

SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF MEDICAL ELECTRONICS

QUESTION BANK



II YEAR - IV SEMESTER

MD 3464-MEDICAL INSTRUMENTATION

Regulation – 2023

Academic Year 2024 – 2025 (Even)

Prepared by

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SUBJECT : MD 3464 -MEDICAL INSTRUMENTATION

SEM / YEAR : IV / II Yr

UNIT I – BASIC CONCEPTS OF MEDICAL INSTRUMENTATION AND BIO SENSORS

BASIC CONCEPTS OF MEDICAL INSTRUMENTATION: Terminology of medicine and medical devices, generalized medical instrumentation system, alternative operational modes, medical measurement constraints-classification of biomedical instruments biostatistics-regulations of medical devices.

BIO POTENTIAL & BIO SENSORS: Origin of bio potential and its propagation. Electrode–skin interface, half-cell potential. Types of electrodes and its application. Recording problems - measurement with two electrodes.

BIOSENSOR: Need of sensors, working principle of biosensor, various types of biosensors and its applications, bio transducers, bio interface.

PART – A

Q.No	Questions	CO	BT Level	Competence
1	What is the role of biosensors in medical field?	CO1	BTL 1	Remembering
2	List the components in biosensors.	CO1	BTL 1	Remembering
3	How are biological signals generated in humans?	CO1	BTL 2	Understanding
4	Identify the types of Biopotential electrodes for measuring bio signal.	CO1	BTL 2	Understanding
5	Write about the origin of bioelectric signal.	CO1	BTL 2	Understanding
6	Categorize the difference between active and passive bio signals?	CO1	BTL 2	Understanding
7	Examine the function of electrode-electrolyte interface and electrode tissue interface are used in human tissue?	CO1	BTL 2	Understanding
8	What are the changes that occur at the electrode-electrolyte interface when current is passed?	CO1	BTL 1	Remembering
9	Draw the equivalent circuit for Half-cell potential electrode electrolyte interface.	CO1	BTL 1	Remembering
10	Point out the need of biosensors are used in measuring bio signals?	CO1	BTL 2	Understanding
11	Outline the terminology of medical devices?	CO1	BTL 2	Understanding
12	Mention the alternative operational modes.	CO1	BTL 2	Understanding
13	Outline the different processing methods are involved in generalised medical instrumentation system.	CO1	BTL 1	Remembering
14	What is resting potential?	CO1	BTL 2	Understanding
15	List the medical measurement constraints.	CO1	BTL 2	Understanding
16	Write down the Nernst equation for resting membrane potential.	CO1	BTL 1	Remembering
17	Draw a diagram for electrode- skin interface.	CO1	BTL 2	Understanding

18	Enumerate the various types of equipment classification based on method of electrodes.	CO1	BTL 2	Understanding
19	Name the types of electrodes for EEG signal.	CO1	BTL 1	Remembering
20	Point out the different properties of Electrode in skin interface.	CO1	BTL 2	Understanding
21	Draw and mark typical cell potential waveform.	CO1	BTL 1	Remembering
22	Mention the types of microelectrodes. What are their applications?	CO1	BTL 2	Understanding
23	Write about regulations of medical devices.	CO1	BTL 2	Understanding
24	Write the different between Metal microelectrode and Micropipette?	CO1	BTL 2	Understanding
Part-B				
1	Describe with the help of a diagram of generalized medical instrumentation system. (16)	CO1	BTL 3	Applying
2	Draw the diagram for electrode-tissue interface for surface electrodes used with electrode jelly. Explain metal-electrolyte and electrolyte skin interface. (16)	CO1	BTL 4	Analyzing
3	i. Define half-cell potential and draw the equivalent circuit of surface electrode and explain. (8) ii. Write about surface electrode and state its applications. (8)	CO1	BTL 3	Applying
4	Classify the various types of electrodes used for recording of ECG signal? Write a brief description of at least 3 types of electrodes. (16)	CO1	BTL 3	Applying
5	Explain the origin of bio potential and its propagation? (16)	CO1	BTL 3	Applying
6	Explain in detail about classification of Biomedical instruments. (16)	CO1	BTL 3	Applying
7	What is a biosensor? Describe with the help of a diagram the construction of a blood glucose biosensor. (16)	CO1	BTL 3	Applying
8	Write the classification of the electrochemical biosensors. Explain working principle any two and give their applications (16)	CO1	BTL 4	Analyzing
9	Write short notes on the following (i) Types of electrodes and its application (8) (ii) Types of biosensors and its applications (8)	CO1	BTL 3	Applying
10	Describe following regulations based on medical devices (i) Biomedical instruments biostatistics (8) (ii) Generalized medical instrumentation system (8)	CO1	BTL 4	Analyzing
11	Explain in terms of constructional and working details of the following types of real time electrodes. (i) Skin interface electrode (8) (ii) Half-cell potential electrode (8)	CO1	BTL 3	Applying
12	Outline the terminology used in medicine and medical devices based on concept of medical instrumentation system (16)	CO1	BTL 4	Analyzing
13	Mention the recording problems that are occurred when using biosensor of two electrodes and explain. (16)	CO1	BTL 4	Analyzing
14	(i) Summarize the origin of bio potential signal and its propagation. (8) (ii) Write a note on the signal artifacts for measuring bio instrumentation for need sensor. (8)	CO1	BTL 3	Applying
15	Sketch and write in detail about bio transducers in detail. (16)	CO1	BTL 3	Applying
16	Describe the following, a). Body surface electrodes (8) b). Needle electrode. (8)	CO1	BTL 3	Applying

17	Illustrate how the biosensors are fetched into human body to receive the signal, what are the recording problems are arrived? (16)	CO1	BTL 3	Applying
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UNIT II - BIO SIGNALS CHARACTERISTICS

Bio signals characteristics – ECG frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system. EEG -EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode.

PART – A

Q.No	Questions	CO	BT Level	Competence
1	Name the characteristics of Bio signals?	CO2	BTL 1	Remembering
2	What is the frequency range of human bioelectrical signals?	CO2	BTL 1	Remembering
3	Distinguish between ECG and EMG of bio signals?	CO2	BTL 2	Understanding
4	Define Einthoven's triangle?	CO2	BTL 1	Remembering
5	List the frequency range of EEG.	CO2	BTL 2	Understanding
6	Mention the significance of Einthoven's triangle explain the lead system of ECG measurement?	CO2	BTL 2	Understanding
7	What is mean by conduction velocity?	CO2	BTL 1	Remembering
8	List the names and frequency bands of EEG waveforms	CO2	BTL 2	Understanding
9	Write the signal characteristics of ECG.	CO2	BTL 2	Understanding
10	What is Ventricular fibrillation?	CO2	BTL 1	Remembering
11	What type of electrodes are used for EMG?	CO2	BTL 1	Remembering
12	Define the term latency in EMG.	CO2	BTL 2	Understanding
13	What is evoked potential?	CO2	BTL 2	Understanding
14	Draw a typical ECG waveform	CO2	BTL 1	Remembering
15	Define vector cardiograph.	CO2	BTL 1	Remembering
16	What are the essential features required for bio potential amplifiers?	CO2	BTL 1	Remembering
17	Which factors affects the EMG signal quality?	CO2	BTL 2	Understanding
18	How ECG and EMG are measured?	CO2	BTL 2	Understanding
19	Point out the principle of EMG.	CO2	BTL 2	Understanding
20	What does an abnormal EMG sound like?	CO2	BTL 1	Remembering
21	Which leads make up the Einthoven triangle?	CO2	BTL 2	Understanding
22	Sketch the 10-20 electrode system in EEG recording.	CO2	BTL 2	Understanding
23	Where are the electrodes T ₁ and T ₂ placed?	CO2	BTL 2	Understanding
24	What is Bipolar measurement?	CO2	BTL 1	Remembering
	PART – B			
1	Mention the various types of depth and needle electrodes used to measure EEG and EMG potentials (16)	CO2	BTL 4	Analyzing

2	Explain the placement of electrodes to measure EMG waveform and recording procedure. (16)	CO2	BTL 3	Applying
3	Analysis the following bio electrode and amplifier function, a) EEG-10-20 electrode average mode. (8) b) Bio signal characteristics. (8)	CO2	BTL 4	Analyzing
4	Sketch and explain the recording method of ECG . (16)	CO2	BTL 4	Analyzing
5	Explain and compare the various Bio signal characteristics with neat diagram. (16)	CO2	BTL 4	Analyzing
6	Neat diagram, explain the schematic diagram of EEG machine. Also, show the recording method of unipolar and bipolar EEGs (16)	CO2	BTL 3	Applying
7	Discuss about the different EEG signal frequency bands. (16)	CO2	BTL 3	Applying
8	(i) Explain 10 – 20 electrode system of EEG. (8) (ii) Explain the measurement of EMG. (8)	CO2	BTL 3	Applying
9	Draw a typical ECG waveform and mark the important features and the associated function of the heart. (16)	CO2	BTL 4	Analyzing
10	Describe the standard 12 lead configuration used in ECG recording (16)	CO2	BTL 3	Applying
11	(i) What is the frequency range of human bioelectrical signals? Mention the primary characteristics of bio signals? (8) (ii) Write the standard position of electrode in ECG and explain (8)	CO2	BTL 3	Applying
12	Explain the characteristics of Bio signals? Give the brief description of their functionality and related clinical applications. (16)	CO2	BTL 3	Applying
13	Describe the Wilson central terminal 12 lead system of ECG measurement with suitable diagrams. (16)	CO2	BTL 3	Applying
14	Interpret the 4 landmarks of the skull that are used for the 10 - 20 electrode placement and explain? (16)	CO2	BTL 4	Analyzing
15	Explain the following electrode configuration, a). ECG standard 12 lead systems (8) b). EEG unipolar mode and bi polar mode. (8)	CO2	BTL 3	Applying
16	An electrocardiograph has a broad frequency response so that its amplifier has a first-order time constant of 16 s. The electrocardiograph amplifier has a broad dynamic range of input voltage, but any input voltage grater then ± 2 mV will be out the range of its display and cut off. Will recording the ECG of a patient, a transient occurs that has an amplitude of 10 mV, and this cases the ECG to fall out of the range of the instruments display. If the ECG R wave has an amplitude of 1 mV. How long will it take for the entire signal to be visible on display? (16)	CO2	BTL 4	Analyzing
17	Describe the electrode configuration EMG– unipolar and bipolar mode and explain. (16)	CO2	BTL 4	Analyzing

UNIT III - BIO AMPLIFIER

Need for bio-amplifier - Differential bio-amplifier -Single ended bio-amplifier- Band Pass filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Chopper amplifier, Power line interference.

PART – A				
Q.No	Questions	CO	BT Level	Competence
1	List the characteristics needed for Bio Amplifier.	CO3	BTL 2	Understanding
2	What is the need of bio amplifier?	CO3	BTL 1	Remembering
3	What are the types of Bio amplifier?	CO3	BTL 1	Remembering
4	Write about single ended differential amplifier.	CO3	BTL 2	Understanding
5	Point out the two stages in a typical isolation amplifier.	CO3	BTL 2	Understanding
6	Draw the block diagram of Isolation amplifier.	CO3	BTL 2	Understanding
7	What are the advantages of DC chopper?	CO3	BTL 1	Remembering
8	When the differential amplifier is single-ended? Justify.	CO3	BTL 1	Remembering
9	What is the need of differential amplifier in bio potential measurement	CO3	BTL 1	Remembering
10	What is Lock in amplifier? give its advantages.	CO3	BTL 1	Remembering
11	What is the need of differential amplifier in bio potential measurement?	CO3	BTL 1	Remembering
12	Locate the list of application of Isolation Amplifier.	CO3	BTL 2	Understanding
13	Write the challenges of designing of bio potential amplifier?	CO3	BTL 2	Understanding
14	How to reduce power line interference?	CO3	BTL 2	Understanding
15	What is mean by Power line interference?	CO3	BTL 1	Remembering
16	Why isolation amplifiers are needed for bio signal acquisition design?	CO3	BTL 1	Remembering
17	Define CMRR of differential amplifier. Mention the significance of CMRR in bio potential measurement.	CO3	BTL 1	Remembering
18	Mention the different types of filters used for bio signal measurement?	CO3	BTL 2	Understanding
19	Write short notes on transformer coupled ECG amplifier	CO3	BTL 2	Understanding
20	Why Operational amplifiers are preferred to design Bio amplifiers?	CO3	BTL 1	Remembering
21	Instrumentation amplifiers are preferred over differential amplifiers. Justify?	CO3	BTL 2	Understanding
22	What are the types of isolation amplifiers used in Bio-medical instrumentation?	CO3	BTL 1	Remembering
23	How power line interferences are affected the ECG waveform?	CO3	BTL 2	Understanding
24	Why band pass filter used in ECG amplifier?	CO3	BTL 1	Remembering
	PART B			

1	What should be the characteristics of biopotential amplifier? Explain with proper justification.	CO3	BTL 3	Applying
2	Explain in detail about single ended bio amplifier and differential bio amplifier	CO3	BTL 3	Applying
3	What is the need of optical isolation? Explain about isolated DC amplifier and AC carrier amplifier?	CO3	BTL 3	Applying
4	Explain the working of different types of isolation amplifier with necessary diagram.	CO3	BTL 3	Applying
5	(i) Why isolation amplifiers are needed in the biomedical instrumentation? Explain with an example (8) (ii) Explain the construction and working of Transformer type and optical isolation amplifier (8)	CO3	BTL 3	Applying
6	Write the function of following amplifier characteristics, a). Differential Bio-Amplifier. (8) b). Optical isolation. (8)	CO3	BTL 3	Applying
7	Analyses the type of Chopper Amplifier and draw the circuit diagram and explain the working principle of each and list the application. (16)	CO3	BTL 4	Analyzing
8	(i). Describe in detail about ECG Isolation amplifier. (8) (ii). Mention the advantages and disadvantages of the isolation amplifier. (8)	CO3	BTL 3	Applying
9	Interpret the type of Chopper Amplifier and draw the circuit diagram and explain the working principle of each and list the application. (16)	CO3	BTL 4	Analyzing
10	Explain in detail the working of transformer coupling isolation amplifier and Optical Isolation Amplifier. (16)	CO3	BTL 3	Applying
11	(i) Describe in detail about requirements of biological amplifiers (8) (ii) Draw the voltage and frequency range of common bio potential signals (8)	CO3	BTL 4	Analyzing
12	Categorize the need of an 'Isolation Amplifier'? Explain the working of optically isolated isolation amplifier. (16)	CO3	BTL 4	Analyzing
13	Explain how the isolated DC amplifier and AC carrier amplifier used to measure low frequency signal and explains the operation of low frequency amplifier. (16)	CO3	BTL 3	Applying
14	Describe the operation of transformer isolated amplifier and write the detail about merits of isolated amplifier. (16)	CO3	BTL 4	Analyzing
15	Explain the differential amplifier and why it is preferred for applications in recording of bioelectric signals? (16)	CO3	BTL 3	Applying
16	(i) How is a single ended amplifier different from a differential Amplifier? (8) (ii) Explain the working principle of single ended amplifier? (8)	CO3	BTL 3	Applying
17	Explain the different types of filters used for bio signal measurement? (16)	CO3	BTL 3	Applying

**UNIT – IV:
MEASUREMENTS OF BLOOD PRESSURE, BLOOD VOLUME AND
CARDIAC OUTPUT**

PRESSURE: Direct and indirect measurements-harmonic analysis of blood pressure waveforms-heart sounds-phonocardiography.

Blood volume: Electromagnetic flow meters-ultrasonic flowmeters-chamber plethysmography-photo plethysmography.

CARDIAC OUTPUT MEASUREMENTS: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement.

PART – A

Q.No	Questions	CO	BT Level	Competence
1	Name the direct method of measuring blood pressure.	CO4	BTL 1	Remembering
2	What type of sphygmomanometer is commonly used in measuring indirect blood pressure?	CO4	BTL 2	Understanding
3	Which type of typical set-up of a fluid-filled system for measuring blood pressure.	CO4	BTL 2	Understanding
4	Write the equation of natural frequency of the system blood pressure and specify the parameters.	CO4	BTL 3	Applying
5	Identify the Principle of blood pressure measurement based on Korotkoff sounds.	CO4	BTL 2	Understanding
6	Write the suitable equation of diastolic blood pressure.	CO4	BTL 1	Remembering
7	Define harmonic blood pressure and draw the waveforms of harmonic pressure.	CO4	BTL 2	Understanding
8	Outline the mean of Phonocardiogram.	CO4	BTL 1	Remembering
9	Write the frequency range of heart sounds.	CO4	BTL 1	Remembering
10	State the characteristics of amplifiers with commonly employed filters in phonocardiography systems.	CO4	BTL 2	Understanding
11	Name the methods available for Phonocardiography based blood pressure.	CO4	BTL 1	Remembering
12	How do you find the magnitude of voltage in an electromagnetic blood flow meter?	CO4	BTL 2	Understanding
13	Point out the principle of electromagnetic blood flow meter.	CO4	BTL 2	Understanding
14	Define the Residual Blood Volume.	CO4	BTL 2	Understanding
15	State the principle of ultrasonic blood flow meter.	CO4	BTL 1	Remembering
16	What are the types of flow meters?	CO4	BTL 1	Remembering
17	Write the difference between the AC and DC flow meter.	CO4	BTL 1	Remembering
18	Identify what are the two primary factors determine cardiac output?	CO4	BTL 2	Understanding
19	What is Ficks technique?	CO4	BTL 2	Understanding
20	What are the parameters that Photoplethysmography measure?	CO4	BTL 2	Understanding
21	List the types of measurements in blood pressure?	CO4	BTL 1	Remembering
22	Sketch the phonocardiography waveform using cardiac cycle.	CO4	BTL 2	Understanding
23	Name the four physical principles based on which blood flow meters are constructed?	CO4	BTL 2	Understanding

24	What is the need for cardiac output measurement?	CO4	BTL 2	Understanding
PART – B				
1	Describe which method is using direct methods of measuring blood pressure? Draw a typical set up of a pressure measuring system by direct method. (16)	CO4	BTL 3	Applying
2	What type of transducer is used for measuring direct blood pressure? Draw a simple circuit for calculating systolic and diastolic blood pressure (16)	CO4	BTL 3	Applying
3	Explain the origin of heart sounds and the sensors used for recording the same. What are the special characteristics of the amplifiers used in phonocardiography? (16)	CO4	BTL 3	Applying
4	Illustrate the specifications of the Photo plethysmography and draw the electrical circuit and explain (16)	CO4	BTL 3	Applying
5	(i) What is thermal dilution method for cardiac output measurement? (8) (ii) Explain the block diagram of the processing and computing circuit of thermal dilution method for cardiac output. (8)	CO4	BTL 3	Applying
6	Describe the impedance technique for measuring of increasing cardiac output and indicate its advantages. (16)	CO4	BTL 4	Analyzing
7	Describe the working of an electromagnetic flowmeter with the help of a block diagram. Explain the working of each sub-system. (16)	CO4	BTL 4	Analyzing
8	Sketch the various methods for measurement of blood flow and explain one of them in detail. (16)	CO4	BTL 4	Remembering
9	Explain the following: (i) Fick's method for the determination of cardiac output (ii) Impedance pneumography method of respiration	CO4	BTL 4	Analyzing
10	Analysis the harmonic analysis of blood pressure waveforms, write detail in harmonic analysis of blood pressure. (16)	CO4	BTL 4	Analyzing
11	Write short notes on following. (i) Heart sounds (8) (ii) Ultrasonic flowmeters. (8)	CO4	BTL 3	Applying
12	Mention the types of blood flow meter and explain Square Wave Electromagnetic Flowmeters with suitable diagram. (16)	CO4	BTL 3	Applying
13	Outline the principle of ultrasonic flowmeters and give the suitable diagram. (16)	CO4	BTL 3	Applying
14	Summarize the operation of ultrasound blood flow measurement and thermal dilution blood cardiac measurement. (16)	CO4	BTL 3	Applying
15	What is the function of Intravascular pressure sensor? Explain their classification and functions? (16)	CO4	BTL 3	Applying
16	Describe the operation of chamber plethysmography, photo plethysmography with necessary diagrams. (15)	CO4	BTL 4	Analyzing
17	Explain the elements required for an automatic indirect system for measuring blood pressure and draw the block diagram. (16)	CO4	BTL 3	Applying

	UNIT – V BIOCHEMICAL MEASUREMENTS			
	Biochemical sensors - pH, pO ₂ and pCO ₂ , Ion selective Field effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors. Blood gas analysers, colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyser.			
	PART – A			
Q.No	Questions	CO	BT Level	Competence
1	What is meant by pH value blood?	CO5	BTL 1	Remembering
2	Identify the physiology of acid base balance?	CO5	BTL 2	Understanding
3	Which blood gas causes changes in pH?	CO5	BTL 2	Understanding
4	Mention the four components of blood gasses?	CO5	BTL 2	Understanding
5	Name the instrument used to measure the PO ₂ and PCO ₂	CO5	BTL 2	Understanding
6	What kind of blood tests are indicating multiple myeloma?	CO5	BTL 2	Understanding
7	What is an auto analyzer? What are its advantages?	CO5	BTL 1	Remembering
8	What is the need of blood cell counter?	CO5	BTL 1	Remembering
9	How long does a haemoglobin electrophoresis test take?	CO5	BTL 2	Understanding
10	What is the principle of IMFET?	CO5	BTL 2	Understanding
11	Point out the errors due to Temperature Variation for blood cell.	CO5	BTL 2	Understanding
12	Write about automated type of electrophoresis.	CO5	BTL 1	Remembering
13	Identify the application of electrophoresis	CO5	BTL 1	Remembering
14	Mention the effect of Blood on Electrodes.	CO5	BTL 2	Understanding
15	Distinguish between Flame Photometer and spectrophotometer.	CO5	BTL 2	Understanding
16	What wavelength does a colorimeter use?	CO5	BTL 1	Remembering
17	What is ISFET?	CO5	BTL 2	Understanding
18	Name the three essential parts of flame photometer.	CO5	BTL 1	Remembering
19	Draw the Schematic diagram of a flame photometer.	CO5	BTL 2	Understanding
20	List the components of a spectrophotometer.	CO5	BTL 1	Remembering
21	What are the important critical care analytes of blood levels?	CO5	BTL 1	Remembering
22	Write the blood gases related parameter of following metrics Po ₂ , Pco ₂ , pH.	CO5	BTL 2	Understanding
23	Sketch the schematic diagram Po ₂ electrode.	CO5	BTL 3	Applying
24	Write the pH value of venous and arterial blood.	CO5	BTL 1	Remembering
	PART – B			
1	What is the function of a blood gas analyser? Why is it necessary to maintain acid-base balance in the body? Indicate the normal blood pH value. (16)	CO5	BTL 3	Remembering
2	Write the equation giving relationship between potential generated and pH (nearest equation) for a glass electrode. Define slope factor and draw a graph showing relationship between pH and emf at 25 °C. (16)	CO5	BTL 3	Applying

3	Determine pH, pCO ₂ and pO ₂ are measured based on in a blood gas analyser and briefly those measurements. (16)	CO5	BTL 4	Analyzing
4	Explain in detail (i) the PO ₂ and PCO ₂ measurements in detail. (8) (ii) Blood cell counter (any one method) (8)	CO5	BTL 3	Applying
5	Illustrate the commonly used methods for blood cell counting? Explain the principle of electrical conductivity method. (16)	CO5	BTL 4	Analyzing
6	Write a note about the following (i) ISFET , (ii) Blood glucose sensor (i) IMFFT (16)	CO5	BTL 3	Applying
7	Define and explain the following. (a) Packed Cell Volume (PcV) (4) (b) Mean Cell Volume (McV) (4) (c) Mean Cell Haemoglobin value (McH) (4) (d) Mean Platelet Volume (MPV) (4)	CO5	BTL 3	Applying
8	Illustrate and draw the block diagram of electro chemical sensor chromatology and explain its working. (16)	CO5	BTL 3	Applying
9	Describe the function of following. (i) Essential parts of a flame photometer with diagram (8) (ii) Schematic diagram of a flame photometer. (8)	CO5	BTL 3	Applying
10	Examine the principle of colorimeter, write the Sample concentration of colorimeter and Multi-channel Colorimeter. (16)	CO5	BTL 4	Analyzing
11	Explain the working principle of optical filter in spectrometers and write the classification and draw suitable block diagram with explanation. (16)	CO5	BTL 3	Applying
12	Describe the three-essential part of flame photometer, and draw the essential part of flame photo meter, explain each block in detail. (16)	CO5	BTL 4	Analyzing
13	(i) Mention the component of the ABG analyzer? (8) (ii) How pH, PCO ₂ and PO ₂ are measured in a blood gas analyser and briefly state the underlying principle behind each of those measurements. (8)	CO5	BTL 3	Applying
14	How to find the blood cell count using Optical method? Explain with suitable block diagram. (16)	CO5	BTL 3	Applying
15	Explain the principle and application of the following measurement (i) Flame photometer (ii) Spectro photometer (16)	CO5	BTL 3	Applying
16	Sketch the schematic diagram of a pH electrode? How to measure pH values of blood using pH electrode, and explain in detail.	CO5	BTL 3	Applying
17	Describe the block diagram of an automated blood cell counter and explain its functioning (16)	CO5	BTL 4	Analyzing
