Vocational Higher Secondary Education (VHSE)

Second Year

BIO MEDICAL EQUIPMENT TECHNOLOGY

Reference Book - Teachers' Version

Government of Kerala
Department of Education

State Council of Educational Research and Training (SCERT),
KERALA
2016

Foreword

Dear Teachers

This reference book **(Teachers' Version)** is intended to serve as a transactional aid to facilitate classroom transaction and as a ready reference for teachers of Vocational Higher Secondary Schools. It offers some guidelines for the transaction of the course content and for undertaking the practical work listed in the course content. As the curriculum is activity based, process oriented and rooted in constructivism focusing on the realisation of learning outcomes, it demands higher level proficiency and dedication on the part of teachers for effective transaction.

In the context of the Right- based approach, quality education has to be ensured for all learners. The learner community of Vocational Higher Secondary Education in Kerala should be empowered by providing them with the best education that strengthens their competences to become innovative entrepreneurs who contribute to the knowledge society. The change of course names, modular approach adopted for the organisation of course content, work-based pedagogy and the outcome focused assessment approach paved the way for achieving the vision of Vocational Higher Secondary Education in Kerala. The revised curriculum helps to equip the learners with multiple skills matching technological advancements and to produce skilled workforce for meeting the demands of the emerging industries and service sectors with national and global orientation. The revised curriculum attempts to enhance knowledge, skills and attitudes by giving higher priority and space for the learners to make discussions in small groups, and activities requiring hands-on experience.

The SCERT appreciates the hard work and sincere co-operation of the contributors of this book that includes subject experts, industrialists and the teachers of Vocational Higher Secondary Schools. The development of the teachers' version of reference books has been a joint venture of the State Council of Educational Research and Training (SCERT) and the Directorate of Vocational Higher Secondary Education.

The SCERT welcomes constructive criticism and creative suggestions for the improvement of the book.

With regards,

Dr. J. Prasad
Director
SCERT, Kerala

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About The Course

A variety of electrical and electronic equipment are used in hospitals for various diagnostic and therapeutic purposes; including operation theatre as for anesthesia and surgical purposes. Modern medicine is emerging in new trend in equipment technology. The success of the procedures and safety of patient depends largely on the reliability, precision sensitivity and trouble free performance of these equipment. It is also necessary that Biomedical equipment used in hospitals and diagnostic centers should be standardized by calibrating in time. For this, we need qualified and skilled technicians. But skilled hands are very less in this sector. Due to the lack of these technicians Biomedical equipments are remain un operational condition without adequate maintenance support especially in govt sector. So this course can fill this lacunae providing trained manpower in almost all branches of modern medicine like Cardiology, Neurology, Physical Medicine, Medical imaging, CSSD, Dialysis room, Manifold, etc.. They can get vertical mobility in all these disciplines in medical field. This will lead to better service to the mankind aiming at better healthcare management.

2. JOB ROLES

Biomedical Equipment Technology Pass outs are able to do Routine Maintenance, Calibration, up keeping Of Biomedical Equipment. They can do the Trouble Shooting and Installation of Biomedical Equipment under the Supervision of Biomedical Engineers. By giving proper Training they can join as Trainees in Biomedical Equipment manufacturing units. They can work in different departments in a hospital also like cardiology , operation theatre, CSSD, ECG, EEG, EMG rooms ,Medical Imaging & manifold

GOVT. SECTOR	PRIVATE SECTOR	SELF EMPLOYMENT
> Biomedical Technician In Govt. Hospitals. > Lab Assistant/Technical Assistant In Biomedical Department In Taluk / District / CHC Hospitals under NRHM Scheme > ECG Technician > Radiology Technician > EEG Technician > EMG/NCV Technician > Lab.Assistant In Cardiology Dept. (TMT and CATH Lab) > Lab.Assistant In Operation Theatre > Gas Technician in Central Medical Gas Supply Division > Technician in CSSD > Lab Assistant In Biomedical Workshop > Lab Technical Assistant in VHSE Department	> Biomedical Technician In Private. Hospitals. > Lab.Assistant In Biomedical Department In Private Hospital > ECG Technician > Radiology Technician > EEG Technician > EMG/NCV Technician > Lab .Assistant In Cardiology Dept. (TMT & CATH Lab) > Lab.Assistant In Operation Theatre > Lab. Assistant In Central Gas Supply Division > Lab. Assistant In CSSD > Lab Asst.in hemodialysis > Lab Assistant In Biomedical Workshop > Asst. in Dialysis room	> Sales And Supplier Of Medical Equipment (Franchise). > Medicalequipment Manufacturers > Medical Equipment Dealers > Biomedical Equipment Service Centres > Microscope Service Centre

3.BET COURSE – MAJOR SKILLS

This course offers therapeutic/ analytical and surgical equipment in module 3 and medical imaging equipment in module 4.

- Understand Production, properties and applications of X-rays, absorption of X-rays, unit of X-ray the principle of radiography,
- Identify the block diagram of X-ray machine , types of X-ray machine, unit of X rays- Mobile, stationary, OPG, C arm, mammography, digital X-ray. X-ray film- Construction- processing and digital processing. AERB regulations and general safety in radiography, Effect of X-ray in human body.
- Familiarize and identify operation theater equipment like OT lights, OT tables, Anesthesia equipment, Electro surgical unit, and other OT equipments
- Aims and objectives of CSSD, workflow in CSSD, concept of sterilization – definition and importance of sterilization, classification and methods of sterilization, equipment used for sterilization and their uses, autoclave , hot air oven. Equipment safety and sterilization controls (chemical and biological controls), and introduction to liquid oxygen supply.
- Identify and understand Microscopy – different types of microscopes, working principle, parts, magnification, adjustments, maintenance and uses of a compound microscope
- Identify and understand photoelectric colorimeter – working principle, parts, block diagram, procedure, maintenance and applications, introduction to glucometers.
- Identify and understand - PH meter- working principle, parts, block diagram, procedure, maintenance and applications, Clinical relevance of blood PH,
- Importance of general safety in hospitals, the effects of electricity on human body, electric shock hazards and precautions to avoid shock, IEC document and safety codes of biomedical equipment, grounding in Biomedical Equipment, familiarize Rules and Ethics in medical field.

Minor skills

- Familiarize and identify - Centrifuge- parts, working, maintenance of table top centrifuge, Fundamentals of Eletrolyte analyzer, Blood gas analyser, incubator and water bath , Familiarise Automatic Hemo analysers and blood cell counters, General safety, equipment safety and Quality Control in Medical laboratories, name and uses of Blood bank equipments-Blood bank refrigerators, Blood bank centrifuges, cryo centrifuge,cry bath, deep freezers, machines, donor couch, blood bag sealer, platelet agitator, blood shaker.
- Familiarize and identify - concept of central medical gas supply system, basic components, manifold, suction apparatus – parts, working and uses, introduction to pendant for gas supply, safety and precautions in manifold and pipeline supply.
- Familiarize dialysis – Importance of dialysis, Types of dialysis – peritoneal dialysis and hemo dialysis, Hemodialysis – fundamentals and applications
- Enlist therapeutic equipments- Radiotherapy , physiotherapy ,phototherapy, magneto therapy equipment. Radiotherapy Equipment – Physiotherapy equipment – Short wave diathermy, microwave diathermy, ultrasound diathermy, nerve and muscle stimulators, TENS, IFT, IR lamps, CPRM,
- Familiarize biomedical waste management – definition and classification of biomedical waste., steps in waste management, segregation, collection, storage, transportation, disposal – equipment used, autoclave, incinerator, safety aspects regarding biomedical waste.
- Enlist Fiber optic equipment in medicine and equipment in an ICU,
- Familiarize - computer system (hard ware, soft ware and inventory control)and communication (HIS) , civil engineering - water supply, mechanical work shop, air conditioning, electrical- power distribution
- Understand ultra sound physics, principle of oscillation, circuit diagram-working of crystal oscillator, fundamentals of ultra sonography, medical applications of ultra sonography

- Familiarize fundamentals of CT scanning, Fundamentals of MRI scanning. Familiarization of modern imaging techniques- names only, Applications of PET, SPECT, gamma camera.

4.Learning Outcome

Upon completion of two modules, the learner will be able to:-

Module 3-SURGICAL/ ANALYTICAL THERAPEUTIC EQUIPMENT

Unit 1 - Operation Theatre Equipment

3.1.1 Fundamentals of operation theatre.

3.1.2 List of OT equipments and its applications.

3.1.3 Familiarise OT table and light.

3.1.4 Familiarise fundamentals of anesthesia, parts of anesthesia machine.

3.1.5 Understand the principles of diathermy.

3.1.6 Familiarise different electrodes used in surgical diathermy.

3.1.7 Familiarise different modes of operation in surgical diathermy.

3.1.8 Identify the block diagram and description of ESU.

3.1.9 Identify the applications of ESU.

3.1.10 Identify the general safety aspects and equipment safety in OT.

Unit 2 – Central Sterile Supply Department [CSSD]

3.2.1 Identify the aims and objectives of CSSD

3.2.2 Familiarise work flow in CSSD.

3.2.3 Identify the definition and importance of sterilization

3.2.4 Classification and methods of sterilization.

3.2.5 Identify the equipment used for sterilization and their uses.

3.2.6 Autoclave- Working principle, parts.

3.2.7 Hot Air Oven – Parts, procedure, uses.

3.2.8 Familiarise general safety aspects and sterilization control.

3.2.9 Idea about liquid oxygen supply

Unit -3 –Central Medical Gas Distribution System

3.3.1 An idea of medical gas distribution system

3.3.2 Identify the components of medical gas distribution system

3.3.3 Familiarise manifold.

3.3.4 Identify the parts, working and use of suction apparatus.

3.3.5 Discuss safety in manifold and distribution of medical gas.

Unit 4 – Laboratory and blood bank Instruments

3.4.1 Identify the different types of microscope.

3.4.2 Understand the working principle, parts, magnification adjustments, care and uses of a compound microscope.

3.4.3 Understand the working principle, parts, block diagram, procedure and applications of a photoelectric colorimeter.

3.4.4 Familiarise semi and fully auto analyser

3.4.5 Understand the principle, procedure, block diagram and working of pH meter.

3.4.6 Understand the clinical relevance of pH of blood.

3.4.7 Familiarise the parts and working of table top centrifuge.

3.4.8 Naming and uses of electrolyte.

3.4.9 Naming and uses of haemo analysers and blood cell counters.

3.4.10 Familiarise safety and quality control aspects in a laboratory.

3.4.11 Naming and uses of blood bank equipment.

Unit 5 – Dialysis Equipments

3.5.1 Identify the importance and types of dialysis.

3.5.2 Familiarise haemo dialysis machine.

Unit 6 – Therapeutic Equipment

3.6.1 Name and uses of radio therapeutic equipment.

3.6.2 Naming and uses of physiotherapy equipment.

Unit 7 – Biomedical Waste Management

3.7.1 Classification of biomedical waste

3.7.2 Identify the steps in biomedical waste management.

3.7.3 Identify the methods of disposal of waste.

3.7.4 Identify the equipment used in waste management.

Unit 8 – Audiometry

3.8.1 Understand the anatomy of ear and mechanism of hearing.

3.8.2 Identify pure tone audiometer and speech tone audiometer.

3.8.3 Identify the parts and operation of pure tone audiometer.

3.8.4 Identify the types and uses of hearing aids.

Unit 9 - Major equipment in other medical departments.

3.9.1 Familiarise the applications of fibre optics in medicine.

3.9.2 List out the equipment based on fibre optics, endoscope, laproscope, bronchoscope and laryngoscope.

3.9.3 Familiarise other engineering services in a hospital – Civil, Electrical , mechanical
Note: Name and uses only is required.

5.COURSE STRUCTURE

This Course Will Consist Of Four Modules as

Module 1: Biomedical Instrumentation

Module 2: Diagnostic Equipment

Module 3: Surgical /Analytical & Therapeutic Equipment

Module 4: Medical Imaging

6.SYLLABUS

MODULE 3

SURGICAL/ANALYTICAL &THERAPEUTIC EQUIPMENT

UNIT 1: OPERATION THEATRE EQUIPMENT

- Basic fundamentals of operation theatre, List of OT equipment and its applications (OT tables, OT lights, Anesthesia machines, Anesthesia ventilators, multi para monitor, ESU, central suction, heart lung machine – names and uses only), Characteristics, classification, types of OT table and light, fundamentals of Anesthesia, parts of anesthesia machine and applications, principle of surgical diathermy, different electrodes used in surgical diathermy, different modes of operation in surgical diathermy (electrotomy, coagulation, fulguration, desiccation), block diagram and description of ESU, applications of ESU, safety in OT - general guidelines, equipment safety – ESU and anesthesia machines, concept of modular OT.

UNIT 2 : CENTRAL STERILE SUPPLY DEPARTMENT (CSSD)

- Aims and objectives of CSSD, workflow in CSSD, concept of sterilization – defini9sion and importance of sterilization, classification and methods of sterilization, equipment used for sterilization and their uses, autoclave – working principle - parts, procedure, maintenance and uses, hot air oven - parts, procedure, maintenance and uses. Equipment safety and sterilization controls (chemical and biological controls), introduction to liquid oxygen supply.

UNIT 3 : CENTRAL MEDICAL GAS DISTRIBUTION SYSTEM

- Introduction to concept of central medical gas supply system, basic components, manifold, suction apparatus – parts, working and uses, introduction to pendant for gas supply, safety and precautions in manifold and pipeline supply.

UNIT4 : LABORATORY AND BLOOD BANK INSTRUMENTS

- Microscopy – introduction , different types of microscopes, working principle, parts, magnification, adjustments, maintenance and uses of a compound microscope, photoelectric colorimeter – working principle, parts, block diagram, procedure, maintenance and applications, introduction to glucometers. PH meter- working principle, parts, block diagram, procedure, maintenance and applications, Clinical relevance of blood PH, Centrifuge- parts, working, maintenance of table top centrifuge, Fundamentals of Eletrolyte analyser, Blood gas analyser, incubator and water bath , Familiarise Automatic Hemoanalysers and blood cell counters, General safety, equipment safety and Quality Control in Medical laboratories, name and uses of Blood bank equipments-Blood bank refrigerators, Blood bank centrifuges, cryo centrifuge, deep freezers, Apheresis machines, donor couch, blood bag sealer, platelet agitator, blood shaker.(name and uses only is required)

UNIT5: DIALYSIS EQUIPMENT

- Introduction to dialysis – Importance of dialysis, Types of dialysis – peritoneal dialysis and hemo dialysis, Hemodialysis – fundamentals and applications

UNIT 6: THERAPEUTIC EQUIPMENTS

- Introduction to types of therapeutic equipments- Radiotherapy , physiotherapy ,phototherapy, magneto therapy equipment. Radiotherapy Equipment –
  Physiotherapy equipment – Short wave diathermy, microwave diathermy, ultrasound diathermy, nerve and muscle stimulators, TENS, IFT, IR lamps, CPRM, (NAMES AND USES ONLY IS REQUIRED.)

UNIT 7: BIOMEDICAL WASTE MANAGEMENT

- Introduction to biomedical waste management – definition and classification of biomedical waste., steps in waste management, segregation, collection, storage, transportation, disposal – equipment used, autoclave, incinerator, safety aspects regarding biomedical waste.

UNIT 8: AUDIOMETRY

- Anatomy of ear and mechanism of hearing. Types of audiometers - Pure tone audiometer and speech audiometer, the parts and operation of pure tone audiometer, the types and uses of hearing aids.

UNIT 9: MAJOR EQUIPMENT S IN OTHER DEPARTMENTS

- Fiber optics in medicine(List out equipment and its uses) , civil engineering , mechanical, electrical-

MODULE 4

MEDICAL IMAGING

UNIT1: RADIOGRAPHY

- Production, properties and applications of X-rays, absorption of X-rays, unit of X-ray the principle of radiography, block diagram of X-ray machine , types of X-ray machine, unit of X rays- Mobile, stationary, OPG, C arm, mammography, digital X-ray. X-ray film- Construction- processing and digital processing. AERB regulations and general safety in radiography, Effect of X-ray in human body.

UNIT2 : ULTRASONOGRAPHY

- To understand ultra sound physics, principle of oscillation, circuit diagram- working of crystal oscillator, fundamentals of ultra sonography, medical applications of ultra sonography

Unit 3 – MODERN EQUIPMENT IN MEDICAL IMAGING

- Fundamentals of CT scanning, Fundamentals of MRI scanning. Familiarization of modern imaging techniques- names only, Applications of PET, SPECT, gamma camera.

Unit 4 – PATIENT SAFETY

- Importance of general safety in hospitals, the effects of electricity on human body, electric shock hazards and precautions to avoid shock, IEC document and safety codes of biomedical equipment, grounding in Biomedical Equipment, familiarize Rules and Ethics in medical field.

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LIST OF PRACTICALS IN BET COURSE – II YEAR

MODULE 3

OT Equipment

1.1Operation theatre equipment : Collection of details using internet and preparing charts.

1.2Field Visit to operation theatre and prepare field visit report

1.3Preparation of vocational album using operation theatre lights, table, electro surgical unit and other surgical equipment

2. CSSD

2.1 Working of simple autoclave – laboratory practical.
2.2 Working of hot air oven – Lab practical

2.3 Preparation of report on work flow in CSSD.

2,4 Visit to CSSD in a hospital and preparation of visit report.

3. CENTRAL GAS DISTRIBUTION SYSTEM

3.1 Hospital visit and report preparation of central medical gas distribution system.
3.2 List preparation of colour coding in various gases used in a hospital.

Unit 4 LABORATORY EQUIPMENT

4.1 Compound Microscope

Parts, operation and maintenance of compound microscope.
Diagram

Parts of compound microscope
Adjustments of compound microscope namely low power high power and oil immersion objectives.
Procedure of focusing a microscope
Care of compound microscope.

4.2 Photoelectric colorimeter

To study the operation of photoelectric colorimeter and determine the concentration of unknown solution.
Principle
Block diagram
Procedure
Uses.

4.3 pH Meter

Study the operation of pH meter and to find the pH of a given solution.
Principle
Parts
Procedure
Applications.

4.4 Prepare an album containing list of equipments and its use in medical lab and blood bank by doing OJT or conducting a field visit.

5. DIALYSIS EQUIPMENT

5.1 Field visit to haemo dialysis room and preparation of field visit report.

6. THERAPEUTIC EQUIPMENT

6.1 Field Visit to medical radiology department and prepare Field Visit Report

6.2. Prepare e album on medical radiology equipments

7.BIOMEDICAL WASTE MANAGEMENT

7.1 Identification of category and color code of BMW and record work

8. Audiometery

8.1 Illustration of anatomy of human ear and hearing mechanisum

8.2 Study of pure-tone audio metric and plotting of audio gram

9.OTHER MEDICAL EQUIPMENT

9.1 Listing of major equipment in other department

9.1 Prepare an E album of other medical equipment

MODULE 4

UNIT :1 MEDICAL IMAGING

1.1 Study of X- ray machine, X- ray tube – working,record work

1.2 Radiography technique..basicprocedure

1.3 Study about processing of x- raf film – conventional method and digital

1.4 Collection of x ray film, different models of x ray machine,x ray tubes..- album making

1.5 Study of radiological safety- AERB regulations

Unit 2 ULTRASONOGRAPHY

2.1 Fabrication of crystal oscillator

2.2 study of wave forms

2.3 Study of ultrasound and applications of ultrasound in medical field

2.4 Study of ultrasonograph

Unit 3 Modern equipment in medical imaging

3.1 Prepare an E album of other medical equipment in imaging , Field visit to medical radiology department and prepare field visit report.

Unit 4

4.1 Study of safety precautions in a hospital environment

4.2 Study of IEC document and IEC codes of Biomedical equipments.

7. Scheme of work

Module 3

Month	Name of units	Period
June	Operation Theatre equipment	50
June/July	Central Sterile Supply Department	50
July	Central Medical Gas Distribution System	30
July/August	Laboratory and Blood bank instruments	90
September	Dialysis equipment	30
September	Therapeutic Equipment	30
October	Biomedical Waste Management	30
October	Audiometry	30
	Total	340

Module 4

Month	Name of units	Period
November/ December	Radiography	120
December/ January	Ultra Sonography	80
January/ February	Modern equipment in imaging	80
February	Patient Safety	60
	Total	340

1. CLASS ROOM ACTIVITIES

- Demonstration
- Chart Preparation
- Assignment
- Seminar
- Project Preparation
- Power Point Preparation
- Album Preparation
- Collection
- Module Preparation
- Structured Interview
- Flow Chart
- General Discussion
- Expert Talk
- Video Presentation
- e Album Preparation
- Still/ working Model Presentation
- Exhibition
- Field Visit
- Interaction with Expert
- Observation
- Guided discussion
- Class test
- Open book exam
- Illustration

2. PRACTICAL ACTIVITY

- Observation
- demonstration
- Fabrication Of Circuits, calculation,results
- Record Making
- Album Making
- e Album making
- Practical Experiment
- Recording Of Biochemical parameters
- OJT
- PTC
- Vocational Survey
- Vocational Exhibition
- Field Visit
- Dissertation
- Focus Group Discussion
- Collection Of Data-Questionnaire, Check List
- Analysis and Inferring Data
- Recording
- Reporting

3. Structure of Module 3

Module 3, Surgical , Analytical, Therapeutic instruments are included in this nine units. OT Equipments, CSSD Equipments, Central Gas Distribution system, Common Laboratory and blood bank equipments, Equipment in dialysis, Some specialized therapeutic equipment, Basics of Biomedical waste management system, Audiomtery, some specialized investigative equipment like endoscope, laryngoscope ,etc..And to familiarize engineering departments in a hospital viz,civil, mechanical, electrical are also include in this module.

Unit 1 ,Operation theatre is a space for surgical procedures in a hospital. It consists of a preparatory area, pre surgical area and a procedure area. The procedure area is an absolutely sterile area for during the surgery. All surgical equipment is kept in this area.OT tables, OT lights, anesthesia cart, ESU, all other surgical tools are kept in this area. Details of principle, parts, working and applications of ESU is also included in the syllabus.

This unit 2 deals with the processes done in the CSSD , Aims and objectives of CSSD, work flow in a CSSD, Importance of sterilization in a hospital, methods of sterilization, equipments used for sterilization ,their working, parts, and applications.

The central sterile supply department (CSSD) is an important facility of a hospital which ensures a high standard of sterilization and disinfection to minimize hospital acquired infections. CSSD services are responsible for receiving, processing, storing, issue and control of professional supply of instruments, equipments and surgicals.

In unit 3, medical importance of medical gases are included.In modern medicine supply of medical gases is of significant role. In olden days gases were supplied in gas cylinders and the attenders used to roll it to the casualty or operation theatres. Now central pipeline system is available in pipeline system in all modern hospitals.

Unit 4 deals with laboratory and blood bank instruments. Dialysis machine, therapeutic equipments come under units 5 and 6.

Learners are supposed to understand the importance of biomedical waste management program in hospital environment. t is of most importance in safety of staff as well as students working in hospitals.

Other medical equipments like audiometer, instruments based on fiber optics,, laser etc ..are also included in module 3 syllabus.

4. Structure of Module 4

Module 4 consists of Medical imaging – Medical imaging include radiography, basics of ultrasonography, elementary details of CT, MRI, PET, SPECT and gamma camera. Radiography include radiograph preparation ,.study of X ray machine and processing of x- ray film. Ultrasonography includes study of ultra sound, parts of machine and its uses in medical field. Patient safety is also included in this module. Effects of elecrticity on human body, grounding of equipment and other safety aspects are also included in this module

5. OVERVIEW OF MODULE 3

SURGICAL/ANALYTICAL &THERAPEUTIC EQUIPMENT

This module includes different surgical , analytical and therapeutic equipment used in medical field. As a beginner in biomedical equipment technology, a learner can be exposed to all these equipment. In unit 1 , general surgical equipment like OT table, OT lights, surgical diathermy, anesthesia machines, anesthesia ventilators , and electro surgical unit are included .

Importance of sterilization in a hospital environment , Types of sterilization ,Equipment its applications, sterile materials and its supply is given in unit 2.

Central medical gas distribution system is given as third unit, It includes types of medical gases, storage and supply through pipeline system. Suction apparatus its working and application is also included in this unit.

Unit 4 include laboratory and blood bank instruments. Here in this module we cover Microscopy, Maintenance, parts, uses and working of Photo electric colorimeter, PH meter, Basic idea of Electrolyte analyzer, blood gas analyser, incubator and waterbath. Biochemical and hematology auto analyzers are also included. Introduction to blood cell counters and blood bank equipment is also given.

Hemodialysis equipment, radiotherapy equipment, physiotherapy equipment, are introduced. An important department in medical field included is Biomedical waste management. As a person working in a hospital environment one should understand the importance of Biomedical waste management. Fundamentals of collection, segregation, processing only is given.

An introduction to fiberoptic instruments,equipment in an ICU, civil, mechanical and electrical departments is given for familiarization for the learner. Hospital computer applications and and importance of hospital information system is also included.

13. OVERVIEW OF MODULE 4

MODULE 4 Medical Imaging

Medical Imagin is the technique and process of creating visual representation of the interior of a boy for clinical analysis and medical intervention. The visual representation of the function of organs and tissues help in the diagnosis as well as treatmernt. Medical imaging include readiography, ultrasonography, elementary details of CT, MRI, PET, SPECT and gamma camera. Rediography include radiograph prepration dtudy of X ray machine and processing. Ultrasonography includes study of ultra sound, parts of machine and its uses in medical field. Patient safety is also included in this module. Effects of elecrticity on human body, grounding of equipment and other safety aspects are also included in this module.

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14. UNIT GRID

Module 3

1. OT EQUIPMENT

• Basic fundamentals of operation theatre.	*Familiarise basic fundamentals of operation theatre.*	*Video and CD presentation.* *Guided discussion.* *Refer internet* *Illustration.*	Activity
• List of OT equipments and its applications.	*List of OT equipments and its applications.*	*Video and CD presentation.* *Illustration.*	Activity
• Familiarise OT table and light.	*Familiarise OT table and light.*	*Video and CD presentation.* *Illustration.*	Activity
• Familiarise fundamentals of anesthesia, parts of anesthesia machine.	*Familiarise fundamentals of anaesthesia, parts of anaesthesia machine.*	*Assignment* *Illustration.* *Video and CD presentation.*	Assignm Activity
• Understand the principles of diathermy.	*Understand the principle of diathermy.*	*Illustration. Video and CD presentation*	Activity
• Familiarise different electrodes used in surgical diathermy.	*Familiarise different electrodes used in surgical diathermy*	*Video and CD presentation.*	Activity
• Familiarise different modes of		Discussion based on chart	Particip

operation in surgical diathermy. • Identify the block diagram and description of ESU. • Identify the applications of ESU. • Identify the general safety aspects and equipment safety in OT.	Familiarise different modes of Operation in surgical diathermy. Identify the block diagram and description of ESU Identify the application of ESU Identify the general safety aspects and equipment safety In OT.	Chart preparation Illustration of block diagram Discussion Field visit and discussion	Chart ev Activity Activity Visit rep Activity

UNIT GRID :

UNIT 2 : CENTRAL STERILE SUPPLY DIVISION (CSSD)

Ideas/Concepts	Learning Outcomes	Suggested activity	
❖ Aims and Objectives of CSSD	❖ Identify the Aims and Objectives of CSSD	❖ Illustration ❖ Chart preparation and discussion	❖ A
❖ Work flow in a CSSD	❖ Familiarize work flow in a CSSD.	❖ Displaying a flow chart showing work flow in a CSSD. ❖ Discussion on the components of CSSD and the work pattern.	❖ A ❖ Id c
❖ Importance of sterilization.	❖ Identify the importance of sterilization.	❖ Guided discussion – study material given for discussion and deliberation.	❖ P d ❖ a
❖ Classification and methods of sterilization	❖ Categorize different methods of sterilization.	❖ Flow chart preparation ❖ Discussion with handouts ❖ Presentation of power point.	❖ C ❖ D ❖ W c
❖ Autoclave - working principle, parts and maintenance	❖ Understand the working, parts and maintenance of autoclave	❖ Discussion ❖ Demonstration of working ❖ Practical experiment ❖ Record work ❖ Maintenance procrdures	❖ D ❖ R ❖ C m

UNIT 3 CENTRAL MEDICAL GAS DISTRIBUTIONS SYSTEM

Idea/Concept	Learning out come	Suggested Activity	
Idea of medical gas distribution system	Get idea of medical gas distribution system	Guided discussion material given for discussion. Noting discussion points is activity log	Act
Components of medical gas distribution system	Identity the components of medical gas distribution system	Guided discussion	Act
Basic knowledge about manifold	Familiarize manifold	Chart preparation & illustrating Hospital visit	Cha
Working, parts and uses of suction apparatus	Identity parts working and uses of suction apparatus	Students to collect instruction from test book, reference book & CD's and present the topic or Hospital visit or chart preparations & Instructions	Ser visi cha
Safety in manitold and distribution of medical gases	Discuss safety in manitold and distribution of medical gases	Guided discussion materials give for discussions. Noting discussion points in activity log.	Act

UNIT GRID : Unit 4 – Laboratory and blood bank Instruments

Ideas/Concepts	Learning Outcomes	Suggested activity	Assessment
Microscopy – introduction , different types of microscopes	Identify the different types of microscope.	Illustration Chart preparation and discussion Guided discussion	Activity log Participation in discussion.
Working principle, parts, magnification, adjustments, maintenance and uses of a compound microscope,	Understand the working principle, parts, magnification adjustments, care and uses of a compound microscope	Chart preparation Demonstration of working Practical experiment Record work	Participation in discussion. activity log Record evaluation Chart prepared
Photoelectric colorimeter – working principle, parts, block diagram, procedure, maintenance and applications	Understand the working principle, parts, block diagram, procedure and applications of a photoelectric colorimeter	Discussion Demonstration of working Practical experiment Record work Video and CD presentation Hospital visit Visit report preparation	Discussion notes activity log Record evaluation Activity log Report evaluation
The principle, procedure, block diagram and working of pH meter.	Understand the principle, procedure, block diagram and working of pH meter.	Discussion Demonstration of working Practical experiment Record work	Discussion notes activity log Record evaluation
The clinical relevance of pH of blood the parts and working of table top	Understand the clinical relevance of pH of blood	Discussion Video and CD	Discussion notes Activity log Report evaluation

centrifuge Naming and uses of electrolyte Naming and uses of haemo analysers and blood cell counters Safety and quality control aspects in a laboratory. Naming and uses of blood bank equipment.	Familiarise the parts and working of table top centrifuge Naming and uses of electrolyte Naming and uses of haemo analysers and blood cell counters Familiarise safety and quality control aspects in a laboratory. Naming and uses of blood bank equipment.	presentation Hospital visit Visit report preparation Discussion Internet Power point presentation and Chart prepare Discussion Video and CD presentation Hospital visit Visit report preparation Discussion Internet Power point presentation and Chart prepare Discussion Internet Power point presentation and Chart prepare	Discussion notes Chart prepared Discussion notes Report evaluation Discussion notes Chart prepared Activity log. Discussion notes Chart prepared Activity log.

UNIT 5 :-UNIT GRID: DIALYSIS EQUIPMENT

Ideas/Concepts	Learning Outcomes	Suggested activity	Assessment
Importance and types of dialysis.	Identify the importance and types of dialysis.	Internet Power point Guided discussion	Oral test Class test
Hemo dialysis	Familiarise haemo dialysis machine.	field visit, internet,discussion	Field visi report, discussion notes,

UNIT 6: Unit grid THERAPEUTIC EQUIPMENT

Idea/ Concept	Learning Outcome	Suggested Activity	Assessm
Introduction to types of therapeutic equipments- Radiotherapy, phototherapy, magneto therapy equipment. Radiotherapy Equipment ,brachy therapy	Name and uses of radio therapeutic equipment.	Guided discussion Illustration. Chart preparation	Evaluatio Chart eva
Physiotherapy equipment – Short wave diathermy, microwave diathermy, ultrasound diathermy, nerve and muscle stimulators, TENS, IFT, IR lamps, CPRM, (NAMES AND USES ONLY IS REQUIRED.)	Naming and uses of physiotherapy equipment.	Guided discussion Illustration. Chart preparation	Evaluatio Chart eva

UNIT 7 : BIOMEDICAL WASTE MANAGEMENT

Ideas/Concepts	Learning Outcomes	Suggested activity	
❖ Introduction to biomedical waste management- definition, classification	❖ Classification of biomedical waste	❖ Illustration ❖ Chart preparation and discussion	❖ Ac
❖ Steps in waste management .	❖ Identify the steps in biomedical waste management	❖ Displaying a flow chart showing steps in waste management ❖ Discussion on the steps in waste management	❖ Ac ❖ Id wa
❖ Categories and type of biomedical waste	❖ Categorize different types of waste	❖ Guided discussion – study material given for discussion and deliberation.	❖ Pa ❖ ac
❖ Different processes of waste management	❖ Identify the equipment used in waste management.	❖ Flow chart preparation ❖ Discussion with handouts ❖ Presentation of power point.	❖ Ch ❖ Di ❖ W co
❖ Methods of disposal of waste.	❖ Identify the methods of disposal of waste	❖ Discussion	❖ Di

UNIT 8:- AUDIOMETRY

Idea / Concept	Learning Outcome	Suggested activity	Assesment
Anatomy of ear	Understand the anatomy of ear	Chart preparation Illustration	Activity log evaluation

15. MODULE 4

UNIT GRID MEDICAL IMAGING

Idea/Concept	Learning Outcome	Suggested Activity
4.1.1 Production properties and application of X rays	Understand production properties and application of X rays	Prepare chart on productio X rays. Video and CD presentation. Illustration based on activit Guided discussion.
4.1.2 Absorbtion of X rays. Unit of X rays	Familarize absobtion of X rays. Study unit of X rays.	Guided discussion.
4.1.3 Principal of radiography.	Understand principal of radiography.	Guided discussion.
4.1.4 Block diagram of X ray machine	Understand the block diagram of X ray machine	Chart preparation Illustration.
4.1.5 Different types of machine using X rays	Familiarise different types of machine using X rays mobile, Stationary OPG,Carm,Mamography Digital Xray	Video and CD presentation Hospital visit. Assignment Seminar
4.1.6 Construction and Processing of X ray film and digital film Processing	Familiarise construction and Processing of X ray film and digital film processing	Chart preparation Hospital visit. Illustration.

4.1.7 AERB regulation General safety in radiography. Effect of X rays in human body.	Familiarise AERB regulation, general safety in radiography and effect of X rays in human body.	Guided discussion.

16. ASSESSMENT ACTIVITIES

Assessment is mainly done in 3 ways- Continuous evaluation (CE),term evaluation (TE) and Skill evaluation(SE). Skill evaluation include practical evaluation(PE), and evaluation of professional skills (PP).

Assessment activities in each unit include class test, open book exam, evaluation of activity log , peer evaluation, quiz, assessment using assignment, seminar, project, oral exam etc.

Assessment can be done during class as well as at the end of each unit.

This can be done along with the learning activities, and at the end of each term and annually.

Vocational skills can be evaluated at the end of each practical experiment and during practical evaluation. Skill evaluation can be done during OJT, PTC, VOC.EXPO etc.OJT dairy is a tool which can be assessed at the end of the training.

Regularity in class room as well as lab activities and time bound action is essential in skill evaluation.

Observation, analysis, inference during lab activities can be assessed during lab work.

17. List of items in portfolio

1. Regularity

2. Punctuality

3. Time bound action

4. Assignment

4. Seminar

7. Class test

8. Project report

9. Field visit report

10. OJT dairy

11. Oral exam

12. Vocational survey

13. Vocational Exhibition

14. Record work

18. **Extended Activities**

Unit 1

An operating theatre (also known an operating room, operating suite, operation theatre, operation room or operation suite) is a facility within a hospital where surgical operations are carried out in a sterile environment.

An operating theatre is a facility within a hospital where surgical operations are carried out in a sterile environment.

Operating rooms are spacious, easy to clean, and well-lighted.

Operating rooms consist of overhead surgical lights, operation table and may have equipment, viewing screens and monitors

Rooms are supplied with wall suction, oxygen, and possibly other anesthetic gases.

There is storage space for common surgical supplies.

Operation theatre is designed to achieve high sepsis. OT is divided into 4 zones.

1. Protective zone – This is entrance of OT. Patient waiting area , pre anesthesia room, change room, store room..etc.
2. Clean room – pre operating room, recovery room, -ray room, plaster room, staff room, store room etc.
3. Sterile room – scrub room, operating suite, instrument trolley, etc.
4. Disposal room – It will inclu8de dirty room, disposal corridor and janitor corridor.

OT TABLE

Anesthesia Cart

Four essential functions are

1.Provides oxygen

2.Mix anesthetic gas with vapours

3.Enable patient ventilation

4.Minimise anesthesia related risk to patient and staff

Parts of a anesthetic machine

1 .Oxygen supply system

2. Oxygen flow meter

3. Breathing circuit

4. Pressure manometer

5. Resorvoir bag

6. Scavenging system

When anaethesia is given, the patient loses consciousness. The usual method of anaethesia is inhalation anaethesia. The most widely used **anesthetic gases** are halogenated ethers such as enflurane, halothane, isoflurane, and desflurane coupled with nitrous oxide. During anaethesia, required amount of oxygen is also supplied to the patient. In critical stage it is necessary to support the patient with controlled ventilation also.

Four essential functions are

1.Provides oxygen

2.Mix anesthetic gas with vapours

3.Enable patient ventilation

4.Minimise anaesthesia related risk to patient and staff

MODULAR OPERATION THEATRE

There is emergence of new concept, known as modular suite. The operating suites are built somewhere else (outside the hospital) and then transported to the desired hospital and installed as and when

required. The modular suite include theatre, anesthetic, scrub, dirty utility, recovery area with beds, reception area, staff changing rest room, and link attaching the new suite to the existing hospital.

LIQUID OXYGEN SUPPLY

Medical liquid oxygen is stored in an insulated stainless steel container that works in a similar way to a thermos flask. These storage containers are referred to as base units and they hold the medical liquid oxygen at an extremely low temperature.

Medical liquid oxygen base units are low pressure storage containers designed to safely store more oxygen than gas cylinders can.
The temperature of liquid oxygen is -183°C and can cause painful 'cold' burns if it should ever come into contact with your skin.
A medical liquid oxygen system that is installed in your home will generally consist of the base unit mounted on a roller base with a separate portable unit.

Medical liquid oxygen systems are installed to meet portable oxygen requirements outside the home. If you have been supplied with an oxygen concentrator for use in the home, you should not use your medical liquid oxygen system for this purpose.

UNIT 7

SAFETY IN BIOMEDICAL WASTE MANAGEMENT

Health-care waste management in India is receiving greater attention due to recent regulations (the Biomedical Wastes (Management & Handling) Rules, 1998). The prevailing situation is analysed covering various issues like quantities and proportion of different constituents of wastes, handling, treatment and disposal methods in various health-care units (HCUs). The waste generation rate ranges between 0·5 and 2·0 kg $bed^{-1}day^{-1}$. It is estimated that annually about 0·33 million tonnes of waste are generated in India. The solid waste from the hospitals consists of bandages, linen and other infectious waste (30–35%), plastics (7–10%), disposable syringes (0·3–0·5%), glass (3–5%) and other general wastes including food (40–45%). In general, the wastes are collected in a mixed form, transported and disposed of along with municipal solid wastes. At many places, authorities are failing to install appropriate systems for a variety of reasons, such as non-availability of appropriate technologies, inadequate financial resources and absence of professional training on waste management.

Hazards associated with health-care waste management and shortcomings in the existing system are identified. The rules for management and handling of biomedical wastes are summarised, giving the categories of different wastes, suggested storage containers including colour-coding and treatment options. Existing and proposed systems of health-care waste management are described. A waste-management plan for health-care establishments is also proposed, which includes institutional arrangements, appropriate technologies, operational plans, financial management and the drawing up of appropriate staff training programmes.

In India, the rules are as follow

1. The Biomedical Waste (Management and Handling) Rules ,1998
2. The Biomedical Waste (Management and Handling) Rules 2000
3. The Biomedical Waste (Management and Handling) Rules,2003

Sl no	Category of waste	Recommended colour code
1	Syringe, blood bag, catheters, etc.	Red
2	Sharps (Infected or not)	White
3	Infected waste (not containing sharps)	Yellow
4	Chemical and pharmaceutical waste (other than cytotoxic drugs, radioactive wastes, high pressure containers	Black
5	Clinical waste that need autoclaving	blue

UNIT **4**

INTRODUCTION TO GLUCOMETERS

A **glucose meter** (or **glucometer**) is a medical device for determining the approximate concentration of glucose in the blood. It can also be a strip of glucose paper dipped into a substance and measured to the glucose chart. It is a key element of home blood glucose monitoring (HBGM) by people with diabetes mellitus or hypoglycemia. A small drop of blood, obtained by pricking the skin with a lancet, is placed on a disposable test strip that the meter reads and uses to calculate the blood glucose level. The meter then displays the level in units of mg/dl or mmol/l.

here are several key characteristics of glucose meters which may differ from model to model:

- **Size**: The average size is now approximately the size of the palm of the hand, although hospital meters can be the size of a remote control. They are battery-powered.
- **Test strips**: A consumable element containing chemicals that react with glucose in the drop of blood is used for each measurement. For some models this element is a plastic test strip with a small spot impregnated with glucose oxidase and other components. Each strip is used once and then discarded. Instead of strips, some models use discs, drums, or cartridges that contain the consumable material for multiple tests.

- **Coding**: Since test strips may vary from batch to batch, some models require the user to manually enter in a code found on the vial of test strips or on a chip that comes with the test strip. By entering the coding or chip into the glucose meter, the meter will be calibrated to that batch of test strips. However, if this process is carried out incorrectly, the meter reading can be up to 4 mmol/L (72 mg/dL) inaccurate. The implications of an incorrectly coded meter can be serious for patients actively managing their diabetes. This may place patients at increased risk of hypoglycemia. Alternatively, some test strips contain the code information in the strip; others have a microchip in the vial of strips that can be inserted into the meter. These last two methods reduce the possibility of user error. One Touch has standardized their test strips around a single code number, so that, once set, there is no need to further change the code in their older meters, and in some of their newer meters, there is no way to change the code.

- **Volume of blood sample**: The size of the drop of blood needed by different models varies from 0.3 to 1 µl. (Older models required larger blood samples, usually defined as a "hanging drop" from the fingertip.) Smaller volume requirements reduce the frequency of unproductive pricks.
- **Alternative site testing**: Smaller drop volumes have enabled "alternate site testing" — pricking the forearms or other less sensitive areas instead of the middle of the fingertips; pricking the sides of the fingertips is actually the least uncomfortable method of testing. Although less uncomfortable, readings obtained from forearm blood lag behind fingertip blood in reflecting rapidly changing glucose levels in the rest of the body.
- **Testing times**: The times it takes to read a test strip may range from 3 to 60 seconds for different models.
- **Display**: The glucose value in mg/dl or mmol/l is displayed on a digital display. The preferred measurement unit varies by country: mg/dl are preferred in the U.S., France, Japan, Israel, and India. mmol/l are used in

Canada, Australia, China and the UK. Germany is the only country where medical professionals routinely operate in both units of measure. Many meters can display either unit of measure; there have been a couple of published instances in which someone with diabetes has been misled into the wrong action by assuming that a reading in mmol/l was really a very low reading in mg/dl, or the converse. In general, if a value is presented with a decimal point, it is in mmol/l, without a decimal it is most likely mg/dl.

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- METHOD OF TESTING

Laboratory quality control

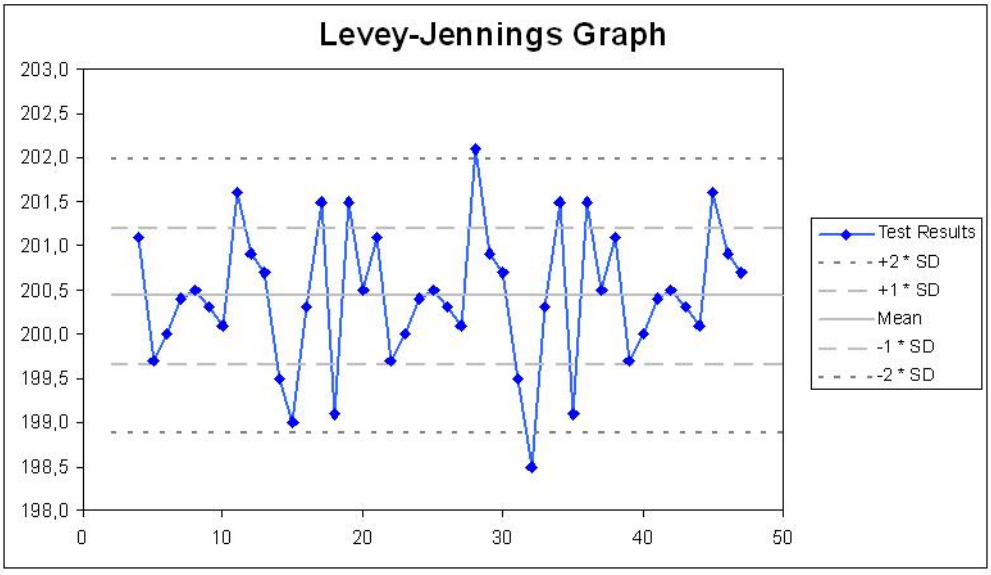
Laboratory quality control is designed to detect, reduce, and correct deficiencies in a laboratory's internal analytical process prior to the release of patient results, in order to improve the quality of the results reported by the laboratory. Quality control is a measure of precision, or how well the measurement system reproduces the same result over time and under varying operating conditions. Laboratory quality control material is usually run at the beginning of each shift, after an instrument is serviced, when reagent lots are changed, after calibration, and whenever patient results seem

inappropriate.[1] Quality control material should approximate the same matrix as patient specimens, taking into account properties such as viscosity, turbidity, composition, and color. It should be simple to use, with minimal vial to vial variability, because variability could be misinterpreted as systematic error in the method or instrument. It should be stable for long periods of time, and available in large enough quantities for a single batch to last at least one year. Liquid controls are more convenient than lyophilized controls because they do not have to be reconstituted minimizing pipetting error.

Levey-Jennings chart is a graph that quality control data is plotted on to give a visual indication whether a laboratory test is working well.The distance from the mean is measured in standard deviations (SD). It is named after S. Levey and E. R. Jennings who in 1950 suggested the use of Shewhart's individuals control chart in the clinical laboratory. On the x-axis the date and time, or more usually the number of the control run, are plotted. A mark is made indicating how far off the actual result was from the mean (which is the expected value for the control). Lines run across the graph at the mean, as well as one, two and sometimes three standard deviations either side of the mean. This makes it easy to see how far off the result was.

Rules, such as the Westgard rules can be applied to see whether the results from the samples when the control was done can be released, or if they need to be rerun. The formulation of Westgard rules were based on statistical methods. Westgard rules are commonly used to analyse data in Shewhart control charts. Westgard rules are used to define specific performance limits for a particular assay and can be used to detect both random and systematic errors. Westgard rules are programmed in to automated analyzers to determine when an analytical run should be rejected. These rules need to be applied carefully so that true errors are detected while false rejections are minimized. The rules applied to high volume chemistry and hematology instruments should produce low false rejection rates.[3] [4]

The Levey-Jennings chart differs from the Shewhart individuals control chart in the way that sigma, the standard deviation, is estimated. The Levey-Jennings chart uses the long-term (i.e., population) estimate of sigma whereas the Shewhart chart uses the short-term (i.e., within the rational subgroup) estimate.



BLOOD BANK EQUIPMENTS

Blood bank equipments include the following equipments.
Blood bank refrigerators, Blood bank centrifuges, cryo centrifuge, cryo bath, deep freezers, Apheresis machines, donor couch, blood bag sealer, platelet agitator, blood shaker.

The blood bank refrigerator is an essential piece of equipment in the immunohematology department and provides safe and convenient storage of whole blood, blood components (e.g., blood cells, plasma), and reagents. Blood bank refrigerators ensure freshness and integrity of blood and blood components.
The refrigeration system includes an electrically powered compressor, a condenser, a capillary tube or expansion valve, an evaporator, and interconnecting tubing. A thermostat regulates the refrigerator temperature. In many models, the compressor and motor are connected to the same shaft and sealed in a compact, airtight compartment, making more space available for storage. Systems are either cylindrical with rotating shelves or rectangular with pullout drawers or shelves. A

temperature alarm is either included or optional. An emergency power system is necessary in the event of a power failure. Configurations include tabletop, or floor units.

blood bank centrifuge

Apheresis (aphairesis) is a medical technology in which the blood of a donor or patient is passed through an apparatus that separates out one particular constituent and returns the remainder to the circulation. It is thus anextracorporeal therapy.

Depending on the substance that is being removed, different processes are employed in apheresis. If separation by density is required, centrifugation is the most common method. Other methods involve absorption onto beads coated with an absorbent material and filtration.

The centrifugation method can be divided into two basic categories:

Continuous flow centrifugation (CFC)

Continuous flow centrifugation (CFC) historically required two venipunctures as the "continuous" means the blood is collected, spun, and returned simultaneously. Newer systems can use a single venipuncture. The main advantage of this system is the low extracorporeal volume (calculated by volume of the apheresis chamber, the donor's hematocrit, and total blood volume of the donor) used in the procedure, which may be advantageous in the elderly and for children.

Intermittent flow centrifugation

Intermittent flow centrifugation works in cycles, taking blood, spinning/processing it and then giving back the unused parts to the donor in a bolus. The main advantage is a single venipuncture

site. To stop the blood from coagulating, anticoagulant is automatically mixed with the blood as it is pumped from the body into the apheresis machine.

Centrifugation variables

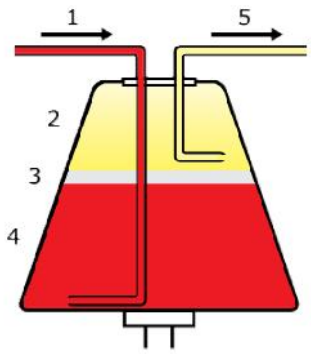
The centrifugation process itself has four variables that can be controlled to selectively remove desired components. The first is spin speed and bowl diameter, the second is "sit time" in centrifuge, the third is solutes added, and the fourth is not as easily controllable: plasma volume and cellular content of the donor. The end product in most cases is the classic sedimented blood sample with the RBC's at the bottom, the buffy coat of platelets and WBC's (lymphocytes/granulocytes (PMN's, basophils, eosinophils/monocytes) in the middle and the plasma on top.

Blood taken from a healthy donor can be separated into its component parts during blood donation, where the needed component is collected and the "unused" components are returned to the donor. Fluid replacement is usually not needed in this type of collection. There are large categories of component collections:

- Plasmapheresis - blood plasma. Plasmapheresis is useful in collecting FFP (fresh frozen plasma) of a particular ABO group. Commercial uses aside from FFP for this procedure include immunoglobulin products, plasma derivatives, and collection of rare WBC and RBC antibodies.
- Erythrocytapheresis - red blood cells. Erythrocytapheresis is the separation of erythrocytes from whole blood. It is most commonly accomplished using the method of centrifugal sedimentation. This process is used for red blood cell diseases such as sickle cell crises or severe malaria. The automated red blood cell collection procedure for donating erythrocytes is referred to as 'Double Reds' or 'Double Red Cell Apheresis.'[1]
- Plateletpheresis (thrombapheresis, thrombocytapheresis) - blood platelets. Plateletpheresis is the collection of platelets by apheresis while returning the RBCs, WBCs, and component plasma. The yield is normally the equivalent of between six and ten random platelet concentrates. Quality control demands the platelets from apheresis be equal to or greater than 3.0×10^{11} in number and have a pH of equal to or greater than 6.2 in 90% of the products tested and must be used within five days.
- Leukapheresis - leukocytes (white blood cells). Leukopheresis is the removal of PMNs, basophils, eosinophils for transfusion into patients whose PMNs are ineffective or where traditional therapy has failed. There is limited data to suggest the benefit of granulocyte infusion. The complications of this procedure are the difficulty in collection and short shelf life (24 hours at 20 to 24 °C). Since the "buffy coat" layer sits directly atop the RBC layer, HES, a sedimenting agent, is employed to improve yield while minimizing RBC collection. Quality control demands the resultant concentrate be 1.0×10^{10} granulocytes in 75% of the

units tested and that the product be irradiated to avoid graft-versus-host disease (inactivate lymphocytes). Irradiation does not affect PMN function. Since there is usually a small amount of RBCs collected, ABO compatibility should be employed when feasible.

- Stem cell harvesting - circulating bone marrow cells are harvested to use in bone marrow transplantation.



Whole blood enters the centrifuge (1) and separates into plasma (2), leukocytes (3), and erythrocytes (4). Selected components are then drawn off (5).

Donor couch

It is for the donor to lie down comfortably for donating blood. Blood bag sealer seals the blood bags properly after the blood collection. Platelet agitator helps to collect platelet without being coagulated. Blood shaker helps in collecting blood without being coagulated. It keeps blood well mixed so that is collected properly.

HEARING AIDS IN AUDIOMETRY

A **hearing aid** or **deaf aid** is a device designed to improve hearing. Hearing aids are classified as medical devices in most countries, and regulated by the respective regulations. Small audio amplifiers such as PSAPs or other plain sound reinforcing systems cannot be sold as "hearing aids".

Earlier devices, such as ear trumpets or ear horns,[1][2] were passive amplification cones designed to gather sound energy and direct it into the ear canal. Modern devices are computerised electroacoustic systems that transform environmental sound to make it more intelligible or comfortable, according to audiometrical and cognitive rules. Such sound processingcan be considerable, such as highlighting a spatial region, shifting frequencies, cancelling noise and wind, or highlighting voice.

Modern hearing aids require configuration to match the hearing loss, physical features, and lifestyle of the wearer. This process is called "fitting" and is performed by audiologists. The amount of benefit a hearing aid delivers depends in large part on the quality of its fitting. Devices similar to hearing aids include the bone anchored hearing aid, and cochlear implant.

Medical ethics

Medical ethics is a system of moral principles that apply values and judgments to the practice of medicine. As a scholarly discipline, medical ethics encompasses its practical application in clinical settings as well as work on its history, philosophy, and sociology. A common framework used in the analysis of medical ethics is the "four principles" approach postulated by Tom Beauchamp and James Childress in their textbook Principles of biomedical ethics. It recognizes four basic moral principles, which are to be judged and weighed against each other, with attention given to the scope of their application. The four principles are:[7]

• Respect for autonomy - the patient has the right to refuse or choose their treatment. (Voluntas aegroti suprema lex.)

• Beneficence - a practitioner should act in the best interest of the patient. (Salus aegroti suprema lex.) The term beneficence refers to actions that promote the well being of others. In the medical context, this means taking actions that

serve the best interests of patients. However, uncertainty surrounds the precise definition of which practices do in fact help patients.
• Non-maleficence - "first, do no harm" (primum non nocere). he concept of non-maleficence is embodied by the phrase, "first, do no harm," or the Latin, primum non nocere. Many consider that should be the main or primary consideration (hence primum): that it is more important not to harm your patient, than to do them good. This is partly because enthusiastic practitioners are prone to using treatments that they believe will do good, without first having evaluated them adequately to ensure they do no (or only acceptable levels of) harm. Much harm has been done to patients as a result, as in the saying, "The treatment was a success, but the patient died." It is not only more important to do no harm than to do good; it is also important to know how likely it is that your treatment will harm a patient. So a physician should go further than not prescribing medications they know to be harmful - he or she should not prescribe medications (or otherwise treat the patient) unless s/he knows that the treatment is unlikely to be harmful; or at the very least, that patient understands the risks and benefits, and that the likely benefits outweigh the likely risks.
• Justice - concerns the distribution of scarce health resources, and the decision of who gets what treatment (fairness and equality). (Iustitia.)

19. ON THE JOB TRAINING

On-the-Job Training (OJT) and Integration of Knowledge and Skills During the transaction of the vocational courses, a continuous integration of knowledge and skills take place in the schools. It, however, needs to be augmented through On-the-Job Training (OJT) and project work.

In order to be enriched with practical experience, the students are taken to a service centre or repair centre or production unit to work in a real life

situation under the guidance of an expert practitioner.There must, therefore, be provision for On-the-Job Training (OJT) for certain number of hours for every vocational course. The students may be evaluated jointly by the teacher and the expert practitioner. Students are to be given project work to be done individually or in small groups. It will help them consolidate their learning, learn to communicate, and achieve the time target.

O J T for Biomedical Equipment Technology is done in multispeciality hospitals both government and private sector . A total of 30 days O J T is proposed for 2 year course .10 days after completion of module 1 and 2 and 20 days at the end of second year (after completion of module 3 and 4). O J T for 20 days at a stretch in multispeciality hospitals or diagonostic lab and scan centers is very much useful for the effective curriculum transaction and skill development. In this course modern equipment cannot be set in school laborotary.

So a nodel VHS School can be set up in district wise or region wise. O J T certificate should have a common format.

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