Exam Date & Time: 18-Jun-2022 (02:00 PM - 05:00 PM)



MANIPAL ACADEMY OF HIGHER EDUCATION

FOURTH SEMESTER B.TECH END SEMESTER EXAMINATIONS, JUNE 2022 BIOMEDICAL INSTRUMENTATION - I [BME 2252]

Marks: 50

Duration: 180 mins.

A

Answer all the questions.

Instructions to Candidates: Answer ALL questions Missing data may be suitably assumed

- 1) Determine which of the non-metallic resistors can be used for temperature measurement and explain the same. List the advantages and disadvantages of the transducer mentioned above, with two medical applications (4)
 - A)
 - B) Calculate the temperature of a particular medium, when the resistance measured by the thermistor is 2330 Ω . The reference temperature of the thermistor is 1050 Ω at 27⁰C. Assume the material constant of the thermistor to be 3140. (3)
 - C) Differentiate between the third and fourth generation CT machines. Also, discuss the hazards and safety precautions to be considered in the use of X-rays. (3)
- 2) With a neat figure, interpret the equivalent circuit model of an electrode in a cell.
- (4)

- A)
- B) Calculate the series resistance (in a metal microelectrode model) and determine the frequency response of a KCL filled microelectrode, if the micropipette radius is $0.2\mu m$ and the inner tip radius is $0.15\mu m$. The value of the dielectric constant (ρ) for KCl is 3.7 (3) Ωcm , and the taper angle is $\pi/180$. Given: The dielectric constant of glass is 4, and the electrode is immersed 3cm deep in the electrolyte.
- C) In a certain defibrillator, a constant voltage of 1800V is observed across the electrodes for 5msec, and then the voltage drops to 0V. The delivered energy is 200J. Compute the energy delivered when the constant voltage
 - i. Drops to 900V and the duration of the pulse remains 5msec. (3)
 - (ii)Drops to 900V and the duration of the pulse is 10msec.
- Select the type of defibrillator that would be ideal to treat the condition of tachycardia.
 Justify your answer and explain the specific type of defibrillator in detail. (4)

	A)		
	B)	Compute the energy per pulse, when the pacemaker pulse width is 0.5msec, the circuit current drain is 1 μ A, the heart-electrode resistance is 200 Ω and the peak voltage is 1.8V. (Given: heart rate is 70bpm). Also, compute the battery lifetime (in years), when the battery energy is 6480J.	(3)
	C)	Explain how grounding method and ground fault circuit interrupter can used to prevent electrical accidents.	(3)
4)		Correlate the heart sounds with the ECG signal and explain in detail about each heart sound.	(4)
	A)		
	B)	Draw the energy-level diagram and explain the laser set-up of a molecular gas laser. Give two medical applications of this laser.	(3)
	C)	A 0.1m long by 0.005m diameter elastic resistive transducer has a resistance of $1K\Omega$. (i) Calculate the resistivity of the elastically conductive material inside the transducer. (ii) Calculate the resistance of the transducer after it has been wrapped around a patient's chest having a circumference of 1.2m. Assume that the cross sectional area of the transducer remains unchanged.	(3)
5)		Interpret the code 'VAT' and explain the pacemaker which is identified by this code.	(5)
	A)		
	B)	Determine the non-invasive technique of measuring blood flow velocity and explain the same in detail.	(3)
	C)	Calculate the heart rate (in beats/min), given the pulse period generated by the pacemaker to be 0.859 sec.	(2)

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