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) Thermo-resistive temperature transducers work on the principle of:
(a) Change in capacitance (b) Change in resistance with temperature
(c) Change in magnetic field (d) Change in pressure

(ii) Which of the following transducers is NOT used for measuring blood flow?
(a) Piezoelectric (b) Electromagnetic
(c) Photovoltaic (d) Doppler

(iii) Electrode gels and creams are used to:
(a) Reduce skin resistance (b) Increase signal noise
(c) Block electrical signals (d) Measure impedance

(iv) EMG measures:
(a) Brain activity (b) Muscle activity
(c) Heart activity (d) Lung activity

(v) Which type of radiation is used in X-ray imaging?
(a) Infrared (b) Microwave (c) Gamma (d) Electromagnetic

(vi) Which imaging modality is best suited for detecting bone fractures?
(a) MRI (b) X-ray (c) Ultrasound (d) PET Scan

(vii) Which of the following parameters is measured to assess respiratory function?
(a) pH (b) pCO_2 (c) Blood glucose (d) Haematocrit

(viii) Which technology is commonly used in modern biotelemetry systems for signal transmission?
(a) Infrared (b) Radiofrequency (RF)
(c) Ultrasound (d) Fiber optics

(ix) What is the normal pH range of human blood?
(a) 6.8 – 7.0 (b) 7.35 – 7.45 (c) 8.0 – 8.45 (d) 6.0 – 6.5

(x) pO_2 measurement in blood is essential for assessing:
(a) Carbon dioxide levels (b) Oxygen transport efficiency
(c) pH balance (d) Glucose concentration

Fill in the blanks with the correct word

(xi) A strain gauge transducer is commonly used to measure _____.

(xii) Electroencephalography is used to measure the electrical activity of the _____.

(xiii) _____ imaging is based on the principle of nuclear magnetic resonance.

(xiv) _____ is used for the remote monitoring of biological signals.

(xv) Isolation amplifiers are used for ensuring _____ safety.

Group - B

2. (a) Describe the RTD and explain how it can be used to measure temperature. *[(CO1)(Analyse/IOCQ)]*
(b) Distinguish between RTD and Thermistor. *[(CO1)(Understand/LOCQ)]*
(c) What is meant by Pt_{100}? *[(CO1)(Remember/LOCQ)]*

5 + 5 + 2 = 12

3. (a) Explain how Magnetic flow meter is measuring instantaneous blood flow rate. *[(CO1)(Analyse/IOCQ)]*
(b) What are the drawbacks of using DC source in electromagnetic blood flow meter? *[(CO1)(Analyse/IOCQ)]*
(c) Illustrate the principle of ultrasonic Doppler-shift flow-velocity meter. Explain the working of Doppler-shift blood flowmeter. *[(CO1)(Analyse/IOCQ)]*

5 + 2 + 5 = 12

Group - C

4. (a) What is a biopotential electrode? Draw the electrical equivalent circuit of a polarizable electrode. *[(CO2)(Understand/LOCQ)]*
(b) For a patient which type of electrode is least traumatic and why? *[(CO2)(Analyse/IOCQ)]*
(c) When microelectrodes are needed? *[(CO2)(Understand/LOCQ)]*
(d) Show the different unipolar and bipolar lead configurations in an ECG? Construct Goldberger's common terminal. *[(CO2)(Apply/IOCQ)]*

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

5. (a) Describe the step-by-step electrical impulse conduction through the wall of chambers of heart related to ECG graph. *[(CO2)(Analyse/IOCQ)]*
(b) Explain the Bipolar limb leads from Einthoven's triangle. Draw the connection. *[(CO2)(Analyse/IOCQ)]*
(c) What are the different sources of artefacts during the recording of ECG signal? *[(CO2)(Understand/LOCQ)]*

4 + (3 + 3) + 2 = 12

Group - D

6. (a) What are the limitations of conventional radiology? How it is overcome in computed tomography? *[(CO3)(Understand/LOCQ)]*
   (b) What is CT Number or Hounsfield Unit (H)? Indicate the CT number for water and air. *[(CO3)(Remember/LOCQ)]*
   (c) What are the various scanning techniques used in computed tomography? *[(CO3)(Understand/LOCQ)]*

(2 + 2) + (2 + 2) + 4 = 12

7. (a) Define plethysmography. Explain its applications. *[(CO4)(Remember/LOCQ)]*
   (b) Compare CT Scans and MRI. *[(CO4)(Understand/LOCQ)]*
   (c) What are the safety considerations in imaging systems? *[(CO4)(Analyse/IOCQ)]*

(3 + 3) + 4 + 2 = 12

Group - E

8. (a) Distinguish between gross shock and micro current shock. *[(CO6)(Understand/LOCQ)]*
   (b) Explain the effects of electric current on the human body. *[(CO6)(Analyse/IOCQ)]*
   (c) Define leakage current and explain its various types. *[(CO6)(Understand/LOCQ)]*

4 + 4 + 4 = 12

9. (a) Discuss Let-go current of human body. *[(CO6)(Understand/LOCQ)]*
   (b) What is meant by macro shock? Classify the ways by which macro shocks can be reduced. *[(CO6)(Analyse/IOCQ)]*
   (c) Explain a real-time patient monitoring telemetry system. *[(CO5)(Analyse/IOCQ)]*

2 + (3 + 3) + 4 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	41.67	34.37	23.96