



Name :
Roll No. :
Invigilator's Signature :

CS/M.TECH (EIE)/SEM-2/EIEM-204 b/2011

2011

MEDICAL INSTRUMENTATION

Time Allotted : 3 Hours

Full Marks : 70

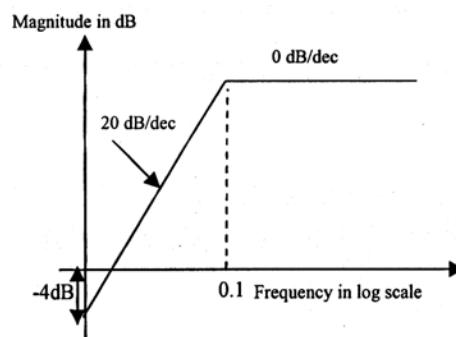
The figures in the margin indicate full marks.

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

Answer any *five* questions

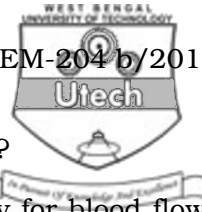
5 × 14 = 70

1.
 - a) Explain the function of an electrode as a transducer.
 - b) Draw the equivalent circuit of an electrode.
 - c) What are the different types of electrodes ? Differentiate them according to their electrical characteristics and applications.
 - d) A skin surface electrode is used to measure bio-electrical potential using a preamplifier. The Bode-magnitude plot of the electrode-lead assembly is shown below. Design the input circuit taking skin surface electrode resistance as 100 ohm. 2 + 2+ 4 + 6





2.
 - a) Name the factors that are considered in the design of biomedical instrument system.
 - b) Derive the transfer function of the generalized input circuit to preamplifier using skin surface electrode. What will be a change in transfer function when someone is using a microelectrode ?
 - c) Draw the polar plots of the each and put your comments on the deviations. 4 + 6 + 4
3.
 - a) Differentiate between ECG, VCG and ECHO cardiography.
 - b) With the neat diagram explain the working of the ultrasonic blood flowmeter.
 - c) Define bipolar and unipolar lead systems. Draw and explain Einthoven's Triangle.
 - d) Describe the 12-lead system used in ECG and also explain the procedure to record the ECG signal. 3 + 3 + 3 + 5
4.
 - a) State the basic principle of ultrasonography.
 - b) Draw the circuits of ultrasonic transmitter and receiver stating the operating frequency range.
 - c) What are the different scanning modes in ultrasonography ? Mention the corresponding application fields.
 - d) Explain the terms Acoustic Impedance, Attenuation Constant related to ultrasonography.
 - e) Why are lower ultrasonic frequencies used for deeper penetration ? 2 + 3 + 4 + 3 + 2



5.
 - a) What are the different blood flowmeters ?
 - b) Explain the impedance plethysmography for blood flow-meter.
 - c) What are the other physiological quantities that can be estimated with the help of impedance plethysmography ?
 - d) Explain with a neat and labeled diagram the principle of cardiac output measurement by Fick's method.

2 + 4 + 2 + 6

6.
 - a) What is resting potential of a cell ? Give typical values.
 - b) What is an action potential ? How can it be evoked ?
 - c) What are the properties of cell membrane action potential ?
 - d) How does action potential propagate ?
 - e) What is neuronal spike ? Draw a typical spike showing amplitude and duration.
 - f) How does the sodium pump work ? 2 + 3 + 2 + 2 + 3 + 2
7.
 - a) Write and explain Goldman's constant field equation. Find the value of E_m (membrane potential) of potassium ions using Goldman series.
 - b) If concentration gradient of potassium ions = 4meq./L and that inside the cell = 155 meq./L. Find potential difference across the cell membrane using Nernst Equation.

- Data given are $P_{K^+} : P_{Na^+} : P_{Cl^-} = 1:0.04 : 0.45$, where P stands for permeability of the ions.

	Na ⁺	K ⁺	Cl ⁻
Outside the cell	145	5	110
Inside the cell	12	160	10

a) Hearing aids b) Artificial heart
c) Half cell potential d) Infrared detectors.