

M.TECH/AEIE/3RD SEM/AEIE 6151/2018
MEDICAL INSTRUMENTATION
(AEIE 6151)

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

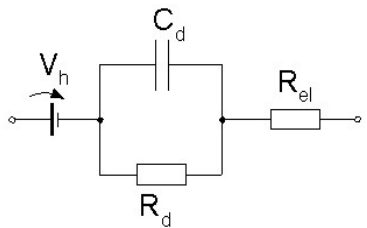
Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

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) Bio-potential amplifier should have
 - (a) Low gain, low-input impedance, low CMRR
 - (b) High gain, high input impedance, low CMRR
 - (c) Low gain, high input impedance, low CMRR
 - (d) High gain, high input impedance, high CMRR.
- (ii) Strain gauge is usually used to measure blood-----
 - (a) pressure
 - (b) temperature
 - (c) cardiac output
 - (d) both (a) and (b).
- (iii) If the rate of heart beat is faster than the normal, then it is called:
 - (a) Tachycardia
 - (b) Arrhythmia
 - (c) Fibrillation
 - (d) Bradycardia.
- (iv) X-ray imaging combined with computer technique is known as
 - (a) EMG
 - (b) ECG
 - (c) USG
 - (d) CT.
- (v) In LEAD-II confi
 - (a) LL-RA
 - (b) LL-RL.
 - (c) LL-LL
 - (d) LL-RL.
- (vi) Let-go-current (
 - (a) 5-7 μA
 - (b) 5-7 mA
 - (c) 5-7 V
 - (d) 7-9 mA.
- (vii) After a cell is s
 - (a) restoration p
 - (b) recovery period
 - (c) regain period
 - (d) regenerative period.
- (viii) Korrotkoff sound is used in
 - (a) blood flow measurement
 - (b) heart valve functioning
 - (c) ultrasound imaging
 - (d) blood pressure measurement.



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- (ix) Which flow meter works on constant pressure drop principle?
 - (a) venturimeter
 - (b) rotameter
 - (c) turbine flow meter
 - (d) vortex flow meter.
- (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) Explain the working principle of ultrasonic flow meter that features compensation against source frequency variation.
- (b) Explain with a neat sketch, the operation of a differential capacitive type sensor used for chest movement measurements.

6 + 6 = 12

- 3. (a) What are the conditions for diffusion of the species across a semi permeable membrane? How can we quantify the contribution of multiple ionic species?
- (b) A piezoelectric pressure sensor has a bandpass characteristic with cut-off frequencies of 0.1 Hz and 1 MHz, and a sensitivity of 100 mV/ kPa. The sensor is subjected to a static constant pressure of 100 kPa. What should be the steady-state output offered by the sensor? Justify the answer.

Is it possible to measure the blood flow using an electromagnetic flow meter? Justify your answer.

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

Group - C

- 4.(a) List the principal ions that are responsible for producing cell potentials.
- (b) Derive the transfer function of the equivalent circuit of an electrode as shown in Fig. 1.

Draw the frequency response of the impedance of the electrode taking frequency axis in logarithmic scale.

2 + (5 + 5) = 12

- 5.(a) How does a half-cell potential form? On what factors the magnitude of such a potential depend? How can one measure the half-cell potential?
- (b) What are polarization and over potential related to the electrodes? What are the polarizable and non-polarizable electrodes? Give one example of each.

$$(2+2+2) + (2+2+2) = 12$$

Group - D

6. (a) Explain the electrical conductive pathways of the heart with the necessary diagrams. Classify in details about the ECG electrodes.
- (b) What is medical imaging? What are the different imaging techniques and respective applications in biomedical instrumentation ?

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

7. (a) What are the sections in biotelemetry? Explain with a neat sketch the block diagram of a telemetry system to send patient's physiological events.
- (b) With suitable diagram, explain the operation of an Ultrasonic imaging Technique.

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

Group - E

8. (a) What are the physiological effects of current in human body? What is leakage current ? Describe any one of the way for its prevention.
- (b) What are the different types of a pacemaker? Draw the block diagram of a typical Pacemaker.

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

9. Write Short notes on any two:
- (i) Thermocouple's burn out feature
 - (ii) Dye dilution method of blood flow measurements
 - (iii) Applications of strain gauge and thermistor in medical instrumentation
 - (iv) Hearing aids

$$6 + 6 = 12$$