UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
Online Examination, December, 2020

Course: Biomedical Mechatronics   Semester: VII
Program: B.Tech- Mechatronics   Time: 03 hrs.
Course Code: MECH4031   Max. Marks: 100

Instructions: Attempt all the questions.

SECTION A

S. No.		Marks	CO
Q 1	List the main factors involved in the movement of ion across the cell membrane in the steady state condition.	5	CO1
Q 2	Define the following terms (a) absolute refractory period (b) relative refractory period (c) compound nerve action potential	5	CO1
Q 3	Identify the technique to measure eye movements. List the two applications of this technique.	5	CO2
Q 4	An ECG has a scalar magnitude of 1mV of lead II and a scalar of magnitude of 0.5 mV on lead III. Predict the scalar magnitude on lead I.	5	CO2
Q5	List the two basics causes of abnormal heart murmur.	5	CO3
Q6	Identify the elements required for an automatic indirect system for measuring blood pressure.	5	CO4

SECTION B

Q1	A physician is using the rapid injection thermodilution method for finding a patient/t cardiac output. Calculate the cardia output(in milliliters per second and in liters per minute) from the following date: $$V_i = 10\,\text{ml},\ \Delta T_i = -30\,\text{K}$$ $$\rho_i = 1005\,\text{kg/m}^3,\ c_i = 4170\,\text{J/(kg·K)}$$ $$\rho_b = 1060\,\text{kg/m}^3,\ c_b = 3640\,\text{J/(kg·K)}$$ $$\int_0^{t_1} \Delta T_b dt = -5.0\,\text{s·K}$$	10	CO2
Q2	The maximal average velocity of blood in a dog, 1m/s, occurs in the dog's aorta, which is 0.015m in diameter. The magnetic flux density in an electromagnetic blood flowmeter is 0.03 T. Calculate the voltage at the electrodes.	10	CO2
Q3	Design a system that has as input the scalar voltage of lead II and lead III and as output the scalar voltage of the cardiac vector M.	10	CO3

Q4	A physician wishes to obtain two simultaneous ECGs in the frontal plane from leads that have lead vectors at right angles. The signal will be used to generate a VCGs. Describe the steps to obtaining signals, and suggest a test to determine whether the leads are truly orthogonally	10	CO3
Q5	A set of biopotential electrodes made of silver is attached to the chest of a patient to detect the electrocardiogram. When current passes through the anode, it causes silver to be oxidized, producing silver ions in solution. There is a 10µA leakage current between these electrodes. Determine the number of silver ions per second entering the solution at the electrode –electrolyte interface.	10	CO4

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SECTION-C

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Q1	For a long mechanical unit lung , assume that the relationship among pressure, volume, and number of moles of ideal gas in the lung is given by $$P_A \left(\frac{V_L}{N_L} \right)^{\alpha} = K$$ Where $\alpha = 1$ and K is constant. Derive the lowest order approximation to the relationship among change in pressure, change in volume, changes in moles of gas within the lung. **OR** In order to determine the frequency response of an electromagnetic flowmeter, the clinical can transiently short circuit the magnet current by using a micro switch. For steady flow, sketch the resulting output of the flowmeter. Describe the mathematical step could implement on computer in order to convert the resulting transient wave to the flowmeter's frequency response.	20	CO4