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

Directorate General of Training

ELECTRICIAN – POWER DISTRIBUTION

(Engineering Trade)

(Designed in 2019)

Version: 1.2

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 5

Developed By

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1. COURSE INFORMATION

During the two years duration of Electrician-Power Distribution trade a candidate is trained on professional skills & knowledge, Engineering Drawing, Workshop Calculation & Science and Employability skill related to job role. In addition to this a candidate is entrusted to undertake project work and extracurricular activities to build up confidence. The Broad components covered during the course are given 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.

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 Directorate General of Training (DGT). Craftsman Training Scheme (CTS) with variants and Apprenticeship Training Scheme (ATS) are two pioneer schemes of DGT for strengthening vocational training.

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

Trainee broadly needs to demonstrate that they are able to:

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

2.2 PROGRESSION PATHWAYS

- Can join industry as Technician and will progress further as Senior Technician, Supervisor and can rise up to the level of Manager.
- Can appear in 10+2 examination through National Institute of Open Schooling (NIOS) for acquiring higher secondary certificate and can go further for General/ Technical education.
- Can take admission in diploma course in notified branches of Engineering by lateral entry.

- Can join Apprenticeship programme in different types of industries leading to National Apprenticeship certificate (NAC).
- Can join Advanced Diploma (Vocational) courses under DGT as applicable.

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	
		1st Year	2nd Year
1	Professional Skill (Trade Practical)	1000	1000
2	Professional Knowledge (Trade Theory)	280	360
3	Workshop Calculation & Science	80	80
4	Engineering Drawing	80	80
5	Employability Skills	160	80
	Total	**1600**	**1600**

2.4 ASSESSMENT & CERTIFICATION

The trainee will be tested for his skill, knowledge and attitude during the period of course through formative assessment and at the end of the training programme through summative assessment as notified by the DGT from time to time.

a) The **Continuous Assessment** (Internal) during the period of training will be done by **Formative Assessment Method** by testing for assessment criteria listed against learning outcomes. The training institute has to maintain individual *trainee portfolio* as detailed in assessment guideline. The marks of internal assessment will be as per the formative assessment template provided on www.bharatskills.gov.in.

b) The final assessment will be in the form of summative assessment. The All India Trade Test for awarding NTC will be conducted by **Controller of examinations, DGT** as per the guidelines. The pattern and marking structure is being notified by DGT 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 Trade Practical and Formative assessment is 60% & for all other subjects is 33%. There will be no Grace marks.

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 (Occupational Safety & Health Environment) and self-learning attitude are to be considered while assessing competencies.
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 and records of internal (Formative) 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 work which demonstrates attainment of a reasonable standard of craftsmanship, with little guidance, and regard for safety procedures and practices.	• Good skill levels in the use of hand tools, 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.

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 filled 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

4. GENERAL INFORMATION

Name of the Trade	**ELECTRICIAN – POWER DISTRIBUTION**
Trade Code	DGT/2011
NCO - 2015	7411.0100, 7412.0200, 7413.0100, 7413.9900
NSQF Level	Level-5
Duration of Craftsmen Training	Two Years (3200 Hours)
Entry Qualification	Passed 10th class examination with Science and Mathematics or its equivalent.
Minimum Age	14 years as on first day of academic session.
Eligibility for PwD	**----**
Unit Strength (No. Of Student)	20 (There is no separate provision of supernumerary seats)
Space Norms	98 Sq. m
Power Norms	5.2 KW (for two units in one shift)
Instructors Qualification for	
(i) Electrician – Power Distribution Trade	B.Voc/Degree in Electrical/ Electrical and Electronics Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Electrical/ Electrical and Electronics Engineering from AICTE/recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/NAC passed in the Trade of "Electrician – Power Distribution" With three years' experience in the relevant field. **<u>Essential Qualification:</u>** Relevant National Craft Instructor Certificate (NCIC) in any of the variants under DGT. **NOTE: Out of two Instructors required for the unit of 2 (1+1), one must have Degree/Diploma and other must have NTC/NAC qualifications. However both of them must possess**

	NCIC in any of its variants.
(ii) Workshop Calculation & Science	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE/recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the engineering trades with three years experience. **<u>Essential Qualification:</u>** National Craft Instructor Certificate (NCIC) in relevant trade **OR** NCIC in RoDA or any of its variants under DGT
(iii) Engineering Drawing	.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE /UGC recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the Electrical groups (Gr-II) trades categorized under Engg. Drawing'/ D'man Mechanical / D'man Civil' with three years' experience. **<u>Essential Qualification:</u>** National Craft Instructor Certificate (NCIC) in relevant trade OR NCIC in RoDA / D'man (Mech /civil) or any of its variants under DGT.
(iv) Employability Skill	MBA/ BBA / Any Graduate/ Diploma in any discipline with Two years' experience with short term ToT Course in Employability

	Skills from DGT institutes. (Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above) **OR** Existing Social Studies Instructors in ITIs with short term ToT Course in Employability Skills from DGT institutes.
(v) Minimum age for Instructor	21 years
List of Tools & Equipment	As per Annexure-I

Distribution of training on Hourly basis: (Indicative only)

Year	Total Hrs. /week	Trade Practical	Trade Theory	Workshop Cal. & Sc.	Engg. Drawing	Employability Skills
1st	40 Hours	25 Hours	7 Hours	2 Hours	2 Hours	4 Hours
2nd	40 Hours	25 Hours	9 Hours	2 Hours	2 Hours	2 Hours

5. LEARNING OUTCOME

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

5.1 LEARNING OUTCOMES (TRADE SPECIFIC)

FIRST YEAR

1. Prepare profile with an appropriate accuracy as per drawing following safety precautions.
2. Prepare electrical wire joints, carry out soldering and crimping.
3. Verify basic characteristics of electrical and magnetic circuits and perform measurements using analog / digital instruments.
4. Assemble simple electronic circuits and test for functioning.
5. Carry out installation, testing and maintenance of batteries and battery room in distribution substation.
6. Estimate, Assemble, install and test wiring system.
7. Plan and install electrical illumination system and test.
8. Plan, execute commissioning, testing of AC motors & Starters and carry out their maintenance.
9. Perform testing and carry out maintenance of Alternator and Synchronous motor.
10. Perform speed control of AC motors by using solid state devices/ AC drives.
11. Detect the faults and troubleshoot inverter, stabilizer, battery charger and UPS etc.

SECOND YEAR

12. Assemble accessories and carry out wiring of control cabinets and equipment.
13. Perform on-site installation, preventive maintenance, testing, repair/ replacement of electrical power distribution equipment viz., circuit breakers, isolators, lightening arresters, reactor, capacitor bank etc.
14. Carry out testing, maintenance and evaluate performance of transformers.
15. Plan and prepare LT/ HT cable and Underground cable joints.
16. Perform testing, repair/ replacement and maintenance of control elements viz., CT, PT, etc., used for protection and measurement in power distribution.
17. Plan and prepare Earthing installation, carryout testing and maintenance.
18. Plan and commission overhead distribution line including ABC and HVDS.
19. Carry out installation, repair/ replacement and maintenance of tower/pole and accessories in Power Distribution System.

20. Monitor meter readings, generate bill, maintain & upkeep various log sheets and energy accounting.
21. Examine the faults and carry out repairing of substation equipment and panels.
22. Read and understand electrical Schematic drawings of power and control circuits of outdoor substation.
23. Operate fire fighting equipment and systems used in substation.

6. ASSESSMENT CRITERIA

LEARNING OUTCOMES	ASSESSMENT CRITERIA
FIRST YEAR	
1. Prepare profile with an appropriate accuracy as per drawing following safety precautions.	Identify the trade tools; demonstrate their uses with safety, care & maintenance.
	Prepare a simple half lap joint using firmer chisel with safety.
	Prepare tray using sheet metal with the safety.
	Demonstrate fixing surface mounting type of accessories.
	Prepare an open box from metal sheet.
	Make and wire up of a test board and test it.
2. Prepare electrical wire joints, carry out soldering and crimping.	Observe safety precautions during joints & soldering.
	Identify types of wires, cables and verify their specifications.
	Make simple straight twist /rat-tail joints in single strand conductors.
	Make married and 'T' (Tee) joint in stranded conductors.
	Prepare a Britannia straight / 'T' (Tee) joint in bare conductors.
	Prepare western union joint in bare conductor.
	Solder the finished copper conductor joints with precaution.
3. Verify basic characteristics of electrical and magnetic circuits and perform measurements using analog / digital instruments.	Observe safety precautions while working on electrical circuits.
	Verify the characteristics of series/ parallel / combinational circuit.
	Analyze the effect of the short and open in series / parallel circuits.
	Verify the relation of voltage components of RLC series circuit in AC.
	Determine the power factor by direct / indirect methods in an AC single phase RLC parallel circuit.
	Identify the phase sequence of a 3 ø supply using a phase-sequence meter.
	Prepare /connect a lamp load in star and delta and determine relationship between line and phase values with precaution.
	Connect balanced and unbalanced loads in 3 phase star system and measure the power of 3 phase loads.
	Measure resistance using voltage drop/ Wheatstone bridge method.
	Demonstrate the change in resistance due to temperature.
	Verify the characteristics of series parallel combination of resistors.
	Plot the field of a magnet bar and determine the poles.
	Wind a solenoid and demonstrate the magnetic effect of electric

	current.
	Measure induced emf due to change in magnetic field and determine direction of induced emf and current.
	Measure the resistance, impedance and determine inductance of choke coils in different combinations.
	Group the given capacitors to get the required capacity and voltage rating.
	Measure various electrical parameters using digital multifunction meter.
4. Assemble simple electronic circuits and test for functioning.	Perform soldering on components, lug and board with safety.
	Identify the passive /active components by visual appearance, Code number and test for their condition.
	Identify the control and functional switches in CRO and analyze different waveforms.
	Construct and test a half /full wave rectifier with and without filter circuits.
	Construct circuit by using transistor as a switch.
	Operate and set the required frequency using function generator
	Make a printed circuit board for power supply.
	Identify and troubleshoot defects in simple power supplies.
	Construct and test lamp dimmer using TRIAC/DIAC.
	Construct and test logic gate circuits.
5. Carry out installation, testing and maintenance of Batteries and Battery room in distribution substations.	Observe safety precautions while working on batteries.
	Determine the internal resistance of cell and make grouping of cells.
	Demonstrate charging of battery and test for its condition with safety/ precaution.
	Explain installation, care and maintenance of batteries.
	Measure specific gravity of electrolyte and determine correction factor.
	Determine total number of cells required for a given power requirement.
	Identify various components of battery charger used in sub-station.
	Explain trickle charging/ C5 and C10 charging methods.
	Perform charging / discharging of Ni-Cd battery.
	Charge batteries by using float and boost charger.
	Check DC leakage and demonstrate methods of its protection.

6. Estimate, Assemble, install and test wiring system.	Comply with safety & IE rules while performing wiring.
	Prepare and mount the energy meter board.
	Draw and wire up the consumers main board with ICDP switch and distribution fuse box.
	Draw and wire up a PVC conduit wiring.
	Identify the types of fuses their ratings and applications.
	Identify the parts of a relay, MCB & ELCB and demonstrate operation.
	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.
	Estimate the requirement for PVC casing-capping/ conduit wiring (3 phase) and wire up.
	Estimate the materials and wire up a lighting circuit for a corridor in conduit.
	Test, locate the fault and repair a domestic wiring installation.
7. Plan and install electrical illumination system and test.	Plan work in compliance with standard safety norms related with electrical illumination system.
	Group different wattage of lamps in series for specified voltage.
	Assemble and connect a single twin tube fluorescent light.
	Demonstrate installation of HP sodium vapour lamps/ metal halide.
	Connect, install and test the lamp with accessories.
	Prepare and test a decorative serial lamp set for 240 V using 6V bulb and flasher.
	Install light fitting for show case window lighting.
	Install light fittings with various types of LEDs and fixture.
8. Plan, execute commissioning, testing of AC motors & Starters and carry out their maintenance.	Plan work in compliance with standard safety norms related with electrical machines.
	Explain power and control schematic drawings of AC motors and starters.
	Draw circuit diagram and connect forward & reverse a 3-phase squirrel cage induction motor.
	Start, run and reverse an AC 3 phase squirrel cage induction motor by different type of starters.
	Determine the efficiency of 3 phase squirrel cage induction motor by no load test/ blocked rotor test and brake test.
	Connect, start, run and reverse the direction of rotation of slip-ring

	motor through rotor resistance starter.
	Demonstrate speed control of 3 phase induction motor.
	Connect start, run, control speed and reverse the DOR of given single phase motor.
	Install a single-phase AC motor.
	Test continuity and insulation resistance of AC motor.
	Maintain, service and trouble shoot of three phase AC motor.
	Maintain, service and trouble shoot of given single phase AC motor.
	Maintain, service and trouble shoot the AC motor starter.
9. Perform testing and carry out maintenance of Alternator and Synchronous motor.	Plan work in compliance with standard safety norms related with Alternator & MG set.
	Test for continuity and insulation resistance of an alternator.
	Connect, start and run a 3-phase synchronous motor.
	Connect start and run an alternator and build up the voltage.
	Determine the load performance of a 3-phase alternator.
	Explain preventive and breakdown maintenance of alternator / MG set.
	Explain the effect of excitation current in terms of V-curves of synchronous motor.
10. Perform speed control of AC motors by using solid state devices/ AC drives.	Plan work in compliance with standard safety norms related to AC drives.
	Enter motor data and perform auto tuning on thyristors/ AC drive.
	Control speed and reverse the direction of rotation of different type of three phase induction motors using VVVF control /AC drive
	Perform connections and identify parameters of AC drives.
11. Detect the faults and troubleshoot inverter, stabilizer, battery charger and UPS etc.	Plan work in compliance with standard safety norms related to electrical circuits.
	Assemble circuits of battery charger and inverter.
	Test, analyze defects and repair voltage stabilizer/ emergency light / UPS.
	Explain operation of inverter/ voltage stabilizer/ ups.
	Identify the parts, trace the connection and test the DC regulated power supply with safety.
	Troubleshoot and service a DC regulated power supply.
	Test battery charger for its operation.

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

of transformers.	phase transformer.
	Perform series and parallel operation of two single phase transformers.
	Verify the terminals and accessories of three phase transformer HT and LT side.
	Carry out open circuit test for measurement of no-load loss and current.
	Perform BDV (Dielectric strength) and water particle content test of transformer oil.
	Connect 3 single phase transformers for 3 phase operation of delta-delta/ delta-star/ star-star/ star-delta.
	Carry out insulation resistance & polarization index test of distribution transformer used in substations.
	Measure Transformer winding resistance.
	Identify phase and neutral bushings of HV & LV side of the distribution transformer and carry out IR test of individual bushings.
	Perform transformation ratio test.
	Carry out Short circuit test and measure impedance voltage/ short circuit impedance/ load loss.
	Carry out induced Voltage Test of Transformer.
	Carry out tests on buchholz relay/ Temperature indicators/ pressure relief devices/ oil preservation system.
	Explain maintenance of transformer.
15. Plan and prepare LT/ HT cable and Underground cable joints.	Comply with safety & IE rules while working on LT/ HT cables.
	Identify different types of HT/LT cables.
	Identify different parts of various underground cables.
	Prepare cables for termination and joining.
	Demonstrate termination kits and make terminations of LT/HT cables.
	Make straight joint of given underground cable.
	Carry out high pot test.
	Explain procedure for laying of HT/LT cables in raceways and trenches.
	Identify various cable glands.
	Demonstrate passing of cables through cable entry plate.
	Demonstrate split cable entry for multiple pre-terminated cables.
	Demonstrate bonding and grounding of raceways, cable assembly

	and panels.
	Test underground cables for faults and explain removal of the fault.
16. Perform testing, repair/ replacement and maintenance of control elements viz., CT, PT, etc., used for protection and measurement in power distribution.	Comply with safety & IE rules while working on substation equipment.
	Identify Current transformers, its specifications.
	Carry out ratio test/Polarity test/ insulation resistance/ winding resistance test/ Saturation test/ Burden test on CT.
	Carry out knee point voltage test of protection core.
	Carry out ratio change of CT by changing taps in primary and secondary side.
	Identify potential transformers and its specifications.
	Perform insulation resistance test/ Polarity test/ turn's ratio test on PT.
	Explain installation and commissioning of current transformer/ potential transformer.
	Identify isolation transformers and its specifications.
	Explain repair/ replacement and maintenance of CT and PT.
17. Plan and prepare Earthing installation, carryout testing and maintenance.	Plan work in compliance with standard safety norms related with earthing installation.
	Install pipe/ plate earthing and test it.
	Demonstrate earthing of delta connected system.
	Explain grid/ mesh/ chemical earthing.
	Measure the earth electrode resistance using earth tester.
	Carry out earth resistance improvement.
	Perform grounding of equipment and systems.
	Test earth leakage by ELCB and relay.
18. Plan and commission overhead distribution line including ABC and HVDS.	Comply with safety & IE rules while working on overhead distribution line.
	Identify given conductors.
	Perform mechanical /electrical testing of overhead conductors.
	Identify various sizes of copper wires and cable insulation FR/FRLS/FRLSH.
	Demonstrate joining of overhead line conductors.
	Explain commissioning of distribution line using Aerial bunched cables.

	Explain components and working of High Voltage Distribution System (HVDS).
19. Carry out installation, repair/ replacement and maintenance of tower/pole and accessories in Power Distribution System.	Comply with safety & IE rules while working on overhead distribution system.
	Identify different Supports, Transmission Towers, and various accessories.
	Perform digging of pit/ erection of supports/ fitting various accessories on poles.
	Perform stringing and sagging of line conductors.
	Fasten jumper in pin/ shackle/ suspension type insulators.
	Erect an overhead service line pole for single phase 240v distribution system.
	Identify different type of insulator used in HT and LT line
	Measure current carrying capacity of conductors.
	Connect feeder cable with domestic service line.
	Demonstrate installation and sealing of energy meter.
	Install bus bar and bus coupler on LT line.
	Demonstrate working of thermo vision camera.
20. Monitor meter readings, generate bill, maintain & upkeep various log sheets and energy accounting.	Explain collection of meter reading from various meters.
	Demonstrate study of MRI reports.
	Take meter reading by using USB / Optical cable.
	Observe/ Study log sheet at substation.
	Generate electricity bill using SBM.
21. Examine the faults and carry out repairing of substation equipment and panels.	Demonstrate isolation procedure/ switching procedure preparation.
	Explain permit system and steps of LOTO system.
	Carry out testing of Control Room Wiring Installations.
	Identify various fuse sets viz., HRC, DO, 33KV fuse set, etc.
	Measure and select appropriate size of fuse wire.
	Examine faults in Control Room Wiring and perform repairing.
	Demonstrate various parts of relay and ascertain the operation.
	Demonstrate setting of pick up current/ time setting multiplier for relay operation.
22. Read and understand electrical Schematic	Interpret Single line/ Layout drawings with Equipment and Protection codes as per ANSI.

drawings of power and control circuits of outdoor substation.	Interpret Layout drawings of 400kV/220kV/132kV/66kV/33kV/11kV outdoor substations.
	Interpret various panel wiring drawings of substation equipment.
23. Operate fire-fighting equipment and systems used in substation.	Explain various categories of fire.
	Identify various firefighting equipment used in distribution substations.
	Demonstrate use of different firefighting extinguishers.

7. TRADE SYLLABUS

SYLLABUS FOR ELECTRICIAN – POWER DISTRIBUTION TRADE			
DURATION - FIRST YEAR			
Duration	**Reference Learning outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 125 Hrs; Professional Knowledge 35 Hrs	Prepare profile with an appropriate accuracy as per drawing following safety precautions.	1. Visit various sections of the institutes and location of electrical installations. (05 hrs) 2. Identify safety symbols and hazards. (05 Hrs) 3. Preventive measures for electrical accidents and practice steps to be taken in such accidents. (05 hrs) 4. Practice safe methods of fire fighting in case of electrical fire. (05 hrs) 5. Use of fire extinguishers. (05 Hrs) 6. Practice elementary first aid. (05 hrs) 7. Rescue a person and practice artificial respiration. (05 Hrs) 8. Disposal procedure of waste materials. (05 Hrs) 9. Use of personal protective equipments. (05 hrs) 10. 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. (14 hrs.)
		11. Identify trade tools and machineries. (10 Hrs) 12. Practice safe methods of lifting and handling of	Concept of Standards and advantages of BIS/ISI. Trade tools specifications. Introduction to National

		tools & equipment. (05 Hrs) 13. Select proper tools for operation and precautions in operation. (05 Hrs) 14. Care & maintenance of trade tools. (05 Hrs)	Electrical Code-2011. Store keeping of equipments for Repair works. (07 hrs.)
		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, planning, 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. (14 hrs.)
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Prepare profile with an appropriate accuracy as per drawing following safety precautions.	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, Scribers, punches, surface gauges Types, Uses, Care and maintenance. Sheet metal tools: Description of marking & cutting tools. Types of rivets and riveted joints. Use of thread gauge. Care and maintenance of tools. (14 hrs.)
Professional Skill 75 Hrs; Professional Knowledge	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)	Fundamentals of electricity, definitions, units & effects of electric current. Conductors and insulators. Conducting materials and their

21 Hrs		25. Identify various types of cables and measure conductor size using SWG and micrometre. (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	comparison. Joints in electrical conductors, contact resistance measurement and required pressure. Techniques of soldering. Types of solders and flux. (21 hrs.)
Professional Skill 75 Hrs; Professional Knowledge 21 Hrs	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)	Ohm's Law; Simple electrical circuits and problems. Kirchhoff'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,

		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) 41. Determine direction of induced emf and current. 1(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)	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. (21 hrs.)

Professional Skill 75 Hrs; Professional Knowledge 21 Hrs	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) 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	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. (21 hrs.)

		wattmeter readings. (15Hrs)	
Professional Skill 75 Hrs; Professional Knowledge 21 Hrs	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 multifunction meter.(13hrs)	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. (21 hrs.)
Professional Skill 50 Hrs;	Assemble simple electronic circuits and test for	61. Determine the value of resistance by colour code and identify types. (06Hrs)	Resistors – colour code, types and characteristics. Active and passive components.

Professional Knowledge 14 Hrs	functioning.	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)	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. (14 hrs.)
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	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	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. (14 hrs.)

		using IC. (05Hrs) 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)	
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Carry out installation, testing and maintenance of batteries and battery room in distribution substation.	76. Identify and use of various types of cells. (02Hrs) 77. Measure voltage of different cells and Batteries. (03Hrs) 78. Practice on grouping of cells for specified voltage and current under different conditions with due care. (02Hrs) 79. Measure specific gravity of electrolyte and determine correction factor. (03Hrs) 80. Identify various components of battery charger used in sub-station. (02Hrs) 81. Perform proper setting of voltage according to mode of charging and practice on Battery charging. (03Hrs) 82. Perform setting and carry	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 - Change over operation Boost charging Two Battery two charger system End cell cutting. C5 and C10 charging methods

		out Trickle charging of Battery. (05Hrs) 83. Practice charging and discharging of Ni-Cd battery. (05Hrs) 84. Charge batteries by using float and boost charger. (05Hrs) 85. Check DC leakage and practice for its protection. (05Hrs) 86. Carry out testing of batteries. (05Hrs) 87. Practice on routine, care/ maintenance of batteries. (05Hrs) 88. Determine the number of solar cells in series / parallel for given power requirement. (05Hrs)	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. (14 hrs.)
Professional Skill 75 Hrs; Professional Knowledge 21 Hrs	Estimate, Assemble, install and test wiring system.	89. Identify various conduits and different electrical accessories. (03Hrs) 90. Practice cutting, threading of different sizes & laying Installations. (03Hrs) 91. Prepare test boards / extension boards and mount accessories like lamp holders, various switches, sockets, fuses, relays, MCB, RCCB, RCBO, MPCB, MCCB etc. (08Hrs) 92. Draw layouts and practice in PVC Casing-capping, Conduit wiring with minimum to a greater number of points of minimum 15 metres.	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.

		length. (08Hrs) 93. Wire up PVC conduit wiring to control one lamp from two or three different places. (08 Hrs) 94. Wire up PVC conduit wiring and practice control of sockets and lamps in different combinations using switching concepts. (08Hrs) 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. (03Hrs) 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. (08Hrs) 99. Practice wiring of institute and workshop as per IE rules. (08Hrs) 100. Practice testing / fault detection of domestic and industrial wiring installation and repair. (08Hrs)	Different types of wiring - Power, control, Communication 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. (21 hrs.)
Professional Skill 50 Hrs; Professional Knowledge	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.	Laws of Illuminations. Types of illumination system. Illumination factors, intensity of light. Type of lamps, advantages/

14 Hrs		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 effect. (06 Hrs) 105. Install light fitting for show case lighting. (08Hrs) 106. Install light fittings with various types of LEDs and fixture. (08Hrs)	disadvantages and their applications. Calculations of lumens and efficiency. Different types of LEDs and fixtures. Luminous efficiency of LED Various color temperatures – Cool Day light - 5700K/ 6500K, Warm white - 2700K/ 300K False Recess type / Surface type. (14 hrs.)
Professional Skill 100 Hrs; Professional Knowledge 28 Hrs	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. (05Hrs) 109. Connect, start and run three phase induction motors by using DOL, star-delta starters. (06Hrs) 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	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

		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) 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. (10 Hrs) 118. Practice on speed control of single phase AC motors. (10 Hrs) 119. Practice repair and maintenance of AC motors. (10 Hrs)	motors. Domestic and industrial applications of different AC motors. Characteristics, losses and efficiency. (28 hrs.)
Professional Skill 75Hrs; Professional Knowledge 21Hrs	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	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

		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)	motor. Effect of change of excitation and load. V and anti V curve. Power factor improvement. Rotary Converter, MG Set description and Maintenance. (21 hrs.)
Professional Skill 25 Hrs; Professional Knowledge 07 Hrs	Perform speed control of AC motors by using solid state devices/ AC drives.	128. Enter motor data and perform auto tuning on 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)	Working, parameters and applications of AC drive. Speed control of 3 phase induction motor by using VVVF/AC Drive. (07 hrs.)
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Detect the faults and troubleshoot inverter, stabilizer, battery charger and UPS etc.	131. Identify and assemble circuits of voltage stabilizer and UPS. (08 Hrs) 132. Assemble circuits of battery charger and inverter. (10 Hrs) 133. Test, analyze defects and repair voltage stabilizer, emergency light and UPS. (12 Hrs) 134. Maintain, service and	Basic concept, block diagram and working of voltage stabilizer, battery charger, emergency light, inverter and UPS. Preventive and breakdown maintenance. (14 hrs.)

		troubleshoot battery charger and inverter. (10 Hrs) 135. Install an Inverter with battery and connect it in domestic wiring for operation. (10 Hrs)	

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.
f) Protection of electrical equipment.
g) Automatic control using relays.
h) Fuse and power failure indicator using relays.
i) Door alarm/indicator.
j) Decorative light.
k) Motor circuits, speed control and testing.
l) Inverter/ UPS/ Battery charger/ Stabilizer

SYLLABUS FOR ELECTRICIAN – POWER DISTRIBUTION TRADE			
SECOND YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 75 Hrs; Professional Knowledge 27 Hrs	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. (27 hrs.)
Professional Skill 75 Hrs; Professional Knowledge	Perform on-site installation, preventive maintenance, testing, repair/	141. Identify outdoor and indoor switchgears. (05 Hrs) 142. Identify power and distribution transformers.	Various ways of electrical power generation by conventional and non-conventional methods. Transmission and distribution networks.

27 Hrs	replacement of electrical power distribution equipment viz., circuit breakers, isolators, lightening arresters, reactor, capacitor bank etc.	(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 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)	General layout of substation Single line diagram, general symbols for various equipment installed at substation. 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. (27 hrs.)
Professional Skill 75 Hrs; Professional Knowledge	Perform on-site installation, preventive maintenance, testing, repair/	150. Practice operation of isolators. (04 Hrs) 151. Identify different components of Circuit Breakers. (04 hrs)	Types of isolators like Horizontal centre break, Double break, Pantograph type. **Circuit Breakers;** Types of circuit breakers, their

27 Hrs	replacement of electrical power distribution equipment viz., circuit breakers, isolators, lightening arresters, reactor, capacitor bank etc.	152. Perform operation of circuit breakers in maintenance (test) mode. (06 hrs) 153. Practice use of grounding rod and make visible earthing. (04 hrs) 154. Practice operation of Circuit Breakers; ACB, SF-6 and VCB etc. (12 hrs) 155. Practice filling and evacuation of gas in SF-6 Circuit breaker. (05 hrs) 156. Carry out timer test on circuit breakers. (05 hrs) 157. Carry out repair and maintenance of circuit breakers. (13 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)	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 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. (27 hrs.)
Professional Skill 150 Hrs; Professional Knowledge 54 Hrs	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.	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

		(10Hrs) 164. Perform series and parallel operation of two single phase transformers. (10 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. (10Hrs) 170. Carry out IR & PI test of distribution transformer used in substations using analog & digital megger. (10Hrs) 171. Measure Transformer winding resistance. (02Hrs) 172. Carry out IR test of individual bushings of distribution transformer. (03Hrs) 173. Identify phase and neutral	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. 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. (54 hrs.)

		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. (05 Hrs) 177. Carry out Short circuit test and measure impedance voltage/ short circuit impedance (principal tap) and load loss. (05 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. (10Hrs) 181. Carry out maintenance of transformer. (10Hrs)	
Professional Skill 100 Hrs; Professional Knowledge	Plan and prepare LT/HT cable and Underground cable joints.	182. Identify different types of HT/LT cables. (05hrs) 183. Identify different parts of various underground cables. (05hrs)	Power cables: Need of HT cables, advantages and disadvantages, various types viz., PVC, XLPE, Halogen, Optical fiber, etc. Awareness of HT/LV cable

36 Hrs		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	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. 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. (36 hrs.)

		fault. (12 hrs)	
Professional Skill 75 Hrs; Professional Knowledge 27 Hrs	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. (05 hrs) 203. Carry out ratio change of CT by changing taps in primary and secondary side. (05 hrs) 204. Perform installation and commissioning of current transformer. (10 hrs) 205. Identify potential transformers, its specifications and carry out visual inspection. (02 hrs) 206. Perform insulation resistance tests on PT;	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 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. (27 hrs.)

		winding to winding and each winding to ground. (03hrs) 207. Carry out Polarity test on PT. (02hrs) 208. Perform turn's ratio test on PT. (03hrs) 209. Perform installation and commissioning of potential transformer. (05hrs) 210. Identify isolation transformers and its specifications. (03hrs) 211. Carry out repair/ replacement and maintenance of CT and PT. (02 hrs)	
Professional Skill 75 Hrs.; Professional Knowledge 27 Hrs.	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.	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. (27 hrs.)

		(06Hrs) 220. Carry out maintenance of earth system. (06Hrs) 221. Test earth leakage by ELCB and relay. (06Hrs)	
Professional Skill 100 Hrs; Professional Knowledge 36 Hrs	Plan and commission overhead distribution line including ABC and HVDS.	222. Identify various conductors viz., All aluminium conductor (AAC), ACSR conductor, etc. (08Hrs) 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)	Objectives of Distribution System. Classification of Conductors and Nomenclature Current rating Jointing 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. (36 hrs.)
Professional Skill 75 Hrs; Professional	Carry out installation, repair/ replacement and maintenance of	230. Identify different Supports, Transmission Towers, and various accessories.(08 Hrs)	CEA safety regulation 2010 Supports and Accessories: PCC Pole, ST Pole, Cross Arms, Clamps, Transmission Towers

Knowledge 27 Hrs	tower/pole and accessories in Power Distribution System.	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)	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. (27 hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 18 Hrs.	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. (12 hrs) 241. Take meter reading by using USB / Optical cable. (12 hrs) 242. Observe/ Study log sheet at substation. (08 hrs) 243. Practice generation of electricity bill using SBM. (05 hrs) 244. Demonstrate shut down	**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. (18

		and work permit proforma. (05 hrs)	hrs.)
Professional Skill 75 Hrs.; Professional Knowledge 27 Hrs.	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) 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)	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 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. (27 hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 18 Hrs.	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	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. (18 hrs.)

		hrs)	
Professional Skill 25 Hrs.; Professional Knowledge 09 Hrs.	Operate firefighting 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. (09 hrs.)
Project work / Industrial visit **Broad Areas:** Visit to Substation Control Panel Room (Components, Power distribution, Grid management, Quality of Electrical Supply, etc.) a) Patrolling of Line b) Installation of pole mounted substation c) Maintenance of substation d) Testing of substation equipment			

SYLLABUS FOR CORE SKILLS
1. Workshop Calculation & Science (Common for two year course) (80 Hrs + 80 Hrs.)
2. Engineering Drawing (Common for Group-II (Electrical, Electronics & IT Trade Group)) (80 Hrs + 80 Hrs.)
3. Employability Skills (Common for all CTS trades) (160 Hrs + 80 Hrs.)

Learning outcomes, assessment criteria, syllabus and Tool List of Core Skills subjects which is common for a group of trades, provided separately inwww.bharatskills.gov.in

ANNEXURE-I

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	15 meter	20+1 Nos.
2.	Combination Plier Insulated	200 mm	20+1 Nos.
3.	Screw Driver Insulated	4mm X 150 mm, Diamond Head	20+1 Nos.
4.	Screw Driver Insulated	6mm X 150 mm	20+1 Nos.
5.	Electrician screw driver thin stem insulated handle	4mm X 100 mm	20+1 Nos.
6.	Heavy Duty Screw Driver insulated	5mm X 200 mm	20+1 Nos.
7.	Electrician Screw Driver thin stem insulated handle	4mm X 250 mm	20+1 Nos.
8.	Punch Centre	9mm X 150 mm	20+1 Nos.
9.	Knife Double Bladed Electrician	100 mm	20+1 Nos.
10.	Neon Tester	500 V	20+1 Nos.
11.	Steel Rule Graduated both in Metric and English Unit	300 mm with precision of 1/4th mm	20+1 Nos.
12.	Hammer, cross peen with handle	250 grams	20+1 Nos.
13.	Plier side cuttting	150 mm	20+1 Nos.
14.	Electrician Helmet	Yellow Colour	20+1 Nos.
15.	Hand gloves	Standard quality	20+1 Nos.
16.	Gum Boot	Standard quality	20+1 Nos.
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.	Hammer Ball 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 Fixed 150 mm	2 Nos. each
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 center 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	1 No.

		Output- 220 volt AC	
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 terminals	16 Amp	4 Nos.
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	1 No.

		Secondary Cu Strip 20x5mm	
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, TRAIC, 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 cable, ribbon cable, metallic sheathed cable, Multi conductor cable, direct buried cable.	1 Mtr.	1 No. each
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. *Internet facility is desired to be provided in the class room.*

ANNEXURE – II

The DGT sincerely acknowledges contributions of the Industries, State Directorates, Trade Experts, Domain Experts, trainers of ITIs, NSTIs, faculties from universities and all others who contributed in revising the curriculum.

Special acknowledgement is extended by DGT to the following expert members who had contributed immensely in this curriculum.

List of Expert Members contributed/ participated for finalizing the course curriculum of "Electrician – Power Distribution" Trade at Office of DTE, U.P. Lucknow on 30.08.2018			
S No.	**Name & Designation Sh/Mr./Ms.**	**Organization**	**Remarks**
1.	N. P. Saxena, DG (T & HRD)	Electricity Training Institute, UPPCL, Lucknow	Chairman
2.	L. K. Mukhrejee, DDT	CSTARI, Kolkata	Coordinator
3.	Niraj Kumar, Additional Director	DTE, U.P. Lucknow	Member
4.	C.B. Ojha, AGM	NCPS Dadri, NTPC Ltd., Vidyot Nagar, G.B. Nagar, U.P.	Member
5.	Anil Mishra, Director	U.P. Power Corporation Ltd., ETI- Lucknow.	Member
6.	Ajit Singh, Joint Director of Training	Training & Employment Directorate, U.P.- Lucknow	Member
7.	Sabiha Ahammad, Manager-Training	Larsen & Toubro Ltd., Sarojini Nagar, Lucknow.	Member
8.	Ashok Kumar Singh, Executive Engineer	Electricity Training Institute, U.P. Power Corporation Ltd., Lucknow	Member
9.	C.P. Agarwal, Dy. Director (Parishad)	SCVT, U.P., Lucknow	Member
10.	Satya Kant, Principal	Govt. ITI, Aliganj, Lucknow	Member
11.	Dinesh Kr. Yadav, HOD, Electrical Engineer	Govt. Polytechnic, Lucknow	Member
12.	A. Vara Prasad Rao, Executive Engg. (Electrical)	Centre for Cellular and Molecular Biology, Hyderabad	Expert
13.	N. K. Samal, Assistant Manager	OPTCL, Choudwar, Cuttack	Expert
14.	Suresh K. Trivedi, Assistant Engineer	MPPTCL, Bhopal	Expert
15.	Dileep K. Nigam, Superintendent	Sohar Aluminium, Sultanate of Oman	Expert

16.	Sanjay Sharma, Executive Engineer (Tech.)	Electricity Training Institute, U.P. Power Corporation Ltd., ETI- Lucknow.	Member
17.	R.K. Sharma, Sr. Officer,	TATA Motors, Lucknow	Member
18.	Dr. Pushkar Tripathi, Assistant Professor	IET Lucknow	Member
19.	Ratnakar Singh, ADT	DTE, U.P. Lucknow	Member
20.	S.C. Pandey, ADT	RDAT, Kanpur	Member
21.	Mahesh Chandra, Instructor	Govt. Industrial Training Institute, Aliganj, Lucknow	Member
22.	J.R. Mathur, Training Officer	Regional Directorate of Apprenticeship Training, NSTI Campus, Kanpur	Member
23.	R.N. Manna, Training Officer	CSTARI, Kolkata	Member
24.	Bharat Kr. Nigam, Training Officer	CSTARI, Kolkata	Member/ Coordinator

ABBREVIATIONS

CTS	Craftsmen Training Scheme
ATS	Apprenticeship Training Scheme
CITS	Craft Instructor Training Scheme
DGT	Directorate General of Training
MSDE	Ministry of Skill Development and Entrepreneurship
NTC	National Trade Certificate
NAC	National Apprenticeship Certificate
NCIC	National Craft Instructor Certificate
LD	Locomotor Disability
CP	Cerebral Palsy
MD	Multiple Disabilities
LV	Low Vision
HH	Hard of Hearing
ID	Intellectual Disabilities
LC	Leprosy Cured
SLD	Specific Learning Disabilities
DW	Dwarfism
MI	Mental Illness
AA	Acid Attack
PwD	Person with disabilities


कौशलं बलम्