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

COMPETENCY BASED CURRICULUM

ELECTRICIAN

(Duration: Two Years)
Revised in July 2022

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 4

SECTOR – POWER

कौशल बलम्
Directorate General of Training

ELECTRICIAN

(Engineering Trade)

(Revised in July 2022)

Version: 2.0

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 4

Developed By

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1. COURSE INFORMATION

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

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

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

Trainees broadly need 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 become Entrepreneur in the related field.
- Can appear in 10+2 examination through National Institute of Open Schooling (NIOS) for acquiring higher secondary certificate and can go further for General/ Technical education
- Can take admission in diploma course in notified branches of Engineering by lateral entry.
- Can join Apprenticeship programme in different types of industries leading to National Apprenticeship certificate (NAC).

- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming instructor in ITIs.
- 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)	840	840
2	Professional Knowledge (Trade Theory)	240	300
3	Employability Skills	120	60
	Total	**1200**	**1200**

Every year 150 hours of mandatory OJT (On the Job Training) at nearby industry, wherever not available then group project is mandatory.

4	On the Job Training (OJT)/ Group Project	150	150

Trainees of one-year or two-year trade can also opt for optional courses of up to 240 hours in each year for 10th/ 12th class certificate along with ITI certification, or, add on short term courses.

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%.

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

Assessment will be evidence based comprising some of 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
- Computer based multiple choice question examination
- Practical Examination

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 for formative assessment:

Performance Level	Evidence
(a) Marks in the range of 60 -75% to be allotted during assessment	
For performance in this grade, the candidate with occasional guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of an acceptable standard of craftsmanship.	● Demonstration of good skill in the use of hand tools, machine tools and workshop equipment ● 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) Marks in the range of above75% - 90% to be allotted during assessment	
For this grade, the candidate, with little guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of a reasonable standard of craftsmanship.	● Good skill levels in the use of hand tools, machine tools and workshop equipment ● 70-80% 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) Marks 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 powerhouse, business and residential premises etc. Studies drawings and other specifications to determine electrical circuit, installation details etc. Positions and installs electrical motors, transformers, switchgears. Switch boards and other electrical equipment, fittings and lighting fixtures. Makes connections and solders terminals. Tests electrical installations and equipment and locates faults using megger, test lamps etc. Repairs or replaces defective wiring, burnt out fuses and defective parts and keeps fittings and fixtures in working order. May do armature winding, draw wires and cables and do simple cable jointing. May operate, attend and maintain electrical motors, pumps etc.

Electrical Fitter; fits and assembles electrical machinery and equipment such as motors, transformers, generators, switchgears, fans etc., Studies drawings and wiring diagrams of fittings, wiring and assemblies to be made. Collects prefabricated electrical and mechanical components according to drawing and wiring diagrams and checks them with gauges, megger etc. to ensure proper function and accuracy. Fits mechanical components, resistance, insulators, etc., as per specifications, doing supplementary tooling where necessary. Follows wiring diagrams, makes electrical connections and solders points as specified. Checks for continuity, resistance, circuit shorting, leakage, earthing, etc. at each stage of assembly using megger, ammeter, voltmeter and other appliances and ensures stipulated performance of both mechanical and electrical components 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 powerhouse work and be designated accordingly.

Reference NCO-2015:

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

Reference NOS:

(i) PSS/N2001
(ii) PSS/N0108
(iii) PSS/N6001
(iv) PSS/N6003
(v) PSS/N6002
(vi) PSS/N1707
(vii) PSS/N6003
(viii) PSS/N2406
(ix) PSS/N2407
(x) PSS/N4402
(xi) PSS/N1709
(xii) PSS/N0106
(xiii) PSS/N7001

4. GENERAL INFORMATION

Name of the Trade	**ELECTRICIAN**
Trade Code	DGT/1001
NCO - 2015	7411.0100, 7412.0200
NOS Covered	PSS/N2001, PSS/N0108, PSS/N6001, PSS/N6003, PSS/N6002, PSS/N1707, PSS/N6003, PSS/N2406, PSS/N2407, PSS/N4402, PSS/N1709, PSS/N1709, PSS/N0106, PSS/N7001 PSS/N9401 PSS/N9402, PSS/N9403, PSS/N9404 PSS/N9405 PSS/N9406 PSS/N9407, PSS/N9408, PSS/N9409, PSS/N9410
NSQF Level	Level-4
Duration of Craftsmen Training (Instructional Hours)	Two Years (2400 hours + 300 hours OJT/Group Project)
Entry Qualification	Passed 10th class examination with Science and Mathematics or with vocational subject in same sector or its equivalent.
Minimum Age	14 years as on first day of academic session.
Eligibility for PwD	LD, LC, DW, AA, DEAF, HH
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 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" with three years' experience in the relevant field. **Essential Qualification:** Relevant Regular / RPL variants of National Craft Instructor Certificate (NCIC) 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 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. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR** Regular / RPL variants NCIC in RoDA or any of its variants under DGT
(iii) Engineering Drawing	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 Mechanical group (Gr-I) trades categorized under Engg. Drawing'/ D'man Mechanical / D'man Civil' with three years' experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR** Regular / RPL variants of 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. (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.
(v) Minimum age for Instructor	21 years
List of Tools & Equipment	As per Annexure-I

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. (NOS: PSS/N2001)
2. Prepare electrical wire joints; carry out soldering, crimping and measure insulation resistance of underground cable. (NOS: PSS/N0108)
3. Verify characteristics of electrical and magnetic circuits. (NOS: PSS/N6001, PSS/N6003)
4. Install, test and maintenance of batteries and solar cell. (NOS: PSS/N6001)
5. Estimate, Assemble, install and test wiring system. (NOS: PSS/N6001)
6. Plan and prepare Earthing installation. (NOS: PSS/N6002)
7. Plan and execute electrical illumination system and test. (NOS: PSS/N9403)
8. Select and perform measurements using analog / digital instruments and install/ diagnose smart meters. (NOS: PSS/N1707)
9. Perform testing, verify errors and calibrate instruments. (NOS: PSS/N9404)
10. Plan and carry out installation, fault detection and repairing of domestic appliances. (NOS: PSS/N6003)
11. Execute testing, evaluate performance and maintenance of transformer. (NOS: PSS/N2406, PSS/N2407)
12. Read and apply engineering drawing for different application in the field of work. (NOS: PSS/N9401)
13. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: PSS/N9402)

SECOND YEAR

14. Plan, execute commissioning and evaluate performance of DC machines. (NOS: PSS/N4402)
15. Execute testing, and maintenance of DC machines and motor starters. (NOS: PSS/N4402)
16. Plan, execute commissioning and evaluate performance of AC motors. (NOS: PSS/N1709)
17. Execute testing, and maintenance of AC motors and starters. (NOS: PSS/N1709)
18. Plan, execute testing, evaluate performance and carry out maintenance of Alternator / MG set. (NOS: PSS/PSS/N9405)

19. Execute parallel operation of alternators. (NOS: PSS/N9405)
20. Distinguish, organise and perform motor winding. (NOS: PSS/N4402)
21. Assemble simple electronic circuits and test for functioning. (NOS: PSS/N9406)
22. Assemble accessories and carry out wiring of control cabinets and equipment. (NOS: PSS/N9407)
23. Perform speed control of AC and DC motors by using solid state devices. (NOS: PSS/N9408)
24. Detect the faults and troubleshoot inverter, stabilizer, battery charger, emergency light and UPS etc. (NOS: PSS/N6002)
25. Plan, assemble and install solar panel. (NOS: PSS/N9409)
26. Erect overhead domestic service line, outline various power plant layout and explain smart distribution grid and its components. (NOS: PSS/N0106)
27. Examine the faults and carry out repairing of circuit breakers. (NOS: PSS/N7001)
28. Install and troubleshoot Electric Vehicle charging stations. (NOS: PSS/N9410)
29. Read and apply engineering drawing for different application in the field of work.(NOS: PSS/N9401)
30. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: PSS/N9402)

6. ASSESSMENT CRITERIA

LEARNING OUTCOMES	ASSESSMENT CRITERIA
FIRST YEAR	
1. Prepare profile with an appropriate accuracy as per drawing. (NOS: PSS/N2001)	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 of surface mounting type of accessories.
	Perform connections of electrical accessories.
	Make and wire up of a test board and test it.
2. Prepare electrical wire joints, carry out soldering, crimping and measure insulation resistance of underground cable. (NOS: PSS/N0108)	Observe safety/ precaution during joints & soldering.
	Make simple straight twist and rat-tail joints in single strand conductors.
	Make married and 'T' (Tee) joint in stranded conductors.
	Prepare a Britannia straight and 'T' (Tee) joint in bare conductors.
	Prepare western union joint in bare conductor.
	Solder the finished copper conductor joints with precaution.
	Prepare termination of cable lugs by using crimping tool.
	Make straight joint in different types of underground cables.
	Measure insulation resistance of underground cable.
3. Verify characteristics of electrical and magnetic circuits. (NOS: PSS/N6001, PSS/N6003)	Identify types of wires, cables and verify their specifications.
	Verify the characteristics of series, parallel and its combination circuit.
	Analyze the effect of the short and open in series and parallel circuits.
	Verify the relation of voltage components of RLC series circuit in AC.
	Determine the power factor by direct and 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.
	Make the solenoid and determine its polarity for the given direction of current.
	Group the given capacitors to get the required capacity and voltage rating.

4. Install, test and maintenance of batteries and solar cell. (NOS: PSS/N6001)	Assemble a DC source 6V/500 mA using 1.5V cells.
	Determine the internal resistance of cell and make grouping of cells.
	Explain charging of battery and test for its condition with safety/ precaution.
	Carry out installation and maintenance of batteries.
	Determine total number of cells required for a given power requirement.
5. Estimate, Assemble, install and test wiring system. (NOS: PSS/N6001)	Comply with safety & IE rules when performing the 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 bank/hostel/jail in PVC conduit.
	Identify the types of fuses their ratings and applications.
	Identify the parts of a relay, MCB & ELCB and check its operation.
	Estimate the cost of material for wiring in PVC channel for an office room having 2 lamps, 1 Fan, one 6A socket outlet and wire up.
	Estimate the requirement for conduit wiring (3 phase) and wire up.
	Estimate the materials and wire up the lighting circuit for a godown.
	Estimate the materials and wire up a lighting circuit for a corridor in conduit.
	Test, locate the fault and repair a domestic wiring installation.
6. Plan and prepare Earthing installation. (NOS: PSS/N6002)	Plan work in compliance with standard safety norms related with earthing installation.
	Install the pipe earthing and test it.
	Install the plate earthing and test it.
	Measure the earth electrode resistance using earth tester.
	Carry out earth resistance improvement.
7. Plan and execute electrical illumination system and test. (NOS: PSS/N9403)	Plan work in compliance with standard safety norms related with electrical illumination system.
	Install light fitting with reflectors for direct and indirect lighting.
	Assemble and connect a single twin tube fluorescent light.
	Connect, install and test the HPMV & HPSV 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.
8. Select and perform	Identify the type of electrical instruments.

measurements using analog / digital instruments and install/ diagnose smart meters. (NOS: PSS/N1707)	Extend the range of MC voltmeter and ammeter.
	Measure the frequency by frequency meter.
	Measure the power and energy in a single & three phase circuit using wattmeter and energy meter with CT and PT.
	Measure the value of resistance, voltage and current using digital multimeter.
	Measure the power factor in poly-phase circuit and verify the same with voltmeter, ammeter, watt-meter readings.
	Identify components of smart meters.
	Install and diagnose smart meters.
9. Perform testing, verify errors and calibrate instruments. (NOS: PSS/N9404)	Test single phase energy meter for its errors.
	Determine the measurement errors while measuring resistance by voltage drop method.
	Calibrate the analog multimeter.
10. Plan and carry out installation, fault detection and repairing of domestic appliances. (NOS: PSS/N6003)	Plan work in compliance with standard safety norms related with domestic appliances.
	Service and Repair of calling bell/ buzzer/ Alarm.
	Service and repair an automatic iron.
	Repair and service of oven having multi-range heat control.
	Replace the heating element in a kettle and test.
	Service and repair an induction heater.
	Service and repair a geyser.
	Service and repair a mixer.
	Service and repair of washing machine.
	Install a pump set.
	Service and repair of table fan.
	Service, repair and install a ceiling fan.
11. Execute testing, evaluate performance and maintenance of transformer. (NOS: PSS/N2406, PSS/N2407)	Plan work in compliance with standard safety norms related with transformer.
	Identify the types of transformers and their specifications.
	Identify the terminals; verify the transformation ratio of a single-phase transformer.
	Connect and test a single-phase auto- transformer.
	Determine the losses (iron loss and copper loss) and the regulation of a single-phase transformer at different loads.
	Measure the current and voltage using CT and PT.
	Carry out winding for small transformer of 1KVA rating.
	Test the transformer oil with oil testing kit.
	Connect 3 single phase transformers for 3 phase operation of delta-delta /delta-star /star-star /star-delta.

	Connect the given two single phase transformers in parallel /series (secondary only) and measure voltage.
	Connect & test 3 phase transformer in parallel.
12. Read and apply engineering drawing for different application in the field of work. (NOS: PSS/N9401)	Read & interpret the information on drawings and apply in executing practical work.
	Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
13. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: PSS/N9402)	Solve different mathematical problems
	Explain concept of basic science related to the field of study
SECOND YEAR	
14. Plan, execute commissioning and evaluate performance of DC machines. (NOS: PSS/N4402)	Plan work in compliance with standard safety norms related with DC machines.
	Determine the load performance of a different type of DC generator on load.
	Connect, start, run and reverse direction of rotation of different types of DC motors.
	Conduct the load performance tests on different type of DC motor.
	Control the speed of a DC motor by different method.
15. Execute testing, and maintenance of DC machines and motor starters. (NOS: PSS/N4402)	Test a DC machine for continuity and insulation resistance.
	Maintenance, troubleshooting & servicing of DC machines.
	Test armature by using growler.
	Maintain, service and troubleshoot the DC motor starter.
16. Plan, execute commissioning and evaluate performance of AC motors. (NOS:	Plan work in compliance with standard safety norms related with AC motors.
	Draw circuit diagram and connect forward & reverse a 3-phase squirrel cage induction motor.

PSS/N1709)	Start, run and reverse an AC 3 phase squirrel cage induction motor by different type of starters.
	Measure the slip of 3 phase squirrel cage induction motor by tachometer for different output. Draw slip/ load characteristics of the motor.
	Determine the efficiency of 3 phase squirrel cage induction motor by no load test/ blocked rotor test and brake test.
	Plot the speed torque (Slip/Torque) characteristics of slip ring induction motor.
	Demonstrate speed control of 3 phase induction motor.
	Connect, start and run a 3-phase synchronous motor.
	Connect start, run, control speed and reverse the DOR of different type of single-phase motors.
	Install a single-phase AC motor.
17. Execute testing, and maintenance of AC motors and starters. (NOS: PSS/N1709)	Test continuity and insulation of various AC motors.
	Maintain, service and troubleshoot of three phase AC motors.
	Maintain, service and troubleshoot of different types of single-phase AC motors.
	Maintain, service and troubleshoot the AC motor starter.
18. Plan, execute testing, evaluate performance and carry out maintenance of Alternator / MG set. (NOS: PSS/PSS/N9405)	Plan work in compliance with standard safety norms related with Alternator & MG set.
	Connect start and run an alternator and build up the voltage.
	Determine the load performance of a 3-phase alternator.
	Start and load a MG set with 3 phase induction motor coupled to DC shunt generator and build up the voltage.
	Perform/ Explain alignment of MG set.
	Preventive and breakdown maintenance of alternator / MG set.
	Explain the effect of excitation current in terms of V-curves of synchronous motor.
19. Execute parallel operation of alternators. (NOS: PSS/N9405)	Demonstrate parallel operation of an alternator Bright lamp method/ Dark lamp method/ Bright and dark lamp method.
	Parallel operation of an alternator by using synchroscope.
20. Distinguish, organise and perform motor	Rewind the field coil /armature winding/ table fan /ceiling fan.
	Draw winding diagram & rewind a single-phase split type motor (Concentric coil winding).

winding. (NOS: PSS/N4402)	Draw winding diagram & rewind a 3-phase squirrel cage induction motor (single layer distributed winding).
	Draw winding diagram & rewind a 3-phase induction motor (single layer concentric type half coil connection).
	Draw winding diagram & rewind a 3-phase squired cage induction motor. (Double layer distributed type winding)
21. Assemble simple electronic circuits and test for functioning. (NOS: PSS/N9406)	Perform soldering on components/ lug / 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 measure the D.C. & A.C. voltage, frequency and time period.
	Construct and test a half &full wave rectifier with and without filter circuits.
	Construct circuit by using transistor as a switch.
	Construct and test a UJT as relaxation oscillator & electronic timer.
	Construct amplifier circuit using Transistor, FET and JFET and test.
	Construct and test lamp dimmer using TRIAC/DIAC.
	Test IGBT and use in circuit for suitable operation.
	Construct and test the universal motor speed controller using SCR with safety.
	Construct and test logic gate circuits.
22. Assemble accessories and carry out wiring of control cabinets and equipment. (NOS: PSS/N9407)	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.
	Perform wiring for automatic start delta starter.
	Draw & wire up control panel for sequential motor control for three motors.
	Draw & wire up the control panel for a given circuit diagram and connect the motor.
	Test the control panel for all the required logics.
23. Perform speed control of AC and DC motors by using solid state devices. (NOS: PSS/N9408)	Control the speed of DC motor by using DC drive.
	Speed control of universal motor by using SCR.
	Control speed and reverse the direction of rotation of different type of three phase induction motors using VVVF control /AC drive

24. Detect the faults and troubleshoot inverter, stabilizer, battery charger, emergency light and UPS etc. (NOS: PSS/N6002)	Operation and maintenance of inverter.
	Troubleshoot and service a voltage stabilizer.
	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.
	Prepare an emergency light.
	Carryout maintenance of UPS.
25. Plan, assemble and install solar panel. (NOS: PSS/N9409)	Plan work in compliance with solar panel installation norms.
	Combination of solar cells for given power requirement.
	Assemble and install solar panel.
	Check the functionality of solar panel.
26. Erect overhead domestic service line and outline various power plant layout and explain smart distribution grid and its components. (NOS: PSS/N0106)	Prepare single line diagram of thermal/ hydel/ Solar /Wind power plants.
	Prepare layout plan and single line diagram of transmission line.
	Draw an overhead and domestic service line.
	Explain erection ofan overhead service line pole for single phase 240V distribution system.
	Identify different type of insulator used in HT and LT line.
	Fasten jumper in insulators.
	Connect feeder cable with domestic service line.
	Identify components and equipment of smart distribution grid.
	Explain Smart Grid Communication infrastructure components.
27. Examine the faults and carry out repairing of circuit breakers. (NOS: PSS/N7001)	Prepare layout plan and single line diagram of Distribution substation
	Illustrate application of relays in control circuits and examine its operation.
	Identify parts of circuit breaker and check its operation.
28. Install and troubleshoot Electric Vehicle charging stations. (NOS: PSS/N9410)	Explain charger specifications.
	Demonstrate installation of EV charging Station for Public places/ Home.
29. Read and apply engineering drawing for different	Read & interpret the information on drawings and apply in executing practical work.
	Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.

application in the field of work. (NOS: PSS/N9401)	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
30. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: PSS/N9402)	Solve different mathematical problems
	Explain concept of basic science related to the field of study

7. TRADE SYLLABUS

SYLLABUS FOR ELECTRICIAN TRADE			
FIRST YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 40 Hrs.; Professional Knowledge 10 Hrs.	Prepare profile with an appropriate accuracy as per drawing following safety precautions. (Mapped NOS: PSS/N2001)	1. Visit various sections of the institutes and location of electrical installations. (01hrs.) 2. Identify safety symbols and hazards. (02Hrs.) 3. Preventive measures for electrical accidents and practice steps to be taken in such accidents. (03hrs.) 4. Practice safe methods of fire fighting in case of electrical fire. (02hrs.) 5. Use of fire extinguishers. (03Hrs.)	Scope of the electrician trade. Safety rules and safety signs. Types and working of fire extinguishers. (03 hrs.)
		6. Practice elementary first aid. (02hrs.) 7. Rescue a person and practice artificial respiration. (01Hrs.) 8. Disposal procedure of waste materials. (01Hrs.) 9. Use of personal protective equipment. (01hrs.) 10. Practice on cleanliness and procedure to maintain it. (02 hrs.)	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. (03 hrs.)
		11. Identify trade tools and machineries. (03Hrs.) 12. Practice safe methods of lifting and handling of tools	Concept of Standards and advantages of BIS/ISI. Trade tools specifications. Introduction to National

		& equipment. (03Hrs.) 13. Select proper tools for operation and precautions in operation. (03Hrs.) 14. Care & maintenance of trade tools. (03Hrs.)	Electrical Code-2011. (02 hrs.)
		15. Operations of allied trade tools. (05 Hrs.) 16. Workshop practice on filing and hacksawing. (05Hrs.)	Allied trades: Introduction to fitting tools, safety precautions. Description of files, hammers, chisels hacksaw frames, blades, their specification and grades. Types of drills, description & drilling machines. (02 hrs.)
Professional Skill 95 Hrs.; Professional Knowledge 20 Hrs.	Prepare electrical wire joints, carry out soldering, crimping and measure insulation resistance of underground cable. (Mapped NOS: PSS/N0108)	17. Prepare terminations of cable ends (03 hrs.) 18. Practice on skinning, twisting and crimping. (08 Hrs.) 19. Identify various types of cables and measure conductor size using SWG and micrometer. (06Hrs.)	Fundamentals of electricity, definitions, units & effects of electric current. Conductors and insulators. Conducting materials and their comparison. (06 hrs.)
		20. Make simple twist, married, Tee and western union joints. (15 Hrs.) 21. Make britannia straight, britannia Tee and rat tail joints. (15Hrs.) 22. Practice in Soldering of joints / lugs. (12 Hrs.)	Joints in electrical conductors. Techniques of soldering. Types of solders and flux. (07 hrs.)
		23. Identify various parts, skinning and dressing of underground cable. (10Hrs.) 24. Make straight joint of different types of underground cable. (10Hrs.) 25. Test insulation resistance of	Underground cables: Description, types, various joints and testing procedure. Cable insulation & voltage grades Precautions in using various types of cables. (07 hrs.)

		underground cable using megger. (06 hrs.) 26. Test underground cables for faults and remove the fault. (10Hrs.)	
Professional Skill 160 Hrs.; Professional Knowledge 36 Hrs.	Verify characteristics of electrical and magnetic circuits. (Mapped NOS: PSS/N6001, PSS/N6003)	27. Practice on measurement of parameters in combinational electrical circuit by applying Ohm's Law for different resistor values and voltage sources and analyse by drawing graphs. (08 Hrs.) 28. Measure current and voltage in electrical circuits to verify Kirchhoff's Law (08Hrs.) 29. Verify laws of series and parallel circuits with voltage source in different combinations. (05Hrs.) 30. Measure voltage and current against individual resistance in electrical circuit (05hrs.) 31. Measure current and voltage and analyse the effects of shorts and opens in series circuit. (05 Hrs.) 32. Measure current and voltage and analyse the effects of shorts and opens in parallel circuit. (05 Hrs.)	Ohm's Law; Simple electrical circuits and problems. Kirchoff's Laws and applications. Series and parallel circuits. Open and short circuits in series and parallel networks. (04 hrs.)
		33. Measure resistance using voltage drop method. (03Hrs.) 34. Measure resistance using wheatstone bridge. (02 Hrs.) 35. Determine the thermal	Laws of Resistance and various types of resistors. Wheatstone bridge; principle and its applications. Effect of variation of temperature on resistance.

		effect of electric current. (03Hrs.) 36. Determine the change in resistance due to temperature. (02Hrs.) 37. Verify the characteristics of series parallel combination of resistors. (03Hrs.)	Different methods of measuring the values of resistance. Series and parallel combinations of resistors. (04 hrs.)
		38. Determine the poles and plot the field of a magnet bar. (05Hrs.) 39. Wind a solenoid and determine the magnetic effect of electric current. (05Hrs.) 40. Determine direction of induced emf and current. (03hrs.) 41. Practice on generation of mutually induced emf. (03hrs.) 42. Measure the resistance, impedance and determine inductance of choke coils in different combinations. (05Hrs.) 43. Identify various types of capacitors, charging / discharging and testing. (05 Hrs.) 44. Group the given capacitors to get the required capacity and voltage rating. (05 Hrs.)	Magnetic terms, magnetic materials and properties of magnet. Principles and laws of electro-magnetism. Self and mutually induced EMFs. Electrostatics: Capacitor- Different types, functions, grouping and uses. (08 hrs.)
		45. Measure current, voltage and PF and determine the characteristics of RL, RC and RLC in AC series circuits. (06Hrs.) 46. Measure the resonance	Inductive and capacitive reactance, their effect on AC circuit and related vector concepts. Comparison and Advantages of DC and AC systems.

		frequency in AC series circuit and determine its effect on the circuit. (05hrs.) 47. Measure current, voltage and PF and determine the characteristics of RL, RC and RLC in AC parallel circuits. (06Hrs.) 48. Measure the resonance frequency in AC parallel circuit and determine its effects on the circuit. (05hrs.) 49. Measure power, energy for lagging and leading power factors in single phase circuits and compare characteristic graphically. (06Hrs.) 50. Measure Current, voltage, power, energy and power factor in three phase circuits. (05hrs.) 51. Practice improvement of PF by use of capacitor in three phase circuit.(03Hrs.)	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. (10 hrs.)
		52. Ascertain use of neutral by identifying wires of a 3-phase 4 wire system and find the phase sequence using phase sequence meter. (07Hrs.) 53. Determine effect of broken neutral wire in three phase four wire system.(04hrs.) 54. Determine the relationship between Line and Phase values for star and delta connections. (07Hrs.)	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. (10 hrs.)

		55. Measure the Power of three phase circuit for balanced and unbalanced loads. (10Hrs.) 56. 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. (07hrs.)	
Professional Skill 50 Hrs.; Professional Knowledge 10 Hrs.	Install, test and maintenance of batteries and solar cell. (Mapped NOS: PSS/N6001)	57. Use of various types of cells. (08 Hrs.) 58. Practice on grouping of cells for specified voltage and current under different conditions and care. (12 Hrs.) 59. Prepare and practice on battery charging and details of charging circuit. (12 Hrs.) 60. Practice on routine, care/ maintenance and testing of batteries. (08 Hrs.) 61. Determine the number of solar cells in series / parallel for given power requirement. (10 Hrs.)	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, Safety precautions, test equipment and maintenance. Basic principles of Electro-plating and cathodic protection Grouping of cells for specified voltage and current. Principle and operation of solar cell. (10 Hrs.)
Professional Skill 200 Hrs.; Professional Knowledge 42 Hrs.	Estimate, Assemble, install and test wiring system. (Mapped NOS: PSS/N6001)	62. Identify various conduits and different electrical accessories. (8 Hrs.) 63. Practice cutting, threading of different sizes & laying Installations. (17 Hrs.) 64. Prepare test boards /	I.E. rules on electrical wiring. Types of domestic and industrial wirings. Study of wiring accessories e.g. switches, fuses, relays, MCB, ELCB, MCCB etc. Grading of cables and current

		extension boards and mount accessories like lamp holders, various switches, sockets, fuses, relays, MCB, ELCB, MCCB etc. (25 Hrs.)	ratings. Principle of laying out of domestic wiring. Voltage drop concept. (14 Hrs.)
		65. Draw layouts and practice in PVC Casing-capping, Conduit wiring with minimum to more number of points of minimum 15 mtr length. (15 Hrs.) 66. Wire up PVC conduit wiring to control one lamp from two different places. (15 Hrs.) 67. Wire up PVC conduit wiring to control one lamp from three different places. (15 Hrs.) 68. Wire up PVC conduit wiring and practice control of sockets and lamps in different combinations using switching concepts. (15 Hrs.)	PVC conduit and Casing-capping wiring system. Different types of wiring - Power, control, Communication and entertainment wiring. Wiring circuits planning, permissible load in sub-circuit and main circuit. (14 Hrs.)
		69. Wire up the consumers main board with MCB & DB's switch and distribution fuse box. (15 Hrs.) 70. Prepare and mount the energy meter board. (15 Hrs.) 71. Estimate the cost/bill of material for wiring of hostel/ residential building and workshop. (15 Hrs.) 72. Practice wiring of hostel and residential building as per IE rules. (15 Hrs.)	Estimation of load, cable size, bill of material and cost. Inspection and testing of wiring installations. Special wiring circuit e.g. godown, tunnel and workshop etc. (14 Hrs.)

		73. Practice wiring of institute and workshop as per IE rules. (15 Hrs.) 74. Practice testing / fault detection of domestic and industrial wiring installation and repair. (15Hrs.)	
Professional Skill 25 Hrs.; Professional Knowledge 07 Hrs.	Plan and prepare Earthing installation. (Mapped NOS: PSS/N6002)	75. Prepare pipe earthing and measure earth resistance by earth tester / megger. (10 Hrs.) 76. Prepare plate earthing and measure earth resistance by earth tester / megger. (10 Hrs.) 77. Test earth leakage by ELCB and relay. (5 Hrs.)	Importance of Earthing. Plate earthing and pipe earthing methods and IEE regulations. Earth resistance and earth leakage circuit breaker. (5 Hrs.)
Professional Skill 45Hrs.; Professional Knowledge 10Hrs.	Plan and execute electrical illumination system and test. (Mapped NOS: PSS/N9403)	78. Install light fitting with reflectors for direct and indirect lighting. (10 Hrs.) 79. Group different wattage of lamps in series for specified voltage. (5 Hrs.) 80. Practice installation of various lamps e.g. fluorescent tube, HP mercury vapour, LP mercury vapour, HP sodium vapour, LP sodium vapour, metal halide etc. (18 Hrs.) 81. Prepare decorative lamp circuit to produce rotating light effect/running light effect. (6 Hrs.) 82. Install light fitting for show case lighting. (6 Hrs.)	Laws of Illuminations. Types of illumination system. Illumination factors, intensity of light. Type of lamps, advantages/ disadvantages and their applications. Calculations of lumens and efficiency. (10 hrs.)

Professional Skill 50 Hrs.; Professional Knowledge 08 Hrs.	Select and perform measurements using analog / digital instruments and install/ diagnose smart meters. (Mapped NOS: PSS/N1707)	83. Practice on various analog and digital measuring Instruments. (5 Hrs.) 84. Practice on measuring instruments in single and three phase circuits e.g. multi-meter, Wattmeter, Energy meter, Phase sequence meter and Frequency meter etc. (12Hrs.) 85. Measure power in three phase circuit using two wattmeter methods. (8 Hrs.) 86. Measure power factor in three phase circuit by using power factor meter and verify the same with voltmeter, ammeter and wattmeter readings. (10Hrs.) 87. Measure electrical parameters using tong tester in three phase circuits. (08Hrs.) 88. Demonstrate Smart Meter, its physical components and Communication components. (03 Hrs.) 89. Perform meter readings, install and diagnose smart meters. (04 Hrs.)	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. Automatic meter reading infrastructures and Smart meter. Concept of Prosumer and distributed generation. Electrical supply requirements of smart meter, Detecting/clearing the tamper notifications of meter. (08 hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 05Hrs.	Perform testing, verify errors and calibrate instruments. (Mapped NOS: PSS/N9404)	90. Practice for range extension and calibration of various measuring instruments. (10 Hrs.) 91. Determine errors in resistance measurement by voltage drop method. (8	Errors and corrections in measurement. Loading effect of voltmeter and voltage drop effect of ammeter in circuits. Extension of range and calibration of measuring

		Hrs.) 92. Test single phase energy meter for its errors. (7 Hrs.)	instruments. (05 hrs.)
Professional Skill 75 Hrs.; Professional Knowledge 10 Hrs.	Plan and carry out installation, fault detection and repairing of domestic appliances. (Mapped NOS: PSS/N6003)	93. Dismantle and assemble electrical parts of various electrical appliances e.g. cooking range, geyser, washing machine and pump set. (25 Hrs.) 94. Service and repair of electric iron, electric kettle, cooking range and geyser. (12 Hrs.) 95. Service and repair of induction heater and oven. (10 Hrs.) 96. Service and repair of mixer and grinder. (10 Hrs.) 97. Service and repair of washing machine. (13Hrs.)	Working principles and circuits of common domestic equipment and appliances. Concept of Neutral and Earth. (10 hrs.)
Professional Skill 75 Hrs.; Professional Knowledge 12 Hrs.	Execute testing, evaluate performance and maintenance of transformer. (Mapped NOS: PSS/N2406, PSS/N2407)	98. Verify terminals, identify components and calculate transformation ratio of single-phase transformers. (8 Hrs.) 99. Perform OC and SC test to determine and efficiency of single-phase transformer. (12Hrs.) 100. Determine voltage regulation of single-phase transformer at different loads and power factors. (12 Hrs.) 101. Perform series and parallel operation of two single phase transformers. (12 Hrs.)	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 transformer. Voltage Regulation and efficiency. Auto Transformer and instrument transformers (CT & PT). (12 Hrs.)

		102. Verify the terminals and accessories of three phase transformer HT and LT side. (6Hrs.)	
		103. Perform 3 phase operation (i) delta-delta, (ii) delta-star, (iii) star-star, (iv) star-delta by use of three single phase transformers. (6 Hrs.) 104. Perform testing of transformer oil. (6 Hrs.) 105. Practice on winding of small transformer. (8 Hrs.) 106. Practice of general maintenance of transformer. (5 Hrs.)	Method of connecting three single phase transformers for three phase operation. Types of Cooling, protective devices, bushings and termination etc. Testing of transformer oil. Materials used for winding and winding wires in small transformer. (06 Hrs.)
ENGINEERING DRAWING: 40 Hrs.			
Professional Knowledge ED- 40 Hrs.	Read and apply engineering drawing for different application in the field of work. (Mapped NOS: PSS/N9401)	**ENGINEERING DRAWING** Introduction to Engineering Drawing and Drawing Instruments – ● Conventions ● Sizes and layout of drawing sheets ● Title Block, its position and content ● Drawing Instrument Free hand drawing of – ● Geometrical figures and blocks with dimension ● Transferring measurement from the given object to the free hand sketches. ● Free hand drawing of hand tools. Drawing of Geometrical figures: ● Angle, Triangle, Circle, Rectangle, Square, Parallelogram. ● Lettering & Numbering – Single Stroke Dimensioning Practice ● Types of arrowhead Symbolic representation ● Different electrical symbols used in the related trades Reading of Electrical Circuit Diagram Reading of Electrical Layout drawing	
WORKSHOP CALCULATION & SCIENCE: 30 Hrs			
Professional Knowledge	Demonstrate basic mathematical	**WORKSHOP CALCULATION & SCIENCE** **Unit, Fractions**	

WCS- 30 Hrs.	concept and principles to perform practical operations. Understand and explain basic science in the field of study. (Mapped NOS: PSS/N9402)	Classification of unit system Fundamental and Derived units F.P.S, C.G.S, M.K.S and SI units Measurement units and conversion Factors, HCF, LCM and problems Fractions - Addition, substraction, multiplication & division Decimal fractions - Addition, subtraction, multilipication & division Solving problems by using calculator **Square root, Ratio and Proportions, Percentage** Square and suare root Simple problems using calculator Applications of pythagoras theorem and related problems Ratio and proportion Ratio and proportion - Direct and indirect proportions Percentage Precentage - Changing percentage to decimal and fraction **Material Science** Types metals, types of ferrous and non ferrous metals Introduction of iron and cast iron **Mass, Weight, Volume and Density** Mass, volume, density, weight Related problems for mass, volume, density, weight Work, power, energy, HP, IHP, BHP and efficiency Potential energy, kinetic energy and related problems with assignment **Heat & Temperature and Pressure** Concept of heat and temperature, effects of heat, difference between heat and temperature, boiling point & melting point of different metals and non-metals Scales of temperature, celsius, fahrenheit, kelvin and conversion between scales of temperature Heat &Temperature - Temperature measuring instruments, types of thermometer, pyrometer and transmission of heat - Conduction, convection and radiation. **Mensuration** Area and perimeter of square, rectangle and parallelogram Area and perimeter of Triangles Area and perimeter of circle, semi-circle, circular ring, sector of circle, hexagon and ellipse Surface area and volume of solids - cube, cuboid, cylinder, sphere and hollow cylinder **Trigonometry** Measurement of angles Trigonometrical ratios Trigonometrical tables

Project work / Industrial visit

Broad Areas:

a) Overload protection of electrical equipment
b) Automatic control of streetlight/night lamp
c) Fuse and power failure indicator using relays
d) Door alarm/indicator
e) Decorative light with electrical flasher

SYLLABUS FOR ELECTRICIAN TRADE			
SECOND YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 35 Hrs.; Professional Knowledge 09 Hrs.	Plan, execute commissioning and evaluate performance of DC machines. (Mapped NOS: PSS/N4402)	107. Identify terminals, parts and connections of different types of DC machines. (05 Hrs.) 108. Measure field and armature resistance of DC machines. (05 Hrs.) 109. Determine build up voltage of DC shunt generator with varying field excitation and performance analysis on load. (10 Hrs.) 110. Test for continuity and insulation resistance of DC machine. (5 Hrs.) 111. Start, run and reverse direction of rotation of DC series, shunt and compound motors. (10 Hrs.)	General concept of rotating electrical machines. Principle of DC generator. Use of Armature, Field Coil, Polarity, Yoke, Cooling Fan, Commutator, slip ring and Brushes, Laminated core etc. E.M.F. equation Separately excited and self-excited generators. Series, shunt and compound generators. (09 Hrs.)
Professional Skill 77 Hrs.; Professional Knowledge 24 Hrs.	Execute testing, and maintenance of DC machines and motor starters. (Mapped NOS: PSS/N4402)	112. Perform no load and load test and determine characteristics of series and shunt generators. (08 Hrs.) 113. Perform no load and load test and determine characteristics of compound generators (cumulative and differential). (07 Hrs.) 114. Practice dismantling and assembling in DC shunt	Armature reaction, Commutation, inter poles and connection of inter poles. Parallel Operation of DC Generators. Load characteristics of DC generators. Application, losses & efficiency of DC Generators. Routine & maintenance. (12 Hrs.)

		motor. (10 Hrs.) 115. Practice dismantling and assembling in DC compound generator. (10 Hrs.)	
		116. Conduct performance analysis of DC series, shunt and compound motors. (14 Hrs.) 117. Dismantle and identify parts of three point and four-point DC motor starters. (06 Hrs.) 118. Assemble, Service and repair three point and four-point DC motor starters. (10 Hrs.) 119. Practice maintenance of carbon brushes, brush holders, Commutator and sliprings. (12 Hrs.)	Principle and types of DC motor. Relation between applied voltage back e.m.f., armature voltage drop, speed and flux of DC motor. DC motor Starters, relation between torque, flux and armature current. Changing the direction of rotation. Characteristics, Losses & Efficiency of DC motors. Routine and maintenance. (12 Hrs.)
Professional Skill 35 Hrs.; Professional Knowledge 09 Hrs.	Distinguish, organise and perform motor winding. (Mapped NOS: PSS/N4402)	120. Perform speed control of DC motors - field and armature control method. (10 Hrs.) 121. Carry out overhauling of DC machines. (10 Hrs.) 122. Perform DC machine winding by developing connection diagram, test on growler and assemble. (15 Hrs.)	Methods of speed control of DC motors. Lap and wave winding and related terms. (09 Hrs.)
Professional Skill 80 Hrs.; Professional Knowledge 26 Hrs.	Plan, Execute commissioning and evaluate performance of AC motors. (Mapped NOS: PSS/N1709)	123. Identify parts and terminals of three phase AC motors. (5 Hrs.) 124. Make an internal connection of automatic star-delta starter with three contactors. (10 Hrs.)	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

	Execute testing, and maintenance of AC motors and starters. (Mapped NOS: PSS/N1709)	125. Connect, start and run three phase induction motors by using DOL, star-delta and auto-transformer starters. (17 Hrs.) 126. Connect, start, run and reverse direction of rotation of slip-ring motor through rotor resistance starter and determine performance characteristic. (13 Hrs.)	three phase induction motors, its necessity, basic contactor circuit, parts and their functions. (13 Hrs.)
		127. Determine the efficiency of squirrel cage induction motor by brake test. (05 Hrs.) 128. Determine the efficiency of three phase squirrel cage induction motor by no load test and blocked rotor test. (05 Hrs.) 129. Measure slip and power factor to draw speed-torque (slip/torque) characteristics. (10 Hrs.) 130. Test for continuity and insulation resistance of three phase induction motors. (5 Hrs.) 131. Perform speed control of three phase induction motors by various methods like rheostatic control, autotransformer etc. (10 Hrs.)	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. (13 Hrs.)
Professional Skill 23 Hrs.; Professional	Distinguish, organise and perform motor winding. (Mapped NOS: PSS/N4402)	132. Perform winding of three phase AC motor by developing connection diagram, test and	Concentric/ distributed, single/ double layer winding and related terms.

Knowledge 09 Hrs.		assemble. (18 Hrs.) 133. Maintain, service and troubleshoot the AC motor starter. (05 Hrs.)	
Professional Skill 39 Hrs.; Professional Knowledge 12 Hrs.	Plan, Execute commissioning and evaluate performance of AC motors. (Mapped NOS: PSS/N1709) Execute testing, and maintenance of AC motors and starters. (Mapped NOS: PSS/N1709)	134. Identify parts and terminals of different types of single-phase AC motors. (5 Hrs.) 135. Install, connect and determine performance of single-phase AC motors. (10 Hrs.) 136. Start, run and reverse the direction of rotation of single-phase AC motors. (08 Hrs.) 137. Practice on speed control of single-phase AC motors. (08 Hrs.) 138. Compare starting and running winding currents of a capacitor run motor at various loads and measure the speed. (08 Hrs.)	Working principle, different method of starting and running of various single-phase AC motors. Domestic and industrial applications of different single-phase AC motors. Characteristics, losses and efficiency. (12 hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 12 Hrs.	Distinguish, organise and perform motor winding. (Mapped NOS: PSS/N4402)	139. Carry out maintenance, service and repair of single-phase AC motors. (10 Hrs.) 140. Practice on single/double layer and concentric winding for AC motors, testing and assembling. (25 Hrs.) 141. Connect, start, run and reverse the direction of rotation of universal motor. (10 Hrs.) 142. Carry out maintenance and servicing of universal	Concentric/ distributed, single/ double layer winding and related terms. Troubleshooting of single-phase AC induction motors and universal motor. (12 hrs.)

		motor. (05 Hrs.)	
Professional Skill 75 Hrs.; Professional Knowledge 22 Hrs.	Plan, execute testing, evaluate performance and carry out maintenance of Alternator / MG set. Execute parallel operation of alternators. (Mapped NOS: PSS/N9405)	143. Install an alternator, identify parts and terminals of alternator. (5 Hrs.) 144. Test for continuity and insulation resistance of alternator. (5 Hrs.) 145. Connect, start and run an alternator and build up the voltage. (5 Hrs.) 146. Determine the load performance and voltage regulation of three phase alternator. (5 Hrs.) 147. Parallel operation and synchronization of three phase alternators. (15 Hrs.)	Principle of alternator, e.m.f. equation, relation between poles, speed and frequency. Types and construction. Efficiency, characteristics, regulation, phase sequence and parallel operation. Effect of changing the field excitation and power factor correction. (10 Hrs.)
		148. Install a synchronous motor, identify its parts and terminals. (10 Hrs.) 149. Connect, start and plot V-curves for synchronous motor under different excitation and load conditions. (10 Hrs.)	Working principle of synchronous motor. Effect of change of excitation and load. V and anti V curve. Power factor improvement. (06 Hrs.)
		150. Identify parts and terminals of MG set. (5 Hrs.) 151. Start and load MG set with 3 phase induction motor coupled to DC shunt generator. (15 Hrs.)	Rotary Converter, MG Set description and Maintenance. (06 Hrs.)
Professional Skill 99 Hrs.; Professional Knowledge 31 Hrs.	Assemble simple electronic circuits and test for functioning. (Mapped NOS: PSS/N9406)	152. Determine the value of resistance by colour code and identify types. (03 Hrs.) 153. Test active and passive electronic components and	Resistors – colour code, types and characteristics. Active and passive components. Atomic structure and semiconductor theory. (04 Hrs.)

		its applications. (05 Hrs.)	
		154. Determine V-I characteristics of semiconductor diode. (05 Hrs.) 155. Construct half wave, full wave and bridge rectifiers using semiconductor diode. (08 Hrs.) 156. Check transistors for their functioning by identifying its type and terminals. (10 Hrs.) 157. Bias the transistor and determine its characteristics. (05Hrs.) 158. Use transistor as an electronic switch and series voltage regulator. (05Hrs.)	P-N junction, classification, specifications, biasing and characteristics of diodes. Rectifier circuit - half wave, full wave, bridge rectifiers and filters. Principle of operation, types, characteristics and various configuration of transistor. Application of transistor as a switch, voltage regulator and amplifier. (12 Hrs.)
		159. Operate and set the required frequency using function generator. (05Hrs.) 160. Make a printed circuit board for power supply. (09 Hrs.) 161. Construct simple circuits containing UJT for triggering and FET as an amplifier. (05 Hrs.) 162. Troubleshoot defects in simple power supplies. (09 Hrs.)	Basic concept of power electronics devices. IC voltage regulators Digital Electronics - Binary numbers, logic gates and combinational circuits. (06 hrs.)
		163. Construct power control circuit by SCR, Diac, Triac and IGBT. (12 Hrs.) 164. Construct variable DC stabilized power supply	Working principle and uses of oscilloscope. Construction and working of SCR, DIAC, TRIAC and IGBT. (09 Hrs.)

		using IC. (08 Hrs.) 165. Practice on various logics by use of logic gates and circuits. (05 Hrs.) 166. Generate and demonstrate wave shapes for voltage and current of rectifier, single stage amplifier and oscillator using CRO. (05 Hrs.)	
Professional Skill 82 Hrs.; Professional Knowledge 24 Hrs.	Assemble accessories and carry out wiring of control cabinets and equipment. (Mapped NOS: PSS/N9407)	167. Design layout of control cabinet, assemble control elements and wiring accessories for: (i) Local and remote control of induction motor. (09 Hrs.) (ii) Forward and reverse operation of induction motor. (09 Hrs.) (iii) Automatic star-delta starter with change of direction of rotation. (12 Hrs.) (iv) Sequential control of three motors. (09 Hrs.)	Study and understand Layout drawing of control cabinet, power and control circuits. Various control elements: Isolators, pushbuttons, switches, indicators, MCB, fuses, relays, timers and limit switches etc. (12 Hrs.)
		168. Carry out wiring of control cabinet as per wiring diagram, bunching of XLPE cables, channeling, tying and checking etc. (13 Hrs.) 169. Mount various control elements e.g. circuit breakers, relays, contactors and timers etc. (09 Hrs.) 170. Identify and install required measuring instruments and sensors in	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. (12 Hrs.)

		control panel. (09 Hrs.) 171. Test the control panel for its performance. (12 Hrs.)	
Professional Skill 50 Hrs.; Professional Knowledge 11 Hrs.	Perform speed control of AC and DC motors by using solid state devices. (Mapped NOS: PSS/N9408)	172. Perform speed control of DC motor using thyristors / DC drive. (18 Hrs.) 173. Perform speed control and reversing the direction of rotation of AC motors by using thyristors / AC drive. (18 Hrs.) 174. Construct and test a universal motor speed controller using SCR. (14 Hrs.)	Working, parameters and applications of AC / DC drive. Speed control of 3 phase induction motor by using VVVF/AC Drive. (11 Hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 10 Hrs.	Detect the faults and troubleshoot inverter, stabilizer, battery charger, emergency light and UPS etc. (Mapped NOS: PSS/N6002)	175. Assemble circuits of voltage stabilizer and UPS. (10 Hrs.) 176. Prepare an emergency light. (10 Hrs.) 177. Assemble circuits of battery charger and inverter. (10Hrs.) 178. Test, analyze defects and repair voltage stabilizer, emergency light and UPS. (05Hrs.) 179. Maintain, service and troubleshoot battery charger and inverter. (07Hrs.) 180. Install an Inverter with battery and connect it in domestic wiring for operation. (08Hrs.)	Basic concept, block diagram and working of voltage stabilizer, battery charger, emergency light, inverter and UPS. Preventive and breakdown maintenance. (10 Hrs.)
Professional Skill 23 Hrs.; Professional	Erect overhead domestic service line, outline various power plant layout	181. Draw layout of thermal power plant and identify function of different layout elements. (5 Hrs.)	Conventional and non-conventional sources of energy and their comparison. Power generation by thermal and

Knowledge 04 Hrs.	and explain smart distribution grid and its components. (Mapped NOS: PSS/N0106)	182. Draw layout of hydel power plant and identify functions of different layout elements. (5 Hrs.) 183. Visit to transmission / distribution substation. (08 Hrs.) 184. Draw actual circuit diagram of substation visited and indicate various components. (5 Hrs.)	hydel power plants. (04 Hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 07 Hrs.	Plan, assemble and install solar panel. (Mapped NOS: PSS/N9409)	185. Prepare layout plan and Identify different elements of solar power system. (05 Hrs.) 186. Prepare layout plan and Identify different elements of wind power system. (05 Hrs.) 187. Assemble and connect solar panel for illumination. (15 Hrs.)	Various ways of electrical power generation by non-conventional methods. Power generation by solar and wind energy. Principle and operation of solar panel. (07 Hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 10 Hrs.	Erect overhead domestic service line, outline various power plant layout and explain smart distribution grid and its components. (Mapped NOS: PSS/N0106)	188. Practice installation of insulators used in HT/LT line for a given voltage range. (04hrs.) 189. Draw single line diagram of transmission and distribution system. (04Hrs.) 190. Measure current carrying capacity of conductor for given power supply. (04hrs.) 191. Fasten jumper in pin, shackle and suspension type insulators. (07Hrs.)	Transmission and distribution networks. Line insulators, overhead poles and method of joining aluminum conductors. (05 Hrs.)
		192. Erect an overhead service line pole for single phase	Safety precautions and IE rules pertaining to domestic service

		230V distribution system in open space. (10 Hrs.) 193. Practice on laying of domestic service line. (10 Hrs.) 194. Install bus bar and bus coupler on LT line. (5 Hrs.)	connections. Various substations. Various terms like – maximum demand, average demand, load factor, diversity factor, plant utility factor etc. (05 Hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 04 Hrs.	Examine the faults and carry out repairing of circuit breakers. (Mapped NOS: PSS/N7001)	195. Identify various parts of relay and ascertain the operation. (5 Hrs.) 196. Practice setting of pick up current and time setting multiplier for relay operation. (5 hrs.) 197. Identify the parts of circuit breaker, check its operation. (5Hrs.) 198. Test tripping characteristic of circuit breaker for over current and short circuit current. (5 hrs.) 199. Practice on repair and maintenance of circuit breaker. (5 hrs.)	Types of relays and its operation. Types of circuit breakers, their applications and functioning. Production of arc and quenching. (04 Hrs)
Professional Skill 22 Hrs.; Professional Knowledge 04 Hrs.	Install and troubleshoot Electric Vehicle charging stations. (Mapped NOS: PSS/N9410)	200. Demonstrate different charger specifications. (05 hrs) 201. Perform installation of EV charging Station for Public places. (10 hrs) 202. Perform installation of Home EV charging stations. (10 hrs)	EV scenario in India and EV Charging basic theory. EV Charging safety requirements. (04 Hrs)
ENGINEERING DRAWING: 40 Hrs.			
Professional Knowledge ED- 40 Hrs.	Read and apply engineering drawing for different application in the field of work.	**ENGINEERING DRAWING:** Reading of Electrical Sign and Symbols. Sketches of Electrical components. Reading of Electrical wiring diagram and Layout diagram. Reading of Electrical earthing diagram. Drawing the schematic diagram of plate	

	(Mapped NOS: PSS/N9401)	and pipe earthing. Drawing of Electrical circuit diagram. Drawing of Block diagram of Instruments & equipment of trades.
WORKSHOP CALCULATION & SCIENCE: 32 Hrs		
Professional Knowledge WCS- 32 Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (Mapped NOS: PSS/N9402)	**<u>WORKSHOP CALCULATION & SCIENCE:</u>** **Friction** Friction - Lubrication **Algebra** Algebra - Addition , subtraction, multiplication & division Algebra - Theory of indices, algebraic formula, related problems **Elasticity** Elasticity - Elastic, plastic materials, stress, strain and their units and young's modulus **Profit and Loss** Profit and loss - Simple problems on profit & loss Profit and loss - Simple and compound interest **Estimation and Costing** Estimation and costing - Simple estimation of the requirement of material etc., as applicable to the trade. Estimation and costing - Problems on estimation and costing
Project work / Industrial visit: a) Battery charger/Emergency light b) Control of motor pump with tank level c) DC voltage converter using SCRs d) Logic control circuits using relays e) Alarm/indicator circuits using sensors		

SYLLABUS FOR CORE SKILLS
1. Employability Skills (Common for all CTS trades) (120 Hrs. + 60 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/ dgt.gov.in

ANNEXURE-I

List of Tools & Equipment			
ELECTRICIAN (for batch of 20candidates)			
S No.	**Name of the Tools and Equipment**	**Specification**	**Quantity**
A. TRAINEES TOOL KIT (For each additional unit trainees tool kit Sl. 1-12 is required additionally)			
1.	Measuring Steel Tape	5 meter	(20 +1) Nos.
2.	Combination Plier Insulated	200 mm	(20 +1) Nos.
3.	Screwdriver Insulated	4mm X 150 mm, Diamond Head	(20 +1) Nos.
4.	Screwdriver Insulated	6mm X 150 mm	(20 +1) Nos.
5.	Electrician screwdriver thin stem insulated handle	4mm X 100 mm	(20 +1) Nos.
6.	Heavy Duty Screwdriver insulated	5mm X 200 mm	(20 +1) Nos.
7.	Electrician Screwdriver 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.
B. SHOP TOOLS & EQUIPMENT – For 2 (1+1) units no additional items are required			
(i) List of Tools & Accessories			
13.	Hammer, ball peen With handle	500 grams	4 Nos.
14.	Pincer	150 mm	4 Nos.
15.	C- Clamp	200 mm and 100 mm	2 Nos. each
16.	Spanner Adjustable drop forged, SS	150 mm & 300mm	2 Nos. each
17.	Blow lamp brass	0.5 ltr	1 No.
18.	Chisel Cold	25 mm X 200 mm	2 Nos.
19.	Chisel firmer with wooden Handle	6 mm X 200 mm	2 Nos.
20.	Allen Key alloy steel	1.5-10 mm (set of 9)	1 Set
21.	Grease Gun	0.5 ltr. Capacity	1 No
22.	Bradawl		2 Nos.
23.	Pully Puller with 3 legs	150 mm & 300mm	1 each
24.	Bearing Puller (inside and outside)	200 mm	1 No. each
25.	Pipe vice Cast Iron with hardened jaw open type	100 mm	2 Nos.

26.	Scissors blade, SS	200mm	4 Nos.
27.	Scissors blade, SS	150 mm	2 Nos.
28.	Crimping Tool	1.5 sq mm to 16 sq mm	2 Nos.
		16 sq mm to 95 sq mm	2 Nos.
29.	Wire Cutter and Stripper	150 mm	4 Nos.
30.	Mallet hard wood	0.50 kg	4 Nos.
31.	Hammer Extractor type	250 grams	4 Nos.
32.	Hacksaw frame	Adjustable 300 mm Fixed 150 mm	2 Nos. each
33.	Try Square	150 mm blade	4 Nos.
34.	Outside Calliper	150 mm spring type	2 Nos.
35.	Inside Calliper	150 mm spring type	2 Nos.
36.	Divider	150 mm spring type	2 Nos.
37.	Pliers long nose insulated	150 mm	4 Nos.
38.	Pliers flat nose insulated	200 mm	4 Nos.
39.	Pliers round nose insulated	100 mm	4 Nos.
40.	Tweezers	150 mm	4 Nos.
41.	Snip Straight and Bent heavy duty	250 mm	2 Nos. each
42.	D.E. metric Spanner Double Ended	6 - 32 mm	2 Set
43.	Drill hand brace	0-100mm	4 Nos.
44.	Drill S.S. Twist block	2 mm, 5 mm and 6 mm set of 3	4 Set
45.	Plane cutters	50 mm X 200mm	2 Nos.
46.	Smoothing cutters	50 mm X 200mm	2 Nos.
47.	Gauge, wire imperial stainlees steel marked in SWG & mm	Wire Gauge - Metric	4 Nos.
48.	File flat	200 mm 2nd cut with handle	8 Nos.
49.	File half round	200 mm 2nd cut with handle	4 Nos.
50.	File round	200 mm 2nd cut with handle	4 Nos.
51.	File flat rough	150 mm with handle	4 Nos.
52.	File flat bastard	250 mm with handle	4 Nos.
53.	File flat smooth	250 mm with handle	4 Nos.
54.	File Rasp, half round	200 mm bastard with handle	4 Nos.
55.	Copper bit soldering iron.	0.25 kg	2 Nos.
56.	De soldering Gun	Heat proof nozzle, PVC type, 250mm	4 Nos.
57.	Hand Vice	50 mm jaw	4 Nos.
58.	Table Vice	100 mm jaw	8 Nos.
59.	Oil Can	250 ml	2 Nos.
60.	Contactor & auxiliary contacts	3 phase, 415 Volt, 25 Amp with 2 NO	2 Nos. each

		and 2 NC	
61.	Contactor & auxiliary contacts.	3 phase, 415 volt, 32 Amp with 2 NO and 2 NC	2 Nos. each
62.	Limit Switch	Limit Switch, Liver operated 2A 500v, 2-contacts	2 Nos.
63.	Rotary Switch	16 A/440v	2 Nos.
64.	Relay- a. Cut out Relays b. Reverse current c. Over current d. Under voltage	 a. 16A, 440V b. 16A, 440V c. 16A, 440V d. 360V-440V	2 No. each
65.	Pin Type, shackle type, egg type & suspension type insulators including hardware fitting		2 Nos. each
66.	Hydrometer		2 Nos.
67.	Hand Drill Machine	0-6 mm capacity	2 Nos.
68.	Portable Electric Drill Machine	0-12 mm capacity 750w, 240v with chuck and key	1 No.
69.	Load Bank (Lamp / heater Type)	6 KW, 3Ph	1 No.
70.	Brake Test arrangement with two spring balance rating	0 to 25 kg	1 No.
71.	Laboratory Type Induction Coil	1000 W	2 Nos.
72.	Out Side Micrometer	0 - 25 mm least count 0.01mm	2 Nos.
73.	Thermometer Digital	0° C - 150° C	1 No.
74.	Series Test Lamp	230V, 60W	4 Nos.
75.	Knife Switch DPDT fitted with fuse terminals	16 Amp	4 Nos.
76.	Knife Switch TPDT fitted with fuse terminals	16 Amp/ 440 V	4 Nos.
77.	Miniature circuit Breaker	16 amp	2 Nos.
78.	Earth Plate	60cm X 60cm X 3.15mm Copper Plate 60cm X 60cm X 6mm GI Plate	1 Each
79.	Earth Electrode	Primary Electrode 2100x28x3.25mm Secondary Cu Strip 20x5mm	1 No.
80.	MCCB	100Amps, Triple pole	1 No.
81.	ELCB and RCCB	25Amps, double pole and 25Amps, double pole, IΔn 30 mA	1 Each
82.	Fuses	HRC Glass Rewire Type	4 Each
83.	Rheostat (Sliding type)	0 - 25 Ohm, 2 Amp 0 - 300 Ohm, 2 Amp 0 -1 Ohm, 10Amp	1 No. each

		0 -10 Ohm, 5 Amp	
84.	Capacitors	Electrolytic Ceramic Polyester film Variable Dual run	2 Each
85.	Various Electronic components	Resistors, Diode, Transistor, UJT, FET, SCR, DIAC, TRAIC, IGBT, Small transformer etc.	As required
86.	Various Lamps	Halogen Incandescent Lamp Fluorescent tube HP mercury vapor Lamp High-pressure sodium Lamp Low-pressure sodium Lamp LED	1 Each
87.	Plug socket Piano Switch Lamp Holder	230 V, 5 A	2 Each
88.	Cables: Twisted Pair Non-Metallic Sheathed Cable Underground Feeder Cable Ribbon Cable Metallic Sheathed Cable Multi-Conductor Cable Coaxial Cable Direct-Buried Cable	1 mtr each	1 Each
89.	Bus bar with brackets	1 mtr each	3 Nos.
90.	Rubber mat	2’ x 4’ x 1”	2 Nos.
91.	Electrician Helmet	Yellow Colour	2 Nos.
92.	RCC Pole with accessories (MS angle iron, ‘C’ clamp, stay insulator etc.) and materials	6 Mtr	1 No.
93.	Safety Belt	Standard quality	2 Nos.
(ii) List of Equipment			
94.	Ohm Meter; Series Type & Shunt Type, portable box type	50/2000-ohm analog	2 Nos. each
95.	Digital Multi Meter	DC 200mv -1000v,0 – 10A & AC 200mv- 750v , 0-10A, resistance 0-20 MΩ and 3 1/2 digit	12 Nos.
96.	A.C. Voltmeter M.I. analog, portable box type housed in Bakelite case	Multi range 75 V - 150V - 300V - 600V	3 Nos.

97.	Milli Voltmeter centre zero analog, portable box type housed in Bakelite case	100 – 0 – 100 mV	2 Nos.
98.	Ammeter MC analog, portable box type housed in Bakelite case	0 - 500 mA, 0-5 A, 0-25 A	2 Nos. each
99.	AC Ammeter MI, analog, portable box type housed in Bakelite case	0 - 1 A, 0-5 A, 0-25 A	2 Nos. each
100.	Kilo Wattmeter Analog	0-1.5-3KW, pressure coil rating-240v/440v, current rating-5A/10A Analoge, portable type Housed in Bakelite case	2 Nos.
101.	Digital Wattmeter	230 V, 1 KW, 50 Hz	2 Nos.
102.	A.C. Energy Meter	Single Phase, 10 A, 240 V induction type	2 Nos.
103.	A.C. Energy Meter	Three Phase, 15 A , 440 V induction type	2 Nos.
104.	Power Factor Meter Digital	440 V, 20 A, Three Phase portable box type	2 Nos.
105.	Frequency Meter	45 to 55 Hz	2 Nos.
106.	Magnetic Flux Meter	0-500 tesla	2 Nos.
107.	Lux meter	lux meter LCD read out 0.05 to 7000 lumens with battery.	2 Nos.
108.	Tachometer	Analog Type - 10000 RPM	1 No.
109.	Tachometer	Digital Photo Sensor Type - 10000 RPM	1 No.
110.	Tong Tester / Clamp Meter	0 - 100 A (Digital Type)	2 Nos.
111.	Megger	Analog - 500 V	2 Nos.
112.	3- point D.C. Starter	For 2.5 KW DC motor	1 No.
113.	4- point D.C. Starter	For 2.5 KW DC motor	1 No.
114.	Wheat Stone Bridge with galvanometer and battery		2 Nos.
115.	Single Phase Variable Auto Transformer	0 - 270 V, 10Amp (Air cooled)	2 Nos.
116.	Phase Sequence Indicator	3 Phase, 415 V	2 Nos.
117.	Growler	230 V, 50 Hz, Single Phase, Adjustable jaws, Testing armature with ampere meter and testing probes.	1 No.

118.	AC Starters: - a. Resistance type starter b. Direct online Starter c. Star Delta Starter- Manual d. Star Delta Starter – Semi automatic e. Star Delta Starter – Fully automatic f. Star Delta Starter - Soft starter g. Auto Transformer type	For A.C Motors of 2 to 5 H.P.	1 No. each
119.	Oscilloscope Dual Trace	20 MHz	1 No.
120.	Function Generator	2 to 200 KHz, Sine, Square, Triangular 220 V, 50 Hz, Single Phase	1 No.
121.	Soldering Iron	25-Watt, 65 Watt and 120-Watt, 230 Volt	2 Nos. each
122.	Temperature controlled Soldering Iron	50-Watt, 230 Volt	2 Nos.
123.	Discrete Component Trainer	Discrete Component (for diode and transistor circuit) with regulated power supply +5,0- 5 V,+12 ,0-12 V	2 Nos.
124.	Linear I.C. Trainer	Linear I.C. Trainer with regulated power supply 1.2V to 15V PIC socket 16pin and 20 pins with bread board	1 No.
125.	Digital I.C. Trainer	Digital I.C. Trainer 7 segment display and bread board	1 No.
126.	Domestic Appliances –		
	a. Electric Induction plate	a. 1500 Watt, 240V	1 No. each
	b. Electric Kettle	b. 1500 Watts, 240V	
	c. Electric Iron	c. Automatic - 750 W, 240 V	
	d. Immersion Heater	d. 1500 Watt, 240V	
	e. A.C. Ceiling Fan and AC Table Fan	e. 68-Watt, 230 V	
	f. Geyser (Storage type)	f. 10 litre	
	g. Mixture & Grinder	g. 750 W, 240 V	
	h. Washing Machine Semi-Automatic	h. 5 Kg,	
	i. Motor Pump set	i. 1 HP, 1 Phase, 240 V	
127.	Oil Testing Kit	Oil Testing Kit 230 V, single phase 50 Hz 60 VA output 0-60 KV Variable	1 No.
128.	Inverter with Battery	1 KVA with 12 V Battery Input- 12 volt DC, Output- 220 volt AC	1 No.
129.	Voltage Stabilizer	AC Input - 150 - 250 V, 600 VA AC Output - 240 V, 10 A	1 No.

130.	DC Power Supply	0 - 30 V, 5 A	2 Nos.
131.	Battery Charger	0 - 6 - 9 - 12 - 24 - 48 V, 30amp	1 No.
132.	Current Transformer	415 V, 50Hz, CT Ratio 25 / 5 A, 5VA	2 Nos.
133.	Potential Transformer	415 V, 50Hz, PT Ratio, 440V/110V, 10VA	2 Nos.
134.	Solar panel with Battery	18 Watt	1 Set
135.	I 5 AND I7 COMPUTER OR latest VERSION	2.8 GHz & above, 1 GB RAM, 80 GB HDD, DVD Combo Drive, 19/21" Monitor, optical scroll mouse, multimedia keyboard, 32 bit LAN card with UPP port, necessary Drivers, etc. OR (Latest Version)	2 Nos.
136.	Ink jet/ laser printer		1 No.
C. Shop Machinery - For 4 (2+2) units no additional items are required			
137.	D.C. Shunt Generator with control panel	D.C. Shunt Generator with control panel,2.5 KW, 220V &3phase Squirrel cage Induction Motor, 5HP, 440V with control panel & star delta starter	1 No.
138.	Motor-Generator (AC to DC)	Squirrel Cage Induction Motor with star delta starter and directly coupled to DC shunt generator and switch board mounted with regulator, air breaker, ammeter, voltmeter, knife blade switches and fuses, set complete with case iron and plate, fixing bolts, foundation bolts and flexible coupling. Induction Motor rating: 7.5 HP, 415V, 50 cycles, 3 phases. DC Shunt Generator rating: 5 KW, 440V (Output voltage varies 110-440v)	1 No.
139.	D.C. Compound Generator with control panel including fitted rheostat, voltmeter, ammeter and breaker	D.C. Compound Generator with control panel including fitted rheostat, voltmeter, ammeter and breaker, 2.5 KW, 220V &3phase Squirrel cage Induction Motor, 5HP, 440V, with control panel & star delta starter	1 No.

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

153.	Diesel Generator Set with changeover switch, over current breaker and water/ air-cooled with armature, star-delta connections AC 3 phase	7.5 KVA, 415 volt or higher rating	1 No. per institute
154.	Used DC Generators-series, shunt and compound type for overhauling practice		1 No. Each
155.	Pillar Electric Drill Machine Motorized	12-20 mm Capacity, 1HP, 440V, 3 phase, Induction Motor with DOL starter, Bench Type	1 No.
156.	Motorised Bench Grinder	1 HP. 3 phase, 440V with DOL starter, Double side with smooth and rough wheel with Tool Base	1 No.
157.	A.C. Series type Motor	1 HP, 240 V, 50 Hz	1 No.
158.	Single Phase Capacitor Motor with starter switch	1 HP, 240 V, 50 Hz	1 No.
159.	Manual Motor coil Winding Machine	With step arbor	1 No.
160.	Ceiling fan coil Winding Machine	250V, 50 Hz, 1-Φ, with speed control	1 No.
161.	Primary current injection set	220V, 50 Hz, 1-Φ, output current - 200 A (min) with timer	1 No.
162.	Stepper Motor with Digital Controller		1 No.
163.	Shaded Pole Motor	Fractional HP, 240 V, 50 Hz	1 No.
164.	Smart Meter	1 Phase - Smart Energy Meter 3 Phase - Smart Energy Meter	1 No. each
165.	EV Charger	3 phase input	1 No.
166.	EV Charger (Home)	1 Phase input	1 No.
D. Shop Floor Furniture and Materials - For 2 (1+1) units no additional items are required			
167.	Working Bench	2.5 m x 1.20 m x 0.75 m	4 Nos.
168.	Wiring Board	3-meter x1 meter with 0.5 meter projection on the top	1 No.
169.	Instructor's table		1 No.
170.	Instructor's chair		2 Nos.
171.	Metal Rack	100cm x 150cm x 45cm	4 Nos.
172.	Lockers with drawers		1 for Each Trainee
173.	Almirah	2.5 m x 1.20 m x 0.5 m	1 No.
174.	Black board/white board	(minimum 4X6 feet)	1 No.
175.	Fire Extinguisher CO2	2 KG	2 Nos.
176.	Fire Buckets	Standard size	2 Nos.

Note: -

1. *All the tools and equipment are to be procured as per BIS specification.*
2. *Internet facility is desired to be provided in the class room.*

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