

**REDESIGNED MODULES FOR THE  
SECTOR**

**E L E C T R O N I C S**

**UNDER  
MODULAR EMPLOYABLE SKILLS (MES)**

**Redesigned in – 2014**

*By*  
Government of India  
Directorate General of Employment & Training  
New Delhi

## Preface

The redesigned modules of Electronics & Hardware Sector consist of the following modules

<b>Module No</b>	<b>Module Name</b>	<b>Space Norms</b>	<b>Power Norms</b>	<b>Unit Size</b>	<b>Instructor's Qualification</b>
M1	Repair and maintenance of Domestic Electronic Appliances	60 sq .m (Minimum size of one side to be 04m)	2 KW	20	As per General Information of each module
M2	Repair and maintenance of Office Electronic Equipments	60 sq .m (Minimum size of one side to be 04m)	2 KW	20	As per General Information of each module
M3	Repair and maintenance of Personnel Electronic Devices	60 sq .m (Minimum size of one side to be 04m)	2 KW	20	As per General Information of each module
M4	Operation, installation and maintenance of Physiotherapy Equipment	60 sq .m (Minimum size of one side to be 04m)	2 KW	20	As per General Information of each module
M5	Operation, Installation and maintenance of ECG & ICCU Instruments	60 sq .m (Minimum size of one side to be 04m)	3.5 KW	20	As per General Information of each module
M6	Operation, and maintenance of X-ray machine & Darkroom Assistance	60 sq .m (Minimum size of one side to be 04m)	4 KW	20	As per General Information of each module
M7	Operation and maintenance of Clinical Equipment	60 sq .m (Minimum size of one side to be 04m)	2 KW	20	As per General Information of each module

## MODULE-1

### General information for **DOMESTIC ELECTRONIC APPLIANCES**

Name of Sector	<b>ELECTRONICS</b>
Name of Module	<b>Repair and maintenance of Domestic Electronic Appliances</b>
MES Code	ELC701
Duration of Course	<b>520 Hrs</b>
Entry Qualification of Trainee	8 <sup>th</sup> Pass + 14 yrs of age
Unit size (No. Of trainees)	20
Power Norms	2.0 KW
Space Norms (Workshop and Class Room)	60 Sq.mtr Minimum size of one side to be 04m.
Instructors Qualification	B.E./ B.Tech. in Electronics / Electronics & Telecommunication/Electronics & Communication with one year experience in the relevant field OR Diploma in Electronics/Electronics & Telecommunication / Electronics & Communication from recognized board of technical education with two years experience in the relevant field. OR NTC/NAC in the relevant trade with three years' experience respectively in the relevant field
Desirable	Craft Instructor Certificate (CIC)

## Objectives:

- Testing of electrical parameters, cables and measurements.
- Select the proper instrument for suitable measurement.
- Identify and test passive and active electronics components.
- Practice soldering and de-soldering of various types of electrical and electronics components.
- Trouble shoot the faults in the given power supply circuits.
- Identify various Input and output sockets/connectors of the given UPS.
- Identify various functional blocks/major components/ICs in the given UPS.
- Monitor, measure major test points and Test the capacity of the given UPS and rectify the faults.
- Identify and test various mechanical and electrical modules of the given appliances.
- Identify electronics parts/components/modules of the given appliances.
- Aware of models of different appliances and features.
- Use reference manuals and identify the information required to service the appliances.
- Practice the standard troubleshooting procedures as suggested in the product manuals.
- Install the given appliance as recommended by manufacturer.

**Terminal Competency:** After completion of the module the participant would be able to maintain and repair of Power supply, inverter and UPS install and repair washing machine, repair microwave oven, steam iron, electric rice cooker, electric kettle and mixer grinder.

Course Contents for Module:- **Repair and Maintenance of Domestic Electronic Appliances**

<b>Practical Competencies</b>	<b>Underpinning Knowledge (Theory)</b>
<p><b><u>Basics of electricity and Electrical Cables</u></b></p> <ul style="list-style-type: none"> <li>• Practice procedure for electrical and personal safety measures</li> <li>• Identify the Live, Neutral and Earth on power Socket</li> <li>• Construct a test lamp and use it to mains healthiness</li> <li>• Use a Tester to monitor AC power.</li> <li>• Measure the voltage between the neutral and ground and rectify earthing</li> <li>• Identify and test different ac mains cables</li> <li>• Skin the electrical wires /cables</li> <li>• Measure the gauge of the wire using SWG</li> <li>• Make the mains cable for termination</li> <li>• Identify the primary and secondary cells</li> <li>• Measure and test the voltages of the given cells/battery using analog and digital Multi-meter</li> <li>• Charge and discharge the battery</li> <li>• Use a hydro-meter to measure the specific gravity of the secondary battery</li> </ul>	<p><b>Basic terms</b> electric charges, Potential difference, Voltage, Current, and Resistance. Basics of AC &amp; DC. Terms such as positive cycle, negative cycle, Frequency, Time period, RMS, Peak value , peak to peak, instantaneous values, Insulators, conductors and semiconductor. Different type of electrical cables and their specifications.</p>
<p><b><u>Multi-meter</u></b></p> <ul style="list-style-type: none"> <li>• Cleaning the switch contacts using switch cleaning solution.</li> <li>• Testing the fuse.</li> <li>• Use the analog and digital Multi-meter to measure the DC voltage by doing measurement at the test points provided.</li> <li>• Use the analog and digital Multi-meter to measure AC voltage measurement by</li> </ul>	<p>Precaution to be taken in handling an analog Multi-meter. Study of different controls on Multimeter Principle of operation of Analog Multi-meter. Precaution to be taken in</p>

<p>doing measurement at the test points provided.</p> <ul style="list-style-type: none"> <li>• Adjust the zero adjustment screw for proper zero setting with the help of a screw driver before using Multi-meter.</li> <li>• Replace the battery in the Multi-meter.</li> <li>• Replacing the open Fuse with correct rating</li> </ul>	<p>handling digital Multi-meter</p> <p>Frequently occurring problems in Analog multimeters and the remedial measures</p> <p>•</p> <p>Precaution to be taken in handling digital Multi-meter, Familiarization with operation controls of digital Multi-meter</p> <p>Principle of operation of digital Multi-meter.</p> <p>Frequently occurring problems in Digital multimeters and the remedial measures</p>
<p><b><u>Basic Electronics Components</u></b></p> <ul style="list-style-type: none"> <li>• Identify the different types of resistors</li> <li>• Measure the resistor values using colour code and verify the reading by measuring in multi-meter</li> <li>• Identify the power rating using size</li> <li>• Identify different inductors and measure the values using LCR meter</li> <li>• Identify the different capacitors and measure capacitance of various capacitors using LCR meter</li> <li>• Dismantle and identify the different parts of a relay</li> <li>• Identify different types of mains transformers and test them</li> <li>• Identify the primary and secondary transformer windings</li> <li>• Measure the primary and secondary voltage of different transformers</li> </ul>	<p>Resistor-definition, types of resistors, their construction &amp; specific use, color-coding, power rating.</p> <p>Types of inductors, specifications and applications.</p> <p>Types of capacitors, specifications and applications</p> <p>Working principle of a Transformer, Specifications of a transformer, Step-up, Step down and isolation transformers</p> <p>Fuse – types, use of fuses and its rating.</p>

<p><b><u>Power supply</u></b></p> <ul style="list-style-type: none"> <li>• Testing of active components</li> <li>• Practice soldering and de-soldering techniques</li> <li>• Assemble and test– half wave, full wave &amp; bridge rectifier circuits with and without filter.</li> <li>• Identify the different types of fixed positive and negative regulator ICs (78/79 series)</li> <li>• Identify the pins</li> <li>• Construct a fixed voltage regulator using 78xx/79xx series ICs</li> <li>• Construct a variable voltage regulator using LM 723.</li> <li>• Observe the output voltage of different IC regulators by varying the input voltage</li> </ul>	<p>Basic Electronics active components, testing of components, Working of half wave, full wave and bridge rectifier circuits. Voltage Regulator circuit. Applications of transistor – its uses MOSFET – precautions when handling. DIAC, SCR, TRIAC - application Identify the pin diagram of Voltage regulator ICs</p>
<p><b><u>UPS/Inverter</u></b></p> <ul style="list-style-type: none"> <li>• Installation of UPS and Inverters</li> <li>• Maintenance of batteries</li> <li>• Dismantle the UPS and identify the major parts</li> <li>• Testing of major components</li> <li>• Testing of power modules</li> <li>• Charging, discharging and testing of batteries.</li> </ul>	<p>Various types of batteries used in UPS and Inverters and their maintenance. Different types of inverter, UPS, Working principle, specifications, explanation with the help of block diagram.</p>
<p><b><u>SMPS</u></b></p> <ul style="list-style-type: none"> <li>• Dismantle the given SMPS and find major sections/ ICs components.</li> <li>• Measure voltages at vital points</li> <li>• Identify various input and output sockets / connectors of the given SMPS.</li> <li>• Repairing of SMPS, simulating various faults diagnosing and rectifying it.</li> </ul>	<p>Block Diagram of Switch mode power supplies and their working principles</p>

<p><b><u>Washing machine</u></b></p> <ul style="list-style-type: none"> <li>• Installation of front load washing machine</li> <li>• Installation of top load washing machine</li> <li>• Identify the internal and external parts of semi-auto washing machine</li> <li>• Identify the internal and external parts of fully automatic washing machine</li> <li>• Operate semi-automatic washing machine</li> <li>• Operate fully-automatic washing machine</li> <li>• Rectify the fault leading to not working of control panel switches.</li> <li>• Rectify the fault leading to not working of pulsator / agitator.</li> <li>• Rectify the fault leading to spin drier not working.</li> <li>• Rectify the fault leading to one side rotation of motor.</li> <li>• Rectify the fault leading to water inlet and outlet valves.</li> </ul>	<p>Washing M/c: different types of machines, washing techniques, parts of manual, semi automatic and fully automatic machines, basic working principle of manual, semi automatic and fully automatic machines, study the working of motors, different types of timers, power supply circuits.</p>
<p><b>Microwave oven</b></p> <ul style="list-style-type: none"> <li>• Identify the internal and external parts of micro wave oven.</li> <li>• Identify the different touch pad controls their functions</li> <li>• Testing of high voltage diode.</li> <li>• Identify the HV capacitor and discharge it.</li> <li>• Rectify the fault leading to fuse blows off when cooking is initiated.</li> <li>• Rectify the fault leading to not responding of touch switches. ( front panel )</li> <li>• Rectify the fault leading to dead set.</li> <li>• Rectify the fault leading to long cooking</li> </ul>	<p>Microwave oven: Different types of oven, study the various functions of Oven, Electrical wiring diagram of microwave oven, working of Power supply.</p>



<p>time.</p> <ul style="list-style-type: none"> <li>• Precautions – importance of interlocking switch in performing maintenance</li> </ul>	
<p><b>Steam Iron</b></p> <ul style="list-style-type: none"> <li>• Dismantle and identification of various parts, wiring, tracing of various controls, Electronic circuits in steam Iron</li> <li>• Identify the faults in steam iron &amp; rectify</li> </ul>	<p>Principle of electric iron, parts of steam iron, thermostat heat controls.</p>
<p><b>Electric Rice cooker</b></p> <ul style="list-style-type: none"> <li>• Identify various components of Electric rice cooker, controls and trace the circuit and rectify the simulated faults.</li> </ul>	<p>Principle of working of rice cooker. Various parts &amp; functions of rice cooker, temperature control and timer unit.</p>
<p><b>Electric kettle</b> Identify various components of Electric kettle , controls and trace the circuit and rectify the simulated faults.</p>	<p>Principle of working of electric kettle. Various parts &amp; functions of electric kettle and temperature control unit.</p>
<p><b>Mixer &amp; Grinder</b></p> <ul style="list-style-type: none"> <li>• Dismantle and identification of various parts, wiring, tracing of various controls, Electronic circuits in various types of Mixers/grinders</li> <li>• Identify the faults in various types of Mixers/grinders &amp; rectify</li> </ul>	<p>Various parts &amp; functions of Mixer/Grinder, speed control circuit &amp; automatic over load protector.</p>

**List of Tools & Equipment for module:- Repair and maintenance of Domestic Electronic Appliances**

<b>Sl no</b>	<b>Name of Tool/ Equipment</b>	<b>Quantity</b>
1.	Inverter / UPS trainer	1 No
2.	Battery charger	4 Nos.
3.	Technicians tool kit	20 Nos
4.	Digital Multi-meter	10 Nos.
5.	Analog Multi-meter	4 Nos
6.	Clip on ammeter	As Required
7.	Soldering iron	4 Nos.
8.	De-soldering pump	4 Nos.
9.	Soldering / de-soldering temp controlled station	1 No.
10.	Washing machine Semi automatic/Fully automatic	1 No. each
11.	Micro wave oven grill, convention type	1 No. each
12.	Spares for micro wave oven	As required
13.	Hand glove	4 pairs
14.	Radiation leakage tester	1 Nos
15.	Steam iron	2 nos
16.	Electric rice cooker	2 nos
17.	Electric kettle	2 nos
18.	Mixer-grinder	2 nos

## MODULE-2

### General information for **Repair and maintenance of Office Electronic Equipment**

Name of Sector	<b>ELECTRONICS</b>
Name of Module	<b>Repair and maintenance of Office Electronic Equipments</b>
MES Code	ELC702
Duration of Course	520 Hrs.
Entry Qualification of Trainee	8 <sup>th</sup> Pass + 14 yrs of age
Unit size (No. Of trainees)	20
Power Norms	2.0 KW
Space Norms	60 sq.m Minimum size of one side to be 04m.
Instructors Qualification	B.E./ B.Tech in Electronics / Electronics & Telecommunication/Electronics & Communication with one year experience in the relevant field OR Diploma in Electronics/Electronics & Telecommunication / Electronics & Communication from recognized board of technical education with two years experience in the relevant field. OR NTC/NAC in the relevant trade with three years' experience respectively in the relevant field
Desirable	Craft Instructor Certificate (CIC)

## Objectives:

- Testing of electrical parameters, cables and measurements
- Select the proper instrument for suitable measurement
- Identify and test passive and active electronic components
- Practice soldering and de-soldering of various types of electrical and electronic components
- Trouble shoot the faults in the given power supply circuits
- Dismantle, identify and troubleshoot the PA system.
- Dismantle, identify and troubleshoot the photo copier faults.
- Dismantle, identify and troubleshoot the FAX of the given FAX
- Dismantle, identify and troubleshoot the printer faults of the given printers
- Dismantle, identify and troubleshoot the scanner faults of the given scanner
- Connect various phones to the EPABX system and troubleshoot various simulated faults

**Terminal Competency:** After completion of the module the participant would be able to repair PA System, Photo copying machine & Fax machines, Printer, Scanner and the EPABX system

Course Contents for Module:- Repair and maintenance of Office Electronic Equipments

Practical Competencies	Underpinning Knowledge (Theory)
<p><b><u>Basics of electricity and Electrical Cables</u></b></p> <ul style="list-style-type: none"> <li>• Practice procedure for electrical and personal safety measures</li> <li>• Identify the Live, Neutral and Earth on power Socket</li> <li>• Construct a test lamp and use it to mains healthiness</li> <li>• Use a Tester to monitor AC power.</li> <li>• Measure the voltage between the neutral and ground and rectify earthing</li> <li>• Identify and test different ac mains cables</li> <li>• Skin the electrical wires /cables</li> <li>• Measure the gauge of the wire using SWG</li> <li>• Make the mains cable for termination</li> <li>• Identify the primary and secondary cells</li> <li>• Measure and test the voltages of the given cells/battery using analog and digital Multi-meter</li> <li>• Charge and discharge the battery</li> <li>• Use a hydro meter to measure the specific gravity of the secondary battery</li> </ul>	<p><b>Basic terms</b> electric charges, Potential difference, Voltage, Current, and Resistance. Basics of AC &amp; DC. Terms such as positive cycle, negative cycle, Frequency, Time period, RMS, Peak, P-P, instantaneous values, Insulators, conductors and semiconductor. Different type of electrical cables and their specifications.</p>
<p><b><u>Multi-meter</u></b></p> <ul style="list-style-type: none"> <li>• Cleaning the switch contacts using switch cleaning solution.</li> <li>• Testing the fuse.</li> <li>• Use the analog and digital Multi-meter to measure the DC voltage by doing measurement at the test points provided.</li> <li>• Use the analog and digital to measure AC voltage measurement by doing measurement at the test points provided.</li> <li>• Adjust the zero adjustment screw for proper zero setting with the help of a</li> </ul>	<p>Precaution to be taken in handling an analog Multi-meter.</p> <p>Study of different controls on Analog Multimeter Principle of operation of Analog Multi-meter. Precaution to be taken in handling digital Multi-meter Frequently occurring problems in Analog</p>

<p>screw driver before using Multi-meter.</p> <ul style="list-style-type: none"> <li>• Replace the battery in the Multi-meter.</li> <li>• Replacing the open Fuse with correct rating.</li> </ul>	<p>multimeters and the remedial measures</p> <p>Precaution to be taken in handling digital Multi-meter, Familiarization with operation controls of digital Multi-meter.</p> <p>Principle of operation of digital Multi meter.</p> <p>Frequently occurring problems in Digital multimeters and the remedial measures</p>
<p><b><u>Basic Electrical Components</u></b></p> <ul style="list-style-type: none"> <li>• Identify the different types of resistors</li> <li>• Measure the resistor values using colour code and verify the reading by measuring in multi meter</li> <li>• Identify the power rating using size</li> <li>• Identify different inductors and measure the values using LCR meter</li> <li>• Identify the different capacitors and measure capacitance of various capacitors using LCR meter</li> <li>• Dismantle and identify the different parts of a relay</li> <li>• Identify different types of mains transformers and test them</li> <li>• Identify the primary and secondary transformer windings</li> <li>• Measure the primary and secondary voltage of different transformers</li> </ul>	<p>Resistor-definition, types of resistors, their construction &amp; specific use, color-coding, power rating.</p> <p>Types of inductors, specifications and applications.</p> <p>Types of capacitors, specifications and applications</p> <p>Working principle of a Transformer, Specifications of a transformer, Step-up, Step down and isolation transformers</p> <p>Fuse – types, use of fuses and its rating.</p>
<p><b><u>Power supply</u></b></p> <ul style="list-style-type: none"> <li>• Testing of active components</li> <li>• Practice soldering and de-soldering techniques</li> </ul>	<p>Basic Electronics active components, testing of components,</p> <p>Working of half wave, full</p>

<ul style="list-style-type: none"> <li>• Assemble and test– half wave, full wave &amp; bridge rectifier circuits with and without filter.</li> <li>• Identify the different types of fixed positive and negative regulator ICs (78/79 series)</li> <li>• Identify the pins</li> <li>• Construct a fixed voltage regulator using 78xx/79xx series ICs</li> <li>• Observe the output voltage of different IC regulators by varying the input voltage</li> </ul>	<p>wave and bridge rectifier circuits.</p> <p>Voltage Regulator circuit.</p> <p>Applications of transistor – its uses</p> <p>MOSFET – precautions when handling.</p> <p>DIAC, SCR, TRIAC - application</p> <p>Identify the pin diagram of Voltage regulator ICs</p>
<p><b><u>UPS/Inverter</u></b></p> <ul style="list-style-type: none"> <li>• Installation of UPS and Inverters</li> <li>• Maintenance of battery</li> <li>• Dismantle the UPS and identify the major parts</li> <li>• Testing of major components</li> <li>• Testing of power modules</li> <li>• Charging, discharging and testing of batteries.</li> </ul>	<p>Various types of batteries used in</p> <p>UPS and Inverters and their maintenance.</p> <p>Different types of inverter, UPS, Working principle, specifications, explanation with the help of block diagram.</p>
<p><b><u>SMPS</u></b></p> <ul style="list-style-type: none"> <li>• Dismantle the given SMPS and find major sections/ ICs components.</li> <li>• Measure voltages at vital points</li> <li>• Identify various input and output sockets / connectors of the given SMPS.</li> <li>• Repairing of SMPS, simulating various faults diagnosing and rectifying it.</li> </ul>	<p>Block Diagram of Switch mode power supplies and their working principles</p>
<p><b><u>PA system</u></b></p> <ul style="list-style-type: none"> <li>• Identify the different devices of PA system</li> <li>• Identify the various types of speakers</li> <li>• Identify various types of microphones</li> <li>• Connect the amplifier with microphone and speakers (Long line connection, line transformers and their connection)</li> </ul>	<p>Microphones – types, construction, principle of working &amp; characteristics</p> <p>Loud speaker , construction, principle of working, Power Level of</p>

<ul style="list-style-type: none"> <li>• Fault finding in pre amplifier sections</li> <li>• Fault finding in power amplifier sections</li> <li>• Rectification of Humming and whistling problems</li> </ul>	<p>loudspeaker,  Practical Loudspeakers:  Woofer, Tweeter &amp; mid range speakers.  Specifications of typical PA (Public Address) System.  various stages of PA System  Importance of Impedance matching, types of wires used for connecting mike and speakers. Pre amplifiers, their necessity, wire-less microphones  Power amplifiers, components used in power amplifier section and their necessity  Multi input amplifiers and their connections.</p>
<p><b>PHOTO COPIER</b></p> <ul style="list-style-type: none"> <li>• Operation of a photo copier.</li> <li>• Dismantling &amp; Troubleshooting of power supply unit (low &amp; High power)</li> <li>• Dismantling and assembling of paper feed mechanism, paper tray, Thermal unit and Toner Unit.</li> <li>• Identify the various sensors used in the copier and their fixtures.</li> <li>• Dismantling and fitting of drum unit- cleaning of drum unit</li> <li>• Fault finding in light unit</li> <li>• Identify the faults and repair in the thermal unit.</li> <li>• Periodic cleaning and servicing of copier machines</li> <li>• Repairing of multipurpose copy printers.</li> </ul>	<p>Principle of photo copying  Image transfer methods  Various types of sensors and their functions.  Electrostatic charger and charging of drum assembly.  Toner and its properties.  Paper trays, Paper feed mechanism and the sensors used for paper movement  Effects of light Intensity on charging the drum unit.  Principle of Colour Copiers  Multipurpose copy printers and heavy duty copiers.</p>



<p><b><u>FAX MACHINE</u></b></p> <ul style="list-style-type: none"> <li>• Operation of a Fax machine.</li> <li>• Telephone line access and phone connection</li> <li>• Dismantling &amp; Troubleshooting of power supply unit .</li> <li>• Dismantling and assembling of paper feed mechanism, paper tray, Thermal unit and Toner Unit of Fax machine</li> <li>• Identify the various sensors used in the Fax machines</li> </ul>	<p>Principle of Fax machine.  Properties of telephone line, ISDN line  Data reception and printing  Checksum and its importance  Scanning of paper and converting to data.  Paper trays, Paper feed mechanism and the sensors used for paper movement</p>
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**Printer**

- Identification & use of controls/ switches/ sockets of a dot matrix printer
- Dismantling & Troubleshooting of power supply unit .
- Identification of internal assembly/ section/parts of DMP
- Testing of the paper sensor, print head coils, print head needle coil & cleaning of ribbon
- Identify the faults in DMP & rectify
- Identification & use of controls/ switches/ sockets of an ink jet printer
- Interconnect printer to computer & perform printer test & cleaning of an ink cartridge
- Identification of internal assembly/ section/parts of an ink jet printer
- Identify the faults of an ink jet printer & rectify
- Identification & use of controls/ switches/ sockets of an Laser printer
- Interconnect printer to computer & perform printer test & cleaning of an ink cartridge
- Identification of internal assembly/ section/parts of Laser printer
- Identify the faults of an Laser printer & rectify

Printer & its types, principle, parts, working of dot matrix , ink jet & Laser printer, Advantages, disadvantages, cables used to interface the various printers to computer

<p><b><u>Scanner</u></b></p> <ul style="list-style-type: none"> <li>• Identification &amp; use of controls/ switches/ sockets of scanner</li> <li>• Identification of internal assembly of scanner</li> <li>• Installation of scanner driver in the computer</li> <li>• Interconnect scanner to computer &amp; perform scanner operation and store in the computer</li> <li>• Identify the faults in the scanner &amp; rectify</li> </ul>	<p>Working principle of scanner, parts. cables used to interface the scanner to computer</p>
<p><b><u>EPABX</u></b></p> <ul style="list-style-type: none"> <li>• Identification &amp; use of controls on the front panel/Console of EPBAX</li> <li>• Identify the terminals of trunk line and extension line and connect the extensions</li> <li>• Setting the call transfer, call wait and other facilities available on EPABX</li> <li>• Dismantle and Identify various sections and the power supply components of the system</li> <li>• Simple Programming of EPABX System</li> <li>• Make modifications to the existing set up by introducing more connections.</li> </ul>	<p>Working principle of Electronic Private Automatic Branch Exchange, applications of EPABX, Block diagram of Electronic Private Automatic Branch Exchange and functions of each block.  Methods to connect the trunk line and extension line in a EPABX  Call wait, call transfer, conference facility available in a EPABX</p>

List of Tools & Equipment for module:- **Repair and maintenance of Office Electronic Equipments**

Sl No	Name of Tool/ Equipment	Quantity
1.	Inverter / UPS trainer	1 No
2.	Battery charger	2 Nos.
3.	Technicians tool kit	20 Nos
4.	Digital Multi-meter	4 Nos.
5.	Analog Multi-meter	4 nos
6.	Clip on ammeter	As Required
7.	Soldering iron	4Nos.
8.	Desoldering pump	4Nos.
9.	Soldering / desoldering temp controlled station	1 Nos.
10.	Photo copier(mono)	01 No.
11.	Photo copier colour	01 No.
12.	Fax machine	01 No.
13.	Dot matrix printer	01 No.
14.	Ink jet printer	01 No.
15.	Laser Printer	01 No.
16.	Scanner	01 No.
17.	EPABX System 2-0-6 or better	01No.
18.	Push button Telephone system	06 No

### MODULE-3

## General information for **Repair and maintenance of Personal Electronic Devices**

Name of Sector	<b>ELECTRONICS</b>
Name of Module	<b>Repair and maintenance of Personal Electronic Devices</b>
MES Code	ELC703
Duration of Course	<b>520 Hrs</b>
Entry Qualification of Trainee	8 <sup>th</sup> Pass + 14 yrs of age
Unit size (No. Of trainees)	20
Power Norms	2.0 KW
Space Norms	60 sq.m Minimum size of one side to be 04 m.
Instructors Qualification	B.E./ B.Tech in Electronics / Electronics & Telecommunication/Electronics & Communication with one year experience in the relevant field OR Diploma in Electronics/Electronics & Telecommunication / Electronics & Communication from recognized board of technical education with two years experience in the relevant field. OR NTC/NAC in the relevant trade with three years' experience respectively in the relevant field
Desirable	Craft Instructor Certificate (CIC)

## Objectives

- Testing of electrical parameters, cables and measurements
- Select the proper instrument for suitable measurement
- Identify and test passive and active electronic components
- Practice soldering and desoldering of various types of electrical and electronic components
- Trouble shoot the faults in the given power supply circuits
- Dismantle, identify and troubleshoot the LCD/LED TV for various faults
- Install DTH system
- Work with tools required for installation like drilling machine, satellite meter or QAM meter and Multi-meter
- Identify and Test necessary components to install a SET TOP BOX
- Install the SET TOP BOX and check its performance
- Check all parameters of STB like Transponder/signal strength/Audio & Video quality
- Operate and rectify faults with Remote
- Dismantle, identify and troubleshoot the given cell/smart phone
- Identify and configure the components of a typical Home theatre system
- Trouble shoot the simulated faults of the given Home theatre system
- Identify , disassemble, and assemble a computer system
- Replace various functional parts HDD, CDD, SMPS, Memory
  
- **Terminal Competency:** After completion of the module the participant would be able to install DTH system, assemble the parts of mini-dish and install independently at customer's premises, Guide the customers to operate the DTH systems installed in their residence, repair cell phones, install and repair the home theatre system and car stereo, replace various functional parts HDD, CDD, SMPS, Memory.

## Course Contents for Module:- **Repair and maintenance of Personal Electronic Devices**

<b>Practical Competencies</b>	<b>Underpinning Knowledge (Theory)</b>
<p><b><u>Basics of electricity and Electrical Cables</u></b></p> <ul style="list-style-type: none"> <li>• Practice procedure for electrical and personal safety measures</li> <li>• Identify the Live, Neutral and Earth on power Socket</li> <li>• Construct a test lamp and use it to mains healthiness</li> <li>• Use a Tester to monitor AC power.</li> <li>• Measure the voltage between the neutral and ground and rectify earthing</li> <li>• Identify and test different ac mains cables</li> <li>• Skin the electrical wires /cables</li> <li>• Measure the gauge of the wire using SWG</li> <li>• Make the mains cable for termination</li> <li>• Identify the primary and secondary cells</li> <li>• Measure and test the voltages of the given cells/battery using analog and digital Multi-meter</li> <li>• Charge and discharge the battery</li> <li>• Use a hydro meter to measure the specific gravity of the secondary battery</li> </ul>	<p><b>Basic terms</b> electric charges, Potential difference, Voltage, Current, and Resistance. Basics of AC &amp; DC. Terms such as positive cycle, negative cycle, Frequency, Time period, RMS, Peak, P-P, instantaneous values, Insulators, conductors and semiconductor. Different type of electrical cables and their specifications.</p>

<p><b><u>Multi-meter</u></b></p> <ul style="list-style-type: none"> <li>• Cleaning the switch contacts using switch cleaning solution.</li> <li>• Testing the fuse.</li> <li>• Use the analog and digital Multi-meter to measure the DC voltage by doing measurement at the test points provided.</li> <li>• Use the analog and digital Multi-meter to measure AC voltage measurement by doing measurement at the test points provided.</li> <li>• Adjust the zero adjustment screw for proper zero setting with the help of a screw driver before using Multi-meter.</li> <li>• Replace the battery in the Multi-meter.</li> <li>• Replacing the open Fuse with correct rating</li> </ul>	<p>Precaution to be taken in handling an analog Multi-meter.</p> <p>Study of different controls on Analog Multimeter Principle of operation of Analog Multi-meter.</p> <p>Precaution to be taken in handling digital Multi-meter Frequently occurring problems in Analog Multi-meters and the remedial measures</p> <p>•</p> <p>Precaution to be taken in handling digital Multi-meter, Familiarization with operation controls of digital Multi-meter Principle of operation of digital Multi meter. Frequently occurring problems in digital of Multi-meters and the remedial measures</p>
<p><b><u>Basic Electronic Components</u></b></p> <ul style="list-style-type: none"> <li>• Identify the different types of resistors.</li> <li>• Measure the resistor values using colour code and verify the reading by measuring in multi meter.</li> <li>• Identify the power rating using size</li> <li>• Identify different inductors and measure the values using LCR meter.</li> <li>• Identify the different capacitors and measure capacitance of various capacitors using LCR meter.</li> <li>• Dismantle and identify the</li> </ul>	<p>Resistor-definition, types of resistors, their construction &amp; specific use, color-coding, power rating.</p> <p>Types of inductors, specifications and applications.</p> <p>Types of capacitors, specifications and applications</p> <p>Working principle of a Transformer, Specifications of a transformer, Step-up, Step down and isolation transformers.</p>



<p>different parts of a relay.</p> <ul style="list-style-type: none"> <li>• Identify different types of mains transformers and test them.</li> <li>• Identify the primary and secondary transformer windings.</li> <li>• Measure the primary and secondary voltage of different transformers.</li> </ul>	<p>Fuse – types, use of fuses and its rating.</p>
<p><b><u>Power supply</u></b></p> <ul style="list-style-type: none"> <li>• Testing of active components</li> <li>• Practice soldering and de-soldering techniques</li> <li>• Assemble and test– half wave, full wave &amp; bridge rectifier circuits with and without filter.</li> <li>• Identify the different types of fixed positive and negative regulator ICs (78/79 series)</li> <li>• Identify the pins</li> <li>• Construct a fixed voltage regulator using 78xx/79xx series ICs</li> <li>• Observe the output voltage of different IC regulators by varying the input voltage</li> </ul>	<p>Basic Electronics active components, testing of components, Working of half wave, full wave and bridge rectifier circuits. Voltage Regulator circuit. Applications of transistor – its uses MOSFET – precautions when handling. DIAC, SCR, TRIAC - application Identify the pin diagram of Voltage regulator ICs</p>
<p><b><u>UPS/Inverter</u></b></p> <ul style="list-style-type: none"> <li>• Installation of UPS and Inverters</li> <li>• Maintenance of battery.</li> <li>• Dismantle the UPS and identify the major parts.</li> <li>• Testing of major components.</li> <li>• Testing of power modules.</li> <li>• Charging, discharging and testing of batteries.</li> </ul>	<p>Various types of batteries used in UPS and Inverters and their maintenance. Different types of inverter, UPS, Working principle, specifications, explanation with the help of block diagram.</p>
<p><b><u>SMPS</u></b></p> <ul style="list-style-type: none"> <li>• Dismantle the given SMPS and find major sections/ ICs components.</li> <li>• Measure voltages at vital points</li> </ul>	<p>Block Diagram of Switch mode power supplies and their working principles.</p>

<ul style="list-style-type: none"> <li>• Identify various input and output sockets / connectors of the given SMPS.</li> <li>• Repairing of SMPS, simulating various faults diagnosing and rectifying it.</li> </ul>	
<p><b><u>TV RECEIVER</u></b></p> <ul style="list-style-type: none"> <li>• Installation of a TV receiver.</li> <li>• Identify the different controls of LCD/LED TV</li> <li>• Identify the various connector provided on LCD/LED TV and test the healthiness</li> <li>• Dismantle the panel of LCD/LED TV</li> <li>• Dismantle, identify the parts of remote control</li> <li>• Trace and rectify the faults of remote control</li> <li>• Check power supply and front panel control</li> </ul>	<p>Explain the working principle of color TV using block diagram.  Explain the need and working principle of each block.  Detailed explanation of power supply and high voltage generation section. Explanation of PTC , various voltages required for PTC.  Difference between a conventional CTV with LCD &amp; LED TVs.  Principle of LCD and LED TV and function of its different section. TV Remote Control – Types, parts and functions, Working principle, operation of remote control. Different adjustments, general faults in Remote Control.</p>
<p><b><u>DTH System</u></b></p> <ul style="list-style-type: none"> <li>• Practice procedures for safety and health hazards measures</li> <li>• Identify the various mini-dish components and their functions</li> <li>• Identify &amp; use of different tools and equipments used in DTH installation procedure &amp; cabling procedure</li> <li>• Identification of Various types of</li> </ul>	<p>Electrical and personal safety, dangers and preventions  Basic satellite communication, Merits &amp; Demerits of satellite communication, applications, types of satellite &amp; its orbits, Satellite Frequency Bands.</p>

<p>connectors, cables and wiring procedure.</p> <ul style="list-style-type: none"> <li>• Follow the chronological order to assemble the minidisk.</li> <li>• Install a DTH system &amp; track a TV channel</li> <li>• Site selection, installation mounting tracking for azimuth and elevation angles using SAT meter.</li> <li>• Identify the faults in DTH system &amp; rectify.</li> <li>• Identification &amp; use of various I/O ports of STB.</li> <li>• STB connection and first installation.</li> <li>• Identify the faults in STB &amp; rectify.</li> </ul>	<p>Basic components of DTH system: PDA, LNBC, Satellite receiver terminal, dish installation aspects, Azimuth &amp; elevation settings of dish/ DTH receiver.</p> <p>Types of cables used in DZTH system, impedance and specification</p> <p>Multi-dwelling unit design, headed amplifier, line amplifier, cascaded in/out multi-switch, tap, and splitter.</p> <p>Set top box features, block diagram of set top box, I/O ports, Cable modem termination system, software &amp; customer premises equipments.</p>
<p><b><u>Cell phones</u></b></p> <ul style="list-style-type: none"> <li>• Dismantle, identify the parts and assemble different types of cell phone/smart phones.</li> <li>• Dismantle the cell phone/smart phone replace the display</li> <li>• Dismantle the cell phone/smart phone remove the key pad and clean it, test for the continuity of the matrix/tracks</li> <li>• Test the battery and battery charger with Multi-meter.</li> <li>• Check track continuity and use jumpers for track problems.</li> <li>• Test and rectify the problems in antenna and antenna switch</li> <li>• Interface the cell phone/smart phone to the PC and transfer the</li> </ul>	<p>Introduction to various types of mobile handsets, their description, features &amp; uses of these features. Identify the keys and their uses. Identify the components used in a cell phone.</p> <p>Use of various solders , flux and cleaning Agents</p> <p>Use of antenna and antenna switch.</p> <p>SIM and SIM related problems of GSM &amp; CDMA PHONES.</p> <p>Use of computer for cell phone servicing – cell phone software Flashing and its need- precautions to be taken while flashing</p> <p>Knowledge of downloading of</p>

<p>data</p> <ul style="list-style-type: none"> <li>• Connect internet on cell phone and browse popular web sites</li> <li>• Flash the various brands of cell phone/smart phone ( at least 3)</li> <li>• Upgrade the OS</li> <li>• Format the cell phone/smart phone for virus( approach the mobile repair chop)</li> <li>• Identify the defective parts and rectify</li> </ul>	<p>add-on software, ring tones, wall papers, themes, etc. on non multimedia and multimedia handsets, window based handsets</p>
<p><b><u>Home theatre</u></b></p> <ul style="list-style-type: none"> <li>• Identification of different parts of home theatre</li> <li>• Testing of speakers, woofers&amp; tweeters</li> <li>• Set up of home theatre using specific devices</li> <li>• Identification of different parts of AV receiver</li> <li>• Identify the faults in AV receiver &amp; rectify</li> </ul>	<p>Introduction to Home theatre, surround sound system, basic components, block diagram of home theatre &amp; working</p>
<p><b><u>CAR STEREO :</u></b></p> <ul style="list-style-type: none"> <li>• Testing of speakers</li> <li>• Identify the faults in CAR STEREO receiver &amp; rectify</li> </ul>	<p>Block diagram of car stereo. Components of car stereo.</p>
<p><b><u>Computer Hardware,</u></b></p> <ul style="list-style-type: none"> <li>• Identification of various indicators, Connectors, ports on the computer cabinet</li> <li>• Identify drives and their capacity.</li> <li>• Identify various connectors and cables inside the cabinet &amp; Identify connections to rear side and front panel of the cabinet</li> <li>• Identify various parts of the system</li> </ul>	<p>Basic blocks of a computer, Hardware and software, I/O devices, keyboard, types of mouse, Different types of printers, HDD, DVD. Various ports in the computer.</p>

unit and motherboard

- Replace the CMOS battery
- Replace/Extend a memory module
- Test and Replace the SMPS
- Replace the given HDD on the system
- Replace the given DVD on the system
- Configuring and troubleshooting display problems

List of Tools & Equipment for module:- Repair and maintenance of Personal Electronic Devices

Sl No	Name of Tool/ Equipment	Quantity
1.	DTH System with all accessories	1 set
2.	Inverter / UPS trainer	1 No
3.	Battery charger	4 Nos.
4.	Technicians tool kit	20 Nos
5.	Digital Multi-meter	10 Nos.
6.	Analog Multi-meter	4 Nos
7.	Clip on ammeter	As Required
8.	Soldering iron	10 Nos.
9.	Desoldering pump	10 Nos.
10.	Soldering / desoldering temp controlled station	2 Nos.
11.	SMD soldering tools	4 Nos.
12.	Satellite finder (digital)	1 No
13.	Set top box	1 No
14.	Magnifying lens with illumination	1 No
15.	BGA soldering kit	1 No
16.	Computer with Flashing Unit	1 No
17.	ANTI-STATIC PAD	1 No
18.	Software compatible with different types of handsets.	As required
19.	Screw drivers assorted size and shapes (TROX) for cell phones	As required
20.	Different cell /smart phone	4 Nos each
21.	Power supply tester unit for cell phone	2 Nos
22.	Home theatre unit	1 No
23.	Tool Kit (Comprising various tools added as per requirements)	4 Nos
24.	Colour TV	1 No
25.	LNBF (Universal, dual, quad, quattero)	1 No each
26.	SMD rework station	1 No
27.	Computer system	2 nos
28.	Cell phones latest (CDMA & GSM) & smart phone	1 each

## MODULE-4

### General information for Operation, installation and maintenance of Physiotherapy Equipment

Name of Sector	<b>ELECTRONICS</b>
Name of Module	Operation, installation and maintenance of Physiotherapy Equipment
MES Code	ELC 704
Duration of Course	<b>200 Hrs</b>
Entry Qualification of Trainee	8 <sup>th</sup> Pass + 14 yrs of age and Should be able to read and write English
Unit size (No. Of trainees)	20
Power Norms	2.0 KW
Space Norms	60 sq.m Minimum size of one side to be 04 m.
Instructors Qualification	B.E./B.Tech in Electronics with one year experience in the relevant field OR Diploma in Electronics from recognized board of technical education with two years experience in the relevant field. OR NTC/NAC in the trade with three years' experience respectively in the relevant field
Desirable	Craft Instructor Certificate (CIC)

## Objectives

- Testing of electrical parameters, cables and measurements
- Select basic tools and multimeter
- To acquire brief knowledge of human anatomy and terms related to physiology.
- To identify treatment areas as guided by doctor/physiotherapist
- To understand and practice short wave diathermy
- To understand and practice ultrasound diathermy
- To understand and practice IFT
- To maintain the equipments, cleaning of electrodes etc

Terminal Competency: After the course the participant will be able to

- Operate the Physiotherapy Equipment.
- Assist BPT doctor in using the equipment properly.
- Able to use basic tools and Multimeter.
- Able to test electrical supply and identify faulty mains chord and replace.
- Test fuses and replace them when required.



Course contents for the module:- Operation, installation and maintenance of Physiotherapy Equipment

<b>Practical Competencies</b>	<b>Underpinning Knowledge (Theory)</b>
<ul style="list-style-type: none"> <li>• Electrical safety and Hazards.</li> <li>• Use of basic tools, Multimeter.</li> <li>• Anatomy and Physiology of muscles, Nerves, cell stimulation, conduction system.</li> <li>• Identification of the points/ areas to be treated as guided by Physiotherapist/ Doctor.</li> <li>• Understanding basic concepts and controls of Short wave Diathermy (SWD), use of different electrodes, practice treatment methods i.e condenser &amp; inductive method.</li> <li>• Electrodes and their usage.</li> <li>• Understanding basic concepts and controls of Ultrasound Diathermy (USD), use of transducer probe, Testing of transducer probe, understanding modes i.e. pulse &amp; cont. modes, importance of gel and practice treatment.</li> <li>• Understanding basic concepts and controls of</li> </ul>	<ul style="list-style-type: none"> <li>• Electrical and personal safety.</li> <li>• Human anatomy. Muscles, cell stimulation, Conduction systems, etc.</li> <li>• Introduction to Medical terminology – Medical terms related to physiotherapy.</li> <li>• Basic electrotherapy concepts, Diathermy concept.</li> <li>• Basic concepts and controls of Short wave Diathermy (SWD), Oscillator of 27.12 MHz generation, Types of SWD, Types of electrodes, types of treatment method.</li> <li>• Basic concepts and controls of Ultrasound diathermy, use of Transducer, selection of different frequency ranges, pulse ranges and practice treatment. Gel and its use.</li> <li>• Basic concepts and controls of TENS, use of electrodes, selection of different frequency ranges, pulse ranges and treatment procedure.</li> </ul>

<p>TENS, use of electrodes, selection of different frequency ranges, pulse ranges and practice treatment.</p> <ul style="list-style-type: none"> <li>• Understanding basic concepts and controls of Interferential Therapy unit (IFT), use of electrodes, selection of different frequency ranges, positioning of electrodes and practice treatment.</li> <li>• Understanding basic concepts of UV &amp; IR radiation, Identification of the light sources/ Bulbs used for UV/IR generation. practice treatment.</li> <li>• Cleaning of electrodes, care and maintenance.</li> </ul>	<ul style="list-style-type: none"> <li>• Basic concepts and controls of Interferential Therapy unit (IFT), use of electrodes, selection of different frequency ranges, positioning of electrodes and treatment procedure.</li> <li>• Basic concepts and controls of Interferential Therapy unit (IFT), use of electrodes, selection of different frequency ranges, positioning of electrodes and treatment procedure.</li> <li>• Basic concepts of UV &amp; IR radiation, Identification of the light sources/ Bulbs used for UV/IR generation.</li> <li>• Precautions in using therapy equipment. Care and maintenance.</li> </ul>
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**List of Tools & Equipment for module:- Operation, installation and maintenance of Physiotherapy Equipment**

Sl No	Name of Tool/ Equipment	Quantity
1.	Shortwave Diathermy machine (250 Watt) with both condenser type and Inductive type electrodes	2 nos
2.	Shortwave Diathermy machine (500 Watt)	1 no*
3.	Ultrasound diathermy machine	1 no
4.	TENS	1 no
5.	Interferential Therapy Unit (IFT)	1 no
6.	UV/IR lights	2 each
7.	Stimulators (Muscle stimulator)	1 no*
8.	Laser therapy Equipment	1 no*
9.	Tool kit	As required
10.	Multimeter	2 nos
11.	Patient table	1 no
12.	Gel	As required
13.	Anatomy & Physiology charts related to Physiotherapy positions	As required

- PRACTICAL MAY BE CONDUCTED AT NEAR BY HOSPITAL

## **MODULE-5**

General information for Operation, Installation and maintenance of ECG & ICCU Instruments

Name of Sector	<b>ELECTRONICS</b>
Name of Module	Operation, installation and maintenance of ECG & ICCU Instruments
MES Code	ELC705
Duration of Course	<b>200 Hrs</b>
Entry Qualification of Trainee	8 <sup>th</sup> Pass + 14 yrs of age and Should be able to read and write English
Unit size (No. Of trainees)	20
Power Norms	3.5. KW
Space Norms	60 sq.m Minimum size of one side to be 04 m.
Instructors Qualification	B.E./B.Tech in Electronics / Bio-medical Engg.with one year experience in the relevant field OR Diploma in Electronics/ Bio- medical Engg. from recognized board of technical education with two years experience in the relevant field. OR NTC/NAC in the trade with three years' experience respectively in the relevant field
Desirable	Craft Instructor Certificate (CIC)

## **Objectives:**

- Testing of electrical parameters, cables and measurements
- Select basic tools and multimeter
- To understand basic electronic and power supply components
- To acquire brief knowledge of human anatomy and terms related to physiology particularly heart, circulatory system, cell stimulation, conduction system and to understand few related diseases
- To understand, operate and maintain equipments like ECG recorder, Multi para monitor, pulse oximeter, NIBP measuring equipment, defibrillator etc

Terminal Competency: At the end of the course the participant will be

- Able to Connect electrode/ Leads, load the paper and operate ECG machines.
- Able to Connect electrode/ Leads and operate ECG monitor.
- Able to Connect electrode/ Leads and operate Pulse oximeter.
- Able to Connect electrode/ Leads and operate NIBP machine.
- Able to Connect electrode/ Leads and operate Pace maker & Defibrillator.
- Able to Connect electrode/ Leads and operate Multipara monitor machine.
  - Able to check mains supply and replace faulty mains cord.
  - Able to check fuses and replace faulty ones.
  - Able to clean electrodes and maintain them properly.

Course contents for the module:- Operation, Installation and maintenance of ECG & ICCU Instruments

<b>Practical Competencies</b>	<b>Underpinning Knowledge (Theory)</b>
<ul style="list-style-type: none"> <li>● Electrical safety and Hazards.</li> <li>● Use of basic tools, Multimeter.</li> <li>● Checking of supply, Mains cable, testing of basic electronic components, power supply components.</li> <li>● Anatomy and Physiology of heart, circulatory system, cell stimulation, conduction system.</li> <li>● Heart disease, coronary Artery disease, Fibrillation, etc.</li> <li>● Identifying and practicing on controls of ECG recorder, Types of electrodes i.e. Vacuum cup Suction electrodes, Pre gelled disposable electrodes, etc.</li> <li>● Electrode gels and its properties, cleaning of electrodes.</li> <li>● Connecting cables -</li> </ul>	<ul style="list-style-type: none"> <li>● Electrical and personal safety.</li> <li>● Human anatomy. Heart, Circulatory system, Conduction systems, etc.</li> <li>● Introduction to Medical terminology – Medical terms related to ECG. Normal Sinus rhythm – Basic ECG wave form analysis.</li> <li>● ECG waveform and its components.</li> <li>● ECG Recorder, types, Lead system, Electrodes and types, color coding of leads, Thermo sensitive paper, stylus, multi channel recorder, calibration using 1 mV control, care and maintenance,</li> <li>● Pulse oximeter, various sections of Pulse oximeter. Identification of various test points and voltages measurement. Electrodes</li> </ul>

<p>Shielded cables. Lead systems – Bipolar system – Uni polar system. 12 lead system – Einthoven system – Augmented lead system – Chest lead system.</p> <ul style="list-style-type: none"> <li>• Placement of electrodes – Patient preparation.</li> <li>• Standardization and Calibration, Sensitivity, Speed of recording – Standard 12 lead patient ECG recording – Amplitude and duration of various ECG complex.</li> <li>• Recording artifacts, tracing problems.</li> <li>• Single channel, Multi channel ECG recording – Pediatric recording, Adult recording.</li> <li>• ECG Paper loading and speed setting.</li> </ul>	<p>and types, care and maintenance.</p> <ul style="list-style-type: none"> <li>• BP apparatus, NIBP measurement, various sections of NIBP. Identification of various test points and voltages measurement, care and maintenance,</li> <li>• Defibrillators, Various sections of Defibrillator. Identification of various test points and voltages measurement. Lead system, Electrodes and types, care and</li> <li>• Defibrillators, electrodes, types of defibrillators, types of electrodes. Electrical safety – Physiological effects of electricity on the human – Shocks – Macro shock, Micro shock – Leakage currents – Isolation – Earthing – Identification of ground faults – Multi meter.</li> </ul>
<ul style="list-style-type: none"> <li>• Identifying various controls of multi para cardiac monitor. Patient cable, electrodes. Practice operation.</li> <li>• Identifying various controls of a Pulse oximeter. Finger tip pulse oxi-meter probe and its attachment practice.</li> </ul>	<p>AC interference – Lead continuity measurement – Power supply trouble shooting – Electrode cleaning – Upkeep and maintenance of ECG Machine</p>

- Identifying various controls of a of BP measuring equipment. Non invasive methods, NIBP measurement modes. Cuff placement, measurement.  
Identifying various controls of a Defibrillator.  
Practice on charging & discharging of defibrillator  
Electrodes used and discharging. Types of defibrillators. Types of electrodes. Positioning of electrodes.
- Identifying various controls of a Pacemaker. Electrodes used. Types of Pacemakers. Types of electrodes. Positioning of electrodes.
- Electrical safety – Physiological effects of electricity on the human – Shocks – Macro shock, Micro shock – Leakage currents – Isolation – Earthing – Identification of ground faults – Multi meter.
- AC interference – Lead continuity measurement – Power supply trouble shooting – Electrode cleaning – Upkeep and maintenance of ECG Machine & MULTIPARA MONITOR.



- Routine maintenance of NIBP machine BP apparatus, connectors. Mercury filling, Rubber bulb replacement, and maintenance.
- Routine maintenance of pace maker and connectors. Types of electrodes and maintenance Routine maintenance of defibrillator, types, electrodes, electrode discharge buttons and connectors and maintenance.
- Electrical safety – Physiological effects of electricity on the human – Shocks – Macro shock, Micro shock – Leakage currents – Isolation – Earthing – Identification of ground faults – Multi meter.
- AC interference – Lead continuity measurement – Power supply trouble shooting – Electrode cleaning – Upkeep and maintenance of ECG Machine.

List of Tools & Equipment for module:- Operation, Installation and maintenance of ECG & ICCU Instruments

Sl No	Name of Tool/ Equipment	Quantity
1.	ECG recorder-Single channel (Manual and Automatic)	2 nos. each
2.	ECG Recorder-Multi channel	2 nos
3.	Multipara monitor (ECG,NIBP & SPO2) Monitor	2 nos
4.	Pulse Oximeter	2 nos
5.	NIBP Machine	2 nos
6.	Pace maker	2 nos
7.	Defibrillator	2 nos
8.	BP apparatus-Sphygmomanometer	2 nos
9.	Different types of ECG electrodes	As required
10.	Patient table	1 no
11.	ECG Gel	As required
12.	ECG paper	As required
13.	Cotton/tissue paper	As required
14.	Basic hand tools	As required
15.	Multimeter	2 nos
16.	Inverter/UPS	2 nos
17.	Anatomy & physiology charts related to chest/lead positions	As required

## MODULE-6

General information for Operation and maintenance of X-ray machine & Darkroom Assistance

Name of Sector	<b>ELECTRONICS</b>
Name of Module	Operation and maintenance of X-ray machine & Darkroom Assistance
MES Code	ELC706
Duration of Course	<b>240 Hrs</b>
Entry Qualification of Trainee	8 <sup>th</sup> Pass + 14 yrs of age and Should be able to read and write English
Unit size (No. Of trainees)	20
Power Norms	8.0 KW
Space Norms	60 sq.m Minimum size of one side to be 04 m.
Instructors Qualification	B.E./B.Tech in Electronics/Bio- Medical Engg. with one year experience in the relevant field OR Diploma in Electronics/Bio-medical Engg. from recognized board of technical education with two years experience in the relevant field. OR NTC/NAC in the trade with three years' experience respectively in the relevant field
Desirable	Craft Instructor Certificate (CIC)

## Objectives

- To use Multimeter and identify some Electronic components.
- To understand, Operate and maintain X-ray machine
- To develop X-ray films.
- To identify electrical earth, faulty power cord, High tension cable, locating broken wires, and faults in plugs and sockets and to undertake minor repairs.
- To understand fuses, switches, Relays, Contactors, Circuit breaker, special fuses for HT section.
- To understand Exposure switch and bulb in the collimator, Relays in the Bucky Mechanism.
- To maintain Patient table, Tube stand and tracks.

Terminal competency : At the end of the course the participant will be

- Able to Operation of X-ray machine.
- Able to develop X-ray films.
- Able to identify electrical earth, faulty power cord, High tension cable, locating broken wires, and faults in plugs and sockets.
- Able to identify fuses, switches and replace faulty ones.
- Able to Identify Exposure switch and bulb in the collimator, Relays in the Bucky Mechanism.
- Able to follow safety methods in the X-ray room as well as in the darkroom.

Course contents for the module:- Operation and maintenance of X-ray machine & Darkroom Assistance

<b>Practical Competencies</b>	<b>Underpinning Knowledge (Theory)</b>
<ul style="list-style-type: none"> <li>● Electrical Safety and Hazards.</li> <li>● Use of Basic tools, Multimeter, Checking of Electrical supply, Single phase, Three Phase voltages and Earthing.</li> <li>● Testing of electronic components, wire wound resistors, Transformers and replace faulty ones.</li> <li>● Positioning and anatomical terminology.</li> <li>● Identify different types of X-ray machines.</li> <li>● X-ray equipment controls identification and proper use.</li> <li>● Exposure factors and use of exposure chart.</li> <li>● Use of Collimator, Grid &amp; Bucky mechanism and patient table.</li> <li>● Handling of films, Storage of films and cassettes.</li> <li>● Darkroom layout, safe lights, accessories, Use of chemicals,</li> </ul>	<ul style="list-style-type: none"> <li>● Electrical supply AC, Single phase, Three Phase voltages. Personal safety, dangers and preventions.</li> <li>● Basic tools, Multimeter, Electronic component description, Transformers, wire wound resistor and its importance in mA circuit</li> <li>● Types of switches i.e. SPST, SPDT, DPST, DODT, Single pole multi through, Rotary switches, Toggle switches, push button switches, etc.</li> <li>● Fuses i.e. glass fuses, HRC fuses and other types.</li> <li>● Properties of X-rays, Generation, Radiation safety, types of radiation protection methods used by radiographer as well as patient.</li> <li>● Different types of X-ray machines, i.e Portable, mobile, Static, Dental, OPG, etc</li> <li>● Various controls. i.e. Kv, mA, Timer, and switches.</li> </ul>

<p>Procedure to develop the film.</p> <ul style="list-style-type: none"><li>• Routine maintenance of controls, X-ray tube, X-ray generator, Tube stand, Tube, Collimator, Bucky table, Automatic Film processor,</li><li>• Checking of Relays, Contactors, Interlocking circuits, switches, Exposure bulb.</li><li>• Testing of different exposure controls i.e. Kv, mA, mAS, Timer, Exposure switches etc and replace.</li><li>• Repairs of Collimator, Bucky and Bucky table.</li><li>• Repairs of HT generator and HT cables.</li><li>• Repairs of X-ray tube and its circuit.</li></ul>	<ul style="list-style-type: none"><li>• Collimator, Grid &amp; Bucky mechanism and patient table.</li><li>• Film theory, types, application, storage, cassette, screens, safe lights etc.</li><li>• Chemical mixing, storage, waste management related to darkroom. X-ray tubes and tube circuits. Fixed anode and rotating anode, stator and rotor.</li><li>• Various controls. i.e. Kv, mA, Timer, and Exposure switches.</li><li>• HT Generator, cables, tube head assembly.</li><li>• Collimator, Grid &amp; Bucky mechanism and patient table.</li><li>• Electromagnetic relays, Reed relays, contactors, Interlocking circuits.</li></ul>
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**List of Tools & Equipment for module:- Operation and maintenance of X-ray machine & Darkroom Assistance**

Sl No	Name of Tool/ Equipment	Quantity
1.	X-Ray Machine (Dental/portable)	1 no each
2.	X-Ray machine-mobile-100mA with Bucky table	1 no
3.	Darkroom model and accessories	As required
4.	Safety badges, other accessories	As required
5.	Cassette pass box	1 no
6.	Cassettes (different types ) at least two types	2 no each
7.	Electronic components-relays, contactors, switches, transformers- for demonstration	As required
8.	Basic hand tools	As required
9.	Multimeter	1 no
10.	Anatomy & Physiology charts related to X ray positions	As required

## MODULE-7

### General information for Operation and maintenance of Clinical Equipment

Name of Sector	<b>ELECTRONICS</b>
Name of Module	Operation and maintenance Clinical Equipment
MES Code	ELC707
Duration of Course	<b>200 Hrs</b>
Entry Qualification of Trainee	8 <sup>th</sup> Pass + 14 yrs of age and Should be able to read and write English
Unit size (No. Of trainees)	20
Power Norms	2.0 KW
Space Norms	60 sq.m Minimum size of one side to be 04 m.
Instructors Qualification	B.E./B.Tech in Electronics with one year experience in the relevant field OR Diploma in Electronics from recognized board of technical education with two years experience in the relevant field. OR NTC/NAC in the trade with three years' experience respectively in the relevant field
Desirable	Craft Instructor Certificate (CIC)



## Objectives

- ✓ To use Multimeter and identify some Electronic components.
- ✓ To understand, Operate and maintain centrifuges
- ✓ To understand, Operate and maintain incubator
- ✓ To understand, operate and maintain colorimeter
- ✓ To understand, operate and maintain spectrophotometer and flame photometer
- ✓ To understand, operate and maintain gamma counter
- ✓ To understand, operate and maintain microscope

Terminal competency : At the end of the course the participant will be

- Able to Operate and maintain Centrifuges.
- Able to Operate and maintain Incubator.
- Able to Operate and maintain Colorimeter.
- Able to Operate and maintain spectrophotometer and Flame photometer.
- Able to Operate and maintain gamma counter.
- Able to Operate and maintain Microscope.

Course contents for the module:- Operation and maintenance of Clinical Equipment

<b>Practical Competencies</b>	<b>Underpinning Knowledge (Theory)</b>
<ul style="list-style-type: none"> <li>● Practice procedures for safety and health hazards measures.</li> <li>● Use of Basic tools, Multimeter, Checking of Electrical supply, Single phase, Three Phase voltages and Earthing.</li> <li>● Testing of electronic components and replace faulty ones.</li> <li>● Identifying parts of Centrifuges and its types , control.practice its operation</li> <li>● Identifying parts of Incubator and its control.</li> <li>● Identifying parts of Colorimeter and its control.Calibration &amp; Practice of Colorimeter</li> <li>● Identifying parts of Spectrophotometer and its control. Calibration &amp; Practice of Spectrophotometer.</li> <li>● Identifying various parts of Hot air oven and its control.Operation of Hot air oven.</li> <li>● Identifying various parts of Flame Photometer, Practice on</li> </ul>	<ul style="list-style-type: none"> <li>● Safety and security, health hazards</li> <li>● Basic tools, Multimeter, Electronic component description.</li> <li>● List out various instruments in clinical laboratory,</li> <li>● Hot plate and magnetic stirrer – operating procedure, care important specification</li> <li>● Centrifuges – construction, working principle, use, care rpm calibration, timer calibration, thermometer calibration, preventive maintenance, selection of centrifuge, various types of centrifuges.</li> <li>● Hot air oven – use, operating procedure, construction procedure, use, care, important specification.</li> <li>● Incubator – use, construction, care.</li> <li>● Temperature bath: - use, construction, care.</li> <li>● Body fluids- blood, urine, CSF &amp; other body fluids               <ul style="list-style-type: none"> <li>● Colorimetry and photometry – define: light wave, wavelength, unit of Wavelength, monochromator, light source, cuvette, photo detector, coloured solution.</li> </ul> </li> <li>● Colorimeter – use, construction, front panel controls, operating</li> </ul>

Gamma Counter and Microscope and its control. Operational practice on Gamma Counter and Microscope .

- Identify various controls and practice on Centrifuge
- Perform preventive maintenance on Centrifuges, Incubator, Colorimeter, Spectrophotometer, Flame photometer, Gamma Counter and Microscope.

procedure, care, important specification

- Spectrophotometer - use, construction, front panel controls, operating procedure, care, important specification
- Flame photometer - use, construction, front panel controls, operating procedure, care, important specification
- Gamma counter - use, construction, front panel controls, operating procedure, care, important specification
- Use of pH strip
- Microscope with oil immersion - use, construction, operating procedure, care and maintenance, important specification
- Glucometer - use, construction, accessories, front panel controls, operating procedure, care and maintenance, important specification
- Semi auto analyzer - use, construction, accessories, front panel controls, operating procedure, care and maintenance, important specification

List of Tools & Equipment for module:- Operation and maintenance  
of Clinical Equipment

Sl No	Name of Tool/ Equipment	Quantity
1.	Hot plate and magnetic stirrer	1 no each
2.	Centrifuge	1 no
3.	Hot air oven	1 no
4.	Incubator	1 no
5.	Constant temperature bath	1 no
6.	Colorimeter	1 no
7.	Spectrophotometer	1 no
8.	Flame photometer	1 no
9.	Gamma counter	1 no
10.	Microscope with oil immersion/Binocular microscope	1 no
11.	Glucometer	1 no
12.	Stop watch	1 no
13.	Semi-auto analyzer	1 no

## List of the Trade Committee Members

Sl. No.	Name & Designation	Organization	Remarks
1	M.R.K Naidu ,Head (CR&D)	ECIL, Hyderabad	Chairman
2	Pradeep Doshi , SVP	ESSCI, NewDelhi	Member
3	T. Venkataswamy, Assit. Engg.	BHEL, Hyderabad	Member
4	A Prasanna Lakshmi, Faculty	BHEL, Hyderabad	Member
5	T. Venkateswara Sharma, Sr. Officer HR	BEL, Hyderabad	Member
6	P. Chandrashekhar, MD	Techno Design Group, Hyderabad	Member
7	S.CH. Appa rao, Managers(operations)	BEL, Hyderabad	Member
8	T. Ram Mohan Rao, Sr.Manager	BDL, Hyderabad	Member
9	B Udaya Bhaskar Rao, DGM Electronics	BDL, Hyderabad	Member
10	M Manoharan, MD	Automation Solution, Hyderabad	Member
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12	KBR Siva Prasad	HAL, Hyderabad	Member
<b>Mentor</b>			
1.	R.L Singh, DDG(T)	DGET, MOLE, NewDelhi	Mentor
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4.	L K Mukherjee, DDT	CSTARI, Kolkata	Member
5.	N.R Aravindan JDT	NIMI, Chennai	Member
6.	C. Ramasubramanian, DDT	AHI, Bangalore	Member
7.	H.C Goyal, DDT	ATI-EPI, Dehradun	Member
8.	Avinash Kishore, ADT	DGET, MOLE, NewDelhi	Member
9.	R. Malthi, TO	RVTI(W), Bangalore	Member
10.	D K Ojha, DDT	ATI-EPI, Dehradun	Member
11.	DM Basha, TO	ATI, Mumbai	Member
12.	Ashwini Koli, JTA	RVTI, Bangalore	Member

13.	H N Bargal, TO	ITI, Mumbai	Member
14.	R S Nemade, TO	ITI, Mumbai	Member
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