Exam Date & Time: 27-Jul-2022 (02:00 PM - 05:00 PM)



# MANIPAL ACADEMY OF HIGHER EDUCATION

## FOURTH SEMESTER B.TECH MAKEUP EXAMINATIONS, JULY 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 the parameters to be considered for selecting a transducer for a particular measurement. Also, identify which of the temperature transducers would be preferred when a higher sensitivity is required for a measurement. (4)

A)

- B) A 0.1m long by 0.005m diameter elastic resistive transducer has a resistance of 1KΩ. (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)
- C) Differentiate between the first and third generation CT machines. Also, discuss the hazards and safety precautions to be considered in the use of X-rays. (3)
- 2) What is a microelectrode? Draw and interpret the equivalent circuit of a microelectrode.
  - (4)
  - A)
    B) At frequencies above 20KHz, the impedance of a bio-potential surface electrode in contact with the electrolyte is 500Ω. At frequencies less than 50Hz, the electrode-impedance is 30KΩ. The corner frequency is 100Hz. From the preceding data, determine the circuit model for the electrode. (3)
  - C) Calculate the energy stored in a  $16\mu$ F capacitor that is charged to a potential of 5000V dc. (3)
- 3) Select and explain the type of defibrillator where effective defibrillation can be provided at a lower voltage. (4)
  - A) B) A defibrillator produces a square pulse of 3000V with a duration of 5msec. The instrument resistance  $R_D = 10 \Omega$ , skin-electrode resistance  $R_E = 30 \Omega$  and the total (3)

		resistance =100 $\Omega$ . Compute the energy delivered to the patient's thorax when the defibrillator is connected.	
	C)	Differentiate 'micro-shock 'from 'macro-shock'. Explain how the 'grounding' technique can be 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)	Why is Argon laser the most suitable for photocoagulation of biological tissues? With a neat figure, explain the set-up used to control gastric hemorrhage in patients, using argon ion laser photocoagulation.	(3)
	C)	Determine the angle $\theta$ , between the direction of ultrasound propagation and that of the measured blood flow, if the ratio between the Doppler frequency and the transmission frequency is 10 <sup>-5</sup> and the velocity of blood cells is 0.15m/sec. In general, which angle $\theta$ would provide the largest Doppler frequency? Assume that the velocity of sound in blood is equal to 1500m/s.	(3)
5)		Interpret the code 'VAT' and explain the pacemaker which is identified by this code.	(5)
	<b>A</b> )		
	A)		
	в)	what is 'Doppler effect?' Determine the non-invasive technique of measuring blood flow velocity.	(3)
	C)	Calculate the lifetime of a battery source used in a pacemaker, given the following data: Energy/pulse = $9.643 \mu$ J/ pulse, battery energy= $6480$ J and heart rate = $70$ bpm.	(2)

-----End-----