



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

COMPETENCY BASED CURRICULUM

ELECTRICIAN – POWER DISTRIBUTION

(Duration: Two Years)

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL - 5



SECTOR – POWER

ELECTRICIAN – POWER DISTRIBUTION

(Engineering Trade)

Designed in 2018

Version: 1.1

CRAFTSMEN TRAINING SCHEME (CTS)

Skill India
NSQF LEVEL- 5
कौशल भारत - कुशल भारत

Developed By

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1. COURSE INFORMATION

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 under Professional Skill subject are as below:-

First Year: - The trainee learns about safety and environment, use of fire extinguishers, practices elementary first aid, rescue a person and artificial resuscitation. He gets the idea of trade tools & its standardization, identifies different types of conductors, cables & their skinning, jointing, soldering and crimping etc. Basic electrical laws like Kirchhoff's law, ohm's law, laws of resistances and their application in different combinations of electrical circuits 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 and working with analog and digital measuring instruments. The trainee work with different electronic components/ circuits and analyze waveforms in CRO.

The trainee learns about testing and maintenance of batteries and solar cell. Wiring practice with installation of different accessories like ICDP switch, distribution fuse box and mounting energy meters are practiced as per IE rules and its fault detection is done by trainee. Different types of light fitting are to be done like fluorescent tube, HP sodium vapour lamp, LEDs and their fixtures. He learns Practice reading of power and control schematic drawings of motors and starters. Operation, testing and maintenance of induction motors, alternators and synchronous motors is practiced. The trainee learns to perform auto tuning and operation of AC drives. Learns to repair and installation of inverter, stabilizer, battery charger and UPS.

Second Year: - The trainee practices on control cabinet wiring and testing of control elements. Understands power generation, transmission and distribution network. He identifies various substation equipment viz., ., isolators, over current relays, earth fault relay, differential relay, REF relay, lightening arresters, Surge counter, wave trap, Reactor, Capacitor bank, Circuit breakers – ACB, SF-6 and VCB etc. Practices operation and maintenance of isolators, circuit breakers and other equipments used in distribution substations. Skill will be gained on transformer for operation, maintenance and functional tests viz., open circuit, short circuit, IR, PI, induced voltage, BDV of transformer oil, etc. He practices on LT/HT cable jointing, laying of cables, tests and fault finding of underground cables.

The trainee learns to install, test, repair and replace Current and Potential transformers used in distribution substations. The trainee practices for pipe, plate and mesh earthing and carries out maintenance of earth system. Identifies various conductors, ACSR, AAC, ABC and cable insulation. Practices on joining of overhead line conductors, erection of poles, fitting of

accessories and commissioning of distribution line. He learns to monitor meter readings, reading of MRI reports, generating electricity bills using SBM and maintaining log sheets at substations. Practices isolation and switching procedure, lock out / tag out system, settings of relays, examine faults in control room and repair substation equipment and panels. The Trainee also learns and practices on fire-fighting equipment used in substations.



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2. TRAINING SYSTEM

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 – Power Distribution” Trade under CTS is one of the newly designed courses. The CTS courses are delivered nationwide through network of ITIs. The course is of two years duration. It mainly consists of Domain area and Core area. In the Domain area (Trade Theory & Practical) impart professional skills and knowledge, while Core area (Workshop Calculation 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 equipment/circuits as per drawing for functioning, identify and rectify errors.
- Document the technical parameters related to the task undertaken.

2.2 CAREER PROGRESSION PATHWAYS

- 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.
- License Certificate in all State Electricity Boards.

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)	2212
2	Professional Knowledge (Trade Theory)	516
3	Workshop Calculation & Science	172
4	Engineering Drawing	258
5	Employability Skills	110
6	Library & Extracurricular activities	172
7	Project work	320
8	Revision & Examination	400
	Total	4160

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 the 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.

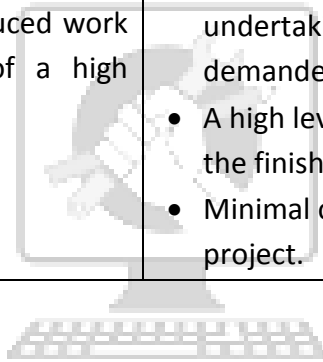
Assessment will be evidence based, comprising the following:

- 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
(a) Weightage in the range of 60 -75% to be allotted during assessment	
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.	• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment. • 60-70% accuracy achieved while undertaking different work with those demanded by the component/job. • A fairly good level of neatness and consistency in the finish. • Occasional support in completing the project/job.
(b)Weightage in the range of above75% - 90% to be allotted during assessment	
For this grade, a candidate should produce	• Good skill levels in the use of hand tools,

work which demonstrates attainment of a reasonable standard of craftsmanship, with little guidance, and regard for safety procedures and practices.	machine tools and workshop equipment. • 70-80% accuracy achieved while undertaking different work with those demanded by the component/job. • A good level of neatness and consistency in the finish • Little support in completing the project/job.
(c) Weightage in the range of above 90% to be allotted during assessment	
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.	• High skill levels in the use of hand tools, machine tools and workshop equipment. • Above 80% accuracy achieved while undertaking different work with those demanded by the component/job. • A high level of neatness and consistency in the finish. • Minimal or no support in completing the project.



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3. JOB ROLE

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.

Lineman, Light and Power; erects and maintains overhead electric power lines to conduct electricity from power plant to place of use. Erects poles and small towers at specified distances with assistance of other workers. Climbs poles and towers and fixes insulators, lightning arresters, cross-brass etc. and other auxiliary equipment at proper heights. Strings and draws cables (wires) through insulators fixed on cross bars, exercising great care to leave proper sag in wires to avoid breakage under changing atmospheric conditions. Joins cable by various methods, fixes joint-boxes at specified places, replaces fuses and faulty components as necessary and tests for electrical continuity. Checks overhead lines in allotted section as necessary and maintains them in order for carrying electricity by effecting repairs of defective lines, poles, towers and auxiliary equipment as directed. May install and repair overhead power lines for electric trains, trams or trolley buses. May work on high tension or low tension power lines.

Electrical Line Installers, Repairers and Cable Jointers, Other; perform number of routine and low skilled tasks in erecting and maintaining overhead lines, joining cables, etc., and are designated as Lineman's Mate; Cable Jointer Helper; etc., according to work performed.

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) 7413.0100 - Lineman, Light and Power
- (iii) 7413.9900 - Electrical Line Installers, Repairers and Cable Jointers, Other
- (iv) 7412.0200 - Electrical Fitter



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4. GENERAL INFORMATION

Name of the Trade	Electrician – Power Distribution
NCO - 2015	7411.0100, 7412.0200, 7413.0100, 7413.9900
NSQF Level	Level-5
Duration of Craftsmen Training	2 Years
Entry Qualification	Passed 10 th class examination with Science and Mathematics or its equivalent.
Unit Strength (No. Of Student)	20
Space Norms	98 Sq. m
Power Norms	5.2 KW (for two units in one shift)
Instructors Qualification for	
(i) Electrician – Power Distribution Trade	Degree in Electrical/ Electrical and Electronics Engineering from recognized Engineering College/ university with one year experience in the relevant field. OR Diploma in Electrical / Electrical and Electronics Engineering from recognized board of technical education with two years experience in the relevant field. OR NTC/NAC passed in the Trade of "Electrician – Power Distribution" With 3 years' post qualification experience in the relevant field. <u>Essential Qualification:</u> Craft Instructor Certificate in relevant trade under NCVT. <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>
(ii) Workshop Calculation & Science	Degree in Engineering with one year experience. OR Diploma in Engineering with two years experience. <u>Essential Qualification:</u> Craft Instructor Certificate in RoD& A course under NCVT.
(iii) Engineering Drawing	Degree in Engineering with one year experience.

	OR Diploma in Engineering with two years experience. OR NTC / NAC passed in the Draughtsman (Mechanical / Civil) with three years experience. Essential Qualification: Craft Instructor Certificate in RoD& A course under NCVT.					
(iv) Employability Skill	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. AND Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above. OR Existing Social Studies Instructors duly trained in Employability Skills from DGT institutes					
List of Tools & Equipment	As per Annexure-I					
Distribution of training on Hourly basis: (Indicative only)						
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 – Power Distribution 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 - Power Distribution** 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/ ASSESSABLE OUTCOME

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 and crimping.
13. Verify basic characteristics of electrical and magnetic circuits and perform measurements using analog / digital instruments.
14. Assemble simple electronic circuits and test for functioning.
15. Carry out installation, testing and maintenance of batteries and battery room in distribution substation.
16. Estimate, Assemble, install and test wiring system.
17. Plan and install electrical illumination system and test.

18. Plan, Execute commissioning, testing of AC motors & Starters and carry out their maintenance.
19. Perform testing and carry out maintenance of Alternator and Synchronous motor.
20. Perform speed control of AC motors by using solid state devices/ AC drives.
21. Detect the faults and troubleshoot inverter, stabilizer, battery charger and UPS etc.

Second Year

22. Assemble accessories and carry out wiring of control cabinets and equipment.
23. Perform on-site installation, preventive maintenance, testing, repair/ replacement of electrical power distribution equipment viz., circuit breakers, isolators, lightening arresters, reactor, capacitor bank etc.
24. Carry out testing, maintenance and evaluate performance of transformers.
25. Plan and prepare LT/ HT cable and Underground cable joints.
26. Perform testing, repair/ replacement and maintenance of control elements viz., CT, PT, etc., used for protection and measurement in power distribution.
27. Plan and prepare Earthing installation, carryout testing and maintenance.
28. Plan and commission overhead distribution line including ABC and HVDS.
29. Carry out installation, repair/ replacement and maintenance of tower/pole and accessories in Power Distribution System.
30. Monitor meter readings, generate bill, maintain & upkeep various log sheets and energy accounting.
31. Examine the faults and carry out repairing of substation equipment and panels.
32. Read and understand electrical Schematic drawings of power and control circuits of outdoor substation.
33. Operate fire fighting equipment and systems used in substation.

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 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	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.

communication	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	8.1	Explain the concept of energy conservation, global warming, pollution and utilize the available resources optimally & remain

conservation, global warming and pollution and contribute in day to day work by optimally using available resources.	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
FIRST YEAR	
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 surface mounting type of accessories.
	11.5 Prepare an open box from metal sheet.
	11.6 Make and wire up of a test board and test it.
12. Prepare electrical wire joints, carry out soldering and crimping.	12.1 Observe safety precautions during joints & soldering.
	12.2 Identify types of wires, cables and verify their specifications.
	12.3 Make simple straight twist /rat-tail joints in single strand conductors.
	12.4 Make married and 'T' (Tee) joint in stranded conductors.
	12.5 Prepare a Britannia straight / 'T' (Tee) joint in bare conductors.
	12.6 Prepare western union joint in bare conductor.
	12.7 Solder the finished copper conductor joints with precaution.
13. Verify basic characteristics of electrical and magnetic circuits and perform measurements using analog / digital instruments.	13.1 Observe safety precautions while working on electrical circuits.
	13.2 Verify the characteristics of series/ parallel / combinational circuit.
	13.3 Analyze the effect of the short and open in series / parallel circuits.
	13.4 Verify the relation of voltage components of RLC series circuit in AC.
	13.5 Determine the power factor by direct / indirect methods in an AC single phase RLC parallel circuit.
	13.6 Identify the phase sequence of a 3 ϕ 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 Measure resistance using voltage drop/ wheatstone bridge method.
	13.10 Demonstrate the change in resistance due to temperature.
	13.11 Verify the characteristics of series parallel combination of resistors.
	13.12 Plot the field of a magnet bar and determine the poles.

	13.13 Wind a solenoid and demonstrate the magnetic effect of electric current.
	13.14 Measure induced emf due to change in magnetic field and determine direction of induced emf and current.
	13.15 Measure the resistance, impedance and determine inductance of choke coils in different combinations.
	13.16 Group the given capacitors to get the required capacity and voltage rating.
	13.17 Measure various electrical parameters using digital multifunction meter
14. Assemble simple electronic circuits and test for functioning.	14.1 Perform soldering on components, lug and board with safety.
	14.2 Identify the passive /active components by visual appearance, Code number and test for their condition.
	14.3 Identify the control and functional switches in CRO and analyze different waveforms.
	14.4 Construct and test a half /full wave rectifier with and without filter circuits.
	14.5 Construct circuit by using transistor as a switch.
	14.6 Operate and set the required frequency using function generator
	14.7 Make a printed circuit board for power supply.
	14.8 Identify and troubleshoot defects in simple power supplies.
	14.9 Construct and test lamp dimmer using TRIAC/DIAC.
	14.10 Construct and test logic gate circuits.
15. Carry out installation, testing and maintenance of Batteries and Battery room in distribution substations.	15.1 Observe safety precautions while working on batteries.
	15.2 Determine the internal resistance of cell and make grouping of cells.
	15.3 Demonstrate charging of battery and test for its condition with safety/ precaution.
	15.4 Explain installation, care and maintenance of batteries.
	15.5 Measure specific gravity of electrolyte and determine correction factor.
	15.6 Determine total number of cells required for a given power requirement.
	15.7 Identify various components of battery charger used in sub-station.
	15.8 Explain trickle charging/ C5 and C10 charging methods.
	15.9 Perform charging / discharging of Ni-Cd battery.
	15.10 Charge batteries by using float and boost charger.
	15.11 Check DC leakage and demonstrate methods of its protection.
16. Estimate, Assemble,	16.1 Comply with safety & IE rules while performing wiring.

install and test wiring system.	16.2	Prepare and mount the energy meter board.
	16.3	Draw and wire up the consumers main board with ICDP switch and distribution fuse box.
	16.4	Draw and wire up a PVC conduit wiring.
	16.5	Identify the types of fuses their ratings and applications.
	16.6	Identify the parts of a relay, MCB & ELCB and demonstrate operation.
	16.7	Estimate the cost of material for wiring in PVC channel for an office room having 2 lamps, 1 Fan, two 6A socket outlet and wire up.
	16.8	Estimate the requirement for PVC casing-capping/ conduit wiring (3 phase) and wire up.
	16.9	Estimate the materials and wire up a lighting circuit for a corridor in conduit.
	16.10	Test, locate the fault and repair a domestic wiring installation.
17. Plan and install electrical illumination system and test.	17.1	Plan work in compliance with standard safety norms related with electrical illumination system.
	17.2	Group different wattage of lamps in series for specified voltage.
	17.3	Assemble and connect a single twin tube fluorescent light.
	17.4	Demonstrate installation of HP sodium vapour lamps/ metal halide.
	17.5	Connect, install and test the lamp with accessories.
	17.6	Prepare and test a decorative serial lamp set for 240 V using 6V bulb and flasher.
	17.7	Install light fitting for show case window lighting.
	17.8	Install light fittings with various types of LEDs and fixture.
18. Plan, Execute commissioning, testing of AC motors & Starters and carry out their maintenance.	18.1	Plan work in compliance with standard safety norms related with electrical machines.
	18.2	Explain power and control schematic drawings of AC motors and starters.
	18.3	Draw circuit diagram and connect forward & reverse a 3 phase squirrel cage induction motor.
	18.4	Start, run and reverse an AC 3 phase squirrel cage induction motor by different type of starters.
	18.5	Determine the efficiency of 3 phase squirrel cage induction motor by no load test/ blocked rotor test and brake test.
	18.6	Connect, start, run and reverse the direction of rotation of slip-ring motor through rotor resistance starter.

	18.7	Demonstrate speed control of 3 phase induction motor.
	18.8	Connect start, run, control speed and reverse the DOR of given single phase motor.
	18.9	Install a single phase AC motor.
	18.10	Test continuity and insulation resistance of AC motor.
	18.11	Maintain, service and trouble shoot of three phase AC motor.
	18.12	Maintain, service and trouble shoot of given single phase AC motor.
	18.13	Maintain, service and trouble shoot the AC motor starter.
19. Perform testing and carry out maintenance of Alternator and Synchronous motor.	19.1	Plan work in compliance with standard safety norms related with Alternator & MG set.
	19.2	Test for continuity and insulation resistance of an alternator.
	19.3	Connect, start and run a 3 phase synchronous motor.
	19.4	Connect start and run an alternator and build up the voltage.
	19.5	Determine the load performance of a 3 phase alternator.
	19.6	Explain preventive and breakdown maintenance of alternator / MG set.
	19.7	Explain the effect of excitation current in terms of V-curves of synchronous motor.
20. Perform speed control of AC motors by using solid state devices/ AC drives.	20.1	Plan work in compliance with standard safety norms related to AC drives.
	20.2	Enter motor data and perform auto tuning on thyristors/ AC drive.
	20.3	Control speed and reverse the direction of rotation of different type of three phase induction motors using VVVF control /AC drive
	20.4	Perform connections and identify parameters of AC drives.
21. Detect the faults and troubleshoot inverter, stabilizer, battery charger and UPS etc.	21.1	Plan work in compliance with standard safety norms related to electrical circuits.
	21.2	Assemble circuits of battery charger and inverter.
	21.3	Test, analyze defects and repair voltage stabilizer/ emergency light / UPS.
	21.4	Explain operation of inverter/ voltage stabilizer/ ups.
	21.5	Identify the parts, trace the connection and test the DC regulated power supply with safety.
	21.6	Troubleshoot and service a DC regulated power supply.
	21.7	Test battery charger for its operation.

	21.8 Install an Inverter with battery and connect it in domestic wiring for operation.
SECOND YEAR	
22. Assemble accessories and carry out wiring of control cabinets and equipment.	22.1 Draw the layout diagram of 3 phase AC motor control cabinet.
	22.2 Mount the control elements & wiring accessories on the control panel.
	22.3 Carry out wiring in control cabinet for local and remote control of induction motor.
	22.4 Draw & wire up the control panel for forward/ reverse operation of induction motor.
	22.5 Carry out wiring for automatic start delta starter.
	22.6 Draw & wire up the control panel for a given circuit diagram and connect the motor.
	22.7 Test the control panel for its performance and all the required logics.
23. Perform on-site installation, preventive maintenance, testing, repair/ replacement of electrical power distribution equipment viz., circuit breakers, isolators, lightening arresters, reactor, capacitor bank etc.	23.1 Comply with safety & IE rules while working with substation equipment.
	23.2 Identify outdoor /indoor switchgears/ power and distribution transformers.
	23.3 Demonstrate Live-dead-Live test in electrical panel (HV/LV).
	23.4 Draw layout of thermal power plant and identify function of different elements.
	23.5 Draw layout of hydel power plant and identify functions of different elements.
	23.6 Draw single line diagram of transmission and distribution system.
	23.7 Identify substation equipment viz., isolators/ relays/ lightening arresters/ Surge counter/ wave trap/ Reactor/ Capacitor bank/ Circuit breakers.
	23.8 Perform filling / evacuation of gas in SF-6 Circuit breaker
	23.9 Carry out timer test on circuit breakers.
	23.10 Demonstrate installation/ replacement of lightening arrester/ Wave Trap/ LMU.
	23.11 Demonstrate reading of surge counter.
24. Carry out testing, maintenance and evaluate performance of transformers.	24.1 Plan work in compliance with standard safety norms related with transformers.
	24.2 Identify the types of transformers and their specifications.
	24.3 Identify the terminals; verify the transformation ratio of a single phase transformer.
	24.4 Perform series and parallel operation of two single phase transformers.

	24.5	Verify the terminals and accessories of three phase transformer HT and LT side.
	24.6	Carry out open circuit test for measurement of no load loss and current.
	24.7	Perform BDV (Dielectric strength) and water particle content test of transformer oil.
	24.8	Connect 3 single phase transformers for 3 phase operation of delta-delta/ delta-star/ star-star/ star-delta.
	24.9	Carry out insulation resistance & polarization index test of distribution transformer used in substations.
	24.10	Measure Transformer winding resistance.
	24.11	Identify phase and neutral bushings of HV & LV side of the distribution transformer and carry out IR test of individual bushings.
	24.12	Perform transformation ratio test.
	24.13	Carry out Short circuit test and measure impedance voltage/ short circuit impedance/ load loss.
	24.14	Carry out induced Voltage Test of Transformer.
	24.15	Carry out tests on buchholz relay/ Temperature indicators/ pressure relief devices/ oil preservation system.
	24.16	Explain maintenance of transformer.
25. Plan and prepare LT/ HT cable and Underground cable joints.	25.1	Comply with safety & IE rules while working on LT/ HT cables.
	25.2	Identify different types of HT/LT cables.
	25.3	Identify different parts of various underground cables.
	25.4	Prepare cables for termination and joining.
	25.5	Demonstrate termination kits and make terminations of LT/HT cables.
	25.6	Make straight joint of given underground cable.
	25.7	Carry out high pot test.
	25.8	Explain procedure for laying of HT/LT cables in raceways and trenches.
	25.9	Identify various cable glands.
	25.10	Demonstrate passing of cables through cable entry plate.
	25.11	Demonstrate split cable entry for multiple pre-terminated cables.
	25.12	Demonstrate bonding and grounding of raceways, cable assembly and panels.
	25.13	Test underground cables for faults and explain removal of the fault.
26. Perform testing, repair/ replacement and	26.1	Comply with safety & IE rules while working on substation equipment.

maintenance of control elements viz., CT, PT, etc., used for protection and measurement in power distribution.	26.2	Identify Current transformers, its specifications.
	26.3	Carry out ratio test/Polarity test/ insulation resistance/ winding resistance test/ Saturation test/ Burden test on CT.
	26.4	Carry out knee point voltage test of protection core.
	26.5	Carry out ratio change of CT by changing taps in primary and secondary side.
	26.6	Identify potential transformers and its specifications.
	26.7	Perform insulation resistance test/ Polarity test/ turn's ratio test on PT.
	26.8	Explain installation and commissioning of current transformer/ potential transformer.
	26.9	Identify isolation transformers and its specifications.
	26.10	Explain repair/ replacement and maintenance of CT and PT.
27. Plan and prepare Earthing installation, carryout testing and maintenance.	27.1	Plan work in compliance with standard safety norms related with earthing installation.
	27.2	Install pipe/ plate earthing and test it.
	27.3	Demonstrate earthing of delta connected system.
	27.4	Explain grid/ mesh/ chemical earthing.
	27.5	Measure the earth electrode resistance using earth tester.
	27.6	Carry out earth resistance improvement.
	27.7	Perform grounding of equipment and systems.
	27.8	Test earth leakage by ELCB and relay.
28. Plan and commission overhead distribution line including ABC and HVDS.	28.1	Comply with safety & IE rules while working on overhead distribution line.
	28.2	Identify given conductors.
	28.3	Perform mechanical /electrical testing of overhead conductors.
	28.4	Identify various sizes of copper wires and cable insulation FR/FRLS/FRLSH.
	28.5	Demonstrate joining of overhead line conductors.
	28.6	Explain commissioning of distribution line using Aerial bunched cables.
	28.7	Explain components and working of High Voltage Distribution System (HVDS).
29. Carry out installation, repair/ replacement and maintenance of tower/pole and accessories in Power	29.1	Comply with safety & IE rules while working on overhead distribution system.
	29.2	Identify different Supports, Transmission Towers, and various accessories.
	29.3	Perform digging of pit/ erection of supports/ fitting various

Distribution System.	accessories on poles.
	29.4 Perform stringing and sagging of line conductors.
	29.5 Fasten jumper in pin/ shackle/ suspension type insulators.
	29.6 Erect an overhead service line pole for single phase 240v distribution system.
	29.7 Identify different type of insulator used in HT and LT line
	29.8 Measure current carrying capacity of conductors.
	29.9 Connect feeder cable with domestic service line.
	29.10 Demonstrate installation and sealing of energy meter.
	29.11 Install bus bar and bus coupler on LT line.
	29.12 Demonstrate working of thermo vision camera.
30. Monitor meter readings, generate bill, maintain & upkeep various log sheets and energy accounting.	30.1 Explain collection of meter reading from various meters.
	30.2 Demonstrate study of MRI reports.
	30.3 Take meter reading by using USB / Optical cable.
	30.4 Observe/ Study log sheet at substation.
	30.5 Generate electricity bill using SBM.
31. Examine the faults and carry out repairing of substation equipment and panels.	31.1 Demonstrate isolation procedure/ switching procedure preparation.
	31.2 Explain permit system and steps of LOTO system.
	31.3 Carry out testing of Control Room Wiring Installations.
	31.4 Identify various fuse sets viz., HRC, DO, 33KV fuse set, etc.
	31.5 Measure and select appropriate size of fuse wire.
	31.6 Examine faults in Control Room Wiring and perform repairing.
	31.7 Demonstrate various parts of relay and ascertain the operation.
	31.8 Demonstrate setting of pick up current/ time setting multiplier for relay operation.
32. Read and understand electrical Schematic drawings of power and control circuits of outdoor substation.	32.1 Interpret Single line/ Layout drawings with Equipment and Protection codes as per ANSI.
	32.2 Interpret Layout drawings of 400kV/220kV/132kV/66kV/33kV/11kV outdoor substations.
	32.3 Interpret various panel wiring drawings of substation equipment.
33. Operate fire-fighting equipment and systems used in substation.	33.1 Explain various categories of fire.
	33.2 Identify various fire fighting equipment used in distribution substations.
	33.3 Demonstrate use of different fire fighting extinguishers.

8. SYLLABUS

SYLLABUS FOR ELECTRICIAN – POWER DISTRIBUTION TRADE			
DURATION - FIRST YEAR			
Week No.	Reference Learning outcome	Professional Skills (Trade Practical) With Indicative Hours	Professional Knowledge (Trade Theory)
1-2	Apply safe working practices.	- Visit various sections of the institutes and location of electrical installations. (05 hrs) - Identify safety symbols and hazards. (05 Hrs) - Preventive measures for electrical accidents and practice steps to be taken in such accidents. (05 hrs) - Practice safe methods of fire fighting in case of electrical fire. (05 hrs) - Use of fire extinguishers. (05 Hrs) - Practice elementary first aid. (05 hrs) - Rescue a person and practice artificial respiration. (05 Hrs) - Disposal procedure of waste materials. (05 Hrs) - Use of personal protective equipments. (05 hrs) - Practice on cleanliness and procedure to maintain it. (05 hrs)	Scope of the “Electrician – Power Distribution” Trade. Power sector scenario in India. Safety rules and safety signs. Introduction to Electricity Act-2003, CERC, SERC. 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. Types and working of fire extinguishers. Standard distance for safe working zone, clearance from live HV electrical system.
3	Apply safe working practices.	- Identify trade tools and machineries. (10 Hrs) - Practice safe methods of lifting and handling of tools & equipment. (05 Hrs) - Select proper tools for operation and precautions in operation. (05 Hrs) - Care & maintenance of	Concept of Standards and advantages of BIS/ISI. Trade tools specifications. Introduction to National Electrical Code-2011. Store keeping of equipments for Repair works.

		trade tools. (05 Hrs)	
4-5	• Prepare profile with an appropriate accuracy as per drawing.	15. Operations of allied trade tools. (10Hrs) 16. Workshop practice on filing and hacksawing. (10Hrs) 17. Practice on preparing T-joint, straight joint and dovetail joint on wooden blocks. (15Hrs) 18. Practice sawing, planing, drilling and assembling for making a wooden switchboard. (15Hrs)	Allied trades: Introduction to carpentry 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	• Prepare profile with an appropriate accuracy as per drawing.	19. Practice in marking and cutting of straight and curved pieces in metal sheets. (10 Hrs) 20. Workshop practice on drilling, chipping, internal and external threading of different sizes. (15Hrs) 21. Practice of making square and round holes, securing by screw and riveting. (10Hrs) 22. Prepare an open box from metal sheet. (15 Hrs)	Marking tools; Introduction to fitting tools, calipers, Dividers, Surface plates, Angle plates, Scribes, 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. Care and maintenance of tools.
8-10	• Prepare electrical wire joints, carry out soldering and crimping.	23. Prepare terminations of cable ends (02 hrs) 24. Practice on skinning, twisting and crimping. (15 Hrs) 25. Identify various types of cables and measure conductor size using SWG and micrometer. (8 Hrs) 26. Make simple twist, married, Tee and western union joints. (18 Hrs) 27. Make britannia straight, britannia Tee and rat tail joints. (18 Hrs) 28. Practice in Soldering of joints / lugs. (14 Hrs)	Fundamentals of electricity, definitions, units & effects of electric current. Conductors and insulators. Conducting materials and their comparison. Joints in electrical conductors, contact resistance measurement and required pressure. Techniques of soldering. Types of solders and flux.

11-13	• Verify basic characteristics of electrical and magnetic circuits and perform measurements using analog / digital instruments.	29. Practice on measurement of parameters in combinational electrical circuit by applying Ohm's Law for different resistor values and voltage sources. (04 Hrs) 30. Measure current and voltage in electrical circuits to verify Kirchhoff's Law (04 Hrs) 31. Verify laws of series and parallel circuits with voltage source in different combinations. (04Hrs) 32. Measure voltage and current against individual resistance in electrical circuit (04 hrs) 33. Measure current & voltage and analyse the effects of shorts and opens in series and parallel circuits. (04 Hrs) 34. Measure resistance using voltage drop method. (04 Hrs) 35. Measure resistance using wheatstone bridge. (04 Hrs) 36. Determine the change in resistance due to temperature. (04 Hrs) 37. Verify the characteristics of series parallel combination of resistors. (04 Hrs) 38. Determine the poles and plot the field of a magnet bar. (04 Hrs) 39. Wind a solenoid and determine the magnetic effect of electric current. (06 Hrs) 40. Measure induced emf due to change in magnetic field. (05hrs)	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. 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 resistance. Series and parallel combinations of resistors. 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. Inductive and capacitive reactance, their effect on AC circuit and related vector concepts. Handling of charging and discharging of static capacitors and other static charged equipment.
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		41. Determine direction of induced emf and current. (05hrs) 42. Practice on generation of mutually induced emf. (05 hrs) 43. Measure the resistance, impedance and determine inductance of choke coils in different combinations. (06 Hrs) 44. Identify various types of capacitors, charging / discharging and testing. (04Hrs) 45. Group the given capacitors to get the required capacity and voltage rating. (04Hrs)	
14-16	• Verify basic characteristics of electrical and magnetic circuits and perform measurements using analog / digital instruments.	46. Measure current, voltage and PF and determine the characteristics of RL, RC and RLC in AC series circuits. (10Hrs) 47. Measure the resonance frequency in AC series circuit and determine its effect on the circuit. (08hrs) 48. Measure current, voltage and PF and determine the characteristics of RL, RC and RLC in AC parallel circuits. (10Hrs) 49. Measure the resonance frequency in AC parallel circuit and determine its effects on the circuit. (08hrs) 50. Measure power, energy for lagging and leading power factors in single phase circuits and compare characteristic graphically. (10Hrs)	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. Problems on A.C. circuits. Classification of electrical instruments and essential forces required in indicating instruments. PMMC and Moving iron instruments. Measurement of various electrical parameters using different analog and digital instruments. Measurement of energy in three phase circuit.



		51. Measure Current, voltage, power, energy and power factor in three phase circuits. (08hrs) 52. Practice improvement of PF by use of capacitor in three phase circuit.(06Hrs) 53. Measure power factor in three phase circuit by using power factor meter and verify the same with voltmeter, ammeter and wattmeter readings. (15Hrs)	
17-19	• Verify basic characteristics of electrical and magnetic circuits and perform measurements using analog / digital instruments.	54. Ascertain use of neutral by identifying wires of a 3-phase 4 wire system and find the phase sequence using phase sequence meter. (12Hrs) 55. Determine effect of broken neutral wire in three phase four wire system.(08hrs) 56. Determine the relationship between Line and Phase values for star and delta connections. (10Hrs) 57. Measure the Power of three phase circuit for balanced and unbalanced loads. (12Hrs) 58. 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.(10hrs) 59. Measure electrical parameters using tong tester in three phase circuits. (10Hrs) 60. Measure various electrical parameters using digital	Advantages of AC poly-phase system. Concept of three-phase Star and Delta connection. Line and phase voltage, current and power in a 3 phase circuits with balanced and unbalanced load. Phase sequence meter. Basic concept of Digital Multi Function Meter. Basic concept of Accuracy class of meters. Communication from MFM to SCADA system. Improvement of power factor using Capacitor Bank.



		multifunction meter.(13hrs)	
20-21	Assemble simple electronic circuits and test for functioning.	61. Determine the value of resistance by colour code and identify types. (06Hrs) 62. Test active and passive electronic components and its applications. (10Hrs) 63. Determine V-I characteristics of semiconductor diode. (06Hrs) 64. Construct half wave, full wave and bridge rectifiers using semiconductor diode. (14Hrs) 65. Check transistors for their functioning by identifying its type and terminals. (06Hrs) 66. Use transistor as an electronic switch and series voltage regulator. (08Hrs)	Resistors – colour code, types and characteristics. Active and passive components. Atomic structure and semiconductor theory. P-N junction, classification, specifications, biasing and characteristics of diodes. Rectifier circuit - half wave, full wave, bridge rectifiers and filters. Transistors; Principle of operation, types, characteristics various configuration and biasing of transistor. Application of transistor as a switch, voltage regulator and amplifier.
22-23	Assemble simple electronic circuits and test for functioning.	67. Operate and set the required frequency using function generator. (05Hrs) 68. Make a printed circuit board for power supply. (05Hrs) 69. Construct simple circuits containing UJT for triggering and FET as an amplifier. (05Hrs) 70. Troubleshoot defects in simple power supplies. (05Hrs) 71. Construct power control circuit by SCR, Diac, Triac and IGBT. (05Hrs) 72. Construct variable DC stabilized power supply using IC. (05Hrs)	Basic concept of power electronics devices. IC voltage regulators Digital Electronics - Binary numbers, logic gates and combinational circuits. Functions & settings of oscilloscope and waveform analysis. Construction and working of SCR, DIAC, TRIAC and IGBT. Types and applications of various multivibrators.



		73. Practice on various logics by use of logic gates and circuits. (06Hrs) 74. Generate and demonstrate wave shapes for voltage/ current of rectifier and single stage amplifier using CRO. (08Hrs) 75. Construct 1ϕ or 3ϕ bridge rectifier/ inverter/ logic gate, measure input and output voltage and analyze waveforms by using oscilloscope.(06Hrs)	
24-25	Project work / Industrial visit Broad Areas: a) Prepare and assemble a test board with switches, plug socket, lamp holder etc. b) Temperature controlled system for switching 'ON' and 'OFF' of any circuit using bi-metallic strip. c) Series/ parallel combinational circuits. d) Circuits using Electronic components. e) Waveform analysis of circuits.		
26-27	Revision		
28-30	• Carry out installation, testing and maintenance of batteries and battery room in distribution substation.	76. Identify and use of various types of cells. (05Hrs) 77. Measure voltage of different cells and Batteries. (05Hrs) 78. Practice on grouping of cells for specified voltage and current under different conditions with due care. (05Hrs) 79. Measure specific gravity of electrolyte and determine correction factor. (05Hrs) 80. Identify various components of battery charger used in sub-station. (05Hrs) 81. Perform proper setting of voltage according to mode	Chemical effect of electric current and Laws of electrolysis. Explanation of Anodes and cathodes. Types of cells, advantages/ disadvantages and their applications. Lead acid cell; Principle of operation and components. Types of battery charging, Load test of Ni-Cd and Lead Acid batteries, Safety precautions, test equipment and maintenance. Grouping of cells for specified voltage and current. Alkaline batteries Types of Battery operation: - Floating operation



		of charging and practice on Battery charging. (05Hrs) 82. Perform setting and carry out Trickle charging of Battery. (08Hrs) 83. Practice charging and discharging of Ni-Cd battery. (06Hrs) 84. Charge batteries by using float and boost charger.(08Hrs) 85. Check DC leakage and practice for its protection.(06Hrs) 86. Carry out testing of batteries. (06Hrs) 87. Practice on routine, care/ maintenance of batteries. (06Hrs) 88. Determine the number of solar cells in series / parallel for given power requirement. (05Hrs)	- Change over operation Boost charging Two Battery two charger system End cell cutting. C5 and C10 charging methods Factors affecting Battery life: - Over charging - Under charging - Leakage Correction factor, Calculation of Battery capacity Inspection of Battery Principle and operation of solar cell. Awareness of maintenance free battery concept. Safety compliance of battery room.
31-34	• Estimate, Assemble, install and test wiring system.	89. Identify various conduits and different electrical accessories. (05Hrs) 90. Practice cutting, threading of different sizes & laying Installations. (10Hrs) 91. Prepare test boards / extension boards and mount accessories like lamp holders, various switches, sockets, fuses, relays, MCB, RCCB, RCBO, MPCB, MCCB etc. (10Hrs) 92. Draw layouts and practice in PVC Casing-capping, Conduit wiring with minimum to more number of points of minimum 15 mtr length. (10Hrs) 93. Wire up PVC conduit wiring to control one lamp from	I.E. rules on electrical wiring. Types of domestic and industrial wirings. Study of wiring accessories e.g. switches, fuses, relays, MCB, RCCB, RCBO, MCCB etc. MPCB and its accessories. Under voltage, over voltage, shunt modules. Grading of cables and current ratings. Principle of laying out of domestic wiring. Voltage drop concept. PVC conduit and Casing-capping wiring system. Different types of wiring - Power, control, Communication



		two or three different places. (10 Hrs) 94. Wire up PVC conduit wiring and practice control of sockets and lamps in different combinations using switching concepts. (10Hrs) 95. Wire up the consumer's main board with ICDP switch MCB and distribution fuse box. (05Hrs) 96. Prepare and mount the energy meter board. (05Hrs) 97. Estimate the cost/bill of material for wiring of hostel/ residential building and workshop. (05Hrs) 98. Practice wiring of hostel and residential building as per IE rules. (10Hrs) 99. Practice wiring of institute and workshop as per IE rules. (10Hrs) 100. Practice testing / fault detection of domestic and industrial wiring installation and repair. (10Hrs)	and entertainment wiring. Wiring circuits planning, permissible load in sub-circuit and main circuit. 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.
35-36	• Plan and install electrical illumination system and test.	101. Group different wattage of lamps in series for specified voltage. (05 Hrs) 102. Practice installation of various lamps e.g. fluorescent tube, HP sodium vapour, metal halide etc. (18Hrs) 103. Prepare decorative lamp circuit. (05 Hrs) 104. Prepare decorative lamp circuit to produce rotating light effect/running light	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. Different types of LEDs and fixtures. Luminous efficiency of LED

		effect. (06 Hrs) 105. Install light fitting for show case lighting. (08Hrs) 106. Install light fittings with various types of LEDs and fixture. (08Hrs)	Various color temperatures – Cool Day light - 5700K/ 6500K, Warm white - 2700K/ 300K False Recess type / Surface type.
37-40	Plan, Execute commissioning, testing of AC motors & Starters and carry out their maintenance.	107. Identify parts and terminals of three phase AC motors. (05 Hrs) 108. Practice reading of power and control schematic drawings of motors. (07Hrs) 109. Connect, start and run three phase induction motors by using DOL, star-delta starters. (08Hrs) 110. Connect, start, run and reverse the direction of rotation of slip-ring motor through rotor resistance starter. (10Hrs) 111. Practice on connection and settings of Soft starters. (05 Hrs) 112. Determine the efficiency of three phase squirrel cage induction motor by no load test and blocked rotor test. (06Hrs) 113. Test for continuity and insulation resistance of three phase induction motor. (05 Hrs) 114. Perform speed control of three phase induction motor by various methods like rheostatic control, autotransformer etc. (12Hrs) 115. Identify parts and terminals of different types of single phase AC motors. (06 Hrs)	Introduction of DC motors and their applications. 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. Basic knowledge of soft starter Single phasing prevention. No load test and blocked rotor test of induction motor. Losses & efficiency. Various methods of speed control. Braking system of motor. Maintenance and repair. Working principle, different method of starting and running of various single phase AC motors. Domestic and industrial applications of different AC motors. Characteristics, losses and efficiency.

		116. Install, connect and determine performance of single phase AC motors. (10Hrs) 117. Start, run and reverse the direction of rotation of single phase AC motors. (08 Hrs) 118. Practice on speed control of single phase AC motors. (08 Hrs) 119. Practice repair and maintenance of AC motors. (10 Hrs)	
41-43	Perform testing and carry out maintenance of Alternator and Synchronous motor.	120. Identify parts and terminals of alternator. (06 Hrs) 121. Test for continuity and insulation resistance of alternator. (08 Hrs) 122. Connect, start and run an alternator and build up the voltage. (10 Hrs) 123. Determine the load performance and voltage regulation of three phase alternator. (10 Hrs) 124. Parallel operation and synchronization of three phase alternators. (10 Hrs) 125. Identify parts and terminals of a synchronous motor. (06 Hrs) 126. Connect, start and plot V-curves for synchronous motor under different excitation and load conditions. (12 Hrs) 127. Carry out maintenance of Alternator and synchronous motor. (13 Hrs)	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. Working principle of synchronous motor. Effect of change of excitation and load. V and anti V curve. Power factor improvement. Rotary Converter, MG Set description and Maintenance.
44	Perform speed control of AC	128. Enter motor data and perform auto tuning on	Working, parameters and applications of AC drive.

	motors by using solid state devices/ AC drives.	thyristors/ AC drive. (08 Hrs) 129. Perform reversing the direction of rotation of AC motors by using thyristors / AC drive. (08 Hrs) 130. Perform connections and identify parameters of AC drives. (09 Hrs)	Speed control of 3 phase induction motor by using VVVF/AC Drive.
45-47	Detect the faults and troubleshoot inverter, stabilizer, battery charger and UPS etc.	131. Identify and assemble circuits of voltage stabilizer and UPS. (10 Hrs) 132. Assemble circuits of battery charger and inverter. (15 Hrs) 133. Test, analyze defects and repair voltage stabilizer, emergency light and UPS. (20 Hrs) 134. Maintain, service and troubleshoot battery charger and inverter. (20 Hrs) 135. Install an Inverter with battery and connect it in domestic wiring for operation. (10 Hrs)	Basic concept, block diagram and working of voltage stabilizer, battery charger, emergency light, inverter and UPS. Preventive and breakdown maintenance.
48-49	Project work / Industrial visit Broad Areas: - Protection of electrical equipment. - Automatic control using relays. - Fuse and power failure indicator using relays. - Door alarm/indicator. - Decorative light. - Motor circuits, speed control and testing. - Inverter/ UPS/ Battery charger/ Stabilizer		
50-51	Revision		
52	Examination		

Note: -

- Some of the sample project works (indicative only) are given at the mid and end of each year.

2. *Instructor may design their own projects and also inputs from local industry may be taken for designing such new projects.*
3. *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.*
4. *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.*



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SYLLABUS FOR ELECTRICIAN – POWER DISTRIBUTION TRADE			
SECOND YEAR			
Week No.	Reference Learning Outcome	Professional Skills (Trade Practical) With Indicative Hours	Professional Knowledge (Trade Theory)
53-55	Assemble accessories and carry out wiring of control cabinets and equipment.	136. Carry out wiring of control cabinet as per wiring diagram, bunching of XLPE cables, channelling, tying and checking etc. (20Hrs) 137. Mount various control elements e.g. circuit breakers, relays, contactors and timers etc. (15Hrs) 138. Identify and install required measuring instruments and sensors in control panel. (12Hrs) 139. Test the control panel for its performance. (12Hrs) 140. Design layout of control cabinet, assemble control elements and wiring accessories for: (i) Forward and reverse operation of induction motor. (08Hrs) (ii) Automatic star-delta starter with change of direction of rotation. (08Hrs)	Study and understand Layout drawing of control cabinet, power and control circuits. Various control elements: Isolators, pushbuttons, switches, indicators, MCB, fuses, relays, types of timers and limit switches etc. Wiring accessories: Race ways/ cable channel, DIN rail, terminal connectors, thimbles, lugs, ferrules, cable binding strap, buttons, cable ties, sleeves, gromats and clips etc. Testing of various control elements and circuits.
56-58	Perform on-site installation, preventive maintenance, testing, repair/ replacement of electrical power distribution equipment viz., circuit breakers, isolators, lightening	141. Identify outdoor and indoor switchgears.(05 Hrs) 142. Identify power and distribution transformers.(05 Hrs) 143. Visit to power and motor control centre and identify various equipment.(05 Hrs) 144. Practice Live-dead-Live test in electrical panel (HV/LV).(05 Hrs) 145. Draw layout of thermal	Various ways of electrical power generation by conventional and non-conventional methods. Transmission and distribution networks. General layout of substation Single line diagram, general symbols for various equipment installed at substation.

	arresters, reactor, capacitor bank etc.	power plant and identify function of different elements. (10 Hrs) 146. Draw layout of hydel power plant and identify functions of different elements. (10 Hrs) 147. Draw single line diagram of transmission and distribution system. (10 Hrs) 148. Identify various substation equipment viz., isolators, over current relays, earth fault relay, differential relay, REF relay, lightening arresters, Surge counter, wave trap, Reactor, Capacitor bank, Circuit breakers – ACB, SF-6 and VCB etc. (20 Hrs) 149. Video demonstration of laying OPGW along with earth wire at the top of tower of HV Line.(05 Hrs)	Single line diagram for various 33 KV, 132 KV, 220 KV, 400 KV substations. Basic idea about distribution system Electrical Safety guidelines and regulations for HT. Direct and indirect Risks of electricity. Voltage detector and its application Basic Parameters of all equipments and their name plate. Techniques of Hotline maintenance at HVS/s. Protection of transmission line via PLCC system.
59-62	Perform on-site installation, preventive maintenance, testing, repair/ replacement of electrical power distribution equipment viz., circuit breakers, isolators, lightening arresters, reactor, capacitor bank etc.	150. Practice operation of isolators. (06 Hrs) 151. Identify different components of Circuit Breakers. (06 hrs) 152. Perform operation of circuit breakers in maintenance (test) mode. (10hrs) 153. Practice use of grounding rod and make visible earthing. (05 hrs) 154. Practice operation of Circuit Breakers; ACB, SF-6 and VCB etc. (20 hrs) 155. Practice filling and evacuation of gas in SF-6 Circuit breaker. (08hrs) 156. Carry out timer test on circuit breakers. (05 hrs) 157. Carry out repair and maintenance of circuit	Types of isolators like Horizontal centre break, Double break, Pantograph type. Circuit Breakers; Types of circuit breakers, their applications and functioning. Production of arc and arc quenching methods (Air blast, oil, SF-6 and vacuum) Types of male and female contacts. Types of jaws & blades of various isolators Maintenance of equipment Grounding Rod Lightening arrester, surge counter Wave Trap and LMU (Line

		breakers. (18 hrs) 158. Identify lightening arrester in the yard and practice replacement. (06 hrs) 159. Practice reading of surge counter. (04 hrs) 160. Identify Wave Trap and LMU and practice replacement. (06 hrs) 161. Carry out maintenance on wave trap and LMU. (06 hrs)	Matching Unit); power line carrier communication (PLCC) system Corona losses in transmission lines in power system. General routine maintenance. Handling of SF6 gas (filling and evacuation procedure) Inspection of contact resistance of breakers and alignment of contacts. Opening and closing time of breakers.
63-69	Carry out testing, maintenance and evaluate performance of transformers.	162. Verify terminals, identify components and calculate transformation ratio of single phase transformers. (10Hrs) 163. Determine voltage regulation of single phase transformer at different loads and power factors. (12Hrs) 164. Perform series and parallel operation of two single phase transformers. (12 Hrs) 165. Verify the terminals and accessories of three phase transformer HT and LT side. (05Hrs) 166. Perform 3 phase operation (i) delta-delta (ii) delta-star (iii) star-star (iv) star-delta, by use of three single phase transformers. (10Hrs) 167. Perform BDV (Dielectric strength) and water particle content test of transformer oil. (10 Hrs) 168. Video demonstration of filtering of transformer oil. (05Hrs) 169. Carry out routine tests of transformer to check operational performance.	Working principle, construction and classification of transformer. Single phase and three phase transformers. Turn ratio and e.m.f. equation. Series and parallel operation of transformers. Voltage Regulation and efficiency. Auto Transformer and instrument transformers (CT & PT). Method of connecting three single phase transformers for three phase operation. Types of Cooling, protective devices, bushings and termination etc. Testing of transformer oil. Routine tests and Pre-commissioning tests of transformers. On load tap changer, driving mechanism and operation of tap.



		(15Hrs) 170. Carry out IR & PI test of distribution transformer used in substations using analog & digital megger. (12Hrs) 171. Measure Transformer winding resistance. (05Hrs) 172. Carry out IR test of individual bushings of distribution transformer. (08Hrs) 173. Identify phase and neutral bushings of HV & LV side of the distribution transformer. (05Hrs) 174. Identify various components of cooler control system of the transformer. (05Hrs) 175. Carry out manual and auto operation of fan from transformer marshalling kiosk. (05 Hrs) 176. Perform transformation ratio test. (08 Hrs) 177. Carry out Short circuit test and measure impedance voltage/ short circuit impedance (principal tap) and load loss. (08 Hrs) 178. Carry out Open circuit test for measurement of no load loss and current. (10Hrs) 179. Carry out induced Voltage Test of Transformer. (10Hrs) 180. Carry out tests on components / accessories viz., buchholz relay, Temperature indicators, Pressure relief devices, Oil preservation system etc. (15Hrs) 181. Carry out maintenance of transformer. (15Hrs)	Oil test include DGA (Dissolved gas analysis) and its interpretation Metal particle analysis and FURAN test Partial discharge (PD) and tan delta test. Alarm and Trip settings for winding temperature Indicator, oil temperature Indicator and Buchholz etc. On load tap changer (OLTC), Driving mechanism and operation of tap locally as well as remotely from control room. Vector group test for parallel operation of transformers.
70-73	Plan and prepare LT/HT cable and Underground	182. Identify different types of HT/LT cables. (05hrs) 183. Identify different parts of	Power cables: Need of HT cables, advantages and disadvantages, various types



	cable joints.	various underground cables. (05hrs) 184. Practice preparation of cables for termination and joining. (10hrs) 185. Demonstrate termination kits and practice on terminations of LT/HT cables. (10hrs) 186. Make straight joint of different types of underground cable. (14hrs) 187. Carry out high voltage (high pot) test.(06 hrs) 188. Practice laying of HT/LT cables in raceways and trenches. (08 hrs) 189. Demonstrate and identify various cable glands. (06 hrs) 190. Practice passing of cables through cable entry plate for standard cables without connectors, up to IP 68 rated protection. (06 hrs) 191. Practice split cable entry for multiple pre-terminated cables, up to IP 65 rated protection. (06 hrs) 192. Practice cable entry on a switch cabinet wall. (06 hrs) 193. Demonstrate bonding and grounding of raceways, cable assembly and panels. (06 hrs) 194. Test underground cables for faults and remove the fault. (12 hrs)	viz., PVC, XLPE, Halogen, Optical fibre, etc. Awareness of HT/LV cable Cable insulation & voltage grades. Classification of cable on the basis of construction, voltage and current. Need for cable jointing (splicing) Need of termination kits. Joints and terminations; pre-moulded, heat shrinkable, extrusion molded joints Slip on, cold shrink terminations. Types of connectors used in the cable, current path. Methods of conductor connection, contact resistance. Precautions in using various types of cables. Galvanic corrosion and use of bimetals. Connectivity for cable screen and armour, mechanical protection Kits for joints and terminations (cold and heat shrink). HV and LV cable joint procedure. Cable termination to equipment Standards and testing; type, routine, field test Stress control Basic concept of Laying procedure and necessary step during emergency restoration and isolate faulty section of power cable in HV Electrical system.
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			Introduction to IP ratings (Ingress protection) and IP Codes format. Importance of Bonding and grounding, various types. Testing of cables, locating faults, open circuit, short circuit and leakage in cables.
74-75	Project work/Industrial visit Visit to Substation Control Panel Room (Components, Power distribution, Grid management, Quality of Electrical Supply, etc.)		
76-77	Revision		
78-81	Perform testing, repair/ replacement and maintenance of control elements viz., CT, PT, etc., used for protection and measurement in power distribution.	195. Identify Current transformers, its specifications and carry out visual inspection. (05hrs) 196. Carry out ratio test on CT. (05 hrs) 197. Carry out Polarity test on CT. (05 hrs) 198. Check insulation resistance of CT. (05 hrs) 199. Carry out winding resistance test on CT. (05 hrs) 200. Carry out Excitation (Saturation) test on CT. (05 hrs) 201. Carry out Burden test on CT. (05 hrs) 202. Carry out knee point voltage test of protection core. (06 hrs) 203. Carry out ratio change of CT by changing taps in primary and secondary side. (06 hrs) 204. Perform installation and commissioning of current transformer. (10 hrs) 205. Identify potential transformers, its specifications and carry out visual inspection. (04 hrs) 206. Perform insulation resistance	Instrument Transformer: Necessity/ Advantages - Difference between Power Transformer & Instrument Transformer - Location of CT and PT in the System - Difference between Instrument Transformers used for Protection/ Measurement Testing of CT and PT Isolation transformer Basic concept of Live tank and Dead tank CT Basic concept of CVT Various types of CT categories and burden-Cl-1/0.5/0.2, Protection CT – 5P10 etc Special Protection CT – PS

		tests on PT; winding to winding and each winding to ground. (06hrs) 207. Carry out Polarity test on PT. (06hrs) 208. Perform turn's ratio test on PT. (06hrs) 209. Perform installation and commissioning of potential transformer. (15hrs) 210. Identify isolation transformers and its specifications. (04 hrs) 211. Carry out repair/ replacement and maintenance of CT and PT. (12 hrs)	class Various substations; outdoor, indoor, pole mounted, Gas insulated substation (GIS), etc. Various terms like – maximum demand, average demand, load factor, diversity factor, plant utility factor etc.
82-84	Plan and prepare Earthing installation, carryout testing and maintenance.	212. Identify various earthing components and their specifications. (06Hrs) 213. Plan and prepare pipe earthing. (12Hrs) 214. Plan and prepare plate earthing. (12Hrs) 215. Plan and prepare grid/mesh earthing. (12Hrs) 216. Practice earthing of delta connected system. (05Hrs) 217. Practice grounding of equipment and systems. (05Hrs) 218. Perform measurement of earth resistance using earth tester. (05Hrs) 219. Carry out treatment to minimize earth resistance. (06Hrs) 220. Carry out maintenance of earth system. (06Hrs) 221. Test earth leakage by ELCB and relay. (06Hrs)	Introduction Importance of Earthing Classification of Earthing: - - Depending upon use; Equipment, System, Discharge, Support and Line Earthing. - Depending upon type; Well type, Pipe, Plate, Mesh, Delta and Chemical earthing Plate earthing and pipe earthing methods and IEE regulations. Difference between grounding and earthing. Earth resistance and earth leakage circuit breaker. Balanced/ Restricted earth protection. Awareness of circuit main earth (CME) and portable earth.
85-88	Plan and commission overhead	222. Identify various conductors viz., All aluminium conductor (AAC), ACSR conductor, etc. (08Hrs)	Objectives of Distribution System. Classification of

	distribution line including ABC and HVDS.	223. Perform mechanical and electrical testing of overhead conductors. (12 Hrs) 224. Identify various sizes of copper wires and cable insulation FR/FRLS/FRLSH.(08Hrs) 225. Practice joining of overhead line conductors. (12 Hrs) 226. Identify Aerial Bunched Cables used in distribution system.(08Hrs) 227. Plan and commission overhead distribution line using bare conductors. (20 Hrs) 228. Plan and commission distribution line using ABC.(20 Hrs) 229. Identify components and work with High Voltage Distribution System (HVDS).(12 Hrs)	Conductors and Nomenclature Current rating Joining of conductor ABC System - Prominent Considerations for Selection for ABC System; LT ABC, HT ABC Method of joining aluminum conductors. High Voltage Distribution System (HVDS) Advantages of HVDS Route survey for overhead and underground cable distribution system. Safety Procedures and Permit to Work Operation and Maintenance of Distribution System
89-91	Carry out installation, repair/ replacement and maintenance of tower/pole and accessories in Power Distribution System.	230. Identify different Supports, Transmission Towers, and various accessories.(08 Hrs) 231. Perform digging of pit, erection of supports and fitting various accessories on poles.(12 Hrs) 232. Perform stringing and sagging of line conductors.(10 Hrs) 233. Fasten jumper in pin, shackle and suspension type insulators. (10 Hrs) 234. Perform installation of overhead domestic service lines.(15 Hrs) 235. Measure current carrying capacity of conductors. (05 hrs) 236. Practice installation and sealing of energy meters.(05 Hrs) 237. Install bus bar and bus coupler on LT line. (05 Hrs) 238. Practice working with thermo vision camera. (05 Hrs)	CEA safety regulation 2010 Supports and Accessories: PCC Pole, ST Pole, Cross Arms, Clamps, Transmission Towers Different types of Line insulators Foundations - Dry, Wet, PS, FS and Well type Construction of Distribution and Transmission Network. Erection & Commissioning of Equipments. Safety precautions and IE rules pertaining to domestic service connections. Basic concept of MONO Pole, Multi circuit Tower and 90 degree crossing of two HV Transmission line

			in same tower. Basic concept of transposition of towers. Types of Faults in electrical system. Thermo vision supervision at substation for hot point detection.
92-93	Monitor meter readings, generate bill, maintain & upkeep various log sheets and energy accounting.	239. Practice on collecting meter reading of various meters.(08hrs) 240. Practice study of MRI reports.(10hrs) 241. Take meter reading by using USB / Optical cable.(10hrs) 242. Observe/ Study log sheet at substation.(08 hrs) 243. Practice generation of electricity bill using SBM.(08 hrs) 244. Demonstrate shut down and work permit proforma. (06 hrs)	Energy meters; Types, Meter Reading, Description of MRI, General layout of Meter Test Lab. Testing of Meters, Operation of SBM (Spot billing machine) Knowledge about TOD metering Log Sheet; Maintenance and up keeping of daily Log Sheet at various Substation and energy accounting along with Recording of Complaints and follow-up action Shut down and work Permit.
94-96	Examine the faults and carry out repairing of substation equipment and panels.	245. Practice isolation procedure and switching procedure preparation.(12hrs) 246. Practice implementation of permit system and LOTO system.(12hrs) 247. Identify various fuse sets viz., HRC, DO, 33KV fuse set, etc.(05 hrs) 248. Measure and select size of fuse wire.(06 hrs) 249. Practice reading of energy flow diagram. (06 hrs) 250. Examine faults in Control Room Wiring and practice repairing.(14 hrs)	Isolator , circuit breaker, Earth switch; Working principal and mechanism Emergency lighting system 6 Steps of Lockout/ Tagout (LOTO), colour coding of tags and locks, different types of locks. Energy flow diagram. Necessity, Advantages / Disadvantages of fuses. Types of IT & HT fuses Drop out (DO) Fuses sets Rupturing Capacity & recommended sizes of

		251. Identify various parts of relay and ascertain the operation. (10Hrs) 252. Practice setting of pick up current and time setting multiplier for relay operation. (10 hrs)	fuse elements. Installation and maintenance. Types of relays and its operation. High power rectifier system and its application at various industries. Introduction to SCADA and GIS mapping.
97-98	Read and understand electrical Schematic drawings of power and control circuits of outdoor substation.	253. Interpret Single line/ Layout drawings with Equipment and Protection codes as per ANSI.(15 hrs) 254. Interpret Layout drawings of 400kV/220kV/132kV/66kV/33kV/ 11kV outdoor substations.(15 hrs) 255. Interpret various panel wiring drawings of substation equipment.(20 hrs)	Power and control schematic drawings with interlocks. Isolator and Earth switch wiring, PT terminal box wiring CT terminal box wiring Circuit breaker closing and tripping circuits, Marshalling box wiring, Relay and control panel wiring. RTCC panel wiring. OLTC panel wiring. Mimic panel wiring.
99	Operate fire fighting equipment and systems used in substation.	256. Identify various fire fighting equipment used in substations.(05 hrs) 257. Practice on different fire fighting extinguishers.(20 hrs)	Fire Fighting; Categories of Fire-A, B, C, D & E - General description Description Fire Fighting Equipments Suitable for various categories of fire. Electrical Fire; Origin and Preventive Measures Do's and Don'ts for Electrical Safety. Fire protection system : Various type of system used in the Electrical distribution system.
100-101	Project work / Industrial visit Broad Areas: a) Patrolling of Line b) Installation of pole mounted substation c) Maintenance of substation		

	d) Testing of substation equipment
102-103	Revision
104	Examination

Note: -

1. Some of the sample project works (indicative only) are given at the mid and end of each year.
2. Instructor may design their own projects and also inputs from local industry may be taken for designing such new projects.
3. 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.
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9. SYLLABUS - CORE SKILLS

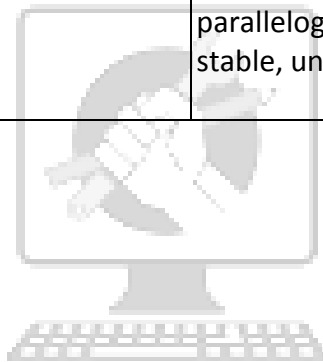
9.1 CORE SKILL – WORKSHOP CALCULATION & SCIENCE

S No.	Description- Workshop Calculation	Description - Workshop Science
FIRST YEAR		
1	Unit: Systems of unit- FPS, CGS, MKS/SI unit, unit of length, Mass and time, Conversion of units	Material Science: properties -Physical & Mechanical, Types -Ferrous & Non-Ferrous, difference between Ferrous and Non-Ferrous metals, introduction of Iron, Cast Iron, Wrought Iron, Steel, difference between Iron and Steel, Alloy steel, carbon steel, stainless steel, Non-Ferrous metals, Non-Ferrous Alloys.
2	Fractions: 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.	Mass .Weight and Density : Mass, Unit of Mass, Weight, difference between mass and weight, Density, unit of density, specific gravity of metals.
3	Square Root: Square and Square Root, method of finding out square roots, Simple problem using calculator. Ratio & Proportion : Simple calculation on related problems.	Speed and Velocity: Rest and motion, speed, velocity, difference between speed and velocity, acceleration, retardation, equations of motions, simple related problems.
4	Percentage: Introduction, Simple calculation. Changing percentage to decimal and fraction and vice-versa.	Work, Power and Energy: work, unit of work, power, unit of power, Horse power of engines, mechanical efficiency, energy, use of energy, potential and kinetic energy, examples of potential energy and kinetic energy.
5	Algebra: Addition, Subtraction, Multiplication, Division, Algebraic formula, Linear equations (with two variables).	Heat & Temperature: 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	Mensuration: Area and perimeter of square, rectangle, parallelogram, triangle, circle, semi circle, Volume of solids - cube, cuboid, cylinder and Sphere. Surface area of solids -cube, cuboid,	Basic Electricity: 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.



	cylinder and Sphere.	
7	Trigonometry: Trigonometrical ratios, measurement of angles. Trigonometric tables.	Levers and Simple Machines: 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	Use of Scientific Calculator: 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	Algebra: 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.	Electrical Engineering materials: 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	Trigonometry: Application in calculating height and distances. Use of trigonometric formulae in calculating areas of geometrical figures. Solution of Triangles.	Magnetism: 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	Mensuration: 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. Heat treatment – Necessity – different methods.
5	Number system: decimal and binary, Octal Hexa decimal. BCD code, conversion from decimal to binary and vice-versa, all other conversions. Practice on conversions.	Friction: Laws of friction, co- efficient of friction, angle of friction, simple problems related to friction. Lubrication Rectifier: RMS. Maximum, Average values of voltage and current in rectifiers form factor, ripple factor.

6	Estimation & costing: Simple estimation of the requirement of materials etc. as applicable to the trade. Problems on estimation and costing. Further Mensuration: Volumes of frustums including conical frustums. Graph- Basics, abscissa, co-ordinate etc. $Y = mz$ and $Y = mx + c$ graph	Forces: 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.	Centre of gravity: 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.



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9.2 CORE SKILL - ENGINEERING DRAWING

S No.	CONTENTS
FIRST YEAR	
1	Engineering Drawing: Introduction and its importance - Relationship to other technical drawing types - Conventions - Viewing of engineering drawing sheets. - Method of Folding of printed Drawing Sheet as per BIS SP:46-2003
2	Drawing Instruments : their Standard and uses - Drawing board, T-Square, Drafter (Drafting M/c), Set Squares, Protractor. - Drawing Instrument Box (Compass, Dividers, Scale, Diagonal Scales etc). - Pencils of different Grades, Drawing pins / Clips.
3	Lines : - Definition, types and applications in Drawing as per BIS SP:46-2003 - Classification of lines (Hidden, centre, construction, Extension, Dimension, Section) - Drawing lines of given length (Straight, curved) - Drawing of parallel lines, perpendicular line - Methods of Division of line segment
4	Drawing of Geometrical Figures: - Definition, nomenclature and practice of angle measurement and its types, method of bisecting. - Triangle - different types - Rectangle, Square, Rhombus, Parallelogram. - Circle and its elements.
5	Lettering and Numbering as per BIS SP46-2003: - Single Stroke, Double Stroke, inclined, Upper case and Lower case.
6	Dimensioning: - Definition, types and methods of dimensioning (functional, nonfunctional and auxiliary) - Types of arrowhead - Leader Line with text
7	Free hand drawing of: - Lines, polygons, ellipse, etc. - Geometrical figures and blocks with dimension - Transferring measurement from the given object to the free hand sketches.

8	Sizes and Layout of Drawing Sheets: • Basic principle of Sheet Size • Designation of sizes • Selection of sizes • Title Block, its position and content • Borders and Frames (Orientation marks and graduations) • Grid Reference • Item Reference on Drawing Sheet (Item List)
9	Method of presentation of Engineering Drawing • Pictorial View • Orthogonal View • Isometric view
10	Symbolic Representation (as per BIS SP:46-2003) of: • Fastener (Rivets, Bolts and Nuts) - Bars and profile sections • Weld, brazed and soldered joints. • Electrical and electronics element • Piping joints and fittings
11	Construction of Scales and diagonal scale
12	Practice of Lettering and Title Block
13	Dimensioning practice: • Position of dimensioning (unidirectional, aligned, oblique as per BIS SP:46-2003) • Symbols preceding the value of dimension and dimensional tolerance. • Text of dimension of repeated features, equidistance elements, circumferential objects.
14	Construction of Geometrical Drawing Figures: • Different Polygons and their values of included angles. Inscribed and Circumscribed polygons. • Conic Sections (Ellipse & Parabola)
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: • Concept of axes plane and quadrant.

	• Orthographic projections • Method of first angle and third angle projections (definition and difference) • Symbol of 1st angle and 3rd angle projection as per IS specification.
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.
SECOND YEAR	
1	<u>Sign & Symbol Trade related</u> Alternating Current • Drawing of simple electrical circuit using electrical symbols. • Drawing of sine square & triangular waves. • Diagram of battery charging circuit. • Practice in reading typical example of circuit containing R, L & C. • Reading of electrical drawing.
2	Electronic components • Symbols for electronic components. Diode, Transistor, Zener diode, SCR, UJT, FET, IC, Diac, Triac, Mosfet, IGBT etc. • Drawing of half wave, Full wave and Bridge rectifier circuit. • Drawing circuit for a single stage Amplifiers and Multi stage Amplifies and types of signals. • Drawing of circuit containing UJT, FET & Simple power control circuits. • Free hand drawing of Logic gates and circuits.
3	Electric wirings & Earthing • Detailed diagram of calling bell, & Buzzers etc • Free hand sketching of Staircase wiring. • Drawing the schematic diagram of plate and pipe earthing. • Diagram for electroplating from A.C / D.C source.
4	DC machines • Graphic symbols for Rotating machines. • Sketching of brush and brush gear of D.C. machines. • Layout arrangement of D.C. Generators & motors, control panel. • Exercises on connection to motors through Ammeter, voltmeter & K.W. meters of electrical wiring diagram.
5	Transformer • Graphic symbols for Transformers. • Free hand sketching of transformer and auxiliary parts and sectional views.

	• Sketching a breather. • Drawing the diagram of typical marking plate of a distribution transformer.
6	Illumination • Free hand sketching of Mercury vapour lamp, sodium vapour lamp, fluorescent tube (Single & Twine), MHL lamp and their connection.
7	Induction motor • Free hand sketching of Slip-ring and Squirrel cage Induction motor. • Typical wiring diagram for drum controller operation of A.C. wound rotor motor. • Drawing the schematic diagram of Autotransformer starter, DOL starter and Star Delta Starter. • Drawing the schematic diagram of A.C. motor speed control by SCR /AC Drive.
8	Alternator • Tracing of panel wiring diagram of an alternator. • Drawing the schematic diagram of automatic voltage regulators of A.C. generators.
9	Control Panel • Practice in reading panel diagram. • Local & Remote control of Induction motor with inching. • Forward & Reverse operation of Induction motor • Automatic Star Delta Starter • Automatic star delta starter with change of direction of rotation • Sequential control of three motors.
10	Distribution of Power • Layout diagram of a generation and transmission of electrical power. • Different type of distribution systems and methods of connections. • Single line diagram of substation feeders. • Types of insulator used in over head line. (Half sectional views) • Domestic service line layout. • Power grid layout.
11	Distribution Substation • Layout of 33/11 KV outdoor substation. • Typical layout of 11 KV indoor substation. • Layout of pole mounted substation. • Substation earthing system layout.

9.3 CORE SKILL – EMPLOYABILITY SKILL

CORE SKILL – EMPLOYABILITY SKILL		
Duration: 110 Hours		
1. English Literacy		Duration : 20 hrs Marks : 09
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.	
2. IT Literacy		Duration : 20 hrs Marks : 09
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.	
3. Communication Skills		Duration : 15 hrs Marks : 07
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.	
4. Entrepreneurship Skills		Duration : 15 hrs Marks : 06
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.
5. Productivity	
Duration : 10 Hrs.	
Marks : 05	
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.
6. Occupational Safety, Health and Environment Education	
Duration : 15 hrs	
Marks : 06	
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.
7. Labour Welfare Legislation	
Duration : 05 hrs Marks : 03	
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.
8. Quality Tools	
Duration : 10 hrs. Marks : 05	
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.

LIST OF TOOLS & EQUIPMENT			
ELECTRICIAN – POWER DISTRIBUTION (for Batch of 20 Candidates)			
S No.	Name of the Tools and Equipment	Specification	Quantity
A. TRAINEES TOOL KIT (For each additional unit trainees tool kit Sl. 1-17 is required additionally)			
1.	Measuring Steel Tape	15meter	*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.
13.	Plier side cutting	150 mm	*21 Nos.
14.	Electrician Helmet	Yellow Colour	*21 Nos.
15.	Hand gloves	Standard quality	*21 Pairs
16.	Gum Boot	Standard quality	*21 Pairs
17.	Safety Belt	Standard quality	*5 Nos.
B. SHOP TOOLS, EQUIPMENT & ACCESSORIES– For 2 (1+1) units no additional items are required			
(i) List of Tools			
18.	HammerBall peen with handle	500 grams	4 Nos.
19.	Pincer	150 mm	4 Nos.
20.	C- Clamp	200 mm and 100 mm,	2 Nos. each
21.	Spanner Adjustable drop forged, SS	150 mm & 300mm	2 Nos. each
22.	Blow lamp brass	0.5 ltr	1 No.
23.	Chisel Cold	25 mm X 200 mm	2 Nos.
24.	Chisel firmer with wooden Handle	6 mm X 200 mm	2 Nos.

25.	Allen Key alloy steel	1.5-10 mm (set of 9)	1 Set
26.	Grease Gun	0.5 ltr. Capacity	1 No
27.	Bradawl		2 Nos.
28.	Pipe vice Cast Iron with hardened jaw open type	100 mm	2 Nos.
29.	Hand Vice	50 mm jaw	4 Nos.
30.	Table Vice	100 mm jaw	8 Nos.
31.	Scissors blade, SS	200mm	4 Nos.
32.	Scissors blade, SS	150 mm	2 Nos.
33.	Crimping Tool	1.5 sq mm to 16 sq mm	2 Nos.
		16 sq mm to 95 sq mm	2 Nos.
34.	Wire Cutter and Stripper	150 mm	4 Nos.
35.	Out Side Micrometer	0 - 25 mm least count 0.01mm	2 Nos.
36.	Thermometer Digital	0° C - 150° C	1 No.
37.	Series Test Lamp	230V, 60W	4 Nos.
38.			
39.	Mallet hard wood	0.50 kg	4 Nos.
40.	Hammer Extractor type	0.40 kg	4 Nos.
41.	Hacksaw frame	Adjustable 300 mm	2 Nos. each
		Fixed 150 mm	
42.	Try Square	150 mm blade	4 Nos.
43.	Pliers flat nose insulated	200 mm	4 Nos.
44.	Pliers round nose insulated	100 mm	4 Nos.
45.	Tweezers	150 mm	4 Nos.
46.	Snip Straight and Bent heavy duty	250 mm	2 Nos. each
47.	D.E. metric Spanner Double Ended	6 - 32 mm	2 Set
48.	Drill hand brace	0-100mm	4 Nos.
49.	Drill S.S. Twist block	2 mm, 5 mm and 6 mm set of 3	4 Set
50.	Plane cutters	50 mm X 200mm	2 Nos.
51.	Smoothing cutters	50 mm X 200mm	2 Nos.
52.	Gauge, wire imperial stainless steel marked in SWG & mm	Wire Gauge - Metric	4 Nos.
53.	File flat	200 mm 2nd cut with handle	8 Nos.
54.	File half round	200 mm 2nd cut with handle	4 Nos.
55.	File round	200 mm 2nd cut with handle	4 Nos.
56.	File flat rough	150 mm with handle	4 Nos.
57.	File flat bastard	250 mm with handle	4 Nos.
58.	File flat smooth	250 mm with handle	4 Nos.

59.	File Rasp, half round	200 mm bastard with handle	4 Nos.
60.	Copper bit soldering iron.	0.25 kg	2 Nos.
61.	De soldering Gun	Heat proof nozzle, PVC type, 250mm	4 Nos.
(ii) List of Equipment			
62.	Ohm Meter; Series Type & Shunt Type, portable box type	50/2000-ohm analog	2 Nos. each
63.	Digital Multi Meter	DC 200mv -1000v, 0 – 10A & AC 200mv- 750v , 0-10A, resistance 0-20 MΩ and 3 1/2 digit	*12 Nos.
64.	A.C. Voltmeter M.I. analog, portable box type housed in Bakelite case	Multi range 75 V - 150V - 300V - 600V	3 Nos.
65.	Milli Voltmeter centre zero analog, portable box type housed in Bakelite case	100 – 0 – 100 mV	2 Nos.
66.	Ammeter MC analog, portable box type housed in Bakelite case	0 - 500 mA, 0-5 A, 0-25 A	2 Nos. each
67.	AC Ammeter MI, analog, portable box type housed in Bakelite case	0 - 1 A, 0-5 A, 0-25 A	2 Nos. each
68.	Kilo Wattmeter Analog	0-1.5-3KW, pressure coil rating- 240v/440v, current rating-5A/10A Analog, portable type Housed in Bakelite case	2 Nos.
69.	Digital Wattmeter	230 V, 1 KW, 50 Hz	2 Nos.
70.	A.C. Energy Meter	Single Phase, 10 A, 240 V induction type (as per IEC 61850)	2 Nos.
71.	A.C. Energy Meter	Three Phase, 15 A , 440 V induction type (as per IEC 61850)	2 Nos.
72.	Digital Energy Meter	Single Phase, three phase (as per IEC 61850)	2 Nos. each
73.	MRI Equipment		1 No.
74.	Power Factor Meter Digital	440 V, 20 A, Three Phase portable box type	2 Nos.
75.	Frequency Meter	45 to 55 Hz	2 Nos.
76.	Magnetic Flux Meter	0-500 Tesla	2 Nos.
77.	Lux meter	Lux meter LCD read out 0.05 to 7000 lumens with battery.	2 Nos.

78.	Tachometer	Analog Type - 10000 RPM	1 No.
79.	Tachometer	Digital Photo Sensor Type - 10000 RPM	1 No.
80.	Hydrometer		2 Nos.
81.	Hand Drill Machine	0-6 mm capacity	2 Nos.
82.	Portable Electric Drill Machine	0-12 mm capacity 750w, 240v with chuck and key	1 No.
83.	Load Bank (Lamp / heater Type)	6 KW, 3Ph	1 No.
84.	Brake Test arrangement with two spring balance rating	0 to 25 kg	1 No.
85.	Tong Tester / Clamp Meter	0 - 100 A (Digital Type)	2 Nos.
86.	Megger	Analog - 500 V	2 Nos.
87.	Earth Resistivity tester		1 set
88.	Wheat Stone Bridge with galvanometer and battery		2 Nos.
89.	Single Phase Variable Auto Transformer	0 - 270 V, 10Amp (Air cooled)	2 Nos.
90.	Phase Sequence Indicator	3 Phase, 415 V	2 Nos.
91.	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	For A.C Motors of 2 to 5 H.P.	1 No. each
92.	Oscilloscope Dual Trace	20 MHz	1 No.
93.	Synchroscope	440V, 50 Hz	1 No.
94.	Function Generator	2 to 200 KHz, Sine, Square, Triangular 220 V, 50 Hz, Single Phase	1 No.
95.	Digital multi function meter	3 Phase	1 No.
96.	Soldering Iron	25 Watt, 65 Watt and 120 Watt, 230 Volt	2 Nos. each
97.	Temperature controlled Soldering Iron	50 Watt, 230 Volt	2 Nos.
98.	Discrete Component Trainer	Discrete Component (for diode and transistor circuit) with regulated power supply +5,0- 5 V,+12 ,0-12 V	2 Nos.
99.	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.

100.	Digital I.C. Trainer	Digital I.C. Trainer 7 segment display and bread board	1 No.
101.	Oil Testing Kit	Oil Testing Kit 230 V, single phase 50 Hz 60 VA output 0-60 KV Variable	1 No.
102.	Inverter with Battery	1 KVA with 12 V Battery Input- 12 volt DC Output- 220 volt AC	1 No.
103.	Ni-Cd Battery	1.2 Amps	3 Nos.
104.	Voltage Stabilizer	AC Input - 150 - 250 V, 600 VA AC Output - 240 V, 10 A	1 No.
105.	DC Power Supply	0 - 30 V, 5 A	2 Nos.
106.	24 V battery set		1 set
107.	110 V battery charger		1 No.
108.	Battery Charger	0 - 6 - 9 - 12 - 24 - 48 V, 30amp	1 No.
109.	Current Transformer	415 V, 50Hz, CT Ratio 25 / 5 A, 5VA	2 Nos.
110.	Potential Transformer	415 V, 50Hz, PT Ratio, 440V/110V, 10VA	2 Nos.
111.	Solar panel with Battery	18 Watt	1 Set
112.	D.C. milli ammeter	0-500m A	1 No.
113.	Hygrometer		1 No.
114.	Potential Transformer	415 volt, 50 Hz, PT ratio 11KV/ 110 V, 10VA	1 No.
115.	Laptop	Latest Version	2 Nos.
116.	Ink jet/ laser printer		1 No.
(iii) List of Accessories			
117.	Oil Can	250 ml	2 Nos.
118.	Contactor & auxiliary contacts	3 phase, 415 Volt, 25 Amp with 2 NO and 2 NC	2 Nos. each
119.	Contactor & auxiliary contacts.	3 phase, 415 volt, 32 Amp with 2 NO and 2 NC	2 Nos. each
120.	Limit Switch	Limit Switch, Liver operated 2A 500v, 2-contacts	2 Nos.
121.	Rotary Switch	16 A/440V	2 Nos.
122.	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
123.	Static relay - distance protection		1 No.
124.	Laboratory Type Induction Coil	1000 W	2 Nos.
125.	Knife Switch DPDT fitted with fuse	16 Amp	4 Nos.

	terminals		
126.	Knife Switch TPDT fitted with fuse terminals	16 Amp/ 440 V	4 Nos.
127.	Miniature Breaker	16 amp	2 Nos.
128.	Earth Plate	60cm X 60cm X 3.15mm Copper Plate 60cm X 60cm X 6mm GI Plate	1 Each
129.	Earth Electrode	Primary Electrode 2100x28x3.25mm Secondary Cu Strip 20x5mm	1 No.
130.	MCCB	100Amps, Triple pole	1 No.
131.	ELCB	2 Pole, 32 Amps, 240V	1 No.
132.	Earth Discharge Rod	33KV	2 Nos.
133.	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
134.	Capacitors	Electrolytic, Ceramic, Polyester film, Variable, Dual run	2 Each
135.	Various Electronic components	Resistors, Diode, Transistor, UJT, FET, SCR, DIAC, TRIAC, IGBT, Small transformer etc.	As required
136.	Various Lamps	Halogen Incandescent Lamp Fluorescent tube High-pressure sodium Lamp	1 Each
137.	LED	Tube, Lamp	4 Each
138.	Plug socket, Piano Switch, Lamp Holder	230 V, 5 A	2 Each
139.	Bus bar with brackets	1 mtr each	3 Nos.
140.	LT fuse set (Henley Unit)		1 set
141.	11 KV DO fuse set		1 set
142.	Fuse Wire	18, 20, 22 SWG	1 Roll each
143.	LT Shackle Insulator		2 Nos.
144.	Bucholtz Relay		1 No.
145.	Breather with Silica Gel & Oil		1 No.
146.	Standard Wire Gauge		4 Nos.
147.	ACSR Conductor - Weasel, Rabbit, Raccoon, Dog, Panther, Zebra, Moose	1 Meter piece	1 set
148.	HT XLPE Cable (1 meter piece)	3x70, 3x120, 3x185, 3x240, 3x300 sq. mm	1 set each
149.	LT PVC insulated cable (1 meter piece)	3½x 120, 3½x150, 3½x 240, 3½x 400, 3½x 600 sq mm	1 set
150.	Twisted pair cable, non-metallic sheathed cable, underground feeder	1 Mtr	1 No. each

	cable, ribbon cable, metallic sheathed cable, Multi conductor cable, direct buried cable.		
151.	Aerial Bunched Cable (ABC)	70, 120, 185 sq mm	1 mtr each
152.	11KV pin insulator		1 No.
153.	11 KV pin with nut		1 No.
154.	11 KV disk insulator		1 No.
155.	11 KV suspension fitting		1 No.
156.	33 KV tension fitting		1 No.
157.	ST pole clamp		1 No.
158.	PCC pole clamp		1 No.
159.	PG clamp - panther to panther, panther to dog & dog to dog		1 set
160.	RCC Pole with accessories (MS angle iron, 'C' clamp, stay insulator etc.) and materials	6 Mtr	2 No.
161.	Stone pad		1 No.
162.	Cross arm	V Type	1 No.

C. Shop Machinery - For 4 (2+2) units no additional items are required

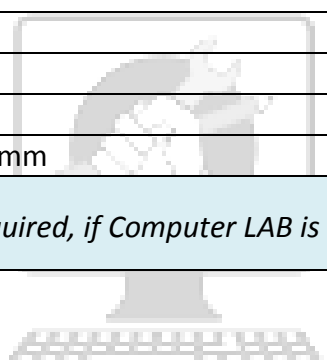
163.	Motor Generator (DC to AC) set consisting of - Shunt Motor with starting compensator and switch directly coupled to AC generator with exciter and switch board mounted with regulator, breaker, ammeter, voltmeter frequency meter, knife blade switch and fuses etc. Set complete with cast iron bed plate, 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, 50 cycles	1 No.
164.	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.
165.	AC phase-wound slip ring Motor with starter switch	5 HP, 440 V, 3 Phase, 50 Hz	1 No.
166.	Universal Motor with starter/switch	240 V, 50 Hz, 1 HP	1 No.
167.	Synchronous motor with accessories like starter, excitation arrangements.	3 Phase, 3 HP, 440V, 50Hz, 4 Pole	1 No.
168.	Thyristor/IGBT controlled A.C. motor drive with	VVVF control 3 Phase, 2 HP	1 No.
169.	Single phase Transformer, core type, air cooled	1 KVA , 240/415 V, 50 Hz	3 Nos.

170.	Three phase transformer, shell type oil cooled with Delta/ Star	3 KVA , 415/240 V, 50 Hz	2 Nos.
171.	Secondary injection set		1 No.
D. Shop Floor Furniture and Materials - For 2 (1+1) units no additional items are required			
172.	Working Bench	2.5 m x 1.20 m x 0.75 m	4 Nos.
173.	Wiring Board	3 meter x1 meter with 0.5 meter projection on the top	1 No.
174.	Instructor's table		1 No.
175.	Instructor's chair		2 Nos.
176.	Metal Rack	100cm x 150cm x 45cm	4 Nos.
177.	Lockers with drawers		1 for Each Trainee
178.	Almirah	2.5 m x 1.20 m x 0.5 m	1 No.
179.	Black board/white board	(minimum 4X6 feet)	1 No.
180.	Fire Extinguisher	Foam type, CO ₂ type & dry power type	3 Nos. each
181.	Fire Buckets	Standard size	2 Nos.
182.	Rubber mat	2' x 4' x 1"	2 Nos.

Note:

1. The Institute can enter into MoU with Facilitator who will provide the Training to Trainees admitted and undergoing training. The Facilitator should have "33KV/ 11KV distribution substation and test facilities for conducting relevant practical training and must provide test facilities used for various testing of transformers, CTs, PTs, Circuit Breakers, etc. The same facilities should be made available to trainees at the time of examination. This clause should be part of MoU to be signed. The training provider must be within the range of 15 Km or within city whichever is less.
2. Quantity marked with * has been increased as per the batch size.
3. Internet facility is desired to be provided in the class room.

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 & Equipment not required, if Computer LAB is available in the institute.		



Skill India
कौशल भारत - कुशल भारत

FORMAT FOR INTERNAL ASSESSMENT

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