

HOSPITAL TRAINING

Submitted in partial fulfilment of the requirements for the course completion of Hospital Training.

By

G. SHAMITHA (41240044)



**DEPARTMENT OF BIOMEDICAL ENGINEERING
SCHOOL OF BIO AND CHEMICAL ENGINEERING**

SATHYABMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

Accredited with Grade “A++” by NAAC

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI-600119



SATHYABAMA

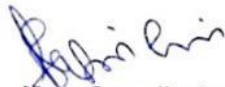
INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)

Accredited "A++" Grade by NAAC | 12B Status by UGC | Approved by AICTE
www.sathyabama.ac.in

DEPARTMENT OF BIOMEDICAL ENGINEERING

BONAFIDE CERTIFICATE

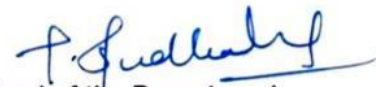
This is to certify that this is the Bonafide work of G. SHAMITHA (41240044) who carried out the project entitled "**HOSPITAL TRAINING ON MEDICAL EQUIPMENT**" at Apollo Hospitals under my supervision from Date 15/05/2023 to 21/07/2023.


Year Coordinator

Dr.A.SABARIVANI, M.Tech.,Ph.D.,


Internal Guide

Ms.SINDHU DIVAKARAN, M.E.,Ph.D.,


Head of the Department
Head of the Department
Department of Biomedical Engineering
Department of Biomedical Engineering
(Deemed to be University)
Category I University by UGC
Jeppiaar Nagar, Rajiv Gandhi Salai,
Chennai - 600 119

Dr.T.SUDHAKAR, M.Sc.,Ph.D.

Submitted for Viva voce Examination held on 03.10.2023


Internal Examiner


External Examiner



TO WHOMSOEVER IT MAY CONCERN

This is to certify that Ms. Gangaraju Shamitha has undergone a practical training on Biomedical Engineering Concepts covering Operating Principles, Troubleshooting, Maintenance, Repairing and Application of Bio Medical equipment at various departments within the Hospital.

Hands on training on different category of equipment namely Critical, Semi Critical and Non - Critical equipment have been given to the student for duration of 1 Week.

We hereby certify that the student has successfully completed the Hospital Training.

Venue: Apollo Hospitals - Grems Road

Period: 15.05.2023 - 21.07.2023

For Faber Sindoori Management Services Pvt Ltd.




Authorized Signatory
Human Resources Department



Faber Sindoori Management Services Private Limited

(ISO 9001:2015 QMS, ISO 14001:2015 EMS, ISO 45001:2018 OH&S, ISO/IEC 17025:2017 NABL & ISO 13485:2016 Certified Company)

No.77, Pottipati Plaza, 4th Floor, Nungambakkam High Road, Nungambakkam, Chennai - 600 034.

Ph: (+91) 44 4264 9403 / 04

Website: www.sindoorifaber.com

CIN: U85100TN2007PTC064527

DECLARATION

I, G. SHAMITHA hereby declare that the report entitled **HOSPITAL TRAINING** done by me under guidance of **Mr. Lawrence** at **Apollo Hospital** is submitted in partial fulfillment of the requirements in internship for Bio and Chemical Engineers.

G. Shamitha

DATE: 03/10/2023

SIGNATURE OF THE CANDIDATE(S)

PLACE: Chennai

ACKNOWLEDGEMENT

My first and foremost thanks to the Almighty for His blessings and grace towards me and for guiding me towards the path of success.

I wish to express my deep sense of gratitude to our beloved Founder Chancellor Col. **Dr. JEPPIAAR, M.A., B.L., Ph.D.**, for providing me an opportunity to educate my selves.

I would also like to extend my gratitude towards our Chancellor **Dr. MARIAZEENA JOHNSON, B.E., M.B.A., M. Phil., PhD.** and President **Dr. MARIE JOHNSON, B.E., M.B.A., M.Phil., PhD.** and our beloved vice presidents **Mr. J. ARUL SELVAN, Ms. MARI BERNADETTE TAMILARASI, Ms. MARIA CATHERINE JAYAPRIYA** of Sathyabama Institute of Science and Technology, Chennai, for their extensive support to carry out my professional training.

I wish to convey my heartfelt sincere thanks to our Vice Chancellor **Dr. T. SASIPRABA, M.E., Ph.D.**, for her motivation and support during my professional training. I offer my sincere gratitude to our Pro Vice Chancellor **Dr. E. LOGASHANMUGAM, M.E., Ph.D.**, for his encouragement and support.

My sincere thanks to **Dr. RAMESH KUMAR, M.Sc., Ph.D.** Dean, School of Bio and Chemical Engineering and **Dr. T. SUDHAKAR, M.Sc., Ph.D.** Head of the Department, Department of Biomedical Engineering for providing me necessary support.

I would like to express my sincere and deep sense of gratitude to my Guides **Dr. SINDU DIVAKARAN, M.E., Ph.D.** and **Dr. A. SABARIVANI, M. Tech., Ph.D.** for thier valuable guidance, suggestions and constant encouragement paved way for the successful completion of my professional training.

Abstract

Hospital Training is focused on equipping healthcare professionals with the essential skills for effective and safe operation of advanced medical equipment. The program integrates hands-on simulations, theoretical modules, and practical scenarios, emphasizing the nuances of diverse medical devices. By addressing the complexities associated with equipment interfaces, maintenance, and troubleshooting, the training seeks to enhance proficiency and confidence among healthcare practitioners. The abstract provides insights into the structured curriculum, incorporating case studies and real-world scenarios to ensure practical applicability. The anticipated outcomes include improved equipment utilization, reduced downtime, and, ultimately, elevated patient care through the proficient use of cutting-edge medical technologies.

Content

	CONTENT	PAGE.NO
1	Introduction	1
1.1	History	1
1.2	Services	1
2	Internship Activity	1
2.1	X-RAYS	2
2.2	CT	5
2.3	MRI	8
2.4	ECG	11
2.5	DEFIBRILLATOR	13
2.6	EEG	17
2.7	MAMMOGRAM	21
2.8	LITHOTRIPSY	25
	Conclusion	28
	Reference	29

LIST OF FIGURES

Figure 1.1	X-RAY Scanner	Pg.2
Figure 1.2	Block Diagram of X-Ray Scanner	Pg.4
Figure 2.1	CT machine	Pg.6
Figure 2.2	Working of CT Machine	Pg.7
Figure 3.1	MRI Scanner	Pg.9
Figure 3.2	Working of MRI Scanner	Pg.10
Figure 4.1	ECG Device	Pg.12
Figure 4.2	Graph of ECG	Pg.14
Figure 5.1	Defibrillator	Pg.16
Figure 6.1	Setup of EEG Electrodes	Pg.18
Figure 6.2	Block Diagram of EEG	Pg.19
Figure 7.1	Mammogram machine	Pg.22
Figure 7.2	Working of Mammogram	Pg.24
Figure 8.1	Lithotripsy	Pg.25

LIST OF ABBREVIATIONS

MRI- Magnetic Resonance Imaging

CT- Computed Tomography

X-Ray- X Radiation

EEG- Electroencephalograph

ECG- Electrocardiograph

CHAPTER 1

INTRODUCTION

1.1 HISTORY OF APOLLO HOSPITALS

Apollo Hospitals was established in 1983 by Dr. Prathap C Reddy, renowned as the architect of modern healthcare in India. As the nation's first corporate hospital, Apollo Hospitals is acclaimed for pioneering the private healthcare revolution in the country. Apollo Hospitals has emerged as Asia's foremost integrated healthcare services provider and has a robust presence across the healthcare ecosystem, including Hospitals, Pharmacies, Primary Care & Diagnostic Clinics and several retail health models. Apollo Hospitals has been honored by the trust of over 150 million individuals who came from 140 countries. Apollo Hospitals was among the first few hospitals in the world to leverage technology to facilitate seamless healthcare delivery. The organization embraced the rapid advancement in medical equipment's across the world, and pioneered the introduction of several cutting-edge innovations in India. Recently, South East Asia's first Proton Therapy Centre commenced operations at the Apollo Centre in Chennai.

1.2 SERVICES INCLUDE

- 24 Hours emergency medical care.
- Multispecialty hospital.
- Providing world standard healthcare.
- Complete laboratory services.
- Fully digital imaging center with MRI, CT, X-RAY And Ultrasound.
- Angiography-Diagnostic and therapeutic.
- It also includes Mammography and Endoscopy.
- Medical pharmacy

CHAPTER 2

INTERNSHIP ACTIVITY

2.1 X-Rays

2.1.1 Introduction

X-ray, short for "X-radiation," is a powerful form of electromagnetic radiation with a wavelength shorter than visible light. It was discovered in 1895 by German physicist Wilhelm Conrad Roentgen. X-rays are invisible to the human eye and have the ability to penetrate various materials, including the human body. This property makes X-rays invaluable in several fields, particularly in medicine and radiography. X-rays are a form of electromagnetic radiation that can pass through objects and are commonly used in medicine for diagnostic imaging, among other applications. X-ray machines operate based on the principles of electromagnetic radiation and differential absorption. X-rays have revolutionized the field of medicine, enabling healthcare professionals to diagnose various conditions, fractures, infections, and abnormalities.

They are widely used in dentistry, orthopedics, and general medical imaging. Additionally, X-ray technology has advanced over the years to include computed tomography (CT) scans and fluoroscopy, which provide three-dimensional and real-time imaging, respectively. X-rays have revolutionized the field of medicine, enabling healthcare professionals to diagnose various conditions, fractures, infections, and abnormalities. They are widely used in dentistry, orthopedics, and general medical imaging.

2.1.2 Principle

The principle behind X-ray imaging is the differential absorption of X-rays by various materials. This property allows healthcare professionals to visualize and diagnose a wide range of medical conditions, including fractures, tumors, infections, and other abnormalities, by examining the contrast between different tissues in the X-ray image.

They can also be harmful if not used with proper safety precautions due to their ionizing radiation. The detector records the intensity of X-rays that reach it. Areas where more X-rays are absorbed (such as bones) appear as lighter areas on the X-ray image, while areas where fewer X-rays are absorbed (like soft tissues) appear darker.



Fig 1.1

2.1.3 Working

X-rays are generated within the X-ray machine's tube. The tube contains a cathode and an anode. The cathode emits a stream of high-speed electrons, and these electrons are accelerated towards the positively charged anode. Then the high-speed electrons from the cathode strike the anode, they suddenly decelerate. These X-rays are produced in a wide spectrum of energies. To remove low-energy X-rays and ensure that only the high-energy X-rays (which are more useful for imaging) reach the patient, a filter made of a material like aluminum is placed in the path of the X-rays. The X-rays then pass through the patient's body.

Different tissues absorb X-rays to varying degrees, with denser tissues like bones absorbing more X-rays, while softer tissues like muscles and organs absorb fewer.

On the other side of the patient, there is a detector or film that captures the X-rays after they have passed through the body. In modern machines, digital detectors are commonly used, which convert the X-ray energy into electrical signals. The electrical signals from the detector are processed by a computer. Denser tissues appear whiter (since they absorb more X-rays), while softer tissues appear darker. The final X-ray image is displayed on a screen or printed for the radiologist or physician to interpret. This process allows healthcare professionals to visualize the internal structures of the body, diagnose conditions, and monitor treatment progress. It's important to note that X-ray machines are operated by trained professionals to minimize radiation exposure and ensure safety.

2.1.4 Block Diagram

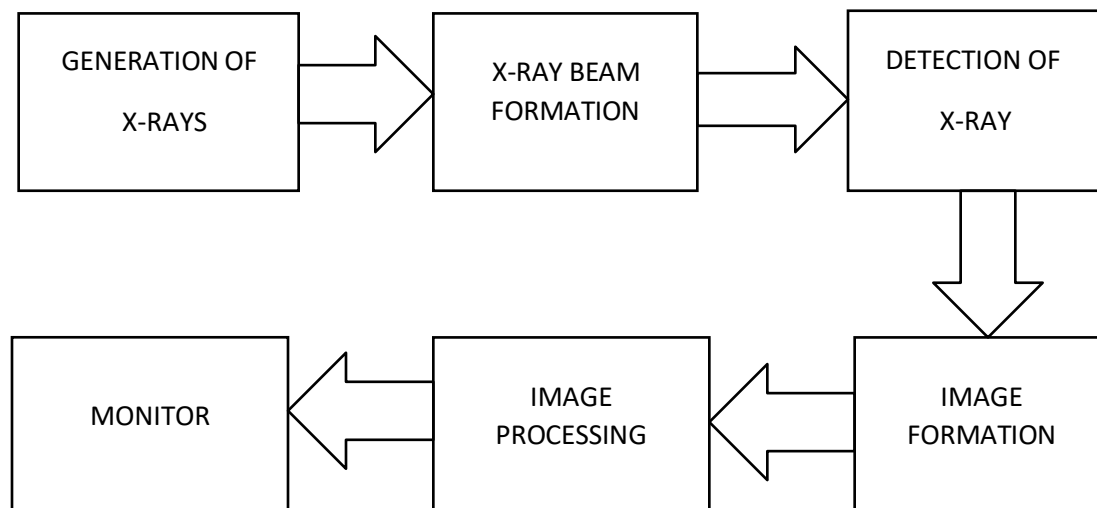


Fig 1.2

2.1.5 Diagnosis

X-ray machines have numerous uses across different fields, primarily revolving around their ability to produce X-rays for imaging and analysis.

X-ray machines are extensively used in medicine to diagnose various conditions and injuries. They can visualize bones, detect fractures, assess joint problems, and identify internal issues like tumors, pneumonia, or foreign objects. Dentists use X-ray machines to examine teeth and jawbones, helping diagnose dental conditions, cavities, and plan orthodontic treatments.

In radiation oncology, X-ray machines (linear accelerators) are used to deliver targeted radiation therapy to cancerous tumors while sparing surrounding healthy tissue. X-rays are used in scientific research, including X-ray crystallography to study the atomic and molecular structure of substances, as well as X-ray fluorescence (XRF) and X-ray diffraction (XRD) for material analysis. X-ray machines are used in medical and technical training programs to educate students on anatomy, radiology, and NDT techniques.

2.1.6 Applications

It has wide range of applications in medicine, industry, Security, and research.

- X-Rays are commonly used for diagnosis purpose in medicine.
- CT scan uses X-Ray to create detailed cross- Sectional images of the body.
- X-Rays are used in Dentistry to diagnose dental problems.
- X-Ray Scanners are employed for baggage and Cargo inspection at airports and security.

2.2 CT (Computed Tomography)

2.2.1 Introduction

CT stands for "Computed Tomography." It is a medical imaging technique that uses X-rays and computer processing to create cross-sectional images, or "slices," of the body. These images provide detailed information about the internal structures of the body, including bones, organs, and tissues. CT scans are valuable for diagnosing a wide range of medical conditions and guiding surgical procedures due to their ability to produce highly detailed and three-dimensional images.



Fig2.1

2.2.2 principle

CT scanning is based on the principle of using X-rays and computer technology to create detailed cross-sectional images of the body.

2.2.3 Working

The CT scanner consists of an X-ray source and a detector array. The X-ray source emits a controlled beam of X-rays that passes through the body. The patient is positioned on a table that can move horizontally and is placed inside a circular or cylindrical structure. This structure, often referred to as a gantry, houses the X-ray source and detector array. The gantry rotates around the patient during the scan. As the gantry rotates, the X-ray source emits multiple narrow beams of X-rays from various angles around the patient. These beams pass through the body and are detected by the detector array on the opposite side. The detector array records the intensity of the X-rays that pass through the body from different angles. This data is collected as a series of 2D X-ray images. A powerful computer processes the collected X-ray data to reconstruct cross-sectional images, or "slices," of the body. This process is known as tomography. By combining the information from multiple angles, the computer creates detailed 3D images. The reconstructed images are displayed on a monitor, providing a clear view of the internal structures of the body. Radiologists use these images for diagnosis and treatment planning.

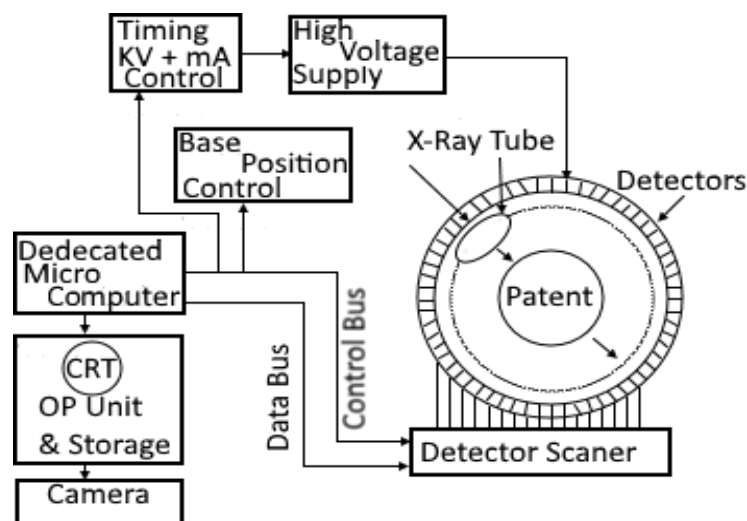


Fig 2.2

2.2.4 Applications

CT (Computed Tomography) imaging has a wide range of applications in the medical field and beyond. Here are some of the key applications:

- Detecting tumors, cysts, and other abnormalities in organs such as the brain, lungs, abdomen, and pelvis.
- Assessing bone fractures, joint disorders, and musculoskeletal injuries.
- Imaging the coronary arteries to diagnose heart disease (CT coronary angiography).
- Identifying the extent of trauma in emergency cases
- CT scans play a crucial role in cancer care by helping oncologists:
 - Determine the stage and size of tumors.
 - Plan radiation therapy and surgical procedures.
 - Monitor the progress of cancer treatment.
- Emergency cases
- CT scans of the brain are valuable for:
 - Detecting and assessing head injuries.
 - Identifying strokes and hemorrhages.
 - Visualizing brain tumors and abnormalities.

2.2.5 Diagnosing Techniques

- CT scans are essential in the emergency department for diagnosing injuries related to trauma, such as fractures, internal bleeding, and organ damage.
- CT colonography, or virtual colonoscopy, is a non-invasive way to screen for colorectal cancer and detect polyps or abnormalities in the colon.
- CT scans are useful for detailed evaluation of bone and joint conditions, including complex fractures and preoperative planning for joint replacement surgery.

2.3 MRI (Magnetic Resonance Imaging)

2.3.1 Introduction

Magnetic Resonance Imaging (MRI) is a medical imaging technique that uses strong magnetic fields and radio waves to create detailed images of the internal structures of the body, including the brain, muscles, and organs. It is commonly used for diagnosis and monitoring of various medical conditions. MRI is a non-invasive and versatile imaging technique that provides detailed anatomical information and can be used to diagnose a wide range of medical conditions without exposing patients to ionizing radiation.



Fig 3.1

2.3.2 Working

MRI equipment operates on the principles of magnetism and radiofrequency signal. The core of an MRI machine is a superconducting magnet that generates a powerful, uniform magnetic field. This field aligns the nuclei of hydrogen atoms within the body's tissues. When a patient enters the MRI scanner, RF coils are used to send a short burst of radio waves into the body. This pulse temporarily disrupts the alignment of the hydrogen nuclei. After the RF pulse is turned off, the hydrogen nuclei return to their aligned state, releasing energy in the process. This energy is detected by the RF coils and is used to create an image. Gradient coils are used to create a spatially varying magnetic field. By changing the strength of these gradient coils, the MRI machine can pinpoint the location of the emitted signals, allowing for the creation of detailed 2D or 3D images. The signals received from the RF coils are processed by a computer to generate detailed cross-sectional images of the body. These images can represent different types of tissue, such as muscles, organs, or bloodvessels, based on variations in the hydrogen nuclei's behavior. Advanced algorithms are used to reconstruct the raw data into high-resolution images that can be interpreted by radiologists or other medical professionals.

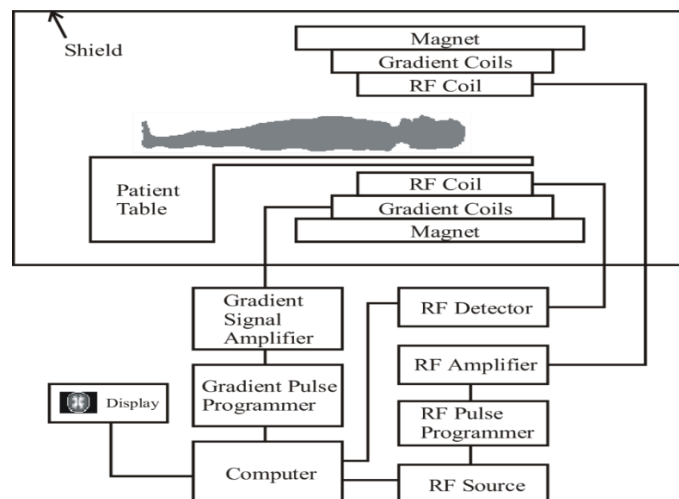


Fig3.2

2.3.3 Uses and Imaging Technique

Magnetic Resonance Imaging (MRI) has a wide range of uses in the field of medicine due to its ability to produce detailed images of the body's internal structures without using ionizing radiation.

- MRI is highly effective in diagnosing injuries or abnormalities in soft tissues such as muscles, ligaments, tendons, and cartilage. It is often used for evaluating sports injuries, joint problems, and musculoskeletal disorders.
- MRI is crucial for imaging the brain and spinal cord. It's used to diagnose conditions like tumors, strokes, multiple sclerosis, and neurological disorders. Functional MRI (fMRI) can even map brain activity
- MRI can provide detailed images of the organs in the abdomen and pelvis, including the liver, kidneys, pancreas, and reproductive organs. It's valuable for detecting tumors, cysts, and other abnormalities.
- Breast MRI is used as a supplementary imaging tool to evaluate breast health. It's often recommended for women at high risk of breast cancer and for further assessment of breast abnormalities.
- MRI is valuable in cancer care for determining the stage of tumors, assessing their size and location, and planning treatments like surgery or radiation therapy.
- MRI is also used in scientific research to study the human body's anatomy and function. It has contributed to advancements in understanding various medical conditions.

2.3.4 Applications

These are just a few of the many applications of MRI in medicine. Its non-invasive nature and ability to provide detailed, multi-dimensional images make it an invaluable tool for diagnosing and monitoring a wide range of health conditions.

2.4 ECG (Electrocardiogram)

2.4.1 Introduction

An Electrocardiogram is a widely used medical test that provides valuable information about the electrical activity of the heart. It is a fundamental tool in cardiology and is employed to diagnose various heart conditions and monitor cardiac health. Here's an introduction to ECG. The primary purpose of an ECG is to record and analyze the electrical impulses generated by the heart as it contracts and pumps blood. These electrical signals, known as heartbeats or cardiac cycles, are essential for maintaining the heart's rhythm and function.

The heart's electrical system controls the sequence of muscle contractions, ensuring that the chambers of the heart contract in a coordinated manner. Any disruptions or abnormalities in this electrical activity can indicate heart problems. Electrodes are strategically placed on the body to capture the heart's electrical signals from multiple angles. The typical leads used include standard limb leads (I, II, III), augmented limb leads (aVR, aVL, aVF), and precordial leads (V1 to V6).

2.4.2 Principle

The principle behind an Electrocardiogram is to measure and record the electrical activity of the heart. This electrical activity, represented as waves on the ECG graph, provides valuable information about the heart's rhythm, rate, and overall function. The principle behind an Electrocardiogram is to measure and record the electrical activity of the heart. This electrical activity, represented as waves on the ECG graph, provides valuable information about the heart's rhythm, rate, and overall function. To capture and record these electrical signals, small adhesive electrodes are placed on specific points of the body, typically on the chest, limbs, and sometimes the precordial area (front of the chest). These electrodes act as sensors that detect changes in electrical potential as the heart's electrical impulses spread through the body.



Fig 4.1

2.4.3 Working and procedure

The electrical signals generated by the heart are very weak, typically measured in millivolts (mV). To make these signals more easily detectable and recordable, the ECG machine amplifies them. Amplification increases the voltage of the electrical signals while preserving their shape and timing. Depending on the type of ECG being performed, the electrodes are connected in different configurations known as leads. Leads capture the electrical activity from different angles, providing a comprehensive view of the heart's electrical behavior.

There are standard limb leads (I, II, III), augmented limb leads (aVR, aVL, aVF), and precordial leads (V1 to V6), among others. As the heart contracts, electrical impulses propagate through the heart muscle, causing depolarization and repolarization of cardiac cells.

The electrical signals detected by the electrodes are transmitted to the ECG machine via electrical conductors or cables. Each lead corresponds to a specific electrode placement, and the machine receives signals from multiple leads simultaneously.

The ECG machine records the electrical signals as a series of waves on a graph paper or a digital screen. This graphical representation is the ECG waveform, which consists of several key components:

P Wave: Represents atrial depolarization, indicating the electrical activity in the atria as they contract.

QRS Complex: Reflects ventricular depolarization, signifying the electrical impulses spreading through the ventricles as they contract.

T Wave: Indicates ventricular repolarization, as the heart prepares for the next cardiac cycle.

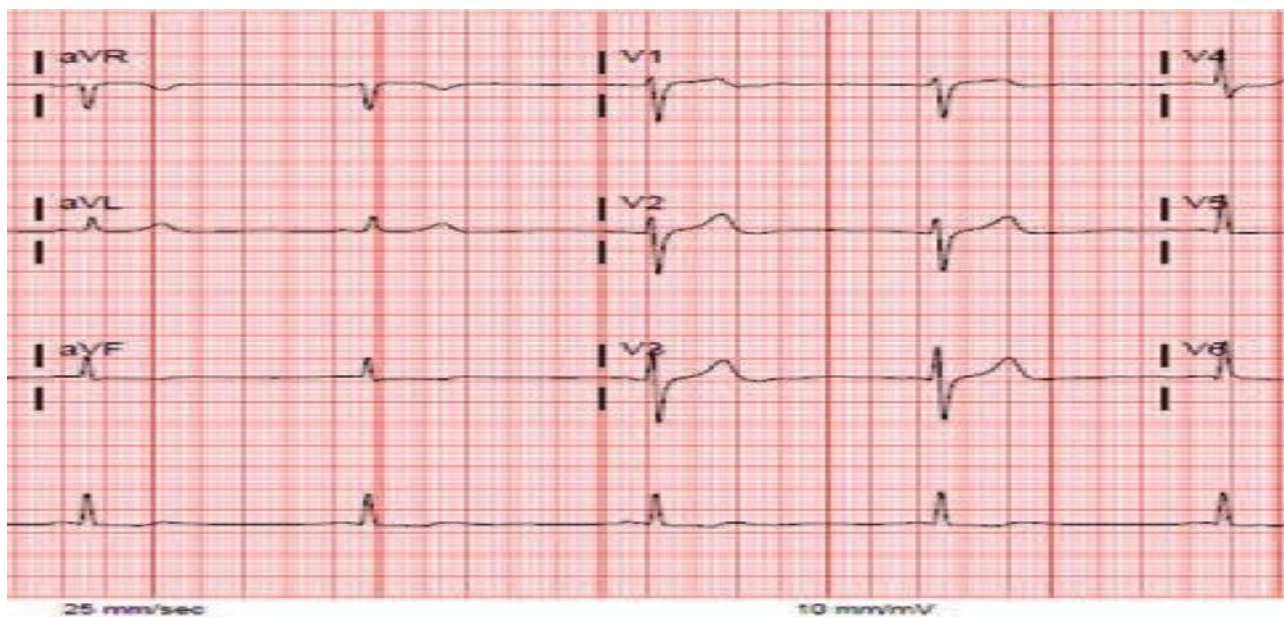


Fig 4.2

2.4.4 Diagnosis

Diagnosing a patient's condition using an Electrocardiogram involves the careful analysis of the ECG waveform, which reflects the electrical activity of the heart. Trained healthcare professionals, such as cardiologists or technicians, interpret the ECG to make clinical assessments and diagnose various heart conditions.

Heart Rate: The healthcare professional calculates the heart rate by measuring the intervals between consecutive R waves (R-R interval) on the ECG. This provides information about the heart's rate, which is usually expressed in beats per minute (bpm).

Rhythm: The regularity or irregularity of the heart's rhythm is assessed. Normal sinus rhythm, arrhythmias (abnormal rhythms), or irregular patterns are identified based on the ECG.

2.4.5 Applications

- It helps identify left ventricular hypertrophy (LVH) or right ventricular hypertrophy (RVH), which are signs of chamber enlargement.
- ECG monitoring is used in sports and fitness settings to assess an athlete's cardiovascular fitness and monitor for potential arrhythmias or abnormalities during intense physical activity.
- ECG is a fundamental tool in cardiovascular research, helping scientists study heart function, arrhythmias, and the effects of drugs or interventions.

2.5 Defibrillator

2.5.1 Introduction

Defibrillator is a life-saving medical device used to restore a normal heart rhythm in individuals experiencing a sudden cardiac arrest (SCA). Here's an overview of defibrillators and their importance in emergency medical care.



Fig 5.1

2.5.2 working

Defibrillators are equipped with sensors or electrodes that can monitor a person's heart rhythm. When an abnormal and potentially life-threatening heart rhythm, such as ventricular fibrillation (VF) or ventricular tachycardia (VT), is detected, the defibrillator delivers an electrical shock. The electrical shock, delivered through the chest wall to the heart, is intended to momentarily stop the abnormal electrical activity in the heart muscle. This brief interruption allows the heart's natural pacemaker to regain control and reestablish a normal rhythm. Modern defibrillators often have built-in monitors that display the patient's heart rhythm. Healthcare providers can assess the effectiveness of the shock and determine if additional shocks are needed.

2.5.3 Procedure

Sudden cardiac arrest can be fatal within minutes. Defibrillators provide a rapid response to restore a normal heart rhythm, increasing the chances of survival. Automated External Defibrillators (AEDs) are designed for use by bystanders, including those without medical training. They are often found in public places, including airports, malls, and sports facilities, making it possible for anyone to initiate lifesaving measures. Cardiac arrest is a leading cause of death worldwide. Defibrillators, when used promptly along with cardiopulmonary resuscitation (CPR), significantly improve survival rates. Modern defibrillators, especially AEDs, are designed to be user-friendly. They provide clear voice and visual instructions to guide laypersons through the process. Defibrillators are standard equipment in hospitals and ambulances. Healthcare providers use them to treat various cardiac arrhythmias and sudden cardiac arrest cases. Timely defibrillation not only saves lives but also prevents brain damage caused by a lack of oxygen during cardiac arrest. It's important to note that while defibrillators are critical in cardiac emergencies, they are not a replacement for professional medical care. After using a defibrillator, it's essential to seek immediate medical attention to address the underlying cause of the cardiac arrest and ensure the patient receives comprehensive care.

2.5.4 Applications

- 1.They are used in cardiac emergencies to increase survival.
- 2.They are used in hospitals.
- 3.They are used in cardiac surgery the electrodes are placed on the chest.
- 4.Defibrillator are sometimes used to stop the heart to counteract the effects of trauma.
- 5.They are found in Malls, Airports, and Sport facilities.

2.6 EEG

2.6.1 Introduction

Electroencephalography (EEG) is a neurophysiological monitoring method that records electrical activity in the brain over time. It's commonly used to diagnose epilepsy and other brain disorders, as well as in research to study brain function.

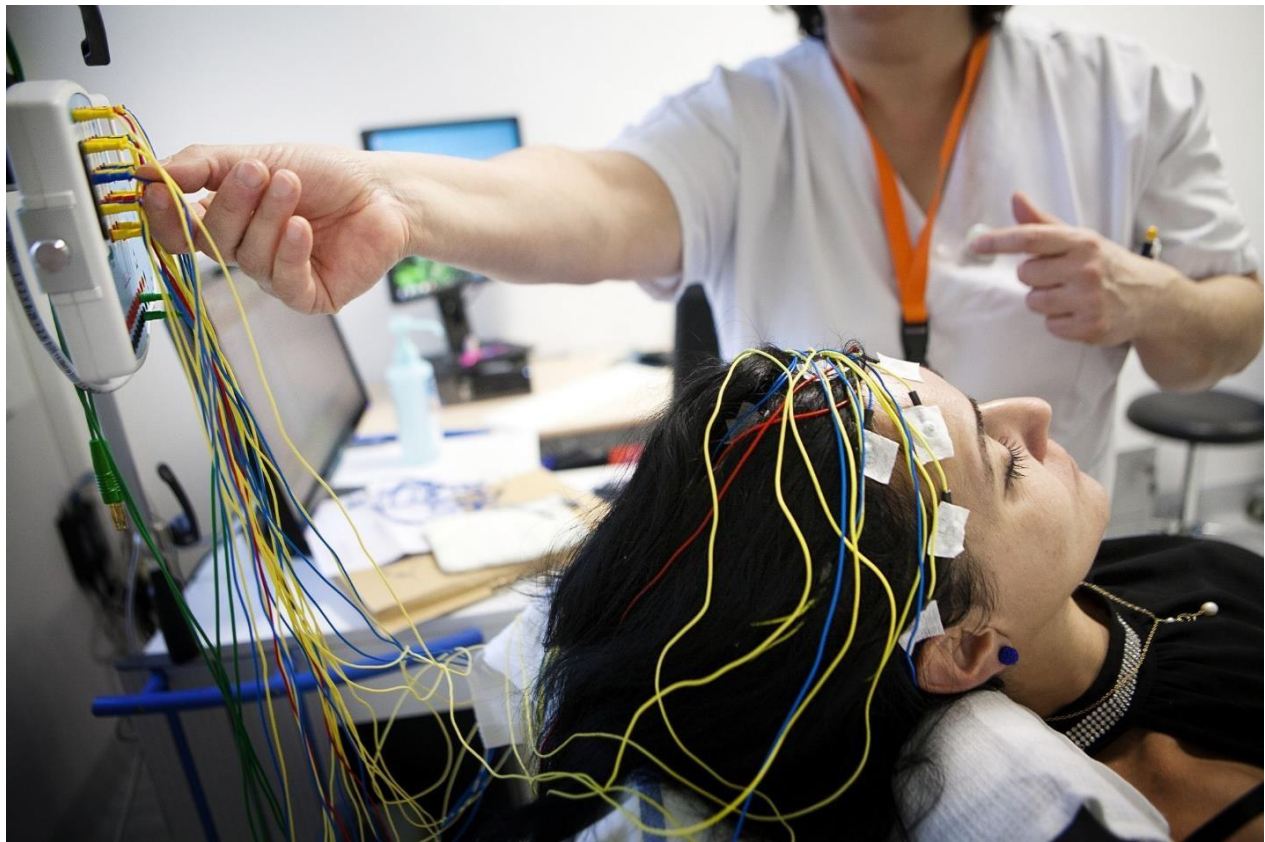


Fig 6.1

2.6.2 Principle

The principle of an Electroencephalogram is to record and monitor the electrical activity of the brain.

2.6.3 Working

EEG works by placing electrodes on the scalp to detect and record electrical activity generated by neurons in the brain. These electrodes are typically attached to different regions of the head to capture the overall brain activity.

The electrical signals, or brainwaves, are measured in terms of frequency (cycles per second, or Hertz) and amplitude (strength of the signal). The main types of brainwaves include delta, theta, alpha, beta, and gamma waves, each associated with different states of consciousness and activities.

EEG data is then amplified, filtered, and displayed on a monitor or recorded for analysis. Changes in the patterns of brainwaves can indicate various conditions, such as sleep stages, seizures, or abnormalities in brain function.

2.6.4 Block Diagram

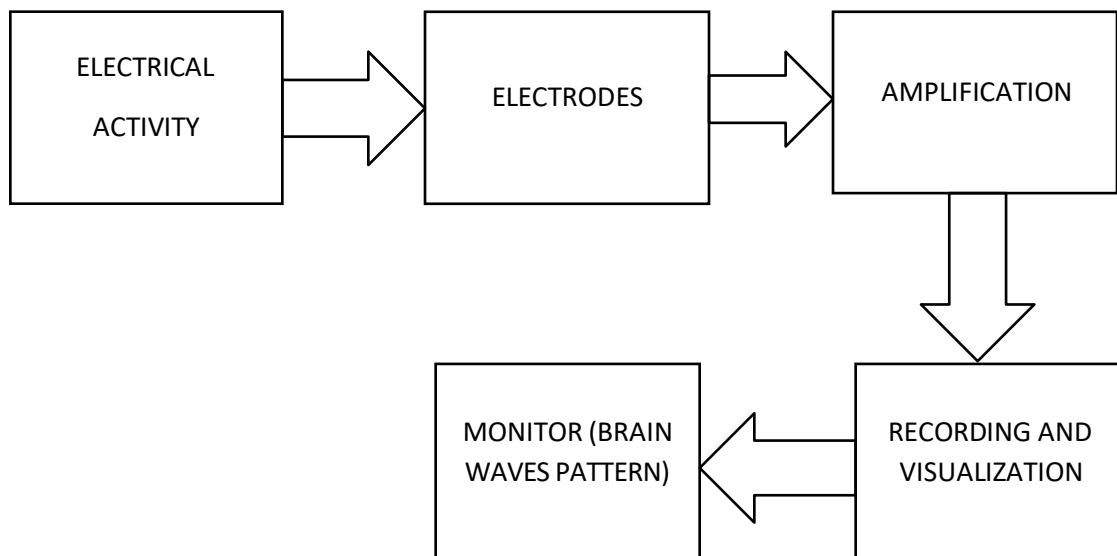


Fig 7.2

2.6.5 Diagnosis

EEG is used in various ways for both clinical and research purposes:

- EEG is commonly used to diagnose and monitor epilepsy. It can help identify abnormal patterns and locate the source of seizures.
- EEG is used to study sleep patterns and diagnose disorders like insomnia, sleep apnea, and narcolepsy. Brain assists in evaluating brain function, detecting abnormalities, and monitoring patients with brain injuries or neurological disorders.
- EEG is employed to study cognitive processes such as attention, memory, and language, providing insights into how the brain works during various tasks.
- EEG is used in developing BCIs, allowing individuals to control devices using their brain activity. EEG is used in neurofeedback therapy where individuals learn to self-regulate and control their brainwave patterns. This can be applied to conditions like ADHD or anxiety.
- EEG helps monitor the depth of anesthesia during surgery, ensuring patients are adequately anesthetized and preventing awareness during the procedure. EEG is used to study the effects of meditation and mindfulness on brain activity, providing insights into altered states of consciousness.

2.6.6 Applications of EEG

- It is used in Pharmacological Studies.
- Research on Brain Function.
- It monitors Anesthesia.
- It is used to detect Brain Injury.

2.7 Mammogram

2.7.1 Introduction

Mammogram is a specialized type of X-ray imaging used for the early detection of breast cancer and the evaluation of breast health in women. Here's how mammograms work and their significance. Mammography is a specialized medical imaging technique used for the early detection and diagnosis of breast cancer. It plays a crucial role in breast cancer screening and has significantly contributed to the early diagnosis and treatment of this disease. Mammography is primarily used for breast cancer screening and the evaluation of breast abnormalities. It aims to detect breast cancer at an early stage when it's more treatable. Mammography has revolutionized breast cancer detection and has saved countless lives by identifying cancers when they are small and more treatable. It is an essential component of breast cancer screening programs and is recommended as part of routine healthcare for women.



Fig 7.1

2.7.2 Working

During a mammogram, the breast is gently compressed between two flat plates. This compression helps spread out breast tissue, ensuring a more detailed and clearer X-ray image-rays are directed through the compressed breast tissue onto a detector. The X-rays are of low energy and safe, but they can be absorbed differently by various types of tissue within the breast. The X-ray images obtained are called mammograms.

They are captured in both a top-to-bottom view (cranio-caudal) and a side view (mediolateral oblique) to provide a comprehensive view of the breast tissue. Radiologists analyze the mammogram images for any signs of abnormal tissue, such as masses, calcifications, or distortions. These could be indicative of breast cancer or other breast health issues.

Mammograms are a critical tool for the early detection of breast cancer, often before physical symptoms develop. Early detection greatly improves the chances of successful treatment and survival. Regular mammography screening is recommended for women, typically starting at the age of 40 or earlier for those at higherrisk. It's a proactive measure to detect breast cancer in its early stages. Mammograms are also used diagnostically when a woman or her healthcare provider detects a breast lump, pain, or other symptoms, or when further evaluation of an abnormal screening result is needed. Women with a history of breast cancer may have regular mammograms to monitor for any recurrence or changes in breast tissue. If an abnormality is found on a mammogram.

2.7.3 Procedure

During a mammogram, the patient's breast is gently compressed between two flat plates of the mammography machine. X-rays are then used to capture images of the breast tissue

Types of Mammography

Screening Mammography: This is the most common type and is performed as a preventive measure for women who have no symptoms. It helps detect breast cancer before any signs or symptoms are noticeable.

Diagnostic Mammography: This is used when a woman has symptoms or when an abnormality is found during a screening mammogram. It provides more detailed images and helps to evaluate specific concerns, such as a lump or pain.

Digital Mammography: Digital mammography is the modern standard, replacing traditional film-based mammography. It captures and stores images electronically, allowing for easier storage, retrieval, and sharing of images. Digital mammography is more precise and can be especially useful for women with dense breast tissue.

3D Mammography: This advanced technique, often called breast tomosynthesis, captures multiple X-ray images from different angles, creating a 3D reconstruction of the breast tissue. It offers improved accuracy in detecting breast cancers, particularly in women with dense breasts.

2.7.4 Clinical Importance

Mammography is a vital tool for breast cancer detection and early intervention. Detecting breast cancer at an early stage greatly increases the chances of successful treatment and survival. Regular mammographic screening is recommended for women, particularly those over 40 years of age, as part of breast cancer prevention and early detection strategies.

Breast Health Awareness: In addition to mammography, regular breast self-exams and clinical breast exams by healthcare professionals are important components of breast health awareness.

2.7.5 Block Diagram

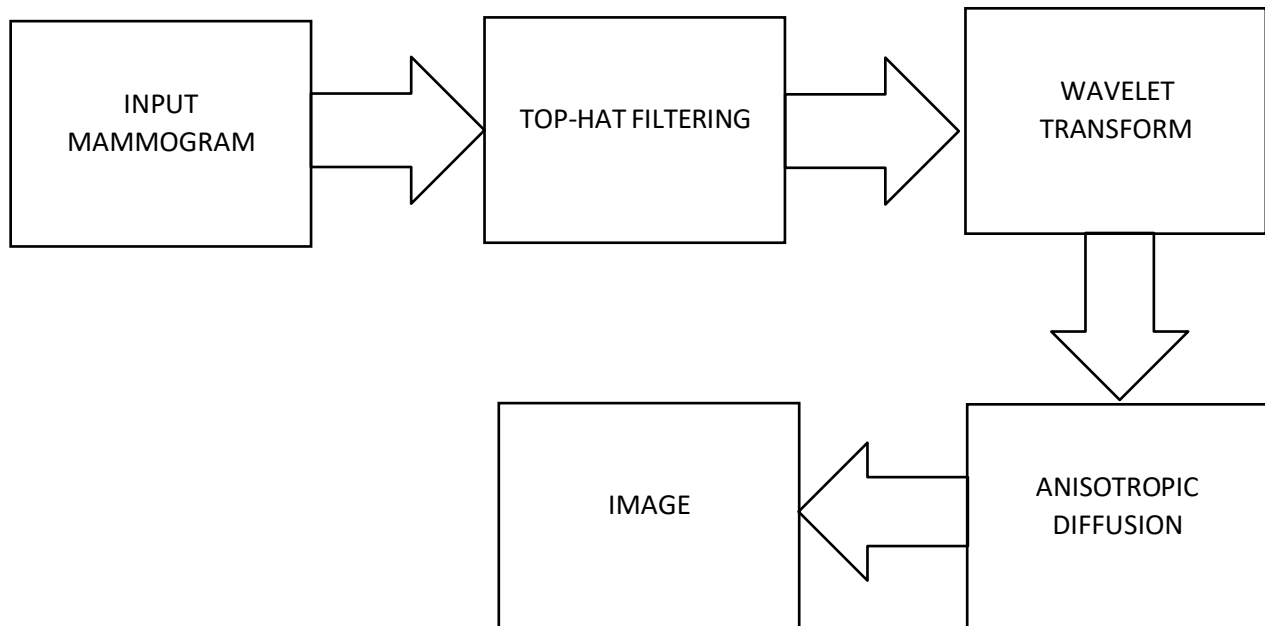


Fig 7.2

2.7.6 Diagnosis

Mammograms are a crucial tool in breast health and breast cancer prevention. They play a vital role in early detection and ultimately save lives by allowing for timely intervention and treatment. It's important for women to discuss mammography recommendations and schedules with their healthcare providers based on their individual risk factors and age.

2.7.7 Applications

- They are used as screening tool to detect early cancer.
- They help to find calcifications, cysts.
- They also help to find cancerous and non-cancerous lumps.

2.8 Lithotripsy

2.8.1 Introduction

Lithotripsy is a medical procedure used to treat certain types of kidney stones and gallstones without the need for surgery. It involves the use of high-energy shock waves or laser energy to break down the stones into smaller fragments, which can then be passed naturally out of the body. Lithotripsy has become a common and effective treatment option for kidney stones, allowing many patients to avoid more invasive surgical procedures. However, the suitability of lithotripsy depends on factors such as the size, location, and composition of the stones, as well as the patient's overall health. It's typically performed under the guidance of a urologist or a healthcare specialist with expertise in kidney stone management. Lithotripsy has evolved over the years, and there are different methods of delivering shock waves, including extracorporeal shock wave lithotripsy (ESWL) and intracorporeal lithotripsy techniques using laser or pneumatic devices.



Fig 8.1

2.8.2 Working

The patient typically undergoes imaging tests, such as an ultrasound or X-ray, to locate the exact position and size of the kidney or gallstones. The patient is positioned on a special table or device that allows precise targeting of the stones. An external machine generates high-energy shock waves.

These shock waves are focused and directed toward the location of the stones in the body. The shock waves are then delivered through the patient's skin and tissues to the stones. The energy from the shock waves is absorbed by the stones, causing them to break into smaller pieces. As the stones fragment, they become smaller and more manageable for the body to pass through the urinary or biliary system. before the procedure, the patient is usually asked to fast for a few hours. An intravenous (IV) line may be inserted to administer medication for pain and sedation.

2.8.3 Procedure

For certain types of stones or those located in specific areas, an alternative method known as endoscopic laser lithotripsy may be used. An endoscope, a thin, flexible tube with a light and camera, is inserted through natural openings or small incisions to access the stones. A laser fiber is passed through the endoscope and directed at the stones. The laser energy breaks down the stones into smaller fragments. The smaller stone pieces can be removed using tools or flushed out naturally depending on their size and location. The patient is positioned in a specialized lithotripter machine. Depending on the type of lithotripter used, the patient may lie on a water-filled cushion or a table.

X-ray or ultrasound imaging is used to precisely locate the kidney stone(s) and determine their size and position. The lithotripter generates high-energy shock waves externally. These shock waves are focused and directed toward the location of the kidney stone(s) using the imaging guidance.

Shock waves are delivered through the skin and tissues to the targeted kidney stones. The waves create intense pressure at the stone's location. The pressure waves generated by the shock waves impact the kidney stone(s), causing them to break into smaller fragments. The process is not painful due to the sedation or anesthesia provided. After lithotripsy, the smaller stone fragments are typically easier to pass naturally through the urinary tract. Patients may experience some discomfort or mild pain as these fragments are eliminated from the body through urine.

2.8.4 Indications for Lithotripsy

Kidney Stones: Lithotripsy is commonly used for kidney stones, particularly those less than 2 centimeters in size. Larger stones may require additional or alternative treatments.

Gallstones: In the case of gallstones, lithotripsy is used when the stones are small and amenable to fragmentation, typically within the bile ducts.

Lithotripsy is generally a less invasive option than surgical procedures for stone removal, which can reduce recovery time and complications. However, the choice of treatment depends on factors such as the size and location of the stones, as well as the patient's overall health. It's important for patients to discuss their specific condition and treatment options with their healthcare provider.

2.8.5 Applications

- It is a medical procedure that uses shock waves to break kidney stones.
- It detects common bile duct stones.
- It removes Kidney stones, Bladder stones and etc.
- It is non-invasive treatment.

CONCLUSION

Hospital training for biomedical engineers typically involves hands-on experience in various aspects of medical equipment maintenance, repair, and calibration. Engineers may learn to troubleshoot and diagnose issues with devices such as imaging equipment, patient monitors, and life support systems. Training often includes understanding hospital protocols, safety standards, and collaboration with medical staff. Biomedical engineers may also receive instruction on compliance with regulatory requirements and advancements in medical technology. Overall, hospital training equips biomedical engineers with the practical skills and knowledge needed to support and enhance healthcare technology within a clinical setting.

REFERENCES

- Institute of Electrical and Electronics Engineers (IEEE)
- World Health Organization (WHO)
- Centers for Disease Control and Prevention (CDC)
- National Institute of Health (NIH)
- Health and Social Care Information Centre (HSCIC)
- International Organization for Standardization (ISO)