Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech/BME(NEW)/SEM-4/BME-402/2012

2012
BIOSENSORS & TRANSDUCERS

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

GROUP – A
(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following : $10 \times 1 = 10$

   i) Strain gauge can be used as a

   a) Flow Sensor b) Temperature Sensor

   c) Humidity Sensor d) None of these.

   ii) If σ be the Poisson Ratio, the Gauge factor (G) is defined as

   a) $G = 1 - 2\sigma$ b) $G = 1 + 2\sigma$

   c) $G = 1 + \sigma/2$ d) $G = 2 + \sigma$.

   iii) Average Frequency range of E.C.G. signal is

   a) 0.05 Hz – 140Hz b) 1kHz – 2kHz

   c) 4 Hz – 40Hz d) 4Hz – 250Hz.

iv) In electrical model of electrode-electrolyte interface, capacitor is incorporated for indicating

a) Conductivity b) Charged double layer

c) Half-cell Potential d) Flow of Current.

v) In a 'Thermopile' the thermocouples are added in series to increase

a) Thermal *emf* b) Thermal current

c) Temperature d) None of these.

vi) In an Optical fibre if μ_1 and μ_2 be Refractive indices of Core and Cladding respectively then

a) $\mu_1 > \mu_2$ b) $\mu_1 < \mu_2$

c) $\mu_1 = \mu_2$ d) $\mu_1^2 = \mu_2$.

vii) The conductivity of an LDR changes with the

a) intensity of light

b) current flowing through the LDR

c) due to P-N junction

d) none of these.

viii) MEMS means

a) Micro Electro Mechanical System

b) Model of Electro Miogram System

c) Model of Eye and Muscle System

d) None of these.

ix) When an ISE electrode is used as pH electrode it senses

a) H^+ ions b) Cl^- ions

c) Na^+ ions d) K^+ ions.

x) Any electrode potential is known as Half Cell Potential because with respect to an Electrical Cell it consists

a) half no. of electrodes

b) same no. of electrodes

c) double no. of electrodes

d) none of these.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. Describe about the resistance temperature characteristics of a thermistor.

3. Draw the basic electrical model to be considered for Electrode-Electrolyte-Skin Interface.

4. Write the advantages and disadvantages of a thermistor.

5. When a potentiometer is used to measure the linear displacement, error (interference to linearity) may be there due to load resistance of the galvanometer. How can you overcome this problem ? 4 + 1

6. Write the five different applications of Strain gauge in Medical field.

7. Briefly discuss about the working principle of a variable capacitance pressure transducer.

GROUP – C

(Long Answer Type Questions)

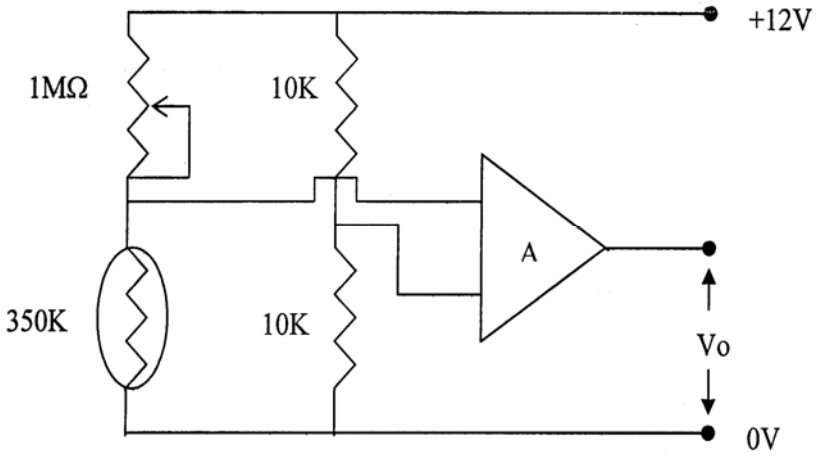
Answer any *three* of the following. 3 × 15 = 45

8. a) Write the different selecting criteria of a transducer.

   b) What do you mean by flow transducers ? Write the names of three different types of flow transducers and their applications in bio-medical field

   c) Write the working principle of P-N junction diode thermometer. 5 + (1 + 4) + 5

9. a) The figure represents a circuit for respiration rate measurement. The bridge is balanced at room temperature (30°C). The sensitivity of the thermistor is 7kΩ per °C rise in temperature. Find out the output voltage (V_o) during measuring of respiration rate. It is given that the gain of Op-Amp is 2 and human body temperature is 37° C.



b) Define and draw the basic structure of a micro-electrode.

c) What do you mean by specific ion electrode ? How this electrode can be used as pH electrode ?

5 + (3 + 2) + (3 + 2)

10. a) Draw the characteristic curve of Power *vs* temperature for the two components of a thermocouple with mathematical calculation.

    b) Draw the five different types of Indicator Mediated Optical Fibre Sensor with sketch.

    c) Briefly discuss about the working principle of Piezoelectric crystals. 7 + 5 + 3

11. a) Write the working principle of glucose sensor with sketch.

    b) Write the name and draw the five different kinds of body surface electrode used in Bio-medical field.

    c) Write the working principle of LVDT and its two applications in Bio-medical field. 5 + 5 + (3 + 2)

12. a) Write the working principle of Optical fibre sensor with sketch.

    b) What type of transducer you should prefer to measure human chest movement and why ? Briefly discuss the working principle of such transducer.

    c) Explain the sensing mechanism of immunosensor.

    5 + (1 + 1 + 3) + 5

13. Write short notes on any *three* of the following : 3 × 5

a) Photoemissive tube

b) Ag/AgCl electrode

c) Bio-MEMS

d) Inductive transducers

e) Optical fibre temperature sensor.