BIOMEDICAL INSTRUMENTATION
(AEIE 4241)

Time Allotted : 2½ hrs **Full Marks : 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

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

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) A strain gauge-based blood pressure transducer works on the principle of:
(a) Piezoelectric effect (b) Resistance change due to strain
(c) Capacitance variation (d) Magnetic field variation

(ii) Which of the following is not a type of blood flow transducer?
(a) Ultrasonic transducer (b) Electromagnetic transducer
(c) Piezoelectric transducer (d) Optical fiber transducer

(iii) The resting potential of a typical cell is approximately:
(a) -70 Mv (b) 0 mV (c) +50 mV (d) -30 mV

(iv) Which of the following is NOT a biopotential?
(a) ECG (b) EEG (c) EMG (d) X-ray

(v) The primary cause of polarization in electrodes is
(a) Excessive current flow (b) Ion movement in the electrolyte
(c) High resistance (d) Electrode material corrosion

(vi) Which of the following is a non-invasive imaging technique?
(a) X-ray (b) MRI (c) CT scan (d) All of the above

(vii) The main disadvantage of X-ray imaging is:
(a) High cost (b) Radiation exposure
(c) Low resolution (d) Limited accessibility

(viii) The 12-lead ECG system is used for
(a) Monitoring brain activity (b) Diagnosing heart abnormalities
(c) Measuring lung function (d) Assessing muscle activity

(ix) Ground Fault Circuit Interrupt (GFCI) is used to:
(a) Prevent overheating (b) Protect against electrical shock
(c) Enhance image quality in X-rays (d) Reduce electromagnetic radiation

(x) The purpose of earthing in biomedical instruments is to
(a) Improve signal quality (b) Reduce electrical hazards
(c) Prevent overheating (d) Reduce equipment cost

Fill in the blanks with the correct word

(xi) The electrical potential across the membrane of a resting neuron is called the _____ potential.

(xii) X-ray imaging provides information about _____ structures.

(xiii) The main component of a signal conditioner is _____.

(xiv) Biotelemetry is the remote monitoring of patients using _____.

(xv) The most common type of current that causes severe injury is _____ current.

Group - B

2. (a) Describe the construction and working of a strain gauge-based blood pressure transducer. *[(CO1)(Remember/LOCQ)]*
(b) Explain how variable capacitance transducers are used for blood pressure measurement. *[(CO1)(Analyse/HOCQ)]*
(c) What are the key operating specifications of blood pressure transducers? *[(CO1)(Apply/IOCQ)]*

5 + 4 + 3 = 12

3. (a) What are the different types of temperature transducers used in biomedical applications? *[(CO1)(Analyse/HOCQ)]*
(b) Discuss the role of semiconductor sensors in temperature measurement. *[(CO1)(Remember/LOCQ)]*
(c) Explain how operating specifications impact the selection of temperature transducers. *[(CO1)(Apply/IOCQ)]*

4 + 4 + 4 = 12

Group - C

4. (a) Explain the electrode-electrolyte interface and its significance in biopotential measurements. *[(CO2)(Analyse/HOCQ)]*
(b) Discuss the concept of half-cell potential in electrodes. *[(CO2)(Remember/LOCQ)]*
(c) What is motion artifact, and how does it affect biopotential recordings? *[(CO2)(Apply/IOCQ)]*

4 + 5 + 3 = 12

5. (a) Explain the role of electrode configurations in ECG recordings. *[(CO2)(Analyse/HOCQ)]*
(b) How does electrode placement affect ECG signal quality? *[(CO2)(Remember/LOCQ)]*
(c) Discuss the concept of lead systems in ECG measurements. *[(CO2)(Apply/IOCQ)]*

4 + 5 + 3 = 12

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Group - D

6. (a) Explain the principle of MRI imaging. *[(CO3)(Analyse/HOCQ)]*
   (b) Discuss the role of radiofrequency waves and magnetic fields in MRI. *[(CO3)(Remember/LOCQ)]*
   (c) Compare MRI and CT in terms of resolution, radiation, and application. *[(CO3)(Apply/IOCQ)]*

4 + 4 + 4 = 12

7. (a) Describe the working principle of Computed Tomography (CT). *[(CO4)(Analyse/HOCQ)]*
   (b) Explain the difference between spiral CT and conventional CT. *[(CO3)(Remember/LOCQ)]*
   (c) Discuss the advantages and limitations of CT imaging. *[(CO3)(Apply/IOCQ)]*

4 + 4 + 4 = 12

Group - E

8. (a) Explain the working principle of a pacemaker. *[(CO5)(Analyse/HOCQ)]*
   (b) Discuss the different types of pacemakers used in biomedical applications? *[(CO5)(Remember/LOCQ)]*
   (c) Discuss the different types of pacemakers used in biomedical applications. *[(CO5)(Apply/IOCQ)]*

4 + 4 + 4 = 12

9. (a) Explain the working principle of hearing aids. *[(CO5)(Remember/LOCQ)]*
   (b) Differentiate between analog and digital hearing aids. *[(CO5)(Analyse/HOCQ)]*
   (c) Discuss the recent advancements in hearing aid technology. *[(CO5)(Apply/IOCQ)]*

5 + 3 + 4 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	37.5	30.21	32.29