Question Paper

Exam Date & Time: 26-Apr-2018 (09:30 AM - 12:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

INTERNATIONAL CENTRE FOR APPLIED SCIENCES
IV SEMESTER B.S. (ENGG)
END-SEMESTER THEORY EXAMINATION- APRIL 2018
DATE:26.04.2018
TIME:9.30AM TO 12.30PM

Biomedical Instrumentation [BM 242]

Marks: 100 **Duration: 180 mins.**

Answer 5 out of 8 questions.

Missing data, if any, may be suitably assumed

1)	A)	(i) A pressure transducer is connected in a balanced bridge network driven by a 10V power supply. Determine the resistance of the transducer when all other resistors in the bridge are balanced at 100 Ω, and the output of the bridge network is 2V. (ii) Explain in detail, a passive temperature transducer which has a negative temperature co-efficient. (iii) Define the 'Gauge factor' of a strain gauge transducer. Discuss its significance.	(8)
	B)	Differentiate 'Sensitivity' and 'Accuracy'.	(4)
	C)	Describe the physiological effects of electric current on the human body. Specify the current-range over which the different effect occurs.	(8)
2)	A)	What is a 'Let-go' current? Differentiate micro-shock from macro-shock.	(6)
	B)	Explain a type of inductive transducer which uses differential output, and mention its application.	(7)
	C)	What are the advantages of needle electrodes over surface electrodes? With suitable diagrams, explain unipolar and bipolar coaxial needle electrodes in detail.	(7)
3)	A)	What are Korotkoff sounds? Explain how these sounds help in the measurement of systolic & diastolic BP.	(4)
	B)	(i) With a neat schematic, illustrate the utility of a photoconductor involved in the instrumentation for the detection of pulse.	(8)

(ii) A strain gauge has a gauge factor of 4. If the strain gauge is attached to a metal bar that stretches from 0.25m to 0.255m when strained, what is the percentage change in resistance? If the unstrained value of gauge resistance is 120Ω, what is its resistance after the application of strain?

C) What are the characteristics of an instrumentation amplifier? With a neat circuit diagram, discuss the design of an instrumentation amplifier. (8)

4) What is a microelectrode? What is its tip-diameter? With neat figures, explain the two forms of "supported metal microelectrodes". (6)

A)

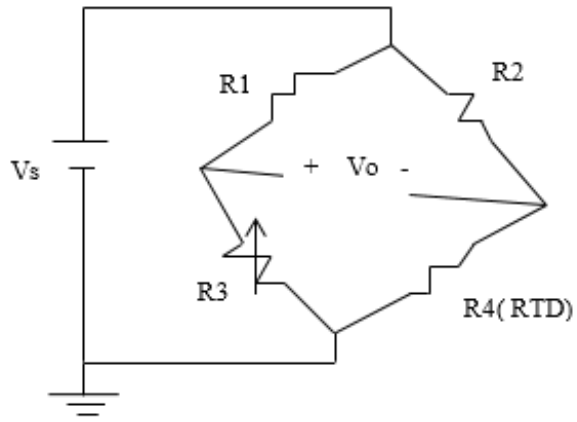
B) List the different writing mechanisms commonly used with the PMMC recorders. Discuss the working of an ink-jet recorder. (8)

C) List the different types of microphones that can be used in a phonocardiograph. Discuss the principle of working of each of them. (6)

5) A piece of zinc metal is immersed in a solution of zinc sulphate; explain how a double layer is formed at the interface between the metal and the solution. (4)

A)

B) An RTD is used for R_4 in a bridge circuit shown in figure. The RTD has R(22^{o}C)=400Ω and α=0.004/^{o}C. The bridge has R_1=4KΩ, R_2=1KΩ, and R_3 is a 10KΩ pot. The source voltage is 10V DC. If the bridge is balanced at R_3=1.5kΩ, determine the RTD temperature. Also, determine the RTD temperature when the output voltage V_o is 10mV with the bridge unbalanced. (8)



C) (i) Explain how the blood flow velocity can be measured using the principle of ultrasound. (8)
(ii) A Doppler blood flow velocity probe is set at an

inclination of 45^{o} with the skin surface to measure the blood flow of an underneath blood vessel. The frequency of the ultrasonic wave being transmitted to the blood flowing in the vessel is 7MHz. The Doppler shift in the frequency of the received ultrasonic wave is observed to be 10KHz. Calculate the blood velocity. Assume that the velocity of the sound in the flowing blood is 1500m/s.
(iii) A blood vessel has a diameter of 0.8cm and the flow velocity is 10cm/sec. A magnetic flow probe surrounds the blood vessel and its magnetic field is $1x10^{-5}$ weber/m^2. Calculate the voltage induced in the probe. [Assume: Constant of proportionality = 1].

6) A) Illustrate the correlation between ECG & PCG. Discuss its significance. (6)

B) Illustrate the 10-20 system of electrode placement used for the measurement of electroencephalogram. (8)

C) Discuss the origin of the normal heart sounds. What are the causes for abnormal heart sounds? How can the abnormal heart sounds be differentiated from the normal heart sounds? (6)

7) A) What is a bio-potential electrode? With suitable figures, explain 'disposable' and 'floating' surface electrodes in detail. (8)

B) (i) The resolution of transducer *A*, transducer *B* and transducer *C* is 0.1V/^{0}F, 0.2V/^{0}F and 0.01V/^{0}F respectively. Which transducer is considered the best under normal conditions? (6)
(ii) Explain the principle behind the blood pressure measurement using the bonded strain gauge and semiconductor strain gauge. What are the advantages of using semiconductor strain gauges over metallic strain gauges?

C) Discuss the following methods used to prevent electric accidents in a hospital environment. (6)
(i) Grounding
(ii) Ground fault circuit interrupter
(iii) Protection by low voltage

8) A) (i) Illustrate the bipolar limb lead configuration used to measure the ECG. (6)
(ii) On an ECG monitor, lead II & lead III display poor quality waveforms. Which electrode and/or lead, is suspected to

be bad?
(iii) Calculate the heart rate in beats/min, if the R-R interval is 21mm. Given: Speed of the ECG paper = 25mm/sec.

B) (i) What is the calibration signal used in the ECG machine? (6)
(ii) Mention the characteristic waves observed in an EEG signal. Also, mention the frequency and characteristics of each of these waves.

C) With a neat schematic, explain the working principle behind the Balancing Null type recorder. (8)

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