

LEARNING OUTCOME BASED VOCATIONAL CURRICULUM

CLASS 11 & 12

**SECTOR:
HEALTH CARE**

JOB ROLE

MEDICAL EQUIPMENT TECHNICIAN

(QUALIFICATION PACK: REF.ID. HSS/Q5601)



State Council of Educational Research & Training (SCERT) Kerala
(Department of General Education, Government of Kerala)
Vidhya Bhavan, Poojappura, Thiruvananthapuram



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www.scert.kerala.gov.in

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FOREWORD

A collaborative initiative for developing learning outcome based vocational curriculum and courseware aimed at integrating both vocational and general qualifications has been implemented by the State Council of Educational Research and Training (SCERT) Kerala and the PSSCIVE Bhopal. This is intended to open up pathways of career progression for students and the SCERT Kerala is developing curricula under the project as an integral part of Vocationalisation of Education under Samagra Shiksha, approved by the Government of Kerala. Decisive improvement in the teaching-learning process and working competencies through learning outcomes that have been judiciously embedded in the vocational subject is expected to be the major impact that will be brought about by the learning outcome based vocational curriculum.

It is a matter of great pleasure to introduce this learning outcome based vocational curriculum as part of the vocational training package for the job role of Medical Equipment Technician (HSS/Q5601). The curriculum has been developed for the higher secondary students of vocational education and is aligned to the National Occupation Standards (NOSs) of a job role identified and approved under the National Skill Qualification Framework (NSQF).

The key aim of the curriculum will be to provide children with employability and vocational skills that would in turn aid occupational mobility and lifelong learning. A major transformation in the teaching process is also aimed at, which will be brought about through interactive sessions in classrooms, practical activities in laboratories and workshops, projects, field visits, and professional experiences.

The curriculum has been meticulously developed and judiciously reviewed by a group of experts and their much-valued contributions are immensely acknowledged. The imminent utility of the curriculum will without doubt, be adjudged by the qualitative improvement that it brings about in teaching-learning. The feedback and suggestions on the content by the teachers and other stakeholders will be of immense value to us in bringing about further enhancement and augmentation to this document.

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We are extremely thankful to Dr. RVG Menon, Chairperson, High Power Committee for the implementation of NSQF in Kerala, Dr. Sukesh Kumar, Former Principal, Government Engineering College Palakkad and Sri. G S Unnikrishnan Nair, Former Director State Agricultural Management and Extension Training Institute (SAMETI), Thiruvananthapuram for their mentorship in the process of developing this document. The contributions made by Dr. Vinay Swarup Mehrotra, Professor and Head, Curriculum Development and Evaluation Centre (CDEC), PSSCIVE Bhopal in development of the curriculum are duly acknowledged.

We are grateful to the experts for their earnest efforts and contributions in the development of this learning outcome based vocational curriculum. Their names are acknowledged in the list of contributors.

We are grateful to the Vocational Higher Secondary wing of the Directorate of General Education (DGE) Kerala for extending the support to develop this curriculum document on time by providing the service of its teaching staff.

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1. COURSE OVERVIEW

COURSE TITLE: MEDICAL EQUIPMENT TECHNICIAN

GENERAL OBJECTIVES

Over the last decade the changing healthcare environment has required hospitals and specifically Biomedical Engineering departments to critically evaluate, optimize and adapt to their operations. The focus is now on new technologies, changes to the environment of care, support requirements and financial constraints. From research of bodily systems and development of medical devices to maintenance of facility networks and instruction on treatment procedures, biomedical engineers and technicians keep hospitals, clinics, and care facilities running and helping patients. The biomedical engineering department of a hospital is dealing with the technical side of this medical equipment. Only a skilled personnel can handle the equipment. Therefore, a medical equipment technician can assist the biomedical engineer/biomedical engineering department to maintain the basic clinical equipment.

On successful completion of the course the learners are expected to develop skills in;

- the proper operation and functioning of basic clinical equipment.
- the installation and repair the basic clinical equipment.
- keeping the record of installation, preventive maintenance, and service reports
- training the paramedical staff regarding operation and maintenance of basic clinical equipment.
- assisting the biomedical engineer in service of all basic clinical equipment
- the demonstration and sales of basic biomedical/clinical equipment

COURSE OUTCOMES

On completion of the course, students should be able to;

- apply effective oral and written communication skills to interact with people and customers;
- identify the principal components of a computer system;
- demonstrate the basic skills of using computer;
- demonstrate self-management skills;
- demonstrate the ability to provide a self-analysis in context of entrepreneurial skills and abilities;
- demonstrate the knowledge of the importance of green skills in meeting the challenges of sustainable development and environment protection;
- identify healthcare delivery system in India and role of medical equipment
- identify various active electronic components, CRO, Signal Generators and UPS

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- identify the basic applications of digital technology and computer systems in biomedical instrumentation
- explain basic biomedical recording system
- test Laryngoscope, Centrifuge, Nebuliser, Phototherapy unit and infant warmer
- explain medical gas supply system in hospitals
- identify the uses of various basic mechanical tools
- describe the function and operation of basic clinical equipment
- use different Personal Protective Equipment
- develop skill in installation of basic clinical equipment
- schedule various periodic preventive maintenance strategies of basic clinical equipment
- develop skill to prepare calibration schedule, do performance test, operate front and rear panel of basic medical equipment
- assist Biomedical Department for performing corrective actions when found faults in basic clinical equipment
- assist Biomedical Engineer for processing of clinical emergency calls and on-site assistance
- train the hospital staff to make use of basic clinical equipment
- assist the biomedical department for accreditation procedures of hospitals
- explain biomedical waste management
- assist the Biomedical department for documentation, database and retrieval
- support third party service provider for up keeping basic biomedical equipment
- explain the basic concept of quality and sustainable quality assurance programme in healthcare
- list legal aspects of privacy and security of patient data
- assist Biomedical engineer for processing of clinical emergency calls and on-site assistance

COURSE REQUIREMENTS

The learner should have the basic knowledge of science.

COURSE DURATION : 600 hrs

Class 11	300 hrs
Class 12	300 hrs
Total	600 hrs

2. SCHEME OF UNITS

The unit-wise distribution of hours and scores for Class 11 is as follows:

CLASS 11			
	Units	No. of Hours for Theory and Practical = 300	Max. scores for Theory and Practical =100
Part A	Employability Skills		
1.	Communication Skills – III	25	10
2.	Self-management Skills – III	25	
3.	Information and Communication Technology Skills – III	20	
4.	Entrepreneurial Skills – III	25	
5.	Green Skills – III	15	
	Total	110	10
Part B	Vocational Skills		
6.	Healthcare Delivery Systems and Role of Medical Devices	7	40
7.	Fundamentals of Electricity and Electronics	26	
8.	Fundamentals of digital technology, Computer Systems and their application in Healthcare Technology	18	
9.	Fundamentals of Biomedical Instrumentation	15	
10.	Electromechanical, Thermodynamics, Physics & Instrumentation	23	
11.	Fundamental Knowledge of Function and Operation of all possible Basic Clinical Equipment	47	
12.	Fundamental Knowledge of Personal Protective Clothing, Equipment and Personnel Monitoring Devices	6	
13.	Fundamentals of Delivery, Installation and Set- up of the Basic Medical Equipment	13	
14.	Fundamentals of Periodic Preventive Maintenance of the Basic Medical Equipment	10	
	Total	165	
Part C	Practical Work		
	Practical Examination	06	15
	Written Test	01	10
	Viva Voce	03	10
	Total	10	35
Part D	Project Work/Field Visit/ OJT		
	Practical File/Student Portfolio	10	10
	Viva Voce	05	05
	Total	15	15
	Grand Total	300	100

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The unit-wise distribution of hours and scores for Class 12 is as follows:

CLASS 12				
	Units	No. of Hours for Theory and Practical =300	Max. scores for Theory and Practical = 100	
Part A	Employability Skills			
1.	Communication Skills – IV	25	10	
2.	Self-management Skills – IV	25		
3.	Information and Communication Technology Skills – IV	20		
4.	Entrepreneurial Skills – IV	25		
5.	Green Skills – IV	15		
	Total	110	10	
Part B	Vocational Skills			
6.	Fundamentals of Calibration of the Basic Clinical Equipment	30	40	
7.	Fundamentals of Diagnosis and Repair the Faults of the Basic Medical Equipment	30		
8.	Safety Issues, Emergencies and Troubleshooting	10		
9.	Standards and Best Practices Related to Biomedical Instrumentation	10		
10.	Fundamentals of On-call and On-site Technical Assistance of the Basic Medical Equipment	22		
11.	Fundamentals of Training, Education and Assessment of the Staff on the Basic Medical Equipment	25		
12.	Third Party Interface	12		
13.	Documentation, Database and Retrieval	10		
14.	Biomedical Waste Management	10		
15.	Medico-legal Aspects of Health Information Portability and Accountability	6		
		165		40
Part C	Practical Work			
	Practical Examination	06		15
	Written Test	01		10
	Viva Voce	03		10
	Total	10	35	
Part D	Project Work/Field Visit/OJT			
	Practical File/Student Portfolio	10	10	
	Viva Voce	05	05	
	Total	15	15	
	Grand Total	300	100	

3.LEARNING OUTCOME BASED VOCATIONAL CURRICULUM

Classroom, Laboratory/workshop and field are the key spots where teaching and learning take place. Classroom and laboratory-based teaching and learning facilitate knowledge creation whereas field visits open venues for free interaction with experts and also helps acquaint learners with various tools, materials, equipment procedures and operations in the workplace. While considering these intensified ways of knowledge acquisition, emphasis should also be laid on the occupational safety, health and hygiene of the participants.

Classroom activities

Classroom activities are mainly interactive lecture sessions, followed by discussions and doubt clarifications. Classes are handled by trained vocational teachers and this is considered as an integral part of the course. The most attractive feature of the class is that the classes are in tune with the outcome-based curriculum. Teaching learning processes are well planned and implemented. Teaching learning materials such as audio-visual materials, colour slides, charts, diagrams, models, exhibits, handouts, on-line teaching materials etc., have been incorporated in accordance with the topic and this may help the teachers to impart the content in an effective manner.

Practical work in Laboratory / Workshop

Practical work is usually performed to enhance the skills of the learners which are indeed essential for them to become specialized technicians. Practical sessions may include hands on training, simulation training, role-play, case-based studies and exercises. Equipment and other appliances are available for use in abundance. Trained personnel teach and exercise specialized techniques. Practical classes involving laboratory/workshop are well planned with tools, equipment, materials and also other skill acquisition activities. Vocational teachers should submit the plan of laboratory/workshop work in advance to the head of the institution and get it sanctioned prior to use.

Field visits/ Educational Tour

Field visit is one of the ways and means of learning outside the classroom. It promotes knowledge acquisition by giving opportunity to learners to interact with renowned experts and to make observations of the activities performed by them. An observation check list may help the students to ensure the collection of required information and its analysis for further use. This may be developed with the help of vocational teachers who are in charge of outdoor learning activities. All the field visits are well planned by taking into consideration the learning requirements, distance to travel, time, health and hygiene. The Principal and teachers should plan to implement at least three field visits within a year by making all necessary arrangements.

Virtual Field Visits, Expert Interactions and Practical Activities

With the rapid potentials offered by information technology in digital classrooms, the extent of virtual field visits, online expert interactions and online demonstrations cum practical activities can be worked out. It may be helpful amid the current Covid 19 pandemic scenario. A State level cluster of teachers and experts in the concerned subject can be pooled together for the purpose. The guidelines for such activities can be issued by the concerned SCERTs.

Suggested Topics for Expert Interaction

1. Scope ,Role and Responsibilities of a Medical equipment technician
2. Fundamentals of biomedical Instrumentation
3. Basic clinical equipment and their operation
4. Introduction to Arduino boards and Robotics in biomedical field
5. Working ,Operation and basic installation of Dialysis machine
6. Medical gas supply system in hospital
7. Central sterile supply department of a Hospital
8. Working installation and basic operation of X ray machines
9. WHO standards in Personal Protective equipment PPE
10. Working ,Operation and basic installation of Ventilator

4. ASSESSMENT AND CERTIFICATION

The National Skill Qualification Framework (NSQF) is based on outcomes rather than inputs referred by the National Occupation Standards (NOSs). Learning outcomes, as per the NSQF level descriptors, include the Process, Professional Knowledge, Professional Skills, Core Skills and Responsibility. Knowledge in the job of a learner shall be the basis of assessment. It would also be considered if the learning program undertaken by the learner has delivered the required output. Certification is based on required standards so that the learner and the employer could come to know about the competency attained in the vocational subject/ course. In order to make the assessment reliable, valid, flexible, convenient, cost effective, fair and transparent standardised assessment tools are to be used. Technology assisted assessment process is in vogue now.

Knowledge Assessment (Theory)

Knowledge Assessment usually includes two components – Internal Assessment and External Assessment. External assessment includes theory examination conducted by the concerned examination Boards. Tools for assessment contain components for testing the application of knowledge. Knowledge testing can be performed by making use of either objective or short answer type paper-based test. Source of the questions should be the content of the curriculum.

Written Test

A group, comprising of academicians, experts from existing vocational subject experts / teachers, subject experts from University/ College or from the industry prepare theory question paper for the vocational subjects. A panel of experts for question paper setting and conducting examination should be formed by the respective central / state boards. Written tests allow the learners to demonstrate that they have acquired the necessary knowledge and skill in the given topics.

The blue print for the question paper may be as follows:

Duration: 3 hrs

Maximum Marks: 50

No. of Questions					
	Typology of Question	Very Short Answer (1 score)	Short Answer (2 scores)	Long Answer (3 scores)	Scores
1.	Remembering – (Knowledge based simple recall questions, to know specific facts, terms, concepts, principles, or theories; identify, define or recite, information)	3	3	3	18
2.	Understanding – (Comprehension – to be familiar with meaning and to understand conceptually, interpret, compare, contrast, explain, paraphrase, or interpret information)	2	4	3	19
3.	Application – (Use abstract information in concrete situation, to apply knowledge to new situations: Use given content to interpret a situation, provide an example, or solve a problem)	0	2	1	07
4.	High Order Thinking Skills – (Analysis and Synthesis – Classify, compare, contrast, or differentiate between different pieces of information; Organize and/ or integrate unique pieces of information from a variety of sources)	0	2	0	04
5.	Evaluation – (Appraise, judge, and/or justify the value or worth of a decision or outcome, or to predict outcomes based on values)	0	1	0	02
	Total	5x1=5	12x2=24	7x3=21	50 (24 questions)

Skill Assessment (Practical)

Skill assessment should be done by considering the practical demonstration of skills by the candidate. It is assessed by making use of a competency checklist prepared by experts. The competency checklist should be developed as per the National Occupation Standards (NOSs). This should be in tune with the qualification pack for the Job Role to ensure necessary consistency in the quality of assessment across different sectors and institutions. As per the performance criteria defined in the National Occupation Standards, the students have to demonstrate their competencies in front of the examiners. Assessment will indicate whether they are competent or incompetent. The assessors assessing the skills of the students should possess enough industrial experience and should have undergone a rigorous training in assessment principles and practices. The Sector Skill Councils (SSCs) should ensure that the assessors are given the required training on the assessment of competencies.

The demonstration of knowledge and skill in performing a task of the learners, is the purpose of the practical examination. This includes practical examination where hands on experience will be displayed and viva voce. A team of two evaluators, one a subject teacher and the other an expert from the relevant industry certified by the relevant Board or SSCs concerned can conduct practical examination as well as viva voce.

Project Work

Project is an efficient strategy to assess the practical skills acquired along a certain timeline. Project is chosen and given to candidates only on the basis of their capabilities, because it needs specific skills. It is performed step by step and the first and foremost step is classroom discussion and selection of the topic for the project. After fixing the topic and objectives, the methodology of the project work should be decided during the classroom discussions. Monitoring and evaluation should be done at each stage. Proper feedback shall be provided to the learners for improvement and innovation. Field visits can be organized as part of the project work. The data collected may be used for presentations and report writing. Accuracy of the data is to be ensured. The entire project work is maintained as a practical work file or as student's portfolio.

Student Portfolio

It is a document that supports the candidate claim of competencies acquired as a part of the teaching learning process. The student portfolio is a compilation of project reports, articles, photos of products prepared by the student.

Viva Voce

Viva voce provides chance to each candidate to demonstrate communication skills and content knowledge. It is a way of obtaining feedback on the student's experience, learning, project work

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and field visit. Audio visual recording of the whole procedure can be done for future reference and documentation. A Board, including external examiners, is constituted as per the norms which in turn should be suitably adapted to the specific requirement of the vocational subjects.

The central/state examination board for secondary education and the respective Sector Skill Councils can certify the competencies of the learner upon the successful completion of the course.

5. UNIT CONTENTS

CLASS 11

Part A: Employability Skills

Sl.No.	Units	Duration (hrs)
1.	Communication Skills- III	25
2.	Self-management Skills – III	25
3.	Information and Communication Technology Skills - III	20
4.	Entrepreneurial Skills – III	25
5.	Green Skills – III	15
	Total	110

Unit 1: Communication Skill– III			
Expected Learning Outcome	Theory (10 hrs)	Practical (15 hrs)	Duration (25 hrs)
1. Demonstrate knowledge of various methods of communication	<ul style="list-style-type: none"> ➤ Methods of communication • Verbal • Non-verbal • Visual 	<ul style="list-style-type: none"> • Writing pros and cons of written, verbal and non-verbal communication • Listing do's and don'ts for avoiding common body language mistakes 	05
2. Identify specific communication styles	<ul style="list-style-type: none"> ➤ Communication styles- assertive, aggressive, passive-aggressive, submissive, etc. 	<ul style="list-style-type: none"> • Observing and sharing communication styles of friends, teachers and family members and adapting the best practices • Roleplays on communication styles. 	10
3. Demonstrate basic writing skills	<ul style="list-style-type: none"> ➤ Writing skills to the following: • Sentence • Phrase • Kinds of Sentences • Parts of Sentence • Parts of Speech • Articles • Construction of a Paragraph 	<ul style="list-style-type: none"> • Demonstration and practice of writing sentences and paragraphs on topics related to the subject 	10
Total			25

Unit 2: Self-Management – III			
Expected Learning Outcome	Theory (10 hrs)	Practical (15 hrs)	Duration (25 hrs)
1. Demonstrate impressive appearance and grooming	<ul style="list-style-type: none"> Describe the importance of dressing appropriately, looking decent and positive body language Describe the term grooming Prepare a personal grooming checklist Describe the techniques of self- exploration 	<ul style="list-style-type: none"> Demonstration of impressive appearance and groomed personality Demonstration of the ability to self-explore 	10
2. Demonstrate team work skills	<ul style="list-style-type: none"> Describe the important factors that influence in team building Describe factors influencing team work 	<ul style="list-style-type: none"> Group discussion on qualities of a good team Group discussion on strategies that are adopted for team building and team work 	10
3. Apply time management strategies and techniques	<ul style="list-style-type: none"> Meaning and importance of time management – setting and prioritizing goals, creating a schedule, making lists of tasks, balancing work and leisure, using different optimization tools to break large tasks into smaller tasks. 	<ul style="list-style-type: none"> Game on time management Checklist preparation To-do-list preparation 	05
Total			25

Unit 3: Information and Communication Technology– III			
Expected Learning Outcome	Theory (08 hrs)	Practical (12 hrs)	Duration (20 hrs)
1. Create a document on word processor	<ul style="list-style-type: none"> Introduction to word processing. Software packages for word processing. Opening and exiting the word processor. Creating a document 	<ul style="list-style-type: none"> ➤ Demonstration and practice of the following: <ul style="list-style-type: none"> Listing the features of word processing Listing the software packages for word processing Opening and exit the word processor Creating a document 	10
2. Edit, save and print a document in word processor	<ul style="list-style-type: none"> Editing text Wrapping and aligning the text Font size, type and face 	<ul style="list-style-type: none"> ➤ Demonstration and practising the following: <ul style="list-style-type: none"> Editing the text 	10

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	<ul style="list-style-type: none"> • Header and Footer • Auto correct • Numbering and bullet • Creating table • Find and replace • Page numbering • Printing document • Saving a document in various formats 	<ul style="list-style-type: none"> • Word wrapping and alignment • Changing font type, size and face • Inserting header and footer • Removing header and footer • Using autocorrect option • Insert page numbers and bullet • Save and print a document 	
Total			20

Unit 4: Entrepreneurial Skills – III			
Expected Learning Outcome	Theory (10 hrs)	Practical (15 hrs)	Duration (25 hrs)
1. Describe the significance of entrepreneurial values and attitude	<ul style="list-style-type: none"> • Values in general and entrepreneurial values • Entrepreneurial value orientation with respect to innovativeness, independence, outstanding performance and respect for work 	<ul style="list-style-type: none"> • Listing of entrepreneurial values by the students. • Group work on identification of entrepreneurial values and their roles after listing or reading 2-3 stories of successful entrepreneur • Exhibiting entrepreneurial values in Ice breaking, rapport building, group work and home assignments 	10
2. Demonstrate the knowledge of attitudinal changes required to become an entrepreneur	<ul style="list-style-type: none"> • Attitudes in general and entrepreneurial attitudes • Using imagination/ intuition • Tendency to take moderate risk • Enjoying freedom of expression and action • Looking for economic opportunities • Believing that we can change the environment • Analyzing situation and 	<ul style="list-style-type: none"> • Preparing a list of factors that influence attitude in general and entrepreneurial attitude • Demonstrating and identifying own entrepreneurial attitudes during the following micro lab activities like thematic 	15

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	<ul style="list-style-type: none"> planning action Involving in activity 	<ul style="list-style-type: none"> appreciation test Preparing a short write-up on “who am I” Take up a product and suggest how its features can be improved Group activity for suggesting brand names, names of enterprises, etc. 	
Total			25

Unit 5: Green Skills – III			
Expected Learning Outcome	Theory (07 hrs)	Practical (08 hrs)	Duration (15 hrs)
1. Describe importance of main sector of green economy	<ul style="list-style-type: none"> Main sectors of green economy- E-waste management, green transportation, renewal energy, green construction, water management Policy initiatives for greening economy in India 	<ul style="list-style-type: none"> Preparing a poster on any one of the sectors of green economy Writing a two-page essay on important initiatives taken in India for promoting green economy 	08
2. Describe the major green Sectors/Areas and the role of various stakeholder in green economy	<ul style="list-style-type: none"> Stakeholders in green economy Role of government and private agencies in greening cities, buildings, tourism, industry, transport, renewable energy, waste management, agriculture, water, forests and fisheries 	<ul style="list-style-type: none"> 1. Preparing posters on green Sectors/Areas: cities, buildings, tourism, industry, transport, renewable energy, waste management, agriculture, water, forests and fisheries 	07
Total			15

PART B: VOCATIONAL SKILLS

Sl.No.	Units	Duration (hrs)
1.	Healthcare delivery systems and role of medical devices	7
2.	Fundamentals of electricity and electronics	26
3.	Fundamentals of digital technology, computer systems and their application in Healthcare Technology	18
4.	Fundamentals of Bio-Medical Instrumentation	15
5.	Electromechanical, thermo dynamics, physics and instrumentations	23
6.	Fundamental knowledge of Function and operation of all possible basic clinical equipment	47

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7.	Fundamental knowledge of personal protective clothing, equipment and personnel monitoring devices	6
8.	Fundamentals of delivery, Installation and set-up of the basic medical equipment	13
9.	Fundamentals of periodic Preventive Maintenance of the basic medical equipment	10
Total		165

Unit 1: Healthcare delivery systems and role of medical devices

Expected Learning Outcome	Theory (3 hrs)	Practical (4 hrs)	Duration (7 hrs)
1. Explain the Functions of hospitals and structure of Healthcare delivery system in India	<ul style="list-style-type: none"> ➤ Healthcare delivery system • Functions of a hospital • Structure of healthcare delivery systems in India. 	<ul style="list-style-type: none"> • Preparation of a presentation slide / Chart containing the healthcare delivery system in India 	4
2. Identify different departments in a hospital and the role of medical devices	<ul style="list-style-type: none"> • Name and functions of various departments in hospitals • Role of medical devices in healthcare 	<ul style="list-style-type: none"> • Prepare a report of departments, equipment and facilities available in a hospital in the home town 	3
Total			7

Unit 2: Fundamentals of electricity and electronics

Expected Learning Outcome	Theory (11hrs)	Practical (15 hrs)	Duration (26 hrs)
1. Develop skill in AC and DC voltage measurement and continuity test	<ul style="list-style-type: none"> - Basic Electricity • Definition and Unit of ➤ Voltage – AC and DC ➤ Current – AC and DC - Introduction to open circuit and short circuit 	<ul style="list-style-type: none"> • Voltage, Current, Resistance and Continuity testing using Multimeter • Fabrication of Extension Board (3 Switch, 3 Socket, 1 indicator, Fuse) 	6
2. Test various Semiconductor devices	<ul style="list-style-type: none"> - Active electronic components • Working, Types and Uses of ➤ Diode ➤ Transistor ➤ FET and MOSFET ➤ Thyristors (SCR, DIAC, TRIAC) - Introduction to IC • Digital and Analog 	<ul style="list-style-type: none"> • Identification and Testing of active electronic components (Diode, Transistor) • Soldering practice • De-soldering practice • Fabrication of a simple power Supply (In PCB) 	12
3. Operate DSO and Signal generator	<ul style="list-style-type: none"> - Introduction to DSO and Signal 	<ul style="list-style-type: none"> • Demonstrate Wave Form (Time Period, 	5

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	<ul style="list-style-type: none"> • Generator • Types and Uses 	Frequency, Amplitude)-Using Signal Generator and DSO	
4. Identify different types of UPS	<ul style="list-style-type: none"> - UPS • Types • Specification 	<ul style="list-style-type: none"> • Familiarisation of UPS 	3
Total			26

Unit 3: Fundamentals of digital technology, computer systems and their application in Healthcare Technology

Expected Learning Outcome	Theory (6 hrs)	Practical (12 hrs)	Duration (18 hrs)
1. List the applications of embedded system in Biomedical Field	<ul style="list-style-type: none"> - Introduction to Embedded System and applications of Embedded system in Biomedical field (Eg: Stepper motor control, Body temperature measurement, Patient monitoring system) - Introduction to Arduino UNO boards and Basic Programming 	<ul style="list-style-type: none"> • Familiarisation of Arduino UNO board (LED blinking) • Temperature measurement using Arduino UNO board (With LM 395 or IR temperature module) 	12
2. List the applications of computers in hospitals	<ul style="list-style-type: none"> - Introduction to • Hospital information system • Electronic Medical records (EMR) • Patient monitoring • Tele medicine 	<ul style="list-style-type: none"> • Demonstrate file sharing (Eg: Google doc) 	3
3. List the applications of IoT in Medical field	<ul style="list-style-type: none"> - Introduction to Internet of things • Concept • Components of IoT • Applications of IoT in Medical field 	<ul style="list-style-type: none"> • Demonstrate basic hardware and ports of computer (Eg: hardware parts and ports) 	3
Total			18

Unit 4: Fundamentals of Bio-Medical Instrumentation

Expected Learning Outcome	Theory (6 hrs)	Practical (9 hrs)	Duration (15 hrs)
1. Explain common basic terminologies used in medical field.	<ul style="list-style-type: none"> - Introduction to basic medical terminology - Terms used for indicating • Numbers 		1

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	<ul style="list-style-type: none"> • Direction and Positions • Conditions • Basic Anatomy terms • Basic Surgical Procedure terms 		
2. Explain bioelectricity	<ul style="list-style-type: none"> - Bioelectric potential • Resting membrane potential • Action potential <ul style="list-style-type: none"> ➤ Depolarization ➤ Repolarization 		1
3. Explain basic biomedical recording system	<ul style="list-style-type: none"> - Block diagram of basic biomedical recording system <ul style="list-style-type: none"> • Transducers • Electrodes <ul style="list-style-type: none"> ➤ Surface ➤ Micro ➤ Needle • Signal processor • Recording system - Working and uses of LVDT - Working and uses of Capacitive transducer - Working and uses of Temperature transducer 	<ul style="list-style-type: none"> ➤ Familiarisation of LVDT (Using Kit) ➤ Familiarisation of various Electrodes ➤ Familiarisation of Opto-couplers (Eg: MCT2E) ➤ Familiarisation of isolation transformer 	10
4. Explain differential amplifier	<ul style="list-style-type: none"> - Instrumentation amplifier <ul style="list-style-type: none"> • Basic Circuit • Working • Characteristics 	<ul style="list-style-type: none"> ➤ Set up and measure the gain of instrumentation amplifier using OP Amp Kit 	3
Total			15

Unit 5: Electromechanical, thermo dynamics, physics and instrumentations

Expected Learning Outcome	Theory (9 hrs)	Practical (14 hrs)	Duration (23 hrs)
1. Explain medical gas supply system in hospitals	<ul style="list-style-type: none"> ➤ Introduction to concept of central medical gas supply system ➤ Manifold and its basic components ➤ Suction apparatus <ul style="list-style-type: none"> • Parts, working and uses ➤ Introduction to liquid 	<ul style="list-style-type: none"> • Demonstration of Suction apparatus • Demonstration of Oxygen flow meter • Demonstration of Control panel (Manifold) • Demonstration of Humidifier 	6

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	oxygen supply		
2. Test Centrifuge	<ul style="list-style-type: none"> ➤ Centrifuge • Working of basic table top centrifuge • Parts and types of Centrifuge 	<ul style="list-style-type: none"> • Maintenance and test of table top centrifuge 	3
3. Recognize various OT tables and their parts	<ul style="list-style-type: none"> ➤ Introduction to Operation theatre table and their features 		1
4. Test Laryngoscope and Nebulizer	<ul style="list-style-type: none"> ➤ Laryngoscope • Application • Parts ➤ Nebulizer • Parts • Working • Application 	<ul style="list-style-type: none"> • Maintenance of Laryngoscope and Nebulizer 	3
5. Identify the parts of phototherapy unit, Infant warmer and Cooling equipment	<ul style="list-style-type: none"> ➤ Photo therapy unit • Types • Parts • Application ➤ Infant warmer • Parts • Working • Application ➤ Basic Concept of refrigeration • Compressor • Evaporator • Condenser • Controller • Thermostat 	<ul style="list-style-type: none"> • Set up electronic circuit of photo therapy unit • Set up electronic circuit of infant warmer • Familiarize components of refrigerator 	7
6. Identify various mechanical tools and their use	<ul style="list-style-type: none"> • Introduction to various Mechanical tool • Screw driver set flat • Screw driver set star • Socket and wrench set • Wire stripper • Cutting plier • Nose plier • Crimping tool • File flat • File round • Wise plier • Allen key (T and L) • Bench vice • Spanner • Drilling Machine 	<ul style="list-style-type: none"> • Demonstration of Screwdrivers, pliers, Crimping tools, bench vice, spanners, hacksaw, drilling machine 	3
Total			23

Unit 6: Fundamental knowledge of Function and operation of all possible basic clinical equipment			
Expected Learning Outcome	Theory (19 hrs)	Practical (28 hrs)	Duration (47 hrs)
1. Explain various categorization of clinical equipment	<ul style="list-style-type: none"> ➤ Definition of clinical equipment ➤ categorization of clinical equipment <ul style="list-style-type: none"> • Laboratory • Diagnostic • Therapeutic • Imaging equipment 		1
2. Explain various basic Diagnostic equipment	<ul style="list-style-type: none"> ➤ Operation and Applications of Digital blood pressure monitor ➤ Operation and Applications of Digital Glucometer ➤ Operation and applications of Digital thermometer ➤ ECG machine <ul style="list-style-type: none"> • ECG waves and their characteristics • Lead configurations • Operation ➤ Introduction to TMT and Holter Monitor ➤ Multipara monitor <ul style="list-style-type: none"> • Different accessories • Applications ➤ Introduction to Pulse Oximeter 	<ul style="list-style-type: none"> • Operation of Digital BP apparatus • Operation of Glucometer • Operation of Digital thermometer • Operation of ECG Machine • Operation of Multiparamonitor • Operation of Pulse Oximeter 	15
3. Explain various basic Laboratory equipment	<ul style="list-style-type: none"> ➤ Compound microscope <ul style="list-style-type: none"> • Parts • Working • Operation • Maintenance • Applications ➤ Photoelectric colorimeter <ul style="list-style-type: none"> • Parts • Block diagram • Working • Applications ➤ Introduction to Auto analyzers <ul style="list-style-type: none"> • Types and functions ➤ Introduction to Blood 	<ul style="list-style-type: none"> • Identification of parts of a Compound Microscope • Operation and Maintenance of compound Microscope • Identification of different parts of Photoelectric colorimeter • Operation of Photoelectric colorimeter 	8

	<p>Bank Equipment: Name and function of</p> <ul style="list-style-type: none"> • Blood bank refrigerators • Blood bank centrifuges • Cryocentrifuge • Deep freezers • Apheresis machine • Blood bag sealer • Platelet agitator • Blood shaker 		
4. Explain various basic Therapeutic equipment	<ul style="list-style-type: none"> ➤ ESU <ul style="list-style-type: none"> • Principle • Modes of Operation ➤ Anesthesia machine <ul style="list-style-type: none"> • Parts • Working ➤ Defibrillator <ul style="list-style-type: none"> • Uses • Different types ➤ Infusion pump <ul style="list-style-type: none"> • Working and Uses ➤ Syringe pump <ul style="list-style-type: none"> • Working and Uses ➤ Ventilator <ul style="list-style-type: none"> • Respiratory Parameters ➤ Tidal Volume ➤ Minute volume ➤ Functional Residual Capacity ➤ Total lung capacity ➤ Vital Capacity • Types and applications ➤ Introduction to dialysis <ul style="list-style-type: none"> • Types of dialysis • Hemodialysis Machine ➤ Parts and Working 	<ul style="list-style-type: none"> • Familiarisation of Infusion pump • Familiarisation of syringe pump 	14
5. Explain various basic Imaging equipment	<ul style="list-style-type: none"> ➤ X-ray machine <ul style="list-style-type: none"> • Parts and working • Basic settings • KV, mA, mAS ➤ Digital radiography ➤ Basic parts of Ultra sound scanner ➤ Introduction to 3D-4D ultra sound machine 	<ul style="list-style-type: none"> • Set up a timer circuit using IC 555 • Distance measurement using Arduino UNO with Ultrasound transmitter/Receiver module • Familiarisation of 	9

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	➤ Applications of Ultrasonography	pocket foetal doppler	
Total			47

Unit 7: Fundamental knowledge of personal protective clothing, equipment and personnel monitoring devices

Expected Learning Outcome	Theory (4 hrs)	Practical (2 hrs)	Duration (6 hrs)
1. Identify different Personal protective equipment (PPE)	<ul style="list-style-type: none"> ➤ Introduction to • Face shield • Goggles • Mask • Respirator • Gloves • Gown / Coverall • Boot • Head cover • Waterproof apron 	<ul style="list-style-type: none"> ➤ Familiarisation of different personal protective equipment • How to use it without contamination • Safety disposal 	3
2. Explain technical specifications of PPE as per WHO standards	<ul style="list-style-type: none"> ➤ The WHO standards for personal protective equipment 		1
3. List various PPE in Radiology	<ul style="list-style-type: none"> ➤ Safety measures in handling Xray and CT scan ➤ Personal monitoring device • TLD badge ➤ AERB regulations • In wall thickness • Lead glass • Apron 		2
Total			6

Unit 8: Fundamentals of delivery, Installation and set-up of the basic medical equipment

Expected Learning Outcome	Theory (8 hrs)	Practical (5 hrs)	Duration (13 hrs)
1. Develop an awareness about delivery, installation and setup of clinical equipment	<ul style="list-style-type: none"> ➤ Introduction to • Delivery of equipment • Installation of equipment • Requirements for installation • End user training • Documentation of installation ➤ Setup of equipment for clinical purpose 		2
2. Develop skill in	<ul style="list-style-type: none"> • Delivery of ECG 	<ul style="list-style-type: none"> • Install and Set up an 	3

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installation and setup of ECG Machine	Machine <ul style="list-style-type: none"> • Requirement • Installation of ECG Machine • Setup of ECG Machine 	ECG Machine	
3. Develop skill in installation and setup of Autoclave machine	<ul style="list-style-type: none"> • Requirements for installing Autoclave machine • Delivery of Autoclave machine • Installation procedures • Testing of performance • Demonstration • Check list of performance 	<ul style="list-style-type: none"> • Install and Set up an Autoclave Machine 	4
4. Develop skill in installation and setup of Oxygen Cylinder with Regulator, flowmeter and Humidifier	<ul style="list-style-type: none"> • Delivery of Oxygen Cylinder with Regulator and flowmeter, Humidifier • Requirements • Installation procedures • Testing of performance • Demonstration • Check list of performance 	<ul style="list-style-type: none"> • Install and Set up an Oxygen Cylinder with regulator and flow meter 	4
Total			13

Unit 9: Fundamentals of periodic Preventive Maintenance of the basic medical equipment			
Expected Learning Outcome	Theory (4 hrs)	Practical (6 hrs)	Duration (10 hrs)
1. Explain various maintenance strategies	<ul style="list-style-type: none"> ➤ Types and approaches to Maintenance of Medical Equipment • Corrective Maintenance (or Repair) • Planned (or Scheduled) Preventive Maintenance • Maintenance by in-house trained technicians • Maintenance by manufacturer or third party 		1

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2. Develop skill in preventive maintenance procedures of Microscope	<ul style="list-style-type: none"> ➤ Preventive maintenance procedures of Microscope • User level. • Technician level • Specialized 	<ul style="list-style-type: none"> • Conduct Preventive Maintenance and Prepare report of Microscope 	3
3. Develop skill in maintenance procedures of ECG Machine	<ul style="list-style-type: none"> ➤ Preventive maintenance procedures of ECG Machine • User level: • Technician level • Third party 	<ul style="list-style-type: none"> • Conduct Preventive Maintenance and Prepare report of ECG Machine 	3
4. Develop skill in preventive maintenance procedures of Digital BP Apparatus	<ul style="list-style-type: none"> ➤ Preventive maintenance procedures of Digital BP Apparatus • User level: • Technician level • Third party 	<ul style="list-style-type: none"> • Conduct Preventive Maintenance and Prepare report of BP apparatus 	3
Total			10

CLASS 12

Part A: Employability Skills

Sl.No.	Units	Duration (hrs)
1.	Communication Skills- IV	25
2.	Self-management Skills – IV	25
3.	Information and Communication Technology Skills - IV	20
4.	Entrepreneurial Skills – IV	25
5.	Green Skills – IV	15
Total		110

Unit 1: Communication Skills - IV

Expected Learning Outcome	Theory (10 hrs)	Practical (15 hrs)	Duration (25 hrs)
1. Describe the steps to active listening skills	<ul style="list-style-type: none"> • Importance of active listening at workplace • Steps to active listening 	<ul style="list-style-type: none"> • Demonstration of the key aspects of becoming active listener • Preparing posters of steps for active listening 	10
2. Demonstrate basic writing skills	<ul style="list-style-type: none"> ➤ Writing skills to the following: • Sentence • Phrase 	<ul style="list-style-type: none"> • Demonstration and practice of writing sentences and paragraphs on topics 	

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	<ul style="list-style-type: none"> • Kinds of Sentences • Parts of Sentence • Parts of Speech • Articles • Construction of a Paragraph 	related to the subject	15
Total			25

Unit 2: Self-Management Skills – IV			
Expected Learning Outcome	Theory (10 hrs)	Practical (15 hrs)	Duration (25 hrs)
1. Describe the various factors influencing self-motivation	<ul style="list-style-type: none"> • Finding and listing motives (needs and desires); • Finding sources of motivation and inspiration (music, books, activities); expansive thoughts; living fully in the present moment; dreaming big 	<ul style="list-style-type: none"> • 1.Group discussion on identifying needs and desire • Discussion on sources of motivation and inspiration 	10
2. Describe the basic personality traits, types and disorders	<ul style="list-style-type: none"> • Describe the meaning of personality • Describe how personality influence others • Describe basic personality traits • Describe common personality disorders- paranoid, antisocial, schizoid, borderline, narcissistic, avoidant, dependent and obsessive 	<ul style="list-style-type: none"> • Demonstrate the knowledge of different personality types 	15
Total			25

Unit 3: Information and Communication Technology Skills– IV			
Expected Learning Outcome	Theory (06 hrs)	Practical (14 hrs)	Duration (20 hrs)
1. Perform tabulation using spreadsheet application	<ul style="list-style-type: none"> • Introduction to spreadsheet application • Spreadsheet applications • Creating a new worksheet • Opening workbook and entering text • Resizing fonts and 	<ul style="list-style-type: none"> ➤ Demonstration and practice on the following: <ul style="list-style-type: none"> • Introduction to the spreadsheet application • Listing the spreadsheet applications • Creating a new worksheet • Opening the workbook 	10

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	styles <ul style="list-style-type: none"> • Copying and moving • Filter and sorting • Formulas and functions • Password protection. • Printing a spreadsheet. • Saving a spreadsheet in various formats. 	and enter text <ul style="list-style-type: none"> • Resizing fonts and styles • Copying and move the cell data • Sorting and Filter the data • Applying elementary formulas and functions • Protecting the spreadsheet with password • Printing a spreadsheet • Saving the spreadsheet in various formats. 	
2. Prepare presentation using presentation application	<ul style="list-style-type: none"> • Introduction to presentation • Software packages for presentation • Creating a new presentation • Adding a slide • Deleting a slide • Entering and editing text • Formatting text • Inserting clipart and images • Slide layout • Saving a presentation • Printing a presentation document. 	<ul style="list-style-type: none"> • Demonstration and practice on the following: • Listing the software packages for presentation • Explaining the features of presentation • Creating a new presentation • Adding a slide to presentation. • Deleting a slide • Entering and edit text • Formatting text • Inserting clipart and images • Sliding layout • Saving a presentation • Printing a presentation document 	10
Total			20

Unit 4: Entrepreneurial Skills – IV			
Expected Learning Outcome	Theory (10 hrs)	Practical (15 hrs)	Duration (25 hrs)
1. Identify the general and entrepreneurial behavioural competencies	<ul style="list-style-type: none"> • Barriers to becoming entrepreneur • Behavioural and entrepreneurial competencies – adaptability/decisiveness, initiative/perseverance, interpersonal skills, organizational skills, 	<ul style="list-style-type: none"> • Administering self- rating questionnaire and score responses on each of the competencies • Collect small story/ anecdote of prominent successful entrepreneurs • Identify entrepreneurial competencies reflected in each story and connect it to the definition of 	10

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	stress management, valuing service and diversity	behavioural competencies <ul style="list-style-type: none"> • Preparation of competencies profile of students 	
2. Demonstrate the knowledge of self-assessment of behavioural competencies	<ul style="list-style-type: none"> • Entrepreneurial competencies in particular: self-confidence, initiative, seeing and acting on opportunities, concern for quality, goal setting and risk taking, problem solving and creativity, systematic planning and efficiency, information seeking, persistence, influencing and negotiating, team building 	<ul style="list-style-type: none"> • Games and exercises on changing entrepreneurial behaviour and development of competencies for enhancing self-confidence, problem solving, goal setting, information seeking, team building and creativity 	15
Total			25

Unit 5: Green Skills – IV			
Expected Learning Outcome	Theory (05 hrs)	Practical (10 hrs)	Duration (15 hrs)
1. Identify the role and importance of green jobs in different sectors	<ul style="list-style-type: none"> • Role of green jobs in toxin-free homes, • Green organic gardening, public transport and energy conservation, • Green jobs in water conservation • Green jobs in solar and wind power, waste reduction, reuse and recycling of wastes, • Green jobs in green tourism • Green jobs in building and construction • Green jobs in appropriate technology • Role of green jobs in Improving energy and raw materials use • Role of green jobs in limiting greenhouse gas emissions • Role of green jobs minimizing waste and pollution 	<ul style="list-style-type: none"> • Listing of green jobs and preparation of posters on green job profiles • Prepare posters on green jobs. 	15

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	<ul style="list-style-type: none"> • Role of green jobs in protecting and restoring ecosystems • Role of green jobs in support adaptation to the effects of climate change 		
Total			15

Part B–Vocational Skills

Sl.No.	Units	Duration (hrs)
1.	Fundamentals of Calibration of the Basic Clinical Equipment	30
2.	Fundamentals of Diagnosis and Repair the Faults of the Basic Medical Equipment	30
3.	Safety Issues, Emergencies and Troubleshooting	10
4.	Standards and Best Practices Related to Biomedical Instrumentation	10
5.	Fundamentals of On-call and On-site Technical Assistance of the Basic Medical Equipment	22
6.	Fundamentals of Training, Education and Assessment of the Staff on the Basic Medical Equipment	25
7.	Third Party Interface	12
8.	Documentation, Database and Retrieval	10
9.	Biomedical Waste Management	10
10.	Medico-legal Aspects of Health Information Portability and Accountability	6
		165

Unit 1: Fundamentals of Calibration of the Basic Clinical Equipment

Expected Learning Outcome	Theory (10 hrs)	Practical (20 hrs)	Duration (30 hrs)
1. Explain functions of front and rear panel controls of basic medical equipment	<ul style="list-style-type: none"> ➤ Usage of knobs, switches, control panel of <ul style="list-style-type: none"> • Digital BP apparatus • Pulse oximeter • ECG machine • Infusion pump • Centrifuge • Syringe pump • Multiparamonitor 	<ul style="list-style-type: none"> ➤ Operating each knobs, switches and controls of <ul style="list-style-type: none"> • Digital BP apparatus • Pulse oximeter • ECG machine • Infusion pump • Centrifuge • Syringe pump • Multiparamonitor 	10
2. Explain electrical parameters and ratings to operate basic medical equipment	<ul style="list-style-type: none"> ➤ Introduction to electrical parameters <ul style="list-style-type: none"> • Voltagerating • Currentrating • Power rating • RPM • Batteryrating • Single phase /three phase • Frequency 	<ul style="list-style-type: none"> ➤ Familiarise electrical parameters of <ul style="list-style-type: none"> • Digital BP apparatus • Pulse oximeter • ECG machine • Infusion pump • Centrifuge 	8

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	<ul style="list-style-type: none"> ➤ Electrical specifications of <ul style="list-style-type: none"> • Digital BP apparatus • Pulse oximeter • ECG machine • Infusion pump • Centrifuge • Syringe pump • Multiparamonitor 	<ul style="list-style-type: none"> • Syringe pump • Multiparamonitor ➤ Familiarisation of Electrical safety analyser ➤ Measurement of electrical parameters using Electrical safety analyser 	
3. List the calibration and test equipment for basic medical equipment	<ul style="list-style-type: none"> ➤ Introduction to Calibration <ul style="list-style-type: none"> • Definition of calibration • Need for calibration • Schedule for calibration • Authorized person for doing calibration(as per manufacturer and accreditation standards) ➤ List of calibration equipment for basic biomedical equipment 		2
4. Prepare calibration schedule for basic medical equipment	<ul style="list-style-type: none"> • Importance of scheduling calibration • Calibration standards (manufacturer recommendation and accreditation standard) 	<ul style="list-style-type: none"> ➤ Preparation of schedule for calibration of <ul style="list-style-type: none"> • Digital BP apparatus • Pulse oximeter • ECG machine • Infusion pump • Centrifuge • Syringe pump • Multi paramonitor 	10
Total			30

Unit 2: Fundamentals of Diagnosis and Repair the Faults of the Basic Medical Equipment			
Expected Learning Outcome	Theory (10 hrs)	Practical (20 hrs)	Duration (30 hrs)
1. Explain steps to be followed when fault found in basic medical equipment	<ul style="list-style-type: none"> ➤ Introduction to common faults found in basic biomedical equipment <ul style="list-style-type: none"> • Power failure • Mechanical failure • Operational failure ➤ Common indication or error code of failure of basic biomedical equipment <ul style="list-style-type: none"> • Test points • Alarms • Circuit breakers 	<ul style="list-style-type: none"> ➤ Trouble shooting of <ul style="list-style-type: none"> • Digital BP apparatus • Pulse oximeter • ECG machine • Infusion pump • Centrifuge • Syringe pump • Multiparamonitor 	10

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	<ul style="list-style-type: none"> • Error codes • LED indications ➤ Introduction to trouble shooting strategy recommended by the manufacturer of basic biomedical equipment 		
2. Differentiate Component level, Board level and Device or system level service	<ul style="list-style-type: none"> ➤ Introduction to Service of basic biomedical equipment ➤ Different levels of services <ul style="list-style-type: none"> • Component level • Board level • Device or system level 	<ul style="list-style-type: none"> • Component level service of power supply 	8
3. Explain factors affecting equipment failure	<ul style="list-style-type: none"> ➤ Introduction to failure Factors <ul style="list-style-type: none"> • Improper use • Failure to perform preventive maintenance • Failure to continuously monitor the performance • Tear and wear 	<ul style="list-style-type: none"> • Analysis report preparation of any equipment failure in the MET lab 	6
4. List systematic fault-finding techniques and troubleshooting procedure methods	<ul style="list-style-type: none"> ➤ Steps involved in the fault findings and troubleshooting of basic biomedical equipment <ul style="list-style-type: none"> • Collect the Evidence • Analyze the Evidence • Locate the Fault • Determination and Removal of the Cause • Rectification of the Fault • Check the System performance 	<ul style="list-style-type: none"> ➤ Preparation of steps involved in trouble shooting of <ul style="list-style-type: none"> • Centrifuge • ECG machine • Digital BP apparatus • Laryngoscope 	6
Total			30

Unit 3: Safety issues, emergencies and troubleshooting			
Expected Learning Outcome	Theory (5 hrs)	Practical (5 hrs)	Duration (10 hrs)
1. List various safety issues related to maintenance and operation of medical equipment	<ul style="list-style-type: none"> ➤ Introduction to safety issues in performing effective maintenance programme of medical equipment ➤ Various Safety issues related to maintenance and operation of medical equipment 	<ul style="list-style-type: none"> ➤ Earth testing using Multi Meter (Voltage between earth and neutral) 	6
2. List various hazards related with maintenance of	<ul style="list-style-type: none"> ➤ Introduction to various hazards related with maintenance of biomedical 	<ul style="list-style-type: none"> ➤ Familiarisation of warning signs <ul style="list-style-type: none"> • Radiation area 	4

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biomedical equipment	<ul style="list-style-type: none"> equipment • High voltage hazards • Chemical hazards • Magnetic hazards • Radiation hazards • Medical gas explosion hazards ➤ Electric shock hazards and precaution to avoid shock 	<ul style="list-style-type: none"> • Biohazard • Flammable • Poison • Radioactive • Non-ionizing Radiation • High Voltage • Risk of Explosion • Medical Isolation 	
Total			10

Unit 4: Standards and best practices related to biomedical instrumentation			
Expected Learning Outcome	Theory (5 hrs)	Practical (5 hrs)	Duration (10 hrs)
1. Explain the concept and importance of quality standards in biomedical instrumentation	<ul style="list-style-type: none"> ➤ Introduction to quality standards in biomedical instrumentation ➤ Importance of quality standards in biomedical instrumentation 	<ul style="list-style-type: none"> • Check list preparation of Quality Indicators for at least one equipment in MET lab. 	5
2. List different standards in biomedical instrumentation	<ul style="list-style-type: none"> ➤ Introduction to different standards • CE • FDA • ECRI 	<ul style="list-style-type: none"> • Identify different standard certifications of the medical equipment in MET lab 	3
3. List Objectives and Benefits of NABH accreditation	<ul style="list-style-type: none"> ➤ Introduction to NABH Accreditation ➤ Objectives and Benefits of NABH accreditation 		2
Total			10

Unit 5: Fundamentals of on-call and on-site technical assistance of the basic medical equipment			
Expected Learning Outcome	Theory (7 hrs)	Practical (15 hrs)	Duration (22 hrs)
1. Explain on call and on-site maintenance	<ul style="list-style-type: none"> ➤ Introduction to • On call support services • On-site support services 	<ul style="list-style-type: none"> • Illustrate the on-call service of an ECG machine 	8
2. Differentiate operating manual and service manual	<ul style="list-style-type: none"> ➤ Introduction to • Operation manual and its contents • Service manual and its contents 	<ul style="list-style-type: none"> • Create an operation manual of a basic biomedical equipment 	9
3. Assist for prioritizing work schedule of biomedical department	<ul style="list-style-type: none"> ➤ Criteria for prioritizing work schedule in Biomedical department • Risk based • Mission based • Resource based • Revenue generation 	<ul style="list-style-type: none"> • Prioritize the work schedule of medical equipment (The list of equipment should be provided) 	5

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	based	
Total		22

Unit 6: Fundamentals of training, education and assessment of the staff on the basic medical equipment

Expected Learning Outcome	Theory (10 hrs)	Practical (15 hrs)	Duration (25 hrs)
1. List various training methods	<ul style="list-style-type: none"> ➤ Introduction to various training methods • Self-study • One to one training • Third party training • Manufacturer training 		2
2. List various terms and parameters related to each basic biomedical equipment	<ul style="list-style-type: none"> ➤ Terms, parameters, normal values of human body parameters, Placement position of consumables and accessories related to • Pulse oximeter • Digital BP monitor • ECG machine • Multiparamonitor • Digital thermometer • Glucometer 	<ul style="list-style-type: none"> • Demonstrate a basic medical equipment with the help of the Company Brochure(In a sales point of viewEg: Glucometer) 	7
3. Provide technical assistance and instructions to hospital staff regarding the common faults of basic clinical equipment	<ul style="list-style-type: none"> ➤ Following Details of Pulse oximeter, Digital BP monitor, ECG machine, Multiparamonitor, Digital thermometer, Glucometer and Foetal doppler • Product specification • Common problems • Environment of use • Consumables 	<ul style="list-style-type: none"> • Illustrate the training of aPulse oximeter/ Digital BP monitor/ ECG machine/ Multiparamonitor/ Digital thermometer/ Glucometer/Foetal doppler 	16
Total			25

Unit 7: Third party interface

Expected Learning Outcome	Theory (6 hrs)	Practical (6 hrs)	Duration (12 hrs)
1. Assist to Coordinate with third party for Annual Maintenance Contract (AMC) and Comprehensive Maintenance Contract (CMC)	<ul style="list-style-type: none"> • Introduction to Warranty, Terms and Condition • Introduction to Annual maintenance contract (AMC) • Introduction to Comprehensive maintenance Contract (CMC) • Introduction to Preventive maintenance frequency 	<ul style="list-style-type: none"> • Illustrate an AMC agreement form 	6
2. Assist to Coordinate with third party for Breakdown	<ul style="list-style-type: none"> • Introduction to Corrective maintenance • Steps involved in 	<ul style="list-style-type: none"> • Prepare a model Service report 	6

MEDICAL EQUIPMENT TECHNICIAN

Maintenance and Medical Equipment Insurance	coordinating with third party		
Total			12

Unit 8: Documentation, database and retrieval			
Expected Learning Outcome	Theory (5hrs)	Practical (5hrs)	Duration (10 hrs)
1. Assist Biomedical department to maintain Medical Equipment Inventory and Files	<ul style="list-style-type: none"> ➤ Introduction to Healthcare technology management cycle ➤ Introduction to medical equipment inventory (MEI) <ul style="list-style-type: none"> • Definition • Aims of MEI • Items included in MEI • Data included MEI ➤ Introduction to Inventory Management ➤ Applications of Inventory 	<ul style="list-style-type: none"> • Preparation of inventory of MET lab (Hard copy / Soft copy) ➤ Illustrate data collection format for Medical Equipment Inventory 	6
2. Use Inventory management and Computerised Maintenance Management System (CMMS)	<ul style="list-style-type: none"> • Introduction to Computerised Maintenance Management System (CMMS) <ul style="list-style-type: none"> ➤ Functions of CMMS • Functionality flow chart ➤ CMMS structure ➤ Seven step process for implementing CMMS (Implementation flow chart) 	<ul style="list-style-type: none"> ➤ Familiarise any one CMMS software (Can use trial copy) 	4
Total			10

Unit 9: Bio-medical waste management			
Expected Learning Outcome	Theory (5 hrs)	Practical (5 hrs)	Duration (10 hrs)
1. List the categories and colour code used for biomedical waste	<ul style="list-style-type: none"> • Introduction to Biomedical Waste (BMW) • Categories of BMW • Colour code of BMW • Safety measures in BMW management • Introduction to BMW rules in India 	<ul style="list-style-type: none"> • Categorise and assign colour code for wastes in school campus 	4
2. Explain various steps involved in biomedical waste management system	<ul style="list-style-type: none"> ➤ Steps involved in Biomedical waste management <ul style="list-style-type: none"> • Collection • Segregation • Storage • Transportation • Disposal 	<ul style="list-style-type: none"> • Operation of needle burner • Operation of Autoclave 	6

	<ul style="list-style-type: none"> ➤ Introduction to Processes for Biomedical Waste Disposal • Chemical processes • Thermal processes • Mechanical processes • Irradiation processes • Biological processes ➤ Introduction to equipment used for Biomedical waste management • Autoclave • Shredder • Incinerator 		
Total			10

Unit 10: Medico-legal aspects of health information portability and accountability			
Expected Learning Outcome	Theory (3 hrs)	Practical (3 hrs)	Duration (6 hrs)
1. Develop an awareness about legal and ethical aspect of patient record	<ul style="list-style-type: none"> ➤ Importance of <ul style="list-style-type: none"> • Confidentiality • Privacy • Security 		1
2. Develop an awareness about the importance of security and secrecy of patient record	<ul style="list-style-type: none"> ➤ Importance of medical records and medico legal cases ➤ Importance of data protection in hospitals ➤ Introduction to Standard formats for keeping patient record and laboratory record 	<ul style="list-style-type: none"> • Case study (From visual or text media) related to any incident on data security 	5
Total			6

6. ORGANISATION OF FIELD VISITS/ ON-THE-JOB TRAINING

In a year, at least 3 field visits/educational tours should be organized for the students to expose them to the activities in the hospitals or Medical Equipment manufacturing industries or Medical equipment service centres. During the field visit/On the job training the students will be able to translate their acquired skills and theoretical knowledge from the classroom to practical experience in the professional ecosystem of hospital industry. Field visit to Engineering colleges/Polytechnique Colleges will help to acquire practical knowledge in digital technology and biomedical instrumentation

During the visit/OJT, students will be able to obtain the following information from the hospital and technical institutions.

1. Structural idea about hospital

2. Exposure to various clinical and non-clinical departments
3. Medical gas supply system
4. Exposure to clinical equipment
5. Exposure to digital and computer technology used in hospital
6. Exposure to medical electronics and biomedical instrumentation
7. Exposure to service techniques and various maintenance strategy
8. Exposure to biomedical waste management system
9. Exposure to hospital related safety and accreditation standards

Centres for field visits/OJT

1. Hospitals/Clinics
2. Dialysis Centres
3. Polytechnique Colleges
4. Engineering colleges
5. Biomedical service centres
6. Small scale medical manufacturing units
7. Radiology centres

On-the-job training of at least 80 hours is to be organised by the institution to provide hands-on training to the students.

7. LIST OF EQUIPMENT AND MATERIALS

The list given below is suggestive and an exhaustive list should be prepared by the vocational teacher. Only basic tools, equipment and accessories should be procured by the Institution so that the routine tasks can be performed by the students regularly for practice and acquiring adequate practical experience.

1. Digital Storage Oscilloscope
2. Digital Multimeter
3. Digital Clamp meter
4. Analog Multimeter
5. Function generator
6. DC regulated power supply
7. Dual DC Power Supply
8. Soldering station
9. Soldering iron
10. De soldering pump
11. Soldering iron stand
12. SMPS

13. Suction Apparatus
14. Oxygen flow meter with humidifier and C-type cylinder
15. Table top centrifuge
16. Digital BP apparatus
17. Glucometer
18. Digital thermometer
19. Portable OT Light
20. Nebulizer
21. Weighing Scale
22. Vaporizer
23. Infusion Pump
24. Autoclave
25. Cardiac Monitor
26. Pulse Oximeter
27. Laryngoscope
28. ECG machine
29. Compound Microscope
30. Photoelectric Colorimeter
31. Electrical Safety analyzer
32. Windows based Laptop
33. Screw Driver Set
34. Screw driver with long handle
35. Socket wrench set
36. Wire stripper
37. Combination plier
38. Nose plier
39. Crimping tool
40. File flat
41. File round
42. Precision knife
43. Allen key
44. Adjustable Spanner
45. Spanner set
46. Hammer metal small
47. Hammer rubber

48. Hacksaw Frame with blade
49. Tweezers
50. Bench vice
51. Drilling Machine
52. Line tester
53. Timer IC NE/SE 555
54. OP-AMP IC 741 C
55. Diode 1N 4007
56. IC BT 151
57. Diac DB3
58. Resistor
59. Capacitor
60. LED
61. BT136
62. Bread Board
63. Cuvette
64. Standard Flask
65. Beaker
66. Arduino UNO board
67. IR kit for Arduino Board
68. Temperature sensor LM 35
69. LVDT trainer kit
70. Electrodes
71. IC MCT 2E Optocoupler
72. Isolation transformer
73. OP-AMP trainer kit
74. UV lamp
75. UV lamp choke
76. Toggle Switch

8. LIST OF CONTRIBUTORS

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