



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

**COMPETENCY BASED CURRICULUM**

# **ELECTRICIAN**

(Duration: Two Years)

**CRAFTSMEN TRAINING SCHEME (CTS)**

**NSQF LEVEL- 5**



**SECTOR – POWER**

# **ELECTRICIAN**

(Engineering Trade)

(Revised in 2017)

Version: 1.1

**CRAFTSMEN TRAINING SCHEME (CTS)**

**NSQF LEVEL- 5**

**Skill India**

कौशल भारत - कुशल भारत

Developed By

Ministry of Skill Development and Entrepreneurship  
Directorate General of Training

**CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE**

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## 1. COURSE INFORMATION

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During the two years duration of Electrician trade a candidate is trained on professional skill, professional knowledge, Engineering Drawing, Workshop Calculation & Science and Employability skill. In addition to this a candidate is entrusted to undertake project work and extracurricular activities to build up confidence. The Broad components covered professional skill, subjects are as below:-

**First Year**– In this year the trainee learns about safety and environment, use of fire extinguishers, artificial respiratory resuscitation to begin with. He gets the idea of trade tools & its standardization, identifies different types of conductors, cables & their skinning & joint making. Basic electrical laws like Kirchhoff's law, ohm's law, laws of resistances and their application in different combinations of electrical circuit are practiced along with laws of magnetism. The trainee practices on circuit for single phase and poly-phase circuits for 3 wire /4 wire balanced & unbalanced loads. Skilling practice on different types & combination of cells for operation and maintenance is being done. Wiring practice with installation of different accessories like ICDP switch, distribution fuse box and mounting energy meters are practiced as per IE rules for hostel/residential building, workshop and its fault detection is done by trainee. The trainee will practice for pipe & plate earthing. Different types of light fitting are to be done like HP/LP mercury vapour and sodium vapour are prominent. The trainee will practice on different types of measuring instruments like multimeter, wattmeter, energy meter, phase sequences meter, frequency meter, for measurement of electrical parameters in single & three phase circuits. He will gain skill on range extension, calibration and testing of meters. Practice for dismantling, assembling and testing of heating element equipment, induction heating equipment, grinding machines and washing machines will be done by trainee. Skill will be gained on transformer for operation, efficiency, series parallel operation, replacement of transformer oil and combination of single phase transformers for 3 phase operation. The trainee will practice on winding of small transformer.

**Second Year**– In this year the trainee will study the details of rotating machines: DC machines, induction motors, alternators & MG sets and practice on them. The trainee will practice on determining characteristics, their performance analysis, starting, speed control and reversing direction of rotation of machines. He will practice on parallel operation & synchronization of alternators, winding practice and over hauling will be practiced for DC machine and induction motors. Practices on diodes for bridge rectifier, switching devices & amplifiers by electronic components, different wave shape generation and testing by CRO is carried out. Designing control cabinet, assembling control elements and their wiring are to be practiced. Speed control of AC/DC motors by electronic controller is being practiced. The trainee will practice on testing, analyzing and repairing of voltage stabilizer, emergency light, battery charger, UPS and inverter. He will gain knowledge of thermal, hydel, solar & wind energy systems. The trainee will practice on distribution system, domestic service line and accessories & their protection by practicing on relay and circuit breaker for operation and maintenance.

## 2. TRAINING SYSTEM

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### 2.1 GENERAL

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

Electrician trade under CTS is one of the most popular courses delivered nationwide through network of ITIs. The course is of two years duration. It mainly consists of Domain area and Core area. The Domain area (Trade Theory & Practical) impart professional skills and knowledge, while Core area(Workshop Calculation and science, Engineering Drawing and Employability Skills) impart requisite core skill, knowledge and life skills. After passing out of the training programme, the trainee is awarded National Trade Certificate (NTC) by NCVT which is recognized worldwide.

#### **Trainee broadly needs to demonstrate that they are able to:**

- Read and interpret technical parameters/ documents, 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 & employability skills while performing jobs.
- 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.

### 2.2 CAREER PROGRESSION PATHWAYS

- Can appear in 10+2 examination through National Institute of Open Schooling (NIOS) for acquiring higher secondary certificate and can go further for General/ Technical education.
- Can take admission in diploma course in notified branches of Engineering by lateral entry.
- Can join Apprenticeship programme in different types of industries leading to National Apprenticeship certificate (NAC).
- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming instructor in ITIs.



## 2.3 COURSE STRUCTURE

Table below depicts the distribution of training hours across various course elements during a period of two-years: -

S No.	Course Element	Notional Training Hours
1	Professional Skill (Trade Practical)	2184
2	Professional Knowledge (Trade Theory)	504
3	Workshop Calculation & Science	168
4	Engineering Drawing	252
5	Employability Skills	110
6	Library & Extracurricular activities	142
7	Project work	320
8	Revision & Examination	480
	<b>Total</b>	<b>4160</b>

## 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 the Govt. of India from time to time. The employability skills will be tested in first year itself.

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 NTC will be conducted by NCVT as per the 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

For the purposes of determining the overall result, weightage of 100% is applied for six months and one year duration courses and 50% weightage is applied to each examination for two years courses. The minimum pass percent for Practical is 60% & minimum pass percent for Theory subjects is 33%.

## 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 teamwork, avoidance/reduction of scrap/wastage and disposal of scrap/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.

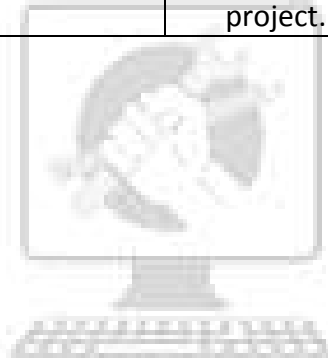
Assessment will be evidence based, comprising the following:

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

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

Performance Level	Evidence
<b>(a) Weightage in the range of 60 -75% to be allotted during assessment</b>	
For performance in this grade, the candidate should produce work which demonstrates attainment of an acceptable standard of craftsmanship with occasional guidance, and due regard for safety procedures and practices.	<ul style="list-style-type: none"> <li>• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment.</li> <li>• 60-70% accuracy achieved while undertaking different work with those demanded by the component/job.</li> <li>• A fairly good level of neatness and consistency in the finish.</li> <li>• Occasional support in completing the project/job.</li> </ul>
<b>(b)Weightage in the range of above75% - 90% to be allotted during assessment</b>	
For this grade, a candidate should produce work which demonstrates attainment of a reasonable standard of craftsmanship, with little guidance, and regard for safety procedures and practices.	<ul style="list-style-type: none"> <li>• Good skill levels in the use of hand tools, machine tools and workshop equipment.</li> <li>• 70-80% accuracy achieved while undertaking different work with those demanded by the component/job.</li> </ul>

	<ul style="list-style-type: none"> <li>• A good level of neatness and consistency in the finish</li> <li>• Little support in completing the project/job.</li> </ul>
(c) Weightage in the range of above 90% to be allotted during assessment	
<p>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.</p>	<ul style="list-style-type: none"> <li>• High skill levels in the use of hand tools, machine tools and workshop equipment.</li> <li>• Above 80% accuracy achieved while undertaking different work with those demanded by the component/job.</li> <li>• A high level of neatness and consistency in the finish.</li> <li>• Minimal or no support in completing the project.</li> </ul>



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**Electrician General;** installs, maintains and repairs electrical machinery equipment and fittings in factories, workshops power house, business and residential premises etc. Studies drawings and other specifications to determine electrical circuit, installation details etc. Positions and installs electrical motors, transformers, switchgears. Switchboards and other electrical equipment, fittings and lighting fixtures. Makes connections and solders terminals. Tests electrical installations and equipment and locates faults using megger, test lamps etc. Repairs or replaces defective wiring, burnt out fuses and defective parts and keeps fittings and fixtures in working order. May do armature winding, draw wires and cables and do simple cable jointing. May operate, attend and maintain electrical motors, pumps etc.

**Electrical Fitter;** fits and assembles electrical machinery and equipment such as motors, transformers, generators, switchgears, fans etc., Studies drawings and wiring diagrams of fittings, wiring and assemblies to be made. Collects prefabricated electrical and mechanical components according to drawing and wiring diagrams and checks them with gauges, megger etc. to ensure proper function and accuracy. Fits mechanical components, resistance, insulators, etc., as per specifications, doing supplementary tooling where necessary. Follows wiring diagrams, makes electrical connections and solders points as specified. Checks for continuity, resistance, circuit shorting, leakage, earthing, etc. at each stage of assembly using megger, ammeter, voltmeter and other appliances and ensures stipulated performance of both mechanical and electrical components fitted in assembly. Erects various equipment such as bus bars, panel boards, electrical posts, fuse boxes switch gears, meters, relays etc. using non-conductors, insulation hoisting equipment as necessary for receipt and distribution of electrical current to feeder lines. Installs motors, generators, transformer etc. as per drawings using lifting and hoisting equipment as necessary, does prescribed electrical wiring, and connects to supply line. Locates faults in case of breakdown and replaces blown out fuse, burnt coils, switches, conductors etc. as required. Checks, dismantles, repairs and overhauls electrical units periodically or as required according to scheduled procedure. May test coils. May specialize in repairs of particular equipment manufacturing, installation or power house work and be designated accordingly.

**Reference NCO-2015:**

- (i) 7411.0100 - Electrician General
- (ii) 7412.0200 - Electrical Fitter

## 4. GENERAL INFORMATION

<b>Name of the Trade</b>	<b>Electrician</b>
<b>NCO - 2015</b>	7411.0100, 7412.0200
<b>NSQF Level</b>	Level-5
<b>Duration of Craftsmen Training</b>	Two Years
<b>Entry Qualification</b>	Passed 10 <sup>th</sup> class examination with Science and Mathematics or its equivalent.
<b>Unit Strength (No. Of Student)</b>	20
<b>Space Norms</b>	98 Sq. metres
<b>Power Norms</b>	5.2 KW (for two units in one shift)
<b>Instructors Qualification for</b>	
<b>(i) Electrician Trade</b>	<p>Degree in Electrical/ Electrical and Electronics Engineering from recognized Engineering College/ university with one year experience in the relevant field.</p> <p style="text-align: center;"><b>OR</b></p> <p>Diploma in Electrical/ Electrical and Electronics Engineering from recognized board of technical education with two years experience in the relevant field</p> <p style="text-align: center;"><b>OR</b></p> <p>NTC/NAC passed in "Electrician" trade with three years post qualification experience in the relevant field.</p> <p><b><u>Essential Qualification:</u></b> Craft Instructor Certificate in relevant trade under NCVT.</p> <p><b><i>Out of two Instructors required for the unit of 2(1+1), one must have Degree/Diploma and other must have NTC/NAC qualifications.</i></b></p>
<b>(ii) Workshop Calculation &amp; Science</b>	<p>Degree in Engineering with one year experience.</p> <p style="text-align: center;"><b>OR</b></p> <p>Diploma in Engineering with two years experience.</p> <p><b><u>Essential Qualification:</u></b> Craft Instructor Certificate in RoD&amp; A course under NCVT.</p>
<b>(iii) Engineering Drawing</b>	<p>Degree in Engineering with one year experience.</p> <p style="text-align: center;"><b>OR</b></p>

	<p>Diploma in Engineering with two years experience.</p> <p style="text-align: center;"><b>OR</b></p> <p>NTC/ NAC in the Draughtsman (Mechanical / Civil) with three years experience.</p> <p><b>Essential Qualification:</b> Craft Instructor Certificate in RoD&amp; A course under NCVT.</p>					
<b>(iv) Employability Skill</b>	<p>MBA OR BBA with two years experience OR Graduate in Sociology/ Social Welfare/ Economics with Two years experience OR Graduate/ Diploma with Two years experience and trained in Employability Skills from DGT institutes.</p> <p style="text-align: center;">AND</p> <p>Must have studied English/ Communication Skills and Basic Computer at 12<sup>th</sup> / Diploma level and above.</p> <p><b>OR</b> <b>Existing Social Studies Instructors duly trained in Employability Skills from DGT institutes.</b></p>					
<b>List of Tools &amp; Equipment</b>	As per Annexure-I					
<b>Distribution of training on Hourly basis: (Indicative only)</b>						
Total Hrs /week	Trade Practical	Trade Theory	Workshop Cal. & Sc.	Engg. Drawing	Employability Skills	Extra-Curricular Activity
40 Hours	25 Hours	6 Hours	2 Hours	3 Hours	2 Hours	2 Hours

## 5. NSQF LEVEL COMPLIANCE

NSQF level for **Electrician trade** under CTS: Level 5

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
- e. Responsibility

The Broad Learning outcome of **Electrician trade** under CTS mostly matches with the Level descriptor at Level- 5.

The NSQF level-5 descriptor is given below:

Level	Process Required	Professional Knowledge	Professional Skill	Core Skill	Responsibility
Level 5	Job that requires well developed skill, with clear choice of procedures in familiar context	knowledge of facts, principles, processes and general concepts, in a field of work or study.	a range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools, materials and information	Desired mathematical skill, understanding of social, political and some skill of collecting and organising information, communication.	Responsibility for own work and learning and some responsibility for other's works and learning

## 6. LEARNING OUTCOME

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

### 6.1 GENERIC LEARNING OUTCOME

1. Apply safe working practices.
2. Comply with environment regulation and housekeeping.
3. Interpret & use company and technical communication
4. Demonstrate basic mathematical concept and principles to perform practical operations.
5. Understand and explain basic science in the field of study including simple machine.
6. Read and apply engineering drawing for different application in the field of work.
7. Understand and apply the concept in productivity, quality tools, and labour welfare legislation in day to day work to improve productivity & quality.
8. Explain energy conservation, global warming and pollution and contribute in day to day work by optimally using available resources.
9. Explain personnel finance, entrepreneurship and manage/organize related task in day to day work for personal & societal growth.
10. Utilize basic computer applications and internet to take benefit of IT developments in the industry.

### 6.2 SPECIFIC LEARNING OUTCOME

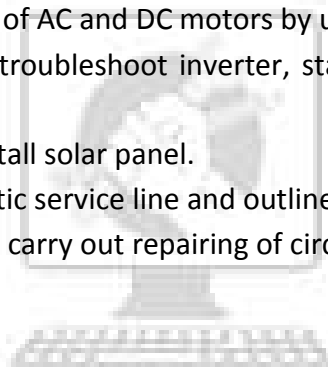
#### FIRST YEAR

11. Prepare profile with an appropriate accuracy as per drawing.
12. Prepare electrical wire joints, carry out soldering, crimping and measure insulation resistance of underground cable.
13. Verify characteristics of electrical and magnetic circuits.
14. Install, test and maintenance of batteries and solar cell.
15. Estimate, Assemble, install and test wiring system.
16. Plan and prepare Earthing installation.
17. Plan and execute electrical illumination system and test.
18. Select and perform measurements using analog / digital instruments.
19. Perform testing, verify errors and calibrate instruments.
20. Plan and carry out installation, fault detection and repairing of domestic appliances.
21. Execute testing, evaluate performance and maintenance of transformer.



**SECOND YEAR**

22. Plan, Execute commissioning and evaluate performance of DC machines.
23. Execute testing, and maintenance of DC machines and motor starters.
24. Plan, Execute commissioning and evaluate performance of AC motors.
25. Execute testing, and maintenance of AC motors and starters.
26. Plan, execute testing, evaluate performance and carry out maintenance of Alternator / MG set.
27. Execute parallel operation of alternators.
28. Distinguish, organise and perform motor winding.
29. Assemble simple electronic circuits and test for functioning.
30. Assemble accessories and carry out wiring of control cabinets and equipment.
31. Perform speed control of AC and DC motors by using solid state devices.
32. Detect the faults and troubleshoot inverter, stabilizer, battery charger, emergency light and UPS etc.
33. Plan, assemble and install solar panel.
34. Erect overhead domestic service line and outline various power plant layout.
35. Examine the faults and carry out repairing of circuit breakers.



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## 7. LEARNING OUTCOME WITH ASSESSMENT CRITERIA

GENERIC LEARNING OUTCOME	
LEARNING OUTCOME	ASSESSMENT CRITERIA
1. Apply safe working practices	1.1 Follow and maintain procedures to achieve a safe working environment in line with occupational health and safety regulations and requirements and according to site policy.
	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 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 Protective 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.
2. Comply with environment regulation and housekeeping	2.1 Identify environmental pollution & contribute to the avoidance of instances of environmental pollution.
	2.2 Deploy environmental protection legislation & regulations
	2.3 Take opportunities to use energy and materials in an environmentally friendly manner.
	2.4 Avoid waste and dispose waste as per procedure
	2.5 Recognize different components of 5S and apply the same in the working environment.
3. Interpret & use company and technical communication	3.1 Obtain sources of information and recognize information.
	3.2 Use and draw up technical drawings and documents.
	3.3 Use documents and technical regulations and occupationally

	related provisions.
	3.4 Conduct appropriate and target oriented discussions with higher authority and within the team.
	3.5 Present facts and circumstances, possible solutions & use English special terminology.
	3.6 Resolve disputes within the team.
	3.7 Conduct written communication.
4. Demonstrate basic mathematical concept and principles to perform practical operations.	4.1 Solve different problems like phase angle, etc. with the help of a calculator.
	4.2 Demonstrate conversion of Fraction to Decimal and vice versa.
	4.3 Explain BCD code, conversion from decimal to binary and vice-versa, all other conversions.
5. Understand and explain basic science in the field of study including simple machine.	5.1 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.
	5.2 Explain levers and its types.
	5.3 Explain relationship between Efficiency, velocity ratio and Mechanical Advantage.
	5.4 Prepare list of appropriate materials by interpreting detail drawings and determine quantities of such materials.
	5.5 Solve simple problems on lifting tackles like crane-Solution of problems with the aid of vectors.
6. Read and apply engineering drawing for different application in the field of work.	6.1 Read & interpret the information on drawings and apply in executing practical work.
	6.2 Read & analyse the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	6.3 Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
7. Understand and apply the concept in productivity, quality tools, and labour welfare legislation in day to day work to improve productivity & quality.	7.1 Explain the concept of productivity and quality tools and apply during execution of job.
	7.2 Explain basic concept of labour welfare legislation, adhere to responsibilities and remain sensitive towards such laws.
	7.3 Knows benefits guaranteed under various acts.

8. Explain energy conservation, global warming and pollution and contribute in day to day work by optimally using available resources.	8.1 Explain the concept of energy conservation, global warming, pollution and utilize the available resources optimally & remain sensitive to avoid environment pollution.
	8.2 Explain standard procedure for disposal of waste.
9. Explain personnel finance, entrepreneurship and manage/organize related task in day to day work for personal & societal growth.	9.1 Explain personnel finance and entrepreneurship.
	9.2 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 familiarize with the policies/programmes, procedure & the available scheme.
	9.3 Prepare a report to become an entrepreneur for submission to financial institutions.
10. Utilize basic computer applications and internet to take benefit of IT developments in the industry.	10.1 Explain the basic hardware of personal computer.
	10.2 Use common application software viz., word, excel, power point etc., in day to day work.
	10.3 Awareness about useful internet websites, search relevant information pertaining to the assigned tasks.

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SPECIFIC LEARNING OUTCOME	
LEARNING OUTCOME	ASSESSMENT CRITERIA
<b>FIRST YEAR</b>	
11. Prepare profile with an appropriate accuracy as per drawing.	11.1 Identify the trade tools; demonstrate their uses with safety, care & maintenance.
	11.2 Prepare a simple half lap joint using firmer chisel with safety.
	11.3 Prepare tray using sheet metal with the safety.
	11.4 Demonstrate fixing of surface mounting type of accessories.
	11.5 Perform connections of electrical accessories.
	11.6 Make and wire up of a test board and test it.
12. Prepare electrical wire joints, carry out soldering, crimping and measure insulation resistance of underground cable.	12.1 Observe safety/ precaution during joints & soldering.
	12.2 Make simple straight twist and rat-tail joints in single strand conductors.
	12.3 Make married and 'T' (Tee) joint in stranded conductors.
	12.4 Prepare a Britannia straight and 'T' (Tee) joint in bare conductors.
	12.5 Prepare western union joint in bare conductor.
	12.6 Solder the finished copper conductor joints with precaution.
	12.7 Prepare termination of cable lugs by using crimping tool.
	12.8 Make straight joint in different types of underground cables.
	12.9 Measure insulation resistance of underground cable.
13. Verify characteristics of electrical and magnetic circuits.	13.1 Identify types of wires, cables and verify their specifications.
	13.2 Verify the characteristics of series, parallel and its combination circuit.
	13.3 Analyze the effect of the short and open in series and parallel circuits.
	13.4 Verify the relation of voltage components of RLC series circuit in AC.
	13.5 Determine the power factor by direct and indirect methods in an AC single phase RLC parallel circuit.
	13.6 Identify the phase sequence of a 3 $\phi$ supply using a phase-sequence meter.
	13.7 Prepare/ connect a lamp load in star and delta and determine relationship between line and phase values with precaution.
	13.8 Connect balanced and unbalanced loads in 3 phase star system and measure the power of 3 phase loads.
	13.9 Make the solenoid and determine its polarity for the given direction of current.

	13.10	Group the given capacitors to get the required capacity and voltage rating.
14. Install, test and maintenance of batteries and solar cell.	14.1	Assemble a DC source 6V/500 mA using 1.5V cells.
	14.2	Determine the internal resistance of cell and make grouping of cells.
	14.3	Explain charging of battery and test for its condition with safety/ precaution.
	14.4	Carry out installation and maintenance of batteries.
	14.5	Determine total number of cells required for a given power requirement.
15. Estimate, Assemble, install and test wiring system.	15.1	Comply with safety & IE rules when performing the wiring.
	15.2	Prepare and mount the energy meter board.
	15.3	Draw and wire up the consumers main board with ICDP switch and distribution fuse box.
	15.4	Draw and wire up a bank/hostel/jail in PVC conduit.
	15.5	Identify the types of fuses their ratings and applications.
	15.6	Identify the parts of a relay, MCB & ELCB and check its operation.
	15.7	Estimate the cost of material for wiring in PVC channel for an office room having 2 lamps, 1 Fan, one 6A socket outlet and wire up.
	15.8	Estimate the requirement for conduit wiring (3 phase) and wire up.
	15.9	Estimate the materials and wire up the lighting circuit for a godown.
	15.10	Estimate the materials and wire up a lighting circuit for a corridor in conduit.
	15.11	Test, locate the fault and repair a domestic wiring installation.
16. Plan and prepare Earthing installation.	16.1	Plan work in compliance with standard safety norms related with earthing installation.
	16.2	Install the pipe earthing and test it.
	16.3	Install the plate earthing and test it.
	16.4	Measure the earth electrode resistance using earth tester.
	16.5	Carry out earth resistance improvement.
17. Plan and execute electrical illumination system and test.	17.1	Plan work in compliance with standard safety norms related with electrical illumination system.
	17.2	Install light fitting with reflectors for direct and indirect lighting.

	17.3	Assemble and connect a single twin tube fluorescent light.
	17.4	Connect, install and test the HPMV & HPSV lamp with accessories.
	17.5	Prepare and test a decorative serial lamp set for 240 V using 6V bulb and flasher.
	17.6	Install light fitting for show case window lighting.
18. Select and perform measurements using analog / digital instruments	18.1	Identify the type of electrical instruments.
	18.2	Extend the range of MC voltmeter and ammeter.
	18.3	Measure the frequency by frequency meter.
	18.4	Measure the power and energy in a single & three phase circuit using wattmeter and energy meter with CT and PT.
	18.5	Measure the value of resistance, voltage and current using digital multimeter.
	18.6	Measure the power factor in poly-phase circuit and verify the same with voltmeter, ammeter, watt-meter readings.
19. Perform testing, verify errors and calibrate instruments.	19.1	Test single phase energy meter for its errors.
	19.2	Determine the measurement errors while measuring resistance by voltage drop method.
	19.3	Calibrate the analog multimeter.
20. Plan and carry out installation, fault detection and repairing of domestic appliances.	20.1	Plan work in compliance with standard safety norms related with domestic appliances.
	20.2	Service and Repair of calling bell/ buzzer/ Alarm.
	20.3	Service and repair an automatic iron.
	20.4	Repair and service of oven having multi-range heat control.
	20.5	Replace the heating element in a kettle and test.
	20.6	Service and repair an induction heater.
	20.7	Service and repair a geyser.
	20.8	Service and repair a mixer.
	20.9	Service and repair of washing machine.
	20.10	Install a pump set.
	20.11	Service and repair of table fan.
	20.12	Service, repair and install a ceiling fan.
21. Execute testing, evaluate performance and maintenance of transformer.	21.1	Plan work in compliance with standard safety norms related with transformer.
	21.2	Identify the types of transformers and their specifications.
	21.3	Identify the terminals; verify the transformation ratio of a single phase transformer.
	21.4	Connect and test a single phase auto- transformer.

	21.5	Determine the losses (iron loss and copper loss) and the regulation of a single phase transformer at different loads.
	21.6	Measure the current and voltage using CT and PT.
	21.7	Carry out winding for small transformer of 1KVA rating.
	21.8	Test the transformer oil with oil testing kit.
	21.9	Connect 3 single phase transformers for 3 phase operation of delta-delta /delta-star /star-star /star-delta.
	21.10	Connect the given two single phase transformers in parallel /series (secondary only) and measure voltage.
	21.11	Connect & test 3 phase transformer in parallel.
<b>SECOND YEAR</b>		
22. Plan, Execute commissioning and evaluate performance of DC machines.	22.1	Plan work in compliance with standard safety norms related with DC machines.
	22.2	Determine the load performance of a different type of DC generator on load.
	22.3	Connect, start, run and reverse direction of rotation of different types of DC motors.
	22.4	Conduct the load performance tests on different type of DC motor.
	22.5	Control the speed of a DC motor by different method.
23. Execute testing, and maintenance of DC machines and motor starters.	23.1	Test a DC machine for continuity and insulation resistance.
	23.2	Maintenance, troubleshooting & servicing of DC machines.
	23.3	Test armature by using growler.
	23.4	Maintain, service and troubleshoot the DC motor starter.
24. Plan, Execute commissioning and evaluate performance of AC motors.	24.1	Plan work in compliance with standard safety norms related with AC motors.
	24.2	Draw circuit diagram and connect forward & reverse a 3 phase squirrel cage induction motor.
	24.3	Start, run and reverse an AC 3 phase squirrel cage induction motor by different type of starters.
	24.4	Measure the slip of 3 phase squirrel cage induction motor by tachometer for different output. Draw slip/ load characteristics of the motor.
	24.5	Determine the efficiency of 3 phase squirrel cage induction motor by no load test/ blocked rotor test and brake test.
	24.6	Plot the speed torque (Slip/Torque) characteristics of slip ring induction motor.
	24.7	Demonstrate speed control of 3 phase induction motor.
	24.8	Connect, start and run a 3 phase synchronous motor.
	24.9	Connect start, run, control speed and reverse the DOR of different type of single phase motors.



	24.10	Install a single phase AC motor.
25. Execute testing, and maintenance of AC motors and starters.	25.1	Test continuity and insulation of various AC motors.
	25.2	Maintain, service and troubleshoot of three phase AC motors.
	25.3	Maintain, service and troubleshoot of different types of single phase AC motors.
	25.4	Maintain, service and troubleshoot the AC motor starter.
26. Plan, execute testing, evaluate performance and carry out maintenance of Alternator / MG set.	26.1	Plan work in compliance with standard safety norms related with Alternator & MG set.
	26.2	Connect start and run an alternator and build up the voltage.
	26.3	Determine the load performance of a 3 phase alternator.
	26.4	Start and load a MG set with 3 phase induction motor coupled to DC shunt generator and build up the voltage.
	26.5	Perform/ Explain alignment of MG set.
	26.6	Preventive and breakdown maintenance of alternator / MG set.
	26.7	Explain the effect of excitation current in terms of V-curves of synchronous motor.
27. Execute parallel operation of alternators.	27.1	Demonstrate parallel operation of an alternator Bright lamp method/ Dark lamp method/ Bright and dark lamp method
	27.2	Parallel operation of an alternator by using synchroscope.
28. Distinguish, organise and perform motor winding.	28.1	Rewind the field coil /armature winding/ table fan /ceiling fan.
	28.2	Draw winding diagram & rewind a single phase split type motor (Concentric coil winding).
	28.3	Draw winding diagram & rewind a 3 phase squirrel cage induction motor (single layer distributed winding).
	28.4	Draw winding diagram & rewind a 3 phase induction motor (single layer concentric type half coil connection).
	28.5	Draw winding diagram & rewind a 3 phase squirrel cage induction motor. (Double layer distributed type winding)
29. Assemble simple electronic circuits and test for functioning.	29.1	Perform soldering on components/ lug / board with safety.
	29.2	Identify the passive /active components by visual appearance, code number and test for their condition.
	29.3	Identify the control and functional switches in CRO and measure the D.C. & A.C. voltage, frequency and time period.
	29.4	Construct and test a half & full wave rectifiers with and without filter circuits.
	29.5	Construct circuit by using transistor as a switch.

	29.6	Construct and test a UJT as relaxation oscillator & electronic timer.
	29.7	Construct amplifier circuit using Transistor, FET and JFET and test.
	29.8	Construct and test lamp dimmer using TRIAC/DIAC.
	29.9	Test IGBT and use in circuit for suitable operation.
	29.10	Construct and test the universal motor speed controller using SCR with safety.
	29.11	Construct and test logic gate circuits.
30. Assemble accessories and carry out wiring of control cabinets and equipment.	30.1	Draw the layout diagram of 3 phase AC motor control cabinet.
	30.2	Mount the control elements & wiring accessories on the control panel.
	30.3	Carry out wiring in control cabinet for local and remote control of induction motor.
	30.4	Draw & wire up the control panel for forward/ reverse operation of induction motor.
	30.5	Perform wiring for automatic start delta starter.
	30.6	Draw & wire up control panel for sequential motor control for three motors.
	30.7	Draw & wire up the control panel for a given circuit diagram and connect the motor.
	30.8	Test the control panel for all the required logics.
31. Perform speed control of AC and DC motors by using solid state devices.	31.1	Control the speed of DC motor by using DC drive.
	31.2	Speed control of universal motor by using SCR.
	31.3	Control speed and reverse the direction of rotation of different type of three phase induction motors using VVVF control /AC drive
32. Detect the faults and troubleshoot inverter, stabilizer, battery charger, emergency light and UPS etc.	32.1	Operation and maintenance of inverter.
	32.2	Troubleshoot and service a voltage stabilizer.
	32.3	Identify the parts, trace the connection and test the DC regulated power supply with safety.
	32.4	Troubleshoot and service a DC regulated power supply.
	32.5	Test battery charger for its operation.
	32.6	Prepare an emergency light.
	32.7	Carryout maintenance of UPS.
33. Plan, assemble and install solar panel.	33.1	Plan work in compliance with solar panel installation norms.
	33.2	Combination of solar cells for given power requirement.
	33.3	Assemble and install solar panel.

	33.4	Check the functionality of solar panel.
34. Erect overhead domestic service line and outline various power plant layout.	34.1	Prepare single line diagram of thermal/ hydel/ Solar /Wind power plants.
	34.2	Prepare layout plan and single line diagram of transmission line.
	34.3	Draw an overhead and domestic service line.
	34.4	Explain erection of an overhead service line pole for single phase 240V distribution system.
	34.5	Identify different type of insulator used in HT and LT line.
	34.6	Fasten jumper in insulators.
	34.7	Connect feeder cable with domestic service line.
35. Examine the faults and carry out repairing of circuit breakers.	35.1	Prepare layout plan and single line diagram of Distribution substation.
	35.2	Illustrate application of relays in control circuits and examine its operation.
	35.3	Identify parts of circuit breaker and check its operation.

  
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<b>SYLLABUS FOR ELECTRICIAN TRADE</b>			
<b>FIRST YEAR</b>			
<b>Week No.</b>	<b>Reference Learning Outcome</b>	<b>Professional Skills (Trade Practical) With Indicative Hours</b>	<b>Professional Knowledge (Trade Theory)</b>
1	<ul style="list-style-type: none"> <li>Apply safe working practices</li> </ul>	<ol style="list-style-type: none"> <li>Visit various sections of the institutes and location of electrical installations. (05 hrs)</li> <li>Identify safety symbols and hazards. (05 Hrs)</li> <li>Preventive measures for electrical accidents and practice steps to be taken in such accidents. (05 hrs)</li> <li>Practice safe methods of fire fighting in case of electrical fire. (05 hrs)</li> <li>Use of fire extinguishers. (05 Hrs)</li> </ol>	Scope of the electrician trade. Safety rules and safety signs. Types and working of fire extinguishers.
2	<ul style="list-style-type: none"> <li>Apply safe working practices</li> <li>Comply environment regulation and housekeeping</li> </ul>	<ol style="list-style-type: none"> <li>Practice elementary first aid. (05 hrs)</li> <li>Rescue a person and practice artificial respiration. (05 Hrs)</li> <li>Disposal procedure of waste materials. (05 Hrs)</li> <li>Use of personal protective equipments. (05 hrs)</li> <li>Practice on cleanliness and procedure to maintain it. (05 hrs)</li> </ol>	First aid safety practice. Hazard identification and prevention. Personal safety and factory safety. Response to emergencies e.g. power failure, system failure and fire etc.
3	<ul style="list-style-type: none"> <li>Prepare profile with an appropriate accuracy as per drawing.</li> </ul>	<ol style="list-style-type: none"> <li>Identify trade tools and machineries. (10 Hrs)</li> <li>Practice safe methods of lifting and handling of tools &amp; equipment. (05 Hrs)</li> <li>Select proper tools for operation and precautions in operation. (05 Hrs)</li> <li>Care &amp; maintenance of trade</li> </ol>	Concept of Standards and advantages of BIS/ISI. Trade tools specifications. Introduction to National Electrical Code-2011.

		tools. (05 Hrs)	
4-5	<ul style="list-style-type: none"> <li>Prepare profile with an appropriate accuracy as per drawing.</li> </ul>	15. Operations of allied trade tools. (05 Hrs) 16. Workshop practice on filing and hacksawing. (10Hrs) 17. Prepare hand coil winding assembly. ( 5 Hrs) 18. Practice on preparing T-joint, straight joint and dovetail joint on wooden blocks. (15Hrs) 19. Practice sawing, planing, drilling and assembling for making a wooden switchboard. (15Hrs)	Allied trades: Introduction to fitting tools, safety precautions. Description of files, hammers, chisels hacksaw frames, blades, their specification and grades. Marking tools description and use. Types of drills, description & drilling machines. Various wooden joints.
6-7	<ul style="list-style-type: none"> <li>Prepare profile with an appropriate accuracy as per drawing.</li> </ul>	20. Practice in marking and cutting of straight and curved pieces in metal sheets, making holes, securing by screw and riveting. (10 Hrs) 21. Workshop practice on drilling, chipping, internal and external threading of different sizes. (20Hrs) 22. Practice of making square holes in crank handle. (5 Hrs) 23. Prepare an open box from metal sheet. (15 Hrs)	Marking tools; calipers Dividers, Surface plates, Angle plates, Scribers, punches, surface gauges Types, Uses, Care and maintenance. Sheet metal tools: Description of marking & cutting tools. Types of rivets and riveted joints. Use of thread gauge. Description of carpenter's tools Care and maintenance of tools.
8	<ul style="list-style-type: none"> <li>Prepare electrical wire joints, carry out soldering, crimping and measure insulation resistance of underground cable.</li> </ul>	24. Prepare terminations of cable ends (02 hrs) 25. Practice on skinning, twisting and crimping. (15 Hrs) 26. Identify various types of cables and measure conductor size using SWG and micrometer. (8 Hrs)	Fundamentals of electricity, definitions, units & effects of electric current. Conductors and insulators. Conducting materials and their comparison.
9-10	<ul style="list-style-type: none"> <li>Prepare electrical wire joints, carry out soldering, crimping and measure insulation resistance of underground cable.</li> </ul>	27. Make simple twist, married, Tee and western union joints. (18 Hrs) 28. Make britannia straight, britannia Tee and rat tail joints. (18 Hrs) 29. Practice in Soldering of joints / lugs. (14 Hrs)	Joints in electrical conductors. Techniques of soldering. Types of solders and flux.
11-12	<ul style="list-style-type: none"> <li>Prepare electrical</li> </ul>	30. Identify various parts, skinning	Underground cables:

	wire joints, carry out soldering, crimping and measure insulation resistance of underground cable.	and dressing of underground cable. (15 Hrs) 31. Make straight joint of different types of underground cable. (15 Hrs) 32. Test insulation resistance of underground cable using megger. (05 hrs) 33. Test underground cables for faults and remove the fault. (15 Hrs)	Description, types, various joints and testing procedure. Cable insulation & voltage grades Precautions in using various types of cables.
13-14	<ul style="list-style-type: none"> <li>Verify characteristics of electrical and magnetic circuits.</li> </ul>	34. Practice on measurement of parameters in combinational electrical circuit by applying Ohm's Law for different resistor values and voltage sources and analyse by drawing graphs. (15 Hrs) 35. Measure current and voltage in electrical circuits to verify Kirchhoff's Law (10 Hrs) 36. Verify laws of series and parallel circuits with voltage source in different combinations. (05Hrs) 37. Measure voltage and current against individual resistance in electrical circuit (10 hrs) 38. Measure current and voltage and analyse the effects of shorts and opens in series circuit. (05 Hrs) 39. Measure current and voltage and analyse the effects of shorts and opens in parallel circuit. (05 Hrs)	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.
15	<ul style="list-style-type: none"> <li>Verify characteristics of electrical and magnetic circuits.</li> </ul>	40. Measure resistance using voltage drop method. (5 Hrs) 41. Measure resistance using wheatstone bridge. (5 Hrs) 42. Determine the thermal effect of electric current. (5 Hrs) 43. Determine the change in resistance due to temperature.	Laws of Resistance and various types of resistors. Wheatstone bridge; principle and its applications. Effect of variation of temperature on resistance. Different methods of measuring the values of

		(5 Hrs) 44. Verify the characteristics of series parallel combination of resistors. (5 Hrs)	resistance. Series and parallel combinations of resistors.
16-17	<ul style="list-style-type: none"> <li>Verify characteristics of electrical and magnetic circuits.</li> </ul>	45. Determine the poles and plot the field of a magnet bar. (08 Hrs) 46. Wind a solenoid and determine the magnetic effect of electric current. (06 Hrs) 47. Measure induced emf due to change in magnetic field. (06 hrs) 48. Determine direction of induced emf and current. (06 hrs) 49. Practice on generation of mutually induced emf. (08 hrs) 50. Measure the resistance, impedance and determine inductance of choke coils in different combinations. (06 Hrs) 51. Identify various types of capacitors, charging / discharging and testing. (05 Hrs) 52. Group the given capacitors to get the required capacity and voltage rating. (05 Hrs)	Magnetic terms, magnetic materials and properties of magnet. Principles and laws of electro-magnetism. Self and mutually induced EMFs. Electrostatics: Capacitor-Different types, functions, grouping and uses.
18-19	<ul style="list-style-type: none"> <li>Verify characteristics of electrical and magnetic circuits.</li> </ul>	53. Measure current, voltage and PF and determine the characteristics of RL, RC and RLC in AC series circuits. (08 Hrs) 54. Measure the resonance frequency in AC series circuit and determine its effect on the circuit. (07 hrs) 55. Measure current, voltage and PF and determine the characteristics of RL, RC and RLC in AC parallel circuits. (08 Hrs) 56. Measure the resonance frequency in AC parallel circuit	Inductive and capacitive reactance, their effect on AC circuit and related vector concepts. Comparison and Advantages of DC and AC systems. Related terms frequency, Instantaneous value, R.M.S. value Average value, Peak factor, form factor, power factor and Impedance etc. Sine wave, phase and phase difference. Active and Reactive power. Single Phase and three-phase system.

		<p>and determine its effects on the circuit. (07 hrs)</p> <p>57. Measure power, energy for lagging and leading power factors in single phase circuits and compare characteristic graphically. (08 Hrs)</p> <p>58. Measure Current, voltage, power, energy and power factor in three phase circuits. (07 hrs)</p> <p>59. Practice improvement of PF by use of capacitor in three phase circuit.(05 Hrs)</p>	Problems on A.C. circuits.
20-21	<ul style="list-style-type: none"> <li>Verify characteristics of electrical and magnetic circuits.</li> </ul>	<p>60. Ascertain use of neutral by identifying wires of a 3-phase 4 wire system and find the phase sequence using phase sequence meter. (10 Hrs)</p> <p>61. Determine effect of broken neutral wire in three phase four wire system.(05 hrs)</p> <p>62. Determine the relationship between Line and Phase values for star and delta connections. (10Hrs)</p> <p>63. Measure the Power of three phase circuit for balanced and unbalanced loads. (15 Hrs)</p> <p>64. Measure current and voltage of two phases in case of one phase is short-circuited in three phase four wire system and compare with healthy system.(10 hrs)</p>	<p>Advantages of AC poly-phase system.</p> <p>Concept of three-phase Star and Delta connection.</p> <p>Line and phase voltage, current and power in a 3 phase circuits with balanced and unbalanced load.</p> <p>Phase sequence meter.</p>
22-23	<p><b>Project work / Industrial visit</b></p> <p><b>Broad Areas:</b></p> <p>a) Prepare and assemble a test board with switches, plug socket, lamp holder etc.</p> <p>b) Temperature controlled system for switching 'ON' and 'OFF' of any circuit using bi-metallic strip.</p> <p>c) Series/ parallel combinational circuits</p>		
24-26	<b>Revision</b>		
27-28	<ul style="list-style-type: none"> <li>Install, test and maintenance of</li> </ul>	<p>65. Use of various types of cells. (08 Hrs)</p>	<p>Chemical effect of electric current and Laws of</p>



	batteries and solar cell.	<p>66. Practice on grouping of cells for specified voltage and current under different conditions and care. (12 Hrs)</p> <p>67. Prepare and practice on battery charging and details of charging circuit. (12 Hrs)</p> <p>68. Practice on routine, care/ maintenance and testing of batteries. (08 Hrs)</p> <p>69. Determine the number of solar cells in series / parallel for given power requirement. (10 Hrs)</p>	<p>electrolysis.</p> <p>Explanation of Anodes and cathodes.</p> <p>Types of cells, advantages / disadvantages and their applications.</p> <p>Lead acid cell; Principle of operation and components.</p> <p>Types of battery charging, Safety precautions, test equipment and maintenance.</p> <p>Basic principles of Electroplating and cathodic protection</p> <p>Grouping of cells for specified voltage and current.</p> <p>Principle and operation of solar cell.</p>
29-30	<ul style="list-style-type: none"> <li>Estimate, Assemble, install and test wiring system.</li> </ul>	<p>70. Identify various conduits and different electrical accessories. (8 Hrs)</p> <p>71. Practice cutting, threading of different sizes &amp; laying Installations. (17 Hrs)</p> <p>72. Prepare test boards / extension boards and mount accessories like lamp holders, various switches, sockets, fuses, relays, MCB, ELCB, MCCB etc. (25 Hrs)</p>	<p>I.E. rules on electrical wiring.</p> <p>Types of domestic and industrial wirings.</p> <p>Study of wiring accessories e.g. switches, fuses, relays, MCB, ELCB, MCCB etc.</p> <p>Grading of cables and current ratings.</p> <p>Principle of laying out of domestic wiring.</p> <p>Voltage drop concept.</p>
31-32	<ul style="list-style-type: none"> <li>Estimate, Assemble, install and test wiring system.</li> </ul>	<p>73. Draw layouts and practice in PVC Casing-capping, Conduit wiring with minimum to more number of points of minimum 15 mtr length. (15 Hrs)</p> <p>74. Wire up PVC conduit wiring to control one lamp from two different places. (10 Hrs)</p> <p>75. Wire up PVC conduit wiring to control one lamp from three different places. (10 Hrs)</p> <p>76. Wire up PVC conduit wiring and practice control of sockets and lamps in different</p>	<p>PVC conduit and Casing-capping wiring system.</p> <p>Different types of wiring - Power, control, Communication and entertainment wiring.</p> <p>Wiring circuits planning, permissible load in sub-circuit and main circuit.</p>

		combinations using switching concepts. (15 Hrs)	
33-35	<ul style="list-style-type: none"> <li>Estimate, Assemble, install and test wiring system.</li> </ul>	77. Wire up the consumers main board with ICDP switch and distribution fuse box. (10 Hrs) 78. Prepare and mount the energy meter board. (10 Hrs) 79. Estimate the cost/bill of material for wiring of hostel/ residential building and workshop. (10 Hrs) 80. Practice wiring of hostel and residential building as per IE rules. (15 Hrs) 81. Practice wiring of institute and workshop as per IE rules. (15 Hrs) 82. Practice testing / fault detection of domestic and industrial wiring installation and repair. (15 Hrs)	Estimation of load, cable size, bill of material and cost. Inspection and testing of wiring installations. Special wiring circuit e.g. godown, tunnel and workshop etc.
36	<ul style="list-style-type: none"> <li>Plan and prepare Earthing installation.</li> </ul>	83. Prepare pipe earthing and measure earth resistance by earth tester / megger. (10 Hrs) 84. Prepare plate earthing and measure earth resistance by earth tester / megger. (10 Hrs) 85. Test earth leakage by ELCB and relay. (5 Hrs)	Importance of Earthing. Plate earthing and pipe earthing methods and IEE regulations. Earth resistance and earth leakage circuit breaker.
37-38	<ul style="list-style-type: none"> <li>Plan and execute electrical illumination system and test.</li> </ul>	86. Install light fitting with reflectors for direct and indirect lighting. (10 Hrs) 87. Group different wattage of lamps in series for specified voltage. (5 Hrs) 88. Practice installation of various lamps e.g. fluorescent tube, HP mercury vapour, LP mercury vapour, HP sodium vapour, LP sodium vapour, metal halide etc. (18 Hrs) 89. Prepare decorative lamp	Laws of Illuminations. Types of illumination system. Illumination factors, intensity of light. Type of lamps, advantages/ disadvantages and their applications. Calculations of lumens and efficiency.

		<p>circuit using drum switches. (5 Hrs)</p> <p>90. Prepare decorative lamp circuit to produce rotating light effect/running light effect. (6 Hrs)</p> <p>91. Install light fitting for show case lighting. (6 Hrs)</p>	
39-40	<ul style="list-style-type: none"> <li>Select and perform measurements using analog / digital instruments</li> </ul>	<p>92. Practice on various analog and digital measuring Instruments. (5 Hrs)</p> <p>93. Practice on measuring instruments in single and three phase circuits e.g. multi-meter, Wattmeter, Energy meter, Phase sequence meter and Frequency meter etc. (15 Hrs)</p> <p>94. Measure power in three phase circuit using two wattmeter methods. (8 Hrs)</p> <p>95. Measure power factor in three phase circuit by using power factor meter and verify the same with voltmeter, ammeter and wattmeter readings. (12 Hrs)</p> <p>96. Measure electrical parameters using tong tester in three phase circuits. (10 Hrs)</p>	<p>Classification of electrical instruments and essential forces required in indicating instruments.</p> <p>PMMC and Moving iron instruments.</p> <p>Measurement of various electrical parameters using different analog and digital instruments.</p> <p>Measurement of energy in three phase circuit.</p>
41	<ul style="list-style-type: none"> <li>Perform testing, verify errors and calibrate instruments.</li> </ul>	<p>97. Practice for range extension and calibration of various measuring instruments. (10 Hrs)</p> <p>98. Determine errors in resistance measurement by voltage drop method. (8 Hrs)</p> <p>99. Test single phase energy meter for its errors. (7 Hrs)</p>	<p>Errors and corrections in measurement.</p> <p>Loading effect of voltmeter and voltage drop effect of ammeter in circuits.</p> <p>Extension of range and calibration of measuring instruments.</p>
42-44	<ul style="list-style-type: none"> <li>Plan and carry out installation, fault detection and repairing of</li> </ul>	<p>100. Dismantle and assemble electrical parts of various electrical appliances e.g. cooking range, geyser,</p>	<p>Working principles and circuits of common domestic equipment and appliances.</p> <p>Concept of Neutral and Earth.</p>

	domestic appliances.	<p>washing machine and pump set. (25 Hrs)</p> <p>101. Service and repair of bell/buzzer. (5 Hrs)</p> <p>102. Service and repair of electric iron, electric kettle, cooking range and geyser. (12 Hrs)</p> <p>103. Service and repair of induction heater and oven. (10 Hrs)</p> <p>104. Service and repair of mixer and grinder. (10 Hrs)</p> <p>105. Service and repair of washing machine. (13Hrs)</p>	
45-46	<ul style="list-style-type: none"> <li>Execute testing, evaluate performance and maintenance of transformer.</li> </ul>	<p>106. Verify terminals, identify components and calculate transformation ratio of single phase transformers. (8 Hrs)</p> <p>107. Perform OC and SC test to determine and efficiency of single phase transformer. (12Hrs)</p> <p>108. Determine voltage regulation of single phase transformer at different loads and power factors. (12 Hrs)</p> <p>109. Perform series and parallel operation of two single phase transformers. (12 Hrs)</p> <p>110. Verify the terminals and accessories of three phase transformer HT and LT side. (6Hrs)</p>	<p>Working principle, construction and classification of transformer.</p> <p>Single phase and three phase transformers.</p> <p>Turn ratio and e.m.f. equation.</p> <p>Series and parallel operation of transformer.</p> <p>Voltage Regulation and efficiency.</p> <p>Auto Transformer and instrument transformers (CT &amp; PT).</p>
47	<ul style="list-style-type: none"> <li>Execute testing, evaluate performance and maintenance of transformer.</li> </ul>	<p>111. Perform 3 phase operation (i) delta-delta (ii) delta-star (iii) star-star (iv) star-delta by use of three single phase transformers. (6 Hrs)</p> <p>112. Perform testing of transformer oil. (6 Hrs)</p> <p>113. Practice on winding of small transformer. (8 Hrs)</p>	<p>Method of connecting three single phase transformers for three phase operation.</p> <p>Types of Cooling, protective devices, bushings and termination etc.</p> <p>Testing of transformer oil.</p> <p>Materials used for winding and winding wires in small transformer.</p>

		114. Practice of general maintenance of transformer. (5 Hrs)	
48-49	<b>Project work / Industrial visit</b> <b>Broad Areas:</b> <ol style="list-style-type: none"> <li>Overload protection of electrical equipment</li> <li>Automatic control of street light/night lamp</li> <li>Fuse and power failure indicator using relays</li> <li>Door alarm/indicator</li> <li>Decorative light with electrical flasher</li> </ol>		
50-51	<b>Revision</b>		
52	<b>Examination</b>		

**Note: -**

- Some of the sample project works (indicative only) are given at the mid and end of each year.
- Instructor may design their own projects and also inputs from local industry may be taken for designing such new projects.
- The project should broadly cover maximum skills in the particular trade and must involve some problem solving skill. Emphasis should be on Teamwork: Knowing the power of synergy/ collaboration, work to be assigned in a group (Group of at least 4 trainees). The group should demonstrate Planning, Execution, Contribution and Application of Learning. They need to submit a Project report after completion.
- If the instructor feels that for execution of specific project more time is required then he may plan accordingly in appropriate time during the execution of normal trade practical.

कौशल भारत - कुशल भारत

## SYLLABUS FOR ELECTRICIAN TRADE

### SECOND YEAR

Week No.	Reference Learning Outcome	Professional Skills (Trade Practical) With Indicative Hours	Professional Knowledge (Trade Theory)
53-54	<ul style="list-style-type: none"> <li>Plan, Execute commissioning and evaluate performance of DC machines.</li> </ul>	115. Identify terminals, parts and connections of different types of DC machines. (10 Hrs) 116. Measure field and armature resistance of DC machines. (10 Hrs) 117. Determine build up voltage of DC shunt generator with varying field excitation and performance analysis on load. (15 Hrs) 118. Test for continuity and insulation resistance of DC machine. (5 Hrs) 119. Start, run and reversedirection of rotation of DC series, shunt and compound motors. (10 Hrs)	General concept of rotating electrical machines. Principle of DC generator. Use of Armature, Field Coil, Polarity, Yoke, Cooling Fan, Commutator, slip ring and Brushes, Laminated core etc. E.M.F. equation Separately excited and self excited generators. Series, shunt and compound generators.
55-56	<ul style="list-style-type: none"> <li>Plan, Execute commissioning and evaluate performance of DC machines.</li> <li>Execute testing, and maintenance of DC machines and motor starters.</li> </ul>	120. Perform no load and load test and determine characteristics of series and shunt generators. (12 Hrs) 121. Perform no load and load test and determine characteristics of compound generators (cumulative and differential). (13 Hrs) 122. Practice dismantling and assembling in DC shunt motor. (12 Hrs) 123. Practice dismantling and assembling in DC compound generator. (13 Hrs)	Armature reaction, Commutation, inter poles and connection of inter poles. Parallel Operation of DC Generators. Load characteristics of DC generators. Application, losses & efficiency of DC Generators. Routine & maintenance.

		Hrs)	
57-58	<ul style="list-style-type: none"> <li>Plan, Execute commissioning and evaluate performance of DC machines.</li> <li>Execute testing, and maintenance of DC machines and motor starters.</li> </ul>	124. Conduct performance analysis of DC series, shunt and compound motors. (15 Hrs) 125. Dismantle and identify parts of three point and four point DC motor starters. (10 Hrs) 126. Assemble, Service and repair three point and four point DC motor starters. (15 Hrs) 127. Practice maintenance of carbon brushes, brush holders, Commutator and slip-rings. (10 Hrs)	Principle and types of DC motor. Relation between applied voltage back e.m.f., armature voltage drop, speed and flux of DC motor. DC motor Starters, relation between torque, flux and armature current. Changing the direction of rotation. Characteristics, Losses & Efficiency of DC motors. Routine and maintenance.
59-60	<ul style="list-style-type: none"> <li>Execute testing, and maintenance of DC machines and motor starters.</li> <li>Distinguish, organise and perform motor winding.</li> </ul>	128. Perform speed control of DC motors - field and armature control method. (10 Hrs) 129. Carry out overhauling of DC machines. (15 Hrs) 130. Perform DC machine winding by developing connection diagram, test on growler and assemble. (25 Hrs)	Methods of speed control of DC motors. Lap and wave winding and related terms.
61-62	<ul style="list-style-type: none"> <li>Plan, Execute commissioning and evaluate performance of AC motors.</li> <li>Execute testing, and maintenance of AC motors and starters.</li> </ul>	131. Identify parts and terminals of three phase AC motors. (5 Hrs) 132. Make an internal connection of automatic star-delta starter with three contactors. (10 Hrs) 133. Connect, start and run three phase induction motors by using DOL, star-delta and auto-transformer starters. (20 Hrs) 134. Connect, start, run and reverse direction of rotation of slip-ring motor through rotor resistance	Working principle of three phase induction motor. Squirrel Cage Induction motor, Slip-ring induction motor; construction, characteristics, Slip and Torque. Different types of starters for three phase induction motors, its necessity, basic contactor circuit, parts and their functions.

		starter and determine performance characteristic. (15 Hrs)	
63-64	<ul style="list-style-type: none"> <li>Plan, Execute commissioning and evaluate performance of AC motors.</li> <li>Execute testing, and maintenance of AC motors and starters.</li> </ul>	<p>135. Determine the efficiency of squirrel cage induction motor by brake test. (8 Hrs)</p> <p>136. Determine the efficiency of three phase squirrel cage induction motor by no load test and blocked rotor test. (8 Hrs)</p> <p>137. Measure slip and power factor to draw speed-torque (slip/torque) characteristics. (14 Hrs)</p> <p>138. Test for continuity and insulation resistance of three phase induction motors. (5 Hrs)</p> <p>139. Perform speed control of three phase induction motors by various methods like rheostatic control, autotransformer etc. (15 Hrs)</p>	<p>Single phasing prevention.</p> <p>No load test and blocked rotor test of induction motor.</p> <p>Losses &amp; efficiency.</p> <p>Various methods of speed control.</p> <p>Braking system of motor.</p> <p>Maintenance and repair.</p>
65	<ul style="list-style-type: none"> <li>Distinguish, organise and perform motor winding.</li> </ul>	<p>140. Perform winding of three phase AC motor by developing connection diagram, test and assemble. (20 Hrs)</p> <p>141. Maintain, service and troubleshoot the AC motor starter. (05 Hrs)</p>	<p>Concentric/ distributed, single/ double layer winding and related terms.</p>
66-67	<ul style="list-style-type: none"> <li>Plan, Execute commissioning and evaluate performance of AC motors.</li> <li>Execute testing, and maintenance of AC motors and starters.</li> </ul>	<p>142. Identify parts and terminals of different types of single phase AC motors. (5 Hrs)</p> <p>143. Install, connect and determine performance of single phase AC motors. (15 Hrs)</p> <p>144. Start, run and reverse the direction of rotation of</p>	<p>Working principle, different method of starting and running of various single phase AC motors.</p> <p>Domestic and industrial applications of different single phase AC motors.</p> <p>Characteristics, losses and efficiency.</p>



		<p>single phase AC motors. (10 Hrs)</p> <p>145. Practice on speed control of single phase AC motors. (10 Hrs)</p> <p>146. Compare starting and running winding currents of a capacitor run motor at various loads and measure the speed. (10 Hrs)</p>	
68-69	<ul style="list-style-type: none"> <li>Distinguish, organise and perform motor winding.</li> </ul>	<p>147. Carry out maintenance, service and repair of single phase AC motors. (10 Hrs)</p> <p>148. Practice on single/double layer and concentric winding for AC motors, testing and assembling. (25 Hrs)</p> <p>149. Connect, start, run and reverse the direction of rotation of universal motor. (10 Hrs)</p> <p>150. Carry out maintenance and servicing of universal motor. (05 Hrs)</p>	<p>Concentric/ distributed, single/ double layer winding and related terms.</p> <p>Troubleshooting of single phase AC induction motors and universal motor.</p>
70-71	<ul style="list-style-type: none"> <li>Plan, execute testing, evaluate performance and carry out maintenance of Alternator / MG set.</li> <li>Execute parallel operation of alternators.</li> </ul>	<p>151. Install an alternator, identify parts and terminals of alternator. (10 Hrs)</p> <p>152. Test for continuity and insulation resistance of alternator. (5 Hrs)</p> <p>153. Connect, start and run an alternator and build up the voltage. (10 Hrs)</p> <p>154. Determine the load performance and voltage regulation of three phase alternator. (10 Hrs)</p> <p>155. Parallel operation and synchronization of three phase alternators. (15 Hrs)</p>	<p>Principle of alternator, e.m.f. equation, relation between poles, speed and frequency. Types and construction. Efficiency, characteristics, regulation, phase sequence and parallel operation. Effect of changing the field excitation and power factor correction.</p>
72	<ul style="list-style-type: none"> <li>Plan, execute testing, evaluate</li> </ul>	<p>156. Install a synchronous motor, identify its parts</p>	<p>Working principle of synchronous motor.</p>

	performance and carry out maintenance of Alternator / MG set.	and terminals. (10 Hrs) 157. Connect, start and plot V-curves for synchronous motor under different excitation and load conditions. (15 Hrs)	Effect of change of excitation and load. V and anti V curve. Power factor improvement.
73	<ul style="list-style-type: none"> <li>Plan, execute testing, evaluate performance and carry out maintenance of Alternator / MG set.</li> </ul>	158. Identify parts and terminals of MG set. (5 Hrs) 159. Start and load MG set with 3 phase induction motor coupled to DC shunt generator. (20 Hrs)	Rotary Converter, MG Set description and Maintenance.
74-75	<b>Project work/Industrial visit (optional)</b> <b>Broad Areas:</b> <ol style="list-style-type: none"> <li>Phase sequence checker for 3 phase supply</li> <li>Induction motor protection system</li> <li>Motor starters with protection</li> <li>Solar/wind power generation</li> </ol>		
76-78	<b>Revision</b>		
79	<ul style="list-style-type: none"> <li>Assemble simple electronic circuits and test for functioning.</li> </ul>	160. Determine the value of resistance by colour code and identify types. (10 Hrs) 161. Test active and passive electronic components and its applications. (15 Hrs)	Resistors – colour code, types and characteristics. Active and passive components. Atomic structure and semiconductor theory.
80-81	<ul style="list-style-type: none"> <li>Assemble simple electronic circuits and test for functioning.</li> </ul>	162. Determine V-I characteristics of semiconductor diode. (10 Hrs) 163. Construct half wave, full wave and bridge rectifiers using semiconductor diode. (10 Hrs) 164. Check transistors for their functioning by identifying its type and terminals. (10 Hrs) 165. Bias the transistor and determine its characteristics. (10 Hrs) 166. Use transistor as an electronic switch and series voltage regulator. (10 Hrs)	P-N junction, classification, specifications, biasing and characteristics of diodes. Rectifier circuit - half wave, full wave, bridge rectifiers and filters. Principle of operation, types, characteristics and various configuration of transistor. Application of transistor as a switch, voltage regulator and amplifier.
82-83	<ul style="list-style-type: none"> <li>Assemble simple</li> </ul>	167. Operate and set the required	Basic concept of power

	electronic circuits and test for functioning.	<p>frequency using function generator. (12 Hrs)</p> <p>168. Make a printed circuit board for power supply. (10 Hrs)</p> <p>169. Construct simple circuits containing UJT for triggering and FET as an amplifier. (12 Hrs)</p> <p>170. Troubleshoot defects in simple power supplies. (16 Hrs)</p>	<p>electronics devices.</p> <p>IC voltage regulators</p> <p>Digital Electronics - Binary numbers, logic gates and combinational circuits.</p>
84-85	<ul style="list-style-type: none"> <li>Assemble simple electronic circuits and test for functioning.</li> </ul>	<p>171. Construct power control circuit by SCR, Diac, Triac and IGBT. (15 Hrs)</p> <p>172. Construct variable DC stabilized power supply using IC. (10 Hrs)</p> <p>173. Practice on various logics by use of logic gates and circuits. (15 Hrs)</p> <p>174. Generate and demonstrate wave shapes for voltage and current of rectifier, single stage amplifier and oscillator using CRO. (10 Hrs)</p>	<p>Working principle and uses of oscilloscope.</p> <p>Construction and working of SCR, DIAC, TRIAC and IGBT.</p> <p>Principle, types and applications of various multivibrators.</p>
86-87	<ul style="list-style-type: none"> <li>Assemble accessories and carry out wiring of control cabinets and equipment.</li> </ul>	<p>175. Design layout of control cabinet, assemble control elements and wiring accessories for:</p> <p>(i) Local and remote control of induction motor. (15 Hrs)</p> <p>(ii) Forward and reverse operation of induction motor. (10 Hrs)</p> <p>(iii) Automatic star-delta starter with change of direction of rotation. (15 Hrs)</p> <p>(iv) Sequential control of three motors. (10 Hrs)</p>	<p>Study and understand Layout drawing of control cabinet, power and control circuits.</p> <p>Various control elements: Isolators, pushbuttons, switches, indicators, MCB, fuses, relays, timers and limit switches etc.</p>
88-89	<ul style="list-style-type: none"> <li>Assemble accessories and carry out wiring of control cabinets and equipment.</li> </ul>	<p>176. Carry out wiring of control cabinet as per wiring diagram, bunching of XLPE cables, channeling, tying and checking etc. (15 Hrs)</p>	<p>Wiring accessories: Race ways/ cable channel, DIN rail, terminal connectors, thimbles, lugs, ferrules, cable binding strap, buttons, cable ties,</p>

		<p>177. Mount various control elements e.g. circuit breakers, relays, contactors and timers etc. (10 Hrs)</p> <p>178. Identify and install required measuring instruments and sensors in control panel. (10 Hrs)</p> <p>179. Test the control panel for its performance. (15 Hrs)</p>	<p>sleeves, gromats and clips etc. Testing of various control elements and circuits.</p>
90-91	<ul style="list-style-type: none"> <li>Perform speed control of AC and DC motors by using solid state devices.</li> </ul>	<p>180. Perform speed control of DC motor using thyristors / DC drive. (18 Hrs)</p> <p>181. Perform speed control and reversing the direction of rotation of AC motors by using thyristors / AC drive. (18 Hrs)</p> <p>182. Construct and test a universal motor speed controller using SCR. (14 Hrs)</p>	<p>Working, parameters and applications of AC / DC drive. Speed control of 3 phase induction motor by using VVVF/AC Drive.</p>
92-94	<ul style="list-style-type: none"> <li>Detect the faults and troubleshoot inverter, stabilizer, battery charger, emergency light and UPS etc.</li> </ul>	<p>183. Assemble circuits of voltage stabilizer and UPS. (15Hrs)</p> <p>184. Prepare an emergency light. (10 Hrs)</p> <p>185. Assemble circuits of battery charger and inverter. (15 Hrs)</p> <p>186. Test, analyze defects and repair voltage stabilizer, emergency light and UPS. (15 Hrs)</p> <p>187. Maintain, service and troubleshoot battery charger and inverter. (10 Hrs)</p> <p>188. Install an Inverter with battery and connect it in domestic wiring for operation. (10 Hrs)</p>	<p>Basic concept, block diagram and working of voltage stabilizer, battery charger, emergency light, inverter and UPS. Preventive and breakdown maintenance.</p>
95	<ul style="list-style-type: none"> <li>Erect overhead domestic service line and outline various power plant layout.</li> </ul>	<p>189. Draw layout of thermal power plant and identify function of different layout elements. (5 Hrs)</p> <p>190. Draw layout of hydel power</p>	<p>Conventional and non-conventional sources of energy and their comparison. Power generation by thermal and hydel power plants.</p>

		<p>plant and identify functions of different layout elements. (5 Hrs)</p> <p>191. Visit to transmission / distribution substation. (10 Hrs)</p> <p>192. Draw actual circuit diagram of substation visited and indicate various components. (5 Hrs)</p>	
96	<ul style="list-style-type: none"> <li>Plan, assemble and install solar panel.</li> <li>Erect overhead domestic service line and outline various power plant layout.</li> </ul>	<p>193. Prepare layout plan and Identify different elements of solar power system. (05 Hrs)</p> <p>194. Prepare layout plan and Identify different elements of wind power system. (05 Hrs)</p> <p>195. Assemble and connect solar panel for illumination. (15 Hrs)</p>	<p>Various ways of electrical power generation by non-conventional methods.</p> <p>Power generation by solar and wind energy.</p> <p>Principle and operation of solar panel.</p>
97	<ul style="list-style-type: none"> <li>Erect overhead domestic service line and outline various power plant layout.</li> </ul>	<p>196. Practice installation of insulators used in HT/LT line for a given voltage range. (5 hrs)</p> <p>197. Draw single line diagram of transmission and distribution system. (5 Hrs)</p> <p>198. Measure current carrying capacity of conductor for given power supply. (5 hrs)</p> <p>199. Fasten jumper in pin, shackle and suspension type insulators. (10 Hrs)</p>	<p>Transmission and distribution networks.</p> <p>Line insulators, overhead poles and method of joining aluminum conductors.</p>
98	<ul style="list-style-type: none"> <li>Erect overhead domestic service line and outline various power plant layout.</li> </ul>	<p>200. Erect an overhead service line pole for single phase 230V distribution system in open space. (10 Hrs)</p> <p>201. Practice on laying of domestic service line. (10 Hrs)</p> <p>202. Install bus bar and bus coupler on LT line. (5 Hrs)</p>	<p>Safety precautions and IE rules pertaining to domestic service connections.</p> <p>Various substations.</p> <p>Various terms like – maximum demand, average demand, load factor, diversity factor, plant utility factor etc.</p>
99	<ul style="list-style-type: none"> <li>Examine the faults</li> </ul>	<p>203. Identify various parts of relay</p>	<p>Types of relays and its</p>

	and carry out repairing of circuit breakers.	and ascertain the operation. (5 Hrs) 204. Practice setting of pick up current and time setting multiplier for relay operation. (5 hrs) 205. Identify the parts of circuit breaker, check its operation. (5Hrs) 206. Test tripping characteristic of circuit breaker for over current and short circuit current. (5 hrs) 207. Practice on repair and maintenance of circuit breaker. (5 hrs)	operation. Types of circuit breakers, their applications and functioning. Production of arc and quenching.
100-101	<b>Project work / Industrial visit</b> <b>Broad Areas:</b> <ol style="list-style-type: none"> <li>Battery charger/Emergency light</li> <li>Control of motor pump with tank level</li> <li>DC voltage converter using SCRs</li> <li>Logic control circuits using relays</li> <li>Alarm/indicator circuits using sensors</li> </ol>		
102-103	<b>Revision</b>		
104	<b>Examination</b>		

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### 9.1 CORE SKILL – WORKSHOP CALCULATION & SCIENCE

S No.	Workshop Calculation	Workshop Science
<b>FIRST YEAR</b>		
1.	<b>Unit:</b> Systems of unit- FPS, CGS, MKS/SI unit, unit of length, Mass and time, Conversion of units	<b>Material Science:</b> 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.
2.	<b>Fractions:</b> Fractions, Decimal fraction, L.C.M., H.C.F., Multiplication and Division of Fractions and Decimals, conversion of Fraction to Decimal and vice versa. Simple problems using Scientific Calculator.	<b>Mass .Weight and Density :</b> Mass, Unit of Mass, Weight, difference between mass and weight, Density, unit of density, specific gravity of metals.
3.	<b>Square Root:</b> Square and Square Root, method of finding out square roots, Simple problem using calculator. <b>Ratio &amp; Proportion :</b> Simple calculation on related problems.	<b>Speed and Velocity:</b> Rest and motion, speed, velocity, difference between speed and velocity, acceleration, retardation, equations of motions, simple related problems.
4.	<b>Percentage:</b> Introduction, Simple calculation. Changing percentage to decimal and fraction and vice-versa.	<b>Work, Power and Energy:</b> work, unit of work, power, unit of power, Horse power of engines, mechanical efficiency, energy, use of energy, potential and kinetic energy, examples of potential energy and kinetic energy.
5.	<b>Algebra:</b> Addition, Subtraction, Multiplication, Division, Algebraic formula, Linear equations (with two variables).	<b>Heat &amp; Temperature:</b> Heat and temperature, their units, difference between heat and temperature, boiling point, melting point, scale of temperature, relation between different scale of temperature, Thermometer, pyrometer, transmission of heat, conduction, convection, radiation.
6.	<b>Mensuration:</b> 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.	<b>Basic Electricity:</b> Introduction, use of electricity, how electricity is produced, Types of current_ AC, DC, their comparison, voltage, resistance, their units. Conductor, insulator, Types of connections - series, parallel, electric power, Horse power, energy, unit of electrical energy.
7.	<b>Trigonometry:</b> Trigonometrical ratios, measurement of angles. Trigonometric tables.	<b>Levers and Simple Machines:</b> levers and its types. Simple Machines, Effort and Load, Mechanical Advantage, Velocity Ratio, Efficiency of machine, Relationship between Efficiency, velocity ratio and Mechanical Advantage.

SECOND YEAR		
1.	<b>Use of Scientific Calculator:</b> Practice on solving different problems like phase angle, etc. with the help of a calculator.	Matter, forms, specific properties related to solids, liquids and gases. The atom, molecule. Difference between an element and compound.
2.	<b>Algebra:</b> Theory of Indices, related problems. Factorization -different method. Quadratic equations and solution of simultaneous equations with 2/3 unknowns. Different types of related problems involving equations.	<b>Electrical Engineering materials:</b> Properties and uses in electrical field of important materials to be selected from 3 categories as conducting materials, semi- conducting materials, Insulating materials. Insulating materials including transformer oils.
3.	<b>Trigonometry:</b> Application in calculating height and distances. Use of trigonometric formulae in calculating areas of geometrical figures. Solution of Triangles.	<b>Magnetism:</b> Introduction Magnetic Material for permanent magnet, temporary magnet etc. Magnetic field, flux density, permeability, susceptibility – explanation and units of the above terms. Electromagnet (Solenoid) – practical applications.
4.	<b>Mensuration:</b> Volumes and surface areas of solid bodies such as triangular prism, hexagonal prism etc. Volumes and surface area of pyramids including cone.	Concept of terms like pressure, atmospheric pressure, gauge pressure. <b>Heat treatment</b> – Necessity – different methods.
5.	<b>Number system:</b> decimal and binary, Octal Hexa decimal. BCD code, conversion from decimal to binary and vice-versa, all other conversions. Practice on conversions.	<b>Friction:</b> Laws of friction, co- efficient of friction, angle of friction, simple problems related to friction. Lubrication <b>Rectifier:</b> RMS. Maximum, Average values of voltage and current in rectifiers form factor, ripple factor.
6.	<b>Estimation &amp; costing:</b> Simple estimation of the requirement of materials etc. as applicable to the trade. Problems on estimation and costing. <b>Further Mensuration:</b> Volumes of frustums including conical frustums.Graph- Basics, abscissa, co-ordinate etc. $Y = mz$ and $Y = mx + c$ graph	<b>Forces:</b> Resolution and composition of forces. Representation of force by vectors, simple problems on lifting tackles like jib wall, crane- Solution of problems with the aid of vectors. General condition of equilibriums for series of forces on a body. Law of parallelogram, Triangle Law, Lami's Law theorem.
7.	Simple Problems on Profit & Loss. Simple and compound interest.	<b>Centre of gravity:</b> Centre of gravity concept and C.G. of different lamina. Equilibrium different kinds stable, unstable and neutral. Law of parallelogram force. Triangle law, Lami's theorem stable, unstable and neutral equilibrium.



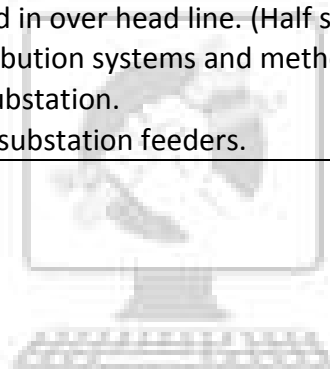
## 9.2 CORE SKILL - ENGINEERING DRAWING

S No.	CONTENTS
<b>FIRST YEAR</b>	
1.	<p>Engineering Drawing: Introduction and its importance</p> <ul style="list-style-type: none"> <li>• Relationship to other technical drawing types</li> <li>• Conventions</li> <li>• Viewing of engineering drawing sheets.</li> <li>• Method of Folding of printed Drawing Sheet as per BIS SP:46-2003</li> </ul>
2.	<p>Drawing Instruments : their Standard and uses</p> <ul style="list-style-type: none"> <li>• Drawing board, T-Square, Drafter (Drafting M/c), Set Squares, Protractor.</li> <li>• Drawing Instrument Box (Compass, Dividers, Scale, Diagonal Scales etc).</li> <li>• Pencils of different Grades, Drawing pins / Clips.</li> </ul>
3.	<p>Lines :</p> <ul style="list-style-type: none"> <li>• Definition, types and applications in Drawing as per BIS SP:46-2003</li> <li>• Classification of lines (Hidden, centre, construction, Extension, Dimension, Section)</li> <li>• Drawing lines of given length (Straight, curved)</li> <li>• Drawing of parallel lines, perpendicular line</li> <li>• Methods of Division of line segment</li> </ul>
4.	<p>Drawing of Geometrical Figures:</p> <ul style="list-style-type: none"> <li>• Definition, nomenclature and practice of angle measurement and its types, method of bisecting.</li> <li>• Triangle - different types</li> <li>• Rectangle, Square, Rhombus, Parallelogram.</li> <li>• Circle and its elements.</li> </ul>
5.	<p>Lettering and Numbering as per BIS SP46-2003: -</p> <ul style="list-style-type: none"> <li>• Single Stroke, Double Stroke, inclined, Upper case and Lower case.</li> </ul>
6.	<p>Dimensioning:</p> <ul style="list-style-type: none"> <li>• Definition, types and methods of dimensioning (functional, nonfunctional and auxiliary)</li> <li>• Types of arrowhead</li> <li>• Leader Line with text</li> </ul>
7.	<p>Free hand drawing of:</p> <ul style="list-style-type: none"> <li>• Lines, polygons, ellipse, etc.</li> <li>• Geometrical figures and blocks with dimension</li> <li>• Transferring measurement from the given object to the free hand sketches.</li> </ul>
8.	<p>Sizes and Layout of Drawing Sheets:</p> <ul style="list-style-type: none"> <li>• Basic principle of Sheet Size</li> <li>• Designation of sizes</li> <li>• Selection of sizes</li> <li>• Title Block, its position and content</li> </ul>

	<ul style="list-style-type: none"> <li>• Borders and Frames (Orientation marks and graduations)</li> <li>• Grid Reference</li> <li>• Item Reference on Drawing Sheet (Item List)</li> </ul>
9.	Method of presentation of Engineering Drawing <ul style="list-style-type: none"> <li>• Pictorial View</li> <li>• Orthogonal View</li> <li>• Isometric view</li> </ul>
10.	Symbolic Representation (as per BIS SP:46-2003) of: <ul style="list-style-type: none"> <li>• Fastener (Rivets, Bolts and Nuts) - Bars and profile sections</li> <li>• Weld, brazed and soldered joints.</li> <li>• Electrical and electronics element</li> <li>• Piping joints and fittings</li> </ul>
11.	Construction of Scales and diagonal scale
12.	Practice of Lettering and Title Block
13.	Dimensioning practice: <ul style="list-style-type: none"> <li>• Position of dimensioning (unidirectional, aligned, oblique as per BIS SP:46-2003)</li> <li>• Symbols preceding the value of dimension and dimensional tolerance.</li> <li>• Text of dimension of repeated features, equidistance elements, circumferential objects.</li> </ul>
14.	Construction of Geometrical Drawing Figures: <ul style="list-style-type: none"> <li>• Different Polygons and their values of included angles. Inscribed and Circumscribed polygons.</li> <li>• Conic Sections (Ellipse &amp; Parabola)</li> </ul>
15.	Drawing of Solid figures (Cube, Cuboids, Cone, Prism, Pyramid, Frustum of Cone and Pyramid.) with dimensions.
16.	Free Hand sketch of hand tools and measuring tools used in respective trades.
17.	Projections: <ul style="list-style-type: none"> <li>• Concept of axes plane and quadrant.</li> <li>• Orthographic projections</li> <li>• Method of first angle and third angle projections (definition and difference)</li> <li>• Symbol of 1<sup>st</sup> angle and 3<sup>rd</sup> angle projection as per IS specification.</li> </ul>
18.	Drawing of Orthographic projection from isometric/3D view of blocks
19.	Orthographic Drawing of simple fastener (Rivet, Bolts, Nuts & Screw)
20.	Drawing details of two simple mating blocks and assembled view.
<b>SECOND YEAR</b>	
1.	<u><b>Sign &amp; Symbol Trade related</b></u> <b>Alternating Current</b> <ul style="list-style-type: none"> <li>• Drawing of simple electrical circuit using electrical symbols.</li> <li>• Drawing of sine square &amp; triangular waves.</li> <li>• Diagram of battery charging circuit.</li> <li>• Practice in reading typical example of circuit containing R, L &amp; C.</li> </ul>

	<ul style="list-style-type: none"> <li>• Reading of electrical drawing.</li> </ul>
2.	<p><b>Electronic components</b></p> <ul style="list-style-type: none"> <li>• Symbols for electronic components. Diode, Transistor, Zener diode, SCR, UJT, FET, IC, Diac, Triac, Mosfet, IGBT etc.</li> <li>• Drawing of half wave, Full wave and Bridge rectifier circuit.</li> <li>• Drawing circuit for a single stage Amplifiers and Multi stage Amplifies and types of signals.</li> <li>• Drawing of circuit containing UJT, FET &amp; Simple power control circuits.</li> <li>• Free hand drawing of Logic gates and circuits.</li> </ul>
3.	<p><b>Electric wirings &amp; Earthing</b></p> <ul style="list-style-type: none"> <li>• Detailed diagram of calling bell, &amp; Buzzers etc</li> <li>• Free hand sketching of Staircase wiring.</li> <li>• Drawing the schematic diagram of plate and pipe earthing.</li> <li>• Diagram for electroplating from A.C / D.C source.</li> </ul>
4.	<p><b>DC machines</b></p> <ul style="list-style-type: none"> <li>• Graphic symbols for Rotating machines.</li> <li>• Sketching of brush and brush gear of D.C. machines.</li> <li>• Sketching of D.C. 3-point and 4-point starter .</li> <li>• Layout arrangement of D.C. Generators &amp; motors, control panel.</li> <li>• Exercises on connection to motors through Ammeter, voltmeter &amp; K.W. meters of electrical wiring diagram.</li> <li>• Drawing the schematic diagram of D.C. motor speed control by Thyristor / DC Drive.</li> </ul>
5.	<p><b>Transformer</b></p> <ul style="list-style-type: none"> <li>• Graphic symbols for Transformers.</li> <li>• Free hand sketching of transformer and auxiliary parts and sectional views.</li> <li>• Sketching a breather.</li> <li>• Drawing the diagram of typical marking plate of a distribution transformer.</li> </ul>
6.	<p><b>Illumination</b></p> <ul style="list-style-type: none"> <li>• Free hand sketching of Mercury vapour lamp, sodium vapour lamp, fluorescent tube (Single &amp; Twine), MHL lamp and their connection.</li> </ul>
7.	<p><b>Three phase Induction motor</b></p> <ul style="list-style-type: none"> <li>• Free hand sketching of Slip-ring and Squirrel cage Induction motor.</li> <li>• Typical wiring diagram for drum controller operation of A.C. wound rotor motor.</li> <li>• Drawing the schematic diagram of Autotransformer starter, DOL starter and Star Delta Starter.</li> <li>• Drawing the schematic diagram of A.C. motor speed control by SCR /AC Drive.</li> </ul>
8.	<p><b>Alternator</b></p> <ul style="list-style-type: none"> <li>• Tracing of panel wiring diagram of an alternator.</li> <li>• Drawing the schematic diagram of automatic voltage regulators of A.C. generators.</li> </ul>
9.	<p><b>Winding</b></p> <ul style="list-style-type: none"> <li>• Drawing the development diagram for D.C. Simplex Lap &amp; Wave winding</li> <li>• with brush position. Drawing the development diagram of A.C 3 – Phase, 4 Pole 24</li> </ul>

	slots single layer winding.
10.	<b>Control Panel</b> <ul style="list-style-type: none"> <li>• Practice in reading panel diagram.</li> <li>• Local &amp; Remote control of Induction motor with inching.</li> <li>• Forward &amp; Reverse operation of Induction motor</li> <li>• Automatic Star Delta Starter</li> <li>• Automatic star delta starter with change of direction of rotation</li> <li>• Sequential control of three motors.</li> </ul>
11.	<b>Domestic Appliances</b> <ul style="list-style-type: none"> <li>• Fire, Alarms, Electric Iron, Heater, Electric Kettle, Heater / Immersion Heater, Hot Plate, etc.</li> </ul>
12.	<b>Distribution of Power</b> <ul style="list-style-type: none"> <li>• Types of insulator used in over head line. (Half sectional views)</li> <li>• Different type of distribution systems and methods of connections.</li> <li>• Layout diagram of a substation.</li> <li>• Single line diagram of substation feeders.</li> </ul>



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### 9.3 CORE SKILL – EMPLOYABILITY SKILL

<b>Duration: 110 Hrs.</b>	
<b>1. English Literacy</b>	
<b>Duration : 20 hrs Marks : 09</b>	
Pronunciation	Accentuation (mode of pronunciation) on simple words, Diction (use of word and speech)
Functional Grammar	Transformation of sentences, voice change, change of tense, spellings.
Reading	Reading and understanding simple sentences about self, work and environment
Writing	Construction of simple sentences Writing simple English
Speaking/ Spoken English	Speaking with preparation on self, on family, on friends/ classmates, on known people, 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 on messages and filling in message forms, greeting and introductions, office hospitality, resumes or curriculum vitae essential parts, letters of application reference to previous communication.
<b>2. IT Literacy</b>	
<b>Duration : 20 hrs Marks : 09</b>	
Basics of Computer	Introduction, computer and its applications, Hardware and peripherals, Switching on-Starting and shutting down computer.
Computer Operating System	Basics of Operating System, WINDOWS, 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.
Word Processing and Worksheet	Basic operating of Word Processing, Creating, opening and closing documents, Use of shortcuts, Creating and Editing 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.
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, Website, Web

	page and Search Engines. Accessing the Internet using web browser, Downloading and printing web pages, Opening an email account and use of email. Social media sites and its implication. Information Security and antivirus tools, Do's and Don'ts in Information Security, Awareness of IT - ACT, types of cyber crimes.
<b>3. Communication Skills</b>	
	<b>Duration : 15 hrs</b> <b>Marks : 07</b>
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.
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.
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.
Facing Interviews	Manners, etiquettes, dress code for an interview. Do's & Don'ts for an interview.
Behavioral Skills	Problem solving, confidence building, attitude.
<b>4. Entrepreneurship Skills</b>	
	<b>Duration : 15 hrs</b> <b>Marks : 06</b>
Concept of Entrepreneurship	Entrepreneur - 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, and the process of setting up a business.

Project Preparation & Marketing Analysis	Qualities of a good Entrepreneur, SWOT and Risk Analysis. Concept & application of PLC, Sales & distribution management. Difference between small scale & large scale business, Market survey, Method of marketing, Publicity and advertisement, Marketing mix.
Institution's 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 familiarize with the Policies/Programmes & procedure & the available scheme.
Investment Procurement	Project formation, feasibility, Legal formalities i.e., Shop Act, Estimation & costing, Investment procedure - Loan procurement - Banking processes.
<b>5. Productivity</b>	
<b>Duration : 10 Hrs.</b> <b>Marks : 05</b>	
Benefits	Personal/ Workman - Incentive, Production linked Bonus, Improvement in living standard.
Affecting Factors	Skills, Working Aids, Automation, Environment, Motivation- How it improves or slows down productivity.
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.
Personal Finance Management	Banking processes, Handling ATM, KYC registration, Safe cash handling, Personal risk and insurance.
<b>6. Occupational Safety, Health and Environment Education</b>	
<b>Duration : 15 hrs</b> <b>Marks : 06</b>	
Safety & Health	Introduction to occupational safety and health importance of safety and health at workplace.
Occupational Hazards	Basic Hazards, Chemical Hazards, Vibroacoustic Hazards, Mechanical Hazards, Electrical Hazards, Thermal Hazards. Occupational health, Occupational hygiene, Occupational Diseases/ Disorders & its prevention.
Accident & Safety	Basic principles for protective equipment. Accident prevention techniques - control of accidents and safety measures.
First-Aid	Care of injured & sick at the workplaces, First-Aid & Transportation of sick person.

Basic Provisions	Idea of basic provision legislation of India. Safety, health, welfare under legislative of India.
Ecosystem	Introduction to Environment. Relationship between society and environment, Ecosystem and factors causing imbalance.
Pollution	Pollution and pollutants including liquid, gaseous, solid and hazardous waste.
Energy Conservation	Conservation of energy, re-use and recycle.
Global Warming	Global warming, climate change and Ozone layer depletion.
Ground Water	Hydrological cycle, Ground and surface water, Conservation and Harvesting of water.
Environment	Right attitude towards environment, Maintenance of in-house environment.
<b>7. Labour Welfare Legislation</b>	
<b>Duration : 05 hrs</b> <b>Marks : 03</b>	
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.
<b>8. Quality Tools</b>	
<b>Duration : 10 hrs.</b> <b>Marks : 05</b>	
Quality Consciousness	Meaning of quality, Quality characteristic.
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.
Quality Management System	Idea of ISO 9000 and BIS systems and its importance in maintaining qualities.
House Keeping	Purpose of House-keeping, Practice of good housekeeping.
Quality Tools	Basic quality tools with a few examples.



<b>List of Tools &amp; Equipment</b>			
<b>ELECTRICIAN (for batch of 20 candidates)</b>			
<b>S No.</b>	<b>Name of the Tools and Equipment</b>	<b>Specification</b>	<b>Quantity</b>
<b>A. TRAINEES TOOL KIT (For each additional unit trainees tool kit Sl. 1-12 is required additionally)</b>			
1.	Measuring Steel Tape	5 meter	*21 Nos.
2.	Combination Plier Insulated	200 mm	*21 Nos.
3.	Screw Driver Insulated	4mm X 150 mm, Diamond Head	*21 Nos.
4.	Screw Driver Insulated	6mm X 150 mm	*21 Nos.
5.	Electrician screw driver thin stem insulated handle	4mm X 100 mm	*21 Nos.
6.	Heavy Duty Screw Driver insulated	5mm X 200 mm	*21 Nos.
7.	Electrician Screw Driver thin stem insulated handle	4mm X 250 mm	*21 Nos.
8.	Punch Centre	9mm X 150 mm	*21 Nos.
9.	Knife Double Bladed Electrician	100 mm	*21 Nos.
10.	Neon Tester	500 V	*21 Nos.
11.	Steel Rule Graduated both in Metric and English Unit	300 mm with precision of 1/4th mm	*21 Nos.
12.	Hammer, cross peen with handle	250 grams	*21 Nos.
<b>B. SHOP TOOLS &amp; EQUIPMENT – For 2 (1+1) units no additional items are required</b>			
<b>(i) List of Tools &amp; Accessories</b>			
13.	Hammer, ball peen With handle	500 grams	4 Nos.
14.	Pincer	150 mm	4 Nos.
15.	C- Clamp	200 mm and 100 mm	2 Nos. each
16.	Spanner Adjustable drop forged, SS	150 mm & 300mm	2 Nos. each
17.	Blow lamp brass	0.5 ltr	1 No.
18.	Chisel Cold	25 mm X 200 mm	2 Nos.
19.	Chisel firmer with wooden Handle	6 mm X 200 mm	2 Nos.
20.	Allen Key alloy steel	1.5-10 mm (set of 9)	1 Set
21.	Grease Gun	0.5 ltr. Capacity	1 No
22.	Bradawl		2 Nos.
23.	Pully Puller with 3 legs	150 mm & 300mm	1 each
24.	Bearing Puller (inside and outside)	200 mm	1 No. each

25.	Pipe vice Cast Iron with hardened jaw open type	100 mm	2 Nos.
26.	Scissors blade, SS	200mm	4 Nos.
27.	Scissors blade, SS	150 mm	2 Nos.
28.	Crimping Tool	1.5 sq mm to 16 sq mm	2 Nos.
		16 sq mm to 95 sq mm	2 Nos.
29.	Wire Cutter and Stripper	150 mm	4 Nos.
30.	Mallet hard wood	0.50 kg	4 Nos.
31.	Hammer Extractor type	250 grams	4 Nos.
32.	Hacksaw frame	Adjustable 300 mm	2 Nos. each
		Fixed 150 mm	
33.	Try Square	150 mm blade	4 Nos.
34.	Outside Calliper	150 mm spring type	2 Nos.
35.	Inside Calliper	150 mm spring type	2 Nos.
36.	Divider	150 mm spring type	2 Nos.
37.	Pliers long nose insulated	150 mm	4 Nos.
38.	Pliers flat nose insulated	200 mm	4 Nos.
39.	Pliers round nose insulated	100 mm	4 Nos.
40.	Tweezers	150 mm	4 Nos.
41.	Snip Straight and Bent heavy duty	250 mm	2 Nos. each
42.	D.E. metric Spanner Double Ended	6 - 32 mm	2 Set
43.	Drill hand brace	0-100mm	4 Nos.
44.	Drill S.S. Twist block	2 mm, 5 mm and 6 mm set of 3	4 Set
45.	Plane cutters	50 mm X 200mm	2 Nos.
46.	Smoothing cutters	50 mm X 200mm	2 Nos.
47.	Gauge, wire imperial stainlees steel marked in SWG & mm	Wire Gauge - Metric	4 Nos.
48.	File flat	200 mm 2nd cut with handle	8 Nos.
49.	File half round	200 mm 2nd cut with handle	4 Nos.
50.	File round	200 mm 2nd cut with handle	4 Nos.
51.	File flat rough	150 mm with handle	4 Nos.
52.	File flat bastard	250 mm with handle	4 Nos.
53.	File flat smooth	250 mm with handle	4 Nos.
54.	File Rasp, half round	200 mm bastard with handle	4 Nos.
55.	Copper bit soldering iron.	0.25 kg	2 Nos.
56.	De soldering Gun	Heat proof nozzle, PVC type, 250mm	4 Nos.
57.	Hand Vice	50 mm jaw	4 Nos.

58.	Table Vice	100 mm jaw	8 Nos.
59.	Oil Can	250 ml	2 Nos.
60.	Contactora & auxiliary contacts	3 phase, 415 Volt, 25 Amp with 2 NO and 2 NC	2 Nos. each
61.	Contactora & auxiliary contacts.	3 phase, 415 volt, 32 Amp with 2 NO and 2 NC	2 Nos. each
62.	Limit Switch	Limit Switch, Liver operated 2A 500v, 2-contacts	2 Nos.
63.	Rotary Switch	16 A/440v	2 Nos.
64.	Relay- a. Cut out Relays b. Reverse current c. Over current d. Under voltage	a. 16A, 440V b. 16A, 440V c. 16A, 440V d. 360V-440V	2 No. each
65.	Pin Type, shackle type, egg type & suspension type insulators including hardware fitting		2 Nos. each
66.	Hydrometer		2 Nos.
67.	Hand Drill Machine	0-6 mm capacity	2 Nos.
68.	Portable Electric Drill Machine	0-12 mm capacity 750w, 240v with chuck and key	1 No.
69.	Load Bank ( Lamp / heater Type)	6 KW, 3Ph	1 No.
70.	Brake Test arrangement with two spring balance rating	0 to 25 kg	1 No.
71.	Laboratory Type Induction Coil	1000 W	2 Nos.
72.	Out Side Micrometer	0 - 25 mm least count 0.01mm	2 Nos.
73.	Thermometer Digital	0° C - 150° C	1 No.
74.	Series Test Lamp	230V, 60W	4 Nos.
75.	Knife Switch DPDT fitted with fuse terminals	16 Amp	4 Nos.
76.	Knife Switch TPDT fitted with fuse terminals	16 Amp/ 440 V	4 Nos.
77.	Miniature Breaker	16 amp	2 Nos.
78.	Earth Plate	60cm X 60cm X 3.15mm Copper Plate 60cm X 60cm X 6mm GI Plate	1 Each
79.	Earth Electrode	Primary Electrode 2100x28x3.25mm Secondary Cu Strip 20x5mm	1 No.
80.	MCCB	100Amps, Triple pole	1 No.
81.	ELCB and RCCB	25Amps, double pole and 25Amps, double pole, IΔn 30 mA	1 Each
82.	Fuses	HRC	4 Each

		Glass Rewire Type	
83.	Rheostat (Sliding type)	0 - 25 Ohm, 2 Amp 0 - 300 Ohm, 2 Amp 0 -1 Ohm, 10Amp 0 -10 Ohm, 5 Amp	1 No. each
84.	Capacitors	Electrolytic Ceramic Polyester film Variable Dual run	2 Each
85.	Various Electronic components	Resistors, Diode, Transistor, UJT, FET, SCR, DIAC, TRAIC, IGBT, Small transformer etc.	As required
86.	Various Lamps	Halogen Incandescent Lamp Fluorescent tube HP mercury vapor Lamp High-pressure sodium Lamp Low-pressure sodium Lamp LED	1 Each
87.	Plug socket Piano Switch Lamp Holder	230 V, 5 A	2 Each
88.	Cables : Twisted Pair Non-Metallic Sheathed Cable Underground Feeder Cable Ribbon Cable Metallic Sheathed Cable Multi-Conductor Cable Coaxial Cable Direct-Buried Cable	1 mtr each	1 Each
89.	Bus bar with brackets	1 mtr each	3 Nos.
90.	Rubber mat	2' x 4' x 1"	2 Nos.
91.	Electrician Helmet	Yellow Colour	2 Nos.
92.	RCC Pole with accessories (MS angle iron, 'C' clamp, stay insulator etc.) and materials	6 Mtr	1 No.
93.	Safety Belt	Standard quality	2 Nos.
<b>(ii) List of Equipment</b>			
94.	Ohm Meter; Series Type & Shunt Type, portable box type	50/2000-ohm analog	2 Nos. each

95.	Digital Multi Meter	DC 200mv -1000v,0 – 10A & AC 200mv- 750v , 0-10A, resistance 0-20 MΩ and 3 1/2 digit	*12 Nos.
96.	A.C. Voltmeter M.I. analog, portable box type housed in Bakelite case	Multi range 75 V - 150V - 300V - 600V	3 Nos.
97.	Milli Voltmeter centre zero analog, portable box type housed in Bakelite case	100 – 0 – 100 mV	2 Nos.
98.	Ammeter MC analog, portable box type housed in Bakelite case	0 - 500 mA, 0-5 A, 0-25 A	2 Nos. each
99.	AC Ammeter MI, analog, portable box type housed in Bakelite case	0 - 1 A, 0-5 A, 0-25 A	2 Nos. each
100.	Kilo Wattmeter Analog	0-1.5-3KW, pressure coil rating- 240v/440v, current rating-5A/10A Analoge, portable type Housed in bakelite case	2 Nos.
101.	Digital Wattmeter	230 V, 1 KW, 50 Hz	2 Nos.
102.	A.C. Energy Meter	Single Phase, 10 A, 240 V induction type	2 Nos.
103.	A.C. Energy Meter	Three Phase, 15 A , 440 V induction type	2 Nos.
104.	Power Factor Meter Digital	440 V, 20 A, Three Phase portable box type	2 Nos.
105.	Frequency Meter	45 to 55 Hz	2 Nos.
106.	Magnetic Flux Meter	0-500 tesla	2 Nos.
107.	Lux meter	lux meter LCD read out 0.05 to 7000 lumens with battery.	2 Nos.
108.	Tachometer	Analog Type - 10000 RPM	1 No.
109.	Tachometer	Digital Photo Sensor Type - 10000 RPM	1 No.
110.	Tong Tester / Clamp Meter	0 - 100 A (Digital Type)	2 Nos.
111.	Megger	Analog - 500 V	2 Nos.
112.	3- point D.C. Starter	For 2.5 KW DC motor	1 No.
113.	4- point D.C. Starter	For 2.5 KW DC motor	1 No.
114.	Wheat Stone Bridge with galvanometer and battery		2 Nos.
115.	Single Phase Variable Auto	0 - 270 V, 10Amp (Air cooled)	2 Nos.

	Transformer		
116.	Phase Sequence Indicator	3 Phase, 415 V	2 Nos.
117.	Growler	230 V, 50 Hz, Single Phase, Adjustable jaws, Testing armature with ampere meter and testing probes.	1 No.
118.	AC Starters: - a. Resistance type starter b. Direct on line Starter c. Star Delta Starter- Manual d. Star Delta Starter – Semi automatic e. Star Delta Starter – Fully automatic f. Star Delta Starter - Soft starter g. Auto Transformer type	For A.C Motors of 2 to 5 H.P.	1 No. each
119.	Oscilloscope Dual Trace	20 MHz	1 No.
120.	Function Generator	2 to 200 KHz, Sine, Square, Triangular 220 V, 50 Hz, Single Phase	1 No.
121.	Soldering Iron	25 Watt, 65 Watt and 120 Watt, 230 Volt	2 Nos. each
122.	Temperature controlled Soldering Iron	50 Watt, 230 Volt	2 Nos.
123.	Discrete Component Trainer	Discrete Component (for diode and transistor circuit) with regulated power supply +5,0- 5 V,+12 ,0-12 V	2 Nos.
124.	Linear I.C. Trainer	Linear I.C. Trainer with regulated power supply 1.2V to 15V PIC socket 16pin and 20 pin with bread board	1 No.
125.	Digital I.C. Trainer	Digital I.C. Trainer 7 segment display and bread board	1 No.
126.	Domestic Appliances –		
	a. Electric Induction plate	a. 1500 Watt, 240V	1 No. each
	b. Electric Kettle	b. 1500 Watts, 240V	
	c. Electric Iron	c. Automatic - 750 W, 240 V	
	d. Immersion Heater	d. 1500 Watt, 240V	
	e. A.C. Ceiling Fan and AC Table Fan	e. 68 Watt, 230 V	
	f. Geyser (Storage type)	f. 10 litre	
	g. Mixture & Grinder	g. 750 W, 240 V	
	h. Washing Machine Semi Automatic	h. 5 Kg,	
	i. Motor Pump set	i. 1 HP, 1 Phase, 240 V	

127.	Oil Testing Kit	Oil Testing Kit 230 V, single phase 50 Hz 60 VA output 0-60 KV Variable	1 No.
128.	Inverter with Battery	1 KVA with 12 V Battery Input- 12 volt DC, Output- 220 volt AC	1 No.
129.	Voltage Stabilizer	AC Input - 150 - 250 V, 600 VA AC Output - 240 V, 10 A	1 No.
130.	DC Power Supply	0 - 30 V, 5 A	2 Nos.
131.	Battery Charger	0 - 6 - 9 - 12 - 24 - 48 V, 30amp	1 No.
132.	Current Transformer	415 V, 50Hz, CT Ratio 25 / 5 A, 5VA	2 Nos.
133.	Potential Transformer	415 V, 50Hz, PT Ratio, 440V/110V, 10VA	2 Nos.
134.	Solar panel with Battery	18 Watt	1 Set
135.	Pentium IV Computer or latest	2.8 GHz & above, 1 GB RAM, 80 GB HDD, DVD Combo Drive, 19/21" Monitor, optical scroll mouse, multimedia key board, 32 bit LAN card with UPP port, necessary Drivers, etc. OR (Latest Version)	2 Nos.
136.	Ink jet/ laser printer		1 No.
<b>C. Shop Machinery - For 4 (2+2) units no additional items are required</b>			
137.	D.C. Shunt Generator with control panel	D.C. Shunt Generator with control panel, 2.5 KW, 220V & 3phase Squirrel cage Induction Motor, 5HP, 440V with control panel & star delta starter	1 No.
138.	Motor-Generator (AC to DC)	Squirrel Cage Induction Motor with star delta starter and directly coupled to DC shunt generator and switch board mounted with regulator, air breaker, ammeter, voltmeter, knife blade switches and fuses, set complete with case iron and plate, fixing bolts, foundation bolts and flexible coupling. Induction Motor rating: 7.5 HP, 415V, 50 cycles, 3 phase. DC Shunt Generator rating: 5 KW, 440V (Output voltage varies 110-440v)	1 No.

139.	D.C. Compound Generator with control panel including fitted rheostat, voltmeter, ammeter and breaker	D.C. Compound Generator with control panel including fitted rheostat, voltmeter, ammeter and breaker, 2.5 KW, 220V & 3phase Squirrel cage Induction Motor, 5HP, 440V, with control panel & star delta starter	1 No.
140.	DC Series Motor coupled with spring balance load	2.5 KW, 220 Volts	1 No.
141.	DC Shunt Motor	2.5 KW, 220 V	1 No.
142.	DC compound Motor with starter and switch	2.5 KW, 220 volts	1 No.
143.	Motor Generator(DC to AC) set consisting of - Shunt Motor with starting compensator and switch directly coupled to AC generator with exciter and switch board mounted with regulator, breaker, ammeter, voltmeter frequency meter, knife blade switch and fuses etc. Set complete with cast iron bed plate, fixing bolts, foundation bolts and flexible coupling.	Shunt Motor rating : 5 HP, 440V AC Generator rating : 3-Phase, 4 wire, 3.5 KVA, 400/230 Volts, 0.8 pf, 50cycles	1 No.
144.	AC Squirrel Cage Motor with star delta starter and triple pole iron clad switch fuse with Mechanical Load.	5 HP, 3-Phase, 415 V, 50 Hz	1 No.
145.	AC phase-wound slip ring Motor with starter switch	5 HP, 440 V, 3 Phase, 50 Hz	1 No.
146.	Universal Motor with starter/switch	240 V, 50 Hz, 1 HP	1 No.
147.	Synchronous motor with accessories like starter, excitation arrangements.	3 Phase, 3 HP, 440V, 50Hz, 4 Pole	1 No.
148.	Thyristor /IGBT controlled D.C. motor drive with tacho-generator feedback arrangement	1 HP	1 No.
149.	Thyristor/IGBT controlled A.C. motor drive with	VVVF control 3 Phase, 2 HP	1 No.
150.	Single phase Transformer, core type, air cooled	1 KVA, 240/415 V, 50 Hz	3 Nos.
151.	Three phase transformer, shell type oil cooled with Delta/ Star	3 KVA, 415/240 V, 50 Hz	2 Nos.
152.	Electrical Machine Trainer –	Suitable for demonstrating the construction and functioning of	1 for 8 (4+4) Units



		different types of DC machines and AC machines (single phase and three phase). Should be fitted with friction brake arrangement, dynamo meter, instrument panel and power supply unit	
153.	Diesel Generator Set with change over switch, over current breaker and water/ air-cooled with armature, star-delta connections AC 3 phase	7.5 KVA, 415 volt or higher rating	1 No. per institute
154.	Used DC Generators-series, shunt and compound type for overhauling practice		1 No. Each
155.	Pillar Electric Drill Machine Motorized	12-20 mm Capacity, 1HP, 440V, 3 phase, Induction Motor with DOL starter, Bench Type	1 No.
156.	Motorised Bench Grinder	1 HP. 3 phase, 440V with DOL starter, Double side with smooth and rough wheel with Tool Base	1 No.
157.	A.C. Series type Motor	1 HP, 240 V, 50 Hz	1 No.
158.	Single Phase Capacitor Motor with starter switch	1 HP, 240 V, 50 Hz	1 No.
159.	Manual Motor coil Winding Machine	With step arbor	1 No.
160.	Ceiling fan coil Winding Machine	250V, 50 Hz, 1- $\Phi$ , with speed control	1 No.
161.	Primary current injection set	220V, 50 Hz, 1- $\Phi$ , output current - 200 A (min) with timer	1 No.
162.	Stepper Motor with Digital Controller		1 No.
163.	Shaded Pole Motor	Fractional HP, 240 V, 50 Hz	1 No.
<b>D. Shop Floor Furniture and Materials - For 2 (1+1) units no additional items are required</b>			
164.	Working Bench	2.5 m x 1.20 m x 0.75 m	4 Nos.
165.	Wiring Board	3 meter x1 meter with 0.5 meter projection on the top	1 No.
166.	Instructor's table		1 No.
167.	Instructor's chair		2 Nos.
168.	Metal Rack	100cm x 150cm x 45cm	4 Nos.

169.	Lockers with drawers		1 for Each Trainee
170.	Almirah	2.5 m x 1.20 m x 0.5 m	1 No.
171.	Black board/white board	(minimum 4X6 feet)	1 No.
172.	Fire Extinguisher CO <sub>2</sub>	2 KG	2 Nos.
173.	Fire Buckets	Standard size	2 Nos.

**Note: -**

1. All the tools and equipment are to be procured as per BIS specification.
2. Quantity marked with \* has been increased as per the batch size.
3. Internet facility is desired to be provided in the class room.

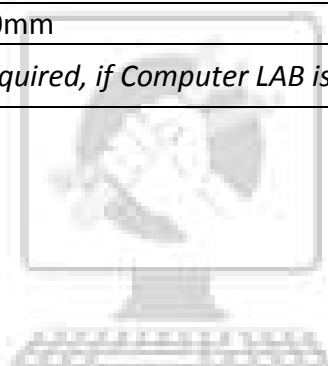


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### TOOLS & EQUIPMENT FOR EMPLOYABILITY SKILLS

S 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**

<b>Name &amp; Address of the Assessor:</b>			<b>Year of Enrollment:</b>											
<b>Name &amp; Address of ITI (Govt./Pvt.):</b>			<b>Date of Assessment:</b>											
<b>Name &amp; Address of the Industry:</b>			<b>Assessment location: Industry / ITI</b>											
<b>Trade Name:</b>		<b>Examination:</b>		<b>Duration of the Trade/course:</b>										
<b>Learning Outcome:</b>														
<b>S No.</b>	<b>Maximum Marks (Total 100 Marks)</b>		<b>15</b>	<b>5</b>	<b>10</b>	<b>5</b>	<b>10</b>	<b>10</b>	<b>5</b>	<b>10</b>	<b>15</b>	<b>15</b>	<b>Total Internal Assessment Marks</b>	<b>Result (Y/N)</b>
	<b>Candidate Name</b>	<b>Father's/Mother's Name</b>	<b>Safety Consciousness</b>	<b>Workplace Hygiene &amp; Economical use of materials</b>	<b>Attendance/ Punctuality</b>	<b>Ability to follow Manuals/ Written instructions</b>	<b>Application of Knowledge</b>	<b>Skills to Handle Tools/ Equipment/ Instruments/ Devices</b>	<b>Economical use of Materials</b>	<b>Working Strategy</b>	<b>Quality in Workmanship/ Performance</b>	<b>VIVA</b>		
<b>1</b>														
<b>2</b>														