CURRICULUM

FOR THE TRADE OF

MECHANIC (NON CONVENTIONAL POWER GENERATION, BATTERY AND INVERTER)

UNDER

APPRENTICESHIP TRAINING SCHEME

सत्यमेव जयते
Government of India

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

CONTENTS

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 to the following industries/organizations who have contributed valuable inputs in revising the curricula through their expert members:

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, Dy Director, FTI, Bangalore

Sl. No.	Name & Designation Sh./Mr./Ms.	Organization	Expert Group Designation
1.	P.Marveldoss, Deputy Director	RDAT, Chennai	Expert Member
2.	Ashokan, Training Officer	CTI, Chennai	Expert Member

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 22nd 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 -Non conventional Power Generation, Battery & Inverter

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 sources of energy which have been in use for a long time, e.g., coal, petroleum, natural gas and water power. They are exhaustible except water. They cause pollution when used, as they emit smoke and ash and also contaminate air, water and soil. They are very expensive to be maintained, stored and transmitted.Coal fills 27 per cent of the global energy requirement. At the present rate use, it would carry its resources until the 22nd century. But the picture of oil resources is quite grim, that it would exhaust its present reserve in about 30 years.

The resources which are now making an impact in the past few years, it includes solar, wind, tidal, biogas, and biomass, geothermal. They are inexhaustible and they are generally pollution free, less expensive due to local use and easy to maintain.

In order to supply highly skilled technicians in the new emerging energy sector particularly in Non conventional Power Generation, the trade has to be introduced and popularized in a large scale. A large number of skilled workers coming out of technical institutes do not possess the required skills and are not readily employable.

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:

- 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.
- 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 & Earthling System.
- Underground cable joining, testing & trouble shooting
- Working of LT and HT Switch- gears and protective relays
- Practice on trouble shooting and maintenance of solar panel and other associated equipments.
- Practice on collecting the power provided by all wind turbines storage of wind power and the process of distribution of power
- Overhauling & maintenance on Wind mill System for power generation
- Test, repair & maintenance of different type of inverters
- Test, repair & maintenance of different types of power supplies.
- Test, repair & maintenance of CVT, SCVS, SCVT, SMPS, Inverter etc.
- Test and Practice on solar pump, concentrator type solar cooker, box type solar cooker; solar cookers for house hold & community applications.
- Test and Practice on solar lighting system: Solar Lantern, street light, and home light.

Reference NCO & NOS:

i) NCO-2004: 8282.10

5. GENERAL INFORMATION

1. **Name of the Trade : Mechanic (Non conventional power generation, battery &Inverter**)

2. **N.C.O. Code No. (**NCO-2004) : 8282.10

3. **Duration of Apprenticeship Training (Basic Training + Practical Training): 0**2 years

3.1 For Fresher's: - 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^{th} class examination under 10+2 system of education or its equivalent.

5. **Selection of Apprentices:** The apprentices will be selected as per Apprentices 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 those who have completed Broad Based Basic Training and Advanced module in "Non conventional power generation, battery & Inverter" 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 -Non conventional Power Generation, Battery &Inverter**

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 "Non conventional power generation, battery &Inverter" / NAC in Mechanic -Non conventional power generation, battery &Inverter, 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** - Viewing of engineering drawing sheets. Method of Folding of printed Drawing Sheet as per BIS SP:46-2003 **Drawing Instruments** : their Standard and uses - 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 :** - Definition, types and applications in Drawing as per BIS SP:46-2003 - Classification of lines (Hidden, centre, construction, Extension, Dimension, Section) - Drawing lines of given length (Straight, curved) - Drawing of parallel lines, perpendicular line - 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 Simplification using BODMAS.	
3	**Drawing of Geometrical Figures**: Definition, nomenclature and practice of - - Angle: Measurement and its types, method of bisecting. - Triangle -different types - Rectangle, Square, Rhombus, Parallelogram. - 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: - 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 :** - Lines, polygons, ellipse, etc. - geometrical figures and blocks with dimension . - 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 : - Fastener (Rivets, Bolts and Nuts) - Bars and profile sections - Weld, brazed and soldered joints. - Electrical and electronics element - 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	Free hand sketch of Circuit diagrams of various models of Inverters Free hand sketch of wind mill Block diagram of wind mill power station			
4	Drawing the schematic diagram of Solar panels Layout of Solar Power stations and its Line diagram		**Algebra:** Addition, Subtraction, Multiplication, Division, Algebraic formula, Linear equations (with two variables).	
5	**Distribution of Power** Types of insulator used in over head line. (Half sectional views) Different type of distribution systems and methods of connections. Layout diagram of a substation. Single line diagram of substation feeders.		**Mensuration :** Area and perimeter of square, rectangle, parallelogram, triangle, circle, semi circle. Volume of solids – cube, cuboid, cylinder and Sphere. 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 (275 Hrs.)	Professional Knowledge (120 Hrs.)
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. **Occupational Safety & Health.** **Importance of housekeeping & good shop floor practices.** Health, Safety and Environment guidelines, legislations & regulations as applicable. Disposal procedure of waste materials like cotton waste, metal chips/burrs etc. Basic safety introduction, Personal protective Equipment(PPE):- Basic injury prevention, Basic first aid, Hazard identification and avoidance, safety signs for Danger, Warning, caution & personal safety message. Preventive measures for electrical accidents & steps to be taken in such accidents. Type and use of Fire extinguishers.	**Occupational Safety & Health** Basic safety introduction, Personal protection:- Basic injury prevention, Basic first aid, Hazard identification and avoidance, safety signs for Danger, Warning, caution & personal safety message. Type and Use of Fire extinguishers. Visit & observation of sections. Various safety measures involved in the Industry. Elementary first Aid. Concept of Standard **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. Response to emergencies eg; power failure, fire, and system failure.
2	Familiarization with signs and symbols of Electrical accessories.	Fundamental of electricity: Fundamental terms- Current, Voltage and resistance definitions, AC, DC, Phase, Neutral, Earth. Units & effects of electric current.
3	Skinning the cables Demonstration & Practice on cable and bare conductors joints--such as rat tail, Britannia, straight, Tee, Western union Joints Practice in soldering & brazing Practice on crimping thimbles, Lugs. Demonstration and identification of types of cables. Demonstration & practice on using standard wire gauge & micrometer.	Solders, flux and soldering technique. Resistors types of resistors & properties of resistors. 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

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 - Simple electrical circuits and problems. Reading of simple Electrical Layout. **Resistors -**Law of Resistance. Series and parallel circuits & related calculation. **Alternating Current -**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. 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. Make test board.	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 & 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. 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).
8	**Diodes**-symbol - Tests - Construct & Test Half wave rectifier ckt. Full wave rectifier ckt. Bridge rectifier ckt. 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 in MS conduits, cutting , threading & laying Installation, and 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	**D.C. Machines –** **Magnetism**- classification of magnets, methods of magnetizing, magnetic material **Electromagnetism-** Solenoid, field around conductors carrying current, polarity, Laws of electromagnetic induction, screw-rule, right- hand grip rule, advantages and application of electromagnet.

	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.	General concept of Electrical Machines. **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.
12	Identification of types of transformers. Connection of transformers, Transformation ratio, testing of transformer, calculate the losses, regulation & efficiency of transformer . 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.	Working principle of **Transformer,** losses & efficiency. classification C.T., P.T. Instrument and Auto Transformer(Variac), Construction, Single phase and Poly phase. Type of Cooling for transformer. Protective devices. 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.
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, Meggar Phase sequence meter, Digital Instruments, etc Range extension of meters.	**Electrical Measuring Instruments -** -types, indicating types PMMC & MI meter (Ammeter, Voltmeter) -Range extension -Multi-meter(Digital/Analog) -Wattmeter - P.F. meter - Energy meter (Digital/analog) –Insulation Tester (Megger), Earth tester. -Frequency meter -Phase Sequence meter - -Tong tester -Tachometer.
	Assessment/Examination 03days	

B. Block –II
Basic Training

Week No.	Professional Skills (275 Hrs.)	Professional Knowledge (120 Hrs.)
1-2	Prepare layout plan, single line diagram of different type of power plant Practice working principle and process involved in water turbines and steam turbines. Practice working principle and process involved in thermal and nuclear power generating stations. Identify parts of AC generator and read its specifications Practice on generator protection simulation. Practice demonstration of the working DG set. Energy management system. Practice on trouble shooting and maintenance of DG set Practice on power generation by non conventional and renewable energy : Tidal waves, micro hydel their suitability and limitation Practice on preparing fuel cell(hydro oxygen cell) Practice on preparation of electrolyte for lead acid cell/ battery, assembling lead acid battery	Generation sources of energy, Comparison of energy resources. Types of fuels. Advantages of liquid fuel & solid fuel. Sources of Energy. Conventional Methods of generating Electricity, Merits and de-merits, choice between AC & DC, low voltage and high voltage. Various ways of electrical power generation. • Thermal • Hydro electric • Nuclear • Non-Conventional . Study of Working Principle of and process involved in hydro electric power generating stations. Study of Working Principle of and process involved in thermal power generating stations. Study of AC generator and its types, construction working characteristics , voltage regulation and efficiency. Study of AC generator: Trouble shooting and Maintenance Study on Captive power plant. Diesel Power generating stations. Study of operation and maintenance of DG set Study on power generation by non conventional and renewable energy: solar, wind, biomass and their suitability and limitation Study on battery : Electrolysis laws, cells, types of cells- primary, secondary, grouping of cells, fuel cell, hydro oxygen cell Study of battery : care and maintenance of lead acid battery, testing of specific gravity of electrolyte, trouble shooting and remedies
3-4	**Practice on assembling and testing of rectifier, filter and regulator circuits. Identification of** Converters AC to DC and DC to AC **Practice : Testing of SCR, TRIAC, DIAC, MOSFET and IGBT .**	Study of rectifier, Converters AC to DC and DC to AC filter and regulator circuits. Linear voltage regulator & transistorized & IC regulator, Reliability Test / Percentage of Regulation test of DC power supplies., Short circuit protection circuits Study of Thyristors: SCR, TRIAC, DIAC, MOSFET and IGBT their symbols, characteristics and its circuits)

	Test & measurements of given SCR power supply circuit. Test & measurements of a given SMPS. Test, faultfinding & repair of given DC power supply. **Assemble and repair practice on Stabilizers using relays and electronic circuit.** **Assemble and repair practice on Servo Stabilizer of single and three phase** **Practice on charging a battery by Constant voltage and constant current methods** Identification of integrated Circuits (ICs)/chips used in Inverters . Assemble a battery charger circuit used in inverter with protection circuit **Identify various ratings and types of inverters and determine the back up time of inverter.** **Practice on assembling** different type of inverters **and testing of inverters.**	. Study on Switch Mode power Supply Study of Stabilizers using relays and electronic circuit. Servo Stabilizer of single and three phase Study of battery charging methods: Constant voltage and constant current methods Study the chips used in Inverters Brief know how of chips like PWM in inverter control circuit, Opamp in annunciate/monitor circuits, programmed/Embedded chips for inverters Study of inverters : Types, construction, working, of protection and annunciating circuits. Power Rating of inverters and calculation of backup time of inverter Study of Online/Offline UPS & and its relation with Inverters
5-6	Practice on solar thermal power generation. Practice Solar photo voltaic power generation Practice on solar inverter (Hybrid). Practice on trouble shooting and maintenance of solar panel and other associated equipments. Practice on solar pump, concentrator type solar cooker, box type solar cooker; solar cookers for house hold & community applications. Practice on solar lighting system:	Study of Solar energy and solar thermal power generation. Study of solar : Solar photo voltaic power generation Study of solar: basic modules of photo voltaic system-solar photo voltaic cell, charge controller, storage battery, solar inverter (Hybrid) and its load testing Study of solar pump, concentrator type solar cooker, box type solar cooker,.

	Solar Lantern, street light, and home light. Assemble a solar lighting system	Description of main parts of solar lighting system
7-9	Practice on Construction and operation of wind mill system for power generation Practice on collecting the power provided by all wind turbines storage of wind power and the process of distribution of power Identify the different types of torque wrenches. Inspect, maintain, and use various torque equipment, Inspect, maintain, and use tension equipment in wind turbine environment Overhauling & maintenance on Wind mill System for power generation. Practice on bio-mass based power generation Practice on gasified based bio-mass power generation Practice night soil based power generation Practice on Overhauling & maintenance of mini hydroelectric System for power generation, Maintenance of turbine, pump, ac/dc generators and flow meters used in hydroelectric system Maintenance and care in power storage through hydrogen, Process of Electrolysis, process of transportation of Hydrogen. Elasticity generation through Reverse electrolytic cell (Fuel cell	Study of wind: basic principles of wind energy generation and types of wind mills and associated generators. Study on Contactors, various types of Relays, Fuses used in wind mills. Study on the process of distributing and collecting the power provided by all types of wind turbines Define torque and tensioning. Study on various torque and tensioning processes in wind mills Study of biomass: digester type bio-mass based power generation Study of biomass: Gasified based bio-mass power generation Study of biomass: Night soil based power generation. Study of mini hydroelectric system and water mill. Study on turbines, pumps, flow meters and ac/dc generators used in hydroelectric system . Introduction to ocean thermal electric conversion for power generation and tidal power generation. Study on storage electricity by producing H2 (Fuel cell) through electrolysis

10-11	Identify electrical hazards associated with the power distribution system at an energy site. Identify sections and components of a power distribution system Identification of Contactors, various types of Relays, Fuses and circuit breakers used in power distribution system associated with wind mills, solar energy parks and other nonconventional energy sources Test the underground cables for open, short circuit & ground fault and also check insulation resistance. Prepare layout plan and single line diagram of transmission /Distribution system. Trouble shooting and servicing of LT circuit breaker. Connect feeder cable/ service line to the bus bar. Test /Check different type of protection relay.	Study on electrical hazards associated with the power distribution system at an energy site. Study on classification of distribution system-AC distribution, Overhead v/s underground distribution system, layout plan and single line diagram of transmission /Distribution system. Study on essential features of switchgears. Isolator, Switch gear equipments, bus-bar arrangement, Short circuit, faults in power system. Circuit breakers – Introduction & Classification of circuit breakers Study on underground cables for open, short circuit & ground fault and also check insulation resistance. Study about grid station
12	Practice on logic gates & combinational circuits using relay logic and testing input & output status using 6V/12V dc sources	Digital Electronics: Binary numbers, symbols of logic gates & its applications in control circuits. Study on relay logic using normally open and normally closed contacts and switches
13	Practice on routine & preventive maintenance of equipments used in renewable power generation	Study of routine & preventive maintenance of equipments used in renewable power generation
	Assessment/Examination 03days	

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 :** Accentuation (mode of pronunciation) on simple words, Diction (use of word and speech)	
2	**Functional Grammar** Transformation of sentences, Voice change, Change of tense, Spellings.	
3	**Reading** Reading and understanding simple sentences about self, work and environment	
4	**Writing** Construction of simple sentences Writing simple English	
5	**Speaking / Spoken English** 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** Introduction, Computer and its applications, Hardware and peripherals, Switching on-Starting and shutting down of computer.	
2	**Computer Operating System** 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** 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	
4	**Computer Networking and INTERNET** 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.	
	Communication Skill	**25**
1	**Introduction to Communication Skills** 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	
2	**Listening Skills** Listening-hearing and listening, effective listening, barriers to effective listening guidelines for effective listening. Triple- A Listening - Attitude, Attention & Adjustment. Active Listening Skills.	
3	**Motivational Training** 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	
4	**Facing Interviews** Manners, Etiquettes, Dress code for an interview Do's & Don'ts for an interview	
5	**Behavioral Skills** Organizational Behavior Problem Solving Confidence Building Attitude Decision making Case study/Exercise	

B. Block– II
Basic Training

Topic No.	Topic	Duration (in hours)
	Entrepreneurship skill	**10**
1	**Concept of Entrepreneurship** **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** 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** 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	**Investment Procurement** Project formation, Feasibility, Legal formalities i.e., Shop Act, Estimation & Costing, Investment procedure - Loan procurement - Banking Processes.	
	Productivity	**10**
1	**Productivity** Definition, Necessity, Meaning of GDP.	
2	**Affecting Factors** Skills, Working Aids, Automation, Environment, Motivation How improves or slows down.	
3	**Comparison with developed countries** 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** Banking processes, Handling ATM, KYC registration, safe cash handling, Personal risk and Insurance.	
	Occupational Safety, Health & Environment Education	**10**
1	**Safety & Health** Introduction to Occupational Safety and Health importance of safety and health at workplace.	
2	**Occupational Hazards** 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** Basic principles for protective equipment. Accident Prevention techniques - control of accidents and safety measures.	
4	**First Aid**	

	Care of injured & Sick at the workplaces, First-Aid & Transportation of sick person	
5	**Basic Provisions** Idea of basic provision legislation of India. of safety, health, welfare under legislation of India.	
6	**Ecosystem** Introduction to Environment. Relationship between Society and Environment, Ecosystem and Factors causing imbalance.	
7	**Pollution** Pollution and pollutants including liquid, gaseous, solid and hazardous waste.	
8	**Energy Conservation** Conservation of Energy, re-use and recycle.	
9	**Global warming** Global warming, climate change and Ozone layer depletion.	
10	**Ground Water** Hydrological cycle, ground and surface water, Conservation and Harvesting of water	
11	**Environment** Right attitude towards environment, Maintenance of in -house environment	
	Labour Welfare Legislation	**5**
1	**Welfare Acts** 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 :** Meaning of quality, Quality Characteristic	
2	**Quality Circles :** 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 :** Idea of ISO 9000 and BIS systems and its importance in maintaining qualities.	
4	**House Keeping :** Purpose of Housekeeping, Practice of good Housekeeping.	
5	**Quality Tools** Basic quality tools with a few examples	
	Leadership and Team Building skills	**5**
	Leadership Discipline and Morale Team Work Case Study/ Exercise	
	Meet the Mentor **Role - play as a Supervisor**	**5**
	Organizing and Planning.	**5**
	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 -Non conventional power generation, battery &Inverter**
2) **Duration of On-Job Training** : As per Apprentices Act amended from 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** :

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

OR

iv) NTC/NAC in the trade of Electrician / BBBT and Advanced module in "Non conventional power generation, battery &Inverter" in CoE Electrical Sector/ NAC in Mechanic -Non conventional power generation, battery &Inverter, 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)

S.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 of 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	Measure voltage, current, resistance, power & energy of DC & AC(1ph & 3ph) supplies
6	Electrical wiring: Repair / replace switches, sockets, light points, provision of new points in PVC casing capping & PVC conduits.
7	Different type of Batteries. Checking specific gravity, voltage and condition monitoring of battery bank,
8	Install pipe & plate earth stations. Measure earth resistance, and improve the earth systems with reference to various standards.
9	Power up to motors, equipments & appliances, crimping lugs and providing cable connections.
10	Attending to minor faults in machines, their controls & electrical appliances.
11	Replacing fans, bulbs, tube lamps and CFLs and wire up in PVC casing & capping.
12	Assisting in operation & maintenance of Transformer substation, circuit breakers, etc.
13	Trouble shooting of dc and ac power supplies
14	Provision of light/socket points and plug connections for various equipments and appliances
15	Determination of size and gauge for cables & provision of general earthing and dedicated earthing
16	Wiring and Replacement of batteries for inverters
	Project Work
	REVISION
	Examination

B. BLOCK – II (09 month)

S. 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	Different types of power plant- Water and, steam turbines, thermal and nuclear power generating stations. Operation & maintenance Connection & testing AC generator and care and maintenance of Alternator
3	Practice on preparing fuel cell(hydro oxygen cell) and maintenance of lead acid battery Identification of Converters AC to DC and DC to AC. Testing of Thyristers
4	Charging a battery by different ways; Maintenance and testing of inverters
5	Practice on Overhauling & maintenance of mini hydroelectric System for power generation; Operation and maintenance of wind mill system for power generation.
6	Operation and maintenance of solar thermal power generation, solar inverter (Hybrid), maintenance of solar panels and other associated equipments and solar energy based gadgets.
7	Operation and maintenance of bio-mass based and night soil based power generation Diesel Generating set: Operation & maintenance
8	Identify electrical hazards associated with the power distribution system at an energy site and Operation and maintenance of power distribution systems; Switchgear, panel meters monitoring
9	Underground cable joining, , Locating faults, open circuit, short circuit & leakage in cables and performing cable joints, Working with LT and HT Switch- gears and protective relays. Operation and maintenance of different circuit breakers and maintenance of transformer equipments
10	Testing & trouble shooting of different power supplies. Repairing of Stabilizers using relays and electronic circuit and Servo Stabilizer of single and three phase
11	Identification of logic gates and study on their applications
12	Routine & Preventive maintenance, Quality assurance in electrical works and power saving techniques
13	**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) Weight age 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) Weight age 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. Wind Mill Power Stations and Solar Energy Stations
3. Private industries in India & abroad.
4. Self employment

ANNEXURE – I

TOOLS & EQUIPMENT FOR BASIC TRAINING

INFRASTRUCTURE FOR PROFESSIONAL SKILL & PROFESSIONAL KNOWLEDGE

TRADE: Mechanic -Non conventional power generation, battery &Inverter

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/ Torque wrenches	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	Electronic Voltage Stabilizer with 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	Servo Stabilizer 5KVA	2
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 &	1 set

	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 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	Solar Inverter	2
18	Universal motor with starter / switch, 230 V, ¼ HP, 50 Hz	1
19	Concentrator type solar cooker, box type solar cooker	2 each
20	Starters for 3-phase, 400 V, 50 cycles, 2 to 5 H.P. A.C. motors a) Direct on line starter b) Star delta starter with manual, semi-auto and automatic c) Auto transformer type starter	1 each
21	Solar Lantern, , Solar heater and Solar street light	2 each
22	Inverter, 1 KVA with 12 V battery, input 12 V DC, Output 220V AC	1
23	Solar Energy module /Solar Panels assembled with energy storing set up along with battery/ inverter	1 set
24	Wind energy module with energy storing set up along with battery/ inverter	1 set
25	Battery charger	1
26	1 Ph variable Auto Transformer	1
27	Load bank, 5 KW. lamp / heater type	1
28	Mini hydroelectric System for power generation	1
29	Discreet component trainer	2
30	Oil testing kit	1
31	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
32	UPS (Online)	2
33	UPS(Offline)	2
34	Solar tool kit	4
35	SMPS	2
36	Transistor Tester	2
37	IC Tester	2
38	Microprocessor Kit	1
39	IC Trainer (Digital)	1
40	Function Generator	1

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 -Non conventional power generation, battery &Inverter

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 -Non conventional power generation, battery &Inverter

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.