

SOLAR TECHNICIAN (ELECTRICAL)

COMPETENCY BASED CURRICULUM

(Duration: 1 Yr. 03 months)

APPRENTICESHIP TRAINING SCHEME (ATS)

NSQF LEVEL- 4



SECTOR – GREEN JOB



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

SOLAR TECHNICIAN (ELECTRICAL)

(Designed in 2020)

APPRENTICESHIP TRAINING SCHEME (ATS)

NSQF LEVEL - 4

Developed By

Ministry of Skill Development and Entrepreneurship

Directorate General of Training

Sectoral Trade Course Committee of Green Job Sector

&

CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE

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1. TATA Motors Ltd
2. Head Standards and Research
3. Vadodara Enviro Channel Ltd
4. E-vehicle

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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 Directorate General of Training (DGT) 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 DGT 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.

2.1 GENERAL

Directorate General of Training (DGT) under Ministry of Skill Development & Entrepreneurship offers range of vocational training courses catering to the need of different sectors of economy/ Labour market. The vocational training programmes are delivered under aegis of Directorate General of Training (DGT). Craftsman Training Scheme (CTS) and Apprenticeship Training Scheme (ATS) are two pioneer programmes of DGT for propagating vocational training.

Solar Technician (Electrical) trade under ATS is of one year 03 months (15 months) duration. It mainly consists of Domain area and Core area. In the Domain area Trade Theory & Practical impart professional - skills and knowledge, while Core area - Workshop Calculation and science, Engineering Drawing and Employability Skills imparts requisite core skills & knowledge and life skills. After passing out the training programme, the trainee is being awarded National Apprenticeship Certificate (NAC) by DGT having worldwide recognition.

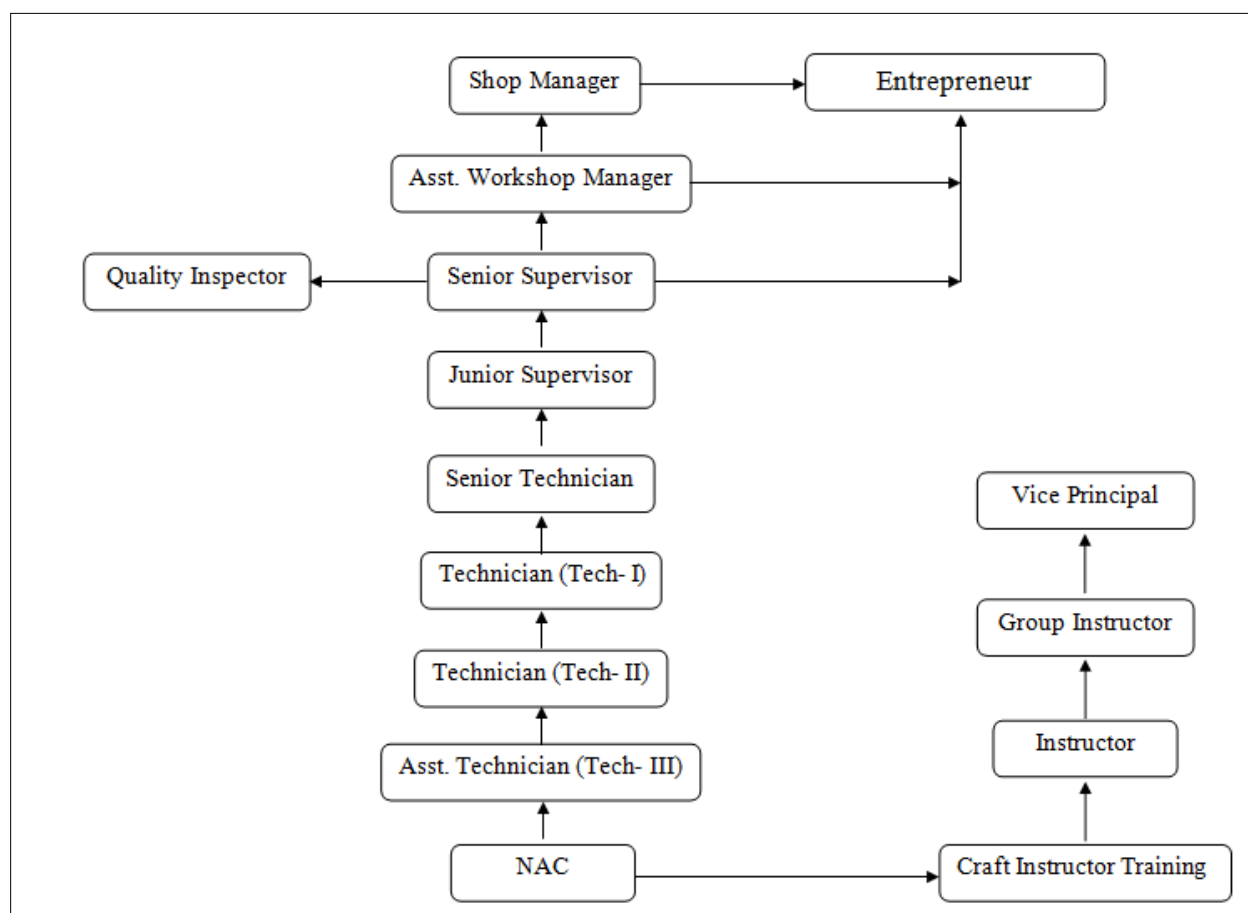
Broadly candidates need to demonstrate that they are able to:

- Read & interpret technical parameters/document, plan and organize work processes, identify necessary materials and tools;
- Perform task with due consideration to safety rules, accident prevention regulations and environmental protection stipulations;
- Apply professional skill, knowledge, core skills & employability skills while performing jobs and solve problem during execution.
- Check the job/assembly as per drawing for functioning, identify and rectify errors in job/assembly.
- Document the technical parameters related to the task undertaken.

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2.2 CAREER PROGRESSION PATHWAYS:

- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming instructor in ITIs.
- Indicative pathways for vertical mobility.



2.3 COURSE STRUCTURE:

Table below depicts the distribution of training hours across various course elements during a period of One year 03 months (*Basic Training and On-Job Training*): -

Total training duration details: -

Time (in months)	1-3	4-15
Basic Training	Block - I	-----
Practical Training (On - job training)	----	Block - I

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*Block-II is defined only in case of qualifications having two year ATS durations.

A. Basic Training

For 02 yrs. course (Engg.) :-(**Total 06 months:** 03 months in 1styr. + 03 months in 2nd yr.)

For 01 yr. 03 month course (Engg.) :-(**Total 03 months:** 03 months in 15 Months)

SL. No.	Course Element	Total Notional Training Hours	
		For 02 Yrs. course	For 01 Yr. course
1.	Professional Skill (Trade Practical)	550	275
2.	Professional Knowledge (Trade Theory)	240	120
3.	Workshop Calculation & Science	40	20
4.	Engineering Drawing	60	30
5.	Employability Skills	110	55
	Total (Including internal assessment)	1000	500

B. On-Job Training:-

For 02 yrs. Course (Engg.) :-(**Total 18 months:** 09 months in 1styr. + 09 months in 2nd yr.)

Notional Training Hours for On-Job Training: 3120 Hrs.

For 15 month Course (Engg.) :-(**Total 12 months**)

Notional Training Hours for On-Job Training: 2080 Hrs.

C. Total training hours:-

Duration	Basic Training	On-Job Training	Total
For 02 yrs. course (Engg.)	1000 hrs.	3120 hrs.	4120 hrs.
For 01 yr. course (Engg.)	500 hrs.	2080 hrs.	2580 hrs.

2.4 ASSESSMENT & CERTIFICATION:

The trainee will be tested for his skill, knowledge and attitude during the period of course and at the end of the training programme as notified by Govt of India from time to time. The Employability skills will be tested in first two semesters only.

a) The **Internal assessment** during the period of training will be done by **Formative assessment method** by testing for assessment criteria listed against learning outcomes. The training institute have to maintain individual *trainee portfolio* as detailed in assessment guideline. The marks of internal assessment will be as per the template (Annexure – II).

b) The final assessment will be in the form of summative assessment method. The All India Trade Test for awarding NAC will be conducted by DGT on completion of course as per guideline of Govt of India. The pattern and marking structure is being notified by govt of India from time to time. **The learning outcome and assessment criteria will be basis for setting question papers for final assessment. The examiner during final examination will also check** individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

2.4.1 PASS REGULATION

The minimum pass percent for Practical is 60% & minimum pass percent for Theory subjects 40%. The candidate should pass in each subject conducted under all India trade test.

2.4.2 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 should be given while assessing for team work, avoidance/reduction of scrap/wastage and disposal of scarp/wastage as per procedure, behavioral attitude, sensitivity to environment and regularity in training. The sensitivity towards OSHE and self-learning attitude are to be considered while assessing competency.

Assessment will be evidence based comprising the following:

- Job carried out in labs/workshop
- Record book/ daily diary
- Answer sheet of assessment
- Viva-voce
- Progress chart

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- Attendance and punctuality
- Assignment
- Project work

Evidences of internal assessments are to be preserved until forthcoming semester examination for audit and verification by examination body. The following marking pattern to be adopted while assessing:

Performance Level	Evidence
(a) Weightage in the range of 60 -75% to be allotted during assessment	
For performance in 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.	• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment • Below 70% tolerance dimension/accuracy achieved while undertaking different work with those demanded by the component/job/set standards. • 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	
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.	• Good skill levels in the use of hand tools, machine tools and workshop equipment • 70-80% tolerance dimension/accuracy achieved while undertaking different work with those demanded by the component/job/set standards. • 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	
For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety	• High skill levels in the use of hand tools, machine tools and workshop equipment • Above 80% tolerance dimension/accuracy

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procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship.	achieved while undertaking different work with those demanded by the component/job/set standards. • A high level of neatness and consistency in the finish. • Minimal or no support in completing the project.
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Brief description of Job roles:

Solar Panel Installation Technician; is also known as 'Panel Installer', the Solar Panel Installation Technician is responsible for installing solar panels at the customers' premises. The individual at work checks the installation site, understands the layout requirement as per design, assesses precautionary measures to be taken, installs the solar panel as per customer's requirement and ensures effective functioning of the system post installation.

Solar PV System Installation Engineer; is responsible for designing and installing the solar photovoltaic system at the customer's premises to meeting their power requirement. The individual at work evaluates the installation site, designs the installation, plans and arranges for materials, and ensures smooth installation process. The individual also supervises the installation technicians' work.

Solar PV System Maintenance Technician; is responsible for maintenance and effective functioning of the installed solar panels. The individual at work cleans the installed solar modules, checks the photovoltaic system for uninterrupted power output and identifies faults in the PV system.

Module Assembly Technician; is responsible for fixing frames and junction box in the solar module. The individual at work prepares the solar module for final assembly, frames the module and fixes the junction box with cables on the rear side of the module. The individual is also responsible for connecting the tabbing wire from the module to the junction box and soldering them.

Reference NCO-2015:

- a) 7421.1401 – Solar Panel Installation Technician
- b) 7421.1402 – Solar Photo Voltaic System Installation Technician
- c) 7421.1403 – PV System Installation Engineer
- d) 8212.2301 – Module Assembly Technician

NSQF level for Solar Technician (Electrical) trade under ATS: **Level 4**

As per notification issued by Govt. of India dated- 27.12.2013 on National Skill Qualification Framework total 10 (Ten) Levels are defined.

Each level of the NSQF is associated with a set of descriptors made up of five outcome statements, which describe in general terms, the minimum knowledge, skills and attributes that a learner needs to acquire in order to be certified for that level.

Each level of the NSQF is described by a statement of learning outcomes in five domains, known as level descriptors. These five domains are:

- a. Process
- b. Professional knowledge,
- c. Professional skill,
- d. Core skill and
- e. Responsibility.

The Broad Learning outcome of Solar Technician (Electrical) trade under ATS mostly matches with the Level descriptor at Level- 4.

The NSQF level-4 descriptor is given below:

Level	Process required	Professional knowledge	Professional skill	Core skill	Responsibility
Level 4	Work in familiar, predictable, routine, situation of clear choice.	Factual Knowledge of field of knowledge or study	Recall and demonstrate practical skill, routine and repetitive in narrow range of application, using appropriate rule and tool, using quality concepts	Language to communicate written or oral, with required clarity, skill to basic Arithmetic and algebraic principles, basic understanding of social political and natural environment.	Responsibility for own work and learning.

5. GENERAL INFORMATION

Name of the Trade	Solar Technician (Electrical)
NCO-2015	a) 7421.1401 – Solar Panel Installation Technician b) 7421.1402 – Solar Photo Voltaic System Installation Technician c) 7421.1403 – PV System Installation Engineer d) 8212.2301 – Module Assembly Technician
Trade Code	DGT/3201
NSQF Level	Level – 4
Duration of Apprenticeship Training (Basic Training + On-Job Training)	15 months
Duration of Basic Training	BT - I : 3 months Total duration of Basic Training: 3 months
Duration of On-Job Training	OJT – I : 9 months Total duration of Practical Training: 12 months
Entry Qualification	Passed 10 th Class examination with science and mathematics or its equivalent
Space Norms (BTP Workshop)	50 Sq. m and Minimum 10 Sq M rooftop space for assembly of 1 KW plant
Power Norms (BTP Workshop)	3 KW
Selection of Apprentices	The apprentices will be selected as per Apprenticeship Act amended time to time.
Instructors Qualification for Basic Training	As per ITI instructors qualifications as amended time to time for the specific trade.
Infrastructure for Basic Training	As per Annexure-I
Examination	The internal examination/ formative assessment will be held on completion of each 3 months duration, based on which sessional marks to be awarded. Final examination for all subjects will be held at the end of course and same will be conducted by DGT.
Rebate to Ex-ITI Trainees	Basic Training – 3 Months Rebate is allowed to any one of Solar Technician (Electrical), Electrician, Electrician – Power Distribution, Wireman, Electronic Mechanic, Technician Power Electronics and Mechanic Consumer Electronic Appliances trade CTS pass out.

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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.*
- *For imparting Basic Training the industry to tie-up with ITIs having such specific trade and affiliated to DGT.*

6.1 GENERIC LEARNING OUTCOME

The following are minimum broad Common Occupational Skills/ Generic Learning Outcome after completion of the Solar Technician (Electrical) course of 01 year 03 months duration under ATS.

Block I :-

1. Recognize & comply safe working practices, environment regulation and housekeeping.
2. Understand and explain different mathematical calculation & science in the field of study including basic electrical. *[Different mathematical calculation & science -Work, Power & Energy, Algebra, Mensuration, Trigonometry, Heat & Temperature, Power transmission, Pressure].*
3. Interpret specifications, different engineering drawing and apply for different application in the field of work. *[Different engineering drawing-Geometrical construction, Dimensioning, Lines, Symbol, scales, Different Projections, Machined components & different thread forms, Assembly drawing, Sectional views, Electrical & electronic symbol].*
4. Select and ascertain measuring instrument and measure dimension of components and record data.
5. Explain the concept in productivity, quality tools, and labour welfare legislation and apply such in day to day work to improve productivity & quality.
6. Explain energy conservation, global warming and pollution and contribute in day to day work by optimally using available resources.
7. Explain personnel finance, entrepreneurship and manage/organize related task in day to day work for personal & societal growth.
8. Plan and organize the work related to the occupation.

6.2 SPECIFIC LEARNING OUTCOME**Block – I**

1. Follow safety procedures for electrical installations by selection of proper tools & measuring instruments.
2. Assemble, install and test wiring system & carry out soldering and crimping.
3. Construct and test various characteristics of electrical and magnetic circuits.

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4. Perform basic Electric energy calculations and understand transmission and distribution of electrical power.
5. Verify natural planetary movements and sunlight's path.
6. Demonstrate characteristics of Photovoltaic cells, Modules, Batteries and Charge controllers and Solar DC appliances.
7. Connect , test & maintain solar panel, batteries , Charge controller, Battery bank and Inverter.
8. Perform various tests and measurement pertaining to PV Modules and their installation as per IEC standards.
9. Assist in Installation and commissioning of Solar PV plant and Hybrid plant and use PV system software.
10. Perform manufacturing of solar panel, prepare and commission marketable solar products.
11. Perform assembly, install, test and maintain Solar PV DC products and systems
12. Perform practice on HV installations and their maintenance including Earthing methods and Lightning arrestors.
13. Perform SCADA monitoring on Solar PV plant.

NOTE:

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

7. LEARNING OUTCOME WITH ASSESSMENT CRITERIA

GENERIC LEARNING OUTCOME		
Learning Outcomes	Assessment Criteria	
1. Recognize & comply safe working practices, environment regulation and housekeeping.	1.1	Follow and maintain procedures to achieve a safe working environment in line with occupational health and safety regulations and requirements.
	1.2	Recognize and report all unsafe situations according to site policy.
	1.3	Identify and take necessary precautions on fire and safety hazards and report according to site policy and procedures.
	1.4	Identify, handle and store / dispose off dangerous/unsalvageable goods and substances according to site policy and procedures following safety regulations and requirements.
	1.5	Identify and observe site policies and procedures in regard to illness or accident.
	1.6	Identify safety alarms accurately.
	1.7	Report supervisor/ Competent of authority in the event of accident or sickness of any staff and record accident details correctly according to site accident/injury procedures.
	1.8	Identify and observe site evacuation procedures according to site policy.
	1.9	Identify Personal Productive Equipment (PPE) and use the same as per related working environment.
	1.10	Identify basic first aid and use them under different circumstances.
	1.11	Identify different fire extinguisher and use the same as per requirement.
	1.12	Identify environmental pollution & contribute to avoidance of same.
	1.13	Take opportunities to use energy and materials in an environmentally friendly manner
	1.14	Avoid waste and dispose waste as per procedure
	1.15	Recognize different components of 5S and apply the

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	same in the working environment.
2. Understand, explain different mathematical calculation & science in the field of study including basic electrical and apply in day to day work. [Different mathematical calculation & science -Work, Power & Energy, Algebra, Geometry & Mensuration, Trigonometry, Heat & Temperature, Levers & Simple machine, graph, Statistics, Centre of gravity, Power transmission, Pressure]	2.1 Explain concept of basic science related to the field such as Material science, Mass, weight, density, speed, velocity, heat & temperature, force, motion, pressure, heat treatment, centre of gravity, friction.
	2.2 Measure dimensions as per drawing
	2.3 Use scale/ tapes to measure for fitting to specification.
	2.4 Comply given tolerance.
	2.5 Prepare list of appropriate materials by interpreting detail drawings and determine quantities of such materials.
	2.6 Ensure dimensional accuracy of assembly by using different instruments/gauges.
	2.7 Explain basic electricity, insulation & earthing.
3. Interpret specifications, different engineering drawing and apply for different application in the field of work. [Different engineering drawing- Geometrical construction, Dimensioning, Layout, Method of representation, Symbol, scales, Different Projections, Machined components & different thread forms, Assembly drawing, Sectional views, Estimation of material, Electrical & electronic symbol]	3.1 Read & interpret the information on drawings and apply in executing practical work.
	3.2 Read & analyse the specification to ascertain the material requirement, tools, and machining /assembly /maintenance parameters.
	3.3 Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
4. Select and ascertain measuring instrument and	4.1 Select appropriate measuring instruments such as micrometers, vernier calipers, dial gauge, bevel

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measure dimension of components and record data.	protector and height gauge (as per tool list).
	4.2 Ascertain the functionality & correctness of the instrument.
	4.3 Measure dimension of the components & record data to analyse the with given drawing/measurement.
5. Explain the concept in productivity, quality tools, and labour welfare legislation and apply such in day to day work to improve productivity & quality.	5.1 Explain the concept of productivity and quality tools and apply during execution of job.
	5.2 Understand the basic concept of labour welfare legislation and adhere to responsibilities and remain sensitive towards such laws.
	5.3 Knows benefits guaranteed under various acts
6. Explain energy conservation, global warming and pollution and contribute in day to day work by optimally using available resources.	6.1 Explain the concept of energy conservation, global warming, pollution and utilize the available recourses optimally & remain sensitive to avoid environment pollution.
	6.2 Dispose waste following standard procedure.
7. Explain personnel finance, entrepreneurship and manage/organize related task in day to day work for personal & societal growth.	7.1 Explain personnel finance and entrepreneurship.
	7.2 Explain 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.
	7.3 Prepare Project report to become an entrepreneur for submission to financial institutions.
8. Plan and organize the work related to the occupation.	8.1 Use documents, drawings and recognize hazards in the work site.
	8.2 Plan workplace/ assembly location with due consideration to operational stipulation
	8.3 Communicate effectively with others and plan project tasks
	8.4 Assign roles and responsibilities of the co-trainees for execution of the task effectively and monitor the same.

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SPECIFIC OUTCOME
<u>Block-I</u>
<i>Assessment Criteria i.e. the standard of performance, for each specific learning outcome mentioned under block – I(section: 10) must ensure that the trainee achieves well developed skill with clear choice of procedure in familiar context. Assessment criteria should broadly cover the aspect of Planning (Identify, ascertain, estimate etc.); Execution (perform, illustration, demonstration etc. by applying 1) a range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools, materials and information 2) Knowledge of facts, principles, processes, and general concepts, in a field of work or study 3)Desired Mathematical Skills and some skill of collecting and organizing information, communication) and Checking/ Testing to ensure functionality during the assessment of each outcome. The assessments parameters must also ascertain that the candidate is responsible for own work and learning and some responsibility for other's work and learning.</i>

BASIC TRAINING (Block – I)**Duration: (03) Three Months**

Week No.	Professional Skills (Trade Practical)	Professional Knowledge (Trade Theory)
1	1. Preventive measures for electrical accidents and use of fire extinguishers. 2. Practice elementary first aid and artificial respiration. 3. Disposal procedure of waste materials. 4. Use of personal protective equipment. Familiarization with signs and symbols of electrical Accessories.	Scope of the trade. Safety rules and safety signs. Types and working of fire extinguishers. First aid safety practice. Hazard identification and prevention. Response to emergencies, e.g. power failure, system failure and fire etc. Concept of Standards and advantages of BIS/ISI.
2	5. Workshop practice on filing and hacksawing, sawing, planning, drilling and assembling for making a wooden switchboard. 6. Workshop practice on drilling, chipping, internal and external threading of different sizes. 7. Prepare an open box from metal sheet. 8. Practice on skinning, twisting and crimping.	Trade tools specifications. Electrical symbols. Introduction to National Electrical Code-2011. Fundamentals of electricity. Concept of current, voltage, power, resistors and capacitors. Generation of DC electricity. Electrical conductors and insulators. Differentiate between AC and DC current.
3	9. Identify various types of cables and measure conductor size using SWG and micrometer. 10. Make joints on single strand conductors. 11. Practice in crimping and soldering of joints / lugs. 12. Measure parameters in combinational DC circuits by	Types of joints and techniques of soldering. Ohm's Law; Simple electrical circuits and problems. Kirchoff's Laws and applications. Series and parallel circuits. Open and short circuits in series and parallel networks. Series and parallel combinations of resistors.

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	applying Ohm's Law for different resistor values and voltage sources. 13. Measure current and voltage in DC circuits to verify Kirchhoff's Law. 14. Verify laws of series and parallel circuits with voltage source in different combinations.	
4	15. Measure current and voltage and analyse the effects of shorts and opens in series and parallel circuits. 16. Verify the characteristics of series parallel combination of resistors. 17. Determine the poles and plot the field of a magnet bar. 18. Identify various types of capacitors, charging / discharging and testing. 19. Test AC circuit with resistive load like lamp, heater, etc. 20. Test AC circuit with inductive load like fan, pump, etc. 21. Measure power, energy for lagging and leading power factors in single phase circuits.	Magnetic terms, magnetic materials and properties of magnet. Electrostatics: Capacitor- Different types, functions, grouping and uses. Inductive and capacitive reactance and their effect on AC circuit. Comparison and Advantages of DC and AC systems. Sine wave, phase and phase difference. Related terms frequency, Instantaneous value, R.M.S. value Average value, Peak factor, form factor, power factor and Impedance etc. Active and Reactive power.
5	22. Measure Current, voltage, power, energy and power factor in three phase circuits. 23. Ascertain use of neutral by identifying wires of a 3-phase 4 wire system and find the phase sequence. 24. Determine the relationship between Line and Phase values for star and delta connections. 25. Measure the Power of three phase circuit for balanced and unbalanced loads. 26. Identify various conduits and different electrical accessories.	Single Phase and three-phase system. Advantages of AC poly-phase system. Concept of three-phase Star and Delta connection. Line and phase voltage, current and power in a 3 phase circuits with balanced and unbalanced load.

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6	27. Practice cutting, threading of different sizes & laying Installations. 28. Prepare test boards / extension boards and mount accessories like lamp holders, various switches, sockets, fuses, relays, MCB, ELCB, MCCB etc. 29. Drawing layouts and practice in PVC Casing-capping, Conduit wiring with minimum to number of points as per IE rules. 30. Wire up PVC conduit wiring to control one lamp from two different places using two way switch.	I.E. rules on electrical wiring. Types of domestic and industrial wirings. Study of wiring accessories e.g. switches, fuses, relays, MCB, ELCB, MCCB, switchgears etc. Grading of cables and current ratings. Principle of laying out of Domestic wiring. Voltage drop concept. PVC conduit and Casing-capping wiring system. Different types of wiring Power, control, Communication and entertainment wiring.
7	31. Practice testing / fault detection of domestic and industrial wiring installation and repair. 32. Practice control panel wiring using wiring accessories and mounting of control elements, e.g. meters, fuses, relays, switches, push buttons, MCB, ELCB etc. 33. Prepare different types of earthing and measure earth resistance by earth tester / megger. 34. Practice Installation of lightning arrestor.	Wiring circuits planning, permissible load in sub-circuit and main circuit. Importance of Earthing. Plate earthing and pipe earthing methods and IEE regulations. Earth resistance and earth leakage circuit breaker. Lightning arrestor.
8	35. Identify and practice of various analog and digital measuring Instruments. 36. Practice on measuring instruments in single and three phase circuits e.g. multi-meter, Wattmeter, Energy meter, Phase sequence meter and Frequency meter etc. 37. Test single phase energy meter for	Classification of electrical instruments and essential forces required in indicating instruments. PMMC and Moving iron instruments. Range extension. Wattmeter, PF meter, Energy meter, Megger, Earth tester, Frequency meter, Phase sequence meter, Multimeter, Tong tester etc. Instrument transformers – CT and PT.

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	its errors. 38. Measure power consumption for different loads with various times of use and calculate watt-hour. 39. Find out power ratings from product label and prepare a load calculation chart.	
9	40. Verify terminals, identify components and calculate the transformation ratio of single phase transformers. 41. Perform OC and SC test to determine and efficiency of single phase transformer. 42. Visit to transmission / distribution substation. 43. Draw actual circuit diagram of substation visited and indicate various components. • Repeat Electrical major fitting practices • Clarify difficult points in Electrical wiring and substation control points	Calculation of total watt hour of all loads per day and daily average watt hour from twelve months electricity bill. Working principle of transformer. Electric power demand, supply and gap in city, state and national level. Conventional energy Generation by thermal (coal, gas diesel) and hydel power plant. (small and large) Advantages of high voltage transmission. Transmission network of India. Study of distribution of power and substation. Overhead v/s underground distribution system. Non-renewable and Renewable energy concept. Advantages over non renewable energy; brief discussion main renewable energy resources viz. solar (PV and thermal), wind, Biofuel, Biomass, small hydro, Tidal power, Wave power, Geo thermal energy etc.
10	44. Plot sun chart and locate the sun at your location for a given time of the day. 45. Find out relations between sunlight and earth motion by globe model. 46. Observe and compare sunlight and angle of inclination during 12 hours of a day on different days. 47. Locate magnetic poles (North and	Solar energy fundamentals. Study of Sun path (east to west, North to south and south to north movement). Study of daily and seasonal changes of sunlight. Angle of inclination of radiant light and its relation with latitude and longitude of different locations on Earth. Definition of key earth-sun angles. Equation of time, solar constant etc. Definition of GHI & DNI. Definition of

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	South) with the help of magnetic compass. 48. Observe on Globe, which countries are in the Northern hemisphere and which on the Southern hemisphere. 49. Prepare a list of places around India, their latitude and longitude. 50. Measure intensity of solar radiation using Solar Insolation meter. 51. Analyse shadow effect on incident solar radiation and find out contributors.	tracking (single axis and double axis) Solar radiation over India (measurements, satellite data and maps) (10-12 years historical data) Application of sun chart on shadow identification. Sunlight spectrum.
11	52. Plot curve of radiation measured with respect to time for a location. 53. Draw a solar map by collecting data of solar radiation in a location for one year. 54. Compare the effects of direct radiation, diffused radiation and reflected radiation and prepare reports. 55. Test an LED and a Photodiode to verify the photo emitting effect and light sensitivity. 56. Test a Photo voltaic cell for different illumination levels and verify photovoltaic property. 57. Plot I-V curve for photovoltaic cell based on the illumination at constant temperature. 58. Plot I-V curve for photovoltaic cell based on temperature at constant illumination. 59. Test photovoltaic cell in sunlight at various angles of inclination and direction. 60. Test different rated Photovoltaic	Semiconductor properties and types. P-type and N-type semiconductors, PN junction, etc. Conversion of solar radiation to electricity. Main materials used to develop solar cells (Silicon, Cadmium tellurides, etc.). Light sensitive properties of PN junction. Difference of photo electric and photo voltaic effects of a PN junction. PV cell characteristics, I-V curve, effects of temperature. Photovoltaic effect. Photo voltaic module: minimal functional specification, cells per module, max watts per module, maximum voltage at max power, maximum current at max power. Standard test conditions (STC) of a PV module.

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	modules (Panels) and plot I-V curve. 61. Record specification of different solar panels and compare specifications to select a panel.	
12	62. Test different types of PV panels such as, mono crystalline, poly crystalline, amorphous silicon and thin film modules. Prepare a report on panels. 63. Determine the relation between number of cells and maximum voltage per module. Connect suitably rated wires in the terminal box of a solar panel and connect end terminals using MC 4 connectors. 64. Connect solar panels in series and measure voltage and current. Repeat with different rated panels. 65. Connect solar panels in parallel and measure voltage and current. Repeat with different rated panels. 66. Shift the panels to rooftop or the place of installation using safe handling practices.	Terminal box and connectors of a Solar PV module. Identification of various test standards of PV module. Measurement of area of the cells and compare with the module area in data sheet. Identification of faulty PV module. Solar PV array; series and parallel calculation. Handling of PV modules. Module mounting; structures requirement. Photovoltaic cell and PV modules: types - mono crystalline, poly crystalline, amorphous silicon and thin film PV cells and their comparison. Recent thin film technologies (CdTe, GIGS, CIS etc.) Safe handling of panels.
13	Revision & Examination	

NOTE: -

- *More emphasis to be given on video/real-life pictures during theoretical classes. Some real-life pictures/videos of related industry operations may be shown to the trainees to give a feel of Industry and their future assignment.*

9.1 WORKSHOP CALCULATION SCIENCE & ENGINEERING DRAWING

Block – I		
Sl. No.	Workshop Calculation and Science (Duration: - 20 hrs.)	Engineering Drawing (Duration : - 30 hrs.)
1	Unit: Systems of unit- FPS, CGS, MKS/SI unit, unit of length, Mass and time, Conversion of units.	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
2	Fractions & Simplification: Fractions, Decimal fraction, Addition, Subtraction, Multiplication and Division of Fractions and Decimals, conversion of Fraction to Decimal and vice versa. Simple Simplification using BODMAS.	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
3	Square Root: Square and Square Root, method of finding out square roots, Simple problem using calculator.	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.
4	Percentage: Introduction, Simple calculation. Changing percentage to	Lettering and Numbering as per BIS SP46-2003: - Single Stroke, Double Stroke, inclined,

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	decimal and fraction and vice-versa.	Upper case and Lower case.
5	Material Science : properties -Physical & Mechanical, Types –Ferrous & Non-Ferrous, introduction of Iron, Cast Iron, Wrought Iron, Steel, Alloy steel, carbon steel, stainless steel, Non-Ferrous metals, Non-Ferrous Alloys.	Free Hand sketch: Hand tools and measuring instruments used in Electrician trade.
6	Mass, Weight and Density : Mass, Unit of Mass, Weight, Density, unit of density, specific gravity of metals.	Free hand drawing of : - Lines, polygons, ellipse, etc. - geometrical figures and blocks with dimension - Transferring measurement from the given object to the free hand sketches.
7	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 Electrical units.	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 - Solar panels -Solar Batteries -Solar Inverter
8	Algebra: Addition, Subtraction, Multiplication, Division, Algebraic formula.	Construction of Scales and diagonal scale 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.
9	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.	Single line diagram of 1 KW solar plant – off grid Single line diagram of 1 KW solar plant – on grid.

9.2 EMPLOYABILITY SKILLS**(DURATION: - 55 HRS.)**

Topic No.	Topic	Duration (in hours)
English Literacy		7
1.	Reading Reading and understanding simple sentences about self, work and environment	
2.	Writing Construction of simple sentences Writing simple English	
3.	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. 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		10
1.	Basics of Computer Introduction, Computer and its applications, Hardware and peripherals, Switching on-Starting and shutting down of computer.	
2.	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. Use of External memory like pen drive, CD, DVD etc,	
3.	Computer Networking and INTERNET 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.	
Communication Skill		18
1.	Introduction to Communication Skills Communication and its importance Principles of Effective communication Types of communication - verbal, nonverbal, written, email, talking on phone. Nonverbal communication - components-Para-language Body - language	

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	Barriers to communication and dealing with barriers.	
2.	Listening Skills Listening-hearing and listening, effective listening, barriers to effective listening guidelines for effective listening.	
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.	
4.	Facing Interviews Manners, Etiquettes, Dress code for an interview Do's & Don'ts for an interview	
Entrepreneurship skill		8
1.	Concept of Entrepreneurship Entrepreneurship- Entrepreneurship - Enterprises:-Conceptual issue. Source of business ideas, Entrepreneurial opportunities, The process of setting up a business.	
2.	Institutions Support 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.	
Productivity		
1.	Productivity Definition, Necessity.	
2.	Affecting Factors Skills, Working Aids, Automation, Environment, Motivation How improves or slows down.	
3.	Personal Finance Management Banking processes, Handling ATM, KYC registration, safe cash handling, Personal risk and Insurance.	
Occupational Safety, Health & Environment Education		6
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	

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	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	
Labour Welfare Legislation		
1.	Welfare Acts Benefits guaranteed under various acts- Factories Act, Apprenticeship Act, Employees State Insurance Act (ESI), Employees Provident Fund Act.	
Quality Tools		6
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.	House Keeping : Purpose of Housekeeping, Practice of good Housekeeping.	
4.	Quality Tools Basic quality tools with a few examples	

10. DETAILS OF COMPETENCIES (ON-JOB TRAINING)

1. Follow safety procedures for electrical installations by selection of proper tools & measuring instruments.
2. Assemble, install and test wiring system & carry out soldering and crimping.
3. Construct and test various characteristics of electrical and magnetic circuits.
4. Perform basic Electric energy calculations and understand transmission and distribution of electrical power.
5. Verify natural planetary movements and sunlight's path.
6. Demonstrate characteristics of Photovoltaic cells, Modules, Batteries and Charge controllers and Solar DC appliances.
7. Connect, test & maintain solar panel, batteries, Charge controller, Battery bank and Inverter.
8. Perform various tests and measurement pertaining to PV Modules and their installation as per IEC standards.
9. Assist in Installation and commissioning of Solar PV plant and Hybrid plant and use PV system software.
10. Perform manufacturing of solar panel, prepare and commission marketable solar products.
11. Perform assembly, install, test and maintain Solar PV DC products and systems
12. Perform practice on HV installations and their maintenance including Earthing methods and Lightning arrestors.
13. Perform SCADA monitoring on Solar PV plant.

Note:

1. Industry must ensure that above mentioned competencies are achieved by the trainees during their on job training.
2. In addition to above competencies/ outcomes industry may impart additional training relevant to the specific industry.

INFRASTRUCTURE FOR PROFESSIONAL SKILL & PROFESSIONAL KNOWLEDGE

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LIST OF TOOLS AND EQUIPMENT for Basic Training (For 20 Apprentices)			
A. TRAINEES TOOL KIT			
Sl. No.	Name of the Tool & Equipments	Specification	Quantity
1.	Measuring Steel Tape	5 meter	21 (20+1) Nos.
2.	Combination Plier Insulated	200 mm	21 (20+1) Nos.
3.	Screw Driver Insulated	4mm X 150 mm, Diamond Head	21 (20+1) Nos.
4.	Screw Driver Insulated	6mm X 150 mm	21 (20+1) Nos.
5.	Electrician screw driver thin stem insulated handle	4mm X 100 mm	21 (20+1) Nos.
6.	Heavy Duty Screw Driver insulated	5mm X 200 mm	21 (20+1) Nos.
7.	Electrician Screw Driver thin stem insulated handle	4mm X 250 mm	21 (20+1) Nos.
8.	Punch Centre	9mm X 150 mm	21 (20+1) Nos.
9.	Knife Double Bladed Electrician	100 mm	21 (20+1) Nos.
10.	Neon Tester	500 V	21 (20+1) Nos.
11.	Steel Rule Graduated both in Metric and English Unit	300 mm with precision of 1/4th mm	21 (20+1) Nos.
12.	Hammer, cross peen with handle	250 grams	21 (20+1) Nos.
B. SHOP TOOLS & EQUIPMENT			
(i) List of Tools & Accessories			
13.	Electrical Symbol and Accessories Charts		04 nos.
14.	Pipe vice Cast Iron with hardened jaw open type	100 mm	2 Nos.
15.	Hand Vice	50 mm jaw	2 Nos.
16.	Table Vice	100 mm jaw	2 Nos.
17.	Hacksaw frame (with blade)	Adjustable 300 mm Fixed 150 mm	2 Nos. Each
18.	File flat	200 mm 2nd cut with handle	2 Nos.
19.	File half round	200 mm 2nd cut with handle	2 Nos.
20.	File round	200 mm 2nd cut with handle	2 Nos.
21.	Pliers long nose insulated	150 mm	4 Nos.
22.	Pliers flat nose insulated	200 mm	4 Nos.

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23.	Pliers, round nose insulated	100 mm	4 Nos.
24.	D.E. metric Spanner Double Ended	6 - 32 mm	2 Set
25.	Gauge, wire imperial stainless steel marked in SWG & mm	Wire Gauge - Metric	2 Nos.
26.	Portable Electric Drill Machine	0-12 mm capacity 750W, 240V with chuck and key	1 No.
27.	Crimping Tool	1.5 sq mm to 16 sq mm 16 sq mm to 95 sq mm	1 No. Each
28.	Pliers Side Cutting	150 mm	2 No.
29.	Wire stripper adjustable length		2 No.
30.	Hammer, ball peen With handle		2 No.
31.	Scriber (Knurled centre position)		2 No.
32.	Tool kit Box/bag portable		5 No.
33.	Allen Key		1 Set
34.	Scissors blade	150 mm	2 No.
35.	Electrical loads: set of Incandescent lamp, Tube light, CFL, LED light, Heater and Geyser	Electrical loads: set of Incandescent lamp, Tube light, CFL, LED light, Heater and Geyser	2 Set
36.	Torque wrench	8N-m to 15N-m	1 No.
37.	Pipe Cutter to cut pipes	upto 5 cm. dia	1 No.
38.	Pipe Cutter to cut pipes	above 5 cm dia	1 No.
39.	Try Square	150 mm blade	2 No.
40.	Multi Meter (analog)	0 to 1000 M Ohms, 2V to 500 V, 100 microA to 10A DC and AC	1 No
41.	Load Bank (variable)	Up to 1.2 KW (Lamp / heater Type)	1 No.
42.	Wire Cutter and Stripper	150 mm	4 Nos.
43.	Earth Plate	60cm X 60cm X 3.15mm Copper Plate 60cm X 60cm X 6mm GI Plate	1 Each
44.	Earth Electrode	Primary Electrode 2100x28x3.25mm Secondary Cu Strip 20x5mm	1 No.
45.	Out Side Micrometer	0 - 25 mm least count 0.01mm	2 Nos.
46.	Tap set	Different size	02 Set Each
47.	Trolley for Transportation of Batteries		02 Nos.
48.	Die for Threading	Different sizes	02 Set
49.	Rooftop Mounting Structure	For 4 x 250 W solar panels mounting practice, with tilt adjustment	2 Set

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50.	Electrical wiring and switch gear rack	Electrical control elements suitable for practice of control circuits using banana plugs and sockets	1 No.
51.	Protective relays and contactors rack	suitable for practice of control circuits using banana plugs and sockets	1 No.
52.	MCCB	100Amps, Triple pole	1 No.
53.	ELCB and RCCB	25Amps, double pole and 25Amps, double pole, IΔn 30 mA	1 Each
54.	Fuses	HRC Glass Rewire Type	4 Each
55.	Cables: Twisted Pair Nonmetallic Sheathed Cable Underground Feeder Cable Ribbon Cable Metallic Sheathed Cable Multi-Conductor Cable Coaxial Cable Direct-Buried Cable	1 mtr each	1 Each
56.	Solar cable (Red)	5 square mm	As required
57.	Solar cable (Black)	5 square mm	As required
58.	Three core wire	(230 V, 15 A)	As required
59.	Battery cable	7.5 sqmm	As required
60.	Resin cored Solder and Solder wax		As required
61.	MC – 4 connector, pins and lugs	5 mm and 7.5 mm	As required
62.	Hacksaw blades	200 mm, 300 mm	As required
63.	Bolts, nuts, anchor bolts, washers, screws, other pins, lugs etc		As required
64.	Civil work utensils	spade, mixing spoon, leveling plates	1 Set
65.	Civil work raw materials		As required
(ii) List of Equipment			
66.	Multimeter	Digital 0 to 1000 M Ohms, 2V to 700 V, 100 microA to 10A DC and AC	02 Nos.

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67.	Megger	Analog - 500 V	01 Nos.
68.	Hydrometer		04 Nos.
69.	Solar Insolation meter		02 Nos.
70.	Magnetic Flux Meter	0-500 tesla	02 Nos.
71.	Tong Tester / Clamp Meter	0 - 100 A (Digital Type)	01 Nos.
72.	Soldering Iron	25 Watt, 65 Watt and 120 Watt, 230 Volt	02 Nos. Each
73.	Temperature controlled Soldering Iron	50 Watt, 230 Volt	02 Nos.
74.	Thermometer Digital	0° C - 150° C	01 No.
75.	Solar cell based sunlight radiation meter	For Solar power measurement up to 2000 w/square meter	02 No.
76.	Magnetic compass		04 No.
77.	Cut models of photo voltaic cell assembly		02 Nos.
78.	Cut model of Lead acid battery		01 No.
79.	Lead Acid battery	12V, 40Ah, 75Ah	01 Each
80.	Lead Acid battery	12V, 100 Ah	04 Nos.
81.	Solar simulator for solar cell characteristic study	To study IV curve of a solar cell of minimum 2 watt under variable illumination, temperature and suitable load	01 No.
82.	Sun path finder		01 No.
83.	Solar energy trainer with grouping of solar cells	To group (series or parallel) at least six solar cells each with minimum 2 W with suitable loads	01 No.
84.	Solar tracker demonstrator kit	To study manual and automatic control of 10 W solar panel in East- west and North-south &back	01 No.
85.	Solar PV e-learning software using animations for training		01 License
86.	Halogen lamp with stand for illumination of solar panels in lab	AC mains operated to provide 0 to 1000 watts per meter square	02 Set
87.	Motorized Bench Grinder	AC mains operated	01 No.
88.	Battery Charger	0 - 6 - 9 - 12 - 24 - 48 V, 30amp	01 No.

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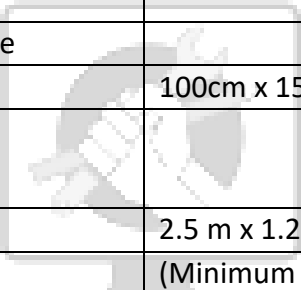
89.	Solar photovoltaic module	75 W mono crystalline module 75 W amorphous silicon module 250 W thin film module 5W, 10W, 40W poly crystalline module	01 Each
90.	Solar panels	250 Wp	04 Nos.
91.	Solar Charge controller with Dusk to Dawn automatic switching	12V, 10A	05 Nos.
92.	Solar charge controller with manual switch (Day lighting)	12 V 10 A	05 Nos.
93.	Array junction box	for connecting 250W x 4 Nos. solar panel with DC fuse, DC MCB, and surge suppressor protection	02 Nos.
94.	Solar lantern assembly set	LED type	01 No.
95.	Solar lantern assembly set	CFL type	01 No.
96.	Home light system	12 V DC with FM receiver, LED bulb and mobile charger as loads	01 No.
97.	Clinometer	for Angle measurement	01 No.
98.	Spirit level	For floor level check	01 No.
99.	Anemometer	for wind speed measurement	01 No.
100.	DC table fan	12 V	01 No.
101.	A.C. Voltmeter M.I	0 –500V AC	02 Nos.
102.	Volt meter	0 - 30V	02 Nos.
103.	Volt meter	0 - 100V	02 Nos.
104.	Ammeter MC	0 - 1A	02 Nos.
105.	Ammeter MC	0 - 5A	02 Nos.
106.	Ammeter MC centre zero	0 - 20A	02 Nos.
107.	Ammeter MC centre zero	0-50A	02 Nos.
108.	Power Factor Meter		01 No.
109.	Rheostat	0 -1 Ohm, 5 Amp 0 -10 Ohm, 5 Amp 0- 25 Ohm, 1 Amp 0- 300 Ohm, 1 Amp	01 No. each
110.	A.C. Energy Meter	Single Phase, 10 A, 240 V	01 No.

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		induction type	
111.	A.C. Energy Meter	Three Phase, 15 A, 440 V induction type	01 No.
112.	Kilo Wattmeter Analog	0-1.5-3KW, pressure coil rating- 240v/440v, current rating- 5A/10A Analog, portable type Housed in bakelite case	02 Nos.
113.	Digital Wattmeter	230 V, 1 KW, 50 Hz	02 Nos.
114.	Phase Sequence Indicator	3 Phase, 415 V	02 Nos.
115.	Frequency Meter	45 to 55 Hz	02 Nos.
116.	DC LED Lamp	3W, 5W, 10W	50 Each
117.	DC Pump	24 V	02 Nos.
118.	PWM Controller		04 Nos.
119.	MPPT Charge Controller		04 Nos.
120.	Inverter with Battery	1 KVA with 12 V Battery Input- 12 volt DC, Output- 220 volt AC	01 No.
121.	Solar PCU	Off grid 1 KW MPPT Sine wave Solar Power Conditioning Unit	04 Nos.
122.	Solar Grid tied inverter Demonstrator kit	300W KW	01 No.
123.	Solar Street Light	12V, 75Ah battery, 75 Wp solar panel, 12V, 10A dusk to dawn charge controller, 60 W LED lights and 9 m height pole all dismountable	01 Nos.
124.	Rechargeable battery	12 V 100 Ah	As required
125.	Rechargeable battery	12 V 7 Ah	As required
126.	Rechargeable battery	6 V 5 Ah	As required
127.	LED lights	12 V DC	As required
128.	LED lights	6 V DC	As required
C. SAFETY AND PROTECTIVE EQUIPMENT			
129.	Rubber gloves		10 Pair
130.	Cotton gloves		05 Pair
131.	Gum boots		02 Pair
132.	Safety Goggles		04 Nos.
133.	Safety Helmet		04 Nos.

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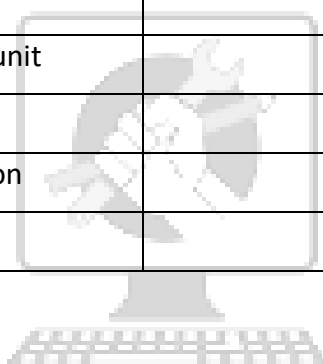
134.	First Aid kit		02 Nos.
135.	Fire Extinguisher CO ₂	2 KG	02 Nos.
136.	Fire Buckets	Standard size	02 Nos.
137.	Safety sign boards		1 set
D. SHOP FLOOR FURNITURE AND MATERIALS			
138.	Working Bench	2.5 m x 1.20 m x 0.75 m	04 Nos.
139.	Wiring Board	3 meters x 1 meter with 0.5 meter projection on the top	01 No.
140.	Instructor's table		01 No.
141.	Instructor's chair		02 Nos.
142.	Trainee Chair		01 for Each Trainee
143.	Trainee table for two trainee		10 Nos.
144.	Metal Rack	100cm x 150cm x 45cm	04 Nos.
145.	Lockers with drawers		01 for Each Trainee
146.	Almirah	2.5 m x 1.20 m x 0.5 m	01 No.
147.	Black board/white board	(Minimum 4X6 feet)	01 No.
Note: - 1. All the tools and equipment are to be procured as per BIS specification.			



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E. ADDITIONAL STORE REQUIREMENT IN INDUSTRY (Not required in BTP)			
148.	Safety Full body PPE kit	Suitable to use high voltage installation	04 nos
149.	HV tester with hand gloves		1 set
150.	Higher capacity SPV plant (On grid/off grid) or ongoing projects		
151.	Material handling equipment as required for field work in ground mount installation		
152.	SCADA monitoring actual onsite installation		
153.	Solar panel manufacturing unit		
154.	Business development cell		
155.	Lightning arrestor installation		
156.	HV substation		



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

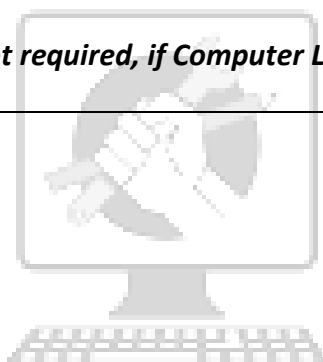
TRADE: SOLAR TECHNICIAN (ELECTRICAL)

LIST OF TOOLS& EQUIPMENTS FOR -20APPRENTICES**1) Space Norms** : 45 Sq. m.(For Engineering Drawing)**2) Infrastructure:**

A : TRAINEES TOOL KIT:-			
Sl. No.	Name of the items	Specification	Quantity
1.	Draughtsman drawing instrument box		20+1 set
2.	Set square celluloid 45° (250 X 1.5 mm)		20+1 set
3.	Set square celluloid 30°-60° (250 X 1.5 mm)		20+1 set
4.	Mini drafter		20+1 set
5.	Drawing board (700mm x500 mm) IS: 1444		20+1 set
B : Furniture Required			
Sl. No.	Name of the items	Specification	Quantity
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	8ft. x 4ft	01
7	Trainer's Table		01
8	Trainer's Chair		01

Tools & Equipments for Employability Skills

Sl. No.	Name of the Equipment	Quantity
1.	Computer (PC) with latest configurations and Internet connection with standard operating system and standard word processor and worksheet software	10 Nos.
2.	UPS - 500VA	10 Nos.
3.	Scanner cum Printer	1 No.
4.	Computer Tables	10 Nos.
5.	Computer Chairs	20 Nos.
6.	LCD Projector	1 No.
7.	White Board 1200mm x 900mm	1 No.
Note: - Above Tools & Equipments not required, if Computer LAB is available in the institute.		



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FORMAT FOR INTERNAL ASSESSMENT

Name & Address of the Assessor :						Year of Enrollment :								
Name & Address of ITI (Govt./Pvt.) :						Date of Assessment :								
Name & Address of the Industry :						Assessment location: Industry / ITI								
Trade Name :			Semester:			Duration of the Trade/course:								
Learning Outcome:														
Sl. No	Maximum Marks (Total 100 Marks)		15	5	10	5	10	10	5	10	15	15	Total internal assessment Marks	Result (Y/N)
	Candidate Name	Father's/Mother's Name	Safety consciousness	Workplace hygiene	Attendance/ Punctuality	Ability to follow Manuals/ Written instructions	Application of Knowledge	Skills to handle tools & equipment	Economical use of materials	Speed in doing work	Quality in workmanship	VIVA		
1														
2														