# CURRICULUM

## FOR THE TRADE OF

# Mechanic (HT, LT Equipments and Cable Jointing)

UNDER

## APPRENTICESHIP TRAINING SCHEME

सत्यमेव जयते
Government of India

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

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# 1. ACKNOWLEDGEMENT

The DGT sincerely express appreciation for the contribution of the Industry, State Directorate, Trade Experts and all others who contributed in revising the curriculum. Special acknowledgement is extended by DGT to the following expert members who had contributed immensely in this curriculum.

**Co-ordinator for the course:** BN Sridhar, Deputy Director, FTI, Bangalore

| Sl. No. | Name & Designation Sh./Mr./Ms. | Organization | Expert Group Designation |
|---|---|---|---|
| **1.** | Ketan Patel,<br>Deputy Director | RDAT, Mumbai | Expert member |
| **2.** | SCPandey,<br>Assistant Director, | RDAT, Kanpur | Expert member |
| **3.** | J R Mathur,<br>Training Officer | RDAT Kanpur | Expert member |

# 2. BACKGROUND

## 2.1 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.

## 2.2 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.

## 2.3 Reformation

The Apprentices Act, 1961 has been amended and brought into effect from 22$^{nd}$ 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-HT, LT Equipments and Cable Jointing** trade)

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.

Electric Power is the main source of our daily life activity and use of Electric Power is increasing everyday in the world. Electricity is being generated through various sources i.e. thermal, hydro, nuclear, solar etc. but its transmission, distribution and utilization is almost everywhere in the world. Consequently, trained man power is very much required at every level i.e. generation, transmission, distribution and utilization.

Whole electrical network is increasing every moment and making network more complex. To operate the complex network of Generation-Transmission-Distribution-Utilization, trained skilled man power is very much needed. Institutional study and theory is the base of understanding of this subject matter but on job training is necessary to make a person employable and capable on the work front.

In view of the above, to develop such type of skilled manpower; to meet the demand of the time and industry, person should be trained for the actual need i.e. he should be able to know the all major HT, LT equipments like motor, generator, substations, transmission through over head lines and underground cable. Fault finding of these machines, repairing and maintenance. DC machines are also a part of our industries and application, operation and repairing of those DC machine is also a part our technical activity. Use of Solar Energy is the future and skilled man power in this area will be in demand.

A large number of skilled workers coming out of technical institutes do not possess the required skills and are not readily employable. 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, the Apprenticeship Training approach with the revised, industrial friendly curriculum is required.

# 4. JOB ROLES: REFERENCE NCO

## Brief description of Job roles:

- Read and interpret the blue print reading ( Electrical layout Drawing as per BIS specification & standards)
- Carryout Installation, maintenance & repair works of Electrical AC/ DC machinery, lighting circuits and equipments used in industries (HT/LT).
- Practice on using fitting carpentry and sheet metal tools.
- Use of electrical instrument(analog/digital) like voltmeter, Ammeter, Wattmeter, Energy Meter, Wheatstone bridge, oscilloscope, Earth tester, Tong tester, Megger etc to measure to different electrical quantities.
- Carry out Wiring & Earthing System.
- Carried out break down, over hauling, routine & preventive maintenance of electrical machines and equipments.
- Operate, maintain and test the switch gears, circuit breakers, relays and transformer.
- Underground cable joining, testing & trouble shooting.
- High voltage safety equipment and safe working procedures with respect to HT&EHT and associated earthing system.
- Working of LT and HT Switch- gears and protective relays.
- Monitoring system for power generation, transmission and utilization including fault repairing.
- Principle of working of hydraulic & Pneumatic components and circuit.
- Substation operation and maintenance (HT/LT). Exposure about EHT under supervision and control.
- Quality Control tools and systems practiced in the modern industry.

**Reference NCO-2004: 7241.90, 7245.90**

# 5. GENERAL INFORMATION

1. **Name of the Trade** **: Mechanic (HT, LT Equipments and Cable Jointing)**

2. **N.C.O. Code No. (**NCO-2004) : **7241.90, 7245.90**

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

**3.1 For Fresher: -** 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 10th 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 CTS-ELECTRICIAN trade and **One year rebate** for trainees completed Broad Based Basic Training and Advanced module in "**Operation & Maintenance of Equipments used in HT, LT, Substation & Cable Jointing"** in Electrical Sector under Centre of Excellence Scheme. 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.*

# 6. COURSE STRUCTURE

**Training duration details: -**

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

| 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 |
| **Basic Training Block - I** | | | | | | | | | | | | | | | | | | | | | | | | |
| **Practical Training Block - I** | | | | | | | | | | | | | | | | | | | | | | | | |
| **Basic Training Block - II** | | | | | | | | | | | | | | | | | | | | | | | | |
| **Practical Training Block - II** | | | | | | | | | | | | | | | | | | | | | | | | |

# 7. SYLLABUS

## 7.1 BASIC TRAINING
## (BLOCK – I & II)
## DURATION: 06 MONTHS

### GENERAL INFORMATION

1) **Name of the Trade** : **Mechanic (HT, LT Equipments and Cable Jointing)**
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 Square meter (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 Egg. 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 "Operation & Maintenance of **Equipments used in HT, LT, Substation & Cable Jointing**" in CoE Electrical Sector / NAC in "Mechanic- **HT, LT Equipments and Cable Jointing"** 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 | **Engineering Drawing: Introduction and its importance**<br>- Viewing of engineering drawing sheets.<br>Method of Folding of printed Drawing Sheet as per BIS SP:46-2003<br>**Drawing Instruments** : their Standard and uses<br>- 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. | **30** | **Unit**: Systems of unit- FPS, CGS, MKS/SI unit, unit of length, Mass and time, Conversion of units. | **20** |
| 2 | **Lines :**<br>- Definition, types and applications in Drawing as per BIS SP:46-2003<br>- Classification of lines (Hidden, centre, construction, Extension, Dimension, Section)<br>- Drawing lines of given length (Straight, curved)<br>- Drawing of parallel lines, perpendicular line<br>- Methods of Division of line segment | | **Fractions & Simplification**: Fractions, Decimal fraction, Multiplication and Division of Fractions and Decimals, conversion of Fraction to Decimal and vice versa. Simple problems<br>Simplification using BODMAS. | |

| | | | | |
|---|---|---|---|---|
| 3 | **Drawing of Geometrical Figures**: Definition, nomenclature and practice of -<br>- Angle: Measurement and its types, method of bisecting.<br>- Triangle -different types<br>- Rectangle, Square, Rhombus, Parallelogram.<br>- Circle and its elements. | | **Square Root** : Square and Square Root, method of finding out square roots, Simple problem using calculator | |
| 4 | **Lettering and Numbering** as per BIS SP46-2003:<br>- Single Stroke, Double Stroke, inclined, Upper case and Lower case. | | **Ratio &Proportion:** Simple calculation on related problems. | |
| 5 | **Free Hand sketch:** Hand tools and measuring instruments used in electronics mechanics trades | | **Percentage:** Introduction, Simple calculation. Changing percentage to decimal and fraction and vice-versa. | |
| 6 | **Free hand drawing :**<br>- Lines, polygons, ellipse, etc.<br>-Geometrical figures and blocks with dimension .<br>- Transferring measurement from the given object to the free hand sketches. | | **Material Science** : properties -Physical & Mechanical, Types –Ferrous & 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. | |

## B. Block- II
## Basic Training

| Topic No. | a) Engineering Drawing | Duration (in hours) | b) Workshop Science & Calculation | Duration (in hours) |
|---|---|---|---|---|
| 1 | **Symbolic Representation** (as per BIS SP:46-2003) of :<br>- Fastener (Rivets, Bolts and Nuts)<br>- Bars and profile sections<br>- Weld, brazed and soldered joints.<br>- Electrical and electronics element<br>- Piping joints and fittings | 30 | **Mass ,Weight and Density** : Mass, Unit of Mass, Weight, difference between mass and weight, Density, unit of density, specific gravity of metals | 20 |
| 2 | **Construction of Scales and diagonal scale** | | **Work, Power and Energy**: 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 | **Three phase Induction motor**<br><br>Free hand sketching of Slip-ring and Squirrel cage Induction motor.<br>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.<br>Drawing the schematic diagram of A.C. motor speed control by SCR /AC Drive. | | **Algebra:** Addition, subtraction, Multiplication, Division, Algebraic formula, Linear equations (with two variables). | |
| 5 | **Distribution of Power**<br>Types of insulator used in over head line. (Half sectional views)<br>Different type of distribution systems and methods of connections.<br>Layout diagram of a substation.<br>Single line diagram of substation feeders. | | **Mensuration:** Area and perimeter of square, rectangle, parallelogram, triangle, circle, semi circle.<br>Volume of solids – cube, cuboid, cylinder and Sphere.<br>Surface area of solids – cube, cuboid, cylinder and Sphere. | |

## 7.1.2 DETAIL SYLLABUS OF PROFESSIONAL SKILLS & PROFESSIONAL KNOWLEDGE

### A. Block –I
### Basic Training

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

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| | identification of types of cables. Demonstration & practice on using standard wire gauge & micrometer. | |
| 4 | Verification of Ohm's Law, Measuring unknown resistance Verification of laws of series and parallel circuits. Experiment on poly phase circuits. Current, voltage, power and power factor measurement in single & poly-phase circuits. Measurement of energy in single and poly-phase circuits. - Use of phase sequence meter. Practice on three phase four wire system for understanding phase and line voltage & current. | **Ohm's Law** -<br>Simple electrical circuits and problems.<br>Reading of simple Electrical Layout. **Resistors -**Law of Resistance. Series and parallel circuits & related calculation.<br>**Alternating Current -**Comparison and Advantages D.C and A.C. Related terms<br>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).<br>Active and Reactive power. Single Phase and three-phase system etc. 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. |
| 5 | Demonstration of trade hand tools. Use, care & maintenance of various hand tools. Practice on installation and overhauling common electrical accessories as per simple Electrical circuit / Layout.<br>Make test board. | Identification of Trade-Hand tools-Specifications<br>Common Electrical Accessories, their specifications in line with NEC 2011-Explanation of switches lamp holders, plugs and sockets. Developments of domestic circuits, Alarm & switches, with individual switches, Two way switch .Security surveillance, Fire alarm, MCB, ELCB, MCCB. Series –parallel testing board & use. |
| 6 | 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 & maintenance of Batteries | **Chemical** effect of electric current-Principle of electrolysis. Faraday's Law of electrolysis. Lead acid cell-description, methods of charging-Precautions to be taken & testing equipment. Different types of lead acid cells. Sealed Maintenance free Batteries, Solar battery. Load & back up time calculation |
| 7 | **Practice on Earthing**-different methods of earthing.<br>Measurement of Earth resistance by earth tester. Testing of Earth Leakage by ELCB and relay. | **Earthing**- Principle of different methods of earthing & selection. i.e. Pipe, Plate, etc. Importance of Earthing. Improving of earth resistance. Earth Leakage circuit breaker (ELCB). |

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| 8 | **Diodes**-symbol - Tests - Construct & Test Half wave rectifier circuit. Full wave rectifier circuit. Bridge rectifier circuit. Measurement & calculation of electrical parameters using C.R.O. Different wave shapes of rectifiers and their values using C.R.O. Identification of terminals, construction & Testing of transistor. Operation, maintenance & troubleshooting of inverter, Voltage stabilizer, DC regulated power supply, UPS, etc | **Basic electronics**- 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 & its application. Specification and rating of transistors. |
| 9 | Practice in casing, Capping and Conduit wiring. Testing of wiring installation by meggar. Fixing of calling bells/buzzers. Identification & demonstration on conduits and accessories & their uses, cutting , threading & laying Installation, Testing, Maintenance and Repairing of wiring. Application of fuses, relay, MCB, ELCB. | **Electric wirings**, I.E. rules. Types & selection of wirings both domestic and industrial. Specifications for wiring. Grading of cables and current ratings. Principle of laying out in domestic wiring. Estimate the cost of wiring system. Voltage drop concept. **Wiring system -** P.V.C., concealed system. Specifications, standards for conduits and accessories,- Power Wiring,- Control Wiring Information Communication,- Entertainment Wiring. Testing of wiring installation by meggar Study of Fuses, Relays, Miniature circuit breakers (MCB), ELCB, etc. |
| 10-11 | Prepare simple electromagnet and find the polarity Identification of the parts of a D.C. machine. No load & Load performance of a different type of DC generator. Calculation of regulation & efficiency. Connect, start, run and reverse a different type of DC motor. Load performance test on different type of DC motor& calculation of efficiency. Speed of a DC motor by different method. Maintenance, troubleshooting & servicing of DC machines. Overhaul a DC machine. | **D.C. Machines –Magnetism**- classification of magnets, methods of magnetizing, magnetic material.<br><br>**Electromagnetism-** Solenoid, field around conductors carrying current, polarity, screw-rule, right- hand grip rule, advantages and application of electromagnet. General concept of Electrical Machines.<br>**Principle of D.C. generator.** Use of Armature, Field Coil, Polarity, Yoke, Cooling Fan, Commutator, slip ring Brushes, Laminated core. Explanation of **D.C. Generators**- 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 & preventive maintenance. |

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| 12 | Identification of types of transformers. Connection of transformers, Transformation ratio, testing of transformer, calculate the losses & efficiency. Use of Current Transformer (CT) and Potential (Voltage) transformer (PT). Testing of single phase and Three Phase Transformers - Cleaning, maintenance, testing and changing of oil. | Working principle of **Transformer,** losses & efficiency.<br>classification C.T., P.T. Instrument and<br>Auto Transformer(Variac), Construction,<br>Single phase and Poly phase.<br>Type of Cooling for transformer.<br>Protective devices.<br>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.<br>Bushings and termination. |
| 13 | Identify & select different type of Instruments. Use of **-P**MMC , MI meter, Multi-meter(Digital/Analog) , Wattmeter, P F meter, Energy meter, Frequency meter, Phase sequence meter, Digital Instruments, etc. Range extension of meters. | **Electrical Measuring Instruments -**<br>-types, indicating types<br>PMMC & MI meter (Ammeter, Voltmeter)<br>-Range extension<br>-Multimeter (Digital/Analog)<br>-Wattmeter<br>- P.F. meter<br>- Energy meter (Digital/analog)<br>–Insulation Tester (Megger), Earth tester.<br>-Frequency meter<br>-Phase Sequence meter<br>-Multimeter –Analog and Digital<br>-Tong tester<br>-Techometer. |
| | **Assessment/Examination 03days** | |

## B. Block –II
## Basic Training

| Week No. | Professional Skills | Professional Knowledge |
|---|---|---|
| 1-5 | Prepare layout plan, single line diagram of different type of power plant. Schematic of an overhead and domestic service line. Prepare layout plan and single line diagram of transmission /Distribution system. Trouble shooting and servicing of LT lines and circuit breaker. Connect feeder cable/ service line to the bus bar. Mounting and un-mounting of line insulator for various type of lines. Precautions and special attention before HT line work.<br><br>Test the underground cables for open, short circuit & ground fault and also check insulation resistance. Skinning and dressing of cables. Straight joint of different types of underground cables. Test /check the insulation resistance of cables by using megger. Locating the faults (open circuit, short circuit & leakage) in cables.<br><br>Understanding different relays and their connection. Connection and operation of overload, under voltage relays used to protect HT and LT sub-station. Practice on faults protection system for AC, DC equipments (motors and | **POWER GENERATION & TRANSMISSION :**<br><br>Generation sources of energy, Comparison of energy resources. Types of fuels. Advantages of liquid fuel & solid fuel. Various ways of electrical power generation. • Thermal • Hydro electric • Nuclear • Non-Conventional.<br><br>**Overhead Lines:**<br><br>Main components of overhead lines. Types of power line-Low, Medium, High and Extra High Voltage lines. Conductors and Insulators for different types of OHTL, line supports, Insulators, types of Insulators and their applications. Line parameter ( Resistance, Capacitance, inductance and Impedance)<br><br>**DISTRIBUTION OF POWER:** HT and LT Sub-stations and associated equipment used in sub-station. Classification of distribution system-AC distribution, Overhead v/s underground distribution system. DC transmission system including HVDC. Essential features of switchgears. Isolator, Switch gear equipments, bus-bar arrangement, classified faults in power system and their maintenance. Introduction to Grid.<br><br>**Under Ground Cable:** Construction of cables. Types of cables and their applications. Material for cables and its insulation. Laying and maintenance of cables. Cable jointing, purpose of cable joints and techniques of joints & Faults in underground line & overhead lines and methods of their rectification.<br><br>**HT and LT sub-stations:** structure of Sub-stations for HT, LT and EHT and associated systems for operation and maintenance. Sub-station equipments. |

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| | generators). Test /Check different type of protection relay. | **Circuit breakers** – Introduction & Classification of circuit breakers. Application, installation and maintenance of different type of CB. Horn Gap Switches, Disconnect Switches, Grounding Switches,<br><br>**Different Types of relay and protection systems:** Protection systems for HT and LT transmission and distribution networks including Sub-Stations (over head and underground). Protection of AC and DC machines. Special Protection System for Alternators connected to Grid and HT/EHT Power cables. |
| 6 | Identification of parts and terminals of Alternator. Connection, starting, running of Alternator. Practice on alternators, voltage Building, Parallel operation & load sharing. Practice on installation, running and maintenance of Alternators. | **Alternator:** Study of alternator, working principle, Installation, voltage build-up, loading, Regulation. Types of prime mover, phase sequence, Parallel operation & load sharing. Specification of alternators, faults and repairing. |
| 7-8 | Identification of parts and terminals of AC motors.<br>Connection, starting, running of AC motors using Starters. Load test & efficiency calculation.<br>Rotor resistance starter, etc.<br>Speed control of Induction motors by various methods.<br>Practical application of A.C. motors. Connection of single phase motor, identification, testing, running and reversing. Troubleshooting, Maintenance, service of single phase motor. Install a single phase motor. Overhauling of 5HP and FHP AC motors. | **Three phase Induction motor:**<br>Construction and working principle –Production of rotating magnetic field, Squirrel Cage Induction motor, Slip-ring induction motor. Control & Power circuit of starters. D.O.L Starter, Forward /Reverse starter, Star /Delta starter, Autotransformer starter, Rotor resistance starter, etc. Single phasing preventer.<br>Application of Induction Motor, Care, Routine & preventive maintenance. Efficiency.<br>**Single phase induction motor-**<br>Working principle, different method of starting and running (capacitor start, permanent capacitor, capacitor start & run, shaded pole technique).<br>FHP motors, Repulsion motor, stepper motor, Application of single phase motor. |
| 9 | Connect, start and run a 3 phase synchronous motor. Practice for Power factor correction. | **SYNCHRONOUS MOTOR -**<br>Construction and working principle, effect of change of excitation and load. Power factor correction of industrial load and other applications. |
| 10 | Brief listing of equipments used for HT and LT systems for whole chain of Generation – Transmission-Distribution- | Briefing of all components, equipments and machines and their protective systems associated from Generation –Transmission-Distribution-Utilization of electric power. Briefing on energy |

| | | |
|---|---|---|
| | Utilization of electric power. Briefing on energy saving machines-star rating. | saving machines-star rating. |
| 11 | Special note and practice before working on HT systems. | **HT System:** Danger and risk associated with HT and EHT line, machines and systems and remedial measures. |
| 12 | Practices on assembly, repair and maintenance of solar power systems. | Introduction of solar energy, Its Importance, usages and limitations. Familiarization of 1 KW solar power plant. |
| | Assessment/ Examination 03 days | |

# 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 12th /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) |
|---|---|---|
| | **English Literacy** | **15** |
| **1** | **Pronunciation :**<br>Accentuation (mode of pronunciation) on simple words, Diction (use of word and speech) | |
| **2** | **Functional Grammar**<br>Transformation of sentences, Voice change, Change of tense, Spellings. | |
| **3** | **Reading**<br>Reading and understanding simple sentences about self, work and environment | |
| **4** | **Writing**<br>Construction of simple sentences Writing simple English | |
| **5** | **Speaking / Spoken English**<br>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. | |
| | **I.T. Literacy** | **15** |
| **1** | **Basics of Computer**<br>Introduction, Computer and its applications, Hardware and peripherals, Switching on-Starting and shutting down of computer. | |
| **2** | **Computer Operating System**<br>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. | |
| **3** | **Word processing and Worksheet**<br>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.<br>Basics of Excel worksheet, understanding basic commands, creating simple worksheets, understanding sample worksheets, use of simple formulas and functions, Printing of simple excel sheets | |
| **4** | **Computer Networking and INTERNET**<br>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),<br>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.<br>Information Security and antivirus tools, Do's and Don'ts in<br>Information Security, Awareness of IT - ACT, types of cyber crimes. | |
| | **Communication Skill** | **25** |
| **1** | **Introduction to Communication Skills**<br>Communication and its importance.<br>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. | |
| **2** | **Listening Skills**<br>Listening-hearing and listening, effective listening, barriers to effective listening guidelines for effective listening.<br>Triple- A Listening - Attitude, Attention & Adjustment.<br>Active Listening Skills. | |
| **3** | **Motivational Training**<br>Characteristics Essential to Achieving Success<br>The Power of Positive Attitude. Self awareness. Importance of Commitment. Ethics and Values. Ways to Motivate Oneself<br>Personal Goal setting and Employability Planning. Case study/Exercise | |
| **4** | **Facing Interviews**<br>Manners, Etiquettes, Dress code for an interview<br>Do's & Don'ts for an interview | |
| **5** | **Behavioral Skills**<br>Organizational Behavior. Problem Solving. Confidence Building<br>Attitude. Decision making. Case study/Exercise | |

## B. Block– II
## Basic Training

| Topic No. | Topic | Duration (in hours) |
|---|---|---|
| | **Entrepreneurship skill** | **10** |
| 1 | **Concept of Entrepreneurship**<br>**Entrepreneurship**- 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 | **Project Preparation & Marketing analysis**<br>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 | **Institutions Support**<br>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 /Programme & procedure & the available scheme. | |
| 4 | **Investment Procurement**<br>Project formation, Feasibility, Legal formalities i.e., Shop Act, Estimation & Costing, Investment procedure - Loan procurement - Banking Processes. | |
| | **Productivity** | **10** |
| 1 | **Productivity**<br>Definition, Necessity, Meaning of GDP. | |
| 2 | **Affecting Factors**<br>Skills, Working Aids, Automation, Environment, Motivation<br>How improves or slows down. | |
| 3 | **Comparison with developed countries**<br>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 | **Personal Finance Management**<br>Banking processes, Handling ATM, KYC registration, safe cash handling, Personal risk and Insurance. | |
| | **Occupational Safety, Health & Environment Education** | **10** |
| 1 | **Safety & Health**<br>Introduction to Occupational Safety and Health importance of safety and health at workplace. | |

| | | |
|---|---|---|
| 2 | **Occupational Hazards**<br>Basic Hazards, Chemical Hazards, Vibro-acoustic Hazards, Mechanical Hazards, Electrical Hazards, Thermal Hazards. Occupational health, Occupational hygienic, Occupational Diseases/ Disorders & its prevention. | |
| 3 | **Accident & safety**<br>Basic principles for protective equipment.<br>Accident Prevention techniques - control of accidents and safety measures. | |
| 4 | **First Aid**<br>Care of injured & Sick at the workplaces, First-Aid & Transportation of sick person | |
| 5 | **Basic Provisions**<br>Idea of basic provision legislation of India.<br>of safety, health, welfare under legislation of India. | |
| 6 | **Ecosystem**<br>Introduction to Environment. Relationship between Society and Environment, Ecosystem and Factors causing imbalance. | |
| 7 | **Pollution**<br>Pollution and pollutants including liquid, gaseous, solid and hazardous waste. | |
| 8 | **Energy Conservation**<br>Conservation of Energy, re-use and recycle. | |
| 9 | **Global warming**<br>Global warming, climate change and Ozone layer depletion. | |
| 10 | **Ground Water**<br>Hydrological cycle, ground and surface water, Conservation and Harvesting of water | |
| 11 | **Environment**<br>Right attitude towards environment, Maintenance of in -house environment | |
| | **Labour Welfare Legislation** | **5** |
| 1 | **Welfare Acts**<br>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. | |
| | **Quality Tools** | **5** |
| 1 | **Quality Consciousness :**<br>Meaning of quality, Quality Characteristic | |
| 2 | **Quality Circles :**<br>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 | **Quality Management System :**<br>Idea of ISO 9000 and BIS systems and its importance in maintaining qualities. | |
| 4 | **House Keeping :**<br>Purpose of Housekeeping, Practice of good Housekeeping. | |
| 5 | **Quality Tools**<br>Basic quality tools with a few examples | |
| | **Leadership and Team Building skills** | **5** |
| | Leadership<br>Discipline and Morale | |

| | | |
|---|---|---|
| | Team Work<br>Case Study/ Exercise | |
| | **Meet the Mentor**<br>**Role - play as a Supervisor** | **5** |
| | **Organizing and Planning.** | **5** |
| | Time Management<br>Group Dynamics<br>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 (HT, LT Equipment and Cable Jointing)**
2) **Duration of On-Job Training** : As per Apprenticeship 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 2nd year.
5) **Instructor Qualification** :

**i)** Degree/Diploma in Electrical Egg. 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 "Operation & Maintenance of **Equipments used in HT, LT, Substation & Cable Jointing**" in CoE Electrical Sector / NAC in "Mechanic- **HT, LT Equipments and Cable Jointing"** 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)

| Week No. | Professional Skills |
|---|---|
| 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 | Connect & measure voltage, current, resistance power & energy in DC & AC(1ph & 3ph) circuits<br>Use of power analyzer, measurement of THd, Harmonics due to digital switching. |
| 6 | Electrical wiring: Repair / replace switches, sockets, light points. Provide new points in PVC casing capping & PVC conduits. |
| 7 | Charging & maintenance of different type of Batteries. Checking specific gravity, voltage, condition monitoring of Battery Bank, assessment of high spots, on line isolation precautions etc. |
| 8 | Install pipe & plate earth stations. 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. Wire up in PVC casing & capping. |
| 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 | Testing the condition of DC motor Checking power input & output in DC drives. Replacing faulty components. |
| | **Project Work** |
| | **REVISION** |
| | **Examination** |

## B. BLOCK – II (09 months)

| Week No. | Professional Skills |
|---|---|
| 1 | Observe & practice safety pre-cautions to be followed in the section/plant including need of special protective equipment. Practice providing First Aid. |
| 2 | Checking Electrical connections, locating faults and removal of faults in HT and LT Sub-stations. Operation & maintenance of Sub-stations, DG Sets, Air Compressor, AC plants, cranes, lifts, hoists etc. familiarization with hydro/thermal/nuclear power plant. Solar Power generation, utilization, fitting of solar panels and associated components for One KW solar power station. |
| 3 | Diesel Generating set: Operation, operating switch gears, trouble shooting & maintenance Protective system for Generator. Care and maintenance of transmission and distribution stations/sub-stations. Application and fitting of different type insulators. |
| 4 | Operation of Control Room, Sub-Stations and load dispatch centers for load, fault and emergency managements. Communication with different field nodes/stations<br>Operation and maintenance of Switchgear in switch yard.<br>Reading of panel meter & filling log sheet. Underground cable joining,<br>Testing of underground cables, trouble shooting, Locating faults, open circuit, short circuit & leakage in cables, performing cable joints. |
| 5 | Working of LT and HT Switch- gears and protective relays.<br>Maintenance of transformer equipment such as: Oil gauge, Tap Changer, Bushes, Breather, Earth fault relay, Protective relay, etc.<br>Installation operation and maintenance of oil circuit breaker, Air circuit breaker, SF6 circuit breaker, Vacuum circuit breaker, etc. Exposure of protective systems on HT and EHT systems. |
| 6 | Connection and running of alternator. Loading of alternators with different type of loads and measure voltage regulation. Practice of parallel operation. Exposure of faults and repairing. |
| 7 | Connection of single phase and three phase induction motors. Running of different capacity induction motors with the DOL and reduced voltage starters.<br>Dismantling of single phase and three phase motors and testing of stator and rotors. Winding of stators. Fault finding in induction machines and their repairing. |
| 8 | Understanding operation and maintenance of Synchronous motors. Running a synchronous motor. Power factor correction with Synchronous motors. |
| 9 | Demonstration and electrical energy flow of Generation-Transmission-Distribution-Utilization chain of the power supply. |
| 10 | Danger and risk management including protective devices used in HT, LT power supply system and machines. Practice of management of emergency abnormal situations due to different Electrical machines and systems. |
| 11 | Knowledge of Quality assurance required in Electrical works. Energy saving concept and star rating of machines/equipments. |

| | |
|---|---|
| 12 | Renewable and Green energy – Generation and utilization-technology awareness. |
| | **Project Work** |
| | **REVISION** |
| | **Examination** |

# 8. 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 above75%- 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 | **08 hrs.** |
| 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. |
| **Grand Total** | **550** | **150** | **700** | **-** | |

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

# 9. FURTHER LEARNING PATHWAYS

**Employment opportunities:**

On successful completion of this course, the candidates shall be gainfully employed in the following industries:

1. Power generating, transmission & distribution industries.
2. Manufacturing & Infrastructure Company.
3. Private industries in India & abroad.
4. Self employment.

**ANNEXURE – I**

# TOOLS & EQUIPMENT FOR BASIC TRAINING

## INFRASTRUCTURE FOR PROFESSIONAL SKILL & PROFESSIONAL KNOWLEDGE

**TRADE:** Mechanic (HT, LT Equipment and Cable Jointing)

## LIST OF TOOLS & EQUIPMENTS FOR 20 APPRENTICES

## A : TRAINEES TOOL KIT:-

| Sl. No. | Name of the items | Quantity |
|---|---|---|
| 1 | Steel rule , 150 mm | 21 nos. |
| 2 | Pliers insulated 150 mm | 21 nos. |
| 3 | Pliers side cutting 150 mm | 21 nos. |
| 4 | Screw driver 100 mm | 21 nos. |
| 5 | Screw driver 150 mm | 21 nos. |
| 6 | Electrician connector, screw driver 100 mm insulated handle thin stem | 21 nos. |
| 7 | Heavy duty screw driver 200 mm | 21 nos. |
| 8 | Electrician screw driver 250 mm thin stem insulated handle | 21 nos. |
| 9 | Punch centre 150 mm X 9 mm | 21 nos. |
| 10 | Double bladed electrician knife | 21 nos. |
| 11 | Neon Tester | 21 nos. |
| 12 | Rule steel 300 mm | 21 nos. |
| 13 | Saw tenon 250 mm | 21 nos. |
| 14 | Hammer, cross peen 115 grams with handle | 21 nos. |
| 15 | Hammer ball peen 0.75 kg. With handle | 21 nos. |
| 16 | Firmer chisel wood 12 mm | 21 nos. |
| 17 | Gimlet 6 mm. | 21 nos. |
| 18 | Bradwal | 21 nos. |
| 19 | Scriber 150 mm X Ø 4 mm (Knurled centre position ) | 21 nos. |
| 20 | Pincer 150 mm | 21 nos. |

## B: TOOLS INSTRUMENTS AND GENERAL SHOP OUTFITS

| Sl. No. | Name of the items | Quantity (Indicative) |
|---|---|---|
| 1 | C- clamp, 100mm, 150mm, 200mm | 2 Nos. each |
| 2 | Adjustable spanner, 150mm, 300mm | 2 Nos. each |
| 3 | Blow lamp, 0.5 ltr | 1 |
| 4 | Melting pot | 1 |
| 5 | Ladel | 1 |
| 6 | Chisel cold firmer, 25mm x 200 mm | 2 |
| 7 | Chisel 25mm & 6 mm | 2 Nos. each |
| 8 | Hand drill machine 0 to 6 mm capacity | 2 |
| 9 | Portable electric drill machine, 12 mm capacity | 1 |
| 10 | Pillar Electric Drill machine, 12 mm capacity | 1 |
| 11 | Allen key set | 2 sets |
| 12 | Oil can 0.12 ltr | 1 |
| 13 | Grease gun | 1 |
| 14 | Out side Micrometer 0 to 25 mm | 2 |
| 15 | Motorised Bench grinder | 1 |
| 16 | Rawl plug tool & bit | 2 sets |
| 17 | Pulley puller | 2 |
| 18 | Bearing puller | 2 |
| 19 | Pliers Gas 150 mm | 2 |
| 20 | Thermo meter 0-100 deg C | 1 |
| 21 | Scissors blade 150mm | 2 |
| 22 | Crimping tool | 2 sets |
| 23 | Wire stripper 20 Cm | 2 |
| 24 | Chissel cold flat 12mm | 2 |
| 25 | Mallet hard wood 0.5Kg | 2 |
| 26 | Drill hand brace 0 to 100 mm | 1 |
| 27 | Drill S.S. Twist block 2 mm, 5 mm 6 mm | 3 sets |
| 28 | Hacksaw frame, 200mm & 300mm adjustable | 2 each |
| 29 | Try square, 150 mm blade | 2 |
| 30 | Outside & inside divider caliper 150 mm | 2 each |
| 31 | Pliers flat nose 150mm | 4 |
| 32 | Pliers round nose, 100 mm | 4 |
| 33 | Tweezers, 100mm | 4 |
| 34 | Snip straight & bent, 150mm | 2 each |
| 35 | Double ended spanner set metric | 2 sets |
| 36 | Vice Hand 150 mm jaw | 2 |
| 37 | Plane, smoothing cutters 50mm | 2 |
| 38 | Gauge, wire imperial | 2 |
| 39 | File, flat 200mm 2nd cut | 8 |
| 40 | File half round 200 mm 2nd cut | 4 |

| | | |
|---|---|---|
| 41 | File round 200mm 2nd cut | 4 |
| 42 | File flat 150mm rough | 4 |
| 43 | File flat 250mm bastard | 4 |
| 44 | File flat 250mm smooth | 4 |
| 45 | File Rasp half round 200 mm bastard | 4 |
| 46 | Soldering iron, 25 W, 65 W, 125 W | 2 each |
| 47 | Copper bit soldering iron 0.25 kg | 2 |
| 48 | Desoldering gun | 4 |
| 49 | Hand vice 50mm jaw | 4 |
| 50 | Bench vice 100mm jaw | 6 |
| 51 | Pipe cutter to cut pipes upto 5cm dia | 2 |
| 52 | Pipe cutter to cut pipes above 5 cm dia | 1 |
| 53 | Stock & die set for 20mm to 50 mm GI pipe | 1 |
| 54 | Stock & dies conduit | 1 |
| 55 | Multimeter (analog), 0-1000 M ohm, 2.5 to 500V | 2 |
| 56 | Digital Multimeter ( 3 ½ digits ) | 2 |
| 57 | Digital Multi meter ( 4 ½ digits ) | 2 |
| 58 | AC voltmeter MI 0-500V | 2 |
| 59 | Milli Voltmeter centre zero 100-0-100 mV | 1 |
| 60 | DC milli Ammeter 0-500 mA | 1 |
| 61 | Ammeter MC 0-5A, 0-15-25A | 1 each |
| 62 | AC Ammeter MI 0-5A, 0-15-25A | 1 each |
| 63 | KiloWatt meter 0-1-3 KW | 1 |
| 64 | AC Energy meter, single phase 5A, 3 ph 15 A | 1 each |
| 65 | Power factor meter, single phase | 1 |
| 66 | Frequency meter | 1 |
| 67 | Wheat stone bridge complete with galvanometer and battery | 1 |
| 68 | DC power supply 0-100V, 5 Amp | 2 |
| 69 | Rheostats 0-1 ohm 5A, 0-10 ohm 5A, 0-25 ohm 1A, 0-300 ohm 1A | 1 each |
| 70 | Digital Tachometer | 1 |
| 71 | Growler | 1 |
| 72 | Tong tester / clamp meter 0-100 Amp. AC | 1 |
| 73 | Meggar 500V | 1 |
| 74 | Oscilloscope dual trace, 30 MHz | 1 |
| 75 | Function Generator | 1 |
| 76 | Hygrometer | 1 |
| 77 | Hydro meter | 1 |
| 78 | Current transformer, 415 V, 50 Hz , CT Ratio 10/5A, | 1 |
| 79 | Potential Transformer, 415/110 V | 1 |
| 80 | Relays – Over current, under voltage, etc. 3 volt, 100 amp. | 1 |
| 81 | Contactor 3phase,440volt,16amp.2 NO &2 NC auxiliary contacts | 3 |
| 82 | Contactor3 phase, 440 volt, 32 amp.2NO&2NCauxiliary contacts | 3 |
| 83 | Limit Switch | 2 |

| | | |
|---|---|---|
| 84 | Rotary Switch 16A | 2 |
| 85 | Laboratory type induction coil 6 volt to 800-10,000 volt | 2 |
| 86 | Cut out, reverse current, over load, under voltage relays | 1 |
| 87 | Knife switch DPDT fitted with fuse terminals 16 amp | 1 |
| 88 | Knife switch TPDT fitted with fuse terminals 16 amp | 1 |
| 89 | Numerical relays | 1 |
| 90 | Portable temperature indicator (0-200 Deg C) | 1 |
| 91 | Motor Checker | 1 |
| 92 | M.C.B. 16 amp. | 1 |
| 93 | LCR meter | 2 |
| 94 | Bearing Puller 6’ | 1 |

## C: GENERAL MACHINERY INSTALLATIONS:-

| Sl. No. | Name of the items | Quantity |
|---|---|---|
| 1 | Voltage Stabilizer, input 15-230 V AC, Output 220 V AC | 1 |
| 2 | 3 point DC starter | 1 |
| 3 | 4 point DC starter | 1 |
| 4 | Electrical Machine Trainer: suitable for demonstrating the construction & functioning of different types of DC machines & AC machines (single phase & 3 phase). Should be fitted with brake arrangement, Dynamometer, Instrument panel & power supply unit. | 1 |
| 5 | Motor generator (AC to DC): consisting of : Squirrel cage induction motor with star delta starter & directly coupled to DC shunt generator & switch board mounted with regulator, air breaker, ammeter, voltmeter, knife blade switches & fuses, set complete with case iron & plate, fixing bolts, foundation bolts & flexible coupling. Induction motor rating: 5 KW, 400V, 50 Hz, 3 ph. DC shunt generator rating: 3.5 KW, 220V | 1 set |
| 6 | Used DC generators – series, shunt & compound type, (for overhauling practice) | 1 each |
| 7 | DC shunt motor 2 – 2.5 KW, 220V with control panel | 1 |
| 8 | DC series motor coupled with mechanical load, 2 KW, 220V | 1 |
| 9 | DC compound motor with starter & switch, 2.5 KW, 220V, | 1 |
| 10 | Single phase Transformer, core type, air cooled, 1 KVA, 240/115-50-24-12 V, 50Hz | 3 |
| 11 | 3 phase transformer, shell type, oil cooled with all mounting, 3 KVA, 415/240V, 50 Hz ( Delta /Star) | 2 |
| 12 | D.C. compound generator, 2.5 K.W. 250 V, with control panel including filed rheostat, voltmeter, ammeter and circuit breaker | 1 |
| 13 | Motor generator (DC to AC) set consisting of Shunt motor with starting compensator & switch directly coupled to AC generator with exciter & switch board mounted with regulator, breaker, ammeter, voltmeter, frequency meter, knife blade switch & fuses etc. Set complete with cast iron bed plate, fixing bolts, foundation bolts & flexible coupling. Shunt | 1 set |

| | | |
|---|---|---|
| | motor Rating- 5KW, 220V. AC generator rating – 3 ph, 4 wire, 3.5 KVA, 400/230 V, 0.8 pf, 50 Hz | |
| 14 | AC squirrel cage induction motor with star delta starter & triple pole Iron clad switch fuse. 2 to 3 HP, 3 ph, 400V, 50 Hz | 1 |
| 15 | AC 3 ph wound slip ring motor with starter & switch, 5 HP, 400V, 50 Hz | 1 |
| 16 | Motor A.C. series type 230V, 50 cycles, ¼ HP with mechanical load | 1 |
| 17 | Single phase capacitor motor with starter switch, 1 HP, 230 V, 50 Hz | 1 |
| 18 | Universal motor with starter / switch, 230 V, ¼ HP, 50 Hz | 1 |
| 19 | Stepper Motor with digital controller. | 1 |
| 20 | Starters for 3-phase, 400 V, 50 cycles, 2 to 5 H.P. A.C. motors<br>a) Direct on line starter<br>b) Star delta starter with manual, semi-auto and automatic<br>c) Auto transformer type starter | 1 each |
| 21 | Ceiling fan 230 volt 1200 mm | 1 |
| 22 | Inverter, 1 KVA with 12 V battery, input 12 V DC, Output 220V AC | 1 |
| 23 | Battery charger | 1 |
| 24 | 1 Ph variable Auto Transformer | 1 |
| 25 | Load bank, 5 KW. lamp / heater type | 1 |
| 26 | Oil testing kit | 1 |
| 27 | Diesel generator set, 5 KVA, 44 volt, AC 3 phase with change over switch, over current circuit breaker and water-cooled with armature, star-delta connections. | 1 |
| 28 | UPS(Offline) | 2 |
| 29 | CVT | 2 |

**Note: In case of basic training setup by the industry the tools, equipment and machinery available in the industry may also be used for imparting basic training. Quantity may be sufficient as per seats utilization / allocated.**

# INFRASTRUCTURE FOR WORKSHOP CALCULATION & SCIENCE AND ENGINEERING DRAWING

## TRADE: Mechanic (HT, LT Equipment and Cable Jointing)

## LIST OF TOOLS & EQUIPMENTS FOR 20 APPRENTICES

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

**2) Infrastructure:**

**A: TRAINEES TOOL KIT:-**

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

**B : FURNITURE REQUIRED**

| Sl. No. | Name of the items | Quantity (indicative) |
|---|---|---|
| 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 |

**ANNEXURE – II**

## TOOLS & EQUIPMENT FOR ON-JOB TRAINING

## INFRASTRUCTURE FOR PROFESSIONAL SKILLS & PROFESSIONAL KNOWLEDGE

**TRADE: Mechanic (HT, LT Equipment and Cable Jointing)**

**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.

**ANNEXURE-III**

## 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.