

SCHEME : K

Name : _____
Roll No. : _____ Year : 20__ 20__
Exam Seat No. : _____

LABORATORY MANUAL FOR DIAGNOSTIC EQUIPMENT (314332)



Picture 2 An automatic device pumps air into the cuff on its own after pressing the start button.

ELECTRONICS ENGINEERING GROUP



**MAHARASHTRA STATE BOARD OF
TECHNICAL EDUCATION, MUMBAI**
(Autonomous) (ISO 9001: 2015) (ISO/IEC 27001:2013)

VISION

To ensure that the Diploma Level Technical Education constantly matches the latest requirements of technology and industry and includes the all-round personal development of students including social concerns and to become globally competitive, technology led organization.

MISSION

To provide high quality technical and managerial manpower, information and consultancy services to the industry and community to enable the industry and community to face the changing technological and environmental challenges.

QUALITY POLICY

We, at MSBTE, are committed to offer the best in class academic services to the students and institutes to enhance the delight of industry and society. This will be achieved through continual improvement in management practices adopted in the process of curriculum design, development, implementation evaluation and monitoring system along with adequate faculty development Programs.

CORE VALUES

MSBTE believes in the followings:

- Education industry produces live products.
- Market requirements do not wait for curriculum changes.
- Question paper is the reflector of academic standards of educational organization
- Well-designed curriculum needs effective implementation too.
- Competency based curriculum is the backbone of need based programs.
- Technical skills do need support for life skills.
- Best teachers are the national assets.
- Effective teaching learning process is impossible without learning resources.

A Laboratory Manual for

DIAGNOSTIC EQUIPMENT (314332)

K-SCHEME

Semester-IV

(MU)



**Maharashtra State
Board of Technical Education, Mumbai**

(Autonomous) (ISO 9001:2015) (ISO/IEC 27001:2013)



Maharashtra State Board of Technical Education, Mumbai
(Autonomous) (ISO 9001:2015) (ISO/IEC 27001:2013)
4th Floor, Government Polytechnic Building, 49, Kherwadi,
Bandra (East), Mumbai- 400051.



**MAHARASHTRA STATE
BOARD OF TECHNICAL EDUCATION
Certificate**

This is to certify that Mr. / Ms.....
Roll No., of Fourth Semester of Diploma
in.....of **Institute Name**
..... (**Inst. Code:.....**)
has completed the term work satisfactorily in Course **Diagnostic
Equipment (314332)** for the academic year 20.....to 20.....as
prescribed in the curriculum.

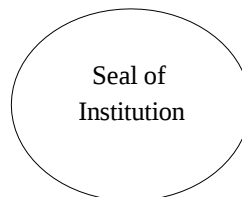
Place: Enrollment No:

Date: Exam Seat No:

Subject Teacher

Head of Department

Principal



Preface

The primary focus of any engineering laboratory/field work in the technical education system is to develop the much needed industry relevant competencies and skills. With this in view, MSBTE embarked on this innovative 'K' Scheme curricula for engineering diploma programs with outcome-based education as the focus and accordingly, relatively large amount of time is allotted for the practical work. This displays the great importance of laboratory work making each teacher; instructor and student to realize that every minute of the laboratory time need to be effectively utilized to develop these outcomes, rather than doing other mundane activities. Therefore, for the successful implementation of this outcome-based curriculum, every practical has been designed to serve as a 'vehicle' to develop this industry identified competency in every student. The practical skills are difficult to develop through "chalk and duster" activity in the classroom situation. Accordingly, the "K" scheme laboratory manual development team designed the practical's to focus on the outcomes, rather than the traditional age old practice of conducting practical's to 'verify the theory" (which may become a byproduct along the way).

This laboratory manual is designed to help all stakeholders, especially the students, teachers and instructors to develop in the student the pre-determined outcomes. It is expected from each student that at least a day in advance, they have to thoroughly read through the concerned practical procedure that they will do the next day and understand the minimum theoretical background associated with the practical. Every practical in this manual begins by identifying the competency, industry relevant skills, course outcomes and practical outcomes which serve key focal point for doing the practical. The students will then become aware about the skills they will achieve through procedure shown there and necessary precautions to be taken, which will help them to apply in solving real-world problems in their professional life.

This manual also provides guidelines to teachers and instructors to effectively facilitate student-centered lab activities through each practical exercise by arranging and managing necessary resources in order that the students follow the procedures and precautions systematically ensuring the achievement of outcomes in the students.

This course deals with the fundamentals of electrical engineering and electronics engineering, working principles of commonly used motors, different electronic components and circuits used. In today's world most of the consumer appliances are based on electronic circuits and devices, working of computer or any of its peripherals are based on electronics. The basic concepts of electrical and electronics engineering in this course will be very useful for understanding and testing simple electrical circuits and electronic circuits. After studying this course students will develop an insight to identify, build and trouble shoot simple electrical and electronic circuits.

Although best possible care has been taken to check for errors (if any) in this laboratory manual, perfection may elude us as this is the first edition of this manual. Any errors and suggestions for improvement are solicited and highly welcome.

Program Outcomes (POs)

- **PO 1. Basic and Discipline specific knowledge:** Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.
- **PO 2. Problem analysis:** Identify and analyze well-defined engineering problems using codified standard methods.
- **PO 3. Design/development of solutions:** Design solutions for well-defined technical problems and assist with the design of system components or processes to meet specified needs.
- **PO 4. Engineering tools, Experimentation and Testing:** Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.
- **PO 5. Engineering practices for society, sustainability and environment:** Apply appropriate technology in context of society, sustainability, environment and ethical practices.
- **PO 6. Project Management:** Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.
- **PO 7. Life-long learning:** Ability to analyze individual needs and engage in updating in the context of technological changes.

List of Industry Relevant Skills

The following hospital / industry relevant skills of the competency "Use medical equipment in diagnostic applications" are expected to be developed in you by undertaking the practical of this laboratory manual.

1. To measure blood pressure digitally and analogically in different body positions and compare techniques.
2. Configuring 12-lead ECGs, identifying points, calculating heart rates and analyzing changes during and after exercise.
3. Operating, sketching waveforms and troubleshooting of EEG and EMG.
4. Identifying components, specifications and troubleshooting of Hearing Aids.
5. Testing auditory responses, plotting audiograms and troubleshooting of Audiometer.
6. Exploring skin responses using GSR meters.

Brief Guidelines to Teachers

1. Teacher should provide the guideline with demonstration of practical to the students with all features.
2. Teacher shall explain prior concepts to the students before starting of each experiment.
3. Involve students in performance of each experiment.
4. Teacher should ensure that the respective skills and competencies are developed in the students after the completion of the practical exercise.
5. Teachers should give opportunity to students for hands on experience after the demonstration.
6. Teacher is expected to share the skills and competencies to be developed in the students.
7. Teacher may provide additional knowledge and skills to the students even though not covered in the manual but are expected the students by the industry.
8. Finally give practical assignment and assess the performance of students based on task assigned to check whether it is as per the instructions.

Instructions for Students

1. Listen carefully the lecture given by teacher about subject, curriculum, learning structure, skills to be developed.
2. Organize the work in the group and make record all programs.
3. Students shall develop maintenance skill as expected by industries.
4. Student shall attempt to develop related hand-on skills and gain confidence.
5. Student shall develop the habits of evolving more ideas, innovations and skills etc. those included in scope of manual.
6. Student shall refer technical magazines.
7. Student should develop habit to submit the practicals on date and time. Student should well prepare while submitting write-up of exercise.
8. Attach /paste separate papers wherever necessary.

Practical course outcome matrix
PRACATICAL COURSE OUTCOME MATRIX

COURSE LEVEL LEARNING OUTCOMES (COS)						
CO1 - Use the blood pressure meter, pulse oximeter and temperature meter to measure vital parameters. CO2 - Use the respiration rate meter to assess a person respiratory status. CO3 - Troubleshoot ECG machine for simple faults. CO4 - Troubleshoot the EEG and EMG machines for ensuring accurate measurements for diagnostic purposes. CO5 - Operate audiometer and GSR meter.						
Sr. No.	Title of the Practical	CO1	CO2	CO3	CO4	CO5
1	*Blood pressure measurement by digital method.	✓	-	-	-	-
2	*Blood pressure measurement by sphygmomanometer method.	✓	-	-	-	-
3	Comparison of blood pressure measurement by sphygmomanometer and digital blood pressure meter.	✓	-	-	-	-
4	Measurement of exercise affect on blood pressure response.	✓	-	-	-	-
5	* Determination of SpO2 variations due to exercise using pulse oximeter.	✓	-	-	-	-
6	Measurement of pulse rate, systolic, diastolic values and relative blood pressure using plethysmograph.	✓	-	-	-	-
7	*Measurement of body temperature precision and accuracy.	✓	-	-	-	-
8	*Precision in respiration rate measurement.	-	✓	-	-	-
9	Determination of fetal heart rate using ultrasonic fetal heart rate meter.	-	✓	-	-	-
10	Using spirometer machine for recording of spirogram.	-	✓	-	-	-
11	*Using 12 lead configurations in ECG for recording electrocardiograph.	-	-	✓	-	-
12	*Determination of R-R interval and heart rate from ECG.	-	-	✓	-	-

13	Determination of exercise induced changes in heart rate and R-R interval.	-	-	✓	-	-
14	*Symphony analysis of phonocardiogram to record different heart sounds.	-	-	✓	-	-
15	*Comparative analysis of heart sounds: phonocardiography vs. traditional stethoscope.	-	-	✓	-	-
16	Characterization of ECG preamplifier CMRR and gain.	-	-	✓	-	-
17	*Operation of ECG machine.	-	-	✓	-	-
18	Generation and analysis of ECG wave using simulator.	-	-	✓	-	-
19	*Fault diagnosis in ECG machine.	-	-	✓	-	-
20	*Operation of EEG machine.	-	-	-	✓	-
21	*Fault diagnosis in EEG machine.	-	-	-	✓	-
22	*Operation of EMG machine.	-	-	-	✓	-
23	Fault diagnosis in EMG machine.	-	-	-	✓	-
24	Plotting of human auditory response using audiometer.	-	-	-	-	✓
25	Troubleshooting audiometer machine.	-	-	-	-	✓
26	*Exploring skin response through galvanic skin response (GSR) measurements.	-	-	-	-	✓
27	*Identification of components of hearing aid.	-	-	-	-	✓
28	Fault diagnosis in hearing aid.	-	-	-	-	✓

Content Page**List of Practical's and Progressive Assessment Sheet**

Sr. No.	Title of the Practical	Page no.	Date of Performance	Date of Submission	Assessment Marks (25)	Dated sign. of Teacher	Remarks (If any)
1	*Blood pressure measurement by digital method.	1					
2	*Blood pressure measurement by sphygmomanometer method.	6					
3	Comparison of blood pressure measurement by sphygmomanometer and digital blood pressure meter.	11					
4	Measurement of exercise affect on blood pressure response.	16					
5	* Determination of SpO ₂ variations due to exercise using pulse oximeter.	21					
6	Measurement of pulse rate, systolic, diastolic values and relative blood pressure using plethysmograph.	26					
7	*Measurement of body temperature precision and accuracy.	31					
8	*Precision in respiration rate measurement.	36					
9	Determination of fetal heart rate using ultrasonic fetal heart rate meter.	41					
10	Using spirometer machine for recording of spirogram.	46					
11	*Using 12 lead configurations in ECG for recording electrocardiograph.	50					
12	*Determination of R-R interval and heart rate from ECG.	56					
13	Determination of exercise induced changes in heart rate and R-R interval.	61					
14	*Symphony analysis of phonocardiogram to record different heart sounds.	67					
15	*Comparative analysis of heart sounds: phonocardiography vs. traditional stethoscope.	72					

Diagnostic Equipment (314332)

16	Characterization of ECG preamplifier CMRR and gain.	77					
17	*Operation of ECG machine.	83					
18	Generation and analysis of ECG wave using simulator.	88					
19	*Fault diagnosis in ECG machine.	93					
20	*Operation of EEG machine.	99					
21	*Fault diagnosis in EEG machine.	105					
22	*Operation of EMG machine.	111					
23	Fault diagnosis in EMG machine.	116					
24	Plotting of human auditory response using audiometer.	121					
25	Troubleshooting audiometer machine.	127					
26	*Exploring skin response through galvanic skin response (GSR) measurements.	132					
27	*Identification of components of hearing aid.	137					
28	Fault diagnosis in hearing aid.	142					

Practical No.1: Blood pressure measurement by digital method

I Practical Significance

Accurate measurement of blood pressure is essential for diagnosing and managing various cardiovascular conditions, making this practical highly relevant for medical professionals.

II Industry/Employer Expected Outcome(s)

A blood pressure measurement technique is crucial for healthcare providers to ensure accurate diagnosis and treatment of patients.

III Course Level Learning Outcome(s)

Use the blood pressure meter, pulse oximeter and temperature meter to measure vital parameters.

IV Laboratory Learning Outcome(s)

- LLO 1.1 Use the digital blood pressure meter to determine the blood pressure in the following body position: i. Supine ii. Sitting

V Relevant Affective Domain related outcome(s)

Students will develop empathy and communication skills essential for creating a comfortable environment during blood pressure measurements.

VI Relevant Theoretical Background

Understanding the physiological principles governing blood pressure regulation and the technology behind digital blood pressure monitors is crucial for accurate measurement.

VII Actual Circuit diagram used in laboratory with related equipment rating.



Fig. 1.1 Digital blood pressure meter

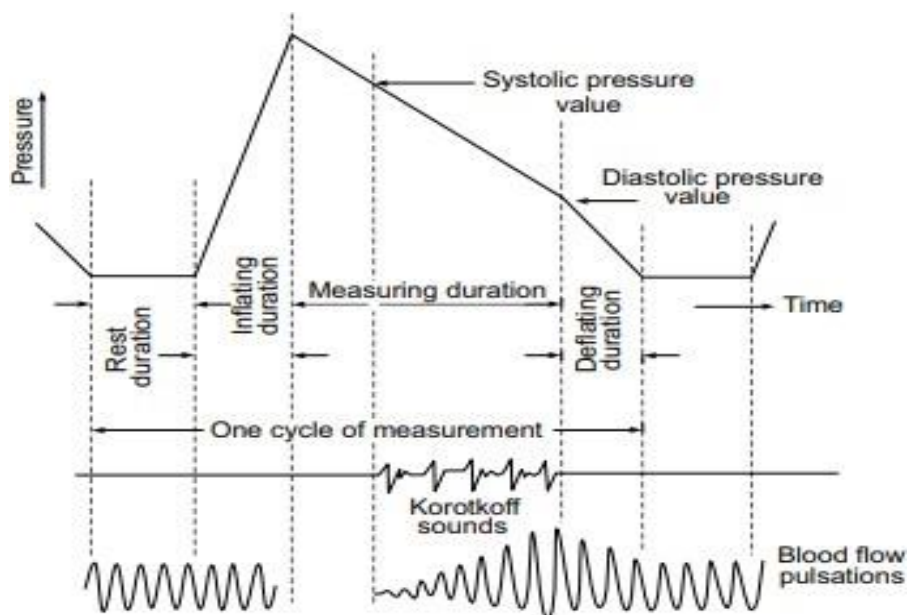


Fig. 1.2 Principle of blood pressure measurement based on Korotkoff sounds

VIII Required Resources/apparatus/equipment with specifications

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Digital blood pressure meter	LCD digital display, Easy, one-touch operation	1

IX Precautions to be followed

1. Ensure the digital blood pressure meter is calibrated correctly.
2. Position the patient properly and comfortably.
3. Allow the patient to rest for a few minutes before measurement.
4. Adhere to manufacturer instructions for the digital blood pressure meter.

X Procedure

1. Prepare the digital blood pressure meter according to manufacturer guidelines.
2. Position the patient in either a supine or sitting position.
3. Apply the blood pressure cuff to the patient's arm at heart level.
4. Initiate the blood pressure measurement following the device's instructions.

XI Resources used

Sr. No.	Name of Resource	Specifications	Quantity

XII Actual Procedure

.....

.....

.....

.....

.....

XIII Observation Table**Table 1.1: Systolic and Diastolic blood pressure**

Sr. No.	Position	Systolic Blood Pressure (mmHg)	Diastolic Blood Pressure (mmHg)
1	Supine		
2	Sitting		

XIV Result(s)

.....

.....

.....

.....

XV Interpretation of results

.....

.....

.....

XVI Conclusion and recommendation

.....

.....

.....

XVII Practical related questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identifies CO.

- 1. Explain the importance of accurate blood pressure measurement in healthcare.
- 2. How does body position affect blood pressure readings?
- 3. State the significance of using a digital blood pressure meter over traditional methods.
- 4. What precautions should be taken to ensure reliable blood pressure measurements?

[Space for Answers]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

XVIII References / Suggestions for further reading

1. Handbook of biomedical instrumentation by R.S. Khandpur (Third edition)
2. <https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering>

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		60 %
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		40%
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusion	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		100 %

Mark Obtained			Dated signature of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No. 2: Blood pressure measurement by sphygmomanometer method

I Practical Significance

Accurate measurement of blood pressure is essential for diagnosing and managing various cardiovascular conditions, making this practical highly relevant for medical professionals.

II Industry/Employer Expected Outcome(s)

A blood pressure measurement technique is crucial for healthcare providers to ensure accurate diagnosis and treatment of patients.

III Course Level Learning Outcome(s)

Use the blood pressure meter, pulse oximeter and temperature meter to measure vital parameters.

IV Laboratory Learning Outcome(s)

- LLO 2.1 Use the analog blood pressure meter to determine the blood pressure in the following body position: i. Supine ii. Sitting

V Relevant Affective Domain related outcome(s)

Students will develop empathy and communication skills essential for creating a comfortable environment during blood pressure measurements.

VI Relevant Theoretical Background

Understanding the physiological principles governing blood pressure regulation and the technology behind digital blood pressure monitors is crucial for accurate measurements.

VII Actual Circuit diagram used in laboratory with related equipment rating.



Fig. 2.1 Sphygmomanometer

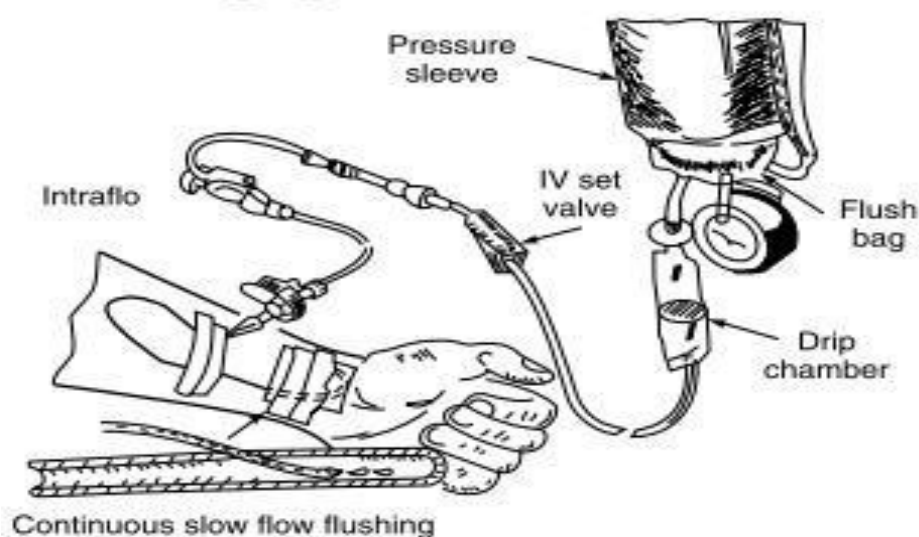


Fig. 2.2 Continuous slow-flow flushing arrangement for pressure measurements
(Courtesy Hewlett Packard, USA)

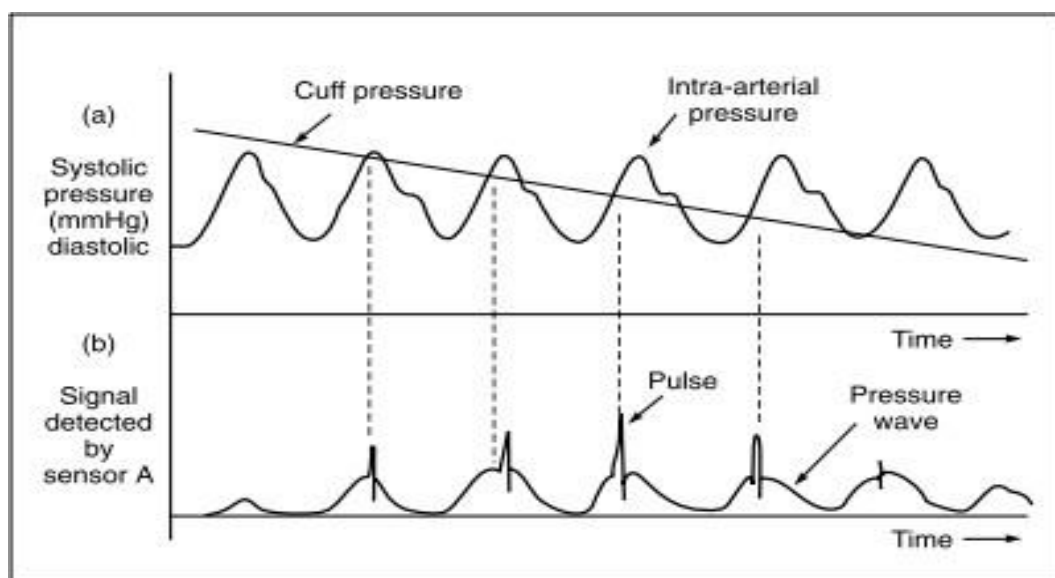


Fig. 2.3 (a) Diagram showing the relationship between cuff pressure and intra-arterial pressure (b) Signal created by the relative pressure changes
(Copyright -Handbook of biomedical instrumentation by R.S. Khandpur (Third edition))

VIII Required Resources/apparatus/equipment with specifications

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Sphygmomanometer	Manual, cuff size: adult	1
2	Stethoscope	Standard acoustic model	1
3	Patient table/chair	Adjustable height	1

IX Precautions to be followed

1. Ensure the cuff is appropriately sized for the patient.
2. Position the patient comfortably before taking measurements.
3. Check for any leaks or defects in the equipment.
4. Use gentle inflation to avoid discomfort or injury to the patient.
5. Record measurements accurately and consistently.

X Procedure

1. Prepare the equipment and ensure its functioning properly.
2. Position the patient and expose the arm for cuff placement.
3. Place the cuff snugly around the upper arm, aligning it with the heart.
4. Inflate the cuff to a pressure higher than the expected systolic pressure.
5. Slowly deflate the cuff while listening for the Korotkoff sounds with the stethoscope.
6. Note the pressure reading at the onset (systolic) and cessation (diastolic) of the sounds.
7. Record the measurements accurately in the observation table.

XI Resources used

Sr. No.	Name of Resource	Specifications	Quantity

XII Actual Procedure

.....

.....

.....

.....

.....

XIII Observation Table**Table 2.1: Blood Pressure measurement**

Sr. No.	Position	Systolic Blood Pressure (mmHg)	Diastolic Blood Pressure (mmHg)
1	Supine		
2	Sitting		

XIV Result(s)

XV Interpretation of results

XVI Conclusion and recommendation

XVII Practical related questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identifies CO.

1. List factors that affect the blood pressure measurement.
2. What is the normal range of systolic and diastolic blood pressure?
3. What precaution should be taken while measuring the blood pressure?
4. State technical specifications of sphygmomanometer.

[Space for Answers]

This image shows a full page of white paper with horizontal dotted lines, typical of primary school writing paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

.....

.....

.....

.....

.....

XVIII References/Suggestions for further reading

1. Handbook of biomedical instrumentation by R.S. Khandpur (Third edition)
2. [https:// www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering](https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering)

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		60 %
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		40%
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusion	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		100 %

Mark Obtained			Dated signature of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No. 3: Comparison of blood pressure measurement by sphygmomanometer and digital blood pressure meter

I Practical Significance

Understanding the differences and accuracy of blood pressure measurement techniques is crucial in healthcare settings to ensure accurate diagnosis and treatment of various cardiovascular conditions.

II Industry/Employer Expected Outcome(s)

Healthcare professionals should be able to effectively use both traditional sphygmomanometers and modern digital blood pressure meters to accurately measure blood pressure in patients.

III Course Level Learning Outcome(s)

Use the blood pressure meter, pulse oximeter and temperature meter to measure vital parameters.

IV Laboratory Learning Outcome(s)

- LLO 3.1 Use sphygmomanometer and digital blood pressure meter to measure in standing position of body.
- LLO 3.2 Find error by comparing the blood pressure readings by the two methods.

V Relevant Affective Domain related outcome(s)

Students will develop a sense of responsibility and accuracy in performing medical procedures, as blood pressure measurement is a critical aspect of patient assessment.

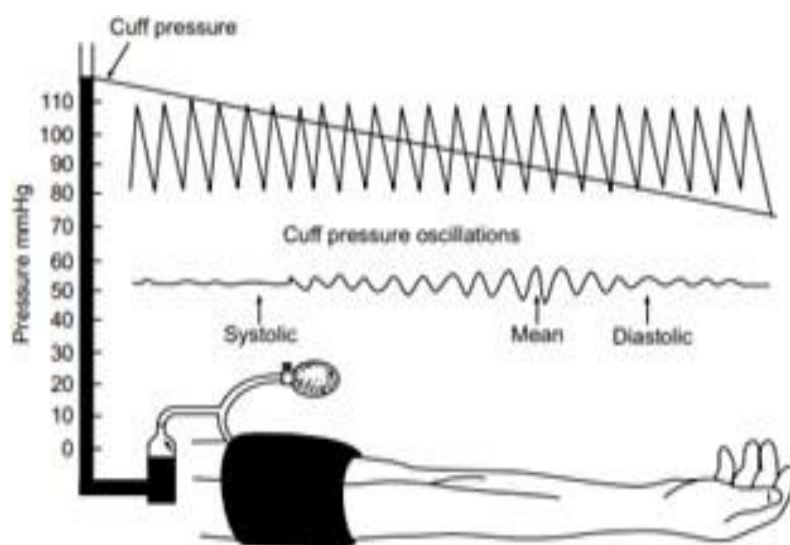
VI Relevant Theoretical Background

Understanding the physiology of blood pressure regulation, the principle of oscillometric measurement used in digital blood pressure meters, and the technique of auscultatory blood pressure measurement used with sphygmomanometers.

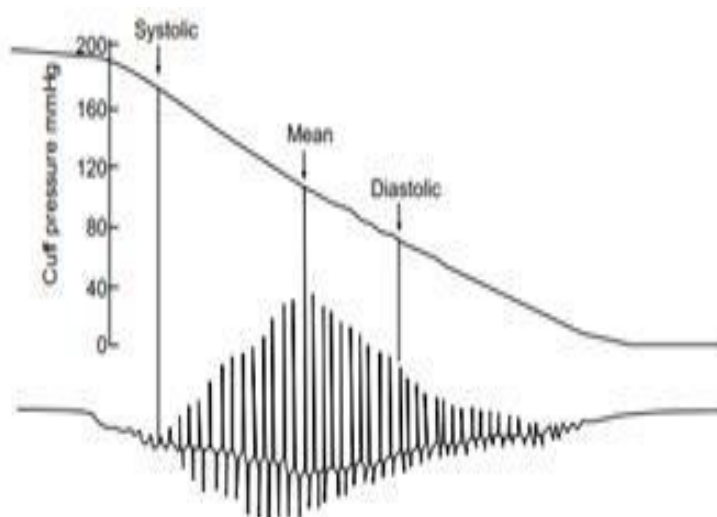
VII Actual Circuit diagram used in laboratory with related equipment rating.



Fig. 3.1 Digital blood pressure meter & sphygmomanometer



a. Oscillometric method



b. Oscillations in cuff pressure

Fig. 3.2 Illustration of oscillometric method of blood pressure measurement
 (Copyright-Handbook of biomedical instrumentation by R.S. Khandpur (Third edition))

VIII Required Resources/apparatus/equipment with specifications

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Sphygmomanometer	Mercury type, standard	1
2	Digital blood pressure meter	Oscillometric type, calibrated	1

IX Precautions to be followed

1. Ensure the devices are properly calibrated before use.
2. Position the patient correctly and ensure they are relaxed during measurement.
3. Use the appropriate cuff size for accurate readings.
4. Avoid any external factors that could interfere with the measurement, such as movement or talking during the procedure.

X Procedure

1. Prepare the sphygmomanometer and digital blood pressure meter according to manufacturer instructions.
2. Position the patient comfortably and expose their arm for measurement.
3. Apply the appropriate cuff size to the patient's upper arm.
4. Inflate the cuff using the sphygmomanometer or start the digital blood pressure meter.
5. Record the systolic and diastolic blood pressure readings obtained from both devices.
6. Repeat the measurements for accuracy if necessary.

XI Resources used

Sr. No.	Name of Resource	Specifications	Quantity

XII Actual Procedure

.....

.....

.....

.....

XIII Observation Table**Table 3.1: Comparison of Blood pressure measurements**

Sr. No	Sphygmomanometer (mmHg)	Digital Blood Pressure meter (mmHg)
1		
2		
3		
4		

XIV Result(s)

.....

.....

XV Interpretation of results

.....

.....

XVI Conclusion and recommendation

.....

.....

XVII Practical related questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identifies CO.

1. Explain the working principle of both sphygmomanometer and digital blood pressure meter.
2. State factors that can affect the accuracy of blood pressure measurement.
3. How do you select the appropriate cuff size for blood pressure measurement?
4. Enlist the advantages and disadvantages of digital blood pressure meter and compared it with traditional sphygmomanometer.
5. How can healthcare professionals ensure accurate blood pressure measurement in clinical practice?

[Space for Answers]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

XVIII References/Suggestions for further reading

1. Handbook of biomedical instrumentation by R.S. Khandpur (Third edition)
2. <https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering>

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		60 %
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		40%
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusion	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		100 %

Mark Obtained			Dated signature of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No. 4: Measurement of exercise affect on blood pressure response

I Practical Significance

Understanding the impact of exercise on blood pressure response is crucial in evaluating cardiovascular health and designing appropriate exercise regimens for individuals.

II Industry/Employer Expected Outcome(s)

Healthcare professionals should be able to assess the effect of exercise on blood pressure and tailor exercise programs accordingly to improve cardiovascular health in patients.

III Course Level Learning Outcome(s)

Use the blood pressure meter, pulse oximeter and temperature meter to measure vital parameters.

IV Laboratory Learning Outcome(s)

- LLO 4.1 Use digital blood pressure meter to observe the immediate and post-exercise effects on blood pressure.

V Relevant Affective Domain related outcome(s)

Students will develop an appreciation for the importance of regular physical activity in maintaining cardiovascular health and overall well-being.

VI Relevant Theoretical Background

It includes knowledge of how exercise affects cardiovascular function, including changes in heart rate, stroke volume and peripheral vascular resistance, leading to alterations in blood pressure.

VII Actual Circuit diagram used in laboratory with related equipment rating.



Fig. 4.1 Blood pressure meter and exercise

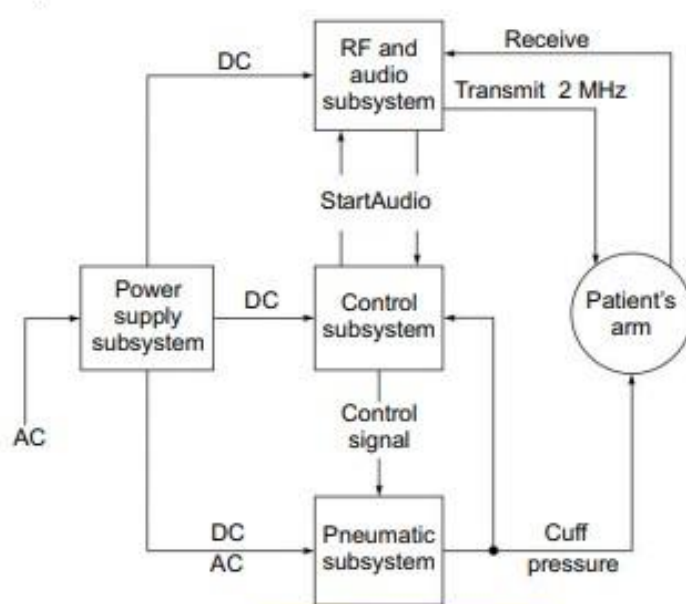


Fig. 4.2 Major Subsystems in ultrasonic blood pressure monitor
(Copyright-Handbook of biomedical instrumentation by R.S. Khandpur (Third edition))

VIII Required Resources / apparatus / equipment with specifications

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Exercise Equipment	Treadmill, Stationary bike or other exercise equipment	1
2	Blood Pressure Meter	Oscillometric type, calibrated	1
3	Stopwatch	Digital or Analog	1

IX Precautions to be followed

1. Ensure participants are medically cleared for exercise.
2. Monitor participants closely during exercise to prevent injury.
3. Use appropriate safety measures with exercise equipment.
4. Allow participants to cool down gradually after exercise to prevent post-exercise hypotension.

X Procedure

1. Measure baseline blood pressure in participants at rest.
2. Instruct participants to engage in a predetermined level of exercise intensity (e.g., brisk walking, jogging) for a specified duration.
3. Monitor blood pressure during exercise at regular intervals (e.g., every 5 minutes).
4. After exercise, measure blood pressure again immediately and at intervals during the recovery period.
5. Record blood pressure measurements and exercise parameters.

XI Resources used

Sr. No.	Name of Resource	Specifications	Quantity

XII Actual Procedure

.....

.....

.....

.....

XIII Observation Table**Table 4.1: Blood Pressure response to exercise**

Sr. No.	Time (min)	Systolic Blood Pressure (mmHg)	Diastolic Blood Pressure (mmHg)
1	Baseline (Rest)		
2	During Exercise (5 min)		
3	During Exercise (10 min)		
4	Post-Exercise (Immediate reading)		
5	Post-Exercise (After 5 min reading)		

XIV Result(s)

.....

.....

XV Interpretation of results

.....

.....

XVI Conclusion and recommendation

.....

.....

XVII Practical related questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identifies CO.

- 1. How does exercise affect cardiac output and peripheral vascular resistance?
- 2. Explain the concept of post-exercise hypotension and its implications for cardiovascular health.
- 3. What factors can influence the magnitude of blood pressure response to exercise?
- 4. How can healthcare professionals use exercise testing to assess cardiovascular fitness?
- 5. What are the recommendations for exercise prescription in individuals with hypertension?

[Space for Answers]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

XVIII References/Suggestions for further reading

1. Handbook of biomedical instrumentation by R.S. Khandpur (Third edition)
2. <https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering>

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		60 %
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		40%
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusion	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		100 %

Mark Obtained			Dated signature of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No. 5: Determination of SpO₂ variations due to exercise using pulse oximeter

I Practical Significance

Monitoring SpO₂ variations during exercise is essential for assessing oxygen saturation levels in individuals undergoing physical activity, providing valuable insights into cardiorespiratory health and exercise tolerance.

II Industry/Employer Expected Outcome(s)

Healthcare professionals should be able to use pulse oximeters effectively to monitor SpO₂ levels during exercise and interpret the results to optimize exercise prescription and monitor patient safety.

III Course Level Learning Outcome(s)

Use the blood pressure meter, pulse oximeter and temperature meter to measure vital parameters.

IV Laboratory Learning Outcome(s)

- LLO 5.1 Use the pulse oximeter to determine variations of SpO₂ (pre-exercise).
- LLO 5.2 Use the pulse oximeter to determine variations of SpO₂ (post-exercise).

V Relevant Affective Domain related outcome(s)

Students will develop empathy and concern for individuals with compromised cardiorespiratory function, understanding the importance of monitoring SpO₂ levels during exercise to ensure patient safety.

VI Relevant Theoretical Background

Understanding the principles of pulse oximetry, the relationship between SpO₂ and oxygen delivery to tissues, and the physiological responses to exercise on oxygen saturation.

VII Actual Circuit diagram used in laboratory with related equipment rating.

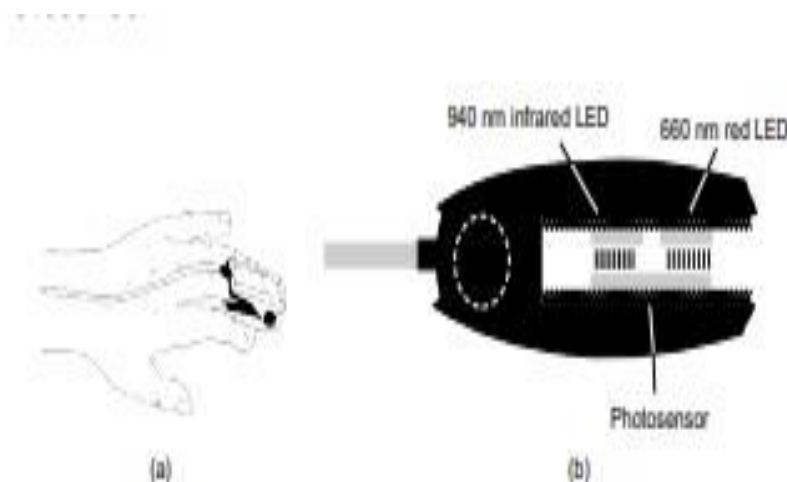


Fig. 5.1 (a) A typical finger tip pulse oximeter probe in use (b) Components of a pulse oximeter probe
(Copyright-Handbook of biomedical instrumentation by R.S. Khandpur (Third edition))

VIII Required Resources/apparatus/equipment with specifications

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Pulse Oximeter	Finger-tip type, calibrated	1
2	Stopwatch	Digital or analog	1
3	Exercise Equipment	Treadmill, stationary bike, or other exercise machines	1

IX Precautions to be followed

1. Ensure participants are medically cleared for exercise.
2. Ensure the pulse oximeter is properly calibrated and positioned on the participant's finger.
3. Monitor participants closely during exercise to prevent injury or adverse events.
4. Use appropriate safety measures with exercise equipment to minimize risks.

X Procedure

1. Measure baseline SpO₂ levels in participants at rest using the pulse oximeter.
2. Instruct participants to engage in a predetermined level of exercise intensity (e.g., brisk walking, cycling) for a specified duration.
3. Monitor SpO₂ levels continuously during exercise using the pulse oximeter.
4. Record SpO₂ levels at regular intervals (e.g., every 5 minutes) during exercise.
5. After exercise, measure SpO₂ levels again immediately and at intervals during the recovery period.
6. Record exercise parameters and SpO₂ measurements.

XI Resources used

Sr. No.	Name of Resource	Specifications	Quantity

XII Actual Procedure

.....

.....

.....

.....

.....

XIII Observation Table**Table 5.1: SpO₂ variations during exercise**

Sr. No	Time (min)	SpO ₂ (%)
1	Baseline (Rest)	
2	During Exercise (5 min)	
3	During Exercise (10 min)	
4	Post-Exercise (Immediate)	
5	Post-Exercise (5 min Recovery)	

XIV Result(s)

.....

.....

XV Interpretation of results

.....

.....

XVI Conclusion and recommendation

.....

.....

XVII Practical related questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identifies CO.

1. Explain the working principle of pulse oximeter.
2. How pulse oximeter measures SpO₂ levels?
3. What factors can influence SpO₂ variations during exercise?
4. Explain the clinical significance of monitoring SpO₂ levels during exercise.
5. What precautions should be taken when using pulse oximeters during exercise testing?

[Space for Answers]

.....

.....

.....

[illegible]

.....

.....

.....

.....

.....

.....

.....

.....

XVIII References/Suggestions for further reading

1. Handbook of biomedical instrumentation by R.S. Khandpur (Third edition)
2. <https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering>

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		60 %
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		40%
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusion	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		100 %

Mark Obtained			Dated signature of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No. 6: Measurement of pulse rate, systolic, diastolic values and relative blood pressure using Plethysmograph

I Practical Significance

Measuring pulse rate, systolic and diastolic blood pressure values, and relative blood pressure using a Plethysmograph is essential for assessing cardiovascular health and understanding circulatory dynamics.

II Industry/Employer Expected Outcome(s)

Professionals should be able to accurately measure pulse rate and blood pressure parameters using plethysmography to assess cardiovascular function in clinical and research settings.

III Course Level Learning Outcome(s)

Use the blood pressure meter, pulse oximeter and temperature meter to measure vital parameters.

IV Laboratory Learning Outcome(s)

- LLO 6.1 Use the Plethysmograph to measure Pulse Rate.
- LLO 6.2 Use to measure systolic and diastolic values from blood pressure waveform.
- LLO 6.3 Use the Plethysmograph to measure relative blood pressure.

V Relevant Affective Domain related outcome(s)

Students will develop an appreciation for the importance of non-invasive methods like plethysmography in assessing cardiovascular health and understanding the physiological basis of pulse and blood pressure measurements.

VI Relevant Theoretical Background

It gives knowledge of the principles of plethysmography, the relationship between pulse rate, blood pressure and the physiological mechanisms underlying variations in blood pressure parameters.

VII Actual Circuit diagram used in laboratory with related equipment rating.



Fig. 6.1 Plethysmography machine

VIII Required Resources/apparatus/equipment with specifications

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Plethysmograph	Non-invasive, calibrated	1
2	Blood Pressure cuff	Standard size, compatible with Plethysmograph	1
3	Pulse sensor	Photoplethysmography (PPG) sensor	1

IX Precautions to be followed

1. Ensure proper placement and calibrated of the plethysmography components.
2. Ensure the participant is in a relaxed state during measurement to minimize artifacts.
3. Use appropriate cuff size and positioning for blood pressure measurements to ensure accuracy.
4. Follow manufacturer's instructions for operating the plethysmograph and associated equipment.

X Procedure

1. Prepare the plethysmograph system according to manufacturer's instructions.
2. Place the pulse sensor on the participant's fingertip or earlobe to measure pulse rate.
3. Inflate the blood pressure cuff to measure systolic and diastolic blood pressure values.
4. Record pulse rate, systolic and diastolic blood pressure values, and relative blood pressure measurements.
5. Repeat measurements at different time points or conditions as necessary.
6. Analyze the data and draw conclusions about cardiovascular function.

XI Resources used

Sr. No.	Name of Resource	Specifications	Quantity

XII Actual Procedure

.....

.....

.....

.....

XIII Observation Table**Table 6.1: Pulse rate and blood pressure measurement**

Sr. No	Time (min)	Pulse rate (bpm)	Systolic Blood Pressure (mmHg)	Diastolic Blood Pressure (mmHg)	Relative Blood Pressure (mmHg)
1					
2					
3					

XIV Result(s)
.....
.....**XV Interpretation of results**
.....
.....**XVI Conclusion and recommendation**
.....
.....**XVII Practical related questions**

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identifies CO.

1. Explain the principle of plethysmography.
2. How plethysmography is used to measure the pulse rate and blood pressure?
3. List the factors that can influence pulse rate and blood pressure measurement during exercise.
4. What are the physiological mechanisms underlying changes in blood pressure during exercise and recovery?
5. How does relative blood pressure differ from absolute blood pressure measurements?
6. Describe the biomedical applications of plethysmography.

[Space for Answers]

[illegible]

.....

.....

.....

.....

.....

.....

.....

XVIII References/Suggestions for further reading

1. Handbook of biomedical instrumentation by R.S. Khandpur (Third edition)
2. <https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering>

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		60 %
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		40%
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusion	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		100 %

Mark Obtained			Dated signature of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No.7: Measurement of body temperature precision and accuracy

I Practical Significance

The measurement of body temperature is essential in various fields such as healthcare, biomedical research, and industrial applications. The precision and accuracy of different methods used for measuring body temperature.

II Industry/Employer Expected Outcome(s)

Accurate measurement of body temperature is crucial in medical diagnosis, monitoring patient health, and ensuring safety in industrial environments where temperature control is critical.

III Course Level Learning Outcome(s)

Use the blood pressure meter, pulse oximeter and temperature meter to measure vital parameters.

IV Laboratory Learning Outcome(s)

- LLO 7.1 Use the digital body temperature meter to determine body temperature.

V Relevant Affective Domain related outcome(s)

Students will appreciate the importance of precision and accuracy in temperature measurement and understand the potential implications of inaccurate measurements in different contexts.

VI Relevant Theoretical Background

It includes principles of thermodynamics, the behavior of temperature sensors, and factors influencing the accuracy of temperature measurements.

VII Actual Circuit diagram used in laboratory with related equipment rating.



Fig. 7.1 Digital temperature meter



Fig. 7.2 An infrared thermometer

VIII Required Resources/apparatus/equipment with specifications

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Digital temperature meter	Digital, with accuracy $\pm 0.1^{\circ}\text{C}$	3
2	An infrared thermometer	Non-contact, with accuracy $\pm 0.2^{\circ}\text{C}$	1

IX Precautions to be followed

1. Ensure calibration of all temperature measurement devices.
2. Handle digital temperature meters carefully to avoid damage.
3. Maintain a stable testing environment to minimize external factors affecting temperature readings.
4. Follow safety protocols when using an infrared thermometer to avoid exposure to laser radiation.

X Procedure

1. Calibrate each digital temperature meter according to manufacturer instructions.
2. Create a controlled environment with stable temperature conditions.
3. Measure body temperature using each digital temperature meter on a sample subject.
4. Record temperature readings and note any discrepancies between devices.
5. Repeat measurements multiple times to assess precision.

XI Resources used

Sr. No.	Name of Resource	Specifications	Quantity

XII Actual Procedure

.....

.....

.....

.....

XIII Observation Table**Table 7.1: Comparison of Body Temperature Measurements**

Sr. No.	Thermometer Type	Temperature Reading (°C)	Observations
1	Digital		
2	An Infrared		

XIV Result(s)

.....

.....

XV Interpretation of results

.....

.....

XVI Conclusion and recommendation

.....

.....

XVII Practical related questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identifies CO.

1. List factors that can affect the accuracy of body temperature measurements.
2. Compare the advantages and disadvantages of digital thermometers versus infrared thermometers for measuring body temperature.
3. How can calibration improve the accuracy of temperature measurement devices?
4. State the significance of precision for temperature measurements in healthcare.
5. How do environmental conditions influence the accuracy of temperature readings?

[Space for Answers]

This image shows a full page of white paper with horizontal dotted lines, typical of primary-ruled notebook paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

.....

.....

.....

.....

.....

.....

.....

XVIII References/Suggestions for further reading

1. Handbook of biomedical instrumentation by R.S. Khandpur (Third edition)
2. <https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering>

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		60 %
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		40%
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusion	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		100 %

Mark Obtained			Dated signature of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No. 8: Precision in respiration rate measurement

I Practical Significance

Understanding the precision in measuring respiration rate is crucial for various applications in medical diagnostics, fitness monitoring, and research.

II Industry/Employer Expected Outcome(s)

Employers in the healthcare and fitness industries expect professionals to accurately measure and interpret respiration rates for patient monitoring and assessment.

III Course Level Learning Outcome(s)

Use the respiration rate meter to assess a person respiratory status.

IV Laboratory Learning Outcome(s)

- LLO 8.1 Use the respiration rate meter to measure respiration rate.

V Relevant Affective Domain related outcome(s)

Students will appreciate the importance of precision in medical measurements for accurate diagnosis and treatment.

VI Relevant Theoretical Background

Respiration rate is the number of breaths taken per minute. It can be measured using various techniques including chest sensors, airflow sensors, and impedance pneumography.

VII Actual Circuit diagram used in laboratory with related equipment rating.



Fig. 8.1 Respiration rate meter

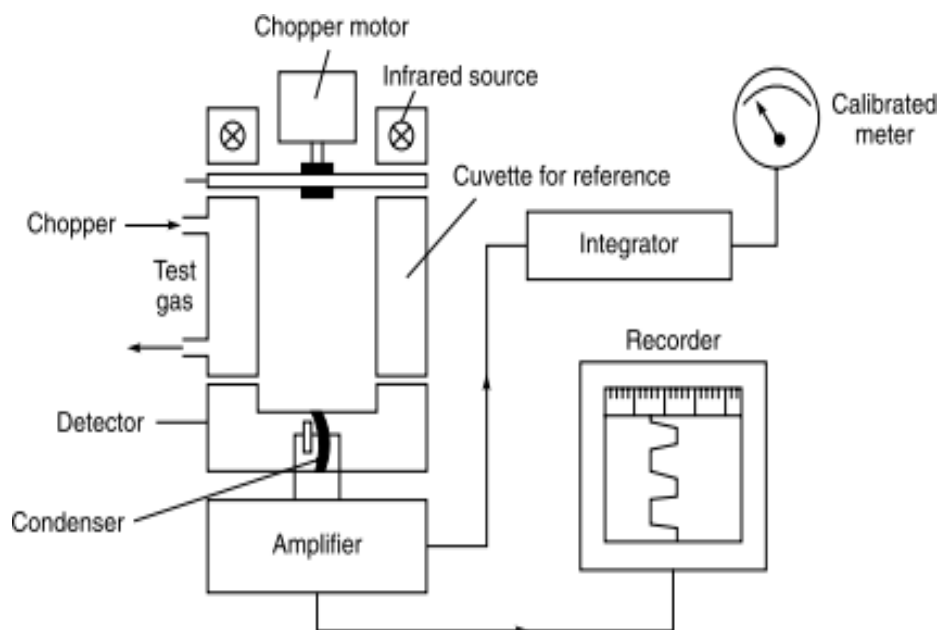


Fig. 8.2 Schematic diagram for detection of CO₂ in the expired air for continuous monitoring of respiration rate

(Copyright- Handbook of biomedical instrumentation by R.S. Khandpur (Third edition))

VIII Required Resources/apparatus/equipment with specifications

Sr. No.	Name of Resource	Suggested Broad Specifications	Quantity
1	Chest sensor	Battery 3V, modulation mode 5.3KHz, AM modulate, Battery life: more than a half year (depending on your usage)	1
2	Data acquisition system	-	1
3	Impedance pneumography unit	-	1
4	Respiration rate meter	-	1

IX Precautions to be followed

1. Ensure proper placement of sensors.
2. Calibrate equipment before use.
3. Avoid movement during measurements.
4. Follow manufacturer's instructions.

X Procedure

1. Connect the chest sensor to the data acquisition system.
2. Place the sensor on the subject's chest.
3. Start the data acquisition software and record baseline readings.

4. Instruct the subject to breathe normally.
5. Record respiration rate for a specified duration.
6. Repeat measurements for accuracy.

XI Resources used

Sr. No.	Name of Resource	Specifications	Quantity

XII Actual Procedure

.....

.....

.....

.....

XIII Observation Table**Table 8.1: Respiration Rate Measurement**

Trial	Time (min)	Respiration Rate (breaths/min)
1		
2		
3		

XIV Result(s)

.....

.....

XV Interpretation of results

.....

.....

XVI Conclusion and recommendation

.....

.....

XVII Practical related questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identifies CO.

1. List factors that affect the accuracy of respiration rate measurement.
2. How does respiration rate vary during exercise?
3. How can technology improve respiration rate monitoring?
4. Explain the importance of calibration in biomedical instruments.

[Space for Answers]

This image shows a full page of white paper with horizontal dotted lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting practice. There are no margins, text, or other markings on the page.

.....

.....

.....

.....

.....

.....

.....

XVIII References/Suggestions for further reading

1. Handbook of biomedical instrumentation by R.S. Khandpur (Third edition)
2. <https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering>

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		60 %
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		40%
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusion	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		100 %

Mark Obtained			Dated signature of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No. 9: Determination of fetal heart rate using ultrasonic fetal heart rate meter

I Practical Significance

The determination of fetal heart rate is crucial in prenatal care as it provides valuable information about the health and development of the fetus.

II Industry/Employer Expected Outcome(s)

The ability to accurately determine fetal heart rate using ultrasonic fetal heart rate meters is essential for professionals in obstetrics and gynecology.

III Course Level Learning Outcome(s)

Use the respiration rate meter to assess a person respiratory status.

IV Laboratory Learning Outcome(s)

- LLO 9.1 Determine fetal heart rate using fetal heart rate meter.

V Relevant Affective Domain related outcome(s)

Students will develop empathy and sensitivity towards prenatal care and the health of expectant mothers and their babies.

VI Relevant Theoretical Background

Ultrasonic fetal heart rate meters work on the principle of Doppler Effect, where the frequency of sound waves changes when reflected by a moving object, in this case, the fetal heart.

VII Actual Circuit diagram used in laboratory with related equipment rating.



Fig. 9.1 Fetal Heart Rate Meter

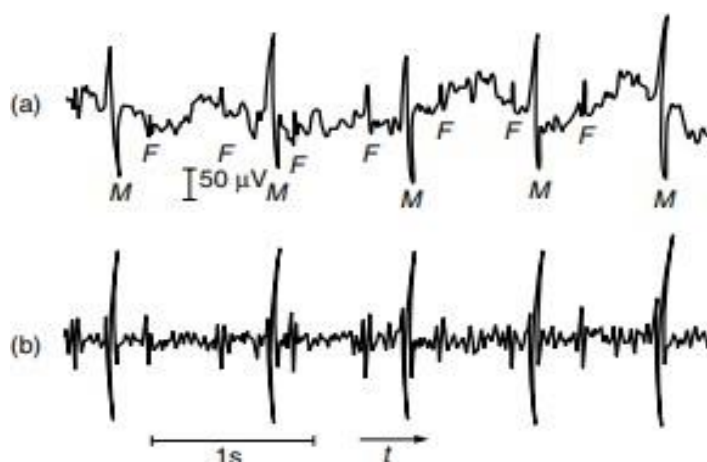


Fig. 9.2 Abdominal recording of fetal electro-cardiogram

Bandwidth (a) 0.2 – 200 Hz (b) 15-40 Hz



Fig. 9.3 Fetal phonocardiogram: (a) unfiltered heart sound, (b) filtered heart sounds
(Copyright--Handbook of biomedical instrumentation by R.S. Khandpur (Third edition))

VIII Required Resources/apparatus/equipment with specifications

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Ultrasonic Fetal Heart Rate Meter	Frequency Range: 2-4 MHz	1
2	Respiration Rate Meter	Suitable for Human Respiration Measurement	1
3	Ultrasound Gel	Standard Medical Grade	As per required

IX Precautions to be followed

1. Ensure proper calibration of the ultrasonic fetal heart rate meter.
2. Use ultrasound gel to ensure good contact between the transducer and the skin.
3. Handle the equipment with care to avoid damage.
4. Maintain a quiet and calm environment during measurements.

X Procedure

1. Apply ultrasound gel on the abdomen of the pregnant woman.
2. Place the ultrasonic fetal heart rate meter probe on the gel-covered area.
3. Adjust the settings of the meter to optimize signal quality.
4. Record the fetal heart rate displayed on the meter.
5. Repeat the measurement multiple times to ensure accuracy.

XI Resources used

Sr. No.	Name of Resource	Specifications	Quantity

XII Actual Procedure

.....

.....

.....

.....

XIII Observation Table**Table 9.1: Fetal Heart Rate Measurements**

Observation	Fetal Heart Rate (bpm)
1	
2	
3	

XIV Result(s)

.....

.....

XV Interpretation of results

.....

.....

XVI Conclusion and recommendation

XVII Practical related questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identifies CO.

1. State the most accurate method to determine the fetal heart rate.
2. List two methods of fetal heart rate monitoring.
3. What ultrasound is used for baby heartbeat?
4. When does the fetal heart rate start?
5. What is the full form of FHR?

[Space for Answers]

[illegible]

.....

.....

.....

.....

.....

.....

.....

XVIII References/Suggestions for further reading

1. Handbook of biomedical instrumentation by R.S. Khandpur (Third edition)
2. <https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering>

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		60 %
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		40%
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusion	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		100 %

Mark Obtained			Dated signature of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No. 10: Using spirometer machine for recording of spirogram

I Practical Significance

The spirometer is a vital tool in assessing pulmonary function and diagnosing respiratory disorders. Understanding its operation and interpreting spirometric data are essential skills for medical professionals.

II Industry/Employer Expected Outcome(s)

Spirometer machine is used in healthcare settings, particularly in respiratory clinics, hospitals and pulmonary function laboratories.

III Course Level Learning Outcome(s)

Use the respiration rate meter to assess a person respiratory status.

IV Laboratory Learning Outcome(s)

- LLO 10.1 Use the spirometer machine to record spirogram.
- LLO 10.2 Use the spirogram to analyse two to three vital parameters.

V Relevant Affective Domain related outcome(s)

Students will cultivate empathy towards patients with respiratory conditions and appreciate the importance of accurate spirometry in diagnosis and management.

VI Relevant Theoretical Background

Spirometry measures lung volumes and capacities by analyzing the flow and volume of air breathed in and out. It provides valuable information about lung function and aids in diagnosing respiratory diseases.

VII Actual Circuit diagram used in laboratory with related equipment rating.

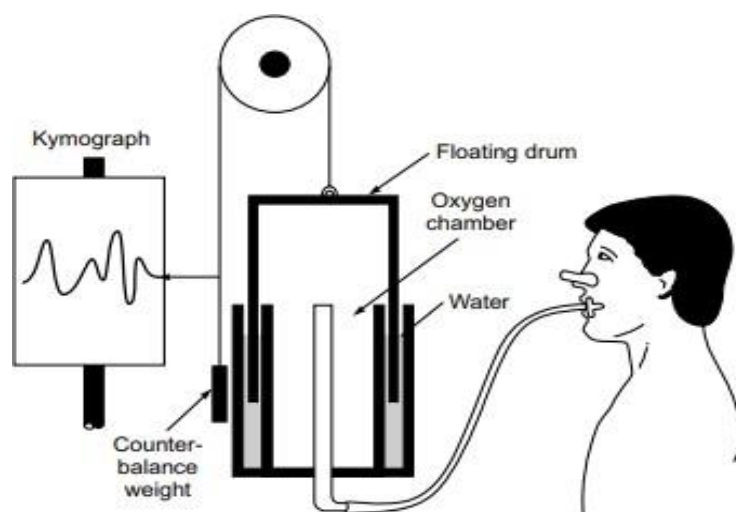


Fig. 10.1 Basic water sealed spirometer
(Handbook of biomedical instrumentation by R.S. Khandpur (Third edition))

VIII Required Resources/apparatus/equipment with specifications

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Spirometer Machine	Digital Spirometer with Calibration Kit	1
2	Nose Clip	Standard Medical Grade	As per required
3	Mouthpiece	Disposable, Sterile	As per required

IX Precautions to be followed

1. Ensure proper calibration of the spirometer before each use.
2. Instruct patients to wear a nose clip to prevent air leakage during testing.
3. Use disposable mouthpieces to maintain hygiene and prevent cross-contamination.
4. Follow manufacturer's guidelines for cleaning and maintenance of the spirometer.

X Procedure

1. Instruct the patient to sit comfortably and relax.
2. Attach the nose clip to the patient's nose to ensure airflow only through the mouth.
3. Instruct the patient to take a deep breath in and then exhale forcefully and completely into the mouthpiece of the spirometer.
4. Record the spirometric tracing displayed on the machine.
5. Repeat the test at least three times to ensure consistency and accuracy.
6. Calculate relevant parameters such as forced vital capacity (FVC), forced expiratory volume in one second (FEV1) and peak expiratory flow rate (PEFR) from the spirometric data.

XI Resources used

Sr. No.	Name of Resource	Specifications	Quantity

XII Actual Procedure

.....

.....

.....

.....

XIII Observation Table**Table 10.1: Spirometry Measurements**

Observations	FVC (L)	FEV1 (L)	PEFR (L/min)
1			
2			
3			

XIV Result(s)

.....

.....

XV Interpretation of results

.....

.....

XVI Conclusion and recommendation

.....

.....

XVII Practical related questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identifies CO.

1. State the purpose of spirogram.
2. List factors that can affect spirometer.
3. Which capacity is measured by spirometer?
4. What is the normal value of spirogram?
5. What are the benefits of a spirometer?
6. What is the unit of spirometer?

[Space for Answers]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

XVIII References/Suggestions for further reading

1. Handbook of biomedical instrumentation by R.S. Khandpur (Third edition)
2. <https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering>

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		60 %
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		40%
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusion	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		100 %

Mark Obtained			Dated signature of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No. 11: Using 12 lead configuration in ECG for recording electrocardiograph

I Practical Significance

Electrocardiogram (ECG) using a 12 lead configuration allows for a comprehensive assessment of cardiac activity, aiding in the diagnosis and monitoring of various cardiac conditions.

II Industry/Employer Expected Outcome(s)

Accurate interpretation of ECG in a clinical setting, contributing to effective patient care and treatment planning.

III Course Level Learning Outcome(s)

Troubleshoot ECG machine for simple faults.

IV Laboratory Learning Outcome(s)

- LLO 11.1 Use ECG machine to 12 lead configuration on human being and identify PQRS points on electrocardiogram.

V Relevant Affective Domain related outcome(s)

Enhanced appreciation for the importance of accurate cardiac monitoring in patient care.

VI Relevant Theoretical Background

Understanding of the electrical activity of the heart and the significance of various ECG leads in capturing cardiac signals.

VII Actual Circuit diagram used in laboratory with related equipment rating.



Fig. 11.1 ECG machine

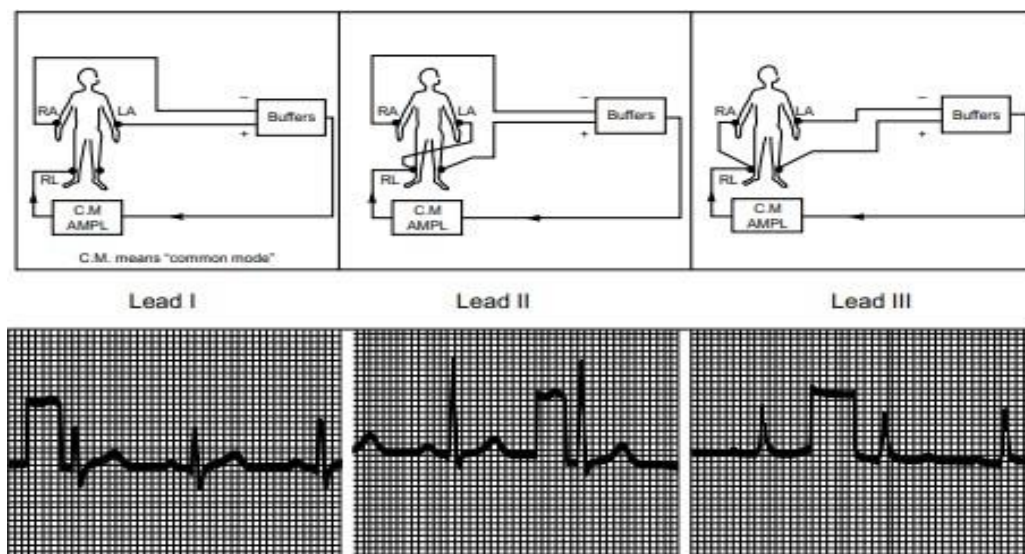


Fig. 11.2 Bipolar Limb Leads

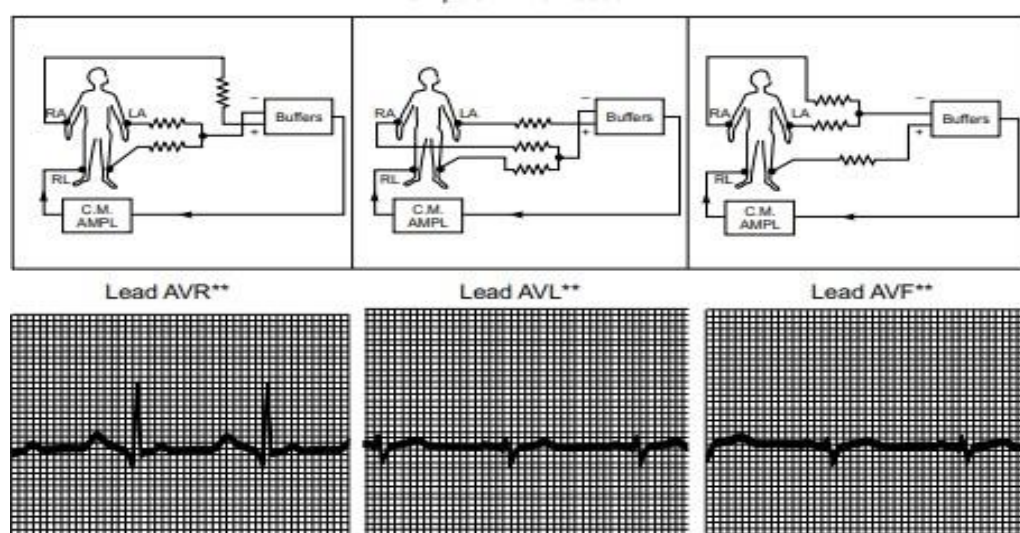


Fig. 11.3 Unipolar Limb Leads

(Copyright -Handbook of biomedical instrumentation by R.S. Khandpur (Third edition))

VIII Required Resources/apparatus/equipment with specifications

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	ECG machine	12 Lead configuration	1
2	Electrodes and leads	AVR, AVL, AVF	As per required
3	Patient cables	-	As per required
4	Recording paper	-	As per required
5	Skin preparation supplies	-	As per required

IX Precautions to be followed

1. Ensure proper placement of electrodes to obtain accurate readings.
2. Avoid electrical interference by keeping the environment free from electrical devices.
3. Monitor patient comfort and safety throughout the procedure.
4. Adhere to infection control protocols.

X Procedure

1. Prepare the patient by exposing the chest area and cleaning the skin where electrodes will be placed.
2. Attach electrodes according to the 12 lead configurations, ensuring proper placement.
3. Connect patient cables to the ECG machine and verify proper connections.
4. Start recording and monitor the ECG signals for quality and consistency.
5. Once recording is complete, analyze the ECG for PQRS points and abnormalities.

XI Resources used

Sr. No.	Name of Resource	Specifications	Quantity

XII Actual Procedure

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

XIII Observation Table

Table 11.1: ECG leads and responsible arteries

Parameters (mv)	I	II	III	aVR	aVL	aVF	V1	Max	In LEAD
R amp (μv)									
R amp (μv)									
P amp (μv)									
P amp (μv)									
T amp (μv)									
T' amp (μv)									
Q amp (μv)									
S amp (μv)									
ST Elevation (mm)									
ST Depression (mm)									
ST Slope (mv/ sec)									
QR Time (m/ sec)									

XIV Result(s)

.....

.....

XV Interpretation of results

.....

.....

XVI Conclusion and recommendation

.....

.....

XVII Practical related questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identifies CO.

1. State the main purpose of 12 lead ECG.
2. How many electrodes are used in 12 lead ECG?
3. What is the normal ECG value?
4. What are V1, V2 and V3 in ECG?
5. What are aVR, aVL and aVF in ECG?

[Space for Answers]

This image shows a full page of white paper with horizontal dotted lines. The lines are evenly spaced and run across the width of the page, providing a guide for handwriting practice. There are no margins, text, or other markings on the page.

.....

.....

.....

.....

.....

.....

XVIII References/Suggestions for further reading

1. Handbook of biomedical instrumentation by R.S. Khandpur (Third edition)
2. <https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering>

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		60 %
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		40%
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusion	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		100 %

Mark Obtained			Dated signature of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No. 12: Determination of R-R interval and heart rate from ECG

I Practical Significance

This experiment aims to demonstrate the process of determining R-R intervals and heart rates from ECG signals. Understanding these measurements is essential for assessing cardiac health and diagnosing potential abnormalities.

II Industry/Employer Expected Outcome(s)

Accurate interpretation of determination of R-R interval and heart rates in a clinical setting, contributing to effective patient care and treatment planning.

III Course Level Learning Outcome(s)

Troubleshoot ECG machine for simple faults.

IV Laboratory Learning Outcome(s)

- LLO 12.1 Measure R-R interval from ECG.
- LLO 12.2 Calculate the heart rate of given human being from ECG.

V Relevant Affective Domain related outcome(s)

Enhanced appreciation for the importance of accurate cardiac monitoring in patient care.

VI Relevant Theoretical Background

The R-R interval, representing the time between successive R waves on an ECG, signifies one complete cardiac cycle, crucial for understanding cardiac rhythm. Heart rate, derived from the reciprocal of the R-R interval, indicates the number of heart beats per minute, serving as a key metric in assessing cardiovascular health. Accurate determination of these parameters aids in diagnosing cardiac conditions and monitoring patients' cardiac function effectively.

VII Actual Circuit diagram used in laboratory with related equipment rating.

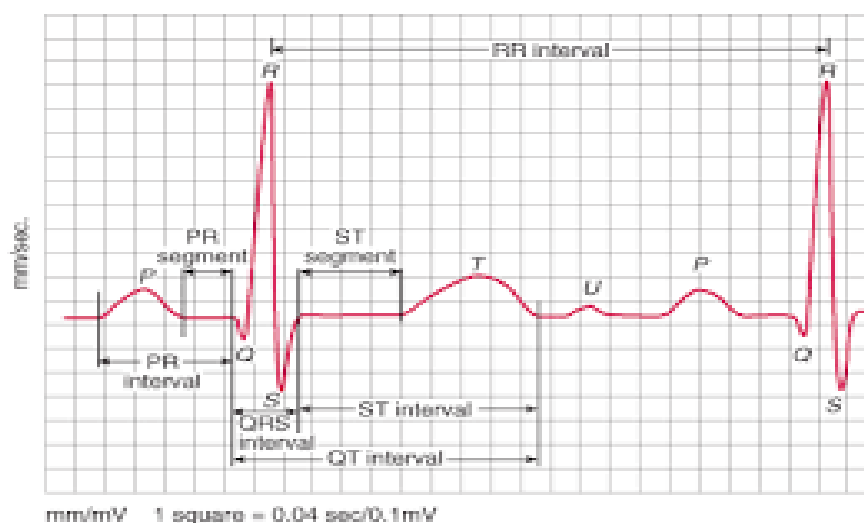


Fig. 12.1 R-R interval in ECG

VIII Required Resources/apparatus/equipment with specifications

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	ECG Machine	12 leads, 0.05-100 Hz bandwidth	1
2	Electrodes	3v power supply voltage, 25g weight, 219h max battery life	6
3	Computer with ECG Analysis Software	99.99 QRS analysis accuracy.	1

IX Precautions to be followed

1. Ensure proper electrode placement according to standard protocol.
2. Calibrate the ECG machine before each use.
3. Handle ECG data carefully to avoid artifacts.
4. Follow safety protocols when working with electrical equipment.

X Procedure

1. Attach electrodes to the patient's chest as per standard ECG placement.
2. Turn on the ECG machine and start recording.
3. Record ECG data for a minimum of 5 minutes.
4. Transfer recorded data to the computer for analysis using the provided software.
5. Use the software to measure R-R intervals and calculate heart rate.
6. Record the results.

XI Resources used

Sr. No.	Name of Resource	Specifications	Quantity

XII Actual Procedure

.....

.....

.....

.....

XIII Observation Table**Table 12.1: ECG data analysis:**

Sr. No	Time (s)	ECG signal (mv)	R-R interval (ms)
1			
2			
3			

XIV Result(s)

.....

.....

XV Interpretation of results

.....

.....

XVI Conclusion and recommendation

.....

.....

XVII Practical related questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identifies CO.

1. State the significance of measuring R-R intervals in ECG analysis.
2. How does heart rate variability affect overall health?
3. Explain the importance of proper electrode placement in obtaining accurate ECG data.
4. What are some common artifacts that can affect ECG recordings?
5. Describe the relationship between R-R intervals and heart rate.

[Space for Answers]

.....

.....

.....

.....

[illegible]

.....

.....

.....

.....

.....

.....

.....

XVIII References/Suggestions for further reading

1. Handbook of biomedical instrumentation by R.S. Khandpur (Third edition)
2. <https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering>

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		60 %
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		40%
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusion	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		100 %

Mark Obtained			Dated signature of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No. 13: Determination of exercise induced changes in heart rate and R-R interval

I Practical Significance

This practical is designed to understand how exercise affects heart rate and the R-R interval (the time interval between two successive R-waves of the QRS signal on an electrocardiogram). These measurements are crucial for assessing cardiovascular fitness and autonomic function.

II Industry/Employer Expected Outcome(s)

- Accurately measure and interpret heart rate and R-R intervals.
- Understand the physiological impacts of exercise on the cardiovascular system.
- Utilize this data to assess and improve patient fitness and health outcomes.

III Course Level Learning Outcome(s)

Troubleshoot ECG machine for simple faults

IV Laboratory Learning Outcome(s)

- LLO 13.1 Use ECG machine to observe and measure changes in heart rate during and after exercise.
- LLO 13.2 Use ECG machine to observe and measure changes in R-R intervals during and after exercise.

V Relevant Affective Domain related outcome(s)

- Develop meticulous attention to detail in physiological measurements.
- Cultivate a professional attitude towards patient care and data handling.
- Show empathy and effective communication when working with subjects.
- Follow safety electrical rules for safe practices.

VI Relevant Theoretical Background

The heart rate and R-R interval are key indicators of autonomic nervous system activity. Exercise typically increases heart rate and decreases the R-R interval due to heightened sympathetic activity and reduced parasympathetic tone. Understanding these changes is essential for assessing cardiovascular health and fitness levels.

VII Actual Circuit diagram used in laboratory with related equipment rating.



Fig. 13.1 ECG machine

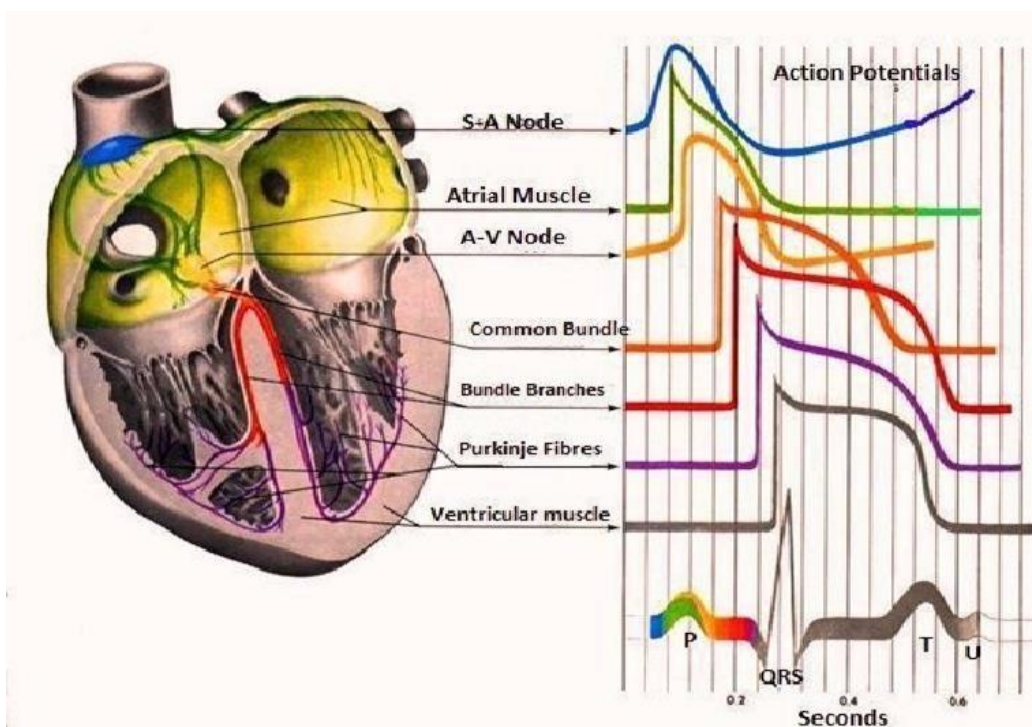


Fig.13.2 Leads Position

(Copyright <https://bmi-iitr.vlabs.ac.in/exp/various-leads-ecg/>)

VIII Required Resources/apparatus/equipment with specifications

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	ECG Machine	12-lead, digital display, printer	1
2	Treadmill/Exercise Bike	Adjustable speed/resistance	1
3	Stopwatch	Digital, precision timing	1
4	Electrodes	Disposable, high-quality adhesion	Multiple

IX Precautions to be followed

1. Ensure the ECG machine is properly calibrated.
2. Verify electrode placement is correct to obtain accurate readings.
3. Make sure the subject is in good health before performing the exercise.
4. Continuously monitor the subject for any signs of distress during exercise.

X Procedure

1. Pre-Exercise Setup:
 - Attach ECG electrodes to the subject following standard placement guidelines.
 - Record baseline heart rate and R-R interval.
2. Exercise Protocol:
 - Have the subject perform moderate exercise (e.g., on a treadmill or exercise bike) for a set duration (e.g., 5-10 minutes).
 - Continuously monitor heart rate during exercise.
3. Post-Exercise Measurements:
 - Immediately after exercise, record heart rate and R-R interval.
 - Continue to record these parameters at 1-minute intervals for 5 minutes post-exercise.
4. Data Recording:
 - Document all measurements accurately in a table for analysis.
5. Analysis:
 - Compare pre- and post-exercise data to determine changes in heart rate and R-R interval.
6. Interpret the physiological significance of these changes.

XI Resources used

Sr. No.	Name of Resource	Specifications	Quantity

XII Actual Procedure

.....

.....

.....

.....

XIII Observation Table**Table 13.1: Exercise-Induced Changes in Heart Rate and R-R Interval**

Sr. No.	Time (minutes)	Heart Rate (bpm)	R-R Interval (ms)
1	Baseline		
2	Immediate Post		
3	1 min Post		
4	2 min Post		

XIV Result(s)

.....

.....

XV Interpretation of results

.....

.....

XVI Conclusion and recommendation

.....

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identifies CO.

- [Space for Answers]**

[illegible]

.....

.....

.....

.....

.....

.....

.....

.....

XVIII References/Suggestions for further reading

1. <https://bmi-iitr.vlabs.ac.in/exp/various-leads-ecg/>
2. <https://bmisp-coep.vlabs.ac.in/exp/pulse-missing-detector/index.html>

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		60 %
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		40%
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusion	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		100 %

Mark Obtained			Dated signature of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No. 14: Symphony analysis of phonocardiogram to record different heart sounds

I Practical Significance

Understanding the phonocardiogram allows for the analysis of various heart sounds, aiding in the diagnosis and monitoring of cardiac health.

II Industry/Employer Expected Outcome(s)

Improved understanding of heart sound analysis techniques for medical professionals in the healthcare industry.

III Course Level Learning Outcome(s)

Troubleshoot ECG machine for simple faults.

IV Laboratory Learning Outcome(s)

- LLO 14.1 Record different heart sounds using phonocardiogram.

V Relevant Affective Domain related outcome(s)

Increased appreciation for the complexity of cardiac physiology and the importance of accurate diagnostics.

VI Relevant Theoretical Background

The phonocardiogram captures the acoustic vibrations generated by the heart during the cardiac cycle, including the sounds of valves opening and closing.

VII Actual Circuit diagram used in laboratory with related equipment rating.



Fig. 14.1 Phonocardiography machine

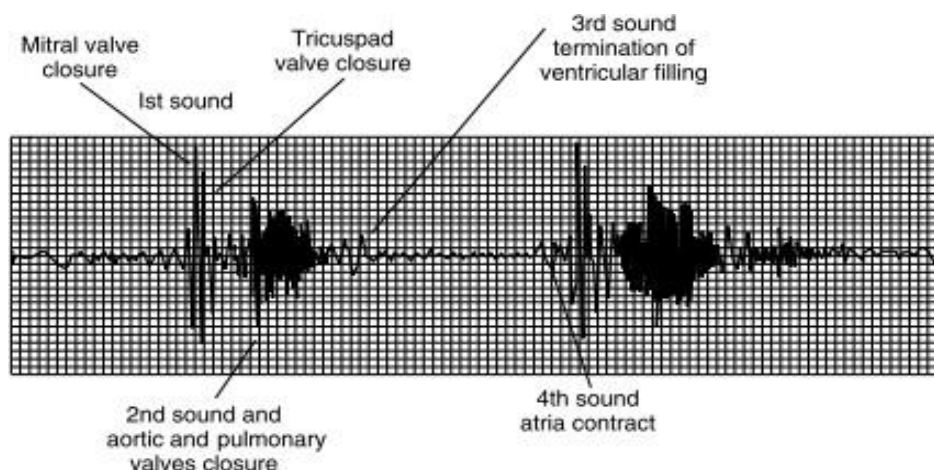


Fig. 14.2 Basic heart sounds in a typical phonocardiogram recording

VIII Required Resources/apparatus/equipment with specifications

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Phonocardiogram Device	-	1
2	Amplifier	10W, 20Hz - 20kHz	1
3	Microphone	Condenser type, frequency response 20Hz - 20kHz	1

IX Precautions to be followed

1. Ensure proper calibration of equipment before recording.
2. Minimize ambient noise in the laboratory.
3. Handle the phonocardiogram device and microphone with care to avoid damage.
4. Maintain a sterile environment to prevent contamination of equipment.

X Procedure

1. Set up the phonocardiogram device according to manufacturer instructions.
2. Connect the microphone to the amplifier.
3. Place the microphone in the appropriate position to capture heart sounds.
4. Record the phonocardiogram while the subject remains still and breathes normally.
5. Save the recorded data for analysis.

XI Resources used

Sr. No.	Name of Resource	Specifications	Quantity

XII Actual Procedure
.....
.....
.....
.....**XIII Observation Table****Table 14.1: Phonocardiogram Analysis**

Sr. No.	Heart Sound	Description	Observation
1	S1		
2	S2		
3	S3		
4	S4		

XIV Result(s)
.....
.....**XV Interpretation of results**
.....
.....**XVI Conclusion and recommendation**
.....
.....**XVII Practical related questions**

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identifies CO.

1. List primary components of a phonocardiogram machine.
2. State the clinical significance of an S3 heart sound.
3. Explain the importance of proper microphone placement in recording phonocardiograms.
4. How can phonocardiogram analysis aid in the diagnosis of cardiac conditions?

[Space for Answers]

[illegible]

.....

.....

.....

.....

.....

.....

XVIII References/Suggestions for further reading

1. Handbook of biomedical instrumentation by R.S. Khandpur (Third edition)
2. <https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering>

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		60 %
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		40%
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusion	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		100 %

Mark Obtained			Dated signature of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No.15: Comparative analysis of heart sounds: phonocardiography vs. traditional stethoscope

I Practical Significance

Understanding the effectiveness of phonocardiography compared to traditional stethoscope in detecting heart sounds is crucial for accurate cardiovascular diagnosis.

II Industry/Employer Expected Outcome(s)

- Improved diagnostic accuracy in medical settings.
- Enhanced patient care through more precise cardiac evaluations.

III Course Level Learning Outcome(s)

Troubleshoot ECG machine for simple faults.

IV Laboratory Learning Outcome(s)

- LLO 15.1 Compare the accuracy and diagnostic capabilities of phonocardiography with a traditional stethoscope in identifying and analyzing various heart sounds.

V Relevant Affective Domain related outcome(s)

- Increased awareness of the importance of thorough cardiac assessments.
- Development of empathy towards patients undergoing diagnostic procedures.

VI Relevant Theoretical Background

Phonocardiography involves the graphic recording of heart sounds, providing a visual representation that can be analyzed for anomalies. Traditional stethoscopes allow auditory examination of heart sounds. Understanding the physiology of heart sounds and the acoustic properties of these devices is essential for accurate diagnosis.

VII Actual Circuit diagram used in laboratory with related equipment rating.



Fig. 15.1 Phonocardiography machine



Fig. 15.2 Stethoscope

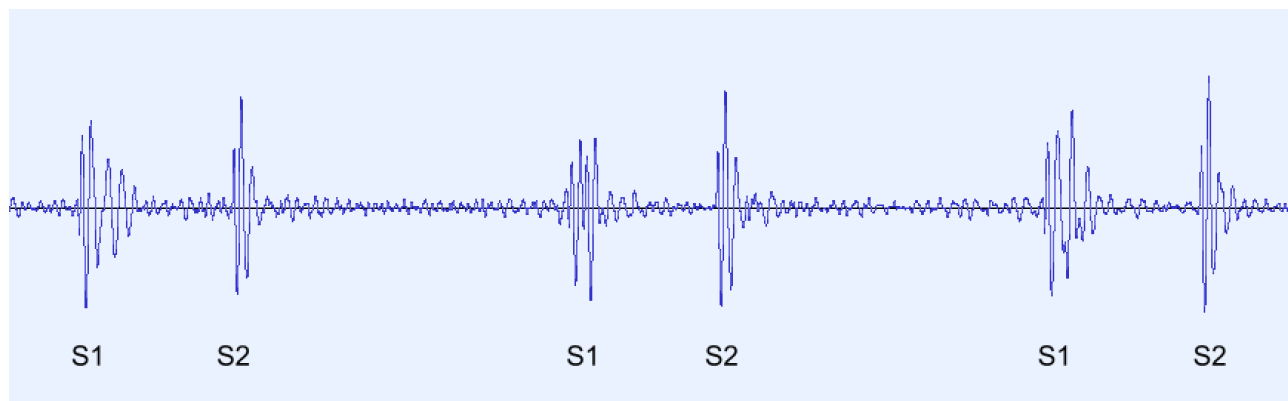


Fig. 15.3 heart sounds from phonocardiography



Fig. 15.4 heart sounds from stethoscope

VIII Required Resources/apparatus/equipment with specifications

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Phonocardiography machine	Digital, high-fidelity	1
2	Traditional Stethoscope	Acoustic, dual-head	1
3	Computer	Compatible with phonocardiograph software	1
4	Recording Device	High-quality audio recorder	1

IX Precautions to be followed

1. Ensure all equipment is sterilized before use.
2. Handle all devices carefully to avoid damage.
3. Follow proper procedures for connecting and operating electronic devices.
4. Respect patient privacy and confidentiality.

X Procedure

1. Prepare the patient and explain the procedure.
2. Use the traditional stethoscope to listen to and record heart sounds.
3. Use the phonocardiography to record heart sounds digitally.
4. Compare and analyze the recordings from both devices.
5. Document the findings and interpretations.

XI Resources used

Sr. No.	Name of Resource	Specifications	Quantity

XII Actual Procedure

.....

.....

.....

.....

.....

.....

XIII Observation Table**Table 15.1: Comparative Analysis of Heart Sounds**

Sr. No.	Heart Sound	Phonocardiography Detection	Stethoscope Detection
1	S1		
2	S2		
3	S3		

XIV Result(s)

.....

.....

XV Interpretation of results

.....

.....

XVI Conclusion and recommendation

.....

.....

XVII Practical related questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identifies CO.

1. How does phonocardiography improve the accuracy of diagnosing heart murmurs compared to a traditional stethoscope?
2. How does the use of a traditional stethoscope remain relevant in modern medical practice despite advances in phonocardiography?
3. Can phonocardiography be used in conjunction with a traditional stethoscope for a comprehensive cardiac assessment?

[Space for Answers]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

XVIII References/Suggestions for further reading

1. Handbook of biomedical instrumentation by R.S. Khandpur (Third edition)
2. <https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering>

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		60 %
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		40%
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusion	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		100 %

Mark Obtained			Dated signature of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No. 16: Characterization of ECG preamplifier CMRR and gain

I Practical Significance

Understanding the characterization of an ECG preamplifier's Common-Mode Rejection Ratio (CMRR) and gain is crucial for ensuring accurate and reliable biomedical signal acquisition, which is vital in medical diagnostics and patient monitoring.

II Industry/Employer Expected Outcome(s)

- Graduates should be able to design and evaluate biomedical instrumentation.
- Proficiency in testing and analyzing the performance of ECG preamplifiers.
- Ability to ensure compliance with medical standards and improve the reliability of ECG readings

III Course Level Learning Outcome(s)

Troubleshoot ECG machine for simple faults.

IV Laboratory Learning Outcome(s)

- LLO 16.1 Measure of CMRR and gain of ECG preamplifier.

V Relevant Affective Domain related outcome(s)

- Demonstrate meticulous attention to detail in laboratory settings.
- Exhibit teamwork and collaborative problem-solving skills.
- Show responsibility in handling and maintaining laboratory equipment

VI Relevant Theoretical Background

The ECG preamplifier is crucial in electrocardiography systems for amplifying the heart's electrical signals. It is characterized by two main parameters: Common Mode Rejection Ratio (CMRR) and gain. CMRR measures the ability to reject unwanted common signals like noise, with higher values (typically 80 dB to 120 dB) indicating better interference rejection. Gain amplifies the input signal to a suitable level (usually 1000 to 5000 times) for accurate interpretation, balancing sensitivity with noise management for reliable ECG recordings.

VII Actual Circuit diagram used in laboratory with related equipment rating.

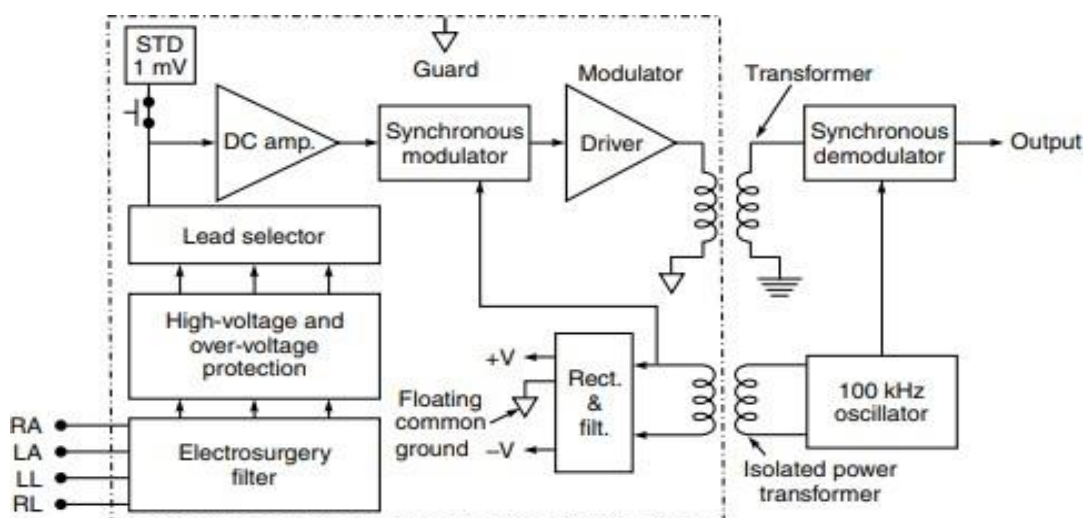


Fig. 16.1 Block diagram of an isolation preamplifier (transformed-coupled) commonly used in modern ECG machines

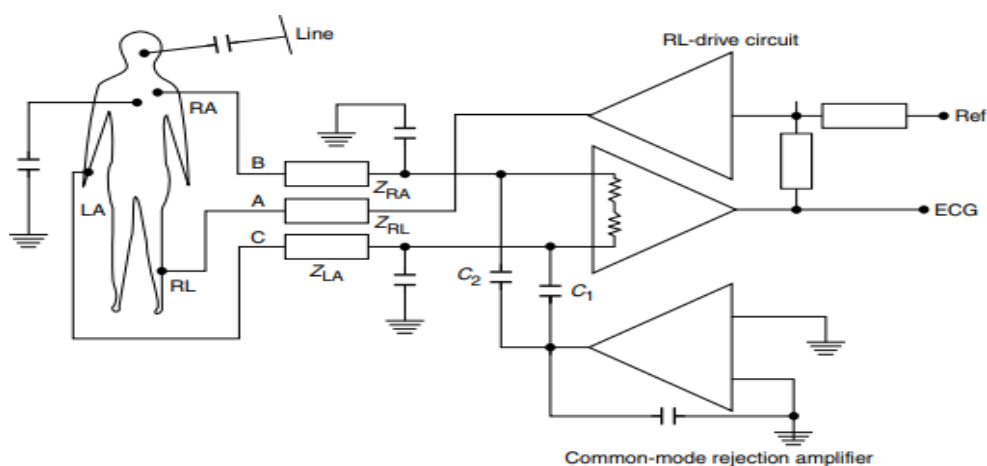


Fig. 16.2 Improvement in CMRR using right-leg drive (Courtesy: Hewlett Packard, U.S.A)

VIII Required Resources/apparatus/equipment with specifications

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	ECG Preamplifier Circuit	-	1
2	Signal Generator	-	1
3	Oscilloscope	-	1
4	Multi meter	-	1
5	Power Supply	-	1
6	Connecting Wires and Probes	-	As per needed

IX Precautions to be followed

1. Ensure all connections are secure before powering the circuit.
2. Avoid short circuits by double-checking the wiring.
3. Use appropriate grounding techniques to prevent noise interference.
4. Handle all equipment according to manufacturer guidelines to avoid damage.

X Procedure

1. Set up the ECG preamplifier circuit on a breadboard or PCB.
2. Connect the signal generator to the input of the preamplifier.
3. Connect the output of the preamplifier to the oscilloscope.
4. Measure and record the gain of the preamplifier using known input signals.
5. Calculate the CMRR by applying common-mode signals and measuring the output.

XI Resources used

Sr. No.	Name of Resource	Specifications	Quantity

XII Actual Procedure

.....

.....

.....

.....

XIII Observation Table**Table 16.1: Measurement data:**

Sr. No.	Input Voltage (V)	Output Voltage (V)	Gain (dB)	CMRR (dB)

XIV Result(s)

.....

.....

XV Interpretation of results

.....

.....

XVI Conclusion and recommendation

.....

.....

XVII Practical related questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identifies CO.

1. Explain the importance of Common-Mode Rejection Ratio (CMRR) in an ECG preamplifier. How does a high CMRR benefit the quality of ECG signals?
2. Describe the procedure for measuring the gain of an ECG preamplifier. What equipment is required, and what steps should be followed to ensure accurate measurements?
3. Identify common sources of noise in ECG signal acquisition. How does the ECG preamplifier's CMRR help mitigate these noise sources?

[Space for Answers]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

This image shows a full page of white paper with horizontal dotted lines, typical of primary school handwriting practice paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

.....

.....

.....

.....

.....

.....

.....

.....

XVIII References/Suggestions for further reading

1. <https://bmi-iitr.vlabs.ac.in/exp/chest-leads/theory.html>
2. <https://bmshp-coep.vlabs.ac.in/exp/electrocardiogram-waveform/theory.html>

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		60 %
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		40%
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusion	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		100 %

Mark Obtained			Dated signature of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No. 17: Operation of ECG machine

I Practical Significance

Understanding the operation of an ECG machine is essential for accurately acquiring and interpreting electrocardiographic data, which is crucial in diagnosing and monitoring cardiac health.

II Industry/Employer Expected Outcome(s)

- Proficiency in operating ECG machines.
- Ability to accurately record and interpret ECG signals.
- Knowledge of troubleshooting and maintaining ECG equipment.

III Course Level Learning Outcome(s)

Troubleshoot ECG machine for simple faults.

IV Laboratory Learning Outcome(s)

- LLO 17.1 Operation of ECG machine
- LLO 17.2 Sketch the waveform of pattern observed on ECG machine.

V Relevant Affective Domain related outcome(s)

- Demonstrate responsibility in handling and maintaining sensitive medical equipment.
- Show attention to detail in acquiring accurate ECG readings.
- Exhibit effective teamwork and communication during practical exercises.

VI Relevant Theoretical Background

The ECG machine operation involves preparing the patient, placing electrodes on specific body areas, and initializing the machine settings. The machine records the heart's electrical activity, displaying it graphically on a screen or printing it on paper. A healthcare professional interprets the waveform to assess the heart's rhythm and detect abnormalities. Results are documented in the patient's medical records, guiding further diagnostic tests or treatments if necessary. Accuracy and attention to detail are critical throughout the process to ensure reliable results and patient care.

VII Actual Circuit diagram used in laboratory with related equipment rating.



Fig. 17.1 ECG machine

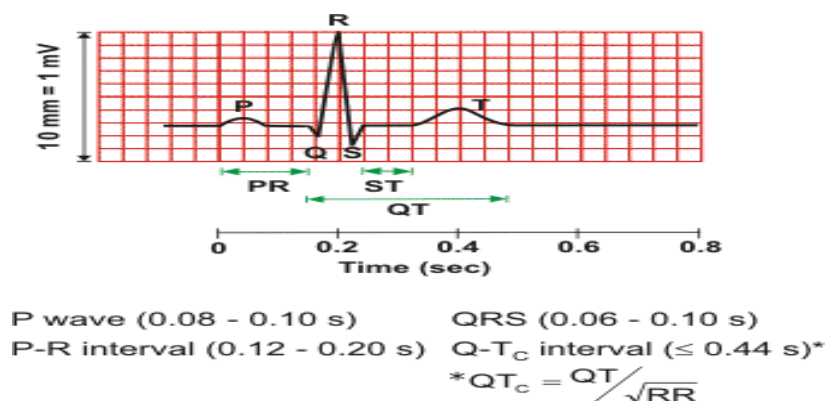


Fig. 17.2 Normal PQRST wave of ECG machines

(Copyright-<https://bmsp-coep.vlabs.ac.in/exp/electrocardiogram-waveform/theory.html>)

VIII Required Resources/apparatus/equipment with specifications

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	ECG Machine	-	1
2	ECG Electrodes	-	As per needed
3	Conductive Gel	-	As per needed
4	Patient Simulator	-	1

IX Precautions to be followed

1. Ensure all electrodes are securely attached to the patient.
2. Avoid placing electrodes over bones or large muscles.
3. Use conductive gel to improve signal quality.
4. Handle the ECG machine and electrodes with care to avoid damage.

X Procedure

1. Set up the ECG machine and ensure it is functioning properly.
2. Prepare the patient by cleaning the electrode sites and applying conductive gel.
3. Attach the electrodes to the appropriate positions on the patient's body.
4. Connect the electrodes to the ECG machine.
5. Start the ECG recording and ensure the signal quality is adequate.
6. Save and print the ECG readings for analysis.

XI Resources used

Sr. No.	Name of Resource	Specifications	Quantity

XII Actual Procedure

.....

.....

.....

.....

XIII Observation Table**Table 17.1: ECG Machine Lead Configuration**

Sr. No.	Lead Configuration	Signal Quality	Heart Rate	Abnormalities

XIV Result(s)

.....

.....

XV Interpretation of results

.....

.....

XVI Conclusion and recommendation

.....

.....

XVII Practical related questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identifies CO.

1. Explain the importance of correct electrode placement in obtaining an accurate ECG reading.
2. Describe the procedure for preparing a patient for an ECG test.
3. Identify common artifacts that can appear on an ECG reading and explain how to minimize them.

[Space for Answers]

[illegible]

.....

.....

.....

.....

.....

.....

XVIII References/Suggestions for further reading

1. <https://bmi-iitr.vlabs.ac.in/exp/various-leads-ecg/>
2. <https://bm-sp-coep.vlabs.ac.in/exp/electrocardiogram-waveform/procedure.html>
3. <https://bmi-iitr.vlabs.ac.in/exp/bipolar-limb-leads/>

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		60 %
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		40%
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusion	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		100 %

Mark Obtained			Dated signature of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No. 18: Generation and analysis of ECG wave using simulator

I Practical Significance

This practical exercise is designed to provide hands-on experience with the generation and analysis of electrocardiogram (ECG) waves using a simulator. Understanding ECG waveforms is critical in biomedical engineering and medical fields as it helps in diagnosing various cardiac conditions.

II Industry/Employer Expected Outcome(s)

- Proficiency in using ECG simulators.
- Ability to interpret ECG waveforms.
- Understanding the application of ECG analysis in clinical settings.

III Course Level Learning Outcome(s)

Troubleshoot ECG machine for simple faults.

IV Laboratory Learning Outcome(s)

LLO 18.1 Simulate ECG signal and analyze the signal parameters.

V Relevant Affective Domain related outcome(s)

- Demonstrate meticulous attention to detail in using simulation software.
- Exhibit effective teamwork and communication during practical exercises.
- Show responsibility in handling and maintaining simulation equipment.

VI Relevant Theoretical Background

Using an ECG simulator involves setting up parameters such as heart rate and waveform characteristics before generating digital representations of the heart's electrical activity. The generated ECG waves are then visualized on a screen or plotted on a graph for analysis. Healthcare professionals analyze these waveforms to assess the heart's rhythm, measure intervals and identify abnormalities like arrhythmias. Findings are interpreted based on comparison with normal reference patterns and results are documented for educational, research or clinical purposes, ensuring accuracy and reliability through validation against known ECG patterns.

VII Actual Circuit diagram used in laboratory with related equipment rating.

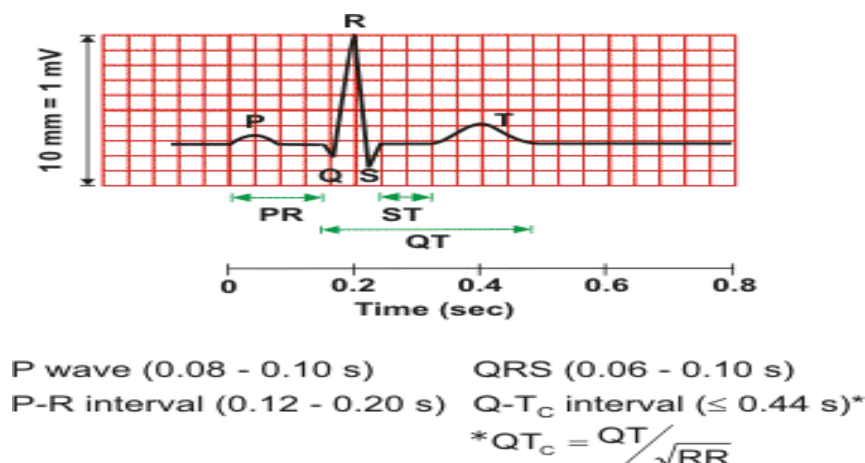


Fig. 18.1 Normal PQRST wave of ECG

(Copyright-<https://bmsh-coep.vlabs.ac.in/exp/electrocardiogram-waveform/theory.html>)

VIII Required Resources/apparatus/equipment with specifications

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	ECG Simulator	-	1
2	Computer with Simulation Software	-	1
3	ECG Analysis Software	-	1
4	ECG Electrodes (if applicable)	-	As per needed

IX Precautions to be followed

1. Ensure the simulator and software is properly installed and functioning.
2. Avoid placing electrodes over bones or large muscles (if using physical electrodes).
3. Follow the software instructions carefully to avoid errors in simulation.
4. Handle the simulator and associated equipment with care to avoid damage.

X Procedure

1. Set up the ECG simulator and ensure it is functioning properly.
2. Launch the simulation software on the computer.
3. Configure the simulator to generate standard ECG waveforms.
4. Use the software to acquire and display the generated ECG waveforms.
5. Analyze the waveforms to identify the P wave, QRS complex, and T wave.
6. Record and interpret the ECG readings.

XI Resources used

Sr. No.	Name of Resource	Specifications	Quantity

XII Actual Procedure

.....

.....

.....

.....

.....

XIII Observation Table**Table 18.1: ECG Machine**

Sr. No.	Waveform Type	P Wave Amplitude (mV)	QRS Complex Duration (ms)	T Wave Amplitude (mV)	Abnormalities
1	Normal				
2	Abnormal				

XIV Result(s)

.....

.....

XV Interpretation of results

.....

.....

XVI Conclusion and recommendation

.....

.....

XVII Practical related questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identifies CO.

1. Explain the significance of each component of an ECG waveform (P wave, QRS complex, T wave).
2. Describe the procedure for configuring an ECG simulator to generate specific waveforms.
3. Identify common artifacts in ECG signals and explain how to minimize them in simulation environment.
4. Write the name of software used to simulate and analyze ECG waveforms?

[Space for Answers]

This image shows a full page of a handwriting practice worksheet. It consists of multiple sets of three horizontal dotted lines spaced evenly down the page, providing a guide for letter height and placement. The background is plain white, and there are no other markings or text present.

XVIII References/Suggestions for further reading

1. <https://bmi-iitr.vlabs.ac.in/exp/chest-leads/theory.html>
2. <https://bmisp-coep.vlabs.ac.in/exp/electrocardiogram-waveform/theory.html>
3. Introduction to Biomedical Equipment Technology by Joseph J. Carr and John M. Brown.
4. Electrocardiography for Healthcare Professionals by Kathryn Booth, Thomas O'Brien, and Leesa Whicker.
5. Online resources such as Medline Plus and the American Heart Association for additional information on ECG interpretation.

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		60 %
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		40%
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusion	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		100 %

Mark Obtained			Dated signature of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No.19: Fault diagnosis in ECG machine

I Practical Significance

Fault diagnosis in ECG machines is crucial for ensuring accurate and reliable electrocardiographic readings. Understanding how to identify and troubleshoot issues in ECG machines helps maintain the integrity of cardiac health monitoring and diagnostics.

II Industry/Employer Expected Outcome(s)

- Proficiency in diagnosing and troubleshooting faults in ECG machines.
- Ability to ensure the ECG machine operates accurately and reliably.
- Knowledge of common issues and their resolutions in ECG equipment.

III Course Level Learning Outcome(s)

Troubleshoot ECG machine for simple faults.

IV Laboratory Learning Outcome(s)

- LLO 19.1 Troubleshoot the given problem in ECG machine.

V Relevant Affective Domain related outcome(s)

- Demonstrate attention to detail in diagnosing and resolving faults.
- Exhibit effective teamwork and communication during troubleshooting exercises.
- Show responsibility in handling and maintaining sensitive medical equipment.

VI Relevant Theoretical Background

Diagnosing faults in an ECG machine involves visually inspecting its components, checking power supply and electrodes, calibrating, assessing signal quality, verifying software settings, performing functional tests, troubleshooting, conducting maintenance and documenting findings.

VII Actual Circuit diagram used in laboratory with related equipment rating.



Fig. 19.1 ECG machine

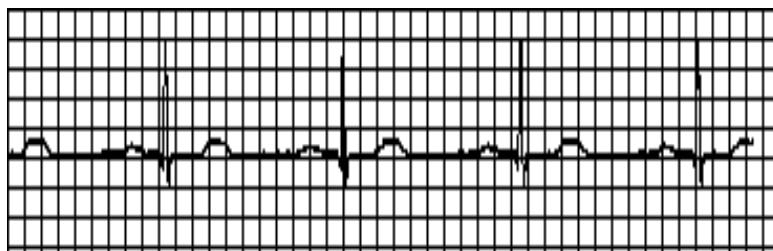


Fig. 19.2 a. Normal ECG Waveform

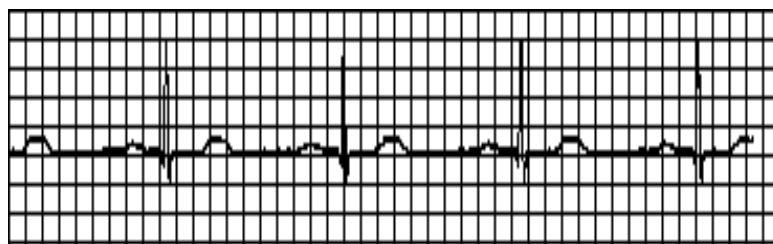


Fig. 19.2 b. Bradycardia



Fig. 19.2 c. Tachycardia

VIII Required Resources/apparatus/equipment with specifications

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	ECG Machine	-	1
2	Multimeter	-	1
3	Oscilloscope	-	1
4	Signal Generator	-	1
5	Test Leads and Probes	-	As per needed
6	Diagnostic Software (if applicable)	-	1

IX Precautions to be followed

1. Ensure the ECG machine is turned off before opening or servicing.
2. Use appropriate safety measures to avoid electric shock.
3. Handle all components and diagnostic tools with care.
4. Follow manufacturer guidelines for servicing and maintenance.

X Procedure

1. Initial Inspection: Visually inspect the ECG machine for obvious signs of damage or wear.
2. Power Supply Check: Verify that the machine is receiving the correct power supply.
3. Electrode and Lead Check: Inspect electrodes and leads for damage or wear.
4. Signal Path Check: Use a multimeter and oscilloscope to trace the signal path and identify any irregularities.
5. Component Testing: Test individual components such as resistors, capacitors, and transistors for faults.
6. Software Diagnostics: If applicable, use diagnostic software to identify issues.
7. Calibration: Ensure the machine is properly calibrated.
8. Documentation: Record all findings and steps taken during the diagnosis.

XI Resources used

Sr. No.	Name of Resource	Specifications	Quantity

XII Actual Procedure

.....

.....

.....

.....

XIII Observation Table**Table 19.1: Fault Diagnosis Data**

Sr. No.	Diagnostic Step	Findings	Corrective Action
1	Initial Inspection		
2	Power Supply Check		
3	Electrode Check		
4	Signal Path Check		
5	Component Testing		
6	Software Diagnostics		
7	Calibration		

.....

.....

1. Explain the common faults that can occur in an ECG machine and their symptoms.
2. Describe the procedure for checking the power supply of an ECG machine.
3. Identify the steps involved in testing the signal path of an ECG machine using an oscilloscope.
4. Write name of the software used for diagnostic purposes in ECG machines?

This image shows a full page of white paper with horizontal dashed lines, typical of primary school handwriting practice paper. The lines are evenly spaced and run across the entire width of the page. There are no margins, text, or other markings present.

[illegible]

XVIII References/Suggestions for further reading

1. <https://medlineplus.gov/ency/article/003868.htm>
2. Introduction to Biomedical Equipment Technology by Joseph J. Carr and John M. Brown.
3. Electrocardiography for Healthcare Professionals by Kathryn Booth, Thomas O'Brien, and Leesa Whicker.
4. Online resources such as Medline Plus and the American Heart Association for additional information on ECG equipment maintenance and troubleshooting.

IXI Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		60 %
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		40%
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusion	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		100 %

Mark Obtained			Dated signature of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No. 20: Operation of EEG machine

I Practical Significance

Understanding the operation of an EEG (Electroencephalogram) machine is essential for recording and analyzing brain activity, which is critical for diagnosing neurological conditions such as epilepsy, sleep disorders and brain injuries.

II Industry/Employer Expected Outcome(s)

- Proficiency in setting up and operating an EEG machine.
- Ability to accurately record and analyze EEG signals.
- Knowledge of the principles and best practices for EEG recording.

III Course Level Learning Outcome(s)

Troubleshoot the EEG and EMG machines for ensuring accurate measurements for diagnostic purposes.

IV Laboratory Learning Outcome(s)

- LLO 20.1 Operation of EEG equipment.
- LLO 20.2 Sketch the waveform of pattern observed on EEG machine.

V Relevant Affective Domain related outcome(s)

- Demonstrate meticulous attention to detail in EEG setup and operation.
- Exhibit effective teamwork and communication during practical exercises.
- Show responsibility in handling and maintaining sensitive medical equipment.

VI Relevant Theoretical Background

An EEG machine measures brain activity by recording electrical signals through electrodes placed on the scalp. After preparation and electrode placement, the machine records the brain's electrical activity while a technician monitors for quality. Any abnormalities or patterns in the data are then analyzed by a neurologist, who provides a report with findings and recommendations for further evaluation or treatment.

VII Actual Circuit diagram used in laboratory with related equipment rating.



Fig. 20.1 EEG Machine

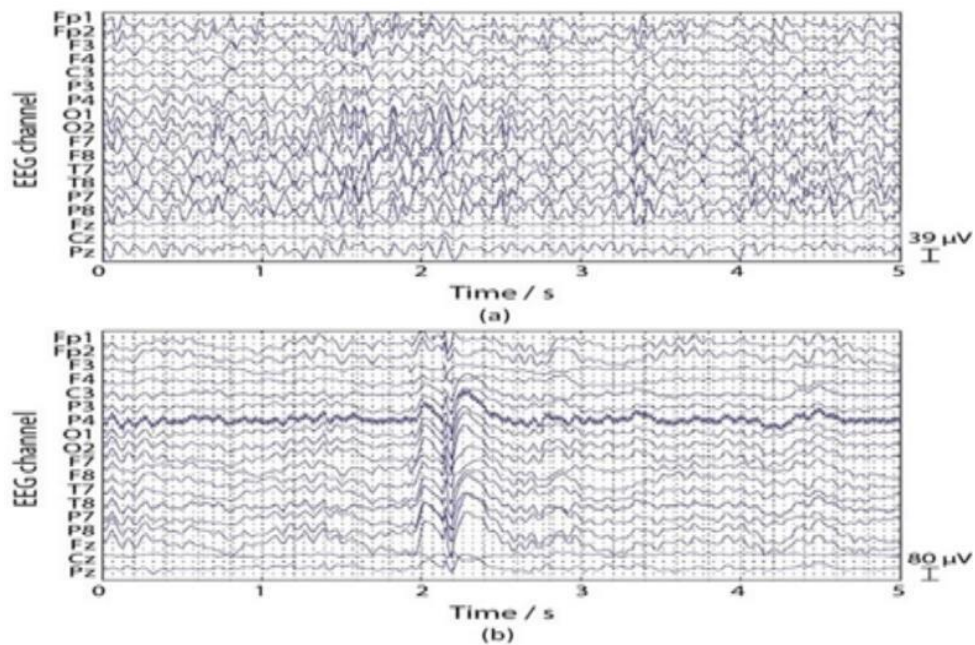


Fig. 20.2 Examples of EEG Waveforms

(a) Free-running background EEG (b) An interictal spike

(Copyright-<https://bmi-iitr.vlabs.ac.in/exp/eeeg-signal-different-lobes/theory.html>)

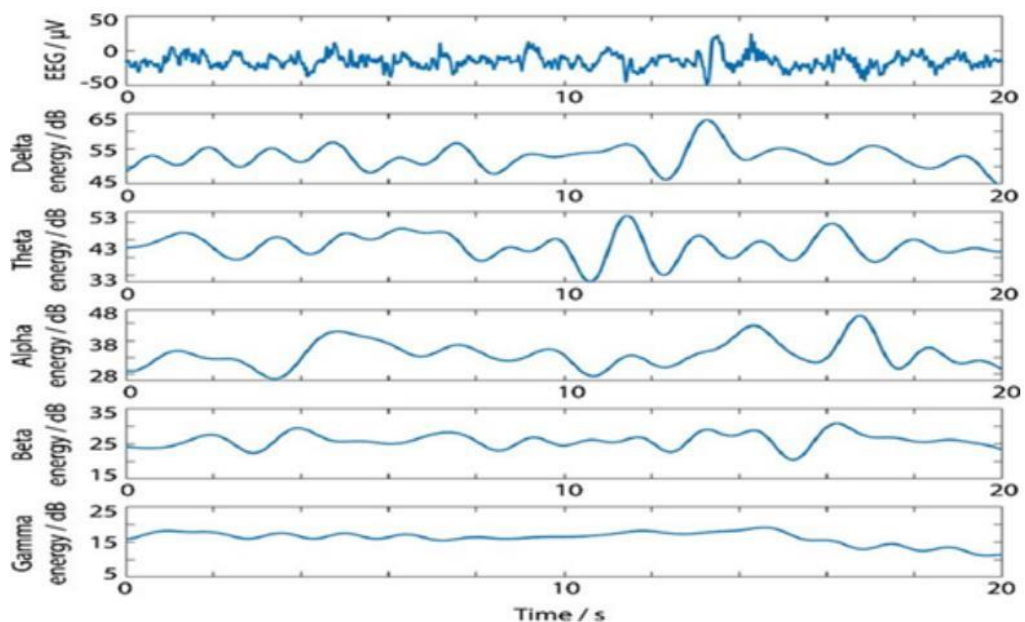


Fig. 20.3 EEG Channel broken down into frequency bands

(Copyright-<https://bmi-iitr.vlabs.ac.in/exp/eeeg-signal-different-lobes/theory.html>)

VIII Required Resources/apparatus/equipment with specifications

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	EEG Machine	-	1
2	EEG Electrodes and Cap	-	1 set
3	Conductive Gel/Paste	-	As per needed
4	Computer with EEG Analysis Software	-	1
5	Alcohol Wipes/Cotton Pads	-	As per needed
6	Syringes for Gel Application	-	As per needed

IX Precautions to be followed

1. Ensure the EEG machine and electrodes are properly sanitized before use.
2. Verify that all connections are secure to avoid signal loss or artifacts.
3. Handle the electrodes and cap with care to avoid damage.
4. Follow the manufacturer's guidelines for applying conductive gel/paste.

X Procedure

1. Preparation: Ensure all equipment is sanitized and functioning.
2. Subject Preparation: Clean the subject's scalp with alcohol wipes.
3. Electrode Placement: Apply conductive gel/paste to electrodes and place them on the scalp according to the 10-20 system.
4. Setup EEG Machine: Turn on the EEG machine and connect the electrodes.
5. Calibration: Calibrate the EEG machine as per the manufacturer's instructions.
6. Recording: Start recording the EEG signals.
7. Monitoring: Monitor the subject and EEG signals for any artifacts.
8. Data Analysis: Use EEG analysis software to interpret the recorded data.
9. Documentation: Save and document the EEG recordings for further analysis.

XI Resources used

Sr. No.	Name of Resource	Specifications	Quantity

XII Actual Procedure

.....

.....

.....

XIII Observation Table**Table 20.1: EEG Waveform Data**

Sr. No.	Waveform Type	Frequency (Hz)	Amplitude (μ V)	Observations
1	Alpha			
2	Beta			
3	Delta			
4	Theta			

XIV Result(s)**XV Interpretation of results****XVI Conclusion and recommendation****XVII Practical related questions**

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identifies CO.

1. Explain the significance of each type of EEG waveform (alpha, beta, delta and theta).
2. Describe the 10-20 system for electrode placement.
3. Identify common artifacts in EEG signals and explain how to minimize them.
4. Write the name of the software used for EEG machine?

[Space for Answers]

[illegible]

XVIII References/Suggestions for further reading

1. <https://bmi-iitr.vlabs.ac.in/exp/electrode-position-electroencephalogram/>
2. <https://bmi-iitr.vlabs.ac.in/exp/various-leads-different-lobes/>
3. <https://bmi-iitr.vlabs.ac.in/exp/eeg-signal-different-lobes/>
4. Electroencephalography: Basic Principles, Clinical Applications, and Related Fields by Ernst Niedermeyer and Fernando Lopes da Silva.

IXI Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		60 %
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		40%
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusion	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		100 %

Mark Obtained			Dated signature of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No. 21: Fault diagnosis in EEG machine

I Practical Significance

This practical aims to understand the problem and remedies for troubleshooting an EEG machine.

II Industry/Employer Expected Outcome(s)

This course aims to help students maintain various diagnostic equipment's.

III Course Level Learning Outcome(s)

Troubleshoot EEG machines for accurate measurements in diagnostic purposes.

IV Laboratory Learning Outcome(s)

LLO 21.1 Troubleshoot the given problem in EEG machine.

V Relevant Affective Domain related outcome(s)

- Develop meticulous attention to detail in physiological measurements.
- Cultivate a professional attitude towards patient care and data handling.
- Show empathy and effective communication when working with subjects.
- Follow safety electrical rules for safe practices.

VI Relevant Theoretical Background

Diagnosing faults in an EEG machine involves checking electrode connections, cables, power supply and machine settings as well as inspecting for visible damage. Calibration tests and comparisons against known standards can aid in identifying specific faults, with collaboration with technical support for complex issues ensuring accurate and reliable operation for brain activity measurement and diagnosis.

VII Actual Circuit diagram used in laboratory with related equipment rating.

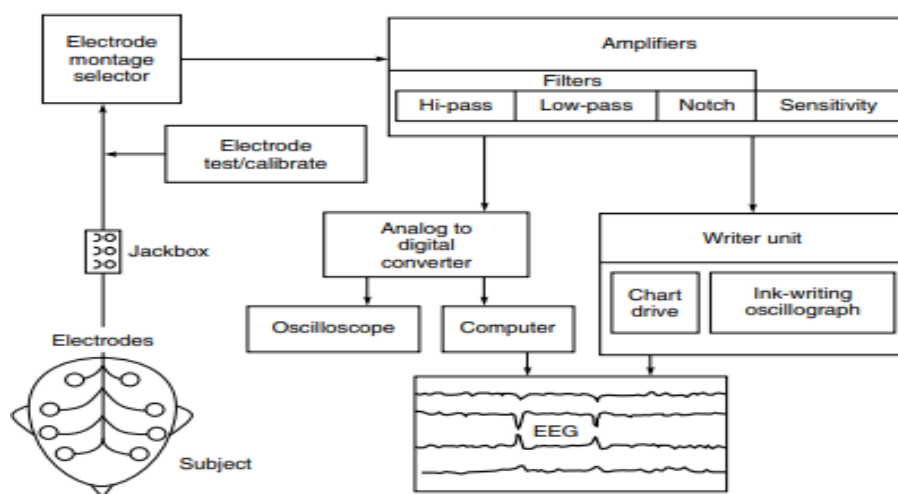


Fig. 21.1 Block diagram of EEG machine

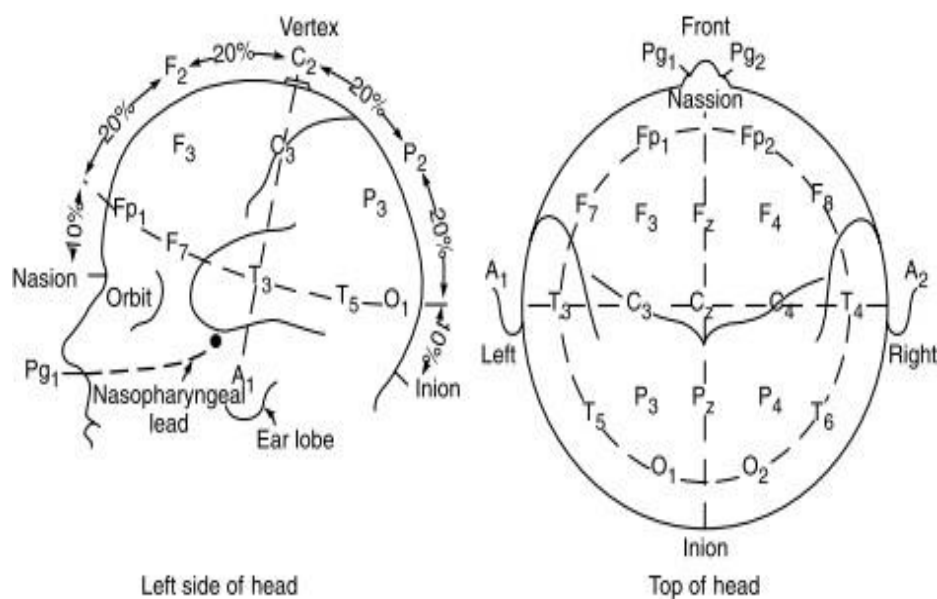


Fig. 21.2 10-20 System of electrode placement

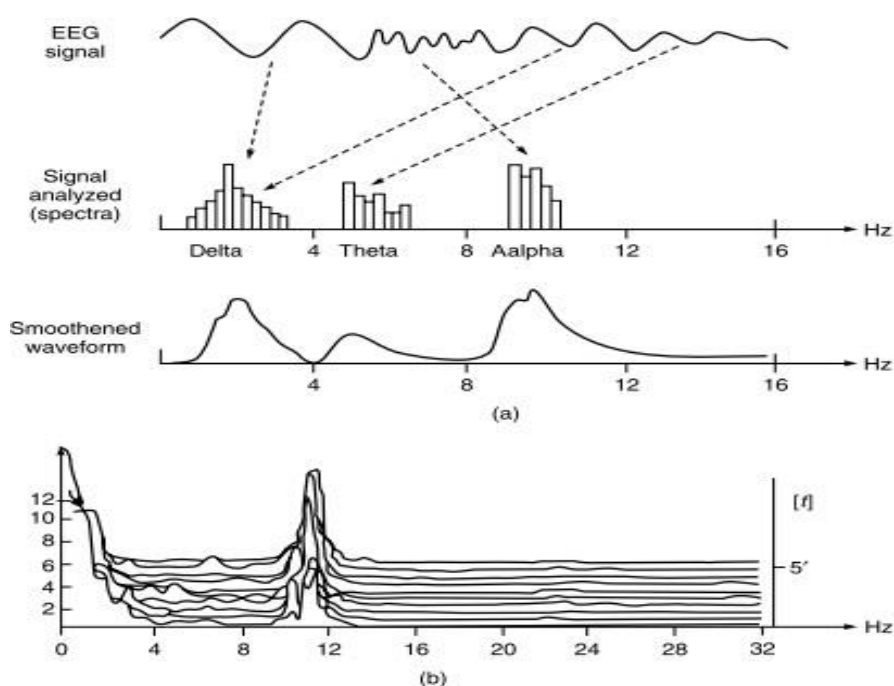


Fig 21.3 a) Typical EEG waveform broken down into frequency components
b) Mathematical and display techniques used to generate the compressed spectral array format
(Copyright-Handbook of biomedical instrumentation by R.S. Khandpur (Third edition))

VIII Required Resources/apparatus/equipment with specifications

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	EEG Machine	8 channel, 512Hz, 24 bits ADC resolution.	1
2	Troubleshooting Tools	-	As per required

IX Precautions to be followed

1. Follow electrical safety rules.
2. Handle equipment with care.
3. Ensure proper grounding.
4. Work in a well-ventilated area.

X Procedure

1. Identify the issue with the EEG machine.
2. Use troubleshooting tools to diagnose the problem.
3. Implement necessary repairs or adjustments.
4. Test the machine to ensure proper functioning.
5. Document the troubleshooting process.

XI Resources used

Sr. No.	Name of Resource	Specifications	Quantity

XII Actual Procedure

.....

.....

.....

.....

.....

XIII Observation Table**Table 21.1: Troubleshooting the EEG machine**

Sr. No.	Fault	Reason	Troubleshooting

XIV Result(s)

.....

.....

XV Interpretation of results

.....

.....

XVI Conclusion and recommendation

.....

.....

XVI I Practical related questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identifies CO.

1. What is EEG?
2. What are the challenges in EEG monitoring and analysis?
3. List the major limitation of EEG. And factors affecting on EEG recording.
4. Draw the Waveform of EEG signal: - a. Awake or resting, b. Sleeping, c. Deep sleep.

[Space for Answers]

.....

.....

[illegible]

.....

.....

.....

.....

.....

.....

.....

.....

.....

XVIII References/Suggestions for further reading

1. Handbook of biomedical instrumentation by R.S. Khandpur (Third edition)

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		60 %
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		40%
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusion	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		100 %

Mark Obtained			Dated signature of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No. 22: Operation of EMG machine

I Practical Significance

The electromyography (EMG) machine is a vital tool in clinical settings and research laboratories for assessing muscle activity through the detection and recording of electrical signals generated by muscle fibers.

II Industry/Employer Expected Outcome(s)

Proficiency in operating EMG machines is essential for healthcare professionals working in fields such as neurology, physical therapy, and sports medicine.

III Course Level Learning Outcome(s)

Troubleshoot EEG machines for accurate measurements in diagnostic purposes.

IV Laboratory Learning Outcome(s)

- LLO 22.1 Operation of EMG machine.
- LLO 22.2 Sketch the waveform of pattern observed on EMG machine.

V Relevant Affective Domain related outcome(s)

- Develop meticulous attention to detail in physiological measurements.
- Cultivate a professional attitude towards patient care and data handling.
- Show empathy and effective communication when working with subjects.
- Follow safety electrical rules for safe practices.

VI Relevant Theoretical Background

EMG records the electrical activity produced by skeletal muscles. This activity can be analyzed to detect muscle health, neuromuscular disorders and motor unit recruitment patterns.

VII Actual Circuit diagram used in laboratory with related equipment rating.

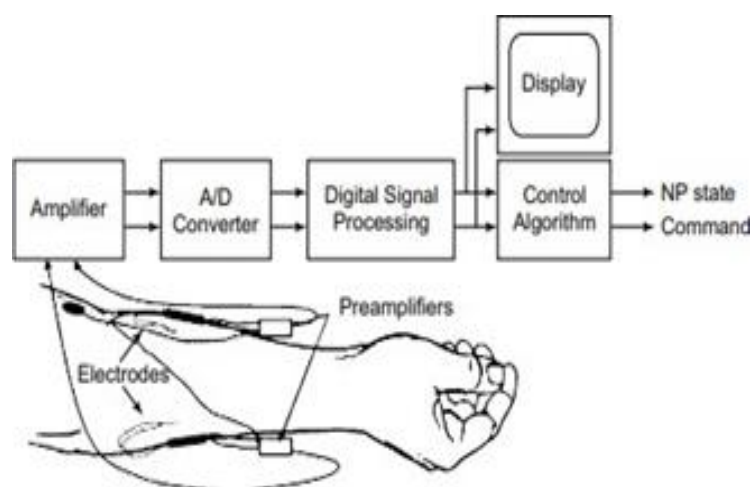


Fig. 22.1 Block diagram of a typical set-up for EMG recording



Fig. 22.2 PC based digital EMG recording system

VIII Required Resources/apparatus/equipment with specifications

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	EMG Machine	16 channel, digital serial based on SPI interface, 5v supply.	1

IX Precautions to be followed

1. Ensure proper electrode placement to obtain accurate readings.
2. Regularly calibrate the machine to maintain accuracy.
3. Follow manufacturer instructions for electrode sterilization to prevent cross-contamination.
4. Handle electrodes and cables with care to avoid damage.

X Procedure

1. Prepare the patient by cleaning the skin at electrode placement sites.
2. Attach electrodes to the patient's skin according to the muscle group being tested.
3. Turn on the EMG machine and adjust settings for the desired recording parameters.
4. Start the recording and instruct the patient to perform specific movements or tasks.
5. Monitor the EMG signals for any anomalies or artifacts during the recording.
6. Document the troubleshooting process.

XI Resources used

Sr. No.	Name of Resource	Specifications	Quantity

XII Actual Procedure

.....

.....

.....

.....

XIII Observation Table**Table 22.1: EMG signal processing**

Sr. No.	Muscle Group	EMG Signal Strength	Abnormal Patterns Detected

XIV Result(s)

.....

.....

XV Interpretation of results

.....

.....

XVI Conclusion and recommendation

.....

.....

XVI I Practical related questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identifies CO.

1. What is EMG and what is the condition diagnosed with an EMG?
2. List the major limitations of EMG.
3. List the factors affecting on EMG recording.
4. What is normal range of EMG?

[Space for Answers]

.....

.....

.....

[illegible]

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

XVIII References/Suggestions for further reading

1. Handbook of biomedical instrumentation by R.S. Khandpur (Third edition)

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		60 %
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		40%
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusion	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		100 %

Mark Obtained			Dated signature of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No. 23: Fault diagnosis in EMG machine

I Practical Significance

Identifying and rectifying faults in EMG machines is essential for ensuring accurate diagnosis and treatment of neuromuscular disorders, thereby improving patient care.

II Industry/Employer Expected Outcome(s)

Employers expect proficiency in fault diagnosis of EMG machines to minimize downtime and maintain smooth operation in clinical settings.

III Course Level Learning Outcome(s)

Troubleshoot the EMG machines for ensuring accurate measurements for diagnostic purpose.

IV Laboratory Learning Outcome(s)

- LLO 23.1 Troubleshoot the given problem in EMG machine.

V Relevant Affective Domain related outcome(s)

Improved confidence and self-efficacy in handling and troubleshooting complex medical equipment such as EMG machines.

VI Relevant Theoretical Background

Understanding the underlying principles of electromyography and the components of EMG machines is crucial for effective fault diagnosis.

VII Actual Circuit diagram used in laboratory with related equipment rating.



Fig. 23.1 EMG Machine

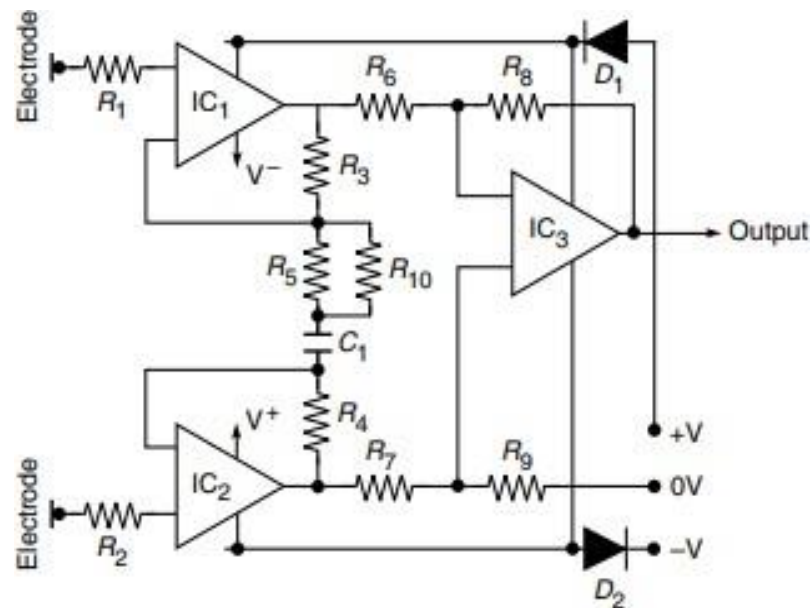


Fig. 23.2 Preamplifier circuit of EMG

(Copyright- Handbook of biomedical instrumentation by R.S. Khandpur (Third edition))

VIII Required Resources/apparatus/equipment with specifications

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	EMG machine	16 channel, digital serial based on SPI interface, 5v supply.	1

IX Precautions to be followed

1. Ensure the EMG machine is disconnected from the power source before attempting any diagnosis or repair.
2. Handle sensitive electronic components with care to avoid damage.
3. Follow manufacturer guidelines and safety protocols during troubleshooting.
4. Document all steps and observations for future reference.

X Procedure

1. Inspect the EMG machine for visible signs of damage or wear.
2. Perform a functional check of the machine by powering it on and observing its behavior.
3. Use diagnostic tools such as multimeter or oscilloscopes to test individual components.
4. Refer to the circuit diagram and service manual to identify faulty components.
5. Replace or repair faulty components as necessary, following proper procedures and safety precautions.

XI Resources used

Sr. No.	Name of Resource	Specifications	Quantity
1			
2			
3			

XII Actual Procedure

.....

.....

.....

.....

XIII Observation Table**Table 23.1: Troubleshooting the EMG machine**

Sr. No.	Fault	Reason	Troubleshooting

XIV Result(s)

.....

.....

XV Interpretation of results

.....

.....

XVI Conclusion and recommendation

.....

.....

XVII Practical related questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identifies CO.

1. How many electrodes are used in EMG recording?
2. What is the source of noise in EMG?
3. State the voltage range of EMG signal.
4. State the significance of amplifier used in EMG machine.

[Space for Answers]

This image shows a full page of white paper with horizontal dotted lines, typical of primary-ruled notebook paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

.....

.....

.....

.....

.....

.....

.....

XVIII References/Suggestions for further reading

1. Handbook of biomedical instrumentation by R.S. Khandpur (Third edition)
2. <https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering>

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		60 %
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		40%
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusion	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		100 %

Mark Obtained			Dated signature of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No. 24: Plotting of human auditory response using audiometer

I Practical Significance

Understanding the human auditory response is crucial for various applications, including designing sound systems, diagnosing hearing impairments and developing communication technologies.

II Industry/Employer Expected Outcome(s)

Professionals equipped with the knowledge of human auditory response can contribute to fields such as audio engineering, healthcare and telecommunications.

III Course Level Learning Outcome(s)

- Operate audiometer and GSR meter.

IV Laboratory Learning Outcome(s)

- LLO 24.1 Test auditory responses and plot audiogram by using audiometer.

V Relevant Affective Domain related outcome(s)

Developing sensitivity to the importance of hearing health and its impact on overall well-being.

VI Relevant Theoretical Background

The human auditory system comprises the outer ear, middle ear, inner ear and auditory nerve. Sound waves are collected by the outer ear, transmitted through the middle ear, converted into neural signals in the inner ear and interpreted by the brain.

VII Actual Circuit diagram used in laboratory with related equipment rating.

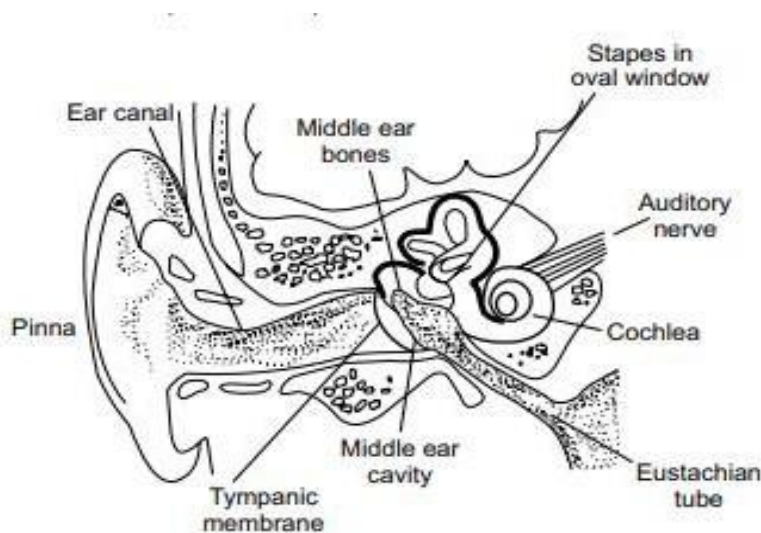


Fig. 24.1 Anatomy of EAR

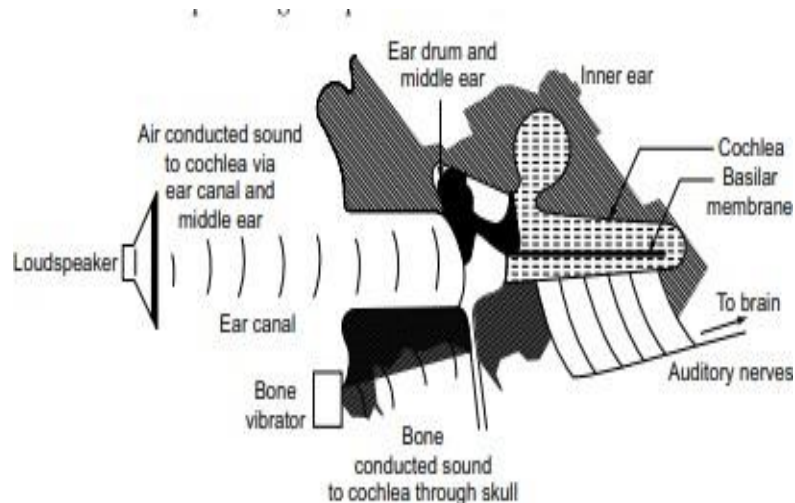


Fig. 24.2 Mechanism of air and bone conduction

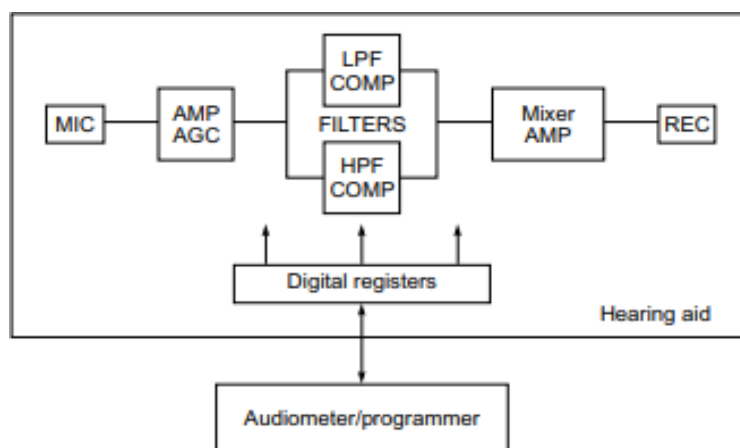


Fig. 24.3 Conventional analog type hearing aid

(Copyright-Handbook of biomedical instrumentation by R.S. Khandpur (Third edition))



Fig. 24.4 Audiometer

VIII Required Resources/apparatus/equipment with specifications

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Audiometer	Frequency :- 50Hz to 8000Hz	1

IX Precautions to be followed

1. Ensure the audiometer is calibrated correctly before use.
2. Use appropriate earphones or transducers for accurate sound delivery.
3. Maintain a quiet testing environment to minimize external interference.
4. Follow standard safety protocols while operating electrical equipment.

X Procedure

1. Set up the audiometer according to manufacturer instructions.
2. Prepare the test subject by explaining the procedure and ensuring comfort.
3. Begin testing at the lowest frequency (250 Hz) and gradually increase in steps.
4. Record the minimum audible sound intensity at each frequency tested.

XI Resources used

Sr. No.	Name of Resource	Specifications	Quantity

XII Actual Procedure

.....

.....

.....

.....

.....

.....

.....

.....

XIII Observation Table**Table 24.1: Auditory Response Data**

Sr. No	Frequency (Hz)	Minimum Audible Sound Intensity (dB)
1	250	
2	500	
3	1000	
4	2000	
5	4000	
6	8000	

XIV Result(s)

.....

.....

XV Interpretation of results

.....

.....

XVI Conclusion and recommendation

.....

.....

XVII Practical related questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identifies CO.

1. State significance of measuring the human auditory response.
2. How does age affect auditory sensitivity?
3. List applications of audiometry in healthcare.
4. Explain the importance of calibrating the audiometer before conducting tests.
5. How can audiometric data aid in diagnosing hearing disorders?
6. Describe the differences between conductive and sensorineural hearing loss.

[Space for Answers]

[illegible]

.....

.....

.....

.....

.....

.....

.....

XVIII References/Suggestions for further reading

1. Handbook of biomedical instrumentation by R.S. Khandpur (Third edition)
2. <https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering>

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		60 %
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		40%
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusion	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		100 %

Mark Obtained			Dated signature of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No. 25: Troubleshooting audiometer machine

I Practical Significance

The practical significance of troubleshooting an audiometer machine lies in its application in audiology clinics, hospitals and hearing aid centers. Audiometer machines are essential tools for assessing hearing abilities and understanding how to troubleshoot them ensures uninterrupted patient care and accurate diagnosis.

II Industry/Employer Expected Outcome(s)

Employers expect individuals to proficiently troubleshoot audiometer machines to maintain operational efficiency in audiology clinics and hospitals. This skill ensures minimal downtime and accurate assessment of patients hearing abilities.

III Course Level Learning Outcome(s)

Operate audiometer and GSR meter.

IV Laboratory Learning Outcome(s)

- LLO 25.1 Troubleshoot the given audiometer machine.

V Relevant Affective Domain related outcome(s)

Students will demonstrate perseverance and patience in diagnosing and solving problems in audiometer machines, fostering a positive attitude towards problem-solving and technical challenges.

VI Relevant Theoretical Background

Troubleshooting an audiometer machine involves several steps to identify and address issues. Start by checking power connections and ensuring the machine is turned on. Verify that headphones or transducers are properly connected and functioning. Next, calibrate the machine according to manufacturer instructions to ensure accurate testing. If there are still issues, check for software or firmware updates and perform any necessary updates.

VII Actual Circuit diagram used in laboratory with related equipment rating.

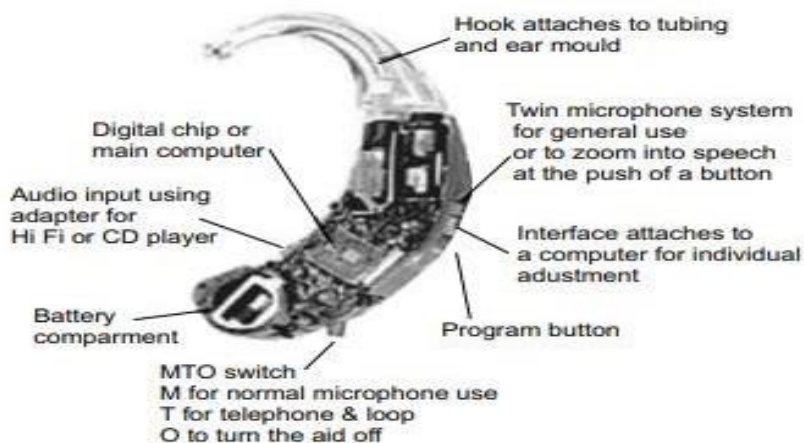


Fig. 25.1 a typical modern digital hearing aid (Courtesy: www.hearingtherapyaustralia.com)

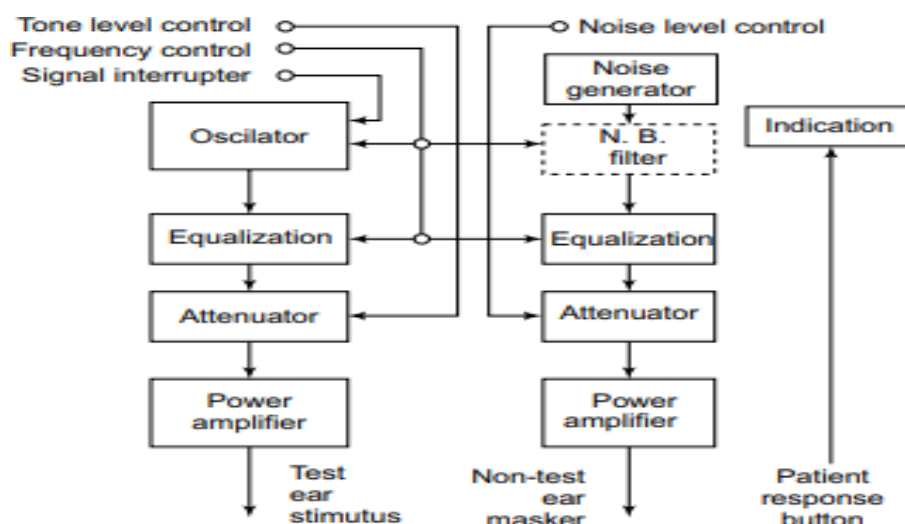


Fig. 25.2 Block diagram of a basic audiometer (Adapted from Patel and Pandey, 2002)
 (Copyright- Handbook of biomedical instrumentation by R.S. Khandpur (Third edition))

VIII Required Resources/apparatus/equipment with specifications

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Audiometer machine components	Various electronic components	Variable
2	Multimeter	Digital, AC/DC voltage, resistance, continuity	1
3	Audiometer	Frequency :- 50Hz to 8000Hz	1

IX Precautions to be followed

1. Handle electronic components with care to avoid damage
2. Ensure proper grounding to prevent electrical hazards.
3. Follow manufacturer's instructions and safety guidelines.
4. Power sources before performing any maintenance or troubleshooting..

X Procedure

1. Inspect the audiometer machine for visible signs of damage or malfunction.
2. Perform a visual inspection of internal components and connections.
3. Use appropriate testing instruments to measure voltages, currents and signal outputs.
4. Identify faulty components or connections and replace or repair them as necessary.

XI Resources used

Sr. No.	Name of Resource	Specifications	Quantity
1			
2			

XII Actual Procedure

.....

.....

.....

.....

XIII Observation Table**Table 25.1: Audiometer Troubleshooting Observations**

Sr. No	Observation	Measurement	Action Taken

XIV Result(s)

.....

.....

XV Interpretation of results

.....

.....

XVI Conclusion and recommendation

.....

.....

XVII Practical related questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identifies CO.

1. Explain the importance of troubleshooting audiometer machines in audiology clinics.
2. Describe the steps involved in diagnosing a faulty audiometer component.
3. How does understanding the theoretical background of electronic circuits aid in troubleshooting?
4. Explain the role of teamwork in efficiently troubleshooting audiometer machines.

[Space for Answers]

[illegible]

.....

.....

.....

.....

.....

.....

.....

XVIII References/Suggestions for further reading

1. Handbook of biomedical instrumentation by R.S. Khandpur (Third edition)
2. <https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering>

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		60 %
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		40%
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusion	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		100 %

Mark Obtained			Dated signature of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No. 26: Exploring skin response through galvanic skin response (GSR) Measurements

I Practical Significance

Understanding galvanic skin response (GSR) and its measurement is crucial in various fields such as psychology, medicine and human-computer interaction. GSR provides insights into emotional arousal, stress levels and autonomic nervous system activity.

II Industry/Employer Expected Outcome(s)

Professionals should be able to effectively measure and interpret GSR data to assess emotional states, stress levels and physiological responses in various settings such as therapy sessions, usability testing and stress management programs.

III Course Level Learning Outcome(s)

Operate audiometer and GSR meter.

IV Laboratory Learning Outcome(s)

- LLO 26.1 Use the GSR meter to examine skin response.

V Relevant Affective Domain related outcome(s)

Students will demonstrate empathy and sensitivity in understanding the emotional and physiological responses measured through GSR, fostering a deeper understanding of human behavior and emotions.

VI Relevant Theoretical Background

Theoretical concepts such as skin conductance, sympathetic nervous system activity and psychological theories related to emotional arousal provide the foundation for understanding GSR measurements.

VII Actual Circuit diagram used in laboratory with related equipment rating.

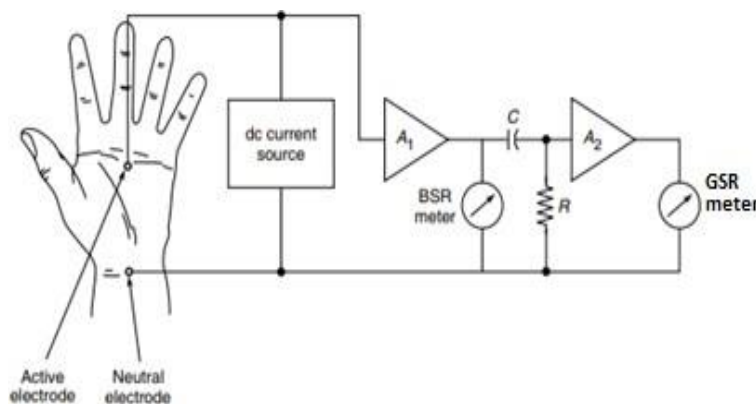


Fig. 26.1 Block diagram for measurement and record of basal skin resistance (BSR) and galvanic skin response (GSR)

(Copyright- Handbook of biomedical instrumentation by R.S. Khandpur (Third edition))



Fig. 26.2 GSR meter

VIII Required Resources/apparatus/equipment with specifications

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	GSR Measurement System	GSR sensors, amplifier, data acquisition unit	Variable
2	GSR Sensors	Skin-contact electrodes, impedance <10 kΩ	Variable

IX Precautions to be followed

1. Handle GSR sensors and equipment carefully to avoid damage.
2. Ensure proper skin preparation to achieve reliable measurements.
3. Follow ethical guidelines when conducting experiments involving human subjects.
4. Calibrate equipment regularly to maintain accuracy.

X Procedure

1. Prepare the participant for GSR measurement by cleaning the skin and attaching sensors.
2. Set up the GSR measurement system and calibrate the sensors.
3. Record baseline GSR readings in a relaxed state.
4. Introduce stimuli or tasks to evoke emotional responses and record corresponding GSR data.
5. Analyze GSR data to identify changes in skin conductance and interpret emotional arousal levels.

XI Resources used

Sr. No.	Name of Resource	Specifications	Quantity
1			
2			

XII Actual Procedure

.....

.....

.....

.....

XIII Observation Table**Table 26.1: GSR Measurement Observations**

Sr. No.	Observations	Measurement	Action taken

XIV Result(s)

.....

.....

XV Interpretation of results

.....

.....

XVI Conclusion and recommendation

.....

.....

XVII Practical related questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identifies CO.

1. Explain the concept of galvanic skin response.
2. List the factors that can influence GSR measurements.
3. How can GSR data be used to assess emotional states in clinical or research settings?

[Space for Answers]

.....

.....

.....

.....

.....

.....

XVIII References/Suggestions for further reading

1. Handbook of biomedical instrumentation by R.S. Khandpur (Third edition)
2. <https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering>

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		60 %
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		40%
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusion	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		100 %

Mark Obtained			Dated signature of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No. 27: Identification of components of hearing aid

I Practical Significance

Understanding the components of a hearing aid is crucial for technicians and audiologists to effectively diagnose, repair, and customize devices for individual patients.

II Industry/Employer Expected Outcome(s)

Proficiency in identifying and understanding the function of each component of a hearing aid is essential for professionals working in the field of audiology and hearing aid technology.

III Course Level Learning Outcome(s)

Operate audiometer and GSR meter.

IV Laboratory Learning Outcome(s)

- LLO 27.1 Identify the components used in the given hearing aid along with specifications.

V Relevant Affective Domain related outcome(s)

Developing attention to detail and precision in component identification fosters a sense of responsibility and competence in students pursuing careers in audiology or related fields.

VI Relevant Theoretical Background

Understanding the basic principles of sound amplification and signal processing is essential for comprehending the function of each component within a hearing aid.

VII Actual Circuit diagram used in laboratory with related equipment rating.



Fig. 27.1 Hearing aids

VIII Required Resources/apparatus/equipment with specifications

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Hearing Aids Components	Various components as per circuit diagram	Sufficient for each student

IX Precautions to be followed

1. Handle delicate components with care to avoid damage.
2. Ensure proper grounding to prevent electrostatic discharge.
3. Follow safety protocols when working with electronic equipment.
4. Keep the workspace clean and organized to avoid misplacing components.

X Procedure

1. Examine the provided circuit diagram to familiarize yourself with the components.
2. Identify each component on the actual hearing aid circuit board.
3. Use appropriate tools and techniques to measure the values of resistors, capacitors etc.
4. Work collaboratively in teams to facilitate learning and troubleshooting.

XI Resources used

Sr. No.	Name of Resource	Specifications	Quantity

XII Actual Procedure

.....

.....

.....

.....

.....

.....

.....

.....

XIII Observation Table**Table 27.1: Component Identification**

Sr. No	Name of Identified Component

XIV Result(s)

.....

.....

XV Interpretation of results

.....

.....

XVI Conclusion and recommendation

.....

.....

XVII Practical related questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identifies CO.

1. Explain the importance of hearing aid.
2. List the components of hearing aid.
3. List the type's audiometry.
4. List the factor affecting on hearing aid.

[Space for Answers]

.....

.....

.....

.....

.....

.....

This image shows a full page of white paper with horizontal dotted lines, typical of primary school writing paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

.....

.....

.....

.....

.....

.....

.....

XVIII References/Suggestions for further reading

1. Handbook of biomedical instrumentation by R.S. Khandpur (Third edition)
2. <https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering>

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		60 %
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		40%
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusion	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		100 %

Mark Obtained			Dated signature of Teacher
Process Related (15)	Product Related (10)	Total (25)	

Practical No. 28: Fault diagnosis in hearing aid

I Practical Significance

The practical significance of diagnosing faults in hearing aids lies in ensuring their optimal functionality, crucial for individuals with hearing impairments to experience improved quality of life.

II Industry/Employer Expected Outcome(s)

Employers expect professionals to proficiently identify and rectify faults in hearing aid circuits, ensuring enhanced customer satisfaction and effective patient care.

III Course Level Learning Outcome(s)

Operate audiometer and GSR meter.

IV Laboratory Learning Outcome(s)

- LLO 28.1 Troubleshoot the given problem in the hearing aid.

V Relevant Affective Domain related outcome(s)

This practical fosters problem-solving abilities, attention to detail and patience, essential traits for audiology professionals.

VI Relevant Theoretical Background

Students should possess basic knowledge of electrical circuits and the functioning of hearing aids before conducting this practical.

VII Actual Circuit diagram used in laboratory with related equipment rating.

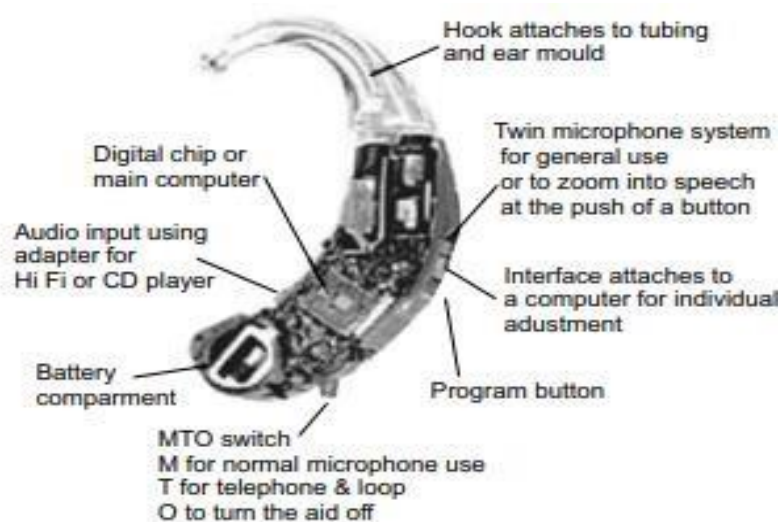


Fig. 28.1 A typical modern digital hearing aid

(Copyright- Handbook of biomedical instrumentation by R.S. Khandpur (Third edition))

VIII Required Resources/apparatus/equipment with specifications

Sr. No.	Name of Resource	Suggested Broad Specification	Quantity
1	Multimeter	Digital multimeter with voltage, current and resistance measuring capabilities	1
1	Hearing Aids Components	Various components as per circuit diagram	1

IX Precautions to be followed

1. Handle components delicately to prevent damage.
2. Ensure proper grounding to minimize electrical hazards.
3. Wear appropriate safety gear, such as gloves and goggles.
4. Disconnect power sources before conducting tests.

X Procedure

1. Visually inspect the hearing aid circuit for visible damage or loose connections.
2. Use the multimeter to measure voltage and resistance at critical points in the circuit.
3. Compare measured values with expected values to detect deviations.
4. Trace the current flow through the circuit to pinpoint fault locations.

XI Resources used

Sr. No.	Name of Resource	Specifications	Quantity

XII Actual Procedure

.....

.....

.....

.....

.....

.....

XIII Observation Table**Table 28.1: Troubleshooting of hearing aid**

Sr. No	Fault	Action Taken	Troubleshooting

XIV Result(s)

.....

.....

XV Interpretation of results

.....

.....

XVI Conclusion and recommendation

.....

.....

XVII Practical related questions

Note: Below given are few sample questions for reference. Teacher must design more such questions so as to ensure the achievement of identifies CO.

1. Which nerve causes hearing loss?
2. Which nerve controls hearing?
3. List hearing problems.

[Space for Answers]

.....

.....

.....

.....

.....

.....

This image shows a full page of primary-ruled paper. It features approximately 20 horizontal dotted lines spaced evenly down the page, providing a guide for handwriting practice. The paper is otherwise blank, with no margins, text, or other markings.

.....

.....

.....

.....

.....

.....

.....

XVIII References/Suggestions for further reading

1. Handbook of biomedical instrumentation by R.S. Khandpur (Third edition)
2. <https://www.vlab.co.in/broad-area-biotechnology-and-biomedical-engineering>

XIX Assessment Scheme

Performance Indicators		Weightage
Process Related : 15 Marks		60 %
1	Handling of the components	10%
2	Identification of components	20%
3	Measuring value using suitable instrument	20%
4	Working in teams	10%
Product Related: 10 Marks		40%
5	Calculated theoretical values of given component	10%
6	Interpretation of result	05%
7	Conclusion	05%
8	Practical related questions	15%
9	Submitting the journal in time	05%
Total (25 Marks)		100 %

Mark Obtained			Dated signature of Teacher
Process Related (15)	Product Related (10)	Total (25)	