

**CURRICULUM**

**FOR THE TRADE OF**

**MECHANIC ELECTRICAL INSTRUMENTS**

**UNDER**

**APPRENTICESHIP TRAINING SCHEME**



**GOVERNMENT OF INDIA**  
**MINISTRY OF SKILL DEVELOPMENT & ENTREPRENURESHIP**  
**DIRECTORATE GENERAL OF TRAINING**

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## 1. ACKNOWLEDGEMENT

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## 2. BACKGROUND

### 1.1 Apprenticeship Training Scheme under Apprentice Act 1961

The Apprentices Act, 1961 was enacted with the objective of regulating the programme of training of apprentices in the industry by utilizing the facilities available therein for imparting on-the-job training. The Act makes it obligatory for employers in specified industries to engage apprentices in designated trades to impart Apprenticeship Training on the job in industry to school leavers and person having National Trade Certificate(ITI pass-outs) issued by National Council for Vocational Training (NCVT) to develop skilled manpower for the industry. There are four categories of apprentices namely; **trade apprentice, graduate, technician and technician (vocational) apprentices.**

Qualifications and period of apprenticeship training of **trade apprentices** vary from trade to trade. The apprenticeship training for trade apprentices consists of basic training followed by practical training. At the end of the training, the apprentices are required to appear in a trade test conducted by NCVT and those successful in the trade tests are awarded the National Apprenticeship Certificate.

The period of apprenticeship training for graduate (engineers), technician (diploma holders and technician (vocational) apprentices is one year. Certificates are awarded on completion of training by the Department of Education, Ministry of Human Resource Development.

### 1.2 Changes in Industrial Scenario

Recently we have seen huge changes in the Indian industry. The Indian Industry registered an impressive growth during the last decade and half. The number of industries in India have increased manifold in the last fifteen years especially in services and manufacturing sectors. It has been realized that India would become a prosperous and a modern state by raising skill levels, including by engaging a larger proportion of apprentices, will be critical to success; as will stronger collaboration between industry and the trainees to ensure the supply of skilled workforce and drive development through employment. Various initiatives to build up an adequate infrastructure for rapid industrialization and improve the industrial scenario in India have been taken.

### 1.3 Reformation

The Apprentices Act, 1961 has been amended and brought into effect from 22<sup>nd</sup> December, 2014 to make it more responsive to industry and youth. Key amendments are as given below:

- Prescription of number of apprentices to be engaged at establishment level instead of trade-wise.

- Establishment can also engage apprentices in optional trades which are not designated, with the discretion of entry level qualification and syllabus.
- Scope has been extended also to non-engineering occupations.
- Establishments have been permitted to outsource basic training in an institute of their choice.
- The burden of compliance on industry has been reduced significantly.

### **3. RATIONALE**

#### **(Need for Apprenticeship in MECHANIC ELECTRICAL INSTRUMENT trade)**

Electrical sector is achieving new heights every day. Electrical sector has got large scale requirement of skilled manpower. Electrical sector ranges from Power Generation, Transmission and Distribution to Power Utilisation and Application. Electrical measurements are important in designing, evaluating, maintaining and servicing electrical circuits and equipment. In order to detect electrical quantities such as current, voltage, resistance or power, it is necessary to transform an electrical quantity or condition into a visible indication. This is done with the aid of instruments (or meters) that indicate the magnitude of quantities either by the position of a pointer moving over a graduated scale (called an analogue instrument) or in the form of a decimal number (called a digital instrument). So wherever electricity is used Electrical Instruments have a wide application. This implies that Electrical Instrument mechanics have a very crucial role to play. Hence, it requires more skilled workers every year.

A large number of skilled workers coming out of technical institutes do not possess the required skills and are not readily employable. It is generally observed that institutionally trained youth have not produced desired result because training imparted in institutions alone is not enough for acquisition of skills but needs to be supplemented by training in the actual world of work. The industries have to spend time and money on their training. It has been observed that most of the existing Industrial Training Institutes run by the government and private sector do not have on the job training facilities.

It is therefore needed to interact with the industry to provide on the job training to the Semi skilled workers and also make changes in the curriculum. So to supply the skilled manpower demand, the Apprenticeship Training approach with the revised, industrial friendly curriculum is required.

## **4. JOB ROLES: REFERENCE NCO**

### **Brief description of Job roles:**

**Mechanic Precision Instrument Electrical; Meter Repairer, Electrical** repairs and sets electrical parts of precision instruments such as megger, voltmeter, ammeter, condensers, galvanometers, etc., to high accuracy for recording correct readings by reviving, replacements and necessary adjustments. Studies drawings, circuit diagrams and other specifications and examines instrument visually to locate any apparent loose connection, short circuits etc. Dismantles instrument using insulated screw drivers, pliers, special spanners etc., and checks components, insulation wiring, fittings and other features with precision mechanical and electrical measuring instruments to locate wear and tear, short circuits and other defects. Cleans necessary or any fluid used in instrument and their various parts using special brushes. Checks gear shell, bearing jewels and other operating parts and repairs or replaces worn out and damaged ones. Assembles parts, replaces insulation and makes electrical wiring and connections according to diagram and prescribed specification. Examines assembled or repaired instrument by standard tests, makes necessary adjustments and ensures correct reading and desired performance within prescribed limits. Seals cut-outs, meters etc to avoid manipulation. May wind coils, set new resistance and perform other electrical functions, if required.

### **Reference NCO & NOS:**

- i) **NCO-2004:** 7241.10

## GENERAL INFORMATION

1. **Name of the Trade** : **MECHANIC ELECTRICAL INSTRUMENTS**

2. **N.C.O. Code No. (NCO-2004)** : 7241.10

3. **Duration of Apprenticeship Training (Basic Training + Practical Training):** 2 years

**3.1 For Freshers: - Duration of Basic Training: -**

a) Block –I : 3 months

b) Block – II : 3 months

**Total duration of Basic Training: 6 months**

**Duration of Practical Training (On -job Training): -**

a) Block–I: 9 months

b) Block–II : 9 months

**Total duration of Practical Training: 18 months**

**3.2 For ITI Passed: Duration of Basic Training: - NIL**

**Duration of Practical Training (On-job Training): 12 Months**

4. **Entry Qualification** : Passed in 10<sup>th</sup> class examination under 10+2 system of education or its equivalent.

5. **Selection of Apprentices:** The apprentices will be selected as per Apprenticeship Act amended time to time.

6. Rebate for ITI passed trainees: - **One year rebate** for those who have passed **Electrician** trade under CTS or have passed one year BBT and advanced module in Repair and Maintenance of Instruments used in Electrical Engineering under CoE Electrical Sector. They will undergo One year On-the-job Training

*Note: Industry may impart training as per above time schedule for different block, however this is not fixed. The industry may adjust the duration of training considering the fact that all the components under the syllabus must be covered. However the flexibility should be given keeping in view that no safety aspects is compromised.*

## 5. COURSE STRUCTURE

Training duration details: -

<b>Time (in months)</b>	<b>1-3</b>	<b>4-12</b>	<b>13-15</b>	<b>16-24</b>
<b>Basic Training</b>	<b>Block– I</b>	<b>-----</b>	<b>Block – II</b>	<b>-----</b>
<b>Practical Training (On - job training)</b>	<b>----</b>	<b>Block – I</b>	<b>-----</b>	<b>Block – II</b>

Components of Training ↓	Duration of Training in Months →																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
<b>Basic Training Block – I</b>	█	█	█																					
<b>Practical Training Block - I</b>				█	█	█	█	█	█	█	█													
<b>Basic Training Block – II</b>													█	█	█									
<b>Practical Training Block - II</b>																█	█	█	█	█	█	█	█	█

**6. SYLLABUS**  
**7.1 BASIC TRAINING**  
**(BLOCK – I & II)**  
**DURATION: 06 MONTHS**

**GENERAL INFORMATION**

- 1) **Name of the Trade** : **MECHANIC ELECTRICAL INSTRUMENTS**
- 2) **Hours of Instruction** : 1000 Hrs. (500 hrs. in each block)
- 3) **Batch size** : 20 nos.
- 4) **Power Norms** : 5.2 KW for Workshop
- 5) **Space Norms** : 98 Sq.m. (For basic Training of Block-I & II)
- 6) **Examination** : The internal assessment will be held on completion of each Block.
- 7) **Instructor Qualification** :

i) Degree/Diploma in Electrical Engg. from recognized university/Board with one/two year post qualification experience respectively in the relevant field.

**OR**

ii) NTC/NAC in the trade of Electrician / BBBT and Advanced module in “Repair & Maintenance of Instruments used in Electrical Engg” / NAC in Mechanic- Electrical Instruments, with three year post qualification experience in the relevant field.

Preference will be given to a candidate with Craft Instructor Certificate (CIC)

- 8) **Tools, Equipments & Machinery required** : - As per Annexure – I

## 7.1.1 DETAIL SYLLABUS OF CORE SKILL

### A. Block– I Basic Training

Topic No.	a) Engineering Drawing	Duration (in hours)	b) Workshop Science & Calculation	Duration (in hours)
1	<p><b>Engineering Drawing: Introduction and its importance</b></p> <ul style="list-style-type: none"> <li>- Viewing of engineering drawing sheets.</li> </ul> <p>Method of Folding of printed Drawing Sheet as per BIS SP:46-2003</p> <p><b>Drawing Instruments</b> : their Standard and uses</p> <ul style="list-style-type: none"> <li>- Drawing board, T-Square, Drafter (Drafting M/c), Set Squares, Protractor, Drawing Instrument Box (Compass, Dividers, Scale, Diagonal Scales etc.), Pencils of different Grades, Drawing pins / Clips.</li> </ul>	<b>30</b>	<p><b>Unit:</b> Systems of unit- FPS, CGS, MKS/SI unit, unit of length, Mass and time, Conversion of units.</p>	<b>20</b>
2	<p><b>Lines :</b></p> <ul style="list-style-type: none"> <li>- Definition, types and applications in Drawing as per BIS SP:46-2003</li> <li>- Classification of lines (Hidden, centre, construction, Extension, Dimension, Section)</li> <li>- Drawing lines of given length (Straight, curved)</li> <li>- Drawing of parallel lines, perpendicular line</li> <li>- Methods of Division of line segment</li> </ul>		<p><b>Fractions &amp; Simplification:</b> Fractions, Decimal fraction, Multiplication and Division of Fractions and Decimals, conversion of Fraction to Decimal and vice versa. Simple problems Simplification using BODMAS.</p>	
3	<p><b>Drawing of Geometrical Figures:</b> Definition, nomenclature and practice of -</p>		<p><b>Square Root :</b> Square and Square Root, method of finding out square roots,</p>	

	<ul style="list-style-type: none"> <li>- Angle: Measurement and its types, method of bisecting.</li> <li>- Triangle -different types</li> <li>- Rectangle, Square, Rhombus, Parallelogram.</li> <li>- Circle and its elements.</li> </ul>		Simple problem using calculator	
4	<p><b>Lettering and Numbering</b> as per BIS SP46-2003:</p> <ul style="list-style-type: none"> <li>- Single Stroke, Double Stroke, inclined, Upper case and Lower case.</li> </ul>		<b>Ratio &amp; Proportion:</b> Simple calculation on related problems.	
5	<p><b>Free Hand sketch:</b> Hand tools and measuring instruments used in electronics mechanics trades</p>		<b>Percentage:</b> Introduction, Simple calculation. Changing percentage to decimal and fraction and vice-versa.	
6	<p><b>Free hand drawing :</b></p> <ul style="list-style-type: none"> <li>- Lines, polygons, ellipse, etc.</li> <li>- geometrical figures and blocks with dimension .</li> <li>- Transferring measurement from the given object to the free hand sketches.</li> </ul>		<p><b>Material Science :</b></p> <p>properties -Physical &amp; Mechanical, Types –Ferrous &amp; Non-Ferrous, difference between Ferrous and Non-Ferrous metals, introduction of Iron, Cast Iron, Wrought Iron, Steel, difference between Iron and Steel, Alloy steel, carbon steel, stainless steel, Non-Ferrous metals, Non-Ferrous Alloys.</p>	

**B. Block- II**  
**Basic Training**

Topic No.	a) Engineering Drawing	Duration (in hours)	b) Workshop Science & Calculation	Duration (in hours)
1	<b>Symbolic Representation</b> (as per BIS SP:46-2003) of : - Fastener (Rivets, Bolts and Nuts) - Bars and profile sections - Weld, brazed and soldered joints. - Electrical and electronics element - Piping joints and fittings	30	<b>Mass ,Weight and Density :</b> Mass, Unit of Mass, Weight, difference between mass and weight, Density, unit of density, specific gravity of metals	20
2	<b>Construction of Scales and diagonal scale</b>		<b>Work, Power and Energy:</b> work, unit of work, power, unit of power, Horse power of engines, mechanical efficiency, energy, use of energy, potential and kinetic energy, examples of potential energy and kinetic energy.	
3	<b>Three phase Induction motor</b>  Free hand sketching of Slip-ring and Squirrel cage Induction motor. Typical wiring diagram for drum controller operation of A.C. wound rotor motor.			
4	Drawing the schematic diagram of Autotransformer starter, DOL starter and Star Delta Starter. Drawing the schematic diagram of A.C. motor speed control by SCR /AC Drive.		<b>Algebra:</b> Addition, Subtraction, Multiplication, Division, Algebraic formula, Linear equations (with two variables).	
5	<b>Distribution of Power</b> Types of insulator used in over head line. (Half sectional views) Different type of distribution systems and methods of connections.		<b>Mensuration :</b> Area and perimeter of square, rectangle, parallelogram, triangle, circle, semi circle. Volume of solids – cube, cuboid, cylinder and Sphere.	

	Layout diagram of a substation. Single line diagram of substation feeders.		Surface area of solids – cube, cuboid, cylinder and Sphere.	
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## 6.1.2 DETAIL SYLLABUS OF PROFESSIONAL SKILLS & PROFESSIONAL KNOWLEDGE

### A. Block –I Basic Training

Week No.	Professional Skills (275 Hours)	Professional Knowledge (120 Hours)
1.	<p>Implementation of various safety measures in the shop floor. Visit to different sections of the Institute/ establishment.</p> <p>Demonstration of elementary first aid. Artificial Respiration.</p> <p>Practice on use of fire extinguishers.</p> <p><b>Occupational Safety &amp; Health.</b></p> <p><b>Importance of housekeeping &amp; good shop floor practices.</b></p> <p>Health, Safety and Environment guidelines, legislations &amp; regulations as applicable. Disposal procedure of waste materials like cotton waste, metal chips/burrs etc. Basic safety introduction, Personal protective Equipment(PPE):-</p> <p>Basic injury prevention, Basic first aid, Hazard identification and avoidance, safety signs for Danger, Warning, caution &amp; personal safety message.</p> <p>Preventive measures for electrical accidents &amp; steps to be taken in such accidents.</p> <p>Use of Fire extinguishers.</p>	<p><b>Occupational Safety &amp; Health</b></p> <p>Basic safety introduction,</p> <p>Personal protection:-</p> <p>Basic injury prevention, Basic first aid, Hazard identification and avoidance, safety signs for Danger, Warning, caution &amp; personal safety message.</p> <p>Use of Fire extinguishers.</p> <p>Visit &amp; observation of sections.</p> <p>Various safety measures involved in the Industry. Elementary first Aid. Concept of Standard</p> <p><b>Soft Skills:</b> its importance and Job area after completion of training. Introduction of First aid.</p> <p>Operation of electrical mains. Introduction of PPEs. Introduction to 5S concept &amp; its application.</p> <p>Response to emergencies eg; power failure, fire, and system failure.</p>
2.	<p>Familiarization with signs and symbols of Electrical accessories.</p> <p>Skinning the cables</p> <p>Demonstration &amp; Practice on bare conductors joints--such as rat tail, Britannia, straight, Tee, Western union Joints</p> <p>Practice in soldering &amp; brazing</p> <p>Practice on crimping thimbles, Lugs.</p> <p>Demonstration and identification of types of cables. Demonstration &amp; practice on using standard wire gauge &amp; micrometer.</p>	<p>Fundamental of electricity:</p> <p>Fundamental terms- Current, Voltage definitions, AC, DC, Phase, Neutral, Earth.</p> <p>Units &amp; effects of electric current.</p> <p>Solders, flux and soldering technique. Resistors types of resistors &amp; properties of resistors.</p> <p>Introduction of National Electrical Code. Explanation, Definition and properties of conductors, insulators and semi-conductors.</p> <p>Types of wires &amp; cables, standard wire gauge. Specification of wires &amp; Cables-insulation &amp; voltage grades- Low , medium &amp; high voltage</p>
3.	<p>Verification of Ohm's Law,</p>	<p><b>Ohm's Law -</b></p>

	<p>Measuring unknown resistance Verification of laws of series and parallel circuits.</p> <p>Experiment on poly phase circuits. Current, voltage, power and power factor measurement in single &amp; poly- phase circuits. Measurement of energy in single and poly-phase circuits. - Use of phase sequence meter.</p> <p>Practice on three phase four wire system for understanding phase and line voltage &amp; current.</p>	<p>Simple electrical circuits and problems. Reading of simple Electrical Layout. <b>Resistors</b> -Law of Resistance. Series and parallel circuits &amp; related calculation. <b>Alternating Current</b> -Comparison and Advantages D.C and A.C. Related terms Frequency, Instantaneous value, R.M.S. value Average value, Peak factor, form factor, sine wave, phase and phase difference. Inductive and Capacitive reactance, Impedance (Z), power factor (p.f). Active and Reactive power. Single Phase and three-phase system etc.</p> <p>Power consumption in series and parallel, P.F. etc. Concept three-phase Star and Delta connection. Line and phase voltage, current and power in a 3 phase circuits with balanced and unbalanced load. Three phase four wire system Use of power analyzer, measurement of THd, Harmonics due to digital switching.</p>
4.	<p>Demonstration of trade hand tools. Use, care &amp; maintenance of various hand tools. Practice on installation and overhauling common electrical accessories as per simple Electrical circuit / Layout. Make test board. Testing of wiring by meggar. -Fixing of calling bells/buzzers. Installation, Testing, Application of fuses, relay, MCB, ELCB.</p>	<p>Identification of Trade-Hand tools- Specifications Common Electrical Accessories, their specifications in line with NEC 2011- Explanation of switches lamp holders, plugs and sockets. Developments of domestic circuits, Alarm &amp; switches, with individual switches, Two way switch . MCB, ELCB, MCCB. Series –parallel testing board &amp; use. <b>Wiring system</b> - Power Wiring - Control Wiring - Information &amp; Communication Wiring. - Entertainment Wiring. Testing of wiring installation by meggar Study of Fuses, Relays, Miniature circuit breakers (MCB), ELCB, etc.</p>

5.	<p>Identification of parts of battery. Practice on Battery Charging, Preparation of battery charging, Testing of cells, Installation of batteries, Charging of batteries by different methods. Routine care &amp; maintenance of Batteries</p> <p><b>Practice on Earthing-</b> different methods of earthing.</p> <p>Measurement of Earth resistance by earth tester. Testing of Earth Leakage by ELCB and relay.</p>	<p><b>Chemical</b> effect of electric current-Principle of electrolysis. Faraday's Law of electrolysis Lead acid cell-description, methods of charging-Precautions to be taken &amp; testing equipment, Different types of lead acid cells. Sealed Maintenance free Batteries, Solar battery. Load &amp; back up time calculation</p> <p><b>Earthing-</b> Principle of different methods of earthing &amp; selection. i.e. Pipe, Plate, etc Importance of Earthing. Improving of earth resistance Earth Leakage circuit breaker (ELCB).</p>
6.	<p><b>Diodes</b>-symbol - Tests - Construct &amp; Test Half wave rectifier ckt. Full wave rectifier ckt. Bridge rectifier ckt. Measurement &amp; calculation of electrical parameters using C.R.O. Different wave shapes of rectifiers and their values using C.R.O. Identification of terminals, construction &amp; Testing of transistor. Operation, maintenance &amp; troubleshooting of inverter, Voltage stabilizer, DC regulated power supply, UPS, etc</p> <p><b>Transistors: identification and testing</b> finding static and dynamic characteristics of transistors in different modes using training kits, calculation of gains. Biasing circuits Identify, test and draw the VI characteristic of FET, MOSFET and UJT.</p>	<p><b>Basic electronics-</b> Semiconductor energy level, atomic structure 'P' type and 'N' type. Type of materials -P-N-junction. Classification of Diodes - Reverse and Forward Bias, Heat sink. Specification of Diode PIV rating. Explanation and importance of D.C. rectifier circuit. Half wave, Full wave and Bridge circuit. Filter circuits-passive filter. Working principle and uses of an oscilloscope. Types of transistors &amp; its application. Specification and rating of transistors.</p> <p><b>Transistors:</b> working, classification, VI characteristics (static and dynamic), CE, CB, CC configuration and their difference, current, voltage gains and their relationship. Biasing and thermal stabilization circuits, heat sink. Packaging, coding, specification, identification and applications in detail DC and AC load lines. H parameters</p> <p><b>Field effect transistors:</b> construction, operation and VI characteristics of JFET, Enhancement and depletion type MOSFET, concepts of CMOS, Difference with bipolar junction transistors, uses.</p> <p><b>UJT-</b> Construction, operation VI characteristics and application</p>

7.	<p>Prepare simple electromagnet and find the polarity  Identification of the parts of a D.C. machine. No load &amp;  Load performance of a different type of DC generator. Calculation of regulation &amp; efficiency.  Connect, start, run and reverse a different type of DC motor.  load performance test on different type of DC motor &amp; calculation of efficiency.  speed of a DC motor by different method.  Maintenance, troubleshooting &amp; servicing of DC machines.  Overhaul a DC machine.</p>	<p><b>D.C. Machines –</b>  <b>Magnetism-</b> classification of magnets, methods of magnetizing, magnetic material  <b>Electromagnetism-</b> Solenoid, field around conductors carrying current, polarity, screw-rule, right- hand grip rule, advantages and application of electromagnet.  General concept of Electrical Machines.  <b>Principle of D.C. generator.</b> Use of Armature, Field Coil, Polarity, Yoke, Cooling Fan, Commutator, slip ring Brushes, Laminated core.  Explanation of <b>D.C. Generators</b>-types, parts- Practical uses. Description of series, shunt and compound generators and their selection.  Types of D. C. Motor.  Starters used in D.C. motors  Types of speed control of DC motors in industry.  Application of D.C. motors.  Care, Routine &amp; preventive maintenance.</p>
8.	<p>Identification of parts and terminals of Alternator.  Connection, starting, running of Alternator.  Practice on alternators, voltage Building,, Parallel operation &amp; load sharing.  Practice on installation, running and maintenance of Alternators.  Connect, start and run a 3 phase synchronous motor  Practice for Power factor correction.</p>	<p><b>Alternator</b>  Explanation of alternator, working principle, voltage build-up, loading, Regulation. Types of prime mover, phase sequence, Parallel operation &amp; load sharing.  Specification of alternators</p> <p><b>SYNCHRONOUS MOTOR -</b>  Working principle, effect of change of excitation and load. Power factor correction of industrial load</p>
9.	<p>Identification of types of transformers. Connection of transformers, Transformation ratio, testing of transformer, calculate the losses &amp; efficiency. Use of Current Transformer (C.T.) and Potential (Voltage) transformer (P.T.)  Testing of single phase and Three Phase Transformers - Cleaning, maintenance, testing and changing of oil.</p>	<p>Working principle of <b>Transformer</b>, losses &amp; efficiency.  classification C.T., P.T. Instrument and Auto Transformer(Variac), Construction, Single phase and Poly phase.  Type of Cooling for transformer.  Protective devices.  Components, Auxiliary parts i.e. breather, Conservator, buchholz relay, other protective devices. Transformer oil testing and Tap changer (off load and on load). Dry type transformer.  Bushings and termination.</p>
10.	<p>Identification of parts and terminals of AC motors.</p>	<p><b>Three phase Induction motor –</b>  Working principle –Production of rotating</p>

	<p>Connection, starting, running of AC motors using Starters. Load test &amp; efficiency calculation.</p> <p>Rotor resistance starter, etc</p> <p>Speed control of Induction motors by various methods.</p> <p>Practical application of A.C. motors.</p> <p>Connection of single phase motor, identification, testing, running and reversing.</p> <p>Maintain, service and trouble shoot the single phase motor.</p> <p>Install a single phase motor.</p> <p>Overhauling of AC motors.</p>	<p>magnetic field, Squirrel Cage Induction motor, Slip-ring induction motor.</p> <p>Control &amp; Power circuit of starters</p> <p>D.O.L Starter, Forward /Reverse starter, Star /Delta starter, Autotransformer starter, Rotor resistance starter, etc</p> <p>Single phasing preventer.</p> <p>Application of Induction Motor</p> <p>Care, Routine &amp; preventive maintenance.</p> <p><b>Single phase induction motor-</b></p> <p>Working principle, different method of starting and running (capacitor start, permanent capacitor, capacitor start &amp; run, shaded pole technique).</p> <p>FHP motors, Repulsion motor, stepper motor, Application of single phase motor.</p>
11.	<p>Measurement of pit resistance. Demonstration of HV safety devices Use of HV tester, cool coat, discharge rod.</p> <p>Layout of various types of power transmission equipment/ devices – conductors, support, insulators and cables.</p> <p>Cable jointing practices.</p> <p>Single line diagram of interconnected industrial power supply system</p> <p>Polarity marking of CT Connection.</p> <p>Connection of lightening arrestors.</p>	<p><b>Power Generation, Transmission and distribution System</b></p> <p>Introductory concepts - generating stations: Hydel, Thermal, Nuclear, Gas turbine, IC engine etc.</p> <p>High voltage safety, use of safety devices like HV tester, discharge rod, cool coat</p> <p>Transmission O/H line, conductor, support, insulators, their merit and demerit, sag, span, joints, guard, binding of insulators, stay, damper jumpers, erection of line, maintenance and inspection of transmission lines.</p> <p>Cables- construction, classification of cables, property of XLPE, paper, PVC, insulation, jointing and laying of cable, testing and fault localization</p> <p>Indoor and outdoor substation, layout, single line diagram, CT&amp; PT, isolators, earth switch, transformer, lightening arrestor, reactor, breaker, bus and its protection.</p> <p>Energy management, maximum demand, load factor, connected load, diversity load curve, tariff. LDC- monitoring system for power generation and utilization.</p>

		Indian electricity rules pertaining to safety of supply system, LT and HT equipment, O/H transmission.
12.	<p>Connection of relays, Maintenance and adjustment of arc chute and contact</p> <p>Opening and assembling - pole assembly, trip assembly and hand assembly.</p> <p>Maintenance of different type of Circuit Breakers.</p> <p>Demo on parameterization of digital relay and numerical relay.</p>	<p><b>Power system protection</b></p> <p>Switch gear- arcing phenomena, ACB parts and their function, maintenance of arc chute, contacts, limitation and tightening, testing and calibration of releases, trouble shooting.</p> <p>Construction, working and maintenance of OCB, VCB and SF6, GIS, their merit and demerit.</p> <p>Protection relay: classification, terms and definitions, comparison of mechanical, solid state, digital and numerical relays. O/C relay- it's testing and calibration, E/F relay – its testing and calibration. Different types of E/F relays, reverse power relay, differential relay, restricted E/F relay, feeder protection relay, directional earth fault relays.</p> <p>Digital motor protection relay, numerical relays used with power system.</p>
13.	<p>Identify &amp; select different type of Instruments.</p> <p>Use of -PMMC , MI meter, Multi-meter(Digital/Analog) , Wattmeter, P F meter, Energy meter, Frequency meter, Phase sequence meter, Digital Instruments, etc</p> <p>Range extension of meters.</p>	<p><b>Electrical Measuring Instruments -</b></p> <ul style="list-style-type: none"> <li>-types, indicating types</li> <li>PMMC &amp; MI meter (Ammeter, Voltmeter)</li> <li>-Range extension</li> <li>-Multimeter(Digital/Analog)</li> <li>-Wattmeter</li> <li>- P.F. meter</li> <li>- Energy meter (Digital/analog)</li> <li>-Insulation Tester (Megger), Earth tester.</li> <li>-Frequency meter</li> <li>-Phase Sequence meter</li> <li>-Multimeter –Analog and Digital</li> <li>-Tong tester</li> <li>-Techometer.</li> </ul>
<b>Assessment/Examination 03days</b>		

**B. Block –II**  
**Basic Training**

<b>Week No.</b>	<b>Professional Knowledge (275 Hours)</b>	<b>Professional Skills (120 Hours)</b>
01	<p><b>Amplifiers:</b> working principle, classification and circuits. Small signal single stage AF/RF amplifiers: different circuits, load line, voltage, current and power gain, waveforms, frequency response</p> <p>Multistage amplifiers- need and types of coupling. RC, transformer and direct couple amplifier circuits, voltage and power gain, frequency response, bandwidth, comparison between different types.</p> <p>Power amplifier- voltage and power amplifier, classification Class A, B.C and AB amplifier circuits</p> <p>Push-pull amplifier, Use of heat sink., harmonic distortion and its control.</p> <p>Feedback amplifiers- circuit and applications</p> <p><b>Oscillators:</b> working principle, classification, circuits and applications. Factors controlling oscillation. Different types of oscillators, their characteristics and applications, crystal oscillators.</p>	<p><b>Assembly and testing of amplifier circuits on PCB:</b></p> <p>Single stage CE, CB, CC amplifiers, RC, Transformer and direct couple amplifiers.</p> <p>Study of input and output wave forms on oscilloscope. Calculation of gain and bandwidth. Drawing the frequency response curve</p> <p>Assembly of oscillator circuits using transistor and measuring the output frequency and waveform.</p>
02	<p><b>Digital Electronics</b></p> <p><b>Number systems:</b> binary, octal, hex, 1's and 2's complements, conversion from one system to other, Boolean algebra: De Morgan theorem and its applications</p> <p><b>Basic logic gates:</b> Symbolic representation and truth tables for logic gates: Buffer, NOT, OR, AND, NAND, NOR, XOR, XNOR. Different logic families and their characteristics, Electrical equivalent of gates, Negative and positive logic gates</p> <p><b>Boolean algebra-</b> Karnaugh map technique, simplification of Boolean expressions, realization of Boolean expression with logic gates</p> <p><b>Combinational logic circuits:</b> Half and full adder and subtractors. Encoders, decoders,</p>	<p>Verification of truth tables of different gates</p> <p>Realization of different Boolean expression with logic gates</p> <p>Realization of adders and subtractors</p> <p>Construct and verify truth tables of flip flops</p> <p>Construct synchronous and asynchronous counters and study its functions</p>

	<p>multiplexer, demultiplexers, parity generators and checker</p> <p><b>Sequential logic circuits:</b> Difference between sequential and combinational circuits, triggering of sequential circuits. Flip-flops: RS, JK, D, T type, preset and clear signals, timing diagrams. Counters, Registers and its application.</p>	
03	<p><b>Memory devices:</b> types, memory cells: RAM, ROM, PROM, EPROM, EEPROM, CD-ROM, memory addressing and IC chips, Static and dynamic RAM, latest development</p> <p><b>Data converters:</b> Digital to analog converters, simple circuits, and applications. Analog to digital converters.</p> <p><b>Multivibrators:</b> Types, characteristics and circuits, Schmidt trigger.</p>	<p>Construct controlled shift register and study their functions</p> <p>Practice on reading and interpretation of IC data sheets.</p>
04	<p><b>Linear ICs and OP-AMPS:</b> working, characteristic, pin diagram, applications as inverting and non-inverting amplifier, calculation of gain, comparator, unity gain buffer and scale changer, adder, subtractor, differentiator, integrator, V/I and I/V converter. Differential and Instrumentation amplifier</p> <p><b>Switching and timer circuits:</b> classification of multi-vibrators, astable, monostable and bi-stable. Internal block diagram, operating of 555 timers and its applications</p> <p><b>Opto-electronics-</b> elementary idea of LED, LCD, photo diodes, photo transistors, solar cells and their applications</p>	<p><b>OPAMPS</b> pins identification, assembly of inverting and non-inverting amplifiers, calculation of voltage gain, assembly of comparator, adder, subtractors, differentiator, integrator, V/I and I/V circuit and its testing. Study of Differential and Instrumentation amplifier</p> <p><b>Construction of multivibrators using 555 timers,</b> Calculation of frequency</p>
05	<p><b>1.Introduction</b> of instruments, need of instruments in industry.</p> <p><b>2.Classification of instruments :</b> - (a) Absolute &amp; Secondary Instruments. (b) Analog &amp; Digital Instruments. (c) Indicating type Instruments. (d) Recording type Instruments. (e) Integrating type Instruments. –</p>	<p>Identification and testing of different components used in different meters</p>
06	<p>Instruments commonly used in power system, their construction, working,</p>	<p>Assemble/ Repair/Calibrate different types of Voltmeters</p>

	<p>Limitations, Merits &amp; Demerits.</p> <p><b>Voltmeter &amp; Ammeter:</b></p> <p>Moving iron type (Attraction &amp; Repulsion type) instruments.</p> <p>Moving coil type (Permanent magnet type &amp; Dynamometer type) instruments.</p> <p>Hot wire type instruments.</p> <p>Induction type instruments</p> <p>Electrostatic type instruments.</p> <p>Digital and programmable instruments.</p>	<p>Assemble/ Repair/ Calibrate different types of Ammeters</p> <p>Connect/assemble/calibrate Digital and Programmable instruments.</p>
07	<p><b>Wattmeter:</b> construction, working, Limitations, Merits &amp; Demerits.</p> <ol style="list-style-type: none"> <li>Dynamometer type instruments.</li> <li>Induction type instruments. – (Single phase &amp; Three phase)</li> <li>Electrolytic meter instruments.</li> <li>Motor type meter instruments.</li> <li>Digital wattmeters</li> </ol> <p><b>Energy meter:</b></p> <ol style="list-style-type: none"> <li>Induction type energy meter. (1-phase &amp; 3-Phase)</li> <li>Electrostatic type energy meter.</li> <li>Electronic type energy meter (Attraction type, Quadrant type.)</li> <li>Digital and programmable Energy meter (single phase &amp; three phase).</li> </ol>	<p>Assemble/ Repair/Calibrate different types of Wattmeter meters</p> <p>Assemble/ Repair/ Calibrate different types of Energy meters</p>
08	<p><b>Frequency meter:</b></p> <ol style="list-style-type: none"> <li>Vibrating type.</li> <li>Electrodynamics type.</li> <li>Moving iron type.</li> <li></li> </ol> <p><b>Power factor meter:</b></p> <ol style="list-style-type: none"> <li>Electrodynamics type</li> <li>Moving iron type.</li> </ol> <p><b>Phase Sequence meter:</b></p> <ol style="list-style-type: none"> <li>Analog type</li> <li>Digital type</li> </ol>	<p>Assemble/ Repair/Calibrate different types of Frequency meters</p> <p>Assemble/ Repair/ Calibrate different types of PF meters</p> <p>Connect/Assemble/ Repair/ Calibrate Analog and digital meters</p>

09	<p><b>Multimeter:</b> i. Analog type ii. Digital type</p> <p><b>Megger (Analog &amp; Digital) :</b> Its construction, working and uses.</p> <p><b>Earth Tester (Analog &amp; Digital) :</b> Its construction, working and uses.</p>	<p>Assemble/ Repair/Calibrate Analog and Digital Multimeter</p> <p>Assemble/ Repair/ Calibrate Analog and Digital Meggers of different Ranges and types</p> <p>Assemble/ Repair/ Calibrate Analog and Digital Earth Tester.</p>
10	<p><b>Tong tester (Analog and Digital):</b> Its construction, working and uses.</p> <p><b>Current Leakage tester :</b> Its construction, working and uses.</p> <p><b>CRO:</b> Its construction, working and uses.</p> <p><b>AC and DC supply source:</b> Its construction, working and uses.</p>	<p>Study and assemble of Tong tester (Analog and Digital) Study and assemble CRO</p> <p>Connect/assemble/calibrate Current Leakage tester</p> <p>Assemble and repair AC and Dc supply source.</p>
11	<p><b>Signal generator:</b> Its construction, working and uses. (k) Sources of error in instrument, their checking and remedies &amp; calibration. (l) Tri-vector meter (m) Synchroscope (n) Lux meter</p> <p><b>Power Analyser:</b> Its construction, working and uses.</p>	<p>Study and assembly of signal generator</p>
12	<p><b>Extension of meter range:</b> A. For D.C. Meter i. Using Shunt. ii. Using multiplier</p> <p>B. For A.C. Meter i. Using Current Transformer ii Using Potential Transformer.</p>	<p>Prepare/Replace a Shunt for extend the range of DC Ammeter. Prepare/Replace a multiplier for extend the range of DC voltmeter. To check the accuracy of different meters and rectify the error in DC and AC work</p>
13	<p><b>Current Transformer:</b> Its construction, working and uses.</p> <p><b>Potential Transformer:</b> Its construction, working and uses.</p> <p><b>Cable fault locator:</b> Its construction, working and uses.</p>	<p>Check and repair the current transformer. • Check and repair the Potential Transformer. • Prepare a current transformer to extend the range of AC Ammeter • Prepare a Potential transformer to extend the range of AC voltmeter.</p> <p>Practice of cable fault locator on cable for fault location.</p>
<b>Assessment/Examination 03days</b>		

### **7.1.3 EMPLOYABILITY SKILLS**

#### **GENERAL INFORMATION**

- 1) **Name of the subject** : **EMPLOYABILITY SKILLS**
- 2) **Applicability** : **ATS- Mandatory for fresher only**
- 3) **Hours of Instruction** : **110 Hrs. (55 hrs. in each block)**
- 4) **Examination** : **The examination will be held at the end of two years Training by NCVT.**
- 5) **Instructor Qualification** :

**i) MBA/BBA with two years experience or graduate in sociology/social welfare/Economics with two years experience and trained in Employability skill from DGET Institute.**

**And**

**Must have studied in English/Communication Skill and Basic Computer at 12<sup>th</sup> /diploma level**

**OR**

**ii) Existing Social Study Instructor duly trained in Employability Skill from DGET Institute.**

### 7.1.3.1 SYLLABUS OF EMPLOYABILITY SKILLS

#### A. Block – I Basic Training

Topic No.	Topic	Duration (in hours)
	<b>English Literacy</b>	<b>15</b>
<b>1</b>	<b>Pronunciation :</b> Accentuation (mode of pronunciation) on simple words, Diction (use of word and speech)	
<b>2</b>	<b>Functional Grammar</b> Transformation of sentences, Voice change, Change of tense, Spellings.	
<b>3</b>	<b>Reading</b> Reading and understanding simple sentences about self, work and environment	
<b>4</b>	<b>Writing</b> Construction of simple sentences Writing simple English	
<b>5</b>	<b>Speaking / Spoken English</b> Speaking with preparation on self, on family, on friends/ classmates, on know, picture reading gain confidence through role-playing and discussions on current happening job description, asking about someone's job habitual actions. Cardinal (fundamental) numbers ordinal numbers. Taking messages, passing messages on and filling in message forms Greeting and introductions office hospitality, Resumes or curriculum vita essential parts, letters of application reference to previous communication.	
	<b>I.T. Literacy</b>	<b>15</b>
<b>1</b>	<b>Basics of Computer</b> Introduction, Computer and its applications, Hardware and peripherals, Switching on-Starting and shutting down of computer.	
<b>2</b>	<b>Computer Operating System</b> Basics of Operating System, WINDOWS, The user interface of Windows OS, Create, Copy, Move and delete Files and Folders, Use of External memory like pen drive, CD, DVD etc, Use of Common applications.	
<b>3</b>	<b>Word processing and Worksheet</b> Basic operating of Word Processing, Creating, opening and closing Documents, use of shortcuts, Creating and Editing of Text, Formatting the Text, Insertion & creation of Tables. Printing document. Basics of Excel worksheet, understanding basic commands, creating simple worksheets, understanding sample worksheets, use of simple formulas and functions, Printing of simple excel sheets	
<b>4</b>	<b>Computer Networking and INTERNET</b> Basic of computer Networks (using real life examples), Definitions of Local Area Network (LAN), Wide Area Network (WAN), Internet, Concept of Internet (Network of Networks), Meaning of World Wide Web (WWW), Web Browser, Web Site, Web page and Search Engines. Accessing the Internet using Web Browser, Downloading and Printing Web Pages, Opening an email account and use of email. Social media sites	

	and its implication. Information Security and antivirus tools, Do's and Don'ts in Information Security, Awareness of IT - ACT, types of cyber crimes.	
	<b>Communication Skill</b>	<b>25</b>
<b>1</b>	<b>Introduction to Communication Skills</b> Communication and its importance Principles of Effective communication Types of communication - verbal, non verbal, written, email, talking on phone. Non verbal communication -characteristics, components-Para-language Body - language Barriers to communication and dealing with barriers. Handling nervousness/ discomfort. Case study/Exercise	
<b>2</b>	<b>Listening Skills</b> Listening-hearing and listening, effective listening, barriers to effective listening guidelines for effective listening. Triple- A Listening - Attitude, Attention & Adjustment. Active Listening Skills.	
<b>3</b>	<b>Motivational Training</b> Characteristics Essential to Achieving Success The Power of Positive Attitude Self awareness Importance of Commitment Ethics and Values Ways to Motivate Oneself Personal Goal setting and Employability Planning. Case study/Exercise	
<b>4</b>	<b>Facing Interviews</b> Manners, Etiquettes, Dress code for an interview Do's & Don'ts for an interview	
<b>5</b>	<b>Behavioral Skills</b> Organizational Behavior Problem Solving Confidence Building Attitude Decision making Case study/Exercise	

**B. Block– II**  
**Basic Training**

<b>Topic No.</b>	<b>Topic</b>	<b>Duration (in hours)</b>
	<b>Entrepreneurship skill</b>	<b>10</b>
1	<b>Concept of Entrepreneurship</b> <b>Entrepreneurship-</b> Entrepreneurship - Enterprises:-Conceptual issue Entrepreneurship vs. Management, Entrepreneurial motivation. Performance & Record, Role & Function of entrepreneurs in relation to the enterprise & relation to the economy, Source of business ideas, Entrepreneurial opportunities, The process of setting up a business.	
2	<b>Project Preparation &amp; Marketing analysis</b> Qualities of a good Entrepreneur, SWOT and Risk Analysis. Concept & application of Product Life Cycle (PLC), Sales & distribution Management. Different Between Small Scale & Large Scale Business, Market Survey, Method of marketing, Publicity and advertisement, Marketing Mix.	
3	<b>Institutions Support</b> Preparation of Project. Role of Various Schemes and Institutes for self-employment i.e. DIC, SIDA, SISI, NSIC, SIDO, Idea for financing/ non financing support agencies to familiarizes with the Policies /Programmes & procedure & the available scheme.	
4	<b>Investment Procurement</b> Project formation, Feasibility, Legal formalities i.e., Shop Act, Estimation & Costing, Investment procedure - Loan procurement - Banking Processes.	
	<b>Productivity</b>	<b>10</b>
1	<b>Productivity</b> Definition, Necessity, Meaning of GDP.	
2	<b>Affecting Factors</b> Skills, Working Aids, Automation, Environment, Motivation How improves or slows down.	
3	<b>Comparison with developed countries</b> Comparative productivity in developed countries (viz. Germany, Japan and Australia) in selected industries e.g. Manufacturing, Steel, Mining, Construction etc. Living standards of those countries, wages.	
4	<b>Personal Finance Management</b> Banking processes, Handling ATM, KYC registration, safe cash handling, Personal risk and Insurance.	
	<b>Occupational Safety, Health &amp; Environment Education</b>	<b>10</b>
1	<b>Safety &amp; Health</b> Introduction to Occupational Safety and Health importance of safety and health at workplace.	
2	<b>Occupational Hazards</b> Basic Hazards, Chemical Hazards, Vibro-acoustic Hazards, Mechanical Hazards, Electrical Hazards, Thermal Hazards. Occupational health, Occupational hygienic, Occupational Diseases/ Disorders & its prevention.	

3	<b>Accident &amp; safety</b> Basic principles for protective equipment. Accident Prevention techniques - control of accidents and safety measures.	
4	<b>First Aid</b> Care of injured & Sick at the workplaces, First-Aid & Transportation of sick person	
5	<b>Basic Provisions</b> Idea of basic provision legislation of India. of safety, health, welfare under legislation of India.	
6	<b>Ecosystem</b> Introduction to Environment. Relationship between Society and Environment, Ecosystem and Factors causing imbalance.	
7	<b>Pollution</b> Pollution and pollutants including liquid, gaseous, solid and hazardous waste.	
8	<b>Energy Conservation</b> Conservation of Energy, re-use and recycle.	
9	<b>Global warming</b> Global warming, climate change and Ozone layer depletion.	
10	<b>Ground Water</b> Hydrological cycle, ground and surface water, Conservation and Harvesting of water	
11	<b>Environment</b> Right attitude towards environment, Maintenance of in -house environment	
	<b>Labour Welfare Legislation</b>	<b>5</b>
1	<b>Welfare Acts</b> Benefits guaranteed under various acts- Factories Act, Apprenticeship Act, Employees State Insurance Act (ESI), Payment Wages Act, Employees Provident Fund Act, The Workmen's compensation Act.	
	<b>Quality Tools</b>	<b>5</b>
1	<b>Quality Consciousness :</b> Meaning of quality, Quality Characteristic	
2	<b>Quality Circles :</b> Definition, Advantage of small group activity, objectives of quality Circle, Roles and function of Quality Circles in Organization, Operation of Quality circle. Approaches to starting Quality Circles, Steps for continuation Quality Circles.	
3	<b>Quality Management System :</b> Idea of ISO 9000 and BIS systems and its importance in maintaining qualities.	
4	<b>House Keeping :</b> Purpose of Housekeeping, Practice of good Housekeeping.	
5	<b>Quality Tools</b> Basic quality tools with a few examples	
	<b>Leadership and Team Building skills</b>	<b>5</b>
	Leadership Discipline and Morale Team Work Case Study/ Exercise	
	<b>Meet the Mentor</b> <b>Role - play as a Supervisor</b>	<b>5</b>
	<b>Organizing and Planning.</b>	<b>5</b>
	Time Management Group Dynamics Case Study/ Exercise	

**7.2 PRACTICAL TRAINING (ON-JOB TRAINING)**  
**(BLOCK – I & II)**  
**DURATION: 18 MONTHS (9 months in each block)**

**GENERAL INFORMATION**

- 1) **Name of the Trade** : **MECHANIC ELECTRICAL INSTRUMENTS**
- 2) **Duration of On-Job Training** : As per Apprentices Act amended time to time.
- 3) **Batch size** : 20
- 4) **Examination** : i) The internal assessment will be held on completion of each block  
ii) NCVT exam will be conducted at the end of 2<sup>nd</sup> year.
- 5) **Instructor Qualification** :

i) Degree/Diploma in Electrical Engg. from recognized university/Board with one/two year post qualification experience respectively in the relevant field.

**OR**

ii) NTC/NAC in the trade of Electrician / BBBT and Advanced module in “Repair & Maintenance of Instruments used in Electrical Engg” / NAC in Mechanic-Electrical Instruments, with three year post qualification experience in the relevant field.

Preference will be given to a candidate with Craft Instructor Certificate (CIC)

- 6) **Tools, Equipments & Machinery required** : - As per Annexure – II

## 7.2.1 BROAD SKILL COMPONENT TO BE COVERED DURING ON-JOB TRAINING

### A. BLOCK – I (09 months)

1	Observe & practice safety pre-cautions to be followed in the section/plant including need of special protective equipment. Practice providing First Aid.
2	Identify & use all hand tools.
3	Check the gauges of wire & select suitable wires for the required current rating. Practice wire joints & providing cable glands. Soldering practice.
4	Carryout fitting & carpentry jobs.
5	Observe and understand various instruments used in industrial power system.
6	Connect & measure voltage, current, resistance power & energy in DC & AC(1ph & 3ph) circuits Use of power analyzer, measurement of THd, Harmonics due to digital switching.
7	Erection and mounting of electrical instruments.
8	Measure earth resistance, improve the same & maintain earth stations. Earth Monitoring systems with reference to various standards, familiarization with health monitoring equipment.
9	Providing power supply to motors, equipments & appliances. Crimping the lugs, providing cable glands & connections.
10	Attending to minor faults in machines, their controls & appliances.
11	Replacing the bulbs, tubes, trouble shooting, repair & maintenance
12	Assisting in operation & maintenance of Transformer substation, circuit breakers, batteries etc
13	Trouble shooting rectifiers, filters, power supplies, voltage stabilizers, controlled rectifiers. Identifying faulty thyristors in circuits, replacing them.
14	Provide light/socket points, for various equipments and appliances.
15	Decides the size of cable & provides power supply to machines & equipments, provide earth connections.
16	Connection of various instruments used in power system.

## B. BLOCK – II (09 months)

1.	To test and identify a defective Instrument
2.	To repair & maintain a testing Instrument
3.	To check the accuracy of Instruments.
4.	To extend the range of Instruments
5.	Dismantle, study their construction, assemble and testing of following analog & digital instrument. a) Voltmeter b) Ammeter c) Frequency meter d) Wattmeter e) Multimeter f) Energy meter g) Megger (insulation tester) h) Earth tester i) Surge tester j) Ratio meter k) Max. demand meter l) Tri-vector meter m) Oscilloscope n) Current transformer (C.T) o) Potential transformer (P.T.) p) Thermo couples
6.	Fault finding & trouble shooting of various types of analog & digital instrument.
7.	Maintenance of instrument according to schedule & maintain history sheet and log sheet.
8.	Inspection & testing of instrument.
9.	Calibration of various instruments.
10.	Method of data transfer from one meter to another meter.

## 7. ASSESSMENT STANDARD

### 8.1 Assessment Guideline:

Appropriate arrangements should be made to ensure that there will be no artificial barriers to assessment. The nature of special needs should be taken into account while undertaking assessment. Due consideration to be given while assessing for team work, avoidance/reduction of scrape/wastage and disposal of scarp/wastage as per procedure, behavioral attitude and regularity in training.

The following marking pattern to be adopted while assessing:

a) Weightage in the range of 60-75% to be allotted during assessment under following performance level:

For this grade, the candidate with occasional guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of an acceptable standard of craftsmanship.

In this work there is evidence of:

- good skill levels in the use of hand tools, machine tools and workshop equipment
- many tolerances while undertaking different work are in line with those demanded by the component/job.
- a fairly good level of neatness and consistency in the finish
- occasional support in completing the project/job.

b) Weightage in the range of above 75%- 90% to be allotted during assessment under following performance level:

For this grade, the candidate, with little guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of a reasonable standard of craftsmanship.

In this work there is evidence of:

- good skill levels in the use of hand tools, machine tools and workshop equipment
- the majority of tolerances while undertaking different work are in line with those demanded by the component/job.
- a good level of neatness and consistency in the finish
- little support in completing the project/job

c) Weightage in the range of above 90% to be allotted during assessment under following performance level:

For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship.

In this work there is evidence of:

- high skill levels in the use of hand tools, machine tools and workshop equipment
- tolerances while undertaking different work being substantially in line with those demanded by the component/job.
- a high level of neatness and consistency in the finish.
- minimal or no support in completing the project

## 8.2 FINAL ASSESSMENT- ALL INDIA TRADE TEST (SUMMATIVE ASSESSMENT)

SUBJECTS	Marks	Sessional Marks	Full Marks	Pass Marks	Duration of Exam.
Practical	300	100	400	240	<b>08 hrs.</b>
Trade Theory	100	20	120	48	3 hrs.
Workshop Cal. & Sc.	50	10	60	24	3 hrs.
Engineering Drawing	50	20	70	28	4 hrs.
Employability Skill	50		50	17	2 hrs.
<b>Grand Total</b>	<b>550</b>	<b>150</b>	<b>700</b>	<b>-</b>	

Note: - The candidate pass in each subject conducted under all India trade test.

## **8. FURTHER LEARNING PATHWAYS**

### **Employment opportunities:**

On successful completion of this course, the candidates shall be gainfully employed in the industries or self employed.

**TOOLS & EQUIPMENT FOR BASIC TRAINING****INFRASTRUCTURE FOR PROFESSIONAL SKILL & PROFESSIONAL  
KNOWLEDGE****TRADE: MECHANIC ELECTRICAL INSTRUMENT****LIST OF TOOLS & EQUIPMENTS FOR 20 APPRENTICES****A : TRAINEES TOOL KIT:-**

<b>Sl. No.</b>	<b>Item</b>	<b>Qty.</b>
1.	Measuring Tape Steel 100cm	21 Nos.
2.	Rule Steel 300mm	21 Nos.
3.	Screw Driver heavy duty 200mm insulated thick stem	21 Nos.
4.	Screw Driver heavy duty 250mm with insulated thick stem handle	21 Nos.
5.	Plier Insulated combination 200 mm	21 Nos.
6.	Knife double blade electrician 100mm	21 Nos.
7.	Pincer 150mm	21 Nos.
8.	Scriber 150mm x 4mm	21 Nos.
9.	Punch center 150mm x 8mm	21 Nos.
10.	Hammer ball peen 0.75kg with handle	21 Nos.
11.	Hammer cross peen 115gms with handle	21 Nos.
12.	Saw Tenon 250mm	21 Nos.
13.	Firmer chisel wood 12mm	21 Nos.
14.	Gimlet 6mm	21 Nos.
15.	Bradawl 100mm	21 Nos.
16.	Wire stripper 150 mm	21 Nos.
17.	Voltage sensor (pencil type) / Electronic Tester	21 Nos.
18.	Screw Driver Kit (Set of six blades with common insulated handle with neon tester)	21 Nos.
19.	Plier insulated 150 mm	21 Nos.
20.	Multimeter	21 Nos.
21.	Soldering iron, 25W, 230 V	21 Nos.

## B. General Tools & Equipment for Workshop

Sl. No.	Item	Qty.
1.	Screw Driver 100 mm with handle	10 Nos.
2.	Screw Driver 150 mm with insulated handle	10 Nos.
3.	Plier Gas 200 mm	10 Nos.
4.	Plier round nose 100 mm	10 Nos.
5.	Plier flat nose 150 mm	10 Nos.
6.	Side cutting plier 150mm.	10 Nos.
7.	Tweezer 100 mm	10 Nos.
8.	Scissor blade 150 mm	2 Nos.
9.	Blow lamp 1 pint capacity	5Nos.
10.	Melting pot	2 Nos.
11.	Soldering iron 65 watt ,125 watt, 250 watt	8 Nos. each
12.	Soldering gun/Desoldering gun	2 Nos.
13.	Chisel wood firmer 25 mm x 6mm	10 Nos.
14.	Chisel wood firmer 19 mm x 6 mm	10 Nos.
15.	Mallet hard wood 0.5 Kg.	10 Nos.
16.	Hammer hard plastic with handle	10 Nos.
17.	Spanner 150mm adjustable as clay burns	2 No.
18.	Drill machine hand 0 to 6mm capacity	10 Nos.
19.	Drill machine electric portable 0 to 6mm capacity	2 Nos.
20.	Drill machine pillar 0 to 12mm capacity	1 No.
21.	Allen Key	2 set.
22.	Oil cane 1/2 litre	4 Nos.
23.	Grease gun	2 Nos.
24.	Micrometer outside 0-25mm (Analog & Digital)	2 Nos.each
25.	Grinder Bench Motorised	1 No.
26.	Rawl plug tool and Bit	5 Nos.
27.	Hacksaw frame 300mm, 200mm	5 Nos each.
28.	Try square 150mm blade	10 Nos.
29.	Plum bob (Brass)	10 Nos
30.	Snip straight 200mm	5 Nos.
31.	Snip curved 150mm	5 Nos.
32.	Gauge wire ( Imperial )	4 Nos.
33.	File flat 200mm 2nd cut	8 Nos.
34.	File flat 250mm Bastard	8 Nos.
35.	File flat 250mm smooth	8 Nos.
36.	File round 200mm 2nd cut	4 Nos.
37.	File half round 2nd cut 200mm.	4 Nos.
38.	File round 100mm 2nd cut	4 Nos.
39.	File triangular 150mm	8 Nos.
40.	File flat 150mm rough	8 Nos.
41.	File Rasp, Half round 200mm Bastard	2 Nos.
42.	Vice hand 50mm jaw	5 Nos.

43.	Stock and die conduit ( for 1" to 2x1/4")	2 Nos.
44.	Vice table 150 mm jaw	4 Nos.
45.	Vice Pipe	2 Nos.
46.	Multimeter (Digital)	2 Nos.
47.	Ammeter MC 0 – 500 mA	4 Nos.
48.	Ammeter 0 –1 A	2 Nos.
49.	Ammeter M I , 0 – 1 A	1 No.
50.	Power factor meter single phase	2 Nos.
51.	Power factor meter three phase	1 No .each
52.	Energy meter 1KW DC	1 No.
53.	Tong tester ( 0 to 25 A, 0 – 50 A multi range )	2 Nos.
54.	Milli voltmeter center zero (100 – 0 – 100 mV)	2 Nos.
55.	Ammeter MC 0 – 25 A	2 Nos.
56.	Ammeter MC 0 – 5 – 10 – 15 A	2 Nos.
57.	Ammeter AC 0 – 25 A	2 Nos.
58.	Ammeter AC 0 – 5 – 10 – 15 A	2 Nos.
59.	Voltmeter DC 0 – 150 – 300 – 600 V	1 No.
60.	Voltmeter AC 0 – 150 – 300 – 600 range	2 Nos.
61.	Wheat stone Bridge (complete with galvanometer and Battery)	1 No.
62.	Meggar 500 ohm	2 Nos.
63.	Earth fault locater	2 Nos.
64.	Energy meter AC 5A 250V (Induction Type)	1 No.
65.	Energy meter 3 phase 4 wire 5 A (Induction Type)	2 Nos.
66.	Watt meter single phase 1 KW	2 Nos.
67.	Watt meter 3 phase 2 element 5A	2 set
68.	Crimping tool	2 Nos.
69.	B A taps and dies 0 – 2 – 4 – 6 – 8 sizes	4 Nos.
70.	Pipe cutter	1 No.
71.	Desoldering pump.	1 No.
72.	VAR meter 1 KVAR	2 Nos.
73.	Laboratory type induction coil 6V to 800 – 10000V	2 Nos.
74.	Magnetic flux meter	2 Nos.
75.	Fixed resistance 5 $\Omega$ 20 watt	2 Nos.
76.	Fixed resistance 10 $\Omega$ 20 watt	2 Nos.
77.	Fixed resistance 50 $\Omega$ 25 watt	2 Nos.
78.	Fixed resistance 100 $\Omega$ 100 watt	2 Nos.
79.	Fixed resistance 100 $\Omega$ 200 watt	2 Nos.
80.	Fixed resistance 500 $\Omega$ 200 watt	2 Nos
81.	Fixed resistance 1000 $\Omega$ 200 watt	2 Nos
82.	Rheostat 84 $\Omega$ 3. 5 watt	16 Nos.
83.	Rheostat 280 $\Omega$ 3.5 watt	16 Nos.
84.	Watt meter single phase, single element (Flush	16 Nos.
85.	mounting type) multi Range: 0-750-1500 Watt. rectangular shape.	16 Nos.
86.	Ammeter MI type, Rectangular shape, flush mounting,size106x84mm, multi range, 0-5-10 A.	6 Nos.
87.	Voltmeter MC type AC, Rectangular shape, flush mounting, size 106x	4 Nos.

	84mm, multi range, 0-150-300 V.	
88.	Auto Transformer, continuous variation, single phase, flush mounting type, 0- 270 V, 5 A.	2 Nos
89.	Transformer single phase 1KVA 230/ 115V 50 Hz core type, air cooled	4 Nos.
90.	Transformer three phase 2.5 KVA 400/ 230V 50 Hz delta and star oil cooled	2 Nos.
91.	Variable auto transformer 0 – 270V 5A -10A single phase	2 Nos. each
92.	Variable auto transformer 0 –440V 3 phase 5-10A U shape /Bar magnet	As reqd.
93.	Current transformer	4 Nos
94.	Potential Transformer	2Nos
95.	Portable Ammeter (Digital)	2 Nos.
96.	Portable Voltmeter (Digital)	2 Nos.
97.	Wattmeter 1kw single phase dynamometer type	2 Nos.
98.	Portable wattmeter 3 phase 3kw dynamometer type	2 Nos.
99.	Wattmeter induction type 1kw single phase	2 Nos.
100.	Portable Wattmeter digital type 1KW	2 Nos.
101.	Portable Frequency meter vibrating type	2 Nos.
102.	Portable Frequency meter digital	2 Nos.
103.	Portable Frequency meter electro dynamo type	2 Nos.
104.	Portable Power Factor meter 0.5-1-05 single phase electro- dynamic type	2 Nos.
105.	Portable Power Factor meter moving iron type	2 Nos.
106.	Portable Power Factor meter 400V, 3 phase	2 Nos.
107.	Portable Power Factor meter, single- phase digital	2 Nos.
108.	Portable VAR meter	2 Nos.
109.	Magnetic flux meter	2 Nos.
110.	Wattmeter electrolytic type	2 Nos.
111.	Energy meter 1phase 230V 5A induction type	2 Nos.
112.	Energy meter 3phase 400V 5A	2 Nos.
113.	Energy meter electronic type (Attraction type)	2 Nos.
114.	Energy meter solid state 1 phase	2 Nos.
115.	Energy meter solid state 3 phase	2 Nos.
116.	LCR Bridge	2 Nos.
117.	Meggar analog type 500V	2 Nos.
118.	Meggar Digital	2 Nos.
119.	Multimeter Digital and Analog.	2 Nos.
120.	Tong Tester	2 Nos.
121.	CRO	2 Nos.
122.	Signal Generator	4 Nos.

<b>Sl. No.</b>	<b>Workshop Furniture</b>	<b>Qty.</b>
1	Instructor table & chair	1 each
2	Suitable work tables with Vices	As required
3	Suitable Table Teak Wood fitted with Back Panel complete with different types of meters/switches, AC/DC supplies etc. required for testing of electronic circuits. Insulation mats to cover below the table.	As required
4	Revolving Stool cum chair	21nos.
5	Green Glass Board	1 no.
6	Metal Rack	As required
7	Locker with 8 drawers (standard size)	2 nos.
8	Storage Almirah	As required
9	Book shelf (Glass panel)	1 no.
10	Firefighting equipment, first aid box etc.	As required

**INFRASTRUCTURE FOR WORKSHOP CALCULATION & SCIENCE AND  
ENGINEERING DRAWING**

**TRADE: MECHANIC ELECTRICAL INSTRUMENT**

**LIST OF TOOLS & EQUIPMENTS FOR 20 APPRENTICES**

1) **Space Norms** : 45 Sq. m.(For Engineering Drawing)

2) **Infrastructure:**

**A : TRAINEES TOOL KIT:-**

<b>Sl. No.</b>	<b>Name of the items</b>	<b>Quantity (indicative)</b>
1.	Draughtsman drawing instrument box	20
2.	Set square celluloid 45 <sup>0</sup> (250 X 1.5 mm)	20
3.	Set square celluloid 30 <sup>0</sup> -60 <sup>0</sup> (250 X 1.5 mm)	20
4.	Mini drafter	20
5.	Drawing board (700mm x500 mm) IS: 1444	20

**B : FURNITURE REQUIRED**

<b>Sl. No.</b>	<b>Name of the items</b>	<b>Quantity (indicative)</b>
1	Drawing Board	20
2	Models : Solid & cut section	as required
3	Drawing Table for trainees	as required
4	Stool for trainees	as required
5	Cupboard (big)	01
6	White Board (size: 8ft. x 4ft.)	01
7	Trainer's Table	01
8	Trainer's Chair	01

**TOOLS & EQUIPMENT FOR ON-JOB TRAINING**

**INFRASTRUCTURE FOR PROFESSIONAL SKILLS & PROFESSIONAL  
KNOWLEDGE**

**TRADE: MECHANIC ELECTRICAL INSTRUMENT**

**For Batch of 20 APPRENTICES**

Actual training will depend on the existing facilities available in the establishments. However, the industry should ensure that the broad skills defined against On-Job Training part (i.e. 9 months + 9 months) are imparted. In case of any short fall the concern industry may impart the training in cluster mode/ any other industry/ at ITI.

**GUIDELINES FOR INSTRUCTORS AND PAPER SETTERS**

1. Due care to be taken for proper & inclusive delivery among the batch. Some of the following some method of delivery may be adopted:

- A) LECTURE
- B) LESSON
- C) DEMONSTRATION
- D) PRACTICE
- E) GROUP DISCUSSION
- F) DISCUSSION WITH PEER GROUP
- G) PROJECT WORK
- H) INDUSTRIAL VISIT

2. Maximum utilization of latest form of training viz., audio visual aids, integration of IT, etc. may be adopted.

3. The total hours to be devoted against each topic may be decided with due diligence to safety & with prioritizing transfer of required skills.