

PROFESSIONAL TRAINING – 2023 REPORT

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

by

ROSHINI CATHERINE VERGHESE (41240030)



**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 GANDHI SALAI, CHENNAI - 600 119

OCT – 2023



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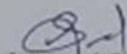
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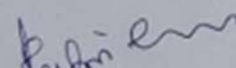
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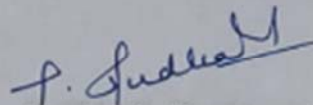
DEPARTMENT OF BIOMEDICAL ENGINEERING

BONAFIDE CERTIFICATE

This is to certify that this Professional Training Report is the bonafide work of **Roshini Catherine Verghese (41240030)** carried out the professional training at **Matha Hospital, Kottayam** as a part of professional development under our supervision from **May 16th 2023 to June 10th 2023**.

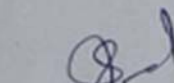

Internal Guide

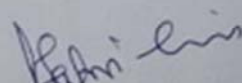

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TO WHOMSOEVER IT MAY CONCERN

Certified that **MS. ROSHINI CATHERINE VERGHESE**, 2nd year student (4th Semester) of Btech Biomedical Engineering, Sathyabama institute of Science and Technology, Chennai, has successfully completed her clinical training in the Biomedical Engineering department of this hospital from 16.05.2023 to 10.06.2023. During her association with us, she was found to be hard working and her conduct & character is good.

We wish her a successful future.

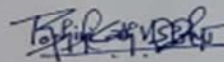
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DECLARATION

I **ROSHINI CATHERINE VERGHESE** hereby declare that the professional training report completed by me during my professional training at Matha Hospital under the guidance of **Dr. A. Sabarivani** (internal), **Ms. Sindu Divakaran** (external) is submitted in partial fulfilments of the requirements for the award of degree in Bachelor of Technology degree in Biomedical Engineering



SIGNATURE OF THE CANDIDATE

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PLACE: CHENNAI

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ABSTRACT

Professional training is an important phase of Biomedical Engineer's life. A well planned, properly executed professional training helps in developing the knowledge and skills for a Biomedical Engineer. The aim and motivation of this professional training is to receive discipline, skills, teamwork and technical knowledge through clinical practice. The effect of working in hospitals before graduation strongly increases the confidence of a Biomedical Engineer and make them aware of those equipment's that further required innovative development. Professional Training programme provides opportunities to refine skills for a Biomedical Engineering. The Professional Training received from Matha Hospital gained valuable theoretical and practical knowledge regarding the various sophisticated medical devices and other biomedical devices. This training provided me in depth and comprehensive understanding of the real-time patient care with biomedical devices. This training helped me to interact with all departments engaged in critical healthcare, engaged with medical professionals, asked insightful questions and displayed a high level enthusiasm and curiosity throughout the training.

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1. INTRODUCTION

Biomedical engineering is also known as medical engineering .This field is an application of engineering principles and designing concepts to medicine field and biology for healthcare purposes. Biomedical engineering field is an interdisciplinary field that includes various aspects of electrical, mechanical, chemical, computer, mathematics, biology, and some real life science. A biomedical engineer is trained rigorously in such a way that he/she can solve or develop biomedical solutions through designing, diagnosing and manufacturing devices, apparatus and medical equipments. Biomedical engineering is a service oriented industry. Biomedical engineer should have innovative idea of each medical devices, working, principle, calibration, complaints and solutions and so on. Biomedical engineering field aims to improve healthcare outcomes of the people using modern technology. Many researchers as well as scientists are working on real life applications to produce better healthcare outcome which makes peoples life better. Biomedical engineer gains knowledge theoretically and practically from college and professional skills and clinical practice from hospitals and through industrial visits. The professional training provides problem solving skills, equipments functioning, calibration, operate, applications required in the biomedical field, the professional exposure and academic success shall make the student successful in this field. A biomedical engineer should be aware of each equipment that requires much more development .This branch of integrated science and engineering is a fascinating multidisciplinary zone of study both theoretical and practical that entail the application of medicine, engineering techinques, in order to aid practitioners like doctors and physicians in their healthcare practices. Biomedical engineering also assist in the rehabilitation of disabled patients. Professional training produces an excellent biomedical engineer.

2. BIOMEDICAL EQUIPMENT

Medical devices form an important component in patient care. Biomedical equipment is a set of instruments used in the field of medicine, biology. The design of biomedical equipment is directly related to biomedical instrumentation, in which instruments are designed to apply treatments, perform biological and chemical processes, to obtain information. It is a profession that requires broad and vast knowledge of biomedical system instrumentation. Maintenance responsibilities, system usage, model name and company name are the ways to obtain data on an extensive range. Biomedical equipment is further divided into two spectrums according to their usage and they are:

THERAPEUTIC BIOMEDICAL EQUIPMENT

These are devices that is used alone or in combination with other devices, to modify, to support or to restore, to replace biological structures or functions for the treatment or alleviation of an injury, illness or disability .It is considered as an active therapeutic device. Examples: Nebulizer, Dialyser, Ventilator, Defibrillator etc.

DIAGNOSTIC BIOMEDICAL EQUIPMENT

These are the devices that is used to identify the cause of a particular phenomenon, its nature. Diagnostic medical equipment supplies help clinician to observe various aspects or to measure various aspects of patient's health so that they can perform diagnosis. Example: Pacemaker, CT, MRI, X – ray etc.

3. TRAUMA CENTER

Trauma center is also known as casualty or emergency department. It is a center that is equipped and staffed to provide immediate care for patients suffering from major traumatic injuries like accidents, motor vehicle collisions, or even gunshot sounds. The operation of trauma center is often expensive. A trauma center will have helipad for receiving patients that have been airlifted to the hospital. In trauma center all the equipments are checked by the Biomedical engineer everyday .



Fig 3.1



Fig 3.2

4. ENDOSCOPE

An endoscope is a medical instrument that is used to examine the interior of a hollow organ or cavity of the body. The modern endoscope was developed in the early 1950s by English physicist Harold Hopkins. This is a device that uses fiber optics and very powerful lens system to provide lighting and clear visualization of the interior body cavity or organ. Depending upon the medical procedure, the endoscope is divided into two types; rigid or flexible. The functioning will be very much similar for both types but appearance differs. Flexible endoscopes are used to look at the digestive and respiratory tracts because they can easily bend. To shine the light into the body they use fiber optics. Rigid endoscopes are shorter compared to flexible endoscopes. They are used to look at the surface of internal organs, inserted through a small cut in the skin. These endoscopes are commonly used to examine the joints. A typical endoscope has been shown in the below diagram fig .

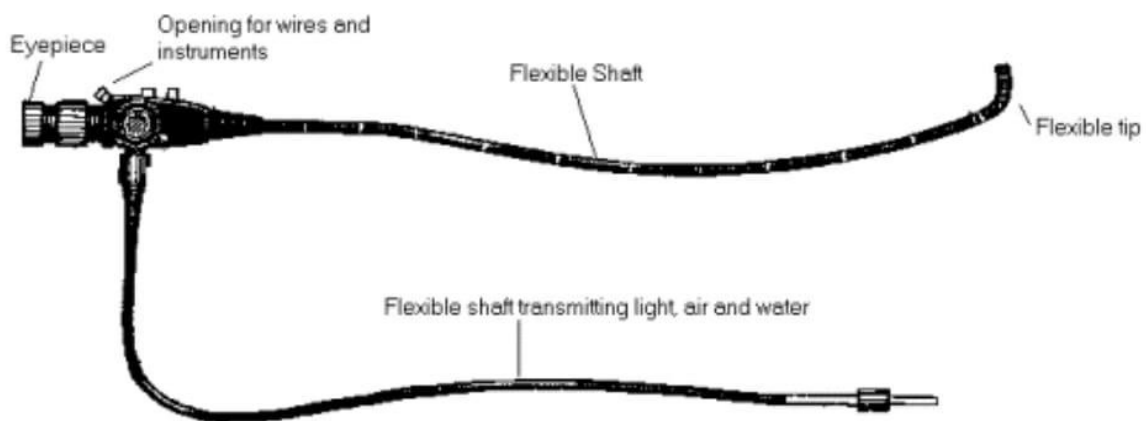


Fig 4.1

Typical endoscope



Fig 4.2

COMPONENTS OF ENDOSCOPE

- o Rigid or flexible tube
- o Light delivery system
- o Lens system
- o An eyepiece
- o Camera
- o Additional channel

WORKING

Light from a bright lamp shines into patient's body into one of the endoscope tubes. The light bounces along the walls of the fiber-optic endoscope tube into the patient's body cavity. The injured or diseased patient's body part is illuminated by the light shining in. Light reflected off the body part travels back up to a second fiber-optic tube, bounces off the glass walls as it goes. The light shines up into the eyepiece of the physician, looking down, the physician examines what's happening inside the body of the patient.

TYPES OF ENDOSCOPES

- o Arthroscope: joints
- o Colonoscope: colon and bowel
- o Bronchoscope: esophagus and lung
- o Duodenoscope: small intestine
- o Fetoscope: womb
- o Gastroscope: stomach
- o Laryngoscope: larynx
- o Hysteroscope: abdomen
- o Esophagogastroduodenoscope: esophagus, stomach and small intestine
- o Rhinoscopy: examination of inside of nose
- o Thoracoscope: thorax
- o Sigmoidoscope: large intestine
- o Cytoscope: bladder
- o Laparoscope: abdomen

APPLICATIONS

This medical equipment allows doctors to check for ulcers, irritation, inflammation, abdominal tissue growth in internal organs. It can also be used to remove small sudden growths or to close off a blood vessel.



Fig 4.3

Company – Fujifilm

Model - Fujinon EPX-2500

5. NICU

NICU (Neonatal intensive care unit) is a place where we can see lots of machines, small babies in incubators, hospital staff like it's a lot to process especially while worrying about your own baby's health condition and have to take important as well as challenging decisions. Babies born premature gestation and babies with other

complications are offered this service. NICU typically look like a nursery that provides around -the clock -care to preterm or sick babies. When babies are born early they might have health problems or a difficult birth then they have to approach neonatal intensive care unit. Depending on the baby's health condition they might stay only a few hours or days: or stay weeks and months. Before entering into the NICU unit make sure that your hands are sanitized ;free from germs .we must wear masks as well as NICU doctor wears(coat and particular footwears) and our hands must be clean so that the new born babies are not exposed to germs or any kind of infections.



Fig 5.0

LIST OF EQUIPMENTS IN NICU

5.1 Baby warmers

Those are small beds having heaters over them which aids babies to stay warm while being monitored as they are open and also allows easy access to babies.



Fig 5.1.1



fig 5.1.2

Company – Zeal, Model – RHW5002B

5.2 Incubators

Those are small beds enclosed by plane, hard plastic. Controlled temperature is calibrated to keep up your baby's body temperature. Babies are cared with the support of doctors, nurses as well as caregivers through the holes.



Fig 5.2

5.3 Phototherapy

Newly born babies suffer from a major problem jaundice which changes their original skin colour to yellow. This equipment is used to treat jaundice. During this treatment, babies are kept on a special light therapy blanket having lights attached to their beds or the incubators. Eyes of the baby should be covered using an eye mask so that the eyes won't be harmed.

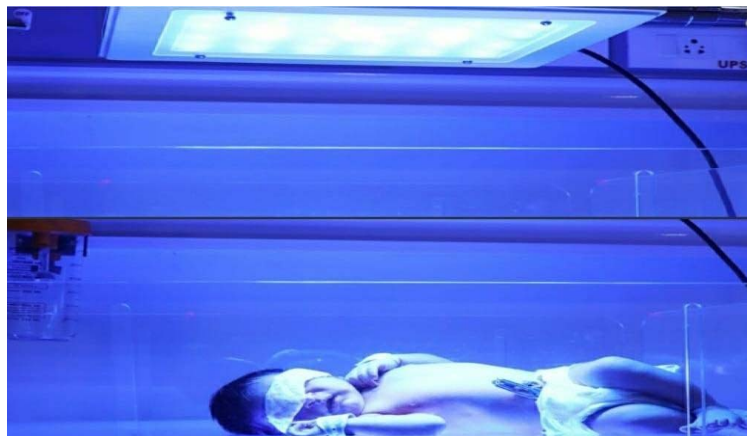


Fig 5.3



Fig 5.3.1



Fig 5.3.2

Company- IBIS

Model - I REX Duo

5.4 MONITOR

Monitor helps doctors and nurses keep track of your baby's vital signs for example like temperature, breathing, heart rate from any place in the NICU.

5.4.1 Chest leads

They are small painless stickers on your baby's chest interconnected With wires further connected to monitor. They track the number of time Baby breathes and heart rate.

5.4.2 Pulse oximeter

This device measures baby's blood oxygen levels. It is painless. the Pulse oximeter is wrapped on baby's finger or toes like similar to a Bandage thus emitting a bright red light.

5.4.3 Temperature probe

This probe records baby's temperature and shows it clearly on the Monitor. The wire is coated well and is placed on baby's skin with Patch.

5.4.4 Blood pressure

Blood pressure is monitored using blood pressure cuff or arterial line.



Fig 5.4

Company-BPL, Model - Cleo plus

5.5 NICU Ventilator

Some baby needs extra help to breathe. Baby is connected to ventilator through an endotracheal tube that is a tube placed into the windpipe through mouth or the nose connected to the ventilator. Modes of ventilator include SIMV (Synchronised intermittent mandatory ventilation), AC(Assist control), SIPPV (Synchronised intermittent positive pressure ventilation, Volume control ventilation (VCV), PSV(Pressure support ventilation), PTV(Patient triggered ventilation), PEEP(Positive end expiratory pressure) is a CDP (Continuous distending airway pressure), BIPAP (Biphasic positive airway pressure), FiO2 (fraction of inspired oxygen).Oxygen saturations should be targeted within the range limit of 91-95%.

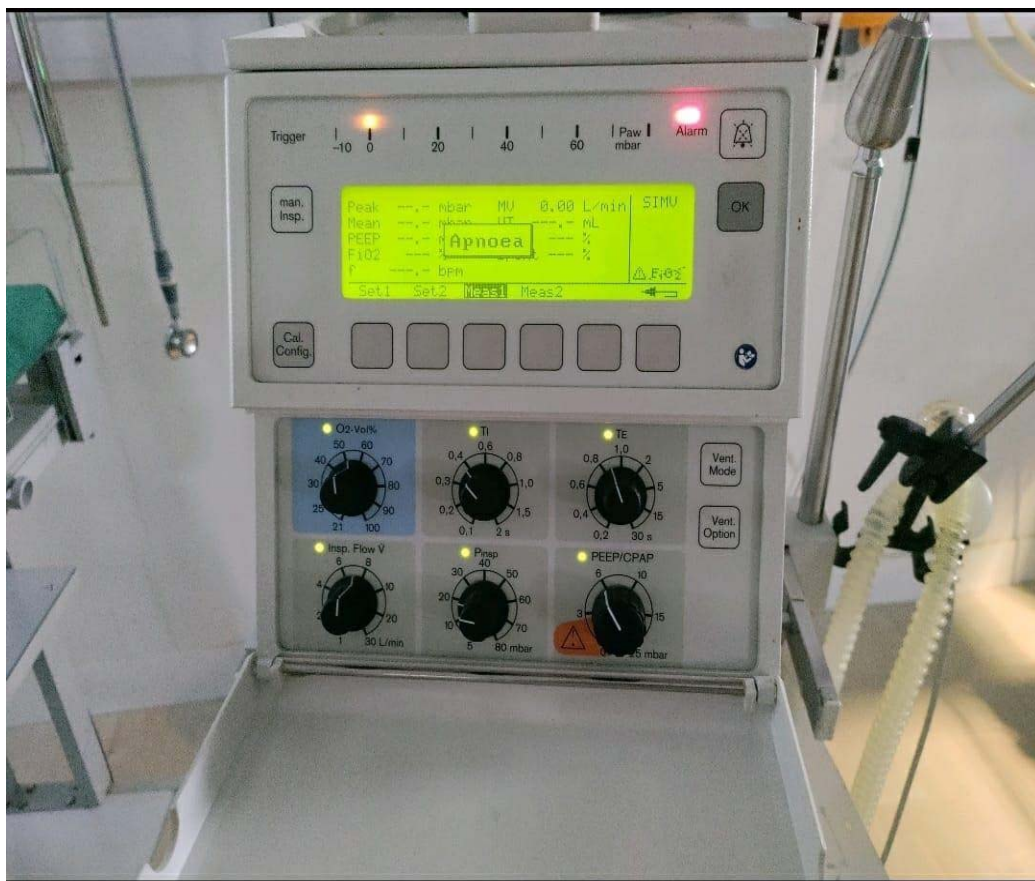


Fig 5.5



Fig 5.5.1



Fig 5.5.2

Company – DRAGER

Model - Babylog 8000 plus

5.6 Infusion pump

It is a small medical device that is used to deliver fluids, such as medications, supplements, nutrients. Insulin, pain relievers, antibiotics etc are infused as medications in the infusion pump. The components or parts of infusion pump are as follows a catheter, a fluid reservoir, very well advanced precision electronic mechanism to regulate the flow.



Fig 5.6.1

Company – BPL

Model - Acura-V

6. MULTIPARAMONITOR

Multiparamonitor is a sophisticated medical device used to monitor patient's vital signs. It allows healthcare professionals to continuously monitor This monitor provides real-time data on parameters such as BP(blood pressure; IBP and NIBP), heart rate, respiratory rate, spo2 (oxygen saturation), temperature, ECG, Co2 concentration. The Parameers are displayed on a LCD or LED screen, it is possible to detect changes in the clinical status of the patient. This further helps the doctor to plan the treatment accordingly and the course of action needed to be taken . It plays a vital role in intensive care, trauma care, hospitalization.



Fig 6.1



Fig 6.2

Company – Covidien , Model – planet50n

7.CTG

CTG(Cardiotocography) also known as EFM(Electronic fetal monitor) is a medical device that is used to monitor or record the fetal heartbeat and contractions of uterus during pregnancy and labour. This machine displays 8" colour LCD, has high resolution, built in thermal recorder. It is built in two rechargeable batteries that works for about two hours even when the power supply breaks off. It has a provision of rotating screen in 60 degree angle. It has function of freezing the image. The parameters in a CTG includes SPO2(Blood oxygen saturation level), NIBP(Non – invasive blood pressure), ultrasound heart rate (both maternal and fetal), ECG(Electrocardiograph), Uterine function , Intrauterine pressure and FSE(Fetal scalp electrode). Two transducers are placed on the abdomen of mother that is one above the fetal heart and the other one at the fundus to detect the uterine muscle activity and fetal heart rate. We can read the CTG paper by assessing what the average rate has been over last 10 minutes but make sure in ignoring accelerations or decelerations. A normal foetal heart rate range is 110-160bpm.



Fig 7.1

Company – Philips

Model - avalon f1 20

8. ECHOCARDIOGRAM

Echocardiogram also known as echo is a non-invasive diagnostic test that use high frequency ultrasound waves to create moving pictures of our heart. The output image shows the size and shape of our heart. This equipment also help us to know how the heart's chambers and valves are working. Doppler ultrasound shows how well blood flows through the heart's chamber and valves. It can also detect possible blood clots inside the heart, problems with aorta, build of fluid in pericardium (sac present around the heart). Different types of echocardiography are transthoracic echocardiography, stress echocardiography, fetal echocardiography, three dimensional echocardiography, transesophageal echocardiography.

Electrocardiographic transducer is placed commonly in four locations and they are parasternal, apical, subcostal, and suprasternal.



Fig 8.1

Company – Sonosite, Model – M-Turbo

9. SUCTION APPARATUS & O2 FLOW METER

9.1 Suction pump- It is an medical instrument also known as aspirator This machine is used to remove obstructions such as saliva, mucus, blood, or any other secretions from airway of a person. It can be seen in most of the rooms connected to walls in in cylindrical shape in the hospital.



Fig 9.1

Company- STEPWELL(600 ml)

9.2 Oxygen flow meter – It is equipment that is used for controlling the oxygen flow delivery in patients who undergo oxygen therapy. The normal range will be (spo2: 94%-98%) and pao2(80 -100 mmHg).



Fig 9.2

Company- MEDIMETER

10. **AIRBED**

A hospital air bed or mattress is a specialized bed which uses air to provide support and pressure relief to patients. It is developed for the comfort of patient's under – recovery who are confined to the bed for more than 15 hours in a day. Those patients are likely to suffer from bedsores caused due to the breakdown of skin cells which later develops into pressure ulcers. This mattress looks like a balloon as its overlays are filled with air. Air mattress is normally made of polyvinyl chloride(PVC) and in many hospitals textile – reinforced urethane plastic material version also still exists. There will be an digital pump or normal pump that is used to either inflate or deflate the mattress and control pressure



Fig 10.1



Fig 10.2 Company - kosmocare

11. NEBULIZER

A nebulizer is a medical device which turns the liquid medicine into a mist further inhaled through a mouthpiece or a mask. It aids people suffering from asthma. Nebulizer should be cleaned properly. Nebulizer is a portable device. Portable nebulizer devices may run on batteries. Nowadays, people have nebulizer machine in their home itself. Nebulizer is classified into three types jet, ultrasonic, mesh. Nebulization therapy is also called as Breathing treatment.



Fig 11.1



Fig 11.2

Company- Romsons

12. X-RAY

12.1 X – rays are a form of electromagnetic radiation. X rays have higher form of energy and can pass through most objects, including our body. The rays of x ray penetrate the body, and they absorb varying amount of radiation. Photographic films are used to visualize the output. Cathode and anode is the electric pair used in this device. Collimators generate heat, beam passes through a series of filters on its way to patient. X ray is safe and accurate , simple to operate.

BLOCK DIAGRAM OF X RAY MACHINE

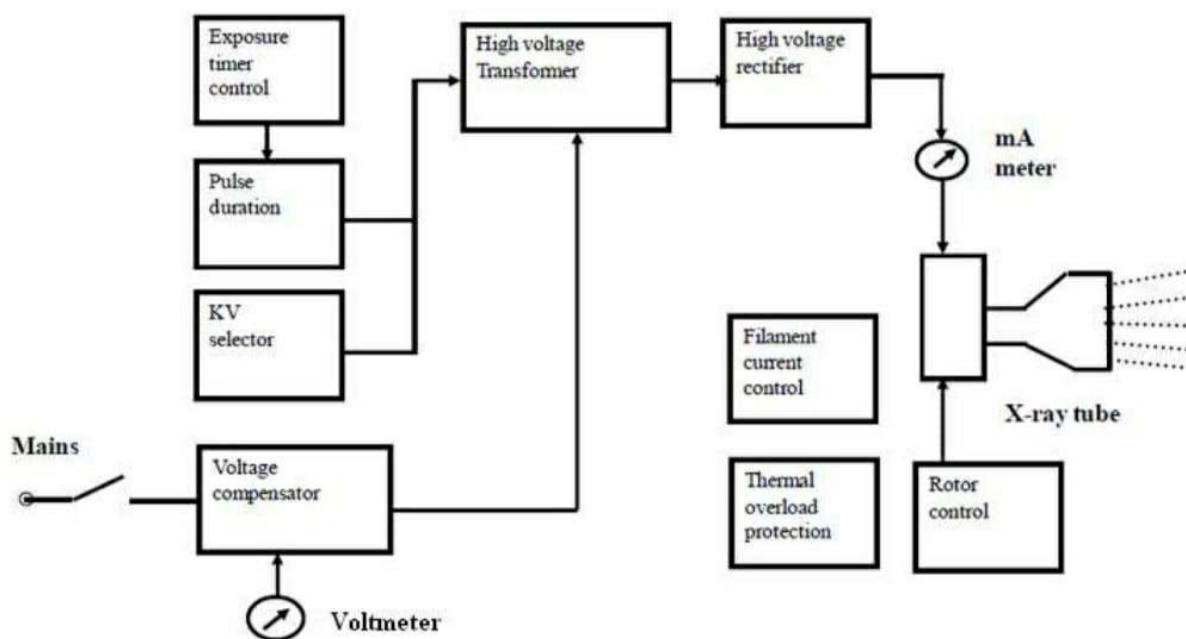


Fig 12.1.1

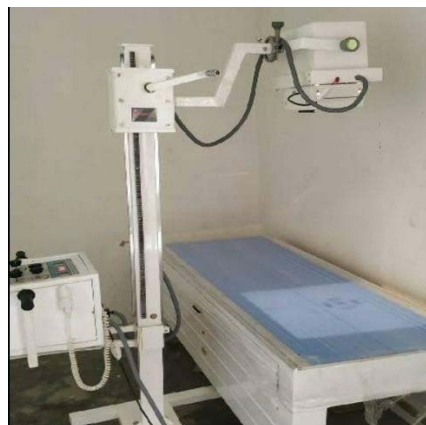


Fig 12.1.2 Company - BPL

12.2 MOBILE X RAY

Mobile x ray is also known as Mobile radiography, it can be seen in hospitals where patients are too unwell or conditioned to transport them to x ray imaging department. Mobile x ray was discovered by Marie Curie over 100 years ago. This device consists of a motorized drive, compact wheelbase that includes generator, x ray tube, exposure control panel. The batteries are separate for drive and generator control. One of the main advantages of this device is that we can avoid extra movements of patients and transports.



Fig 12.2.1

Company - Medion

Model -movx 100ma

13. CT SCANNER

CT(Computed Tomography) is a medical imaging method employing tomography. It is a diagnostic imaging test used to create detailed images of internal organs, bones, soft tissue, and blood vessels. Tomography is derived from a greek word tomo meaning a slice, a cut, or a section and graphy means to write or to record. It involves the principle -the determination of attenuation characteristics for each small volume of tissue in the patient slice which constitute the transmitted radiation intensity recorded from various irradiation directions. These calculated tissue attenuation characteristics compose the CT image.

BLOCK DIAGRAM OF CT SCANNER

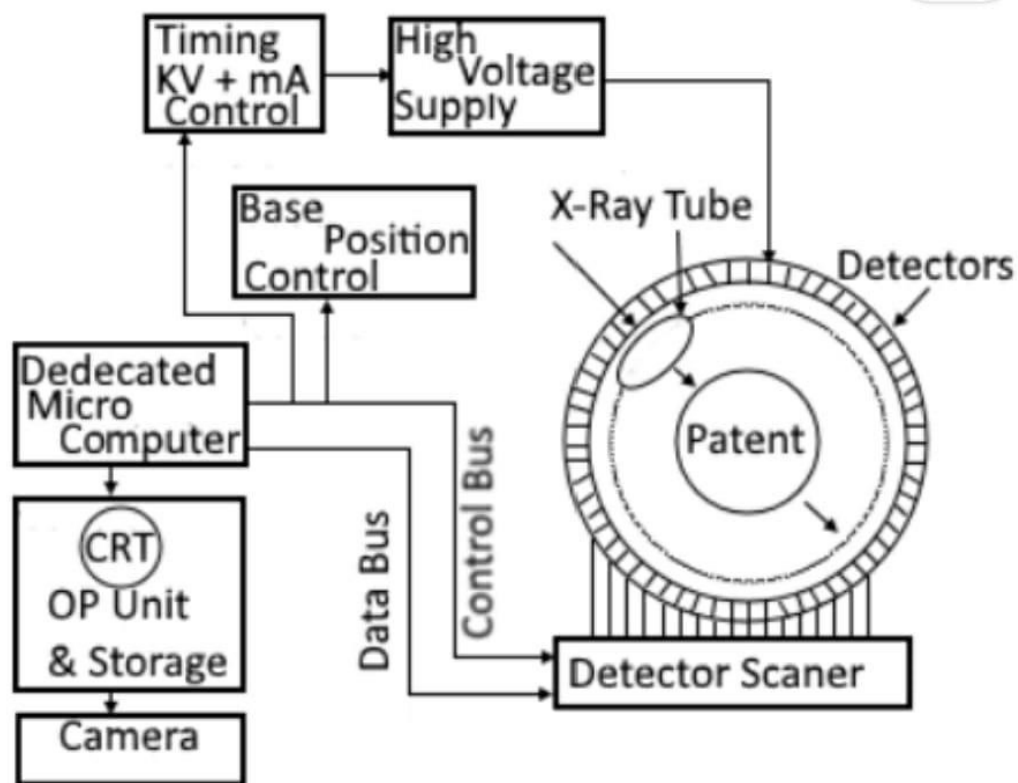


Fig 13.1

Components of CT scanner are an X – ray tube, and object(ie;patient), and a detection system. Patients will be lying on the gantry,x ray passes through the patient gets absorbed and transmitting photons falls on 1000 radiation detectors ,photons strike the detector converted into scintillations. Output unit produces a visual image on gthe CRT. Scanning system is total of six generations.

People should remove objects like jewelry, belt eyeglasses, dentures, like metal objects so that accidents can be avoided. We have to wear hospital gown while scanning. It is very much essential to limit the number of people in a CT room. Other person should stand in the green zone that is the either side of CT.



Fig 13.2

Company- GE

Model- 32 slice

14. MRI

MRI is an imaging technique that is used primarily in medical settings to produce high quality images of the inside of a human body. It is based on the principle of NMR (Nuclear magnetic resonance). This instrument uses a very powerful magnet to align the nuclei of atoms inside the body, and a variable magnetic field. The various magnets used in this equipment are permanent magnets (Ce-Fe alloys), electromagnets, resistive magnet (Al strips), superconducting magnets (NbTi). The system consists of a RF Generator, RF Transmitting coils, RF power amplifier. The detector system detects the nuclear magnetization and generates an output signal. Gradient system obtains spatial distribution information. Imager system consists of computer, display system, control console.



Fig 14.1

Company- SIEMENS

Model - MAGNETOM

15. ULTRASOUND

Ultrasound is also known as sonography or ultrasonography. The images produced by the ultrasound are known as sonograms. Ultrasound refers to acoustical wave of frequency 20-20000HZ above. They are generated from piezo electric crystals like quartz, rochelle salt, lead zirconate etc. Medical ultrasound imaging consists of using high pitched sound bouncing off tissues to generate images of internal body structures. There are different display modes A mode (A=amplitude), M=mode(M=motion), B-mode(B=brightness). Doctor's commonly use ultrasound to study a developing foetus(unborn baby), pelvic organs, a person's abdominal, heart and blood vessels, muscles and tendons. Ultrasound can reveal tumors that may be cancerous. There is no side effect for external and internal ultrasound.

BLOCK DIAGRAM OF ULTRASOUND

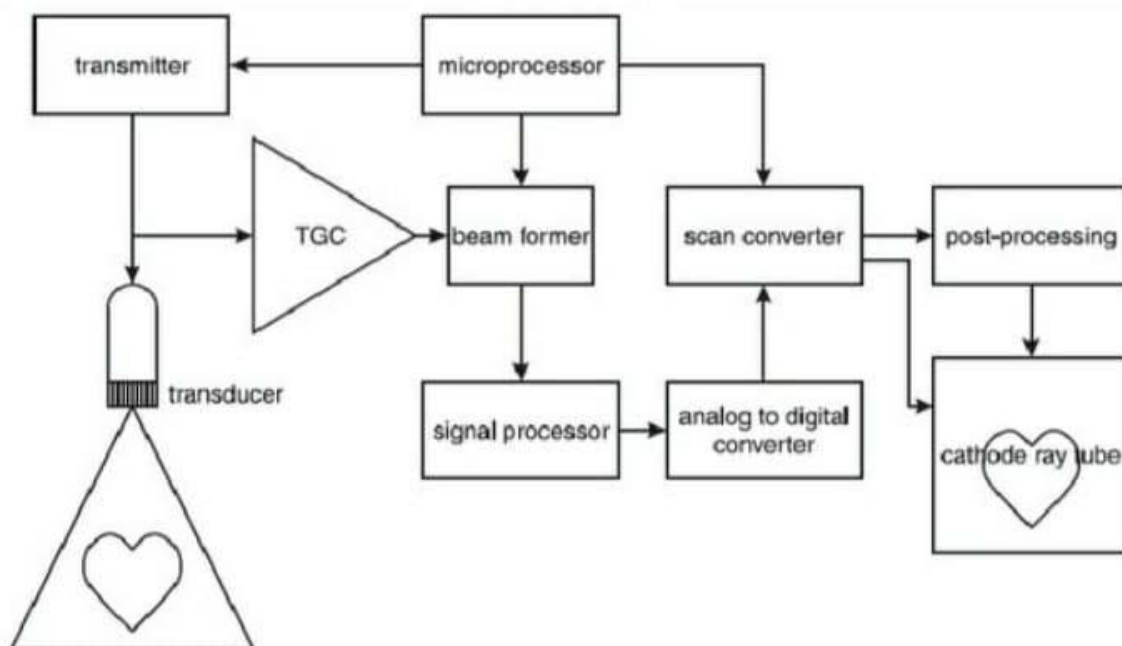


Fig 15.1

Ultrasound is a non-invasive imaging test that shows structures inside of our body using high-intensity sound waves. For diagnosing conditions and during pregnancy, healthcare providers use ultrasound. The different categories of ultrasound include pregnancy ultrasound, diagnostic ultrasound, ultrasound guidance for procedures. 3D (Three-dimensional) ultrasound allows visualization of some facial features of the

foetus and it shows other body parts possibly like fingers and toes where as 4D(Four dimensional) ultrasound is 3D ultrasound in motion. Ultrasound technician or a sonographer also known as doctor or a healthcare provider only can perform ultrasounds. They are specially well-trained to operate properly and safely.



Fig 15.2

Company- wipro (GE)

Model -Voluson s10



Fig 15.3 vivid T9 (GE)



Fig 15.4 company- mindray, model- dp2200plus



Fig 15.5 ports

16. CONCLUSION

Medical devices are the fundamental component of a health system. Medical devices play a vital role in preventing, diagnosing, treating and to rehabilitate illness and diseases in a safe and effective way. Biomedical engineers possess the knowledge and skills to be able to scan physiology, mechanics, health informatics and so on. Biomedical engineer supports the diagnosis of patient, calibrating and repairing biomedical equipment, training the users, maintaining safe and secure operations. Biomedical engineer aims in designing efficient and effective solutions by analyzing the challenges to improve quality of patient care. The three main goals of a biomedical engineer are DESIGN, REPAIR, CONDUCT. Biomedical engineer also has a large future in research. Biomedical engineers work together with doctors, healthcare professionals, surgeons and technicians in order to tackle health issues.

The quick evolution of biomedical equipment and information technology together with the rising need of integration in data, signals, and images in the hospital procedure lead to the need of specialized expertise in computer science and clinical engineering. Biomedical engineer gets an ability to formulate, identify and solve complex engineering problems by applying principles of science, engineering, mechanics and mathematics. Biomedical engineer focuses on the advancing technology and medicine to develop new instruments, equipments for improving human health. Professional training gave a clinical practice and detailed information on devices. Professional training build confidence and credibility, improved efficiency, a very good uniformity in the work process.

17. REFERENCE

17.1 Content

Website-<http://www.mathahospital.org>

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17.2 pictures

Matha hospital(place of training)

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17.3 Books

Sathyabama LMS

“Therapeutic medical devices” by A M Cook & j G webster