	Reg. No.											
--	----------	--	--	--	--	--	--	--	--	--	--	--



MANIPAL INSTITUTE OF TECHNOLOGY

Manipal University, Manipal – 576 104



IV SEMESTER B.Tech (BME) DEGREE END SEMESTER EXAMINATIONS, MAY 2016

SUBJECT: ELEMENTS OF BIO-INSTRUMENTATION (BME 2201)

(REVISED CREDIT SYSTEM)

Thursday, May 05, 2016: 2.00 pm- 5.00 p.m

TIME: 3 HOURS

MAX. MARKS: 100

1							
Inst 1. 2.	Instructions to Candidates: 1. Answer ALL FIVE full questions. 2. Draw labeled diagram wherever necessary						
1.	(a)	(i) Differentiate accuracy of a transducer, from its precision.	(2)				
		(ii) A thermocouple measures over a range of -270 °C to 1372°C by providing an output in the range -6.548mV to 54.874mV. Calculate the sensitivity of the thermocouple.	(2)				
	(b)	(i) A strain gauge of length $l = 0.1m$ is bonded to a surface having an area of 4cm ² . The modulus of elasticity is E=200GN/m ² . The unstrained resistance of the strain gauge is 200 Ω and the gauge factor is 10. When a load is applied, the resistance changes by 0.01 Ω . Find the values of the stress and the force applied.	(4)				
		(ii) Explain in detail, the photoemmisive transducer that can be used for light amplification.	(5)				
		(iii) List the advantages of using a differential output and explain the linear displacement transducer which uses a differential output.	(3)				
	(c)	Mention the primary signal characteristics, and the transducer used in the following measurements, (i) respiratory flow rate, (ii) galvanic skin resistance (iii) phonocardiogram and, (iv) gases in the expired air.	(4)				
2.	(a)	(i) Explain why Ag-AgCl electrode is commonly used for bio-potential measurements. (ii) Explain two methods of manufacturing the Ag-AgCl electrode	(2)				
	(b)	(i) Drow and explain the again along singuit model of a microalectrode	(5)				
	(0)	(i) At frequencies above 20KHz, the impedance of a big notantial surface electrode.	(0)				
		in contact with the electrolyte is 500Ω . At frequencies less than $50Hz$, the electrode-impedance is $30K\Omega$. The corner frequency is $100Hz$. From the preceding data, determine the circuit model for the electrode.	(4)				
	(c)	Differentiate the characteristics of the amplifiers used in ECG and EMG measurements.	(3)				

- 3. (a) Draw and explain the energy level diagram of a molecular gas laser and the laser (2+5+2) setup (of the molecular gas laser) in detail. Also, mention a few medical applications of this laser.
 - (b) Calculate the maximum audio frequency of a Doppler ultrasonic blood flowmeter (3) that has a carrier frequency of 7MHz, and a transducer angle of 45⁰ [Given: blood velocity equal to 150cm/sec, and acoustic velocity equal to 1500m/sec].
 - (c) (i) Explain in detail, a method used to measure the blood volume-changes in the body.
 (ii) On an ECG monitor lead L& III display poor quality waveforms. Which electrode (2)

(ii) On an ECG monitor, lead I & III display poor quality waveforms. Which electrode (2) and /or lead cable is suspected to be bad? Why?

4. (a) (i) Differentiate 'VVI' from 'VVIR' pacemakers. Explain the 'VVI' pacemaker in (1+5) detail.

(ii) Calculate the battery life (in years), associated with the pacemaker unit, given (4) the following characteristics: Battery ampere hours=1.2, pulse voltage=2V, pulse width=1msec, pulse time period=1sec, electrode-heart resistance=150 Ω , current drain on the battery=1.3 μ A.

- (b) List the advantages and drawbacks of the recording method based on an ink filled (2+6+2) stylus. How does the ink-jet recorder overcome these drawbacks? Explain the same with suitable figures and also list the merits of the ink-jet recorders.
- 5. (a) What is the energy required for internal defibrillation? Draw and explain the (1+5) design of an electrode that can be used for internal defibrillation.
 - (b) 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]. (3)
 - (c) (i) Differentiate 'microshock' from 'macroshock'. (1)

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