

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATIONS-2022

B.Tech-VII Semester (ECE)

COURSE CODE (CREDITS): 18B1WEC841 (3)

MAX. MARKS: 35

COURSE NAME: Bio Electronic Sensors

COURSE INSTRUCTOR: Dr. Harsh Sohal

MAX. TIME: 2 Hours

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*Note: All questions are compulsory. Marks are indicated against each question in square brackets.*

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- Q1.** (a) What are limiting errors? Why they are also called as Guarantee errors? [2]  
(b) A 0-145 V voltmeter has a guaranteed accuracy of 1 per cent full-scale reading. The voltage measured by this meter is 33 V. Calculate the limiting error in percentage. [3]
- Q2.** (a) What are smart sensors?? Describe various components of typical smart sensors with a suitable Block diagram. Discuss advantages and disadvantages of smart sensors over traditional sensors. [1+2+2]  
(b) What is a transducer? How is it different from a sensing element? [2]  
(c) One junction of an iron-copper thermocouple is maintained at 220 °C and the other at 5 °C. Calculate the thermo emf generated. The thermoelectric constants are given as  
 $x_1 = 15.42 \mu\text{V C}^{-1}$  ;  $x_2 = -0.019 \mu\text{V C}^{-2}$  [2]
- Q4.** (a) What are different types of EEG waves? Compare them on the basis of frequency range, region or occurrence/measurement, duration of occurrence etc. [4]  
(b) You are working for a biomedical engineering startup company. The company is planning to launch an internal pacemaker. You are tasked to choose a suitable internal electrode for use in the system. Suggest a suitable internal electrode for the same while discussing pros and cons of at least 4 different types of internal electrodes. [4]
- Q5.** (a) Design a summing amplifier such that  $V_O = -10v_1 + 2v_2 + 0.5v_3$ . [2]  
(b) The output of a biopotential preamplifier that measures the EOG, is an undesired dc voltage of  $\pm 3$  V due to half cell potentials, with the desired signal of  $\pm 1$  V superimposed. Design a circuit that will balance dc voltage to zero and provide a gain of -10 for the desired signal without saturating the OpAmp. [5]
- Q6.** Design an ECG amplifier circuit (using suitable filters, circuit and OpAmps and other required components) that meets the following requirements. PTO

- ECG signal range:  $\pm 5\text{mV}$ , 0.5-30Hz
- Electrode dc offset voltage:  $\pm 300\text{mV}$
- dc power supply:  $\pm 6\text{V}$
- Operational amplifiers saturate at  $\pm 5\text{V}$
- ADC input range:  $\pm 5\text{V}$  (Output of the amplifying circuit goes to the input of ADC) [6]

B.T. Examinations May 2012