

PROFESSIONAL TRAINING - 1

Submitted in partial fulfillment of the requirements for the award of Bachelor of
Technology degree in Biomedical Engineering

By

Rithika D (41240029)



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

SATHYABAMA

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

Accredited with Grade “A++” by NAAC

JEPPIAAR NAGAR, RAJIV SALAI, CHENNAI - 600 119

October-2023



SATHYABAMA

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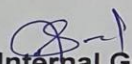
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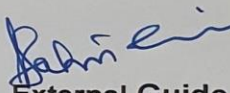
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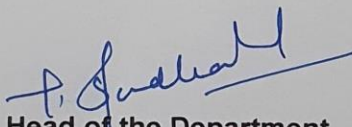
DEPARTMENT OF BIO AND CHEMICAL SCIENCES

BONAFIDE CERTIFICATE

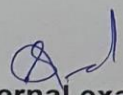
This is to certify that this Professional Training Report is the bonafide work of **RITHIKA D(41240029)** who has completed the training program in "HOSPITAL TRAINING" as a part of professional development under my supervision from 01/06/2023 to 08/06/2023.

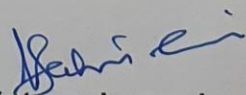

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TRAINING PROGRAMME CERTIFICATE

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OF SCIENCE AND TECHNOLOGY** has undergone training
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period of 01.06.2023 to 08.06.2023.

She displayed keen interest and completed the training program
satisfactory. Her conduct was good during the above period.

We wish her all the best.


MANAGING DIRECTOR
Dr. M. ASIK AMEEN
CHAIRMAN
AASI MULTISPECIALITY HOSPITAL

Exceptional Care , Every Patient , Every Day

DECLARATION

I **RITHIKA D** hereby declare that the professional training Report completed by me during my professional training at “**AASI MULTISPECIALITY HOSPITAL**” under the guidance of **Dr.A.SABARIVANI, M.Tech.,PhD.,** and **Ms.SINDU DIVAKARAN** is submitted in partial fulfillment of the requirements for the award of Degree in Bachelor of Technology in Biomedical Engineering 2021-2025.

DATE: 03.10.2023

PLACE: CHENNAI



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RITHIKA D

ACKNOWLEDGEMENT

I wish to express my most sincere and profound gratitude to our beloved Founder Chancellor **Col. Dr. JEPPIAR,M.A. ,B.L., Ph. D.**, for providing me an opportunity to educate myself.

I am also pleased to acknowledge sincere thanks to 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 President **Mr. J. ARUL SELVAN, Ms. MARIA BERNADETTE TAMILARASI, Ms. MARIA CATHERINE JAYAPRIYA** of Sathyabama Institute of Science and Technology, Chennai, for their unwavering support to carry out my research work.

I am truly thankful to our Vice Chancellor **Dr. T. SASIPRABA, M.E., Ph.D.**, to our Pro Vice Chancellor **Dr. E. LOGASHANMUGAM , M.E., Ph.D.**, our beloved registrar **Dr. S.S. RAO MBA., Ph.D.**, our Director of Administration **Dr. G.SUNDARI M.E., Ph.D.** for their kind encouragement and support.

I would like to extend my thanks to **Dr. B.SHEELA RANI ,M.S., Ph.D.**, Director (research),Our Dean of school of Bio and Chemical sciences **DR. RAMESH KUMAR, M.Sc., Ph.D.** our head of the department **Dr. T. Sudhakar M.Sc., Ph.D.**, and our professional training guides **Ms. SINDU DIVAKARAN** and **Dr. A.SABARIVANI ,M. Tech., Ph.D.** Thank you for being a part of this educational journey with us.

I wish to express my thanks to all Teaching and Non-teaching staff members of the Department of Biomedical engineering who were helpful in many ways for the completion Of the report.

I would like to express my sincere and deep sense of gratitude to my training guide **Dr.M.ASIK AMEEN.,M.S(ORTHO)** and all the staff for their consant guidance and supervision during the period of my professional training and for providing me the necessary technical inputs for the completion of my training.

I extend my thanks to my family members for their unconditional love,belief and care.

ABSTRACT

This abstract provides a concise overview of the professional training experience in biomedical engineering at AASI MUTLISPECIALITY HOSPITAL. The training program is designed to equip aspiring biomedical engineers with essential skills and knowledge required to excel in the dynamic healthcare technology landscape.

Trainees will have the unique opportunity to work closely with healthcare professionals, gaining firsthand experience in a clinical setting. This exposure will enhance their understanding of medical equipment, devices, and systems used for patient care.

Trainees will engage in the maintenance, calibration, and troubleshooting of a wide array of medical devices, including diagnostic equipment, life support systems, and imaging technology. This hands-on experience ensures competence in managing critical healthcare assets.

Biomedical engineers will learn about the stringent regulatory requirements governing medical devices. This includes an understanding of quality assurance, safety standards, and compliance with relevant healthcare regulations.

Biomedical engineers will learn how to effectively communicate and collaborate with multidisciplinary teams to solve complex healthcare challenges.

Biomedical engineers will receive mentorship and guidance to develop their professional skills. This includes career development workshops, resume building, and interview preparation.

The ethical dimension of biomedical engineering will be emphasized, promoting responsible and ethical practices in the development and use of medical technology.

Overall, the professional training in biomedical engineering at AASI MULTISPECIALITY HOSPITAL aims to produce well-rounded biomedical engineers who are prepared to make meaningful contributions to the healthcare industry. The program's comprehensive curriculum and practical experiences ensure that graduates are equipped with the skills, knowledge, and ethical awareness needed to excel in this critical field of healthcare technology.

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I.INTRODUCTION:

AASI MULTISPECIALITY HOSPITAL, formerly known as **CORTEX MULTISPECIALITY HOSPITAL**, is a 100-bedded hospital located at RAMANATHAPURAM, it is headed by its **CHAIRMAN DR.ASIK AMEEN**, besides being as a chairman he is an eminent ORTHOPEDIC SURGEON. He strongly manages a team of expertised, skilled doctor professionals to assist all kind of emergency situations. His focus is to give medical care for all people with ultimate quality at affordable price.

As a biomedical engineer, the journey towards contributing to the advancement of healthcare and medical technology is both exhilarating and challenging. This Professional Training Report encapsulates my immersive experience within the dynamic and critical environment of a hospital. Throughout this report, I will delineate the substantial role I have played in bridging the realms of engineering and healthcare, showcasing the pivotal impact of biomedical engineering on patient care and the overall functioning of the hospital.

This Professional Training Report will serve as a comprehensive documentation of my experiences, challenges, and accomplishments as a biomedical engineer in a hospital. It will shed light on the pivotal role that biomedical engineers play in the healthcare ecosystem and their contributions to improving the well-being of patients. Through this report, I hope to share insights that can inspire and inform future endeavors in the field of biomedical engineering within a hospital context.

II.EQUIPMENT:

2.1PHYSIOTHERAPY:

2.1.1IFT:



fig:2.1.1



fig:2.1.2

Interferential Therapy (IFT) is a type of physical therapy treatment that uses electrical currents to manage pain and promote healing. It's commonly used by physiotherapists and other healthcare professionals to address various musculoskeletal conditions and pain management.

It involves the use of two medium-frequency alternating currents, typically in the range of 2,000 to 4,000 Hz. These currents intersect and interfere with each other where they cross in the target tissue. This interference creates a new frequency, which is lower and can penetrate deeper into the body. IFT machines can be handled by biomedical engineers, particularly in healthcare settings where they are responsible for maintaining and servicing medical equipment.

Biomedical engineers can install IFT machines and ensure they are calibrated correctly. Calibration ensures that the electrical currents produced by the machine are accurate and safe for patient use. Biomedical engineers can also handle upgrades and software updates for IFT machines to ensure they meet current safety and performance standards.

When healthcare professionals encounter technical issues with IFT machines during patient treatments, biomedical engineers can be called upon to diagnose and troubleshoot the problems promptly.

2.1.2. TENS:



fig:2.1.3



fig:2.1.4

A TENS machine ,Transcutaneous Electrical Nerve Stimulation machine, is a portable, battery-operated device that is used for pain management and relief. It works by delivering electrical impulses to the body's nerves through electrodes placed on the skin.

Biomedical engineers can install TENS machines and ensure they are calibrated correctly. Calibration ensures that the electrical currents delivered by the TENS machine are accurate and safe for the intended purpose. They work by stimulating the nerves in the area where the electrodes are placed. This stimulation can help to block or reduce the perception of pain signals sent to the brain, providing relief for various types of pain.

The TENS machine generates low-voltage electrical currents, which are delivered through electrodes placed on the skin. These electrical currents can stimulate sensory nerves, possibly interfering with the transmission of pain signals.

Proper electrode placement is essential for effective TENS therapy. Electrodes are typically placed on or near the area where the pain is experienced. The choice of electrode placement can vary depending on the type and location of pain.

TENS therapy can be used to manage various types of pain, including chronic pain, acute pain (such as post-surgery pain) also pain related to conditions like arthritis, back pain, and muscle strains.

2.1.3. ULTRA SOUND:



fig:2.1.5



fig:2.1.6

Ultrasound machines are commonly used in physiotherapy (physical therapy) for various therapeutic and diagnostic purposes. It is used for physiotherapy are typically handled and maintained by biomedical engineers. Biomedical engineers play a crucial role in ensuring that medical equipment, including ultrasound machines, is functioning correctly, safely, and efficiently.

Therapeutic ultrasound is a common modality in physiotherapy. It involves using an ultrasound machine to deliver high-frequency sound waves to the body's tissues, typically in the range of 1 to 3 MHz. These sound waves generate heat within the tissues, which can have several therapeutic effects.

Ultrasound can help alleviate pain by increasing blood flow to the treated area, promoting the relaxation of muscles, and stimulating the release of endorphins, the body's natural painkillers. It can reduce inflammation by increasing blood flow and promoting the drainage of excess fluids from the affected area. It is believed to accelerate the healing process by increasing the metabolic rate of cells and promoting the production of collagen, a protein essential for tissue repair.

physiotherapists may use ultrasound to monitor the progress of healing and assess whether the treatment plan needs adjustment. it is used to guide certain physiotherapeutic procedures, such as joint injections or needling techniques. The real-time imaging provided by ultrasound can help ensure accurate needle placement.

2.1.4. LASER THERAPY:



fig:2.1.7



fig:2.1.8

Laser therapy, also known as low-level laser therapy (LLLT) or photobiomodulation therapy, is a non-invasive medical treatment that uses low-level lasers or light-emitting diodes (LEDs) to stimulate healing, reduce pain, and promote tissue repair. Laser therapy is increasingly used in physiotherapy and rehabilitation settings for a variety of applications.

Biomedical engineers are responsible for managing the inventory of laser therapy devices and related accessories, such as laser probes. They ensure that the equipment is readily available when needed and that there are sufficient spare parts on hand. Laser therapy can stimulate cellular metabolism, which enhances the production of adenosine triphosphate (ATP), the energy currency of cells. This increased energy can promote cell repair and regeneration.

Laser therapy can stimulate the release of endorphins, the body's natural painkillers, providing pain relief. It may also reduce nerve sensitivity and improve pain threshold. It can be effective in managing acute and chronic pain, including musculoskeletal pain, back pain, and arthritis. Laser therapy is used for wound care, promoting faster healing and reducing the risk of infection.

While biomedical engineers play a vital role in ensuring the proper functioning and safety of laser therapy equipment, it's essential to note that the clinical use of laser therapy, including treatment planning and administration, is typically performed by trained and licensed physiotherapists or healthcare professionals

2.2. ICU:

2.2.1. VENTILATOR:



fig:2.2.1



fig:2.2.2

A ventilator is a medical device used to assist individuals with breathing when they are unable to do so adequately on their own. Ventilators are essential in various healthcare settings, including intensive care units (ICUs), emergency departments, and during surgeries. Ventilators are complex medical devices that are typically managed and maintained by biomedical engineers, especially in hospital and healthcare settings.

Types of Ventilators:

Invasive Ventilators: These are connected to the patient's airway through an endotracheal tube or tracheostomy tube. They are commonly used in critical care settings for patients with severe respiratory distress.

Non-Invasive Ventilators: These deliver breathing support through a mask or nasal prongs, without the need for an artificial airway. They are often used for patients with less severe respiratory issues, such as sleep apnea or chronic obstructive pulmonary disease (COPD).

The ventilator delivers a set number of breaths per minute, with each breath supported by the machine. Patients can also trigger additional breaths. Patients initiate breaths, and the ventilator provides support by maintaining a set pressure. Used for non-invasive ventilation, CPAP maintains positive airway pressure to help keep the airways open during inhalation and exhalation.

Biomedical engineers play a pivotal role in ensuring the proper functioning and safety of ventilators, which are essential life-support devices in critical care settings. Their expertise and attention to detail are critical for maintaining the quality of patient care and preventing equipment failures. Additionally, their collaboration with healthcare providers is vital to delivering safe and effective respiratory support to patients.

2.2.2. ECG:



fig:2.2.3



fig:2.2.4

ECG, or Electrocardiography, is a medical test that records the electrical activity of the heart over a period of time. It is a valuable tool for diagnosing various heart conditions and assessing cardiac health. Biomedical engineers often play a significant role in the development, maintenance, and optimization of ECG (Electrocardiography) systems and equipment, as well as in research related to ECG technology.

The primary purpose of an ECG is to record the electrical impulses generated by the heart as it contracts. It helps in diagnosing various heart conditions, including arrhythmias, heart attacks, heart enlargement, and other cardiac abnormalities. During an ECG, electrodes (small, adhesive patches) are placed on specific locations on the skin, typically on the chest, arms, and legs. These electrodes detect the electrical signals produced by the heart and transmit them to an ECG machine, which records the signals as a series of waves on paper or digitally on a computer screen.

ECG can be used to analyze the heart's rhythm. It can detect abnormal rhythms, such as atrial fibrillation (AFib), ventricular tachycardia, and bradycardia. The ECG recording consists of several waves and intervals, each of which represents a specific electrical

event in the heart's cycle. The most well-known waveforms on an ECG include the P wave, QRS complex, and T wave.

ECGs are commonly used in cardiology, emergency medicine, and general healthcare settings to assess heart health, diagnose conditions, and monitor the effects of treatments. ECG is a non-invasive and essential tool for diagnosing and monitoring a wide range of cardiac conditions. It helps healthcare providers make informed decisions regarding patient care, treatment plans, and interventions for heart-related issues.

Biomedical engineers may be involved in the design and development of ECG machines and related technologies. This includes designing the hardware components (such as electrodes and sensors) and the software algorithms used for signal processing and data analysis. Biomedical engineers are responsible for calibrating ECG machines to ensure that they provide accurate readings. This involves adjusting the equipment to produce the correct voltage and waveform measurements.

Biomedical engineers work alongside healthcare professionals and clinicians to ensure that ECG technology is reliable, accurate, and effectively used for patient care and diagnosis. Their expertise in both engineering principles and healthcare applications is instrumental in advancing the field of electrocardiography.

2.2.3. PULSE OXIMETER:



fig:2.2.5



fig:2.2.6

A pulse oximeter is a medical device used to measure the oxygen saturation level in a person's blood and their heart rate. It is a non-invasive and quick way to assess a person's oxygenation and pulse rate. Biomedical engineers are involved in various

aspects of pulse oximeters, including their design, development, testing, maintenance, and integration into healthcare systems.

Pulse oximeters work based on the principle of spectrophotometry. They emit specific wavelengths of light (typically red and infrared) through a person's skin, and a sensor on the other side of the skin detects the light that emerges. The amount of light absorbed by oxygenated and deoxygenated hemoglobin in the blood provides information about oxygen saturation.

The device provides a percentage value called SpO₂. Normal SpO₂ levels are typically above 95%. Pulse oximeters also display the person's heart rate, usually measured in beats per minute (BPM). Many people use pulse oximeters at home to monitor their own oxygen levels, especially those with chronic respiratory conditions like COPD (Chronic Obstructive Pulmonary Disease) or asthma.

During the COVID-19 pandemic, pulse oximeters gained attention as a tool for monitoring oxygen levels in individuals with mild to moderate COVID-19 symptoms, as low oxygen levels (hypoxemia) can be an early sign of respiratory distress.

Biomedical engineers often participate in the design and development of pulse oximeter devices. They work on the hardware components, optical sensors, signal processing algorithms, and user interfaces. They work on improving sensor performance, reducing interference from ambient light, and enhancing signal processing techniques to obtain accurate oxygen saturation readings.

Biomedical engineers play a vital role in advancing the capabilities and reliability of pulse oximeters, which are essential tools for monitoring oxygen saturation and heart rate in healthcare settings. Their expertise contributes to the design and maintenance of these devices, ensuring their accuracy and effectiveness in patient care.

2.2.4. SYRINGE PUMP:



fig:2.2.7



fig:2.2.8

A syringe pump is a medical device used to deliver precise and controlled amounts of fluids, such as medications, nutrients, or other solutions, into a patient's bloodstream or body. Syringe pumps are commonly used in hospitals, clinics, and healthcare settings where accurate and controlled drug administration is critical.

The primary purpose of a syringe pump is to ensure the controlled and accurate delivery of fluids or medications into a patient's body over a specified period. This precision is essential in situations where even slight variations in dosage can have significant clinical consequences.

Syringe pumps are compatible with various types and sizes of syringes, typically ranging from 1 mL to 60 mL or more. Syringe pumps are designed for continuous infusion, which means they can deliver a consistent flow of fluid or medication at a specified rate over time. Syringe pumps often include alarm systems to alert healthcare providers to issues such as occlusions, empty syringes, or programming errors.

Biomedical engineers are often involved in maintaining, calibrating, and repairing syringe pumps to ensure their accuracy and functionality. They may also be involved in the design and development of syringe pump technology.

2.2.5. DEFIBRILLATOR:



fig:2.2.9



fig:2.2.10

A defibrillator is a medical device that is used to deliver an electric shock to the heart in order to restore a normal heart rhythm during a life-threatening cardiac arrhythmia, particularly ventricular fibrillation (VF) and ventricular tachycardia (VT). Defibrillators are crucial in emergency medical situations, especially for individuals experiencing sudden cardiac arrest. Biomedical engineers play a significant role in various aspects of defibrillator technology, including its development, maintenance, and integration into healthcare systems.

Types of Defibrillators:

Automated External Defibrillators (AEDs): Portable and user-friendly devices designed for use by laypersons, often found in public places. AEDs provide voice prompts and instructions to guide rescuers.

Manual Defibrillators: Used by healthcare professionals, these devices allow the operator to manually control the timing and intensity of the shocks.

Implantable Cardioverter-Defibrillators (ICDs): Surgically implanted devices for individuals at risk of life-threatening arrhythmias. ICDs continuously monitor the heart's rhythm and deliver shocks when needed.

The software used in defibrillators for rhythm analysis, shock delivery, and user interface is a critical aspect. Biomedical engineers develop and optimize software algorithms for

real-time cardiac rhythm analysis and shock delivery, making sure they are safe and effective.

Defibrillators need precise energy management systems to deliver controlled shocks. Engineers work on energy storage, discharge, and delivery systems to ensure that the device delivers the appropriate shock energy at the right time.

Biomedical engineers engage in research and development to advance defibrillator technology. They explore innovative methods for cardiac rhythm analysis, energy delivery, and safety enhancements. Biomedical engineers' expertise ensures that defibrillators are accurate, reliable, and user-friendly medical devices that can quickly and effectively treat life-threatening cardiac arrhythmias.

2.3. LAB:

2.3.1. AIA 360 IMMUNOASSAY ANALYS:



fig:2.3.1

In the field of clinical diagnostics, immunoassay analyzer are used to detect and quantify various substances in biological samples (e.g., blood, serum, urine) using immunoassay techniques. These substances can include hormones, proteins, antibodies, drugs, and various biomarkers related to diseases.

2.3.2. HEMATOLOGY ANALYZER H50:



fig:2.3.2

Hematology analyzers are medical devices used to analyze blood samples and provide various blood-related parameters, including complete blood counts (CBC) and information about different blood cell types. It's possible that a "Hematology Analyzer H50" is a specific model or product offered by a manufacturer in the field of hematology analyzers. These devices are commonly used in clinical laboratories and healthcare settings to assess a patient's overall health and diagnose various medical conditions, including anemia, infections, and blood disorders.

2.3.3. GENUINE BIOSYSTEM GB 235:



fig:2.3.3

2.3.4. GENUINE BIOSYSTEM GBLYTE-3:



fig:2.3.4

2.3.5. BIOCHEMISTRY ANALYZER-DRACA 150:



fig:2.3.5

"Biochemistry Analyzer DRACA 150." However, biochemistry analyzers are commonly used in clinical laboratories and healthcare settings to perform various biochemical tests on blood or serum samples. These tests can include measuring parameters like blood glucose, liver enzymes, kidney function markers, and cholesterol levels, among others.

2.3.6. UROGB 120-URINE ANALYZER:



fig:2.3.6

The "UROGB 120" appears to be a model or product designation for a urine analyzer used in clinical laboratories and healthcare settings to perform various tests on urine samples. Urine analyzers are essential tools for diagnosing and monitoring a wide range of medical conditions and providing insights into a patient's overall health. These analyzers can measure parameters such as urine chemistry, urine microscopy, and specific markers to detect various diseases and conditions.

2.4. OPERATION THEATRE:

2.4.1. OT LIGHT:



fig:2.4.1



fig:2.4.2

Operation theatre lights, also known as surgical lights or operating room lights, are specialized lighting fixtures designed for use in surgical and medical procedures. These lights provide high-intensity, focused illumination to ensure optimal visibility during surgeries and medical interventions.

These lights typically have a color temperature close to natural daylight (around 4,000-6,500 Kelvin), which helps in accurate tissue differentiation and reduces eye strain for medical professionals. Many modern surgical lights use LED (Light Emitting Diode) technology for illumination. LED lights offer advantages such as energy efficiency, long lifespan, and minimal heat generation.

Surgeons often use sterile surgical light handles or controllers to adjust the position and settings of the lights during surgery without breaking sterility. Surgical lights are essential tools in the operating room, providing the illumination needed for surgical precision and accuracy. They are a critical component of the equipment used to create a safe and effective surgical environment.

2.4.2. OPERATION THEATRE TABLE:



fig:2.4.3



fig:2.4.4

An OT (Operating Table) table, also known as a surgical table or operating room table, is a specialized piece of medical equipment used in surgical and medical procedures. These tables are designed to provide a stable and adjustable platform for patients during surgery, allowing surgeons and medical staff to perform procedures with precision and comfort.

Operating tables are engineered to be stable and durable, ensuring that they can support patients of various sizes and weights without wobbling or shifting during surgery. Some surgical tables have radiolucent tops, which do not interfere with X-ray imaging, fluoroscopy, or C-arm procedures. These tables are commonly used in orthopedic and spinal surgeries.

Operating tables are designed to be compatible with various surgical equipment, including anesthesia machines, surgical lights, and imaging equipment. Patient safety is a top priority, and operating tables are equipped with safety features to secure patients during procedures, such as safety straps and padding.

2.4.3. C-ARM:



fig:2.4.5

A C-arm is a specialized medical imaging device used primarily in surgical and interventional radiology procedures. It is named for its C-shaped arm that holds the X-ray source and detector on opposite ends, allowing for real-time X-ray imaging during surgical and medical interventions.

The C-shaped design of the arm allows for flexible positioning and easy maneuverability around the operating table or patient. The arm can be rotated and tilted to obtain optimal imaging angles.

C-arms are often equipped with fluoroscopy, a technique that involves continuously capturing X-ray images to visualize the movement of contrast agents, catheters, or other medical devices in real-time.

C-arms are used in a wide range of medical procedures, including orthopedic surgery (e.g., fracture reduction and joint procedures), vascular surgery (e.g., angiography), cardiology (e.g., cardiac catheterization), and gastrointestinal procedures (e.g., endoscopy).

C-arms can be mobile (mounted on wheels) or fixed (installed in a specific location within an operating room or interventional suite). Mobile C-arms offer flexibility and can be easily moved between rooms.

C-arms are invaluable tools in modern medicine, providing real-time imaging capabilities that enhance the precision and safety of surgical and interventional procedures. They enable healthcare providers to visualize and guide medical interventions effectively, reducing the need for open surgery and promoting quicker recovery times for patients.

2.4.4. ANESTHESIA MACHINE:



fig:2.4.6

An anesthesia machine, also known as an anesthetic machine or anesthesia workstation, is a medical device used in surgical and medical procedures to administer anesthetic gases and medications to patients, ensuring their comfort and safety during surgery or other medical interventions.

Anesthesia machines provide a controlled mixture of medical gases and anesthetic agents to patients. Common gases include oxygen, nitrous oxide, and air. These gases are delivered through breathing circuits to the patient.

Anesthesia machines provide mechanical ventilation to support a patient's breathing during surgery. Ventilation modes can be adjusted based on the patient's needs, including volume-controlled ventilation and pressure-controlled ventilation.

Many anesthesia machines include oxygen concentrators that produce medical-grade oxygen from room air, ensuring a continuous supply of oxygen during procedures. Modern anesthesia machines may integrate with electronic medical records (EMR) systems and other equipment, such as patient monitors and ventilators, for seamless data sharing and coordination during surgery.

Anesthesia machines feature a user interface that allows anesthesiologists and healthcare providers to adjust settings, control gas flow, and monitor the patient's condition. Anesthesia machines are essential in surgical and medical settings, ensuring that patients receive safe and effective anesthesia during procedures.

2.4.5. SUCTION MACHINE:



fig:2.4.7

A suction machine, also known as a suction pump or aspirator, is a medical device used to remove unwanted fluids, secretions, or debris from a patient's airway, respiratory system, or a specific area of the body. Suction machines are commonly used in healthcare settings, including hospitals, clinics, and home healthcare environments, to help patients breathe more easily and maintain clear airways.

Suction machines generate a controlled vacuum or negative pressure to extract fluids and substances. The strength of the suction can often be adjusted to suit the specific requirements of the procedure or patient.

Types of Suction Machines:

Portable Suction Machines: These are compact and lightweight, designed for use in various healthcare settings, including ambulances, clinics, and homes.

Fixed or Wall-Mounted Suction Machines: These are permanently installed in hospital rooms or operating rooms for continuous and high-capacity suction.

Suction machines are used to clear the airways of patients who have excess mucus, blood, or other secretions that hinder breathing. In surgical procedures, suction machines help remove blood and other fluids from the surgical field to maintain visibility and facilitate the surgeon's work. In dentistry, suction machines are used to remove

saliva and debris from the patient's mouth during dental procedures. Suction machines can assist in wound care by removing excess fluids and promoting wound healing.

They are operated by trained healthcare professionals, including nurses, respiratory therapists, and doctors, and are essential tools in ensuring patient comfort and safety.

2.4.6. STERILIZER MACHINE:

AUTOClave:



fig:2.4.8

An autoclave is a specialized medical device used for the sterilization of equipment and instruments in healthcare and laboratory settings. Sterilization is the process of killing or removing all forms of microbial life, including bacteria, viruses, fungi, and spores, from objects to prevent the transmission of infections. Autoclaves use high-pressure steam to achieve this level of sterilization.

Autoclaves operate by exposing items to saturated steam at a high temperature and pressure. This combination effectively kills microorganisms by denaturing their proteins and destroying their cell membranes. Autoclaves are equipped with controls to regulate the pressure and temperature during the sterilization cycle. The typical operating temperature is around 121°C (250°F) at 15 pounds per square inch (psi) of pressure.

Types of Autoclaves:

Gravity Autoclaves: These rely on the natural circulation of steam for sterilization and are commonly used in dental and small medical practices.

Pre-Vacuum Autoclaves: These use vacuum cycles to remove air from the chamber before introducing steam. They are often used in hospitals and larger healthcare facilities.

Autoclaves are designed with safety features to prevent accidents, including pressure relief valves, interlocking systems, and alarms.

Autoclaves are critical tools in healthcare, dental, and laboratory settings for ensuring the sterility of instruments and equipment. Properly sterilized instruments are essential for patient safety and preventing the spread of infections in medical and dental procedures.

2.4.7. OXYGEN CONCENTRATOR:



fig:2.4.9

An oxygen concentrator is a medical device that is used to provide a continuous supply of oxygen to individuals with respiratory conditions or those in need of supplemental oxygen therapy. Oxygen concentrators work by drawing in ambient air, removing nitrogen, and delivering a concentrated stream of oxygen to the user.

Oxygen concentrators typically provide oxygen concentrations ranging from 87% to 95%, depending on the model and settings. This concentration is suitable for most individuals requiring supplemental oxygen.

Portable Oxygen Concentrators (POCs): These are compact and lightweight, designed for on-the-go use. They often run on rechargeable batteries, making them suitable for travel and daily activities.

Stationary Oxygen Concentrators: Stationary models are larger and designed for use in a fixed location, such as a home or healthcare facility. They are typically more powerful and have higher flow rate capabilities.

Oxygen concentrators are commonly used for home oxygen therapy to manage chronic respiratory conditions such as chronic obstructive pulmonary disease (COPD), emphysema, and severe asthma.

Oxygen concentrators are an essential tool in the management of respiratory conditions, providing individuals with a reliable and continuous source of oxygen to improve their quality of life and overall well-being. Users should receive proper training on the operation and maintenance of these devices to ensure their safety and effectiveness.

2.4.8. ELECTROSURGICAL UNIT:



fig:2.4.10

An electrosurgical unit (ESU) is a medical device used in various surgical procedures to cut or coagulate tissues using high-frequency electrical currents. The ESU generates a high-frequency electrical current that passes through a fine wire or electrode. This

heated electrode is used to cut or coagulate tissue. The intense heat created by the current helps to control bleeding during surgery and allows for precise tissue manipulation.

the ESU coagulates tissues by applying a high-frequency current to seal small blood vessels, preventing excessive bleeding during surgery. This is particularly useful in procedures that involve delicate tissues or those with a rich blood supply.

ESUs come in various models and with different features, including monopolar and bipolar modes. Monopolar mode is more commonly used for cutting and coagulation, while bipolar mode is suitable for more delicate procedures where precise control is necessary. Ensuring proper training and following safety protocols are essential when using an electrosurgical unit to minimize the risk of complications.

It's worth noting that electrosurgery should be performed by trained medical professionals who understand the principles and safety measures associated with this technology, as improper use can lead to tissue damage, electrical burns, and other complications.

2.4.9. SMOKE EVACUATOR:



fig:2.4.11

A smoke evacuator is a medical device used in surgical settings to remove smoke, odors, and potentially harmful airborne particles that are generated during various surgical procedures, especially those involving the use of electrosurgical or laser instruments. These devices play a crucial role in maintaining a clean and safe environment in the operating room by reducing the risk of exposure to harmful substances and improving visibility for the surgical team.

The primary function of a smoke evacuator is to capture and remove surgical smoke generated during procedures. Surgical smoke is produced when tissue is cut or coagulated using electrosurgical, laser, or ultrasonic devices. This smoke can contain hazardous substances, including particles, aerosols, and potentially infectious materials.

Removing surgical smoke enhances visibility for the surgical team, reducing the risk of errors and improving overall surgical precision. Surgical smoke can contain harmful substances, including viruses, bacteria, and carcinogenic compounds. By eliminating smoke from the environment, smoke evacuators help protect the health of surgical staff.

Smoke evacuators are commonly used in various surgical specialties, including general surgery, gynecology, plastic surgery, and dermatology, where electrosurgical and laser procedures are routine. Their adoption has become increasingly important in modern healthcare to maintain safe and clean operating rooms.

2.5. X-RAY:



fig:2.5.1



fig:2.5.2

X-rays are a form of electromagnetic radiation with higher energy and shorter wavelengths than visible light. They were discovered by Wilhelm Conrad Roentgen in 1895. X-rays are used in various fields for their ability to penetrate matter, including the human body, and create images of internal structures.

X-rays are commonly used in medicine for diagnostic purposes. They can create images of bones, organs, and tissues, allowing doctors to diagnose and monitor various conditions. X-ray images are particularly useful for detecting fractures, tumors, and infections.

Dentists often use X-rays to assess oral health. Dental X-rays can reveal cavities, gum disease, impacted teeth, and other dental issues. In radiation therapy, high-energy X-rays are used to target and destroy cancer cells. This is known as radiotherapy.

X-rays are employed in scientific research to study the atomic and molecular structures of materials. X-ray crystallography, for example, is used to determine the 3D structures of molecules, including proteins and DNA.

X-rays are also used in astronomy to study high-energy phenomena in space, such as black holes, neutron stars, and supernovae. X-ray telescopes like Chandra provide valuable insights into the universe.

It's important to note that while X-rays are incredibly useful, they can also be harmful if not used carefully. Excessive exposure to X-rays can damage living tissues and increase the risk of cancer. Therefore, medical professionals and radiologic technologists take precautions to limit radiation exposure to patients and themselves during X-ray procedure.

2.6. SCAN:

2.6.1. CT:



fig:2.6.1



fig:2.6.2

CT (computed tomography), is a medical imaging technique that uses X-rays and computer technology to create detailed cross-sectional images of the body. CT scans are also known as CAT scans, which stands for "computerized axial tomography."

CT scans combine multiple X-ray images taken from different angles to create a three-dimensional representation of the body's internal structures. This allows for better visualization of organs, tissues, bones, and abnormalities.

CT scans are widely used in medicine to diagnose and evaluate various conditions, including injuries, infections, tumors, and vascular diseases. CT scans are valuable for assessing traumatic injuries, such as fractures, internal bleeding, and head injuries. They are often used in cancer care to determine the stage of a tumor and its precise location.

While CT scans provide valuable diagnostic information, they involve exposure to ionizing radiation, which can potentially increase the risk of cancer. Therefore, medical professionals carefully consider the risks and benefits when ordering CT scans and aim to use them judiciously.

There are various types of CT scanners, including single-slice, multi-slice (which can capture multiple images in a single rotation), and cone-beam CT (used in dental and orthopedic applications). Advances in technology have led to faster scanning times and improved image quality.

CT scans are an important tool in modern medicine for diagnosing and monitoring a wide range of medical conditions. They provide valuable information that aids healthcare providers in making informed treatment decisions.

2.6.2. ULTRA SOUND:



fig:2.6.3



fig:2.6.4

An ultrasound scan, also known simply as an ultrasound or sonogram, is a medical imaging technique that uses high-frequency sound waves to create images of the inside of the body. It is a non-invasive and safe method for visualizing various organs, tissues, and structures.

Ultrasound imaging works on the principle of sending high-frequency sound waves (ultrasound) into the body. These waves bounce off internal structures, and the echoes are captured and used to create real-time images.

Pregnancy: One of the most well-known uses of ultrasound is during pregnancy to monitor the growth and development of the fetus, determine the baby's sex, and detect any potential abnormalities.

Application:

- Abdominal Imaging
- Pelvic Imaging
- Cardiac Ultrasound
- Cardiac Ultrasound
- Musculoskeletal Ultrasound
- Vascular Ultrasound
- Breast Ultrasound
- Thyroid Ultrasound

Some ultrasound machines can create three-dimensional (3D) or four-dimensional (4D) images, which provide a more detailed view of the fetus during pregnancy or certain structures in the body.

Ultrasound is widely used in various medical specialties and is especially valuable for its real-time imaging capabilities and lack of ionizing radiation. It plays a crucial role in obstetrics, cardiology, and many other fields of medicine for diagnosis and monitoring.

2.6.3. MRI:



fig:2.6.5



fig:2.6.6

Magnetic Resonance Imaging (MRI) is a powerful medical imaging technique that uses strong magnetic fields and radio waves to generate detailed images of the internal structures of the body. MRI provides excellent soft tissue contrast and is particularly valuable for diagnosing a wide range of medical conditions.

MRI relies on the interaction of hydrogen atoms within the body's tissues with strong magnetic fields. When placed in the magnetic field and subjected to radio waves, these hydrogen atoms emit signals that are captured and used to create detailed images.

Application:

- Anatomy
- Neuroimaging
- Orthopedics
- Cardiac MRI
- Breast MRI

- Abdominal and Pelvic Imaging
- Functional MRI (fMRI)

MRI provides high-resolution, detailed images of soft tissues, making it an invaluable tool for diagnosing and monitoring a wide range of medical conditions. Beyond anatomical imaging, MRI techniques like functional MRI (fMRI) can measure brain activity, while diffusion MRI can map the movement of water molecules in tissues, aiding in the diagnosis of conditions like stroke and cancer.

MRI is a versatile imaging technique that plays a crucial role in modern medicine for both diagnosis and research. Its ability to provide detailed images of the body's internal structures without the use of ionizing radiation makes it a valuable tool for healthcare providers.

2.7. DIALYSIS:



fig:2.7.1



fig:2.7.2

Dialysis is a medical treatment used to perform the functions of the kidneys when they are no longer able to do so effectively. The kidneys are responsible for filtering waste products and excess fluids from the blood, maintaining electrolyte balance, and regulating blood pressure. When the kidneys fail due to conditions like kidney disease, injury, or certain medical conditions, dialysis is necessary to remove waste products and maintain the body's overall balance. There are two primary types of dialysis:

Hemodialysis:

In hemodialysis, a machine called a dialyzer or artificial kidney is used to filter the patient's blood. The blood is withdrawn from the patient's body, passed through the dialyzer to remove waste and excess fluids, and then returned to the patient's bloodstream. During hemodialysis, the patient's blood is circulated through the dialysis machine's filter, and the machine carefully monitors and controls blood pressure, fluid removal, and electrolyte levels.

Peritoneal Dialysis:

Peritoneal dialysis involves using the peritoneum (a membrane in the abdominal cavity) as a natural filter. A sterile dialysis solution is introduced into the abdominal cavity through a catheter. The peritoneum acts as a semi-permeable membrane, allowing waste products and excess fluids to pass from the blood into the dialysis solution. Peritoneal dialysis may be a suitable option for patients who prefer home-based treatment or have difficulty accessing a dialysis center.

Dialysis is a life-saving treatment for individuals with end-stage renal disease (ESRD) or severe kidney dysfunction. While it can help maintain the body's essential functions, it is not a cure for kidney disease. Patients on long-term dialysis often need to make significant lifestyle adjustments and adhere to dietary restrictions.

III.CONCLUSION:

My professional training as a biomedical engineer in a hospital has been a transformative and invaluable experience. Throughout this journey, I have had the privilege of working alongside dedicated professionals, facing real-world challenges, and contributing to the healthcare ecosystem in meaningful ways.

My training has provided me with a deep understanding of medical devices, equipment, and systems used in the hospital setting. I have honed my skills in maintenance, calibration, and troubleshooting, ensuring that these critical tools are reliable and safe for patient care. I have also been involved in research projects and quality assurance initiatives, further enhancing my knowledge and expertise in biomedical engineering.