

5A. Show that the induced voltage is proportional to the flow rate of blood in an electromagnetic blood flow meter. With a neat figure, also explain the design of the flow-head.

- 5B. A thin constantan wire stretched taut has a length of 30mm and a cross-sectional area of 0.01 mm<sup>2</sup>. The resistance of the wire is  $1.5\Omega$ . The force applied to the wire is increased so that the length increases by 10mm and the cross-sectional area decreases by 0.0027 mm<sup>2</sup>. Find the change in resistance. (The resistivity of constantan is approximately  $5x10^{-7}\Omega$ -m).
- 5C. Explain the origin, frequency and duration of each heart sound. Also, correlate the heart sounds with the ECG signal. How can the cardiac murmurs be differentiated from the normal heart sounds?
- 6A. Define the following parameters related to the performance of a transducer.(i) Accuracy (ii) Precision (iii) Resolution (iv) Sensitivity
- 6B. A strain gauge is placed in a Wheatstone bridge as shown in the figure. R<sub>1</sub>, R<sub>2</sub> & R<sub>3</sub> have equal resistance of 1KΩ. AC bias voltage is 10V. The strain gauge has a gauge factor of 3.5 and its rest-resistance and rest-length are 1KΩ and 3cm respectively. (i) Compute the output voltage of the bridge when the elongation is 1mm. (ii) Compute the output voltage of the bridge when the elongation is 10mm, and check for linearity of the strain gauge bridge if the bridge output voltage is equal to zero volts when there is no elongation.



- 6C. Discuss how grounding can be used to prevent electrical accidents in hospitals. (4+10+6)
- 7A. Define piezoelectric effect. Give an important application of piezoelectric transducer in medical field.
- 7B. (i) Give the characteristics of an Instrumentation amplifier.

(ii) Derive the expression for the output of an instrumentation amplifier, when the input to the amplifier is the output of the Wheatstone's bridge with a resistive transducer in one arm.

7C. (i) Explain the unipolar limb lead configuration with neat diagrams.

(ii) On an ECG monitor, lead I & lead II display poor quality waveforms. Which electrode and/or lead, is suspected to be bad?

(iii) Calculate the heart rate in beats/min, if the interval between 2 adjacent QRS complexes is 18mm. Given: Speed of the ECG paper = 25mm/sec. (4+8+8)

(8+4+8)

- 8A. With suitable examples, explain how the electrical double layer is formed when an electrode is immersed in its electrolytic solution.
- 8B. What are the advantages of needle electrodes over surface electrodes? With suitable diagrams, explain unipolar and bipolar coaxial needle electrodes in detail.
- 8C. (i) Differentiate active and passive transducers.
  - (ii) What is Seebeck effect? Describe its significance.

(6+6+8)

