



GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
DIRECTORATE GENERAL OF TRAINING

COMPETENCY BASED CURRICULUM

CERTIFICATE COURSE ON

OPERATION AND MAINTENANCE OF RESPIRATORY EQUIPMENT



NSQF LEVEL- 3

SECTOR : ELECTRONICS & HARDWARE

OPERATION AND MAINTENANCE OF RESPIRATORY EQUIPMENT

Duration: 190 Hours

NSQF LEVEL - 3

(Version: 1.0)

Designed in 2021

Developed By

Ministry of Skill Development and Entrepreneurship
Directorate General of Training

**Sectoral Trade Course Committee of Electronics & Hardware Sector
&**

CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE

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1. COURSE INFORMATION

1.1 GENERAL

The Directorate General of Training (DGT) under Ministry of Skill Development & Entrepreneurship offers a range of vocational training courses catering to the need of different sectors of the economy/ labour market. The vocational training programs of short term duration are intended for up skilling of NTC/ NAC pass out candidates. After passing out of the course, the trainee is awarded a competency based certificate approved by DGT.

In terms of Skilling and up-skilling of ITI workforce in industries and Instructors and trainees in ITI ecosystem, the Operation and Maintenance of Respiratory Equipment Short term training (STT) under Electronics & Hardware Sector is one of the high demand job role which penetrates more employment and entrepreneurship delivered nationwide through a network of ITIs.

Operation and Maintenance of Respiratory Equipment is of 190 Hours of duration and will be offered as add on course after completing ITI in Electronics Mechanic or Medical Electronics or Instrument Mechanic trade courses under CTS. The objective of the program is to develop trained workforce which can be employed by medical device manufacturers, suppliers and service providers and bio-medical department of hospitals to assist installation, operation and maintenance of Medical Respiratory equipment used for the treatment of Respiratory Related Disease.

This course is geared to prepare ITI Passed out Trainees in **“Operation and Maintenance of Respiratory Equipment”** who acquire the Skills necessary to act as Support in Installation, Operation and maintenance with least troubleshooting of Respiratory Equipment and their related medical device/ electronic systems.

In this course, during the 190 hours duration, a candidate is trained on subjects - Professional Skill, Professional Knowledge related to Operation and Maintenance of Respiratory Equipment Job Role. The practical skills are imparted in simple to complex manner & simultaneously theory subject is taught in the same fashion to apply cognitive knowledge while executing task. The broad components covered under Professional skill subject are as below:

Module 1: In this module, the course contents covered are Introduction to health care system and Hospital safety standards.

Module 2: In this module, the course contents covered are Basics of Physiology of Human Respiratory System.

Module 3: In this module, the course contents covered are Basics of Electrical and Electronics.

Module 4: In this module, the course contents covered are CPAP, BIPAP and Nebulizer - Operation, Maintenance and calibration.

Module 5: In this module, the course contents covered are Oxygen Concentrator, Pulse Oximeter - Installation, Operation, Maintenance and calibration.

Module 6: In this module, the course contents covered are Medical Ventilator- Installation, Operation, Maintenance and calibration.

Module 7: In this module, the course contents covered are Communication and Interpersonal Skills.

Module 8: Onsite Training of 100 hrs duration at OEM/ Dealer/ Hospitals.

1.2 PROGRESSION PATHWAYS

- Can join industry as Respiratory equipment technician, Medical Equipment Technician and will progress further as Senior Technician, Supervisor and can rise to the higher levels.
- Can join industry as Service / sales Personnel in medical equipment dealers / service franchise, etc.

1.3 COURSE STRUCTURE

Table below depicts the distribution of training hours across various course elements:-

S No.	Course Element	Notional Training Hours
1.	Professional Skill (Trade Practical)	55
2.	Professional Knowledge (Trade Theory)	35
3.	Onsite Training	100
	Total	190

1.4 ASSESSMENT & CERTIFICATION

The trainee will be tested for his skill, knowledge and attitude during the period of course through formative assessment and at the end of the training programme through summative assessment as notified by the DGT from time to time.

a) The Continuous Assessment (Internal) during the period of training will be done by Formative Assessment Method by testing for assessment criteria listed against learning outcomes. The training institute has to maintain an individual trainee portfolio as detailed in assessment guideline.

b) The pattern and marking structure is being notified by DGT from time to time. The learning outcome and assessment criteria will be the basis for setting question papers for final assessment.

c) Assessment will be evidence based comprising the following:

- Job carried out in labs/workshop
- Record book/ daily diary
- Answer sheet of assessment
- Viva-voce
- Progress chart
- Attendance
- Assignment
- Project work
- Participation and punctuality

Evidences of internal assessments are to be preserved until forthcoming examination for audit and verification by examining body.

d) The minimum pass percentage for skill test is 60%.

2. JOB ROLE

Brief description of Job roles:

Medical Equipment Technician; in the health care industry is also known as a Biomedical Equipment Technician (BMET), service technician, Biomedical Electronics technician. Medical Equipment Technicians install, maintain and repair patients care equipment. They perform inspection, installation and preventive maintenance of general clinical equipment, including appropriate documentation for all service activities and training the hospital staff.

Operation and Maintenance of Respiratory Equipment:

- ✓ Deliver and set-up medical equipment (Installation and Commissioning)
- ✓ Assist in Diagnose and Provide on-call and on-site service for equipment malfunctions.
- ✓ Preparation of Action plan for the service of equipment and timely delivery to hospitals.
- ✓ Understanding of Operation for the Demonstration to Hospitals and assist in Calibration Settings and help in Respiratory Equipment maintenance.
- ✓ Analyze, and solve open-ended problems with medical relevance such as those encountered during installation, inspection, repair, and calibration, as well as verify performance with minimal technical supervision
- ✓ Demonstrate professional behaviour, personal qualities and work in team.
- ✓ Demonstrate Good communication and written Skills appropriately for working role in Operation and Maintenance of Respiratory Equipment.
- ✓ Records of Maintenance activity of Equipment.
- ✓ Awareness of Do and Don'ts during handling of Equipment and appraisal of proper reports as and When the Situation demands.

Reference NCO-2015:

3211.0200 – Medical Equipment Technician

3. GENERAL INFORMATION

Name of the Trade	OPERATION AND MAINTENANCE OF RESPIRATORY EQUIPMENT
Course Code	DGT/8016
Reference NCO - 2015	3211.0200
NSQF Level	Level – 3
Duration of Craftsmen Training	190 Hours (90 hrs of institutional + 100 hrs onsite) For ITI Pass outs with 2 months experience: 90 Hrs. (Onsite training is exempted)
Entry Qualification	ITI (NTC / NAC) pass in Electronics Mechanic or Medical Electronics or Instrument Mechanic trade.
Eligibility for PwD	LD, LC, DW, AA, LV, DEAF, AUTISM, SLD
Unit Strength (No. of Student)	16
Space Norms	70 sq. m
Power Norms	3.5 KW
Instructors Qualification for:	
(i) Operation and Maintenance of Respiratory Equipment	<p>B.Voc./Degree in Electronics or Instrumentation or Electronics & Telecommunication or Electronics and Communication Engineering or Biomedical Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field.</p> <p style="text-align: center;">OR</p> <p>03 years Diploma in Electronics or Instrumentation or Electronics & Telecommunication or Electronics and Communication Engineering or Biomedical Engineering from AICTE/ recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field.</p> <p style="text-align: center;">OR</p> <p>NTC/ NAC in Electronics Mechanic or Medical Electronics or Instrument Mechanic trades with three years' experience in the relevant field.</p>
List of Tools and Equip.	As per Annexure – I

4. LEARNING OUTCOME

Learning outcomes are a reflection of total competencies of a trainee and assessment will be carried out as per the assessment criteria.

4.1 LEARNING OUTCOMES

1. Familiarize with the Healthcare System of usage of Respiratory Therapy and illustrate the Safety and First aid practices followed in hospitals
2. Familiarize with the parts, Terminology and mechanics in human Respiratory System.
3. Identify Electrical and Electronics components and perform Repair & maintenance of the Respiratory equipment.
4. Test PCB and Replace defective Components of the Respiratory equipment.
5. Explain operation and troubleshooting of sensors of the Respiratory equipment.
6. Perform operation / working of CPAP, BiPAP and Nebulizer and troubleshoot those equipment under supervision.
7. Install and set up Oxygen Concentrator, demonstrate operation with basic settings, perform functionality test and basic Maintenance i.e. Trouble shooting of Alarms and Calibration setting, etc. under supervision.
8. Explain and execute use of Pulse Oximeter and Measure Parameter related to Pulse rate and Oxygen rate.
9. Install and commission Medical Ventilator, demonstrate operation with basic settings, perform functionality test and basic Maintenance i.e. Trouble shooting of Alarms and Calibration setting, etc. under supervision.
10. Communicate effectively with required clarity with various stakeholders viz Hospital staff, Patients and their Family members.

5. TRADE SYLLABUS

Course Structure Operation and Maintenance of Respiratory Equipment			
Modules	Topic	Professional Knowledge (Trade Theory) in Hours	Professional Skill (Trade Practical) In Hours
1.	Introduction to healthcare system and Hospital safety standards	03	02
2.	Basics of Physiology of Human Respiratory System	03	02
3.	Basics of Electrical and Electronics	06	10
4.	CPAP, BIPAP and Nebulizer - Operation, Maintenance and calibration	15	25
5.	Oxygen Concentrator, Pulse Oximeter - Installation, Operation, Maintenance and calibration	02	04
6.	Medical Ventilator- Installation, Operation, Maintenance and calibration	04	10
7.	Communication and Interpersonal Skills	02	02
8.	Onsite Training	100	
Total		190	

SYLLABUS – OPERATION AND MAINTENANCE OF RESPIRATORY EQUIPMENT			
Duration: 190 Hours			
Duration	Reference Learning outcome	Professional Skills (Trade Practical)	Professional Knowledge (Trade Theory)
Module -1 Introduction to Healthcare systems and Hospital Safety Standards			
Professional Skill : 02 hrs Professional Knowledge: 03 hrs	Familiarize with the Healthcare System of usage of Respiratory Therapy and illustrate the Safety and First aid practices followed in hospitals.	<p>Visit to various sections of the Hospitals and identify location of various installations of usage of Respiratory Therapy</p> <p>Identify safety signs for Danger, warning, Safety Precaution, Grounding & personnel safety.</p> <p>Inspect proper electrical Grounding of Equipment during Installation.</p> <p>Practice on Use and disposal of Personal Protective Equipment (PPE).</p> <p>Practice on elementary first aid required for working environment.</p>	<p>Introduction To Healthcare systems and Hospitals Safety Standards.</p> <p>Health care delivery system in India at primary, secondary and tertiary care</p> <p>Challenges and Issues in Healthcare Delivery.</p> <p>Occupational Safety standards in hospitals ,</p> <p>The training combines lectures, audio-visual presentations, instructor demonstrations and Visit Hospital/ Health care institution as when required.</p>
Module-2 Basics of Physiology of Human Respiratory System			
Professional Skill : 02 hrs Professional Knowledge: 03 hrs	Familiarize with the parts, Terminology and mechanics in human Respiratory System.	<p>Identification of Parts in Respiratory System</p> <p>Demonstration on mechanics of Ventilation in human respiratory system</p>	<p>Basics of Physiology of Human Respiratory System</p> <p>Mechanics of Ventilation.</p> <p>Terminology involved in respiratory System.</p> <p>The training combines lectures, audio-visual presentations, instructor demo to provide the student with a base of knowledge.</p>
Module 3 Basics of Electrical and Electronics			
Professional	Identify Electrical	Identification of Different Types	Basics of Electrical and Electronics

<p>Skill ; 10 hrs</p> <p>Professional Knowledge : 06 hrs</p>	<p>and Electronics components and perform repair & maintenance of the Respiratory equipment.</p> <p>Test PCB and Replace defective Components of the Respiratory equipment.</p> <p>Explain operation and troubleshooting of sensors of the Respiratory equipment..</p>	<p>of IC used in Medical applications.</p> <p>Practice on Power Supply Connections – AC and DC</p> <p>Checking of electrical points</p> <p>Identification of different types of batteries</p> <p>Demo and Practice on Charging the Device Battery and Replacement of battery</p> <p>Demo and Practice on Soldering and Desoldering techniques</p> <p>Practice on Testing of PCB and Replacement of defective Components.</p> <p>Practice on Operation of different types of Switches. Identification of Rating of Relays-Voltage and Current</p> <p>Demo and Practice on Operation of Relay</p> <p>Identification of Types of Display</p> <p>Identification of different types of Sensors in Medical field.</p> <p>Demo and Practice on operation of sensor.</p> <p>Reading and understanding the messages or Alarms of sensors of the equipment displayed on the screen for different OEM's.</p> <p>Practice Troubleshooting of Sensors.</p>	<p>system</p> <p>Introduction to Electronic devices – IC, Power supply Circuits boards. Power Supply connections – AC and DC Connectors, cables. Voltage and Current rating for Medical Equipment</p> <p>Batteries–Types, Voltage and Current rating</p> <p>Introduction to PCB</p> <p>Soldering and Desoldering Techniques ,SMD</p> <p>Testing of PCB and Replacement of defective components</p> <p>Switches, Relays and Displays- Switch Types, Construction Specifications – voltage rating, contact current rating and application.</p> <p>Relays-Construction, working and Application of General Purpose relay. Difference between switch & relay.</p> <p>Display –Types (LED/LCD/& segment)</p> <p>Sensors and Instrumentation</p> <p>Introduction to Sensors- Construction, operation and Types used in Medical Equipment.</p> <p>Temperature, Pressure, Gas and Flow sensors</p> <p>Troubleshooting of Sensors</p>
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<p>Module – 4 CPAP,BIPAP and Nebulizer - Operation, Maintenance and calibration</p>			
<p>Professional Skill : 25 Hrs.</p> <p>Professional Knowledge:</p>	<p>Perform operation / working of CPAP, BiPAP and Nebulizer and troubleshoot</p>	<p>Identification of respiratory Devices.</p> <p>Demo and practice on Set up of equipment:</p> <p>Operation and Working of a CPAP and BiPAP.</p> <p>Demo and Practice on Connection</p>	<p>Introduction to Respiratory Devices in Brief.</p> <p>Oxygen Concentrator-Ventilator-BiPaP, CPap, Pulse Oximeter, Nebuliser.</p> <p>Medical Terminology and Basics Sleep Apnea and Types (OSA and</p>

<p>15 Hrs.</p>	<p>those equipment under supervision.</p>	<p>of Breathing Circuit As per OEM Standards for Clinical Application.</p> <p>Demo and practice of Nebulizer</p> <p>Identification of appropriate compressor Settings for clinical usage as per OEM standards.</p> <p>Demo and practice on Interconnections of Parts in function of device.</p>	<p>CSA), NIV and IV (Non Invasive & Invasive Ventilation) CPaP and BiPaP Parts and Accessories Functional difference between CPAP and BiPAP. Types of Sensors used in the CPAP and BiPAP machine -- Operation and Working of a CPAP and BiPAP machine -- Initial Setting features and Procedures for set up of Machine. of CPAP & BiPAP - IPAP and EPAP as per OEM Standards. Different Modes of Settings and Initial Calibration modes. Safety Precautions as per standards.</p> <p>Nebulizer</p> <p>Study of nebulizer and its clinical usage against the respiratory diseases. Parts and Accessories of Nebulizer. Operation Settings of the device as per the OEM and Clinical standards</p>
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Module-5 Oxygen Concentrator and Pulse Oximeter -Installation, Operation, Maintenance and calibration

<p>Professional Skill : 4 hrs</p> <p>Professional Knowledge : 02 hrs</p>	<p>Install and set up the Oxygen Concentrator, demonstrate operation with basic settings, perform functionality test and basic Maintenance i.e. Trouble shooting of Alarms and Calibration setting, etc. under supervision.</p>	<p>Identification of Parts and Accessories in Oxygen concentrator. Demo and Practice on Installation, operation and functionality of Oxygen Concentrators. checking of AIR and OXYGEN points. Demo and Practice on Functional Test and Measurements - Static Test and Dynamic Test. Measurement of Pressure, % Oxygen using Oxygen Analyzer and Gauges. Demo and Practice on Maintenance, Changing and</p>	<p>Oxygen Concentrator Features, Working Principle of Oxygen Concentrator Need and Use of Oxygen concentrator-Pros and Cons. Parts and Accessories of OC – Electrical, Electronics, Pneumatics. Operation, Installation and Commissioning at Hospitals as per OEM Standards. Functional Testing (Static and Dynamic test) and Safety precautions in OC, Oxygen concentrators Vs Oxygen Cylinders. Measurement of Voltage, current, Pressure and % of Oxygen. Maintenance and Calibration of</p>
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	<p>Explain and execute use of Pulse Oximeter and Measure Parameter related to Pulse rate and Oxygen rate .</p>	<p>cleaning of filters of oxygen concentrators. Troubleshooting of Alarms, Initial calibration settings of Equipment as per OEM Standards.</p> <p>Demo and practice</p> <ol style="list-style-type: none"> 1. Opening of Pulse Oximeter and identify the internal Accuracy Test/ Calibration Settings as per OEM standards connection, Hardware circuitry, LCD display module, power supply module. 2. SpO2 Measurement Test 3. Accuracy Test/ Calibration Settings as per OEM standards. 	<p>Equipment as per the OEM Standards. Troubleshooting of Alarms and Faults. Safety Precautions as per standards.</p> <p>II PULSE OXIMETER</p> <p>Brief of Medical Terminology Brief of oxygen saturation , Principles/ theory of operation of pulse oximetry and use in Emergency intensive care and hospital ward other Clinical applications. Different types of Sensors used in Pulse Oximeters. Construction, Electronic Parts, Types and operation and Study of accuracy level required for clinical applications. Alarms and malfunctioning of device.</p>
<p>Module-6 Medical Ventilator -Installation, Operation, Maintenance and calibration</p>			
<p>Professional Skills : 10 Hrs</p> <p>Professional Knowledge: 04 hrs</p>	<p>Install and commission Medical Ventilator, demonstrate operation with basic settings, perform functionality test and basic Maintenance i.e. Trouble shooting of Alarms and Calibration setting, etc. under supervision.</p>	<p>Identification of Parts of ventilator Demo and Practice on Installation, Commissioning and operation of Medical Ventilator in different Modes and settings features Changing and cleaning of filters of medical compressors, ventilators. Maintaining AIR and OXYGEN pressures in the icu s.</p> <p>Demo and Practice on Maintenance, Troubleshooting of Alarms, calibration settings of Equipment as per OEM Standards</p>	<p>Medical ventilator</p> <p>Brief of Respiratory System and Medical Terminology used . Knowledge features, Working Principle of Medical ventilator, Parts and accessories of electrical, Electronics and Pneumatics. Need and Use of Medical Ventilator Operation, Installation and set up at Hospitals as per OEM Standards. Measurement Settings and Modes on Graphical Display. Maintenance and Calibration of equipment as per the OEM Standards. Troubleshooting of Alarms and Faults. Safety Precautions as per standards.</p>

Module-7 Communication and Interpersonal Skills			
Professional Skill – 2 Hours Knowledge – 2 Hours	Communicate effectively with required clarity with various stakeholders viz Hospital staff, Patients and their Family members	Listen, speak clearly and politely with Hospital Staff, Patients and their relatives. Communicate and use, medical terms, appropriate media effectively and properly.	Gain Knowledge about Communication through Phone, Email, social media like WhatsApp, etc. Work with team, Knowledge of time management, Prioritizing the work.
Module-8 Onsite Training (100 Hrs duration):			
<ol style="list-style-type: none"> 1. Read and interpret the major specifications of different Respiratory equipment. 2. Comply the Procedure for Unpacking of Equipment and its Accessories used for Respiratory Therapy as per OEM instructions. 3. Recognize Make and Model of Respiratory Equipment, Place of Installation and Required power Connections. 4. Assist in Installation of Respiratory Equipment and Accessories (Installation depends on the Equipment Portability). 5. Assist in the Demonstration and Operation of Equipment as per OEM Instruction manual. 6. Participate in the demonstration process of functional checks of the Respiratory Equipment. 7. Interpret the Alarms for Troubleshooting as per OEM Procedures of Respiratory Equipment. 8. Perform routine and preventive maintenance of Respiratory equipment. 9. Prepare and maintain Index Cards for the Respiratory Equipment 10. Practice Do's and Don'ts while handling the Respiratory Equipment at OEM/ hospital environment. 11. Maintain the activity log of the Respiratory Equipment. 12. Check the failed/ faulty components received for the servicing and replace with suitable new spares. 13. Perform necessary calibration and functional check of the equipment necessary for delivery. 			
Examination			

6. ASSESSMENT CRITERIA

LEARNING OUTCOMES	ASSESSMENT CRITERIA
1. Familiarize with the Healthcare System of usage of Respiratory Therapy and illustrate the Safety and First aid practices followed in hospitals.	Explain Healthcare System on usage of Respiratory Therapy
	Demonstrate use and disposal of Personal Protective Equipment (PPE)
	Explain safety signs, personnel safety and Occupational Safety standards in hospitals
	Demonstrate first aid required for working environment.
2. Familiarize with the parts, Terminology and mechanics in human Respiratory System.	Identify Parts in Respiratory System
	State the terminologies involved in respiratory System
	Explain mechanics of Ventilation in human respiratory system
3. Identify Electrical and Electronics components and perform repair & maintenance of the Respiratory equipment.	Identify Different Types of ICs
	Check & replace defective components
	Execute charging of batteries
	Demonstrate replacement of battery
4. Test PCB and Replace defective Components of the Respiratory equipment.	Explain testing of PCB
	Exhibit replacement of defective Components
	Explain Operation of different types of Switches
	Identify Rating of Relays-Voltage and Current
	Identify types of Display
5. Explain operation and troubleshooting of sensors of the Respiratory equipment	Identify different types of Sensors
	Demonstrate operation of sensor.
	Exhibit Troubleshooting of Sensors
6. Perform operation / working of CPAP, BiPAP and Nebulizer and troubleshoot those equipment under supervision.	Exhibit Operation and working of CPAP
	Identify types of sensors used in the CPAP
	Explain Procedures for set up of CPAP as per OEM Standards.
	Explain different Modes of Settings and Initial Calibration of CPAP.
	Explain Functional difference between CPAP and BiPAP.
	Exhibit Operation and working of BiPAP
	Identify types of sensors used in the BiPAP
	Explain Procedures for set up of BiPAP as per OEM Standards.
	Explain different Modes of Settings and Initial Calibration of BiPAP.
	Identify Parts and Accessories of Nebulizer
	Exhibit settings of Nebulizer for clinical usage as per OEM standards.
Demonstrate Interconnections of Parts in function of Nebulizer	

7. Install and set up the Oxygen Concentrator, demonstrate operation with basic settings, perform functionality test and basic Maintenance i.e. Trouble shooting of Alarms and Calibration setting, etc. under supervision.	Identify the Parts and accessories in Oxygen concentrator
	Exhibit installation and commissioning of Oxygen concentrator
	Demonstrate operation with basic settings in Oxygen concentrator
	Perform functional Test and Measurements in Oxygen concentrator
	Exhibit maintenance, troubleshooting of Alarms, Initial calibration settings of Equipment as per OEM Standards.
8. Explain and execute use of Pulse Oximeter and Measure Parameter related to Pulse rate and Oxygen rate.	Explain use of Pulse Oximeter as per OEM standards
	Explain connection, Hardware circuitry, LCD display module, power supply module.
	Demonstrate SpO2 Measurement Test
	Explain Accuracy Test/ Calibration Settings as per OEM standards
	Explain Alarms and malfunctioning of device.
9. Install and commission Medical Ventilator, demonstrate operation with basic settings, perform functionality test and basic Maintenance i.e. Trouble shooting of Alarms and Calibration setting, etc. under supervision.	Identify the Parts of Medical Ventilator
	Exhibit installation and commissioning of Medical Ventilator
	Demonstrate operation of Medical Ventilator in different Modes and settings as per the OEM procedure.
	Demonstrate Changing and cleaning of filters of medical compressors, ventilators.
	Explain maintaining AIR and OXYGEN pressures in the icu s.
	Exhibit maintenance, troubleshooting of Alarms, calibration settings of Equipment as per OEM Standards.
10. Communicate effectively with required clarity with various stakeholders viz Hospital staff, Patients and their Family members.	Exhibit Listening and speaking clearly and politely
	Demonstrate communication using appropriate medical terms
	Demonstrate communication using Phone, Email, social media

7. ANNEXURE-I

LIST OF TOOLS & EQUIPMENT			
OPERATION AND MAINTENANCE OF RESPIRATORY EQUIPMENT			
S No.	Name of the Tools and Equipment	Specification	Quantity
A. GENERAL TOOL :			
1.	Screw driver set	Set of 7	2 sets
2.	Combinational pliers	8 inches	2 Nos.
3.	Combinational Pliers	6 inches	2 Nos.
4.	Allen Key set	Comprising of 8 keys	2 Nos.
5.	Diagonal cutter	6 inches	2 Nos
6.	Diagonal cutter	8 inches	2 Nos.
7.	Long Nose pliers	8 inches	2 Nos.
8.	Wire Stripper		2 Nos.
9.	Tweezers	150mm	2 Nos
10.	Soldering Iron with changeable bits	25 W	2 Nos.
11.	De-soldering Pump (Electrically heated)	40W	2 Nos.
12.	Digital Multi Meter	3 1/2 Digit	5 Nos.
13.	Spo2 sensor	Display:0.96 Inch OLED I2C interface plus INT pin -integrated pulse oximetry and heart rate monitor option -Integrated LEDs, Photo Sensor, and High-Performance Analog Front -End -working voltage 1.8 to 3.3volts	3 Nos.
B. INSTRUMENTS			
14.	SMD Soldering Station	Input 230 Vac Soldering Iron 24 VAC/60W Hot air gun Max, power rating 250 W Air blower 18 VDC brush less fan Air flow 24 LPM Tip to ground resistance under 2 ohms Temp range 180-480 ° C for soldering Temp. range 200 - 450°C for hot air System includes soldering iron, de-soldering pump, SMD Tweezers and pick up tool.	2 Nos.

15.	CPAP	<p>Standards Certification European CE (with verified for product number) Certification number and date : To be provided Conformity to Quality Management standards ISO 13485 & ISO 9001 Conformity to Safety standards ICE-60601-1-2: or equivalent BIS standards. CPAP Generator:-</p> <ul style="list-style-type: none"> • Pressure setting range from 3 to 12 cm H₂O <p>Air Oxygen Blender</p> <ul style="list-style-type: none"> • Fio₂ concentration should be adjustable (21 - 100%) Humidifier • Should automatically regulate the required temp. Battery Back up • Should have battery backup for 45-60 min. <p>Accessories : Standard Spares and accessories for the operation of Equipment to be provided. User manual, Service manual and Calibration report (Confirming to National Accreditation lab) to be supplied. Demonstration of equipment and training to be provided after completing supplies before acceptance.</p>	2 nos
16.	BiPAP	<p>Standards: Certification for product: European CE Conformity to QMS: ISO 13485 & ISO 9001 Conformity to safety Standards: IEC-60601-1-2:2007; IEC 60601-1-8-2006; IEC 60601-1-SER-Ed1.0-2011; or equivalent BIS standard" Certification No. and date: to be provided Performance parameters: Airflow generator Pressure (IPAP) – 4 to 25 cm of H₂O or more. Air flow generator Pressure (EPAP) -- 4 to 15 cm of H₂O or more. Mode of operation: Automatic</p>	2 nos

		<p>Range of Backup respiratory rate (in BPM) -- 5-30 or more Rate of min. Respiratory time - 0.1-0.3 sec Max. Respiratory time 0.3 to 3 sec. Range of rise time (in m secs)- 150-600 Humidifier provided : To be provided Display : Screen 2-4" sharp Should have: leak alert indication/Mask Matching/Filter change alert features. Auto ON/OFF and Auto Cooling Back up : 5-40 min Size of positive airway pressure: (L X W X H in mm) : 313 × 194 × 112 Miscellaneous parameters: Warranty : 2 years Warning signs should be adequately displayed : To be Provided Accessories : Standard Spares and accessories for the operation of Equipment to be provided. User manual, Service manual and Calibration report (Confirming to National Accreditation lab) to be supplied. Demonstration of equipment and training to be provided after completing supplies before acceptance</p>	
17.	Medical Oxygen Concentrator	<p>Certification European CE (with verified for product number) Certification number and date : To be provided Conformity to Quality Management standards ISO 13485 & ISO 9001 Conformity to Safety standards ICE-60601-1-2: or equivalent BIS standards. Type of Oxygen Concentrator: Portable Flow Rate (Minimum) at 93% + - 3% oxygen purity (Litres per minute) Oxygen outlet(s) : Single ,Outlet pressure (KPa): 75-100 Oxygen Concentration monitor: to be provided. Oxygen tank capacity (Ltrs):5 LPM Power Source: Electrical Operated Average Power Consumption (Watt):450-500</p>	2 nos

		<p>approx</p> <p>Type of operation: Continuous Flow Type</p> <p>Adjustable Air Delivery mechanism: to be provided.</p> <p>Continuous flow rate (Litre per Minute):4-5</p> <p>Noise Level (dB): less than 40 dB</p> <p>Digital Display: LED/LCD</p> <p>Alarm: Visual/Audio and Alert of all Technical faults to be provided.</p> <p>Continuous flow setting : 1 LPM</p> <p>Warranty 12 months and above on equipment.</p> <p>Accessories : Standard Spares and accessories for the operation of Equipment to be provided.</p> <p>User manual, Service manual and Calibration report (Confirming to National Accreditation lab) to be supplied.</p> <p>Demonstration of equipment and training to be provided after completing supplies before acceptance</p>	
18.	Oxygen Flow Meter	<p>Certification European CE (with verified for product number)</p> <p>Certification number and date : To be provided</p> <p>Conformity to Quality Management standards ISO 13485 & ISO 9001</p> <p>Conformity to Safety standards IEC-60601-1-2: or equivalent BIS standards.</p> <p>Display: Analog/Digital</p> <p>Calibration Medium /Gas: O₂</p> <p>Mounting: Rail Mounted</p> <p>Connector type: Diss/or compatible</p> <p>Body Finish / Body Material : Silicone or compatible and Plastic or compatible</p> <p>Humidifier capacity (ml):150-250 ml</p> <p>Accuracy,lpm: +/-0.5</p> <p>Output Pressure: Min0.4 mega Pascal</p> <p>Oxygen flow range(l/min): 0-15 min</p> <p>Output Screw: 9 millimetre or compatible</p> <p>Dimension and Size: should be portable</p> <p>Warranty : 12 months and above</p> <p>Accessories : Standard Spares and accessories for the operation of Equipment</p>	1 no

		<p>to be provided. User manual, Service manual and Calibration report (Confirming to National Accreditation lab) to be supplied. Demonstration of equipment and training to be provided after completing supplies before acceptance</p>	
19.	Medical Ventilator	<p>Certification European CE (with verified for product number) Certification number and date : To be provided Conformity to Quality Management standards ISO 13485 & ISO 9001 Conformity to Safety standards ICE-60601-1-2: or equivalent BIS standards. Type of technology : Compressor Tidal volume in ml: Min 50 ml or less Max 1500 ml or more. Respiration rate, breaths/min: up to 50 or more. Trigger mechanism : Both pressure and low Inspiratory Flow rate, L/min: upto 120 or more Inspiratory pressure, cm H₂O : upto 50 or more. FiO₂ %: 21-100 PEEP/CPAP, cm H₂O: Max upto 40 or more Pressure support, cm H₂O: 0-40 or more Leak compensation: to be provided Modes of ventilation: Volume controlled, Pressure Controlled, APCV Pressure Support, SIMV with Pressure support ,SIMV with volume control with pressure support, CPAP/PEEP, Inverse Ratio Ventilation, Non invasive ventilation, Apnea /back up ventilation, SIMV (VC) with Pressure support; SIMV (PC) with Pressure Support; Ventilation monitoring facility: To be provided Monitored / Displayed parameters: Peak inspiratory pressure , Mean airway</p>	1 no

		<p>pressure, PEEP pressure, Tidal volume, Minute volume, Patient alarms: to be provided. Equipment alarms: to be provided RS 232 output port: to be provided Type of colored display: TFT NIV (Non Invasive Ventilation) to be possible in all modes of ventilation available. Power supply: 220-240 V , 50 Hz AC single phase Accessories(2 sets) Reusable silicon breathing circuits for Adult, pediatric and Neonatal Accessories : Standard Spares and accessories for the operation of Equipment to be provided. User manual, Service manual and Calibration report (Confirming to National Accreditation lab) to be supplied. Demonstration of equipment and training to be provided after completing supplies before acceptance</p>	
20.	Pulse Oximeter Hand held	<p>Type of Pulse Oximeter: hand Held Special Signal processing Technology (Motion artifact rejection): Nell cor compatible to be provided. SPO2 probes: Resusable to be provided. Oxygen saturation Range: 0-100% Pulse rate: 25-240 BPM Display of SPO2 and PR: TFT Accuracy: $\pm 5\%$ Type of Patient: Adult/Paediatrician Power source: Inbuilt re-chargeable battery and mains 220-240 V , 50 Hz AC operation RS 232C interface for data communication and transfer. Noise level in dB: less than 40 dB Type of probe: reusable for Adult /paediatrician to be provided each 1no Non invasive blood pressure (NIBP) provided Warranty: Min 1 year Accessories : Standard Spares and accessories for the operation of Equipment to be provided.</p>	1 no

		<p>User manual, Service manual and Calibration report (Confirming to National Accreditation lab) to be supplied.</p> <p>Demonstration of equipment and training to be provided after completing supplies before acceptance.</p>	
21.	Pulse Oximeter - fingertip	<p>Type of Pulse Oximeter: Finger tip</p> <p>Special Signal processing Technology (Motion artifact rejection): Nell cor compatible to be provided.</p> <p>SPO2 probes: Reusable to be provided.</p> <p>Oxygen saturation Range: 0-100%</p> <p>Pulse rate: 25-240 BPM</p> <p>Display of SPO2 and PR: TFT</p> <p>Accuracy: $\pm 5\%$</p> <p>Type of Patient: Adult/Paediatrician</p> <p>Power source: Battery Operated Rechargeable 9 V DC</p> <p>Noise level in dB: less than 40 dB</p> <p>Warranty: Min 6 months - 1 year</p> <p>Accessories : Standard Spares and accessories for the operation of Equipment to be provided.</p> <p>User manual, Service manual and Calibration report (Confirming to National Accreditation lab) to be supplied.</p> <p>Demonstration of equipment and training to be provided after completing supplies before acceptance</p>	2 nos
22.	Nebuliser	<p>Air Flow in Liter Per Minute (LPM): Min 5 ltr</p> <p>Maximum air Flow : Min 5ltrs</p> <p>Medication capacity: 20 ml</p> <p>Granule Size of medication (micron): 8-10</p> <p>Operating Temp/Humidity:-10 degree C to +50 degree C, 30% to 95% Relative Humidity Max.</p> <p>Noise level (db):40-60</p>	2 nos

		<p>Technology: Pneumatic Maximum Pressure (kPa): 100 Nebulizing Rate: 0.2 ml/minute for 5 LMP Dust Filter, Check Valve, Air tube and Air Filter and kit with mask(child and adult) to be provided Power Source: 120V-250V/50 HZ 180 watts Accessories : Standard Spares and accessories for the operation of Equipment to be provided. User manual, Service manual and Calibration report (Confirming to National Accreditation lab) to be supplied. Demonstration of equipment and training to be provided after completing supplies before acceptance</p>	
23.	Pressure gauge	<p>0-200 psi compatible to Oxygen Concentrator Accessories : Standard Spares and accessories for the operation of Equipment to be provided. User manual, Service manual to be supplied.</p>	1 no
24.	Portable Oxygen analyser	<p>Compatible to Measure Oxygen purity 0-5 LPM 95-99% purity. Accessories : Standard Spares and accessories for the operation of Equipment to be provided. User manual, Service manual and Calibration report (Confirming to National Accreditation lab) to be supplied. Demonstration of equipment and training to be provided after completing supplies before acceptance</p>	1 no
25.	Work Stations	<p>OS – Windows 10. With 64 bit professional. Processor: Intel/AMD 64 Bit Processor, 3.2 GHz, HDD: 500 GB,RAM: 16 GB Graphics Card: NVIDIA,QUADRO 4 GB Monitor – 21 Inch, Mouse, Key Board. MS office</p>	<p>16 work stations Per batch of 16 students. 16 MS Office</p>

			License
26.	Class Room Tables / Benches	Specifications As per requirement	16 Nos.
27.	Class Room Chairs	Specifications As per requirement	16 Nos.
28.	Instructor Table	Executive Table	1 No
29.	Instructor Chair	Executive Chair	1 no.
30.	Interactive board with accessories		1 no.
31.	Internet Connection-FTTH	100 mbps minimum	1 No.
32.	Local Area Network (LAN) with 24 port Switch	24 port LAN Switch, 4U Rack Wall mount and Cabling layout for 20 I/O ports, RJ-45 cables with connectors for 20 workstations.	1 LAN system
33.	LCD Projector with accessories		1 no.
34.	Uninterrupted Power Supply (UPS)	5KVA, 3 hours Backup time.	1 no.
35.	Multi-Function Device (MFD) Printer	Printer Scanner Copier With Accessories	1 no.
36.	Computer Tables	As per requirement	16 nos.
37.	Computer Chairs	As per requirement	16 nos.
38.	White Board	1200mm x 900mm	1 no.

8. ANNEXURE-II

The DGT sincerely acknowledges contributions of the Industries, State Directorates, Trade Experts, Domain Experts and all others who contributed in designing/ revising the curriculum. Special acknowledgement is extended by DGT to the following expert members who had contributed immensely in this curriculum.

List of Industry Expert Members contributed/ participated for finalizing the course curriculum of Operation and Maintenance of Respiratory Equipment.			
S No.	Name & Designation (Mr./Ms.)	Organization	Remarks
1.	T V L N Rao ,Regional Director	AP-KAR-TN	Team Lead
2.	Ujjwal Biswas , JD/HOO	NSTI(V) Hyderabad	Team Coordinator
3.	K. Mahendar DD/HOO	NSTI Bengaluru	Team Coordinator
4.	B V Sessa Chari Director	CSTARI, Kolkata	Member
5.	C S Murthy Director	CSTARI, Kolkata	Member
6.	Syed firdost, Director	Saho healthcare manufacturing and services Pvt Ltd.	Industry Expert
7.	S. Sambaiah, Director	Medsonics Mehdipatnam, Hyderabad	Industry Expert
8.	B. Rajani, Biomedical Engineer	Care Hospital, Musheerabad, Hyderabad	Industry Expert
9.	Nanjundaswamy, Deputy Manager	Centre of learning Department, Bharat Electronics Ltd., Bangalore	Industry Expert
10.	Mohd. S. Baig Manager	PS medical System Pvt Ltd Jaynagar, Habsiguda, Street No 6, Hyderabad	Industry Expert
11.	C. Krishna krupa	A. E. E(biomedical) Equipment Maintenance and Training center, dist hospital karimnagar, Telangana	Industry Expert

12.	V.S.R. Someswar Kommuru Asst. Executive Engineer	Biomedical Equipment maintenance and training center, O/o the District Coordinator of Hospital Services, Vaidya Vidhana Parishad W.G. Dist, Eluru Andhra Pradesh	Industry Expert
13.	C. Dharmarao, Area manager (sales and service)	Trans Health Care india pvt ltd.	Industry Expert
14.	K. Sujatha, Principal	Smt. Durgabai Deshmuk Govt. Womens Technical Training Institute Hyderabad	Expert
15.	Anil Yadav Kukatlla, Supercomputing Technician	Indira Gandhi Center for Atomic Research kalpakkam, Tamilnadu	Industry Expert
16.	Srinivasu ,DD	NSTI(R),Hyderabad	Team Member
17.	M. Rajeswari DD	NSTI Bengaluru	Team Member
18.	M. Saravana ADT	NSTI(W) Bengaluru	Team Member
19.	Ritu Rani ADT	NSTI(W) Bengaluru	Team Member
20.	Divya TO	NSTI(W) Bengaluru	Team Member
21.	Nagendra Naik TO	NSTI(W) Bengaluru	Team Member
22.	V.V Saileja JTA	NSTI(W) Bengaluru	Team Member
23.	R N Manna ADT	CSTARI, Kolkata	Member