



SRM VALLIAMMAI ENGINEERING COLLEGE

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DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION
ENGINEERING

QUESTION BANK

SUBJECT : OMD551 BASICS OF BIOMEDICAL INSTRUMENTATION

SEM / YEAR: V / III

UNIT I - BIO POTENTIAL GENERATION AND ELECTRODES TYPES			
SYLLABUS			
Origin of bio potential and its propagation. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Recording problems - measurement with two electrodes.			
PART - A			
Q.No	Questions	BT Level	Competence
1.	What are Bioelectric potentials?	1	Remember
2.	What is resting potential of a cell? Give typical values.	2	Understand
3.	What is an action potential?	1	Remember
4.	Differentiate action potential and resting potential.	2	Understand
5.	At resting potential of a cell, why the inside of a cell is negatively charged.	4	Analyze
6.	Draw the action potential waveform.	3	Apply
7.	What are the properties of cell membrane action potential?	1	Remember
8.	Give the Nernst equation for electrode potential.	2	Understand
9.	How is action potential propagated?	4	Analyze
10.	How is the half cell potential setup?	4	Analyze
11.	Distinguish absolute and relative refractory period?	2	Understand
12.	List different types of electrodes.	1	Remember
13.	Define micro electrode and what are the types of Micro electrodes?	1	Remember
14.	List the different types of surface electrodes.	1	Remember
15.	Give the equivalent circuit diagram of surface electrode placed over the skin.	2	Understand
16.	What is the purpose of electrode paste?	3	Apply
17.	Draw the electrode configuration of av_R output.	3	Apply
18.	What are the electrodes used for ECG, EEG and EMG measurement.	3	Apply
19.	Give the disadvantages of using surface electrodes with EMG.	2	Understand
20.	List the different types of internal electrodes.	1	Remember

PART - B				
1.	i)	How do you record the action potential? (5)	4	Analyze
	ii)	With the action potential waveform summarize depolarization, repolarisation and absolute and relative refractory periods. (8)	5	Evaluate
2.		Explain generation of Action potential and its propagation.(13)	2	Understand
3.	i)	Describe the generation and features of action potential. (7)	2	Understand
	ii)	Explain refractory periods of cell. (6)	4	Analyze
4.	i)	Explain action and resting potential of cell. (6)	4	Analyze
	ii)	With a relevant graph describe the relationship between the action potential and muscle contraction.(7)	2	Understand
5.	i)	Prepare the different factors which affect the accuracy of the recording related to biopotentials. (6)	3	Apply
	ii)	Explain the characteristics of resting potential with reference to Nernst equation.(7)	2	Understand
6.	i)	With an action potential waveform explain the action of the sinoatrial node.(7)	4	Analyze
	ii)	Explain Half cell Potential and over potential of electrode. (6)	4	Analyze
7.		Describe the usage of the various types of electrodes used to measure biopotentials. (13)	2	Understand
8.	i)	Explain the PH, PCO ₂ electrode. (7)	4	Analyze
	ii)	What are the uses of microelectrodes?(6)	1	Remember
9.		Explain Electrode-Skin interface with its equivalent circuit diagram. (13)	4	Analyze
10.	i)	How the Limb and suction cup electrodes can be used for recording of ECG. (8)	4	Analyze
	ii)	Explain the effect of electrode potential on biosignals.(5)	4	Analyze
11.	i)	How the silver –silver chloride electrode is produced, discuss with necessary equation. (7)	4	Analyze
	ii)	Discuss what are the problems encountered in measurement on biological systems.(6)	2	Understand
12.	i)	Draw and explain the equivalent circuit of a biopotential electrode interface. (13)	3	Apply
13.	i)	Explain the construction and working principle of microelectrodes. (7)	4	Analyze
	ii)	Mention the applications of floating and flexible type surface electrodes with necessary figures.(6)	4	Analyze
14.		Draw the electrical equivalent circuit of a glass microelectrode and explain its electrical characteristics.(13)	3	Apply

PART C			
1.		Describe the problems encountered in measurement of physiological system. Explain how these differ from physical systems. (15)	2 Understand
2.		What are body surface electrodes? Describe in brief with suitable examples. (15)	2 Understand
3.	i)	Give the classification of electrodes used for bio-medical applications. (10)	2 Understand
	ii)	Explain the selection criteria for electrodes used in biomedical field. (5)	4 Analyze
4.	i)	Draw a well labelled diagram of action potential waveform. Explain the process of Repolarization & Depolarization of cells. (7)	3 Apply
	ii)	Write short notes on: a. EMG biopotential b. ERG biopotential (4+4)	6 Create

UNIT II - BIOSIGNAL CHARACTERISTICS AND ELECTRODE CONFIGURATIONS			
SYLLABUS			
Biosignals characteristics – frequency and amplitude ranges. ECG – Einthoven’s triangle, standard 12 lead system. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode.			
PART - A			
Q.No	Questions	BT Level	Competence
1.	Name few bioelectrical signals.	1	Remember
2.	Give the frequency range & amplitude of ECG, EEG and EMG waves.	2	Understand
3.	Sketch a typical ‘pqrst’ complex waveform with respect to ECG.	3	Apply
4.	Give the origin, amplitude and duration of the different waves in ECG.	2	Understand
5.	Draw EINTHOVEN TRIANGLE and how it is used in ECG measurement.	3	Apply
6.	Write down the three types of lead systems used to record electrocardiograms.	6	Create
7.	Define the term LATENCY in EMG.	1	Remember
8.	Draw the block diagram for EMG recording set up.	3	Apply
9.	List the brainwaves and their frequency.	1	Remember
10.	Draw the block diagram for EEG recording set up.	3	Apply
11.	What is the use of EMG?	1	Remember
12.	Give the standard 12 lead system used in ECG.	2	Understand
13.	Name three bipolar limb lead selections introduced by Enthoven.	1	Remember
14.	Name three augmented lead connections.	1	Remember
15.	Define unipolar lead system.	1	Remember

16.		What is meant by 10-20-electrode placement system?	2	Understand
17.		Write down the EMG Measurement procedure.	6	Create
18.		What is meant by leads?	2	Understand
19.		From the ECG waveform, state when does the first degree and severe heart attack occurs.	1	Remember
20.		What are the different types of heart block?	2	Understand
PART - B				
1.	i)	Explain origin of ECG, EMG and EEG. (6)	4	Analyze
	ii)	Clearly describe the different lead systems in ECG Wave form recording. (7)	2	Understand
2.		What is evoked potential? Explain EEG recording with suitable block diagram. (13)	4	Analyze
3.	i)	Explain EEG patterns. (6)	4	Analyze
	ii)	What is cardiac vector ? Explain ECG leads with necessary figures. (7)	4	Analyze
4.		Explain 12 lead electrode system for ECG measurement. (13)	2	Understand
5.		Explain EMG measurement with block diagram. (13)	2	Understand
6.		Explain EEG measurement with 10-20 Electrode system. (13)	2	Understand
7.		Draw an ECG of a normal person, labeling the critical features and explain the working of an ECG machine.(13)	3	Apply
8.	i)	Discuss the working of typical EMG recording setup. (8)	2	Understand
	ii)	Mention the advantages in using the multichannel ECG machine. (5)	4	Analyze
9.		Discuss the different components of EMG measurement. Describe the desired features of electromyograph.(13)	2	Understand
10.	i)	Explain Einthoven triangle and describe how ECG lead configurations are employed. (7)	4	Analyze
	ii)	With a neat block diagram illustrate how the electromyogram is recorded from the human body. (6)	3	Apply
11.	i)	Enlist the typical EEG system faults. (6)	1	Remember
	ii)	What are the different types of artefacts seen in an ECG recording? (7)	4	Analyze
12.		Draw an ECG waveform indicating typical time intervals and amplitudes of all the waves. Explain how these waves are physiologically correlated with the heart activity. (13)	3	Apply
13.	i)	Write a short note on ECG system faults & troubleshooting. (8)	6	Create
	ii)	Briefly explain the sleep patterns and the diagnostic uses of EEG. (5)	2	Understand

14.	Describe in detail with the principle involved of electrodes used for measurement of ECG, EMG and EEG. (13)		2	Understand
PART C				
1.	i)	What does 'EMG' mean? Why a normal EMG waveform looks like a noise waveform? (7)	4	Analyze
	ii)	What are the various abnormalities observed in ECG patterns? How they are classified? (8)	4	Analyze
2.	i)	What is Ischemia? Explain the electrocardiographic patterns obtained in ischemia. (8)	4	Analyze
	ii)	Explain the clinical application of EEG. (7)	4	Analyze
3.	Define ECG. Explain its generation and normal wave pattern, with neat figures. (15)		1	Remember
4.	i)	Draw and explain the EEG system block diagram with an emphasis on preamplifiers and system specifications.(8)	3	Apply
	ii)	Describe EEG telemetry and typical EEG system artifacts and faults. (7)	2	Understand

UNIT III - SIGNAL CONDITIONING CIRCUITS

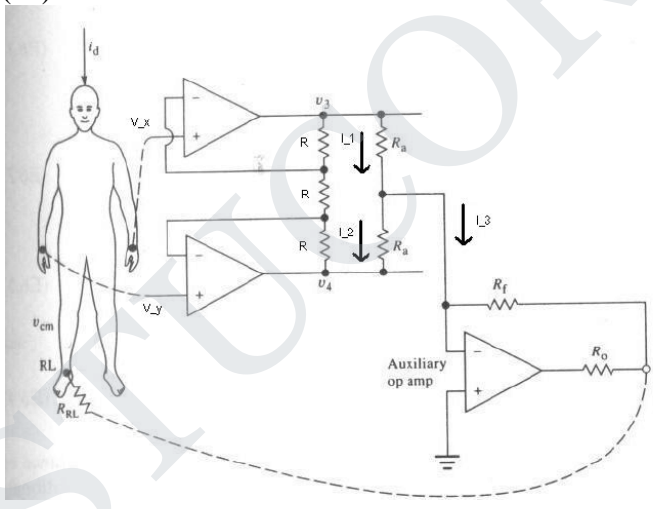
SYLLABUS

Need for bio-amplifier - differential bio-amplifier, Impedance matching circuit, isolation amplifiers, Power line interference, Right leg driven ECG amplifier, Band pass filtering

PART - A

Q.No	Questions	BT Level	Competence
1.	What are the requirements of amplifiers used in biomedical recorders?	1	Remember
2.	Give some of the amplifiers used with recorders.	2	Understand
3.	What is meant by Bio-amplifiers?	1	Remember
4.	What is preamplifier? State its functional requirements.	1	Remember
5.	Define CMRR.	1	Remember
6.	Write the purpose of isolation amplifiers.	6	Create
7.	Mention the different methods of isolation amplifier.	4	Analyze
8.	List the advantages of transformer type isolation amplifier.	1	Remember
9.	Why isolated preamplifier is used for bioelectric signal acquisition	4	analyze
10.	What are the characteristics of a DC amplifier?	1	Remember
11.	What is a filter?	1	Remember
12.	Draw the Impedance matching circuit.	3	Apply
13.	Why Power line interference study is needed for analysis of biosignals?	4	Analyze

14.	Mention the amplifier used to measure Right leg in ECG measurement.	4	Analyze
15.	What is meant by band pass filtering?	1	Remember
16.	Sketch the differential amplifier circuit.	3	Apply
17.	What is meant by differential bio amplifier?	1	Remember
18.	Write the purpose of impedance matching circuit.	6	Create
19.	Distinguish between common mode signal and differential mode signal in differential amplifier.	4	Analyze
20.	What is the need for Band pass filter in bio amplifier circuits?	1	Remember
PART - B			
1.	i) Illustrate the different requirements for biomedical amplifiers? (5)	3	Apply
	ii) Discuss the working of Differential amplifier. Mention their importance in biomedical instrumentation. (8)	2	Understand
2.	Discuss the working of isolation amplifier with diagram. (13)	2	Understand
3.	Write a note on sources of noise in ECG. Explain ECG amplification and signal conditioning circuits with neat figures. (13)	6	Create
4.	Draw the circuit diagram of Darlington pair isolation amplifier and explain. (13)	3	Apply
5.	i) What is the medical use of chopper amplifier? Draw the diagram of mechanical chopper amplifier and explain its working. (7)	3	Apply
	ii) Explain the working of a Non mechanical Chopper amplifier. (6)	4	Analyze
6.	i) Draw the buffer amplifier circuit and explain its working. (7)	3	Apply
	ii) List and discuss the important characteristics of bioamplifier. (6)	1	Remember
7.	i) Draw the circuit diagram of an EEG amplifier and explain. (7)	3	Apply
	ii) With a neat diagram explain carrier amplifier. (6)	4	Analyze
8.	What is an isolation amplifier? What is its significance? Illustrate any one methods. (13)	3	Apply
9.	Sketch a neat circuit diagram of a medical preamplifier and deduce an expression for its net gain. (13)	3	Apply
10.	i) Explain in detail about power line interference reduction techniques. (7)	4	Analyze
	ii) Draw and Explain the ECG amplifier. (6)	3	Apply
11.	Explain in detail the different types of Isolation amplifiers. (13)	4	Analyze

12.	Explain the needs of isolation and chopper amplifiers with circuit schematic. (13)	4	Analyze
13.	Explain with neat sketch about the Right leg driven ECG amplifier. (13)	4	Analyze
14.	i) Describe in detail with neat diagram, Band pass filtering circuits of biological amplifiers. (8)	2	Understand
	ii) Write short notes on impedance matching circuit used in bioamplifier. (5)	6	Create
PART - C			
1.	Distinguish a biological amplifier from a conventional amplifier with suitable equations and circuits. (15)	4	Analyze
2.	Design a Differential bioamplifier Based on the Input and Output Voltage Level Requirements. (15)	6	Create
3.	Determine the common-mode voltage v_{cm} on the patient in the driven right-leg circuit of Fig. when a displacement current i_d flows to the patient from the power lines. Choose appropriate values for the resistances in the circuit so that the common-mode voltage is minimal and there is only a high-resistance path to ground when the auxiliary operational amplifier saturates. What is v_{cm} for this circuit when $i_d=0.2A$? (15)	5	Evaluate
			
4.	Design a band pass filter using inductor and capacitor. Derive and draw the frequency response of band pass filter. (15)	6	Create

UNIT IV - MEASUREMENT OF NON-ELECTRICALPARAMETERS				
SYLLABUS				
Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods -Auscultatory method, direct methods: electronic manometer, Systolic, diastolic pressure, Blood flow and cardiac output measurement: Indicator dilution, and dye dilution method, ultrasound blood flow measurement.				
PART - A				
Q.No	Questions		BT Level	Competence
1.	Define systematic temperature measurement.		1	Remember
2.	Define skin temperature measurement.		1	Remember
3.	What are the types of blood pressures?		2	Understand
4.	What are the two methods of blood pressure measurement?		2	Understand
5.	List the methods used to obtained BP in direct measurement.		1	Remember
6.	What are the two types of probes used in direct method?		2	Understand
7.	What are the methods to measure heart pulse rate?		2	Understand
8.	What are the various methods to measure cardiac output?		2	Understand
9.	Define systole and diastole.		1	Remember
10.	What is the use of blood flow meter?		2	Understand
11.	Define cardiac output.		1	Remember
12.	Write down the physical principle on which the blood flow meter based on.		6	Create
13.	Give the principle of electromagnetic blood flowmeter.		2	Understand
14.	Discuss the reason for decrease in cardiac output?		2	Understand
15.	Generalize Fick's principle.		6	Create
16.	Point out the normal heart rate of human being according to age group.		4	Analyze
17.	Find the cardiac output of a patient whose heart rate is 90 BPM and a stroke volume of 80 millilitres per beat.		5	Evaluate
18.	Generalize "ohm's law" for blood flow.		6	Create
19.	What is the principle of Plethysmograph?		2	Understand
20.	What are the causes of Cerebrovascular accident (CVA)?		2	Understand
PART - B				
1.	i)	Describe the working of a fibre optic temperature sensor.(6)	2	Understand
	ii)	Conclude the part of electrocardiogram which is most useful for determining heart rate? Explain. (7)	4	Analyze
2.	i)	Describe the working principle of ultrasonic blood pressure measurement. (7)	2	Understand
	ii)	Compare direct and indirect blood pressure measurement. (6)	4	Analyze
3.	i)	What are the methods for measuring blood pressure? Sketch a typical setup and explain.(7)	2	Understand
	ii)	What is mean arterial blood pressure? Write its equation. (6)	6	Create

4.	i)	Explain electromagnetic blood flow measurement technique.(13)	4	Analyze
5.		Explain indirect blood pressure measurement. (13)	4	Analyze
6.		What is Cardiac output? Explain its measurement with suitable diagram. (10)	4	Analyze
7.	i)	Write short notes on Indicator dilution technique for cardiac output measurement. (5)	6	Create
	ii)	Discuss with necessary diagram Doppler Imaging system for blood flow measurement. (8)	2	Understand
8.	i)	Explain the any one method of measuring cardiac output. (7)	2	Understand
	ii)	With suitable diagram illustrate how transmission and reflectance method can be used for measurement of pulse rate.(6)	3	Apply
9.	i)	Explain the measurement of continuous cardiac output derived from the aortic pressure waveform. (8)	4	Analyze
	ii)	Briefly discuss about beat to beat to calculation for heart rate measurement. (5)	2	Understand
10.	i)	Explain any one method to measure blood flow. (6)	4	Analyze
	ii)	Explain auditory method of blood pressure measurements with necessary figure. (7)	4	Analyze
11.		Discuss electrical conduction path way of heart and explain the working principle of artificial cardiac pacemaker with necessary figures. (13)	2	Understand
12.		Sketch the block diagram of automated electro sphygmomanometer for blood pressure measurement and explain its operation. (13)	3	Apply
13.	i)	Explain the Rheographic method of blood pressure measurement. (7)	4	Analyze
	ii)	Describe in detail with neat diagram, differential auscultatory technique of blood pressure measurement. (6)	2	Understand
14.	i)	Explain the automatic and semiautomatic methods of measuring blood pressure. (7)	4	Analyze
	ii)	Discuss the Oscillometric blood pressure measurement method. (6)	2	Understand
PART – C				
1.		What are the effects of temperature measurements and explain the types of temperature measurements in detail	1	Remember
2.		Discuss a detailed study about diagnosis and treatment of High blood pressure (hypertension). (15)	2	Understand
3.		Describe the methods used for respiration rate measurement in detail. (15)	2	Understand
4.	i)	Discuss about the different techniques used to measure heart rate. (8)	2	Understand
	ii)	Explain the instantaneous heart rate meter with its diagram. (7)	4	Analyze

UNIT V - BIO-CHEMICAL MEASUREMENT			
SYLLABUS			
Blood gas analyzers and Non-Invasive monitoring, colorimeter, Sodium Potassium Analyser, Spectrophotometer, blood cell counter, auto analyzer (simplified schematic description).			
PART - A			
Q. No.	Questions	BT Level	Competence
1.	What is blood gas analysers?	1	Remember
2.	What is the use of measurement of PH, PCO ₂ , PO ₂ ?	3	Apply
3.	What is meant by PH value of blood?	1	Remember
4.	Give the normal value of PH, PCO ₂ , PO ₂ in human blood?	2	Understand
5.	What is the PH, PCO ₂ value that indicates respiratory failure?	1	Remember
6.	What is the use of oximeters?	3	Apply
7.	What are the two types of oximetry?	1	Remember
8.	Differentiate between vitro oximetry and vivo oximetry?	4	Analyze
9.	What is the use of gas analysers?	3	Apply
10.	What is pH Value of Arterial blood and Venous blood?	1	Remember
11.	Briefly mention the uses of gas analyzers.	3	Apply
12.	State the advantages and disadvantages of an auto analyser.	1	Remember
13.	How does the PH value determine the acidity of alkalinity in blood fluid.	4	Analyze
14.	List few applications of gas analysis.	3	Apply
15.	What is Colorimeter?	3	Apply
16.	What is Autoanalyser?	3	Apply
17.	What is blood cell counter?	3	Apply
18.	Write the principle of spectrophotometer.	6	Create
19.	What you mean by pH?	1	Remember
20.	Mention the purpose of using pCO ₂ in bio medical instrumentation.	4	Analyze
PART - B			
1.	Explain coulter blood cell counter with a neat diagram. (13)	2	Understand
2.	Draw and Explain the block diagram of Auto analyzer. (13)	3	Apply
3.	Explain the optical ray diagram of spectrophotometer and describe any one dispersive device. (13)	2	Understand
4.	Explain with block diagram working of colorimeter. (13)	2	Understand
5.	Explain the measurement of blood pO ₂ and pCO ₂ . (13)	2	Understand

6.	Describe, with neat diagrams, the operation of a blood cell counter working on the principle of conductivity. List the drawbacks of the system. (13)	2	Understand
7.	What are oximeter? Describe finger tip oximeter with suitable diagram. Mention its advantages. (13)	1	Remember
8.	Draw a circuit diagram of a pH meter and explain its working details. (13)	3	Apply
9.	i) Describe the colorimeter method of determining chemical concentration. (7)	2	Understand
	ii) With neat diagram, explain in detail the operation of Gas analyser. (6)	2	Understand
10.	Explain the working principle of spectrophotometer. Discuss its applications in clinical laboratory. (13)	4	Analyze
11.	Explain the working principle for measurement of optical pressure of Oxygen (PO ₂) in the blood and describe suitable scheme for it. (13)	4	Analyze
12.	Describe the hematology of blood. Explain the working of Coulter model STKS type blood analyser with the help of suitable diagram. (13)	2	Understand
13.	Draw and explain the circuit diagram for computation of the following used in complete blood gas analyser.	3	Apply
	i) Bicarbonate (HCO ₃ ⁻) (5)		
	ii) Total CO ₂ (5)		
	iii) Base excess (3)		
14.	i) Describe the operation of blood cell counter based on dark field method. (7)	2	Understand
	ii) Explain the optical methods of blood pH measurement used for continuous monitoring. (6)	2	Understand
PART – C			
1.	Explain in detail about blood gas analyser with neat block diagram. (15)	2	Understand
2.	With suitable figures explain How pH ,Pco ₂ ,and Po ₂ are measured? (15)	4	Analyze
3.	Describe a flame photometer and Blood gas analyser with a suitable diagram. (15)	2	Understand
4.	Draw the block diagram of an automatic blood cell counter and explain its functions. (15)	3	Apply