

**MEDICAL INSTRUMENTATION
(AEIE 5132)**

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) The range of EEG wave frequency above 13 Hz is named
(a) Alpha (b) Beta (c) Gamma (d) Delta.
- (ii) From Einthoven triangle we have
(a) $V_I = V_{II} + V_{III}$ (b) $V_{III} = V_{II} + V_I$
(c) $V_{II} = V_I + V_{III}$ (d) None of these.
- (iii) The heart sounds called 'Lub-Dub', pursuing frequency in the range of
(a) 30-45 kHz and 50-70 kHz (b) 50-70 Hz and 30-45 Hz
(c) 30-45 Hz and 50-70 Hz (d) Above 100 Hz.
- (iv) The most common form of medical imaging, using high-energy radiation to penetrate skin and tissues but not bone is
(a) X-rays (b) CT (c) MRI (d) Ultrasonography.
- (v) Value of resting potential of a cell is approximately
(a) -20 mV (b) -70 μ V (c) 70 mV (d) None of these.
- (vi) In normal ECG signal the typical P wave duration is
(a) 40-80 ms (b) 40-100 ms (c) 60-80 ms (d) 60-120 ms.
- (vii) Indocyanine green is used in bolus of indicator in CO measurement, as it is
(a) inert and economical (b) harmless and measurable
(c) both (a) and (b) (d) None of these.
- (viii) In ECG Waveform QRS complex represents
(a) atrial depolarisation (b) atrial repolarisation
(c) ventricular depolarization (d) both (b) and (c).
- (ix) _____ type of electrodes are employed to study the electrical activities of single cell.
(a) Needle electrodes (b) Micro-electrodes
(c) Surface-electrodes (d) Pre-jelled electrodes

- (x) The minimal threshold value of Let go current in human body is
(a) 0.6 A (b) 6 mA (c) 60 μ A (d) 0.6 mA.

Group- B

2. (a) What do you mean by systolic and diastolic blood pressure (BP)? Compare the direct and indirect BP measurement method. [[CO1](Remember/LOCQ)]
(b) Describe with labelled diagram of a direct BP measurement method using resistive transducer. [[CO3](Explain/LOCQ)]
(c) Does the resistive transducer be used as primary or secondary transducer? Also explain its advantage operating principle. [[CO1](Analyze/IOCQ)]
(2 + 2) + 4 + (2 + 2) = 12
3. (a) Describe an instantaneous blood flow rate measurement technique. Describe its major problems and their solution. [[CO1](Analyze/IOCQ)]
(b) Describe the application of Thermo-resistive Sensor in blood flow measurement. Also explain its operating principle. [[CO2](Remember/LOCQ)]
(3 + 4) + (3 + 2) = 12

Group - C

4. (a) Explain the process of Depolarisation and Repolarisation. [[CO2](Explain/IOCQ)]
(b) Describe different types of invasive and non-invasive types of non-polarisable electrodes. [[CO1](Analyze/IOCQ)]
(3 + 3) + 6 = 12
5. (a) What is Halcell potential? How the value of half cell potential can be calculated? [[CO2](Understand/LOCQ)]
(b) Ag-AgCl is used in the construction of most body surface electrodes. Explain the working and construction of an pH electrode. [[CO3](Analyze/IOCQ)]
(2 + 2) + (3 + 5) = 12

Group - D

6. (a) Explain the concept of bipolar limb leads from Einthoven's triangle. Draw the connections. Write the significance of Wilson's Central terminal. [[CO4](Explain/IOCQ)]
(b) Draw the augmented limb lead connections. Why the leads are called 'augmented'? [[CO4](Analyze/IOCQ)]
(c) Specify the advantages of MRI on CT. [[CO4](Remember/LOCQ)]
(2 + 2 + 1) + (2 + 2) + 3 = 12
7. (a) Describe the twelve lead systems in ECG. Describe the artefacts in ECG tracing. [[CO4](Explain/LOCQ)]
(b) Describe the different components of single channel biotelemetry system with block diagram. [[CO6](Remember/LOCQ)]
(6 + 2) + 4 = 12

Group – E

8. (a) What do you mean by the therapeutic instruments? Show the block diagram of any one of them and describe the operation. Describe about the lead wires or the electrodes. [(CO5)(Remember/LOCQ)]
- (b) Explain the physiological effect of electricity in human body. [(CO6)(Analyse/IOCQ)]
(2 + 4 + 2) + 4 = 12
9. (a) Discuss about the electrical macro shock and micro shock hazards. [(CO6)(Explain/LOCQ)]
- (b) Draw a complete equivalent circuit and compute the r.m.s. current through the patient's heart for following situation. Patient's hand touches the faulty metal lamp that is 120 V r.m.s. above ground. A saline filled catheter (R = 50 k Ohm) for BP measurement is connected to the patient's heart. Some pressure sensor strain gauge wiring is grounded, and sensor is somewhat isolated electrically. However there is 20 M Ohm of leakage resistance in the insulation between the ground and the saline. Assume skin resistance of patient is 1 M Ohm. Is there a micro shock hazard? [(CO6)(Determine/HOCQ)]
4 + 8 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	57.29	34.38	8.33

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.
4. Design signal processing hardware circuits.
5. Learn various therapeutic devices.
6. Aware of the importance of electrical safety and apply it in the design of different assisting, therapeutic and diagnostic medical devices.

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

