

MEDICAL INSTRUMENTATION
(AEIE 4222)

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one from each group.*

Candidates are required to give answer in their own words as far as practicable.

Group - A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) Sphygmomanometer is a clinical device to measure blood _____
(a) pressure (b) cardiac output
(c) volume (d) none of the above.
 - (ii) The generic name of T-type thermocouple is _____
(a) Copper-constantan (b) Iron constantan
(c) Chromel alumel (d) Chromel-constantan.
 - (iii) Resting membrane potential of a living cell is _____.
(a) 70 mV (b) -70 MV (c) 70 μ V (d) -70 μ V
 - (iv) The primary pacemaker of the heart is _____
(a) sino-atrial node (b) atrio-ventricular node
(c) purkinje fibres (d) bundle of his.
 - (v) Half-cell potential is formed due to _____
(a) skin-electrolyte interface (b) electrolytic impedance
(c) metal-electrolyte interface (d) skin impedance.
 - (vi) If the rate of heart beat is faster than the normal, then it is called _____.
(a) Tachycardia (b) Arrhythmia
(c) Fibrillation (d) Bradycardia.
 - (vii) In LEAD-III configuration, electrodes are placed on _____.
(a) LL-RA (b) LL-LA (c) LA-RA (d) LL-RL.
 - (viii) Ultrasound waves are above
(a) 20 Hz (b) 200 kHz (c) 2 kHz (d) 20 kHz.
 - (ix) Blood acidosis means pH value is _____.
(a) < 7 (b) = 7 (c) = 7 (d) any one of the above.

- (x) Computed Axial Tomography (CAT) measures the
(a) transmitted intensity of X-ray (b) incident intensity of X-ray
(c) both (a) and (b) (d) attenuation value of X-ray.

Group - B

2. (a) Differentiate between a sensor and a transducer. *[(CO1)(Remember/LOCQ)]*
(b) Create a schematic diagram to explain the measurement of RTD based body temperature using 555 timer IC. *[(CO1)(Create/HOCQ)]*
(c) How one can monitor the chest movement? Show a schematic diagram for that. *[(CO1)(Evaluate/IOCQ)]*
4 + 4 + 4 = 12
3. (a) What is a Sphygmomanometer? Name the sensors used here. *[(CO1)(Remember/LOCQ)]*
(b) A physician measures the blood pressure of a person and records the data as 120/80. Interpret the information. *[(CO1)(Understand/LOCQ)]*
(c) Explain the working principle of transit time Ultrasonic flow meter. Name the transducers used here. *[(CO1)(Analyse/IOCQ)]*
(2 + 2) + 2 + (5 + 1) = 12

Group - C

4. (a) What is a 10-20 electrode placement system in EEG? With what bioelectric instrument is it used? *[(CO2)(Remember/LOCQ)]*
(b) Fig.1 represents the transient response of a living cell. Various actions are marked by the Numbers like 1, 2 etc. Identify the operations. *[(CO2)(Evaluate/HOCQ)]*

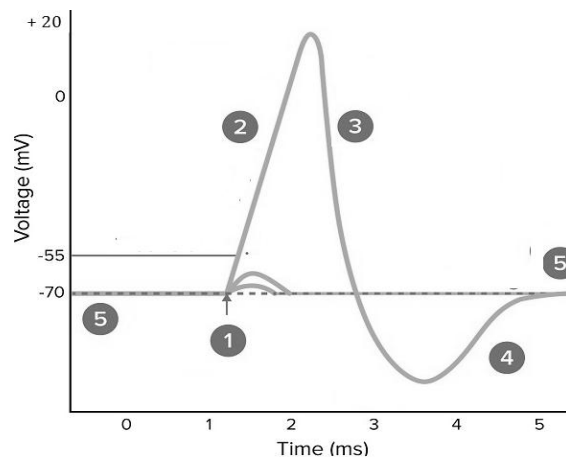


Fig.1

- (c) List the principal ions that are responsible for producing cell potentials. List the different types of the refractory period. *[(CO2)(Analyze/IOCQ)]*
(2 + 1) + 5 + (2 + 2) = 12
5. (a) What is Einthoven's triangle? State Einthoven's Law. What is the basis of Einthoven's law? *[(CO2)(Understand/LOCQ)]*
(b) Show the electrical pathway of ECG electrical signal. *[(CO2)(Remember/LOCQ)]*

- (c) Show the different unipolar and bipolar lead configurations in an ECG?
Construct Goldberger's common terminal. [[CO2](Evaluate/IOCQ)]
3 + 4 + 5 = 12

Group - D

6. (a) What is a pacemaker? Classify pacemakers in terms of pacing mode, and configuration. [[CO4](Analyze/IOCQ)]
(b) Construct the block diagram of an asynchronous pacemaker. [[CO4](Analyze/IOCQ)]
(2 + 6) + 4 = 12
7. (a) What is medical imaging? Show the different imaging techniques and respective applications in biomedical instrumentation? [[CO3](Remember/LOCQ)]
(b) With a neat diagram, explain the operation of an X-Ray computed tomography. Why it is better than the normal X-Ray images? [[CO3](Evaluate/HOCQ)]
(1 + 3) + (6 + 2) = 12

Group - E

8. (a) Present the different sections in biotelemetry? Explain with a neat sketch the block diagram of a telemetry system to send patients' physiological events. [[CO5](Remember/LOCQ)]
(b) List the electrodes that are used in pH measurement. How does the pH value determine the acidity or alkalinity of blood? [[CO3](Remember/Understand/LOCQ)]
(c) Assess the objectives to measure partial pressure of Carbon dioxide in blood? [[CO2](Analyze/HOCQ)]
(2 + 6) + (1 + 1) + 2 = 12
9. (a) Discuss Let-go current of human body. [[CO6](Remember/LOCQ)]
(b) What are macro and Micro shocks? What are the physiological effects of current? [[CO5](Apply/IOCQ)]
(c) Discuss the hazards of leakage current. [[CO6](Evaluate/HOCQ)]
3 + (3 + 3) + 3 = 12

<i>Cognition Level</i>	<i>LOCQ</i>	<i>IOCQ</i>	<i>HOCQ</i>
<i>Percentage distribution</i>	38.54	38.54	22.92

Course Outcome (CO):

After the completion of the course students will be able to

1. Explain the fundamental principles and applications of different transducers used for body parameter measurements.
2. Understand the physiology of biomedical systems and different methods in the design of biomedical instruments.
3. Learn the different methods of medical imaging systems, concepts related to the operations and analysis of biomedical instruments.

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4. Learn various therapeutic devices.
5. Design various type bio-telemetry system.
6. Aware of the importance of electrical safety and apply it in the design of different assisting.

**LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.*