Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

IV SEM B.TECH (BME) DEGREE END-SEMESTER EXAMINATIONS APRIL/MAY 2017

SUBJECT: ELEMENTS OF BIO-INSTRUMENTATION (BME 2201)

(REVISED CREDIT SYSTEM)

Wednesday, 19th May 2017: 2 PM to 5 PM

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

Instructions to Candidates:

Answer ALL questions

1. (a) (i) A strain gauge having a gauge factor of 2.1 and resistance of 120.2Ω is glued to a structure. As the structure is subject to a stress, the resistance changes to 120.25Ω. Calculate the strain and the stress applied on the structure. (Given: Young's modulus, E = 205GPa). (3)

(ii) Give an example of a passive transducer which uses an active circuit element, and explain the same in detail. (5)

(b) (i) Write a note on non-metallic resistors used for temperature measurement. List the advantages and disadvantages of the transducer mentioned above, with two medical applications of the same. (3+2 +1)

(ii) In Figure 1, R_s is the resistance of a resistive temperature sensor (thermistor). When the temperature is 70^0C, R_s has a value of 1KΩ. Determine the value of R_b so that the bridge is balanced at a temperature of 70^0C. When the temperature rises to 71^0C, the resistance R_s drops to 999Ω. Determine the output voltage of the bridge at that temperature. Given V_{in}=12V, R_a= 4700Ω, R_c=1000Ω. (4)

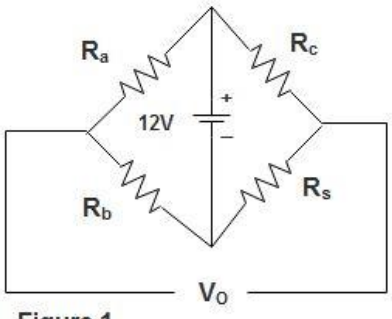

Figure 1

(iii) Mention the characteristics of the following physiological parameters, and determine the transducer which is suitable for the measurement of the same: (a) Galvanic skin resistance, and (b) Gases in the expired air. (2)

2. (a) (i) Calculate the series resistance (in a metal microelectrode model) and determine the frequency response of a KCL filled microelectrode, if the micropipette radious is 0.2μm and the inner tip radious is 0.15μm.The value of the dielectric constant (ρ) for KCl is 3.7Ωcm, and the taper angle is π/180. Given: The dielectric constant of glass is 4, and the electrode is immersed 3cm deep in the electrolyte. (5)

(ii) Differentiate a) Unipolar electrode from a Bipolar electrode, and b) Needle electrode from a surface electrode. (1+2)

(iii) Which type of electrode would be ideal for measuring EMG from a specific muscle of interest? Explain with reason. (2)

(b) (i) List the characteristics of the Ag-AgCl electrode that makes it ideal for bio-potential measurements. (3)

(ii) The output of a bridge network is amplified using an instrumentation amplifier. Show that the amplified voltage is proportional to the change in resistance of the thermistor that is placed in one arm of the bridge network. (7)

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) In the context of lasers, differentiate spontaneous emission from stimulated emission. (3)

(b) (i) With a neat figure, explain the EEG recording instrument in detail. (5)

(ii)What are 'cardiac murmurs'? How are they produced? How can they be differentiated from the normal heart sounds? (3)

(iii) Explain the principle behind the working of a 'transit time velocity meter' used for blood flow measurements. (2)

4. (a) (i) Discuss the five letter code used to define different types of pacemakers. Identify the pacemaker with the code 'VAT', and explain the same in detail. (2+6)

(ii) What is the energy stored by the lithium- iodide battery, if the battery rating is 1Ah with a terminal voltage of 1.5V. (2)

(b) (i) List the different types of recorders that work on the principle of Permanent Magnet Moving Coil (PMMC). Explain the optical writing 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)

5. (a) (i) With a neat block diagram, explain the DC defibrillator synchronized with the ECG signal. (8)

(ii) Determine the energy available for defibrillation, given the following values: Internal resistance of the defibrillator = 12Ω, skin-electrode resistance = 20Ω, thorax resistance = 30Ω and the ideal input square wave pulse is 3200V for 4msec duration. (2)

(b) (i) Explain the physiological effects of electric current on the human body. (5)

(ii) Explain how 'grounding' and 'Ground Fault circuit interrupter' can be used to prevent electrical hazard. (5)