MEDICAL INSTRUMENTATION
(AEIE 4222)

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) Source of Bioelectric potential is _____ in nature.
(a) Mechanical
(b) Electronic
(c) Ionic
(d) Electrical

(ii) Which of the following represents action potential?
(a) -70mV
(b) +70mV
(c) -20mV
(d) +20 mV

(iii) Which of the following is a preferred electrode for measuring EEG?
(a) Micro-electrode
(b) Floating electrode
(c) Needle electrode
(d) All of these

(iv) Which of the following is considered to be the primary pacemaker of the heart?
(a) Sino-Atrial node
(b) Atrio-Ventricular node
(c) Purkinje fibre
(d) Bundle of his

(v) At the time of diastole at left ventricle
(a) SA node generates new pulse
(b) Aortic valve opens
(c) 2nd heart sound occurs
(d) all the above informations are true.

(vi) If the rate of heart beat is faster than the normal, it is called:
(a) Tachycardia
(b) Arrhythmia
(c) Fibrillation
(d) Bradycardia

(vii) Commonly used metal for needle electrode is
(a) Stainless steel
(b) Copper
(c) Lead
(d) Iron

(viii) The beta-wave in the EEG complex signal lies in the range of
(a) 1-3 Hz
(b) 3-13 Hz
(c) 13-30 Hz
(d) >100 Hz

(ix) The number of electrodes in 12 lead ECG system is
(a) 3
(b) 6
(c) 4
(d) 10

(x) In thermo-dilution the indicator is used for
(a) Cold water
(b) Hot water
(c) Indo-cyanine Green
(d) Any of (a) or (b)

Fill in the blanks with the correct word

(xi) ECG electrodes are placed on _____and _____ for Lead-III connection.

(xii) The polarizable electrodes are made of metals like_____.

(xiii) QRS Complex is traced due to _____.

(xiv) Phantom Electrodes are used to adjust _____ voltage.

(xv) PPG is used to measure_____.

Group - B

2. (a) Describe the construction and principle of operation of LVDT. Also mention its application in a Cardio-vascular parameter measurement with neat diagram.
[(CO1)(Analyse/IOCQ)]

(b) Describe the method of Cardiac Output measurement where natural metabolites are used as indicators.
[(CO2)(Understand/LOCQ)]

(3 + 3 + 2) + 4 = 12

3. (a) Explain how Magnetic flow meter is measuring instantaneous blood flow rate. What are the drawbacks of using DC source in electromagnetic blood flow meter? *[(CO3)(Analyse/HOCQ)]*

(b) What is Transformer voltage? Describe one of the convenient methods to eliminate it. *[(CO4)(Remember/LOCQ)]*

(c) Describe briefly about the magnetic flow probe (sensor). *[(CO2)(Apply/IOCQ)]*

(2 + 2) + (1 + 4) + 3 = 12

Group - C

4. (a) What is a 10-20 electrode placement system in EEG instrument? With what bioelectric instrument is it used? *[(CO2)(Remember/LOCQ)]*

(b) Draw the bipolar and unipolar lead configuration in ECG. Write the significance of Wilson Central Terminal (WCT). *[(CO2)(Understand/IOCQ)]*

(c) Prove that voltage at aVR (augmented unipolar lead) is 50% greater than VR (Right arm electrode voltage respect to WCT). *[(CO2)(Evaluate/HOCQ)]*

(2 + 1) + (5 + 1) + 3 = 12

5. (a) With the help of action potential waveforms summarize depolarization, repolarisation and absolute relative refractory periods. *[(CO2)(Understand/LOCQ)]*

(b) Draw and justify the electrical model for skin –electrode junction. *[(CO2)(Elaborate/HOCQ)]*

6 + 6 = 12

Group - D

6. (a) Explain the working of MRI principle. *[(CO3)(Analyse/IOCQ)]*

(b) Explain different modes of Ultrasound used in medical diagnostics. *[(CO3)(Analyse/IOCQ)]*

(c) What is medical imaging? Show the different imaging techniques and respective applications in biomedical instrumentation. *[(CO3)(Remember/LOCQ)]*

3 + 5 + (1 + 3) = 12

7. (a) What is a pacemaker? Classify pacemakers in terms of pacing mode and configuration. *[(CO4)(Analyse/IOCQ)]*

(b) Differentiate between external pacemaker and implanted pacemaker. *[(CO4)(Understand/LOCQ)]*

(c) Distinguish a de-fibrillator from a pace maker. *[(CO4)(Analyze /IOCQ)]*

(1 + 5) + 3 + 3 = 12

Group - E

8. (a) List the electrodes that are used in pH measurement. How does the pH value determine the acidity or alkalinity of blood? [(CO1)(Remember /LOCQ)]

(b) Assess the objectives to measure partial pressure of Carbon dioxide in blood. *[(CO1)(Analyse/HOCQ)]*

(c) Explain the biotelemetry system using proper block diagram. *[(CO5)(Apply/IOCQ)]*

(1.5 + 1.5) + 2 + 7 = 12

9. (a) Discuss Let-go current of human body. *[(CO6)(Remember/LOCQ)]*

(b) What do you mean by macro and Micro shocks? What are the physiological effects of current? *[(CO6)(Apply/IOCQ)]*

(c) Discuss the hazards of leakage current. *[(CO6)(Analyse/IOCQ)]*

3 + (3 + 3) + 3 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	32.29	52.08	15.63

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. Learn various therapeutic devices.
5. Design various type bio-telemetry systems.
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.*