U.S.N.										

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

Autonomous Institute Affiliated to VTU

August 2024 Semester End Main Examinations

Programme: B.E. **Semester: III**
Branch: Medical Electronics Engineering **Duration: 3 hrs.**
Course Code: 23MD3PCBSM **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.

			UNIT - I	*CO*	*PO*	Marks
1	a)		Discuss to differentiate between the following with relevant expressions and examples (i) Accuracy and Precision (ii) Zero Order and First Order Instrument	*CO1*	*PO1*	**08**
	b)		Explain the Step response of a Second order Instrument with suitable illustrations, highlighting the three types based on the value of its damping factor.	*CO1*	*PO1*	**08**
	c)		Define Sensitivity, and illustrate how it's quantified for a measuring instrument with nonlinear static calibration curve.	*CO1*	*PO1*	**04**
			UNIT - II			
2	a)		List out any five relative advantages and disadvantages of Electrical sensors over their mechanical counterparts.	*CO2*	*PO2*	**06**
	b)		Two Strain gauges (R1=R2 = 360 Ω & GF1=GF2 = 4.8) are mounted on the two sides of a specimen, whose Young's modulus is 6000 GN/m2. When it is subjected to a stress of 10000 MN/m2, (i) Determine Strain created, Changes in gauge resistances (ii) Construct a Half bridge circuit excited by 5V. And, assuming the resistances in the other 2 arms to be same and equal to 1kΩ, determine the bridge's output voltage. Explain why, the output of (ii) above will not be affected by temperature changes on the specimen.	*CO2*	*PO2*	**08**
	c)		Piezoelectric Sensors are direction sensitive. Justify this statement with a suitable example.	*CO2*	*PO2*	**06**
			OR			
3	a)		Discuss to differentiate between Active and Passive Sensors giving one example for each type.	*CO2*	*PO2*	**06**

		b)	An LVDT produces an output of say Eo =Es1-Es2 = 0.20 mV ± 200 mV for displacement range of say X = ± 2.5 cm, when the primary is excited by atypical 2V AC at 1kHz. Illustrate how the displacement and its direction are measured, with the help of a block diagram and appropriate waveforms (not to scale).	*CO2*	*PO2*	**10**
		c)	Explain the basic principle of using a Capacitive sensor for displacement measurement.	*CO2*	*PO2*	**04**
			UNIT - III			
	4	a)	Discuss the principle of measuring temperature using AD590, and explain how the device is designed to provide a sensitivity of 1μA/Kelvin, using its simplified internal circuit.	*CO3*	*PO3*	**10**
		b)	When the temperature of a medium increases from 30ºC to 150ºC, determine the resistance changes in these sensors (i) PRTD with $\alpha = 0.00385/^{o}C$, and Ro = 112 Ω (ii) Thermistor with B = 3200 K, and Ro = 10 kΩ Comment on the observed changes in resistance values.	*CO3*	*PO3*	**06**
		c)	Briefly explain Reference junction compensation in Thermocouples	*CO3*	*PO3*	**04**
			OR			
	5	a)	Discuss the basic principle and the technique of measuring SpO2 using the Pulse Oximeter.	*CO3*	*PO3*	**08**
		b)	Discuss the basic principle, and differentiate between the Photovoltaic (PV) and Photoconductive (PC) modes of operation of Photodiodes.	*CO3*	*PO3*	**08**
		c)	Explain the basic principle of a Photoresistor.	*CO3*	*PO3*	**04**
			UNIT - IV			
	6	a)	With suitable illustrations, discuss the generation of Action potentials in the human body, and explain how they become Bioelectrical potentials on the skin surface via Volume conduction.	*CO1*	*PO1*	**08**
		b)	Illustrate the Einthoven triangle, and discuss how 12-lead ECG is obtained using 10 electrodes placed on the human body.	*CO1*	*PO1*	**08**
		c)	Differentiate between Polarizable and Non-polarizable electrodes, and justify why Ag-AgCl electrodes are nearly Non-Polarizable type.	*CO1*	*PO1*	**04**
			UNIT - V			
	7	a)	Define, and briefly explain the major classification of Chemical sensors, with one example for each type.	*CO2*	*PO2*	**08**
		b)	Discuss the principle of Surface Plasmon Resonance (SPR) based Immunosensor.	*CO2*	*PO2*	**08**
		c)	Illustrate the components of a Biosensor, and explain briefly.	*CO2*	*PO2*	**04**

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