

CHECK LIST TO CONSIDER THE PROPOSAL FOR REVISION OF SYLLABI OF EXISTING TRADES UNDER CTS/ATS

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|--------|---|-----------------------------------|
| 1. | Name of the Trade: | Electrician |
| 2. | CTS/ATS/Both: | CTS & ATS both |
| 3(a) | Whether the action to constitute and convene the meetings of the Trade Committee has been taken by the CSTARI, Kolkata? | Yes |
| (b) | If no, reasons therefore | Does not arise |
| 4(a) | In case, the revision is being considered in respect of a trade under CTS or ATS only, Whether a corresponding trades under ATS or CTS exists. | Revised Both CTS & ATS |
| (b) | If yes, why the revision of corresponding trade under ATS or CTS is not being undertaken? | Does not arise |
| 5(a) | Is/Are there any linkage(s) of the trade under CTS with other trades under ATS by way of rebate in period of apprenticeship training? | No |
| (b) | If yes, has the Trade Committee examined the continuation of such linkages? | Does not arise |
| 6(a) | Is there any change proposed in the nomenclature of the Trade/period of training/entry qualification/rebate in period of apprenticeship training? | No |
| (b) | If yes, whether there is consistency in respect of these items between the course contents and the general information? | Does not arise |
| (c) | Whether approval of DGET has been taken for the above changes before circulating it to the members of NCVT/CAC? | Does not arise |
| (d) | Are the changes reflected correctly in the circular letter addressed to the Members of NCVT/CAC? | Does not arise |
| (e) | Are the changes being properly communicated by the CSTARI, Kolkata to The DGE&T (Hqrs) in the forwarding letter. | Does not arise |
| 7. | Whether a copy of the forwarding letter from CSTARI, Kolkata to the DGE&T (Hqrs) along with syllabus has also been encored to the DDG(AT)/Director (AT)? | Yes |
| 8. (a) | Is there a need to issue gazette notification for amendment of Apprenticeship Rules? | No |
| (b) | If yes, whether coordinated action is being taken by the CD and AP Sections for simultaneous issue of administrative instructions and gazette notification? | No |

Syllabus for the trade of

ELECTRICIAN

UNDER

CTS/ATS

REVISED IN 2006

Govt. of India
Ministry of Labour/DGE&T
Central Staff Training & Research Institute
EN Block, Sector V, Salt Lake
Kolkata-91

General Information

1. Name of the Trade	: Electrician
2. N..C.O. Code No.	: 851.10, 851.30
3. Duration of Craftsmen Training	: 2 years
4. Duration of Appr. Training	: 3 years including Basic Training of two years
5. Entry qualification	: Passed in 10 th Class Examination Under 10 + 2 system of Education with Science as one of the subject or its equivalent
6. Rebate of Ex-craftsmen Trainee	: 2 years for NTC (Electrician)
7. Ratio of Apprentice of Workers	: 1 : 7

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SYLLABUS FOR THE TRADE OF ELECTRICIAN UNDER CTS -- DURATION 2 YEARS

Week No.	Trade Theory	Trade Practical	Engineering Drawing	Workshop Calculation & Science
1	2	3	4	5
1	Various safety measures involved in the Industry. Elementary first Aid. Concept of Standard	Implementation in the shop floor of the various safety measures. Visit to the different sections of the Institute Demonstration on elementary first aid. Artificial Respiration	Definition of Engineering Drawing. Uses of Engineering Drawing. Freehand sketching of straight lines, rectangles, squares circle, polygons etc.	Units – Definition, different types & system of units, F.P.S., C.G.S & S.I - conversion.
2	Identification of Trade-Hand tools-Specifications	Demonstration of Trade hand tools. Identification of simple types- screws, nuts & bolts, chassis, clamps, rivets etc. Use, care & maintenance of various hand tools.	Geometrical construction of Square, Rectangle, Triangle, Circle, Ellipse, Polygons, etc.	Applied workshop problems involving addition, subtraction, multiplication and division. Different types of materials used in industry, their uses & properties.
3 & 4	Fundamental of electricity. Electron theory- free electron . Fundamental terms, definitions, units & effects of electric current	Practice in using cutting pliers, screw drivers etc. skinning the cables, and joint practice on single strand. Demonstration & Practice on bare conductors joints--such as Britannia, straight , Tee, Western union. Joints	Do	Applied workshop problems involving common fractions.. Application of fraction to shop problems. Properties and uses of copper, zinc, lead, tin, aluminium, brass, bronze, solder , bearing metals, timber, rubber.
5	Solders, flux and soldering technique. Resistors types of resistors & properties of resistors.	Practice in soldering- Measurement of Resistant and Measurement of specific Resistant. Application of Wheatstone bridge in measurement of Resistance	Lettering practice	Different types of Insulators used in Electrical industry Mass and Weight – Difference between mass and weight.

				Specific Gravity & Density – Related problems. Archimedes principle. Relation between Sp. Gravity and density.
6	Explanation, Definition and properties of conductors, insulators and semi-conductors. Voltage grading of different types of Insulators, Temp. Rise permissible Types of wires & cables standard wire gauge Specification of wires & Cables- insulation & voltage grades -Low , medium & high voltage Precautions in using various types of cables	Demonstration and identification of types of cables. Demonstration & practice on using standard wire gauge. Practice on crimping thimbles, Lugs. Examination and checking of cables and conductors and verification of materials according to the span.	Different types of line. Drawing of different types of line.	Rounding of decimal values use of approximation. Speed, Velocity, Acceleration, Retardation, Equations of motions – related simple problems Properties & uses of cast iron, wrought iron, plain carbon steel, etc.
7	Ohm's Law - Simple electrical circuits and problems. Resistors -Law of Resistance. Series and parallel circuits. Kirchoff's Laws and applications. Wheatstone bridge principle and its applications .	Verification of Ohm's Law, Verification of Kirchoff's Laws. Verification of laws of series and parallel circuits. Verification of open circuit and closed circuit network. Measuring unknown resistance using Wheatstone bridge.	1st angle projection, 3rd angle projection. Orthographic views, Isometric views.	Reduction of common fractions to decimal and vice-versa - related shop problems. Momentum of a moving body. Force, Its units in SI & FPS Systems
8.	Common Electrical Accessories, their specifications-Explanation of switches lamp holders, plugs and sockets .Developments of domestic ckts, Alarm & switches, lamp, fan with individual switches, Two way switch .	Practice on installation and overhauling common electrical accessories. Fixing of switches, holder plugs etc. in T.W. boards. -Identification and use of wiring accessories.	Drawing of plan, elevation & side views from isometric views.	L.C.M., H.C.F. Square roots & Cube roots Newton's Laws of motion and related problems.

Achievements: The trainees should be able to make simple wiring circuits with common electrical accessories with domestic electrical Appliances for a specified voltage and current.

9	<p>Chemical effect of electric current-Principle of electrolysis. Faraday's Law of electrolysis. Basic principles of Electro-plating and Electro chemical equivalents. Explanation of Anodes and cathodes. Lead acid cell-description, methods of charging-Precautions to be taken & testing equipment, Ni-cadmium & Lithium cell, Cathodic protection. Electroplating, Anodising.</p>	<p>Assembly of a Dry cell-Electrodes-Electrolytes. Grouping of Dry cells for a specified voltage and current, Ni cadmium & Lithium cell. Practice on Battery Charging, Preparation of battery charging, Testing of cells, Installation of batteries, Charging of batteries by different methods.</p> <p>Practice on Electroplating and anodising, Cathodic protection.</p>	Do	<p>Factorisation, Simple algebraic problems</p> <p>Laws of parallelogram of forces.</p>
10	<p>Rechargeable dry cell, description advantages and disadvantages. Care and maintenance of cells Grouping of cells of specified voltage & current, Sealed Maintenance free Batteries, Solar cell.</p>	<p>Routine care & maintenance of Batteries</p>	<p>Dimensioning practice on orthographic views</p>	<p>Ratio & proportion, related shop problems.</p> <p>Friction, Laws of friction, co-efficient of friction, angle of friction, simple problems related to friction.</p>
11	<p>Lead Acid cell, general defects & remedies. Nickel Alkali Cell-description charging. Power & capacity of cells. Efficiency of cells</p>	<p>Charging of a Lead acid cell, filling of electrolytes- Testing of charging checking of discharged and fully charged battery</p>	<p>Conventional symbols of Electrical installation as per BIS code & IEEE, IES norms Drawings of the typical diagram of plug and socket outlets. Graphical symbols used in electric technology, ckt. Elements.</p>	<p>Average and related shop problems.</p> <p>Work, Power & Energy – Their units and related problems.</p>

Achievement: Trainees should be able to carry out the necessary steps for charging secondary batteries individually, Installation and Grouping of Batteries, Care and Maintenance of batteries.

12	<u>ALLIED TRADES:</u> Marking use of chisels and hacksaw on flats, sheet metal filing practice, filing true to line.	Introduction of fitting trade. Safety precautions to be observed Description of files, hammers, chisels, hacksaw frames & blades-their specification & grades. Care & maintenance of steel rule try square and files.	Drawing the typical diagram of D-type cartridge fuse, H.R.C. type fuse. Fuse curves Graphics as per relevant IS standard. Symbols indicating the method of operation of the instrument and accessories as per relevant IS: Standard	Factorisation of polynomials. (Simple problems). Rotational motion. Angular velocity and acceleration.
13	Sawing and planing practice. Practice in using firmer chisel and preparing simple half lap joint.	Marking tools description & use. Description of carpenter's common hand tools such as saws planes, chisels mallet claw hammer, marking, dividing & holding tools-their care and maintenance.	Simple isometric drawings, isometric views of simple objects- cubes, rectangular blocks etc.	Square roots & Cube roots by the method of factorisation. Centrifugal & Centripetal forces. Related problems.
14	Drilling practice in hand drilling & power drilling machines. Grinding of drill bits.	Types of drills description & drilling machines, proper use, care and maintenance.	Free hand sketching of nuts & bolts with dimensions from samples.	Standard algebraic formula and related problems. Moment of a force.
15	Practice in using taps & dies, threading hexagonal & square nuts etc. cutting external threads on stud and on pipes, riveting practice.	Description of taps & dies, types in rivets & riveted joints. Use of thread gauge.	Free hand sketching of rivets and washers with dimensions from samples.	- Do - Couple and Torque. Related problems
16	Practice in using snips, marking & cutting of straight & curved pieces in sheet metals. Bending the edges of sheets metals. Riveting practice in sheet metal. Practice in making different joints in sheet metal in soldering the joints.	Description of marking & cutting tools such as snubs shears punches & other tools like hammers, mallets etc. used by sheet metal workers. Types of soldering irons-their proper uses. Use of different bench tools used by sheet metal worker. Soldering materials, fluxes and process.	Free hand sketching of keys with dimensions from samples. Free hand sketching of screw threads with dimensions from samples.	Percentage and related shop problems Moment of Inertia, Radius of gyration. Mechanical properties of metals – tenacity, elasticity, malleability, brittleness, hardness, compressibility and ductility, etc

Achievements:

1. The trainee should be able to mark according to, the given sketch, to file the given job with an accuracy of + 0.25 mm, be able to drill and Tap hole.
2. Should be able to use simple carpenter's hand tools.
3. Should be able to use simple sheet metal workers hand tools.

17-18	<p>Magnetism - classification of magnets, methods of magnetising, magnetic materials. Properties, care & maintenance, methods of magnetising magnetic materials. Para & Diamagnetism and Ferro magnetic materials.</p> <p>Principle of electro-magnetism, Maxwell's corkscrew rule, Fleming's left & right hand rules, Magnetic field of current carrying conductors, loop & solenoid.</p> <p>MMF, Flux density, reluctance. B.H. curve, Hysteresis, Eddy current. Principle of electro-magnetic Induction, Faraday's Law, Lenz's Law.</p> <p>Electrostatics - Capacitor- Different types, functions & uses.</p>	<p>Demonstration on-CRO – The magnetic flux produced by Electromagnet, Demonstration on Tracing the B-H Curve & Hysteresis loop for a specimen using C.R.O and using samples of CRGO & Dynamo grade.</p> <p>Demonstration on effect of eddy current on different samples.</p> <p>Assembly / winding of a simple electro magnet</p> <p>Identification of different types of Capacitors. Charging & discharging of capacitor, Testing of Capacitors using DC voltage and lamp.</p>	<p>Draw the typical symbols used in electrical circuits. Graphical symbols used in electro technology, kinds of distribution systems and methods of connections.</p>	<p>Solving of Quadratic equations.</p> <p>Simple problems on moment of Inertia.</p>
19	<p>Resistance- Different Types of resistors used in electrical ckts. Specification of resistance and tolerance.</p> <p>Effect of variation of temperature on resistance. Different methods of measuring the values of resistance.</p>	<p>Measurement of resistance by different methods- a) Using Wheatstone Bridge b) By voltage drop method.</p> <p>Experiment to demonstrate the variation of resistance of a metal with the change of temperature.</p> <p>-Measure of 'R' by drop method.</p> <p>-Series & shunt ckts-use of Multimeter.</p>	Do.	<p>Simple Problems on Profit & Loss.</p> <p>Levers – its different types and their advantages. Simple related problems.</p>

20-21	Working principles and circuits of common domestic equipments & appliances	<p>Connection of Calling Bell, Buzzer, Alarms, Electric Iron, Heater, Light & Fan etc.</p> <p>Rewinding /assembly of different electrical appliances. Study, maintenance and repair of domestic equipment –</p> <p>Electric Kettle</p> <p>-do- Heater / immersion Heater</p> <p>-do- Hot Plate</p> <p>-do- geyser</p> <p>-do- washing machine</p> <p>-do- Cooking range</p> <p>-do- incubators</p> <p>-do- Furnaces</p> <p>-do- Pump set. Etc.</p>	Detailed diagram of calling bell electromagnet etc	<p>Simple Problems on Profit & Loss.</p> <p>Mechanical advantage, Velocity ratio, Efficiency of different types of levers.</p>
22-23	<p>D.C. Machines - General concept of Electrical Machines. Principle of D.C. generator. Use of Armature, Field Coil, Yoke, and Commutator, slip ring Brushes, Laminated core.</p> <p>Explanation of D.C. Generators-types –parts. E.M.F. equation-self excitation and separately excited Generators-Practical uses. Brief description of series, shunt and compound generators.</p>	<p>Identification and study of the parts of a D.C.machine.</p> <p>Practicing dismantling and assembling in D.C. Machine.</p>	<p>Sketching of brush and brush gear of D.C. machines.</p> <p>Lay out D.C. Panel board arrangement.</p> <p>Lettering-Numbers Alphabets.</p> <p>Sketching of D.C. 3-point face Plate starter top scale.</p>	<p>MENSURATION – Perimeter and Area of Square & Rectangle.</p> <p>Simple problems on straight and bell cranked levers.</p>
24	Expl. Of Armature reaction, interpoles and their uses, connection of interpoles, commutation.	<p>-Connection of shunts Generators, Measurement of voltages-Demonstration on field excitation.</p> <p>- -Connection of compound Generator-Voltage measurement-cumulative and differential –</p> <p>No Load & Load characteristics of Series, Shunt & Compound Generator.</p> <p>Controlling and protecting DC Generator.</p>	Graphic symbols for Rotating m/cs and Transformers.	<p>Perimeter and Area of Triangle.</p> <p>Simple machines - Determination of efficiency of simple m/cs. Like winch, pulley blocks, wheel and compound axle.</p>

25	DC Motors - Terms used in D.C. motor-Torque, speed, Back-e.m.f. etc. their relations practical application. Related problems	Demonstration and practice on identification of parts and terminals. Study of the characteristics of DC motors.	-do-	- do -
26-27	Types, characteristics and practical application of D.C. motors. Special precaution to be taken in DC Series motors. Starters used in D.C. motors	-Study of 3 point & 4 point starters. -Connection, starting, running, speed control of motors. Testing of D.C. motors.	Reading of simple blue prints.	Circumference and area of Circle. Transmission of motion through Belt, Pulley, Gears, etc. and related problems.
28-29	Types of speed control of DC motors in industry Word-Leonard control, Thyristor/electronic controls.	Study of Thyristor/electronic control of DC motor. -Routine maintenance.	Free hand isometric sketching of simple objects with dimensions. Sketching of D.C. - 4-point starter to scale.	Calculation of Volume and weight of simple solid bodies- Cubes, Cuboids, solid and hollow cylinders and related shop problems.

- Achievement:**
1. Should be able to identify D.C. M/cs, measure resistance.
 2. Should be able to build up voltage in a D.C. Generator
 3. Should be able to connect, test and run a D.C. motor and reverse its direction of rotation by a starter.

30	Insulating materials – properties common insulating materials, classifications	Use of megger and HV tester	Do	- Do –
31-32	Electric wirings , importance, I.E.E. rules. Types of wirings both domestic & industrial - Specifications for wiring – Grading of cables and current ratings. Principle of laying out in domestic wiring-testing by meggar Wiring system - Using casing	-Practice in casing, Capping. Conduit wiring with minimum to more number of point. -Use of two way switches -Testing of insulation by two lamp method & meggar. -Fixing of calling bells/buzzers. -Making of test boards & extension boards IS-732-1963/61	Free hand sketching of simple objects. Layout arrangement of D.C. Generators & motors, control panel	Trigonometry functions & Ratios .Use of trigonometric tables-Applied problems. Definition of Stress, Strain, Young’s modulus, Bulk modulus, Factor of safety – Their related problems. Effect of force on materials such as expanding, bending,

	capping, P.V.C., concealed system. -Maintenance & Repairing data sheet preparation.. Specifications, standards for conduits & accessories	Identification & demonstration on conduits and accessories & their uses, cutting , threading & laying,		twisting and shearing.
33 & 34	Earthing - Principle of different methods of earthing. Importance of Earthing. -Earth Leakage Relay.	Earthing – Practice on installation of earthing system and testing of earthing system. -Using an Earth Leakage Relay .	Free hand sketching of Staircase wiring.	Simple problems on Heights & Distances using trigonometric ratios. Heat and temperature, Thermometric scales- centigrade, Fahrenheit & Kelvin scale and their conversion. Names and uses of temperature measuring instruments used in workshop.

Achievement: Should be able to carryout simple wiring ckts. Earthing installation , Undertake, laying of domestic wirings.

35 - 37	<p>Alternating Current - Comparison D.C& A.C. , Advantages of A.C. Alternating current & related terms frequency Instantaneous value, R.M.S. value Average value, Peak factor , form factor. Generation of sine wave, phase and phase difference. Inductive & Capacitive reactance X_L & X_C, Impedance (Z), power factor,(P.f) ; Vector diagram. Active and Reactive power, Simple problems on A.C. circuits, single phase & three-phase system etc.</p> <p>Problems on A.C. ckts. Both series & parallel power consumption P.F. etc.</p> <p>Concept three-phase Star & Delta connection Line voltage & phase voltage, current & power in a 3 ph ckt, with balanced and unbalanced load.</p>	<p>Demonstration of sine wave, instantaneous values etc. Study of the behaviour of R, X_L & X_C in A.C. ckts both in series and in parallel. Experiment on poly phase ckts. Current, voltage & power measurement in poly-phase ckts.</p> <p>Measurement of energy in single & poly-phase ckts.</p> <ul style="list-style-type: none"> - Use of phase sequence meter. - Use of single phase preventor 	<p>Free hand sketching of simple Geometrical shapes & hollow shapes. Drawing of simple electrical ckts. Using electrical symbols. View of simple solid & hollow bodies. Drawing of sine waves. Views of simple solid and hollow bodies' ckt. Diagram of battery charging ckts. With all Details of panel board. Blue print reading.</p>	<p>Calculation of areas of triangles, etc. with the aid of trigonometry.</p> <p>Calorimetry, Latent Heat – Their related problems.</p>
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38 to 41	<p><u>TRANSFORMERS</u></p> <p>Working principle of Transformer, classification C.T., P.T. Instrument and Auto Transformer/Variac Construction, Single phase and Poly phase.</p> <p>E.M.F. equation, parallel operation of transformer, their connections. Regulation and efficiency, Cooling of transformer, protective devices.</p> <p>Specifications, simple problems on e.m.f. Equation, turn ratio, regulations and efficiency. Special transformers.</p> <p>Transformer - construction cores winding shielding, auxiliary parts breather, conservator buckholtz relay, other protective devices cooling of transformer Transformer oil testing and Tap changing off load and on load. Transformer bushings and termination.</p>	<p>Identification of types of transformers. Connection of transformers efficiencies of transformers testing of transformer parallel operation of transformer . Use of C.T. & P.T. use of Instrument transformer.</p> <p>1. Conducting No-load and short circuit tests.</p> <p>Testing of single phase and Three Phase. Transformers - Cleaning and maintenance of Transformers, Changing of oil,</p>	<p>Exercises on Blue print reading of connection to motors through Ammeter, voltmeter & K.W. meters. Exercises on Blue print reading, tracing the wiring diagram of an alternator & reproducing it in proper sequence with protective equipment sketching the synchroniser connections.</p> <p>Free hand sketching of simple objects related to the trades.</p>	<p>Use of trigonometric formulae and applied problems.</p> <p>Expansion of Solid, Liquid and Gases – Their related problems.</p>
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42 - 44	<p>ALTERNATOR – Explanation of alternator, prime mover, types, regulations, phase sequence, specification of alternators and brushless alternator. Automatic Voltage Regulator.</p>	<p>Demonstration on alternators, voltage Building, load characters & regulation.</p> <p>Practice on installation, running and maintenance of Alternators.</p>	<p>Diagram of connection to a squirrel cage induction motor.</p> <p>Sketching the connection diagram of controlling & protective devices for Induction motors.</p> <p>Development of winding diagram for a two-pole D.C. dynamo or motor. Preparation of working drawing from sketches.</p>	<p>Drawing & reading of simple graphs.</p> <p>Transmission of heat - Conduction, Convection and Radiation.</p>
45-47	<p>Electrical measuring Instruments - -types Deflecting torque, Controlling torque & Damping torque , -Moving coil permanent magnet -Moving iron -Range extension -Multimeter -Wattmeter - P.F. meter -Intergrading type, Digital Energy meter – megger. -Energy meter -Frequency meter - Tri vector meter -Max Demand meter -Phase Sequence indicator -Multimeter –Analog and Digital - C.R.O,</p>	<p>-Study of M.C.P.M. meter</p> <p>-do-Multimeter -do-Wattmeter, P F meter -do- Energy meter -do- Frequency meter -do-Calibration of meter -do-Multimeter -do- C.R.O. -do- Maximum Demand meter -do- Phase sequence indicator -do- Digital Instruments</p>	<p>Sketching of simple objects related to trades. Sketching of different shapes of coil. Further practice in Blue print reading. Drawing development diagram for single-phase A.C. motors.</p>	<p>Logarithms- Use of Logarithmic tables for multiplication & division.</p> <p>Different forms of energy, Thermal, mechanical and electrical, conversion from one to another.</p>

48-49	<p>Explanation of light White light-illumination factors, intensity of light –importance of light, human eye factor units. Types illumination & lamps -Neon sign Halogen, Mercury vapour, sodium vapour, Fluorescent tube CFL, Solar lamp applications, Concept of Energy -Characters watt ages, fixing places. Types of lighting. Decoration lighting Drum Switches, Direct & indirect lighting-efficiency in lumens per watt, colour available. Thumb rule calculations of lumens. Estimating placement of lights and fans and ratings.</p>	<p>Installation of - -do- Neon Sign -do-Mercury vapour (H.P. & L.P.) -do- Sodium vapour -do- Halogen Lamps -do- single tube, Double tube</p> <p>Practice on decoration lighting Principle of layout of lighting installation.</p>	<p>Drawing the development diagram for D.C. Simplex Lap & Wave winding</p>	<p>Applied workshop problems involving, use of Logarithmic tables.</p>
50	REVISION & INDUSTRIAL TOUR			
51- 52	TEST			

Achievements:

1. The trainees should be able to install and connect Transformers, parallel connection, carry out necessary maintenance, able to connect and use CT & PT.
2. Able to carry out installation, Running and maintenance of Alternators.
3. Able to install different instruments for measurement of Voltage, Current, Power, Power factor and Energy ,etc.
4. Able to use Analog and Digital Multimeter, C.R.O.
5. Able to install Fluorescent lamp, Sodium Vapour Lamp, Neon Sign, Decorative Lights.

SECOND YEAR –

53-54	TRANSFORMER – winding , Principle of different winding techniques	Practice on winding of Transformers of different types and ratings.	Practice in reading panel diagram. Practice in reading ckts Containing Resistance, inductances Practice in reading typical example of ckts containing R,X & C.	Practice in the use of Logarithmic tables for multiplication, division square root, cube root. Insulating material including transformer oil.
55-56	D.C. m/c Winding-- pole pitch, coil pitch, back pitch, front pitch , Lap & Wave winding , Progressive and retrogressive winding.	Practice on different types of winding ,Growler testing , Baking , Impregnation and Varnishing .Testing for faults .	Further practice in Blue Print reading, drawing the development diagram for simple lap and wave winding.	Calculation of Volume, weight of simple solid bodies by using Logarithm. Further problems on mensuration. Insulating materials synthetic. Brief description and properties of electrical materials such as silicon, Nichrome, silver etc.
57-58	SYNCHRONOUS MOTOR - Working principle, effect of change of excitation and load. Application in industry in power factor improvement.	Practice on starting ,running, connection to bus bar, - Study on effect of changing the field excitation and Power factor correction of Industrial load.	Tracing of wiring diagram of an alternator and reproducing it.	Properties of triangles and circles, tangent, etc. Insulating materials synthetic. Brief description and properties of electrical materials such as silicon, Nichrome, silver etc.
<p>Achievements:</p> <ol style="list-style-type: none"> 1) Carryout simple winding, re-winding of detected faults in Transformers, D.C. M/c's. 2) Able to install starting and running D.C. motors, Synchronous motors, Power facto corrections. 				

59 - 61	<p>Induction motor – Working principle, Squirrel Cage Induction motor , Slip-ring induction motor- Construction and characteristics, starting and speed control.</p> <p>D.O.L Starter, Star /Delta starter, Autotransformer starter.</p> <p>Single phase induction motor- Working principle, different method of starting and running (capacitor start/capacitor run, shaded pole technique). FHP motors.</p>	<p>Induction Motors - Study of Squirrel cage and Slip ring Induction motor , Measurement of slip, P.F. at various loads.</p> <p>Practice on connection of D.O.L Starter, Star /Delta starter, Autotransformer starter, And starting, running & speed control.</p> <p>Connection of single phase motor, identification, testing, running, and reversing.</p>	<p>Drawing the schematic diagram of automatic voltage regulators of A.C. generators. Drawing the schematic diagram of A.C. 3-ph reversing magnetic starter.</p> <p>Sketching a breather.</p> <p>Free hand sketching of transformer and auxiliary parts and sectional views.</p>	<p>Problems on mensuration related to solid bodies of Prism, Pyramid, Sphere, etc.</p> <p>Forms and properties of matter. The molecule and atoms.</p>
62-63	<p>A.C. m/c Winding-- Armature winding terms, coil side, end coil and grouping of coils. Connection to adjacent poles, connected armature winding, alternate pole connection, armature winding.</p>	<p>Making forma, coil insulation, Slot insulation, Insertion of coils in slots, coil connection, Practice on single layer concentric Winding, Baking, impregnating and varnishing.</p>	<p>Drawing the schematic diagram of the starting and controlling gears of slipring and Sq. cage Ind. Motor. IS. 3914 – 1967</p> <p>Drawing the schematic diagram of Autotransformer starter, Push button starter and Star Delta Starter.</p>	<p>Trigonometric function Use of trigonometric tables-applied problems-Calculation of areas of triangles and polygons. Problems on Mensuration.</p> <p>Atmospheric pressure, pressure gauge and absolute pressure.</p>
64	<p>Universal motor-advantages Principle, characteristics, applications in domestic appliances and industry, Fault Location and Rectification.</p>	<p>Identification, connection, testing, running and reversing of universal motor.</p> <p>Practice of winding / rewinding.</p>	<p>Drawing the schematic diagram of plow and pipe earthing I.S.3043.</p> <p>Wiring diagram of the connection of arrangement and push button control of two speed AC motor. IS : 3914 – 1967.</p>	<p>Simple problems involving Trigonometric function.</p>

65	Converter -inverter, M.G.Set- description-Characteristics, specifications-running and maintenance.	Starting, running and building up voltage and loading of M-G set. Maintenance of M-G Sets.	Drawing the schematic diagram of 4 typical D.C. speed regulators for shunt and compound motors. -do- Magnetic controller with dynamic breaking.	Laws of Indices and related problems Inclined plane, Parallelogram laws of Forces – their related problems.
Achievements:-				
<ol style="list-style-type: none"> 1. Should be able to install different induction motors along with DOL / Star Delta starters. 2. Should be able to starting, running and Speed control of different types of induction motors. 3. Should be able to carry out wiring, rewinding of single phase and three phase induction motors. 4. Should be able to carry out wiring, rewinding of Universal motors. 5. Should be able to installation, starting, running and maintenance of M.G.Set 				
66-67	Techniques, procedures of Layout of conduit wiring as per I.S-732- 1963. Use of flame proof and explosion proof, Installation of P.V.C. conduct switches.	Practice on Installation of conduit pipe wiring for lighting and power circuits for both 230V & 400V.	Schematic diagram of magnetically rated. D.C. motors with three-push bottom control station. -do- Lumina sent Lamps.	Further problems on mensuration. Heat treatment processes.
68-69	Fuse / cut out / kit Kat – function, characteristics, and materials. H.R.C Fuses – application. Contactors – Miniature circuit breakers. Relays – Thermal, Electromagnetic, solid state relays, Control Relays and Protective Relays.	Study of fuses. Study of contactors, MCB. Study of relays of different types.	Sketching indicating instruments. Drawing the diagram of typical marking plate of a distribution transformer. Typical wiring diagram for drum and controller operation of A.C. wound rotor motor.	Resolution and composition of forces. Representation of force by vectors, simple problems on lifting tackles like jib wall, crane-Solution of problems with the aid of vectors.
70-75	Industrial wiring. Code of practice & relevant span. Wiring of electric motors, control panel, etc. Types, specifications, advantages of different types of circuit brackets construction and maintenance. I.E.E. rules for overhead service lines, study of U.G.Cables and laying techniques.	Practice on wiring of electric motor, control panel, etc. Study of different circuit Breakers. Laying and installation of overhead and underground cables. Protective and control relays, contactors, circuit breaker, etc.	Layout diagram of a substation. Sketching different shapes of coils, Sketches indicating possible faults in stator winding. Drawing the development diagram for dupler lap and wave winding with brush	Examples of simply supported Load. General condition of equilibriums for series of forces on a body.

	Working principle and construction of domestic and agricultural appliances-their maintenance.		position.	
76	Corona, Lightning arrestor/lighting conductor, Horn gap.	Practice of fixing lightening arrestors and lightening conductors, Horn gap.	Single line diagram of substation feeders. Connection diagram of typical overload current relays. Key diagram of a power station. Central controlling panel.	Centre of gravity simple experiments, stable, unstable and neutral equilibrium.
<p>Achievement: 1. Should be able to carry out wiring of contactors, relays, circuit breakers, control panel, wiring of Industrial / Domestic equipments. 2. Should be able to carry out installation of lighting arrestor, Horn gap, etc.</p>				
77	Introduction to Basic electronics - Semiconductor energy level atomic structure. 'P' & 'N' type of materials – P-N-junction. Diode-classification of Diodes – Reversed Bias and Forward Bias , Heat sink. Specification of Diode – PIV rating.	Identification of semiconductors. Diodes-symbol - Tests on Diodes. Studying the Characteristics of Diodes using multimeter. I.S. 2032 of VIII 1965.	Drawing D.I.S. symbols for electronic components. DIODE, TRANSISTOR Zener diode, S.C.R. I.C. etc.	Mechanical advantages velocity ratio, ratio, efficiency of simple pulley wheel screw jack and winch. Simple harmonic motion – motion of a pendulum, spring, vibrating body .
78-80	Explanation and importance of D.C. Rectifier ckt. Half wave, Full wave and Bridge ckt. L.E.D. and Solar cells. Filter ckts-passive filter. Working principle and uses of an oscilloscope.	Study of Half wave rectifier ckt. -do- Full " " -do- Bridge " " -do- Filter ckts -do- Oscilloscope -do- Different wave shapes and their values using C.R.O.	Filling of m/cs history card and maintenance cards and inventory control cards.	Simple estimation of the requirement of materials etc. as applicable to the trade. Problems on estimation and costing.
81-82	Explanation of principle of working of a transistor- Types of transistors Characters of a transistors Biasing of transistors. Mode of use of transistor. Specification and rating of transistors	Study of a transistors -Identification of construction and terminals. -Testing of Transistors Study of the characters of transistors.	Drawing of B.I.S/I.S.I. symbols for Electronic devices Drawing of half wave, Full wave and Bridge ckts.	-do-

83-84	Explanation of transistor Amplifiers, Amplifiers. – class A,B & C Power amplifier.	Assembly and testing of a single stage Amplifier and checking in an oscilloscope. Study of types of wave shapes. -do- Cascade Amplifier. Study of power amplifier. Uses of standard I.C Amplifier 810	Drawing ckts for a single stage Amplifiers and Multi stage Amplifies and types of signals.	Magnetism , Magnetic material, magnetic field, flux density, magnetic moment, permeability, Susceptibility, electro magnet (solenoid) – practical applications.
85	Explanation of oscillator-working principle Explanation of stages and types. Multivibrator – applications.	Study of oscillator circuit Voltage measurement current And study wave shapes in scope.	-do-	-do-
86	OP-AMP – Working principles and applications. Timer I.C.555	Study of various Op. Amp. Application and Timers.	- do -	Electricity, Effects of electric current.
87-89	Explanation. and working principle and practical applications of U.J.T., F.E.T., S.C.R. Diac, Triac, power MOSFET, G.T.O & I.G.B.T.	Studies of simple ckts containing U.J.T. for triggering. -do- FET as an amplifier. -do- Power control ckts by S.C.R. & Diac, triac, I.G.B.T.	Drawing of ckts containing U.J.T. F.E.T. & Simple power control ckts.	-do-
90	D.C/A.C Power control using power transistor, thyristor. Voltage stabilizer, U.P.S. DC/AC motor drives using transistor/thyristor.	Demonstration on DC/AC power control using transistor/thyristor. Study of voltage stabilizer, UPS. Study of DC/AC motor drives, speed control etc. Uses of SCR and other modern semiconductor devices in controlling speed of motors and in changing the direction of rotation of motors.		Meaning of Horse Power & Brake horsepower. Simple problems on work, power & energy.
91-92	Power Supply Stabilizer, Ferro resistant circuit. DC/AC motor drives using Thyristor/Transistor control.	Demonstration on power supply stabilizer. Study Op DC. /AC. Motor Drives.	-do-	Rectifier,Maximum,Average, R.M.S. current in rectifiers, from factor, ripple factor.
93-94	Digital Electronics -Binary numbers, logic gates and combinational ckts, Flip Flops, Counter, Register & Timer.	Study of Logic gates and ckts. Flip Flops, Counter, Register & Timer. Using digital I.C. chips	Free hand drawing of Logic gates and circuits.	Number system decimal and binary, Hexa decimal. BCD code, conversation from decimal to binary and vice-versa.

Achievement: Should be able to assemble, test and rectify the faults of simple Electronic Circuits - power supply ckts, amplifiers and control ckts, Motor Drives.				
95-96	Complete House-wiring layout. Circuit splitting load wire. I.E.E. Rules. Multistoried system. Fault finding and trouble shooting of domestic electrical appliances.	Practice in wiring and in maintenance of institute and hostel , hotel, residential building. Layout and repairing of workshop electrical installation. Practice on Auto wiring.	Drawing of simple lap and wave winding.	-do-
97	Decorative lighting - Fault finding techniques in Decoration lighting.	Installation Fault finding practice	-do-	-do-
98	I N D U S T R I A L V I S I T & S T U D Y T O U R			
99-100	Fault Finding in simple Electronic ckts. & Controls attached in the electrical controls.			
101 – 103	R E V I S I O N			
104	T E S T			
Final achievement: 1) Carryout wiring for lighting and power as per I.E. rules and test in residential buildings, Workshops. 2) Connect, run, test and rectify the faults of electrical appliances / Installations. 3) Traces the faults and rectify them of the Auto Wirings. 4) To identify and trace the simple electronic ckts, test them and replace the faulty components. 5) Carryout commercial lighting for decoration etc.				

SOCIAL STUDIES - The syllabus is already approved and common for all trades.



LIST OF TOOLS & EQUIPMENT FOR THE TRADE OF ELECTRICIAN

(For the batch of 16 trainees)

Sl. No.	Items	Quantity
<u>TOOL KIT</u>		
1.	Rule wooden 4 fold 60 mm	16
2.	Plier insulated 150 mm	16
3.	Plier side cutting 150 mm	16
4.	Screw driver 100 mm	16
5.	Screw driver 150 mm	16
6.	Electrician connector, screw driver 100 mm insulated handle thin stem	16
7.	Heavy duty screw driver 200 mm	16
8.	Electrician screw driver 250 mm thin stem insulated handle	16
9.	Punch centre 150 mm X 9 mm	16
10.	Knife double bladed Electrician	16
11.	Neon Tester	16
12.	Rule steel 300 mm	16
13.	Saw tenon 250 mm	16
14.	Hammer, cross peen 115 grams with handle	16
15.	Hammer ball peen 0.75 kg. With handle	16
16.	Firmer chisel wood 12 mm	16
17.	Gimlet 6 mm.	16
18.	Bradwal	16
19.	Scriber 150 mm X Ø 4 mm (Knurled centre position)	16
20.	Pincer 150 mm	16

SHOP TOOLS, INSTRUMENTS & MACHINERY

1.	C. Clamp 200 mm, 150 mm and 100 mm.	2 nos. each
2.	Spanner 150 mm adjustable 15 degree	2 nos.
3.	Blow lamp 0.5 litre	2 nos.
4.	Melting pot	1 no
5.	Ladle	2 nos.
6.	Chisel cold firmer 25 mm X 200 mm	2 nos.
7.	Chisel 25 mm & 6 mm	4 nos.
8.	Drill Machine hand 0 to 6 mm capacity	1 no
9.	Electric drill machine portable 6 mm capacity	1 no
10.	Pillar electric drill machine 12 mm capacity	1 no
11.	Allen key	1 set
12.	Oil can 0.12 litre	2 nos.
13.	Grease gun	1 no
14.	Out side micrometer 0 to 25 mm	1 no
15.	Bench grinder motorised	1 no
16.	Rawl plug tool & bit	2 set
17.	Pulley puller	1 no
18.	Bearing puller	1 no
19.	Hygrometer	2 set
20.	Thermometer 0 to 100 deg. centigrade	1 no
21.	Scissors blade 150 mm	4 nos.
22.	Crimping tool	1 set
23.	Wire stripper 20 cm	1 no.
24.	Chisel cold flat 12 mm	4 nos.
25.	Mallet hard wood 0.50 kg.	4 nos.

26.	Hammer Exeter type 0. 40 kg.	8 nos.
27.	Hacksaw frame 200 mm, 300 mm adjustable	4 nos. (2 each)
28.	Square try 150 mm blade	4 nos.
29.	Divider 150 mm, outside & inside calliper	2 each
30.	Plier flat nose 100 mm	4 nos.
31.	Plier gas round nose 100 mm	4 nos.
32.	Plier Gas 150 mm	4 nos.
33.	Tweezers 100 mm	4 nos.
34.	Snip straight 150 mm	2 nos.
35.	Snip bent 150 mm	2 nos.
36.	Spanner D.E. metric standard set	2 nos.
37.	Drill hand brace 0 to 100 mm	4 nos.
38.	Drill S.S. Twist block 2 mm, 5 mm 6 mm set of 3	4 sets.
39.	Plane, smoothing cutters, 50 mm	4 nos.
40.	Gauge, wire imperial	2 nos.
41.	File flat 200 mm 2 nd cut	8 nos.
42.	File half round 200 mm 2 nd cut	4 nos.
43.	File round 200 mm 2 nd cut	4 nos.
44.	File flat 150 rough	4 nos.
45.	File flat 250 mm bastard	4 nos.
46.	File flat 250 mm smooth	4 nos.
47.	Rasp, half round 200 bastard	4 nos.
48.	Iron, soldering 25 watt, 65 watt, 125 watt	4 each
49.	Copper bit soldering iron 0.25 kg.	4 nos.
50.	Desoldering gun	4 nos.
51.	Vice hand 50mm jaw	4 nos.
52.	Vice Table jaw 100 mm	8 nos.
53.	Vice Hand 50 mm jaw	4 nos.
54.	Pipe cutter to cut pipes upto 5 cm. dia	4 nos.
55.	Pipe cutter to cut pipes above 5 cm dia	1 no.
56.	Stock and die set for 20 mm to 50 mm G.I. pipe	1 set
57.	Stock and dies conduit	1 no.
58.	Multi meter 0 to 1000 M Ohms, 2.5 to 500 volt	6 nos
59.	Digital Multi meter (3 ½ digits)	2 nos.
60.	A.C.Voltmeter M.I. 0 –500V A.C.	1 no.
61.	Mill Voltmeter centre zero 100 – 0 – 100 m volt	1 no.
62.	D.C.Milliammeter 0 -500ma	1 no.
63.	D.C.Ammeter MC 0-1 A	1 no.
64.	Ammeter MC 0-5 A	1 no.
65.	Ammeter MC 0-15-25 A	1 no.
66.	A.C. Ammeter M.I.. 0-5A	1 no.
67.	A.C. Ammeter M.I.. 0-15-25A	1 no.
68.	K.W. Meter 0-1-3Kw	2 nos.
69.	A.C. Energy meter (single phase 5 amp. 230 V)	1 no.
70.	Single phase power factor meter	1 no.
71.	Frequency meter	1 no.
72.	Tacho meter with stop watch	2 no.
73.	Current transformer	2 no.
74.	Potential transformer	2 no.
75.	Growler	1 no.
76.	Tong tester / Clamp meter 0 – 100 Amp. AC	1 no.
77.	Megger 500volts	1 no.
78.	Wheat stone bridge complete with galvanometer and battery	1 no.
79.	Relays – Over current, under voltage, etc. 3 volt, 100 amp.	2 each

80	Contactors 3 phase, 440 volt, 16 amp. 2 NO & 2 NC auxiliary contacts	2 nos.
81	Contactors 3 phase, 440 volt, 32 amp. 2 NO & 2 NC auxiliary contacts	2 nos.
82	Limit Switch	2 nos.
83	Rotary Switch 16A	2 nos.
84	Load bank- 5 KW (Lamp / heater Type)	2 nos.
85	Brake test arrangement with two spring balance of 0 to 25 kg rating	2 sets.
86	Knife switch DPDT fitted with fuse terminals 16 amp	12 nos.
87	Knife switch TPDT fitted with fuse terminals 16 amp	12 nos.
88	DC power supply 0 - 100 volt, 5 amp	2 nos.
89	Inverter 1 KVA Input 12 volt DC, Output 220 volt AC with 12 battery	1 no.
90	Voltage stabiliser- Input 150 – 230 volt AC, Output 220 volt AC	1 no.
91	Rheostat 0 – 1 Ohm, 5 Amp.; 0 – 10 Ohm., 5 Amp. ; 0 – 25 Ohm, 1 Amp. ; 0 – 300 Ohm., 1 Amp.	2 no. each
92	Domestic appliances –	
	a) Electric hot plate 1500 watt. 220 V with temperature control	2 nos.
	b) Electric kettle, 1000 watts, 230 V	2 nos.
	c) Electric iron, 1200 watts, 230V with temperature control	2 nos.
	d) Immersion beater 750/1000/1500W-230 V	2 nos.
	e) Geyser 25 litre 240 V (Storage type) .	1 no.
93	Flux meter	2 nos.
94	Laboratory type induction coil 6 volt to 800-10,000 volt	1 no.
95	3-point D.C. starters	1 no.
96	4-point D.C. starters	1 no.
97	Cut out, reverse current, over load, under voltage relays.	1 each
98	Starters for 3-phase, 400 V, 50 cycles, 2 to 5 H.P. A.C. motors	
	a) Direct on line starter	1 no.
	b) Star delta starter with manual, semi-auto and automatic	1 no.
	c) Auto transformer type starter	1 no.
99.	<u>Electrical machine trainer</u> : -Suitable for demonstrating the construction and functioning of different types of DC machines and AC machines (single phase and three phase). Should be completed with friction brake dynamo meter, instrument panel and power supply units	1 per Institute
100	Motor generator (AC to DC) consisting of : Motor induction squirrel cage, 7 HP 400 Volts, 50-cycles, 3-phase with star delta starter and switch directly coupled to DC shunt generator 5 KW 440 volts, and switch board mounted with regulator, air circuit breaker, ammeter, voltmeter knife blade switches and fuses, set complete with case iron and plate, fixing bolts, foundation bolts and flexible coupling.	1 no.
101	Motor generator (DC to AC) set consisting of - Motor shunt 5 HP, 440 Volts with starting compensator and switch directly coupled to generator AC. 3.5 KVA, 400/230 Volts, 3-Phase, 4 wire, 0.8 PF 50 cycles with exciter and 1 switch board mounted with regulator, circuit 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.	1 no.
102	Used DC generators-series, shunt and compound type for overhauling practice	1 each
103	D.C. shunt generator, 2.5 KW, 220 V with control panel	1 no.
104	D.C. compound generator, 2.5 K.W. 250 V, with control panel including filed rheostat, voltmeter, ammeter and circuit breaker	1 no.

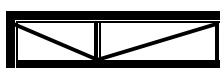
105	Diesel generator set, 5 KVA, 44 volt, AC 3 phase with change over switch, over current circuit breaker and water-cooled with armature, star-delta connections.	1 no.
106	Motor series DC, 220 Volt, 0.5 to 2 HP, coupled with mechanical load	1 no.
107	Motor shunt DC 220 volt, 2 to 3 HP	2 nos.
108	Motor DC compound wound 220 volt 2 to 3 :HP with starter and switch	2 nos.
109	Motor AC squirrel cage, 3-phase 400 volt, 50 cycles, 2 to 3 HP with star delta starter and triple pole iron clad switch fuse.	1 no.
110	Motor AC phase-wound slip ring type 5 HP 400 volts, 3-phase, 50 cycles with starter and switch.	1 no.
111	Motor A.C. series type 230V, 50 cycles, ¼ HP with mechanical load	1 no.
112	Motor AC single phase 230 volt 50 cycles 1 HP capacitor type with starter switch 1 HP	1 no.
113	Motor universal 230 volt, 50 cycles ¼ HP with starter/switch	1 no
114	Stepper motor with digital controller	1 no.
115	Fan A..C. 230 volt 1200 mm	2 nos.
116	Transformer single phase, 1 K.V.A., 230 / 115-50-24-12 volts, 50 cycles core type, air cooled.	3 nos.
117	Transformer three phase, 5 K...V...A., 440/230 volts, 50 cycles, delta / star, shell type oil cooled.	2 nos.
118	Variable auto transformer 0-250 V, 8 amps.	2 nos.
119	Oscilloscope –Dual Trace,30 MHZ	1 no.
120	Function Generator	1 no.
121	Discrete component trainer	1 no.
122	Linear I.C.Trainer	1 no.
123	Digital I.C.Trainer	1 no.
124	Bath impregnating	1 no.
125	Oven stoving	2 nos.
126	Oil testing Kit	1 no.
127	Battery charger with variable output 1 KW	1 no.
128	Hydrometer	1 no.
129	A.C.B. 5 KVA	1 no.
130	M.C.B. 16 amp.	1 no.
131	Thyristor/IGBT controlled D.C. motor drive 1 HP with tacho-generator feedback arrangement.	1 no.
132	Thyristor/IGBT controlled A.C. motor drive with VVVF control ,3 Phase 2 HP	1 no.
133	Lockers with 2 drawers (standard size)	2 nos.
134	Bench working 2.5 x 1.20 x 0.75 meters	4 nos.
135	Almirah 2.5 x 1.20 x 0.5 meter	1 no
136	Instructor's table	1 no.
137	Instructor's chair	2 nos.
138	Fire extinguisher	2 nos.
139	Fire buckets	4 nos.
140	Metal rack 100 x 150 x 45 cm	4 nos.

NOTE

No additional items except those under Trainees Kit are required to be provided for a second batch.

For the batch working in the second shift, only the items under Tool-Kit and lockers are required to be provided.

For the second batch the items under trainees tool kit are required to be provided.



SYLLABUS FOR THE TRADE OF ELECTRICIAN UNDER
APPRENTICESHIP TRAINING

First 2 years – Basic training is same as the syllabus of Electrician under CTS

SYLLABUS FOR SHOP FLOOR TRAINING - DURATION – 1 YEAR

Note:- The Syllabus for this trade should be considered as a guide for imparting apprenticeship Training according to the facilities available in Industries / Establishment

NOTE FOR APPRENTICESHIP TRAINING

1. **The practical training programme of the apprentices under ATS should be as per the facilities available in the industry / Establishment.**
2. **At the end of the Shop floor Training , an Apprentice shall appear for a final Examination to be conducted at Establishment level based on the actual shop floor training received by the apprentices .The examination shall be comprised of assessment of work diaries maintained by the apprentices and viva-voce to be conducted by the external examiners (other than the officials directly responsible for shop floor Training) .**

PRACTICAL

Power Plant -

Installation, Running, Care and Maintenance of Plant equipment and machinery in a Power Generating Station.

Industrial Applications -

Installation, Running, Operation, Care and maintenance of various Electrical installation – Motor drives, Control panel, Hoist, Fork lift, Blower, Furnace, Welding, Illumination, Ventilation and other equipments – in an Industry.

Transmission Distribution -

Laying & Erection/Installation of O/H line & under ground cables. Radial & ring main system. Location cable fault & repairing.

SUBSTATION: -

Installation, operation, care & maintenance of busbars, transformer, circuit breakers, Isolators, CT & PT, lighting Arrestors, earthing / grounding, meter connection, relaying & protection, testing, trouble shooting.

Sub Station Control Room -

Operating of control room, it's equipments. Reading of panel meter & filling log sheet, Operation of switchgear, circuit breaker, Isolator, Bus coupler etc. Use of PLCC other communication system. Preparing report, conversant with protection system. Different types of meter (Kwh, KVRH etc.) and connections, meter fixing, meter & instrument testing. Monetary parameter of switchgear transformer & battery.

Voltage regulations & improvement of P.F –

Switch gears & protection –

Installations, Operation, care & maintenance of fuses, C.B, Protection system, Relays, Meters, CT / PT, grounding system.

Connection & upkeep of various meters and installation, fault finding.

MEASUREMENT, INSTRUMENTATION & CONTROL -

Measurements of current voltage, power, P.F, frequency, Energy, , temperature flow, level , pressure, speed. Etc.

Use, care & maintenance of analog & digital instruments, strip chart recorder, data logging system, telemeter.

Process control automation -

Use care & maintenance of various automations of control system equipment & accessories.

Domestic appliances -

Constrictions, assembly, dis-assembly, repairing of different appliances.

Power Electronics -

Identify, test different types of semi conductor devices (diodes, Transistors, Thyristers, ICS) making simple electronics circuit with above semi conductor devices. Soldering & desoldering practice. Maintenance and minor repair to Electronic control circuit. Setting of protective relays, MCB, ELCB, fuse, etc. Maintenance and minor repair to Electronic control circuits with Electronic Testing Instruments.

RELATED INSTRUCTION

DURATION – 1 Year

General Safety measures & Precautions observed, I.E. Rules & Regulations.

Power Plant – Thermal Power Plant – Coal + Diesel
Hydel Power Plant
Solar Power Plant
Wind Mill
Biomass plant
Nuclear power plant

Thermal Power Station – Power Plant Block layout with explanations
Accessories & mountings

Function of water level indication, stop valves. Feed check valve, safety valve, pressure gauge,
Functions of Economizer, Feed water heater, Super heater, Air preheated, Feed water pump and injector.
Classification of draught – Natural, Artificial, Steam turbines & condensers.

I.C. Engine - Classifications

Principles of working, Different parts and their functions. Function of different system and accessories –
cooling, fuel injections system

Hydraulic Power Station

Classification – Pelton, Francis, Kaplan Turbine

Gas Turbine – Principles of working & functions

Solar Power Plant - Direct, Indirect

Details of solar panel, applications – in Heating, Lighting, Pumps, Battery charging.

Wind Mill – different parts, regulating voltage, Frequency.

Bio-mass plant – Different parts, supply system to rural areas.

Power station Auxiliaries - Electrical Layout of power plant, showing arrangement of switchgears,
control, protective equipment, bus-bar, reactor, transformer, outgoing feeders etc.

Load factor, Diversity factor, Tariff.

Industrial Applications —

Motor drives – Types of drives in different applications

Constant torque and constant H.P. drives.

Thyristorised & Transistor. Central circuits.

Crane, Hoist, Conveyors, Electric drive Fork lift & Blowers other equipments.

Applications in Steel Plant,

Textile mills

Aluminum / Copper mills

Cement mills

Paper mills

Sugar mills

Machine tool

CNC

Power Control circuits – AC/DC voltage control, Phase control, Chopper control, Dual bridge control. V/F Control of induction motors. PWM control, D.C. link speed Control of Induction motors & Cycloconverter, Microprocessor based control.

Applications in Electric Furnaces, Heat treatment, welding, Illumination, Ventilation.

Transmission and Distribution of power-

Elements of transmission & distribution by single line dia, primary and secondary distribution, Feeder, Distributors and service mains.

Transmission

Overhead lines, underground cables, Insulators types. T. & D. line structures, cross-arms, stay and strut conductor span, spacing and ground clearance. Different methods of earthing of poles and structures Guarding, Vibration and dampers.

Function of arcing horn, relative advantage of A.C. and D.C. transmission, system H.V.D.C.

Surge voltage protection, lightning arrester

Short line regulation

Distribution

Comparison between radial and ring main system of distribution

Advantage of using interconnections

Cable fault – types, location of fault.

Voltage regulation and improvement of Power factor. Voltage regulation by Tap-charging transformers and Booster transformer.

Substation - Indoor and outdoor

Bus bar arrangements and layout. Transformer circuit breakers, Isolators – Electrical and mechanical interlocking control and relay panel.

Switchgear & Protection

Fuse – construction & principle of operation of HRC fuses. Selection and specification of fuse.

Circuit Breakers- Classification, constructional features. Principle of operation of Air break, bulk oil, low oil, Air blast. And SF6 circuit breakers

Relay classification -

Construction, principle of operation, and characteristics of thermal , Electromagnetic and induction relay, Solid state relays.

Protection - Basic idea of protection, causes and consequences of faults, zones of protection, primary and back up protection.

System earthing – important and different
Protection of transformers, Alternators, Motors

Protection scheme of an Induction motor

Use of bimetal relay, single phase prevent or, Over current and under voltage relay.
Protection of Feeders, bus bars and transmission line- function of auto reclosures.

Measurements , Instrumentation and control -.

Ammeter, Voltmeters – (Analog and Digital)

Instruments transformers- use of C.T & P.T. in the measurement of current, voltage, power and energy

Measurement and energy – Dynamo meter type and induction type single phase and three phase energy meters.

Measurement of power factor –

Maximum demand , KVAh and KVARh metering (Analog & Digital)
Trivector meter
Energy Management & Pollution Control – Basic Concepts.

Measurement of non-electrical quantities

Concept of Transducers and Sensors, Construction and working principle of LVDT, Potentiometer, Synchro, strain gauge
Measurement of temperature, Flow, Level, Pressure speed.

Strip chart Recorder, Telemetry.

Data acquisition system

Control System –

ON-off control, proportional control, proportional & integral control, proportional, intergral & Derivative control.

Servomechanism

Open loop and closed loop system, Industrial applications.

Domestic appliances

Principle of operation of different Domestic Electrical Appliance & Gadgets.
F H P motors, D G set, Pump Set, Room Heater. Water Heater (Geyser), Electric Iron, Cooking range, Mixer Grinder, Vacuum Cleaner, Washing Machine etc.

Workshop Calculation & Science

Differential and Integral Calculus – Basic concept, Complex Algebra- Basic concept
Vector Diagram –

Electrical Engineering materials –

Conductors, Insulating Materials – Class Y, A,E etc. Properties.

Magnetic material

Magnetic Circuit – Hysteresis & Eddy current, losses involved & Reduction techniques

Electrostatics – Capacitors – different types

Dielectric strength - their applications

Harmonics – Basic idea.

Temp. rise & cooling of Electrical mechanics

Semi-conductors devices – Diode, Rectification transistors, FET – common application

Thyristor - use in power control

Digital Electronics –

Combinational and Sequential circuits, A/D & D/A converter, Multiplexor.

Auto CAD

Engineering Drawing –

Symbols of Electrical Devices & Equipment

Lamp control circuit

Wiring diagram of electric installation in a building, workshop

Diagram of a Thermal, Hydel Power Station

Layout Diagram of a substation

Wiring diagram of –

DOL & Star-Delta Starter

Motor Control Panel for automatic star delta, Starting of Induction motor, using contactor, time relays, with thermal O/L relays. Wiring dia. of a crane/ Hoist.

Mimic diagram
