Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

IV SEMESTER B.Tech (BME) DEGREE MAKE-UP EXAMINATIONS, JUNE 2018

SUBJECT: ELEMENTS OF BIO-INSTRUMENTATION (BME 2201)

(REVISED CREDIT SYSTEM)

Saturday, 23rd June 2018: 2 to 5 PM

TIME: 3 HOURS **MAX. MARKS: 100**

Instructions to Candidates:

Answer ALL questions

1. (a) (i) A strain gauge has a gauge factor of 4. If the strain gauge is attached to a metallic bar that stretches from 0.25m to 0.255m when strained, what is the percentage change in the resistance? If the unstrained value of the gauge is 120Ω, what is the resistance value of the gauge after application of strain? (3)

(ii) Differentiate precision of a transducer from resolution. (2)

(b) (i) Explain the characteristics of the photo emissive transducer and explain any one type of photo emissive transducer in detail. (2+3)

(ii)A thermocouple measures over a range of -270 ^{o}C to 1372 ^{o}C by providing an output in the range -6.548mV to 54.874mV. Calculate the sensitivity of the thermocouple. (2)

(c) (i) List and explain the performance characteristics of the transducer that must be considered before selection of the transducer. (5)

(ii) An RTD has α= 0.004^{o}C and R= 300Ω at 30 ^{o}C. Determine the resistance at 0 ^{o}C and 60 ^{o}C. (3)

2. (a) (i) Define an 'electrode'. With suitable examples, explain how an electrical double layer is formed. (1+3)

(ii) Give reasons and explain why Ag/AgCl electrode is suitable for bio-potential measurements. (2)

(b) (i) 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)

(ii) Differentiate unipolar from bipolar electrodes. (2)

(c) (i) Explain in detail, a method used to measure the blood volume changes in the body. (6)

(ii) The Doppler blood flow meter emits ultrasound at a frequency of 5MHz at an angle of 45^0. What is the Doppler shift frequency between the emitted waves and the waves reflected from the blood cells moving away from the emitter at 0.15m/sec. Assume the velocity of sound to be 1540m/sec in blood. (3)

3. (a) (i) 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. (2+5)

(ii) A blood vessel has a diameter of 0.8cm and the blood flow velocity is 10cm/sec. A magnetic flow probe surrounds the blood vessel with a magnetic field of $1x10^{-5}$ weber/ m^2. Calculate the voltage induced in the probe. (3)

(b) (i) With a neat figure, explain the EEG recording instrument in detail. (6)

(ii) In the case of an ideal square wave defibrillator, determine the energy delivered to the patient. The ideal square wave pulse discharged by the defibrillator has amplitude of 2000V for 5msec duration. [Skin electrode resistance = 25Ω, internal resistance of the defibrillator=5Ω and thorax resistance =30Ω]. (4)

4. (a) (i) Mention the different writing mechanisms based on the PMMC principle and explain the ink-jet recorders in detail. (2+5)

(ii) The chart speed of a recording instrument is 40mm/sec. One cycle of the signal is recorded over 5mm. Determine the frequency of the signal being recorded on the chart paper. (3)

(b) (i) Explain in detail, a type of defibrillator where effective defibrillation can be provided at a lower voltage (5)

(ii) A defibrillator produces a square pulse of 3000V with a duration of 5msec. The instrument resistance R_D = 10Ω, the skin electrode resistance R_E= 30 Ω and the thorax resistance R_T = 30Ω. Compute the energy delivered to the patient's thorax. (3)

(iii) Mention the drawbacks of AC defibrillation and specify the energy required for external defibrillation. (1+1)

5. (a) (i) Differentiate ‘microshock’ from ‘macroshock’. (1)

(ii) What are the precautions required to minimize electric shock hazards? Explain how the ‘grounding’ technique can be used to prevent electrical accidents. (4+6)

(b) (i) Calculate the lifetime of a battery source used in a pacemaker, given the following data: Energy/pulse = 9.643 µJ/ pulse, battery energy=6480 J and heart rate = 70bpm. (3)

(ii) Differentiate ‘Unipolar electrodes’ from ‘Bipolar electrodes’ used in pacemakers. (3)

(iii) Explain the asynchronous pacemaker in detail. (3)