG measurement.	**08**

OR

6	a)	Illustrate the Double-layer formation at an electrolyte-metal interface, and discuss how the ionic potentials in the human body are transduced to electronic potentials by the Electrodes attached to the human body.	**06**
	b)	Discuss the equivalent circuit of ECG Electrode-impedance, and its variation with frequency and current density for any one typical electrode material.	**10**
	c)	Define Biomagnetism and relate them with the Bioelectric properties.	**04**

UNIT - V

7	a)	With the schematic diagram of an ion-selective electrode, its measurement system, and the governing equations, explain the principle of a Chemical measurement.	**10**
	b)	Explain the construction and working principle of a Zirconia oxygen sensor.	**06**
	c)	Define a Biosensor and give an example.	**04**

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REAPPEAR EXAMS 2022-23