

PROFESSIONAL TRAINING - 1

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

By

Sweetha. S (41240046)



**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

INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

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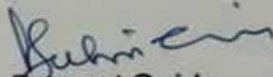
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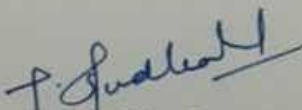
DEPARTMENT OF BIO AND CHEMICAL SCIENCES

BONAFIDE CERTIFICATE

This is to certify that this Professional Training Report is the bonafide work of **SWEETHA S(41240046)** who has completed the training program in "HOSPITAL TRAINING" as a part of professional development under my supervision from 19/05/2023 to 02/06/2023.


Internal Guide

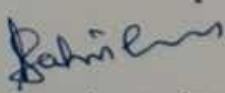

External Guide


Head of the Department

Dr. T. SUDHAKAR, M.Sc., Ph.D.,
Head of the Department,
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Submitted for Viva voce Examination held on 03/09/2023
Category I University by UGC
Approved by the Higher Education Department,
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Internal examiner


External examiner



SRI RAMAKRISHNA
SPECIALTY HOSPITALS PVT. LTD.

Date – 02.06.2023

To whom it may concern

Certificate of Internship

This is to certify that Miss.S.Sweetha,(Reg No.41240046) a 2nd year student of Biomedical Engineering at Sathyabama Institute of Technology, Chennai, has successfully completed an internship at Sri Ramakrishna Specialty Hospital Pvt. Ltd., Trichy from 19.05.2023 to 02.06.2023.

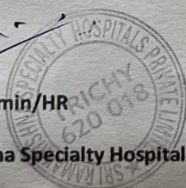
During her internship, Miss. Sweetha demonstrated a strong understanding of biomedical engineering principles and a commitment to patient care. She was a valuable asset to the team and her contributions were greatly appreciated.

We are confident that Miss. Sweetha will be a successful biomedical engineer and we wish her all the best in her future endeavors.

With Regards,

Manager – Admin/HR

Sri Ramakrishna Specialty Hospitals Pvt Ltd



Disclaimer: The results of a laboratory investigation maybe variable in different laboratories for the same patient as the reported results are dependent on the quality of the specimen and the assay procedures used for the particular test. Isolated laboratory investigations only help in arriving at a diagnosis in conjunction with the clinical presentation and other related investigations.

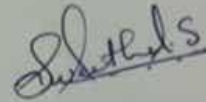
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DECLARATION

I **SWEETHA S** hereby declare that the professional training Report completed by me during my professional training at "**SRI RAMAKRISHNA SPECIALTY 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



SIGNATURE OF THE CANDIDATE

SWEETHA S

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 constant 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 SRI RAMAKRISHNA 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.

This program is meticulously crafted to immerse me in the unique challenges and opportunities within the dynamic healthcare environment. From understanding the intricacies of medical equipment management to developing cutting-edge solutions for patient care, participants will acquire hands-on experience that transcends theoretical knowledge.

The trainer brings a wealth of practical knowledge and a deep understanding of the intricate workings of hospital environments. Their expertise spans various disciplines within healthcare, including biomedical engineering, clinical management, medical technology

The trainers are not only well-versed in the theoretical aspects of hospital operations but also have hands-on experience in navigating the unique challenges and opportunities within healthcare settings

Biomedical engineers will learn how to contribute the design and development of medical devices. They also learn to collaborate with healthcare professionals to understand specific needs and create innovative solutions, ranging from prosthetics to diagnostic tools.

Biomedical engineers are trained to medical staff on the proper use and maintenance of medical equipment. Additionally, they offer technical support, troubleshooting, and guidance in utilizing technology effectively.

Overall, the professional training as biomedical engineering at SRI RAMAKRISHNA 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:

SRI RAMAKRISHNA SPECIALITY HOSPITAL (SRSH), previously known as **Fenix Gastro Hospital**, is a leading hospital for GI & HPB cancer/Oncosurgery in Trichy. There are exclusive center for liver and pancreatic surgery and also offer minimal access surgery for hernia care. hospital is equipped with the latest, state-of-the-art technology to ensure accurate diagnosis and effective treatment of gastrointestinal disorders. They offer a range of services, including endoscopy, colonoscopy, liver and pancreatic care, and surgery.

They specialize in liver and pancreatic cancer surgery, providing world-class treatments and care expert surgeons also perform minimally invasive surgery for hernias, ensuring faster recovery and reduced scarring.

As a biomedical engineer the journey towards the contributing advancement of healthcare and medical technology in both exhilarating and challenging.

During my internship I have demonstrated a strong understanding of biomedical engineering principles and a commitment to patient care

This professional training report will serve as a comprehensive documentation of any experiences challenges, and accomplishments as a biomedical engineer in a hospital

II. EQUIPMENTS

RADIOLOGY EQUIPMENTS:

Radiology instruments are tools and equipment used in the field of radiology, which is a branch of medical science that deals with the use of medical imaging techniques to diagnose and treat diseases. These instruments play a crucial role in capturing and producing images of the internal structures of the body for diagnostic purposes.

X-ray Machine:



Fig 2.1.1



Fig 2.1.2

X-ray machine produces X-rays that pass through the body, creating an image on film or a digital detector. It is a form of electromagnetic radiation which is a quick and painless procedure. While X-rays are immensely valuable, the ionizing radiation they emit can pose health risks with prolonged exposure. Radiologists and technologists follow strict safety protocols to minimize these risks, using lead aprons and other protective measures.

In essence, the X-ray machine is a silent storyteller, revealing the hidden narratives of the human body to healthcare providers, guiding them in their pursuit of health and healing.

The X-ray machine has been constructed with the following materials

X-ray Tube: The heart of the X-ray machine is the X-ray tube. It consists of a cathode and an anode within a vacuum. When high voltage is applied, electrons are accelerated towards the anode, generating X-rays.

Collimator: This device shapes and limits the X-ray beam to the area of interest, reducing unnecessary exposure.

Control Panel: Operators can set parameters such as exposure time and tube current through the control panel.

Image Receptor: In traditional X-ray machines, this is often a film cassette. In modern ones, digital detectors are more common.

The working principal are,

Generation of X-rays: High voltage is applied across the X-ray tube, causing electrons to move from the cathode to the anode. When the high-speed electrons strike the anode, X-rays are produced.

Penetration of Tissues: X-rays pass through the body, with denser tissues absorbing more radiation. The remaining X-rays strike the image receptor, creating an image.

Monitoring Treatment: X-rays are used to monitor the progress of certain medical treatments, such as orthopedic interventions.

Screening and Preventive Care: X-rays are used in various screening programs to detect conditions such as lung cancer and dental issues early on.

They are also used to inspect objects for defect and to detect contraband material such as drug and weapons. X-ray photons have a wide range of energies from low to very high while they are produced when electron are accelerated to high speed and then collide with a metal target.

CT Scanner (Computed Tomography):



fig 2.1.3

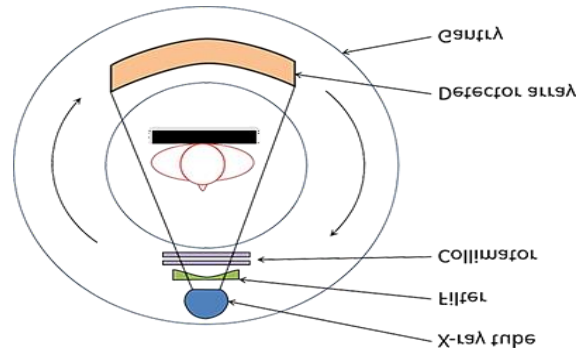


fig 2.1.4

CT scan or computed tomography scan, is a medical imaging procedure that combines X-ray technology with computer processing to create detailed cross-sectional images of the body. It's like taking a series of "slices" through the body to get a 3D view. CT scans are incredibly valuable for diagnosing a wide range of conditions, from injuries to internal diseases, and they provide a level of detail that traditional X-rays often can't match. The process is quick and painless, making it a powerful tool in modern medicine.

CT scans are indeed a vital tool in the field of radiology. They're like the Sherlock Holmes of medical imaging, revealing clues that help doctors solve the mysteries within the human body. Radiologists use CT scans to get detailed images of bones, organs, and tissues, making it easier to diagnose and plan treatments.

The CT scanner itself is a marvel of technology. It rotates around the patient, taking X-ray images from multiple angles. Then, sophisticated computer algorithms reconstruct these images into detailed cross-sectional views. This allows radiologists to examine the body layer by layer, spotting things like fractures, or other abnormalities.

The working of CT (computed tomography) scans involves a combination of X-ray technology and computer processing to create detailed cross-sectional images of the inside of the body. Some of the working principles are,

Patient Positioning: The patient lies on a table that can move through the centre of the CT scanner.

X-ray Beams: The X-ray source emits a series of narrow X-ray beams through the body. These beams are attenuated (absorbed or scattered) by the internal structures such as bones, organs, and tissues.

Detected X-rays : The detector on the opposite side of the patient collects the X-rays that pass through the body. The amount of X-rays detected is influenced by the density of the tissues they pass through.

Data Acquisition: As the patient moves through the scanner, multiple X-ray projections are taken from different angles.

Computer Reconstruction: A computer processes the raw X-ray data and uses sophisticated algorithms to reconstruct cross-sectional images (slices) of the body at various levels.

Image Display: The reconstructed images can be displayed on a computer monitor, providing detailed views of the internal structures of the body in a cross-sectional format.

Fluoroscopy Machine:

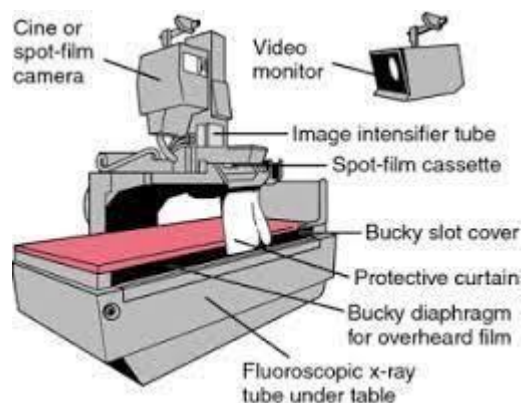


Fig 2.1.5

Fluoroscopy is a specialized imaging technique that uses continuous X-rays to obtain real-time, moving images of the internal structures of a patient's body. Fluoroscopy machines are commonly used in radiology for a variety of diagnostic

and interventional procedures. Fluoroscopy is used in a wide variety of examinations and procedures to diagnose or treat patients. Some examples are: Barium X-rays and enemas is to view the gastrointestinal tract Catheter insertion and manipulation is to direct the movement of a catheter through blood vessels, bile ducts or the urinary system

Components of Fluoroscopy Machine:

X-ray Source: Similar to a standard X-ray machine, fluoroscopy relies on an X-ray tube to produce the X-rays needed for imaging.

Image Intensifier: This device amplifies the X-ray image and converts it into visible light. The intensified image is then captured and displayed on a monitor.

Collimator: As in general X-ray machines, the collimator shapes and limits the X-ray beam, focusing it on the area of interest.

Flat Panel Detector: In modern fluoroscopy machines, digital detectors, such as flat panel detectors, are used to capture the X-ray images. This allows for high-quality images and is more efficient than traditional image intensifiers.

Control Console: Radiologic technologists operate the fluoroscopy machine from the control console. It includes various settings for exposure, image quality, and other parameters.

The fluoroscopy machine as been widely used in which the beam is transmitted to a TV-like monitor so that the body part and its motion can be seen in detail.

Fluoroscopy, as an imaging tool, enables physicians to look at many body systems, including the skeletal, digestive, urinary, respiratory, and reproductive systems.

MRI Machine (Magnetic Resonance Imaging):



Fig 2.1.6

The MRI or Magnetic resonance imaging uses powerful magnets and radio waves to generate detailed images of the internal structures of the body. It is a non-invasive imaging technology that produces three dimensional detailed anatomical images. It is often used for disease detection, diagnosis, and treatment monitoring. It is based on sophisticated technology that excites and detects the change in the direction of the rotational axis of protons found in the water that makes up living tissues.

How does MRI machine works?

MRIs employ powerful magnets which produce a strong magnetic field that forces protons in the body to align with that field. When a radiofrequency current is then pulsed through the patient, the protons are stimulated, and spin out of equilibrium, straining against the pull of the magnetic field. When the radiofrequency field is turned off, the MRI sensors are able to detect the energy released as the protons realign with the magnetic field. The time it takes for the protons to realign with the magnetic field, as well as the amount of energy released, changes depending on the environment and the chemical nature of the molecules. Physicians are able to tell the difference between various types of tissues based on these magnetic properties.

The MRI machine is used for

MRI scanners are particularly well suited to image the non-bony parts or soft tissues of the body. They differ from computed tomography (CT), in that they do not use the damaging ionizing radiation of x-rays. The brain, spinal cord and nerves, as well as muscles, ligaments, and tendons are seen much more clearly

with MRI than with regular x-rays and CT; for this reason MRI is often used to image knee and shoulder injuries.

In the brain, MRI can differentiate between white matter and grey matter and can also be used to diagnose aneurysms and tumors. Because MRI does not use x-rays or other radiation, it is the imaging modality of choice when frequent imaging is required for diagnosis or therapy, especially in the brain. However, MRI is more expensive than x-ray imaging or CT scanning.

MRI does not emit the ionizing radiation that is found in x-ray and CT imaging, it does employ a strong magnetic field. When having an MRI scan, the following should be taken into consideration:

1. People with implants, particularly those containing iron,
2. Noise
3. Nerve Stimulation
4. Contrast agents

Ultrasound Machine:



Fig 2.1.7

One of the most common uses of ultrasound is during pregnancy, to monitor the growth and development of the fetus, but there are many other uses, including imaging the heart, blood vessels, eyes, thyroid, brain, breast, abdominal organs, skin, and muscles

MONITORING EQUIPMENTS:

A monitoring instrument is a device or tool designed to observe, measure, and record specific parameters or activities over time. These instruments play a crucial role in various fields, including healthcare, environmental monitoring, industrial processes, and scientific research.

ECG Machine (Electrocardiogram):



Fig 2.2.1

An electrocardiogram records the electrical signals in the heart. It's a non-invasive and painless procedure commonly used in the medical field for various purposes. An electrocardiogram is also called as ECG or EKG. If the test is normal, it should show that your heart is beating at an even rate of 60 to 100 beats per minute. Many different heart conditions can show up on an ECG, including a fast, slow, or abnormal heart rhythm, a heart defect, coronary artery disease, heart valve disease, or an enlarged heart.

ECG monitoring is crucial for identifying irregularities in the heart's rhythm and detecting abnormalities such as arrhythmias. Continuous monitoring, as seen in Holter monitoring, allows for the observation of heart activity during various activities, aiding in the diagnosis of intermittent issues. Telemonitoring systems enable remote monitoring, allowing healthcare providers to assess patients' cardiac status without them being physically present.

There are several different ways an ECG can be carried out. Generally, the test involves attaching a number of small, sticky sensors called electrodes to your arms, legs and chest. These are connected by wires to an ECG recording machine.

Before the electrodes are attached, you'll usually need to remove your upper clothing, and your chest may need to be shaved or cleaned. Once the electrodes are in place, you may be offered a hospital gown to cover yourself. The test itself usually only lasts a few minutes, and the electrocardiogram

HOLTER MONITOR: A holter monitor is small, a wearable device that records a continuous ECG, usually for 24-48 hours.

EVENT MONITOR: The portable device is similar to a holter device is similar to a holter monitor, but it records only at certain times for a few minutes at a time. You can wear it longer than a holter monitor, typically 30 days. Some devices automatically record when an irregular rhythm is detected.

Pulse oximeter:



Fig 2.2.2

A pulse oximeter is a small, portable device used to measure the oxygen saturation level in a person's blood. It's a non-invasive tool that clips onto a thin part of the body, usually a fingertip, and uses light to measure the amount of oxygen carried by the hemoglobin in the blood.

A resting oxygen saturation level between 95% and 100% is regarded as normal for a healthy person at sea level. At higher elevations, oxygen saturation levels may be slightly lower.

Normal Range: 95% to 100%

Mild Hypoxemia: 91% to 94%

Moderate Hypoxemia: 86% to 90%

Severe Hypoxemia: Below 85%

It's important to note that individual variations exist, and some people may naturally have oxygen saturation levels slightly below 95% without any adverse effects. However, consistently low oxygen levels can indicate respiratory or cardiovascular issues and should be discussed with a healthcare professional.

Capnography:



Fig 2.2.3

The clinical use of capnography extends to a range of settings both inside and outside of the operating room, including monitoring the effectiveness of CPR, during emergency transportation, in ICU/ITU, in the emergency room, and to ensure the correct placement of an endotracheal tube.

The clinical use of capnography extends to a range of settings both inside and outside of the operating room, including monitoring the effectiveness of CPR, during emergency transportation, in ICU/ITU, in the emergency room, and to ensure the correct placement of an endotracheal tube.

Sphygmomanometer:



Fig 2.2.4

A sphygmomanometer is used to indirectly measure arterial blood pressure. Sphygmomanometry is the process of manually measuring one's blood pressure. This is the blood pressure cuff that one would see in the Doctor's office, or in a medical clinical/setting.

Types of a Sphygmomanometer

There are three types of sphygmomanometers that are used to gauge human blood.

Mercury Sphygmomanometer: The mercury sphygmomanometer is considered the “gold standard” among all other types of devices representing the classic and time-tested method of assessing blood pressure. The device consists of an inflatable bladder along with a column of mercury. Varying pressures cause different levels of mercury in the column. Once the column is made, recalibration is not required to take place to their exactness.

Aneroid Sphygmomanometer : The aneroid sphygmomanometer is a device that stands on the stans or walls, consists of a spring device and metal membrane that translates the signals from the cuff and operates a needle in the gauge. The absence of a liquid provides mobility, as this device can be moved easily from one location to another. Since these devices require calibration checks that's why they provide imprecise results. The needle has to be kept to zero before its use. The accurate results are possible by frequent calibrations.

Digital Sphygmomanometer: When you want to measure the blood pressure at your home effortlessly, the diastolic and systolic blood pressure, the digital sphygmomanometer comes out to be handy without preparations. You just need to connect the node of the rubber inside the hole of the monitor and cloak the cuff around your upper arm, as you click on the button, it would evaluate your bp and heart rate by means of oscillometric detection.

Doppler flow meter:



Fig 2.2.5

Doppler flow meters can be a good monitoring option because they do not interfere with flow and require little maintenance. In addition, they can provide fast and accurate flow measurements for a wide range of liquids under a variety of temperature and flow conditions.

Purpose in Medicine:

Vascular Assessment: Doppler flow meters are commonly used to assess blood flow in various blood vessels, including arteries and veins. This is particularly important in diagnosing vascular conditions and monitoring blood circulation.

Pregnancy Monitoring: In obstetrics, Doppler flow meters can be used to monitor blood flow in the umbilical cord, helping assess the well-being of the fetus during pregnancy.

Cardiac Applications: Doppler ultrasound is also utilized in cardiology to evaluate blood flow through the heart and major vessels. It can help identify abnormalities

in blood flow patterns, such as stenosis (narrowing) or regurgitation (backflow) of blood in heart valves.

It works on the principle of A Doppler flow meter emits high-frequency sound waves (ultrasound) toward the moving blood cells within a vessel. When these sound waves encounter moving blood cells, their frequency changes due to the Doppler effect. This change in frequency is known as the Doppler shift. The Doppler shift is detected by the instrument and translated into an audible sound or a visual waveform. This information is then used to calculate the speed and direction of blood flow.

LABORATORY INSTRUMENTS:

The instruments or the equipments which are used in the laboratory are listed below.

Hematology analyzer - Erba H560

A hematology analyzer is a medical instrument used to analyze blood samples for various parameters related to blood cells.



Fig 2.3.1

It automates and streamlines the process of counting and characterizing blood cells, including red blood cells, white blood cells, and platelets. The analyzer provides essential information about the quantity and morphology of blood cells, helping in the diagnosis and monitoring of various medical conditions, such as anemia, infections, and blood disorders. Fully automated hematology analyzers employ two principal methods of counting blood cells: volumetric impedance and light-scatter technique. Both employ variations in the handling of samples before the count, such as automatic dilution and separation of samples into aliquots

Microbiology analyzer:



Fig 2.3.2

A microbiology analyzer is an instrument which allows to measure microbes or different characteristics in any given specimen. Automation level has been lagging in the field of microbiology as compared to other fields because it still remains labor intensive.

Microbiology analyzers play a crucial role in hospital laboratories by facilitating the identification and characterization of microorganisms present in patient samples.

Molecular Diagnostics: Some microbiology analyzers use molecular techniques such as polymerase chain reaction (PCR) to detect and identify specific DNA or RNA sequences of pathogens. This is particularly valuable for rapid and accurate identification of infectious agents.

Blood Culture Systems: These analyzers are designed to detect the presence of microorganisms in blood samples. Timely detection of bloodstream infections is crucial for initiating appropriate treatment

Biochemistry Analyzer:



Fig 2.3.3

A biochemistry analyzer is a medical instrument used in clinical laboratories to analyze blood and other bodily fluids for various biochemical parameters. These parameters provide valuable information about the patient's health and help in the diagnosis, monitoring, and management of various medical conditions.

ABBOT-Urine Analyzer:



Fig 2.3.4

A urine analyzer is a medical instrument designed to analyze urine samples for various parameters. These analyzers are commonly used in clinical laboratories, hospitals, and healthcare settings to provide information about a patient's kidney function, hydration status, and the presence of certain medical conditions. Here are some key reasons highlighting the importance and need for urine analyzers

Diagnostic Screening: Urine analysis is a routine and non-invasive diagnostic screening tool used to assess various aspects of health. A urine analyzer allows

for the quick and comprehensive evaluation of urine samples, providing insights into potential health issues.

Kidney Function Assessment: Urine analyzers help in assessing kidney function by measuring markers such as creatinine and urea. Abnormal levels of these substances can indicate kidney dysfunction or disease.

NEONATAL EQUIPMENTS:

Neonatal equipment refers to medical devices and tools specifically designed and used for the care of newborn infants, particularly those born prematurely or with medical conditions that require specialized attention.

Incubator:



Fig 2.4.1

An incubator is a medical device designed to create a controlled and protective environment for newborn infants, especially those who are premature or have certain medical conditions. The primary goal of an incubator is to provide a warm and stable atmosphere that mimics the conditions of the mother's womb.

Radiant warmer:

Radiant Warmers consist of an open tray where the baby is kept and an overhead heating mechanism that provides artificial heating.



Fig 2.4.2

The heating mechanism is made up of quartz, which generates the desired heat, and a reflecting mechanism, which directs the heat to the baby tray.

Radiant warmers in neonatal care have several benefits, especially for premature or ill infants. Here are some key advantages:

Temperature Control: Radiant warmers allow precise control of the infant's body temperature. Premature infants have underdeveloped thermoregulatory systems, and maintaining a stable body temperature is crucial for their well-being. Radiant warmers ensure that the baby remains warm without the risk of overheating.

Prevention of Hypothermia: Premature infants are at a higher risk of hypothermia due to their limited fat stores and reduced ability to generate heat. Radiant warmers help prevent hypothermia by providing a controlled and warm environment.

Easy to Clean and Maintain: Radiant warmers are designed for easy cleaning and maintenance. The open design and removable parts facilitate cleaning to ensure a hygienic environment for the infant.

Nebulizer Machine:



Fig 2.4.3



fig 2.4.4

Nebulizers are a good option for children with severe breathing issues due to a cough or cold, but it is vital only to use medication that a doctor prescribes and follow their instructions. With proper use, a nebulizer can clear congestion in babies to help them breathe better.

Nebulizers are a safe and effective way to deliver medications to an infant. Always contact your child's doctor if for any reason your child appears to have more difficulty breathing after a breathing treatment. Some infants can have the opposite expected reaction following a treatment.

Biomedical engineers play a significant role in the development, design, maintenance, and improvement of nebulizers such as Device Design and Engineering, Material Science, Fluid Dynamics, Automation and Control Systems, Biocompatibility and Safety, Regulatory Compliance, Research and Development, Clinical Integration, Human Factors Engineering, Maintenance and Calibration.

Phototherapy units:



Fig 2.4.5

Phototherapy is a treatment with special type of light (wavelength range 420 to 480nm) which lower bilirubin level in neonatal, the process is called photo-oxidation in which light wave converts the bilirubin to water soluble non-toxic form, make it easier for baby's liver to break down and remove the bilirubin from their blood.

Jaundice (Hyperbilirubinemia) is a common condition, particularly in pre-mature babies worldwide.

The skin of the newborn baby becomes jaundiced (baby's skin and Sclerae appear yellow) which is caused by a high level of bilirubin in the blood. Bilirubin is a waste product, produced when red blood cells are broken down. It is normally broken down in the liver and removed from the body in the stool. However, an underdeveloped liver of infant cannot filter out the bilirubin as fast as it is being produced, resulting in hyperbilirubinemia (Jaundice).

Technical Specification :

- LED 15 hi power LED(blue) LED (white) optional
- Irradiance >42 mw/cm /nm at 30cm
- Light source lifetime minimum 25,000hrs.
- Less than 10% change in illumination after 25,000hrs(irradiance)
- Wavelength 420-480 nm
- Variation in intensity for 6 hours<10%
- Effective area 50 cm X 30 cm.

Electrical :

Input voltage 100-240 V, 50-60Hz

Dimensions :

Led box : Front : 18" (L)x 10" (w) x3"(H) Backside :18" x 8.5" x 3"

Length -800mm Width-720mm

Height(adjustable)

Min :1230 mm Max : 1600mm

Double Surface Phototherapy Unit (Item Code: ANP1202):

It is a combination of over head phototherapy Unit and undersurface Phototherapy with Baby Bassinet.

STERILIZATION EQUIPMENTS:

Autoclave



Fig 2.5.1

Each instrument or piece of medical equipment which comes into contact with a patient is a potential source of infection. Minimize the risk of exposure to infection for each patient and provider. Sterilization by steam under pressure ensures complete elimination of all forms of microbial life.

The type of autoclave machine used in hospitals is Large steam sterilizers. The large steam sterilizer is the capacity of these types of autoclave usually ranges between 110 to 880 liters. Ideal for large medical facilities like hospitals that generates a notable amount of waste each day and needs to use a lot of medical tools and equipments to treat patients.

PHYSICAL THERAPY EQUIPMENT:

Physical therapy instruments encompass a variety of tools and equipment used by physical therapists to aid in the rehabilitation and treatment of individuals with physical injuries or conditions.

TENS (Transcutaneous Electrical Nerve Stimulation) Units:



Fig 2.6.1

TENS is a method of electrical stimulation which primarily aims to provide a degree of symptomatic pain relief by exciting sensory nerves and thereby stimulating either the pain gate mechanism and/or the opioid system. The different methods of applying TENS relate to these different physiological mechanisms. The effectiveness of TENS varies with the clinical pain being treated, but research would suggest that when used 'well' it provides significantly greater pain relief than a placebo intervention.

There is an extensive research base for TENS in both the clinical and laboratory settings and whilst this summary does not provide a full review of the literature, the key papers are referenced. It is worth noting that the term TENS could represent the use of any electrical stimulation using skin surface electrodes which has the intention of stimulating nerves. In the clinical context, it is most commonly assumed to refer to the use of electrical stimulation with the specific intention of providing symptomatic pain relief.

TENS can relieve sciatica pain—even the radiating, and sometimes debilitating shooting pains that patients often experience. It's a safe, non-addictive painkiller alternative that might help you reduce discomfort and gain some mobility from sciatica.

Transcutaneous electrical nerve stimulation (TENS) is a non-invasive electrical stimulation therapy indicated for pain control that has been applied for the regeneration of nerves.

EMS (Electrical Muscle Stimulation) Devices:



Fig 2.6.2

EMS devices, or Electrical Muscle Stimulation devices, are electronic devices that use electrical impulses to stimulate muscles, causing them to contract. These devices are commonly used in physical therapy, fitness training, and rehabilitation.

LIFE SUPPORTING EQUIPMENTS:

Ventilators:

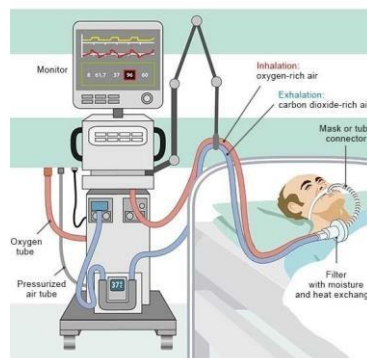


Fig 2.7.1

A ventilator is a machine that helps you breathe. Just like crutches support your weight, the ventilator partially or completely supports your lung functions. A ventilator, Provides oxygen to your lungs. Helps remove carbon dioxide (CO₂) from your lungs.

A ventilator mechanically helps pump oxygen into your body. The air flows through a tube that goes in your mouth and down your windpipe. The ventilator also may breathe out for you, or you may do it on your own.

The coronavirus behind the pandemic causes a respiratory infection called COVID-19. The virus, named SARS-CoV-2, gets into your airways and can make it hard for you to breathe. Estimates so far show that about 5% of people who have COVID-19 get critically sick. And about 1 in 4 of them may need a ventilator to help them breathe.

There are different types of ventilator

Invasive Ventilators: It is used for patients who are unable to breathe adequately on their own and require mechanical support. Invasive ventilators involve the insertion of an endotracheal tube through the mouth or nose into the trachea. The ventilator then delivers breaths directly to the lungs. It can be adjusted for parameters such as tidal volume, respiratory rate, and positive end-expiratory pressure (PEEP).

Non-Invasive Ventilators: It provide respiratory support without the need for intubation. Typically used for patients with respiratory conditions like sleep apnea, chronic obstructive pulmonary disease (COPD), or acute respiratory failure.

3. Transport Ventilators: It is designed for use during patient transport, such as moving a critically ill patient from one part of the hospital to another. Compact, lightweight, and often battery-powered for portability.

They play a crucial role in helping patients who are facing difficulties in breathing,

Oxygenation: Ventilators deliver a controlled mixture of air and oxygen to ensure that the patient receives an adequate supply of oxygen. This is vital for maintaining proper oxygen levels in the blood.

Ventilation: The ventilator assists in moving air in and out of the lungs, helping the patient with the breathing process. This is especially important when the patient's respiratory muscles are weak or when there is an obstruction in the airways.

Defibrillator:



Fig 2.7.2

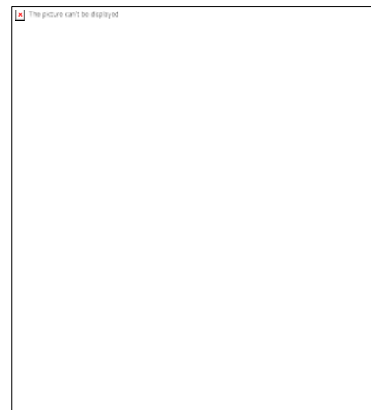


fig 2.7.3

A defibrillator is a medical device that delivers an electric shock to the heart to restore its normal rhythm in the case of a life-threatening cardiac arrhythmia, particularly ventricular fibrillation or ventricular tachycardia.

The primary purpose of a defibrillator is to treat sudden cardiac arrest, where the heart's rhythm becomes chaotic and ineffective in pumping blood.

There are different types of defibrillator that are used in the hospitals they are

Automated External Defibrillator (AED): Designed for use by non-medical personnel, often found in public places. AEDs provide voice prompts to guide users through the process.

Manual Defibrillator: Typically used by trained medical professionals, allowing them to manually control and adjust the settings.

The defibrillator works on the principle of,

Detection of Chaotic Rhythm: Defibrillators are smart. They can detect when the heart is doing its own wild dance instead of the normal heartbeat. The technical term for this chaotic dance is ventricular fibrillation.

Charging Up: Once the defibrillator recognizes the chaotic rhythm, it gets ready for action. It charges up, kind of like a superhero gearing up for a powerful move.

Clear, Everyone Step Back: Before the defibrillator delivers its electric shock, it's crucial that everyone around the person in need steps back. This ensures the safety of both the rescuer and anyone else nearby.

Electric Shock: The defibrillator sends a carefully measured electric shock to the heart. This shock is a bit like hitting the reset button. It momentarily stops all the chaotic electrical activity in the heart.

Hope for Normal Rhythm: The chaotic dance interrupted, there's a chance for the heart to find its way back to a normal, coordinated rhythm. The hope is that when the heart starts beating again, it follows the right musical notes, so to speak.

Analysis and Repeat: After delivering a shock, they analyze the heart's rhythm again. If needed, they might charge up for another shock. It's like the defibrillator is saying, "Let's make sure this heart gets back to playing the right tune."

CPR Dance: While the defibrillator is doing its thing, CPR (cardiopulmonary resuscitation) is often continued. CPR helps to circulate blood throughout the body and provides some life support until the heart can hopefully get back into its regular rhythm.

Infusion Pump:



Fig 2.8.1

An infusion pump is a medical device used to deliver fluids, such as medications, nutrients, or blood, into a patient's circulatory system in a controlled and precise manner. These devices are essential in healthcare settings for various applications, including intravenous (IV) therapy, chemotherapy, pain management, and critical care.

Infusion pump can administrate fluid in ways that would be impractically expensive or unreliable if performed manually by nursing staff. For example, they can administer as little as 0.1ml per hour injection every minute, injection with repeated

boluses requested by the patient, up to maximum number per hour, or fluids whose volumes vary by the time of the day.

DVT Pump:



Fig 2.9.1

A DVT pump, or Deep Vein Thrombosis pump, is a medical device designed to prevent or manage Deep Vein Thrombosis (DVT). DVT is a condition where blood clots form in deep veins, typically in the legs. These clots can be dangerous if they travel to the lungs, causing a pulmonary embolism. DVT pumps, or compression pumps, help improve blood circulation in the affected area by applying intermittent pressure to the legs or other limbs. This helps prevent blood from pooling and clot formation.

Syringe Pumps:



Fig 2.10.1

Syringe pumps are used to deliver a very small amount of medications, mechanically moving the piston of a syringe to send medication into IV tubing

Syringe pumps, or syringe drivers, are motorised devices that accurately control the movement of fluid from a syringe by mechanically inserting or retracting the plunger. Syringe pumps feature stepper motors that accurately move the platform attached to the plunger of a syringe. The body of the syringe is held steady to the body of the unit so that the only movement is from the action of the motor.

Basic models can be used for the infusion (and sometimes withdrawal) of liquids at a set rate and are controlled simply by changing the speed of the motor. More sophisticated syringe pumps are equipped with onboard computers, which allow you to program the motion of the stepper motor with multiple steps.

There are various types of syringe pumps designed for different medical applications.

Volumetric Syringe Pumps: These pumps deliver a specific volume of fluid at a predetermined rate. They are commonly used in medical and research settings where accuracy and precision are crucial.

Infusion Syringe Pumps: Infusion pumps, including syringe infusion pumps, are used to administer fluids, medications, or nutrients directly into a patient's bloodstream. They are often employed in hospitals and healthcare settings for controlled and continuous drug delivery.

Syringe Driver: Syringe drivers are portable infusion devices that use a syringe to administer medications subcutaneously or intravenously over an extended period. They are commonly used for palliative care to provide continuous pain relief or symptom management.

Ambulatory Syringe Pumps: These are lightweight, portable syringe pumps designed for ambulatory or home use. They allow patients to receive continuous infusion therapy while maintaining mobility.

Dual Syringe Pumps: Some syringe pumps are designed to hold and operate two syringes simultaneously. This is useful for applications where the simultaneous delivery of two different substances is required.

High-Pressure Syringe Pumps: High-pressure syringe pumps are designed to handle the delivery of fluids or medications at higher pressures. They are often used in research or clinical applications that require higher force for injection.

Multi-Channel Syringe Pumps: Multi-channel syringe pumps can hold and operate multiple syringes simultaneously, allowing for the delivery of different substances at varying rates. This is advantageous in applications requiring complex protocols.

NEUROLOGY INSTRUMENTS:

EEG (electroencephalogram):



Fig 2.11.1

An electroencephalogram (EEG) is a test that measures electrical activity in the brain using small, metal discs (electrodes) attached to the scalp. Brain cells communicate via electrical impulses and are active all the time, even during asleep. This activity shows up as wavy lines on an EEG recording.

An EEG is one of the main diagnostic tests for epilepsy. An EEG can also play a role in diagnosing other brain disorders.

An EEG can find changes in brain activity that might be useful in diagnosing brain disorders, especially epilepsy or another seizure disorder. An EEG might also be helpful for diagnosing or treating:

- Brain tumors
- Brain damage from head injury
- Brain dysfunction that can have a variety of causes (encephalopathy)
- Sleep disorders

- Inflammation of the brain (herpes encephalitis)
- Stroke
- Sleep disorders
- Creutzfeldt-Jakob disease

An EEG might also be used to confirm brain death in someone in a persistent coma. A continuous EEG is used to help find the right level of anesthesia for someone in a medically induced coma.

ECT Machine:



Fig 2.11.2

Electroconvulsive Therapy (ECT) is a medical treatment that involves passing a carefully controlled electric current through the brain to induce a controlled seizure. ECT is primarily used in the treatment of severe psychiatric disorders, particularly when other treatments have not been effective.

The Purposes of ECT machine are listed below,

Severe Depression: ECT is often used in cases of severe depression that do not respond well to other forms of treatment, such as medication or psychotherapy. It may be particularly effective in cases of treatment-resistant depression.

Bipolar Disorder: ECT is employed in the treatment of severe manic or mixed episodes in individuals with bipolar disorder.

Schizophrenia: ECT may be used in certain cases of schizophrenia, especially when there is a lack of response to antipsychotic medications.

Catatonia: Catatonia is a condition characterized by motor abnormalities and behavioral disturbances. ECT can be effective in treating catatonic states, providing rapid relief of symptoms.

Diagnostic Features:

Thorough Psychiatric Assessment: Before ECT is considered, a comprehensive psychiatric assessment is conducted to determine the severity and nature of the psychiatric condition, as well as the individual's treatment history

ANESTHESIA MACHINE:



Fig 2.11.3

An anesthesia machine, also known as an anesthesia workstation or anesthesia delivery system, is a medical device used to administer general anesthesia to patients during surgical procedures. Its primary function is to control the delivery of anesthetic gases and vapors, as well as other medical gases, to ensure the patient is in a state of controlled unconsciousness, pain-free, and safe during surgery.

The key components and functions of an anesthesia machine:

Gas Sources: Anesthesia machines are connected to various gas sources, including medical gases such as oxygen, nitrous oxide, and sometimes air. These gases are essential for maintaining the patient's oxygenation and providing the necessary anesthesia.

Gas Delivery System: The machine has a system for delivering and controlling the flow of gases to the patient. This includes controls and valves for adjusting the concentration of anesthetic gases and the total gas flow.

Vaporizers: Vaporizers are devices attached to the anesthesia machine that vaporize liquid anesthetic agents into a gas form. This allows for the precise control of the concentration of inhaled anesthetic delivered to the patient.

Breathing Circuit: The anesthesia machine is connected to a breathing circuit, which delivers the anesthetic gases from the machine to the patient and allows for the removal of exhaled gases. The breathing circuit includes tubing, filters, and a patient breathing system.

Ventilator: Many modern anesthesia machines are equipped with a mechanical ventilator to assist or control the patient's breathing during surgery. The ventilator ensures the delivery of a precise volume of air and helps maintain the patient's respiratory parameters.

Monitoring Devices: Anesthesia machines are often integrated with monitoring devices to track the patient's vital signs, including heart rate, blood pressure, oxygen saturation, and end-tidal carbon dioxide levels. These monitors provide real-time feedback to the anesthesia provider.

Emergency Systems: Anesthesia machines have safety features and alarms to alert the anesthesia provider of any issues, such as low oxygen levels or high pressure. There are also manual ventilation options in case of machine failure.

Waste Gas Scavenging System: A waste gas scavenging system is in place to safely remove excess anesthetic gases and prevent exposure of healthcare providers to these gases.

Anaesthetics are used during tests and surgical operations to numb sensation in certain areas of the body or induce sleep. This prevents pain and discomfort, and enables a wide range of medical procedures to be carried out.

CONCLUSION:

My training at **SRI RAMAKRISHNA SPECIALITY HOSPITAL** was a great opportunity for me . I was able to get immense knowledge about the medical equipment.

The training provided me the knowledge of various medical procedure in the hospital and also about the wole of biomedical engineer .

The training has provided me with a deep understanding of medical devices equipment and system used in the hospital setting.