SYLLABUS FOR THE TRADE

OF

E L E C T R I C I A N

(SEMESTER PATTERN)

UNDER
CRAFTSMEN TRAINING SCHEME (CTS)

Designed in – 2013

By

Government of India
CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE
Directorate General of Employment & Training
Ministry of Labour & Employment (DGET)
EN – 81, SECTOR – V, SALT LAKE CITY,
Kolkata – 700 091.

List of members attended the Trade Committee Meeting for revising the course curriculum and introduction of topics related to renewable energy in the trade of "**Electrician"** under Craftsmen Training Scheme (CTS) on 12th & 13th August 2010.

Sl. No.	Name and Designation S/SHRI	Organization	Remarks
1	*S.D.Lahiri, Director*	*C.S.T.A.R.I, Kolkata*	*Chairman*
2	*S. Bhattacharya, Director*	*W.B.R.E.D.A, Kolkata*	*Member*

3	*Amarnath Sanyal, Addl, Director*	*I.EM, Kolkata*	*Member*
4	*R. Gangopadhyay, Lecturer*	*Kanchrapara Railway Workshop, Eastern-Railway*	Member
5	*R, N. Banerjee, Director*	*Sunshine Power Products, Kolkata*	Member
6	*P. K. Ghosh, Training Manager*	*G.R.S.E. Ltd, Kolkata*	Member
7	*S. K. Pal, Manager*	*M/s Mascot Integrated Industry, Kolkata*	Member
8	*Dr. Soumen Bose, Dy, Director*	*Directorate of Industrial Training, WB*	Member
9	*Dibyendu Paul, Lecturer*	*Sahaj Academy, Kolkata*	Member
10	*Dr. Tapas Kr Majumder, Manager*	*B S N L, Kolkata*	Member
11	*S.K.Bose, Manager*	*Trans Bio Energy Ltd, Kolkata*	Member
12	*Monisha Sarkar, Asstt Manager*	*Trans Bio Energy Ltd, Kolkata*	Member
13	*Dr.K. mukhopadhya, Director*	*AGNI, Kolkata*	Member
14	*Anupam Bose, Manager*	*Geetanjali Solar, Kolkata*	Member
15	*A Majumder, DE*	*W.B.R.E.D.A, Kolkata*	Member
16	*Joy Chakraborty, DE*	*W.B.R.E.D.A, Kolkata*	Member
17	*Utpal Kr Roy, Supervisor*	*W.B.R.E.D.A, Kolkata*	Member
18	*A.Ghosh, Supervisor*	*W.B.R.E.D.A, Kolkata*	Member
19	*Moloy Kr Mondal, Supervisor*	*W.B.R.E.D.A, Kolkata*	Member
20	*Rudrendu Basu, Asstt. Director*	*W.B.R.E.D.A, Kolkata*	Member
21	*S.K.Biswas, Asstt Director*	*W.B.R.E.D.A, Kolkata*	Member
22	*D.K.Hazra, Spervisor*	*W.B.R.E.D.A, Kolkata*	Member
23	*A.Karmakar, Supervisor*	*W.B.R.E.D.A, Kolkata*	Member
24	*Gautam Banerjee, Manager*	*ESAB India Ltd, Kolkata*	Member
25	*M.K.Saha, Trg Superintendent*	*G.R.S.E. Ltd. Kolkata*	Member
26	*P.Majumder, Chief Consultant*	*Park Chember Housing Development, Kolkata*	Member
27	*Rabin Debnath, Asstt. Director*	*Directorate of Industrial Training, WB*	Member
28	*Sib Chandra Pal, Instructor*	*Govt, ITI, Howrah Homes, WB*	Member
29	*D.P.Sarkar, Instructor*	*Govt, ITI, Howrah Homes, WB*	Member
30	*Anil Kumar, Joint Director of Trg*	*C.S.T.A.R.I, Kolkata*	Member
31	*L. K. Mukherjee, Dy.Director of Trg*	*C.S.T.A.R.I, Kolkata*	Member
32	*A. Nandi, Dy.Director of Trg*	*C.S.T.A.R.I, Kolkata*	Member
33	*P.K.Dutta, Asstt. Director of Trg*	*C.S.T.A.R.I, Kolkata*	Member
34	*N.Nath, Asstt. Director of Trg*	*C.S.T.A.R.I, Kolkata*	Member
35	*S. B. Sarder, Asstt. Director of Trg*	*C.S.T.A.R.I, Kolkata*	Member
36	*R. N. Manna, Trg. Officer*	*C.S.T.A.R.I, Kolkata*	Member
37	*L. M. Pharikhal, Trg-Officer*	*ATI, Kolkata*	Member

List of members attended the Workshop to finalize the syllabi of existing CTS into Semester Pattern held from 6th to 10th May'2013 at CSTARI, Kolkata.

Sl. No.	Name & Designation	Organisation	Remarks
1.	R.N. Bandyopadhyaya, Director	CSTARI, Kolkata-91	Chairman
2.	K. L. Kuli, Joint Director of Training	CSTARI, Kolkata-91	Member
3.	K. Srinivasa Rao, Joint Director of Training	CSTARI, Kolkata-91	Member
4.	L.K. Muhkerjee, Deputy Director of Training	CSTARI, Kolkata-91	Member
5.	Ashoke Rarhi,	ATI-EPI, Dehradun	Member

	Deputy Director of Training		
6.	N. Nath, Assistant Director of Training	CSTARI, Kolkata-91	Member
7.	S. Srinivasu, Assistant Director of Training	ATI-EPI, Hyderabad-13	Member
8.	Sharanappa, Assistant Director of Training	ATI-EPI, Hyderabad-13	Member
9.	Ramakrishne Gowda, Assistant Director of Training	FTI, Bangalore	Member
10.	Goutam Das Modak, Assistant Director of Trg./Principal	RVTI, Kolkata-91	Member
11.	Venketesh. Ch. , Principal	Govt. ITI, Dollygunj, Andaman & Nicobar Island	Member
12.	A.K. Ghate, Training Officer	ATI, Mumbai	Member
13.	V.B. Zumbre, Training Officer	ATI, Mumbai	Member
14.	P.M. Radhakrishna pillai, Training Officer	CTI, Chennai-32	Member
15.	A.Jayaraman, Training officer	CTI Chennai-32,	Member
16.	S. Bandyopadhyay, Training Officer	ATI, Kanpur	Member
17.	Suriya Kumari .K , Training Officer	RVTI, Kolkata-91	Member
18.	R.K. Bhattacharyya, Training Officer	RVTI, Trivandrum	Member
19.	Vijay Kumar, Training Officer	ATI, Ludhiana	Member
20.	Anil Kumar, Training Officer	ATI, Ludhiana	Member
21.	Sunil M.K. Training Officer	ATI, Kolkata	Member
22.	Devender, Training Officer	ATI, Kolkata	Member
23.	R. N. Manna, Training Officer	CSTARI, Kolkata-91	Member
24.	Mrs. S. Das, Training Officer	CSTARI, Kolkata-91	Member
25.	Jyoti Balwani, Training Officer	RVTI, Kolkata-91	Member
26.	Pragna H. Ravat, Training Officer	RVTI, Kolkata-91	Member
27.	Sarbojit Neogi, Vocational Instructor	RVTI, Kolkata-91	Member
28.	Nilotpal Saha, Vocational Instructor	I.T.I., Berhampore, Murshidabad, (W.B.)	Member
29.	Vijay Kumar, Data Entry Operator	RVTI, Kolkata-91	Member

GENERAL INFORMATION

1. Name of the Trade : ELECTRICIAN

2. N.C.O. Code No. :

3. Duration of Craftsmen Training : 2 Years (4 Semesters having duration of six months each)

4. Power norms : 5.2 KW (for two units in one shift)

5. . Space norms : 98 Sq. metres.

6. Entry Qualification : Pass in 10^{th} Class examination

7. Unit size (No. Of student) : 16

8. Instructors Qualification : Degree in Electrical / Electrical & Electronics Engineering from recognized engg. college/university with one year experience in the relevant field OR

Diploma in Electrical / Electrical & Electronics Engineering from recognized board of technical education with two years experience in the relevant field

OR

10^{th} class examination and NTC/NAC in the Trade of "Electrician" With 3 years' post qualification experience in the relevant field.

9. Desirable qualification : Preference will be given to a candidate with CIC (Craft Instructor Certificate).

NOTE: At least one Instructor must have Degree/ Diploma in the relevant Trade.

Syllabus for the Trade of "*Electrician*"
Duration : Six Month

First Semester
Semester Code: ELE: SEM I

Week No.	Trade Practical	Trade Theory	Engineering Drawing	Vocational Science & Calculation
1	2	3	4	5
1	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	**Occupational Safety & Health** Basic safety introduction, Personal protection:- Basic injury prevention, Basic first aid, Hazard identification and avoidance, safety signs for Danger, Warning, caution & personal safety message. Use of Fire extinguishers. Visit & observation of sections. Various safety measures involved in the Industry. Elementary first Aid. Concept of Standard	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	Demonstration of Trade hand tools. Identification of simple types- screws, nuts & bolts, chassis, clamps, rivets etc. Use, care & maintenance of various hand tools.	Identification of Trade-Hand tools-Specifications	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	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	Fundamental of electricity. Electron theory-free electron, Fundamental terms, definitions, units & effects of electric current	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 and rubber.

5	Practice in soldering-Measurement of Resistant and Measurement of specific Resistant. Application of Wheatstone bridge in measurement of Resistance	Solders, flux and soldering technique. Resistors types of resistors & properties of resistors.	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	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.	Introduction of National Electrical Code 2011 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 / Ferrules	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	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	**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 .	1st angle projection, 3 rd 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.	Practice on installation and overhauling common electrical accessories. Fixing of switches, holder plugs etc. in T.W. boards. -Identification and use of wiring accessories concept of switching.	Common Electrical Accessories, their specifications in line with NEC 2011-Explanation of switches lamp holders, plugs and sockets. Developments of domestic circuits, Alarm & switches, with individual switches, Two way switch .Security surveillance, Fire alarm, MCB, ELCB, MCCB.	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.

9	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. Practice on Electroplating and anodising, Cathodic protection.	**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. Different types of lead acid cells.	Do	Factorisation, Simple algebraic problems Laws of parallelogram of forces.
10	Routine care & maintenance of Batteries	Rechargeable dry cell, description advantages and disadvantages. Care and maintenance of cells Grouping of cells of specified voltage & current, Sealed Maintenance free Batteries, Solar battery.	Dimensioning practice on orthographic views	Ratio & proportion, related shop problems. Friction, Laws of friction, co-efficient of friction, angle of friction, simple problems related to friction.
11	Charging of a Lead acid cell, filling of electrolytes- Testing of charging checking of discharged and fully charged battery	Inverter, Battery Charger, UPS-Principle of working. Lead Acid cell, general defects & remedies. Nickel Alkali Cell-description charging. Power & capacity of cells. Efficiency of cells.	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, circuits. Elements.	Average and related shop problems. Work, Power & Energy – Their units and related problems.

12-13	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. 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.	ALLIED TRADES: Marking use of chisels and hacksaw on flats, sheet metal filing practice, filing true to line. Sawing and planning practice. Practice in using firmer chisel and preparing simple half lap joint.	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 Simple isometric drawings, isometric views of simple objects- cubes, rectangular blocks etc.	Factorisation of polynomials. (Simple problems). Rotational motion. Angular velocity and acceleration. Square roots & Cube roots by the method of factorisation. Centrifugal & Centripetal forces. Related problems.
14	Types of drills description & drilling machines, proper use, care and maintenance. Description of taps & dies, types in rivets & riveted joints. Use of thread gauge.	Drilling practice in hand drilling & power drilling machines. Grinding of drill bits. Practice in using taps & dies, threading hexagonal & square nuts etc. cutting external threads on stud and on pipes, riveting practice.	Free hand sketching of nuts & bolts with dimensions from samples. Free hand sketching of rivets and washers with dimensions from samples.	Standard algebraic formula and related problems. Moment of a force Couple and Torque. Related problems
15	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.	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.	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

16-17	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. Demonstration on effect of eddy current on different samples. Assembly / winding of a simple electro magnet Identification of different types of Capacitors. Charging & discharging of capacitor, Testing of Capacitors using DC voltage and lamp. Use of magnetic compass.	**Magnetism** - classification of magnets, methods of magnetising, magnetic materials. Properties, care & maintenance, methods of magnetising magnetic materials. Para & Diamagnetism and Ferro magnetic materials. Principle of electro-magnetism, Maxwell's corkscrew rule, Fleming's left & right hand rules, Magnetic field of current carrying conductors, loop & solenoid. MMF, Flux density, reluctance. B.H. curve, Hysteresis, Eddy current. Principle of electro-magnetic Induction, Faraday's Law, Lenz's Law. Electrostatics: Capacitor- Different types, functions & uses.	Drawing the typical symbols used in electrical circuits. Graphical symbols used in electro technology, kinds of distribution systems and methods of connections.	Solving of Quadratic equations. Simple problems on moment of Inertia.
18-19	Measurement of resistance by different methods- a) Using Wheatstone Bridge b) By voltage drop method. Experiment to demonstrate the variation of resistance of a metal with the change of temperature. -Measure of 'R' by drop method. -Series & shunt circuits-use of Multimeters	**Resistance-** Different Types of resistors used in electrical circuits. Specification of resistance and tolerance. Effect of variation of temperature on resistance. Different methods of measuring the values of resistance,	Do.	Simple Problems on Profit & Loss. Levers – its different types and their advantages. Simple related problems.
20-21	Connection of Calling Bell, Buzzer, Alarms, Electric Iron, Heater, Light. Rewinding /assembly of different electrical appliances.	Working principles and circuits of common domestic equipments & appliances	Detailed diagram of calling bell electromagnet etc	Simple Problems on Profit & Loss. Mechanical advantage, Velocity ratio, Efficiency of different types of levers.

	Study, maintenance and repair of domestic equipments – Electric Kettle, Heater / Immersion Heater Hot Plate, Geyser, Washing machine Cooking range, Incubators, Furnaces, Pump set. Etc.			
22-23	Identification and study of the parts of a D.C. machine. Practicing dismantling and assembling in D.C. Machine.	**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. 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.	Sketching of brush and brush gear of D.C. machines. Lay out D.C. Panel board arrangement. Lettering-Numbers Alphabets. Sketching of D.C. 3-point face Plate starter top scale.	MENSURATION – Perimeter and Area of Square & Rectangle. Simple problems on straight and bell cranked levers.
24	Connection of shunts Generators, Measurement of voltages-Demonstration on field excitation. Connection of compound Generator-Voltage measurement-cumulative and differential – No Load & Load characteristics of Series, Shunt & Compound Generator. Controlling and protecting DC Generator.	Explanation. Of Armature reaction, interpoles and their uses, connection of interpoles, commutation. **DC Motors - Terms** used in D.C. motor-Torque, speed, Back-e.m.f. etc. their relations practical application. Related problems	Graphic symbols for Rotating m/cs and Transformers.	Perimeter and Area of Triangle. Simple machines - Determination of efficiency of simple m/cs. Like winch, pulley blocks, wheel and compound axle.
25	Project work Industrial visit (optional)			
26	Examination			

Syllabus for the Trade of "*Electrician*"
Duration : Six Month

Second Semester
Semester Code: ELE: SEM II

Week No.	Trade practical	Trade Theory	Engineering Drawing	Vocational Science & Calculation
1-2	Demonstration and practice on identification of parts and terminals. Study of the characteristics of DC motors.	Types, characteristics and practical application of D.C. motors. Special precaution to be taken in DC Series motors. Starters used in D.C. motors	Reading of simple blue prints.	Circumference and area of Circle. Transmission of motion through Belt, Pulley, Gears, etc. and related problems.
3-4	practical application of D.C. motors. Special precaution to be taken in DC Series motors. Starters used in D.C. motors	Types of speed control of DC motors in industry. Control system. AC-DC, DC-DC control. Thyristor/electronic controls.	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.
5	Types of speed control of DC motors in industry Word-Leonard control, Thyristor/electronic controls	Insulting materials – properties common insulting materials, classifications	Do	Do
6-7	**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 - U**sing casing capping, P.V.C., concealed system. -Maintenance & Repairing data sheet preparation.. Specifications, standards for conduits & accessories.	**Electric wirings**, I.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. Voltage drop concept. **Wiring system -** P.V.C., concealed system. -Maintenance & Repairing data sheet preparation.. Specifications, standards for conduits & accessories - Power Wiring - Control Wiring - Information Communication Entertainment Wiring. Basic principle of energy audit.	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, twisting and shearing. Voltage drop calculation. Line regulation cable table reading.

8-9	**Practice on Earthing** - different methods of earthing. Importance of Earthing. -Earth Leakage Relay.	**Earthing** - Principle of different methods of earthing. Importance of Earthing -Earth Leakage Relay. In absence of latest revision in respective BIS provision for Earthing it is recommended to follow IEC 60364 guidelines.	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.
10 - 11	Demonstration of sine wave, instantaneous values etc. Study of the behaviour of R, X_L & X_C in A.C. circuits both in series and in parallel. Experiment on poly phase circuits. Current, voltage & power measurement in poly-phase circuits. Measurement of energy in single & poly-phase circuits. - Use of phase sequence meter. - Use of single phase - Demo of distorted wave - SMPS / Electronic device – Wave distortion - Power measurement True R.M.S concept	**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 & Xc, Impedance (Z), power factor (p.f) ; Vector diagram. Active and Reactive power, Simple problems on A.C. circuits, single phase & three-phase system etc. Problems on A.C. circuits. Both series & parallel power consumption P.F. etc. Concept three-phase Star & Delta connection Line voltage & phase voltage, current & power in a 3 ph circuits, with balanced and unbalanced load. Harmonics: causes & effects	Free hand sketching of simple Geometrical shapes & hollow shapes. Drawing of simple electrical circuits. Using electrical symbols. View of simple solid & hollow bodies. Drawing of sine waves. Views of simple solid and hollow bodies'. Circuit. Diagram of battery charging circuits. With all details of panel board. Blue print reading.	Calculation of areas of triangles, etc. with the aid of trigonometry. Calorimetry, Latent Heat – Their related problems.

12- 15	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. l. Conducting No-load and short circuit tests. Testing of single phase and Three Phase. Transformers - Cleaning and maintenance of Transformers, Changing of oil. Single to 3 phase and six phase connection.	Working principle of Transformer, classification C.T., P.T. Instrument and Auto Transformer/Variac Construction, Single phase and Poly phase. E.M.F. equation, parallel operation of transformer, their connections. Regulation and efficiency, Cooling of transformer, protective devices. Specifications, simple problems on e.m.f. Equation, turn ratio, regulations and efficiency. Special transformers. **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. Dry transformer. Transformer bushings and termination. Transformer bushing and termination and specification.	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. Free hand sketching of simple objects related to the trades. Block diagram of single to three phase and six phase diagram.	Use of trigonometric formulae and applied problems. Expansion of Solid, Liquid and Gases – Their related problems.

16 - 18	Demonstration on alternators, voltage Building, load characters & regulation. Practice on installation, running and maintenance of Alternators.	Explanation of alternator, prime mover, types, regulations, phase sequence, specification of alternators and brushless alternator. Induction generator. Automatic Voltage Regulator.	Diagram of connection to a squirrel cage induction motor. Sketching the connection diagram of controlling & protective devices for Induction motors. Development of winding diagram for an electrical machine. Preparation of working drawing from sketches.	Drawing & reading of simple graphs. Transmission of heat - Conduction, Convection and Radiation.
19-21	Study of - M.C.P.M. meter Multi-meter Wattmeter P F meter Energy meter Frequency meter THD meter Thermograph Calibration of - Multi-meter C.R.O. Maximum Demand meter Phase sequence indicator Digital Instruments.	**Electrical Measuring Instruments -** -types, indicating 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, Solar insulation meter.	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.	Different forms of energy, Thermal, mechanical and electrical, conversion from one to another. .
22-24	Installation of - Neon Sign Mercury vapour (H.P. & L.P.)	Explanation of light White light-illumination factors, intensity of light – importance of light, human eye factor units.	Drawing the development diagram for D.C.	Applied workshop problems.

	Sodium vapour Halogen Lamps single tube & double tube Practice on decoration lighting Principle of layout of lighting installation.	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.	Simplex Lap & Wave winding	
25		Project Work Industrial visit (optional)		
26		Examination		

Syllabus for the Trade of "*Electrician"*
Duration : Six Month

Third Semester
Semester Code: ELE: SEM III

Week no.	Trade practical	Trade Theory	Engg. Drawing	Vocational Science & Calculation
1-2	Practice on winding of Transformers of different types and ratings.	**TRANSFORMER** – winding , Principle of different winding techniques	Practice in reading panel diagram. Practice in reading circuits Containing Resistance, inductances Practice in reading typical example of circuits containing R,X & C.	Practice in the use of Logarithmic tables for multiplication, division square root, cube root. Insulating material including transformer oil.
3-4	Practice on different types of winding ,Growler testing , Baking , Impregnation and Varnishing .Testing for faults	**D.C. m/c Winding--** pole pitch, coil pitch, back pitch, front pitch , Lap & Wave winding , Progressive and retrogressive winding.	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.
5	Practice on starting ,running, connection to bus bar, Study on effect of changing the field excitation and Power factor correction of Industrial load.	**SYNCHRONOUS MOTOR -** Working principle, effect of change of excitation and load. Application in industry in power factor improvement.	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.

6 - 9	**Induction Motors** - Study of Squirrel cage and Slip ring Induction motor , Measurement of slip, P.F. at various loads. Practice on connection of D.O.L Starter, Star /Delta starter, Autotransformer starter, And starting, running & speed control. Connection of single phase motor, identification, testing, running, and reversing. Identification, connection, testing, running and reversing of universal motor.	**Induction motor** – Working principle, Squirrel Cage Induction motor , Slip-ring induction motor- Construction and characteristics, starting and speed control. D.O.L Starter, Star /Delta starter, Autotransformer starter. **Single phase induction motor-** Working principle, different method of starting and running (capacitor start/capacitor run, shaded pole technique). FHP motors. **Universal motor**-advantages Principle, characteristics, applications in domestic appliances and industry, Fault Location and Rectification. Braking system of motor.	Drawing the schematic diagram of automatic voltage regulators of A.C. generators. Drawing the schematic diagram of A.C. 3-ph reversing magnetic starter. Sketching a breather. Free hand sketching of transformer and auxiliary parts and sectional views. Drawing the schematic diagram of plow and pipe earthing I.S.3043. Wiring diagram of the connection of arrangement and push button control of two speed AC motor. IS : 3914 – 1967.	Problems on mensuration related to solid bodies of Prism, Pyramid, Sphere, etc. **Forms and properties of matter. The molecule and atoms.** Trigonometric function Use of trigonometric tables-applied problems-Calculation of areas of triangles and polygons. Problems on Mensuration.
10-11	Making forma, coil insulation, Slot insulation, Insertion of coils in slots, coil connection, Practice on single layer concentric Winding, Baking, impregnating and varnishing.	**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.	Drawing the schematic diagram of the starting and controlling gears of slip ring and Sq. cage Ind. Motor. IS. 3914 – 1967 Drawing the schematic diagram of Autotransformer starter, Push button starter and Star Delta Starter.	Simple problems involving Trigonometric function. Atmospheric pressure, pressure gauge and absolute pressure.
12-13	Starting, running and building up voltage and loading of M-G set. Maintenance of M-G Sets. Solid state controller and invertors. Operation and use. VSD O&M	**Converter**-inverter, M.G. Set-description-Characteristics, specifications-running and maintenance. Solid state controller and invertors. V.S Drive, Theory and application	Drawing the schematic diagram of 4 typical D.C. speed regulators for shunt and compound motors. -do- Magnetic controller with dynamic breaking. Block diagram of solid state systems.	Laws of Indices and related problems Inclined plane, Parallelogram laws of Forces – their related problems.
14-15	Practice on Installation of conduit pipe wiring for lighting and power circuits for both 230V & 400V	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.	Schematic diagram of magnetically rated. D.C. motors with three-push bottom control station, Lumina sent Lamps.	Further problems on mensuration. Heat treatment processes.
16-17	Study of fuses. Study of contactors, MCB. Study of relays of different types.	**Fuse** / cut out / kit Kat – function, characteristics, and materials. H.R.C Fuses – application. Contactors – Miniature circuit breakers.	Sketching indicating instruments. Drawing the diagram of typical marking plate of a distribution transformer. Typical wiring diagram for drum and controller operation of	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

		Relays – Thermal, Electromagnetic, solid state relays, Control Relays and Protective Relays. Different types of contractor and limit switches.	A.C. wound rotor motor.	vectors.
18-22	**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. Operation and use of XLPE cables.	**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. rules for overhead service lines, study of U.G. Cables and laying techniques. XLPE cable. Working principle and construction of domestic and agricultural appliances-their maintenance.	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 position.	Examples of simply supported Load. General condition of equilibriums for series of forces on a body.
23-24	Practice of fixing lightening arrestors and lightening conductors, Horn gap. Identification of semiconductors. Diodes-symbol - Tests on Diodes. Studying the Characteristics of Diodes using multi-meter. I.S. 2032 of VIII 1965. Identification of semiconductors. Diodes-symbol - Tests on Diodes. Studying the Characteristics of Diodes using multimeter. I.S. 2032 of VIII 1965.	Lightning arrestor/lighting conductor, Horn gap. Concept of overhead line, HV transmission, surge voltage. Introduction to **Basic electronics**-Semiconductor energy level atomic structure. 'P' & 'N' type of materials – P-N-junction. Diode-classification of Diodes – Revered Bias and Forward Bias, Heat sink. Specification of Diode – PIV rating.	Single line diagram of substation feeders. Connection diagram of typical overload current relays. Introduction to **Basic electronics**-Semiconductor energy level atomic structure. 'P' & 'N' type of materials –P-N-junction. Diode-classification of Diodes – Revered Bias and Forward Bias, Heat sink. Specification of Diode – PIV rating. Key diagram of a power station. Central controlling panel. Drawing D.I.S. symbols for electronic components. DIODE, TRANSISTOR Zener diode, S.C.R. I.C. etc.	Centre of gravity simple experiments, stable, unstable and neutral equilibrium. Mechanical advantages velocity ratio, ratio, efficiency of simple pulley wheel screw jack and winch. Simple harmonic motion – motion of a pendulum, spring, vibrating body .
25	Project Work Industrial Visit(optional)			
26	Examination			

Syllabus for the Trade of "*Electrician*"
Duration : Six Month

Fourth Semester

Semester Code: ELE: SEM IV

Week No.	Trade Practical	Trade Theory	Engineering Drawing	Vocational Science & Calculation
1-3	Study of – Half wave rectifier ckt. Full wave rectifier ckt. Bridge rectifier ckt. Filter ckt Oscilloscope Different wave shapes and their values using C.R.O.	Explanation and importance of D.C. Rectifier ckt. Half wave, Full wave and Bridge ckt. L.E.D. and Solar cells. Filter circuits-passive filter. Working principle and uses of an oscilloscope.	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.
4-5	Study of a transistors- Identification of construction and terminals. Testing of Transistors Study of the characters of transistors.	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	Drawing of B.I.S/I.S.I. symbols for Electronic devices Drawing of half wave, Full wave and Bridge circuits.	-do-
6-7	Assembly and testing of a single stage Amplifier and checking in an oscilloscope. Study of types of wave shapes & Cascade Amplifier. Study of power amplifier. Uses of standard I.C Amplifier 810	Explanation of transistor Amplifiers, Amplifiers. – class A,B & C Power amplifier.	Drawing circuits 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.
8	Study of oscillator Voltage measurement current And study wave shapes in scope.	Explanation of oscillator-working principle Explanation of stages and types. Multivibrator – applications.	-do-	-do-
9	Study of various Op. Amp. Application and Timers.	OP-AMP – Working principles and applications. Timer I.C.555	- do -	Electricity, Effects of electric current.

10-12	Studies of simple circuits containing U.J.T. for triggering. -do- FET as an amplifier. -do- Power control circuits by S.C.R. & Diac, triac, I.G.B.T.	Introduction of basic concept of ICs, U.J.T., F.E.T., basic concept of power electronics devices e.g. S.C.R. Diac, Triac, power MOSFET, G.T.O & I.G.B.T.	Drawing of circuits containing U.J.T. F.E.T. & Simple power control circuits.	-do-
13-15	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.	D.C/A.C Power control using power transistor, thyristor. Voltage stabilizer, U.P.S. DC/AC motor drives using transistor/thyristor. Voltage regulator .	Block diagram of Voltage regulator .	Meaning of Horse Power & Brake horsepower. Simple problems on work, power & energy.
16-17	Demonstration on power supply stabilizer. Study Op DC. /AC. Motor Drives.	Power Supply Stabilizer, Ferro resistant . DC/AC motor drives using Thyristor/Transistor control.	-do-	Rectifier, Maximum, Average, R.M.S. current in rectifiers, from factor, ripple factor.
18-19	Study of Logic gates and circuits. Flip Flops, Counter, Register & Timer. Using digital I.C. chips	**Digital Electronics** -Binary numbers, logic gates and combinational circuits, Flip Flops, Counter, Register & Timer.	Free hand drawing of Logic gates and s.	Number system decimal and binary, Hexa decimal. BCD code, conversation from decimal to binary and vice-versa.
20-22	Practice in wiring and in maintenance of institute and hostel, hotel, residential building. Layout and repairing of workshop electrical installation. Practice on Auto wiring.	Complete House-wiring layout. splitting load wire in accordance with NEC . I.E.E. Rules. Multistoried system. Fault finding and trouble shooting of domestic electrical appliances.	Schematic drawing of house wiring.	
23-24	Installation Fault finding practice	**Decorative lighting -** Fault finding techniques in Decoration lighting.	-do-	-do-
25	Revision			
26	Examination			

TRADE: ELECTRICIAN

LIST OF TOOLS & EQUIPMENT

A. TRAINEES TOOL KIT FOR 16 TRAINEES +1 INSTRUCTOR

TOOL KIT		
Sl. No.	**Name of the items**	**Quantity**
1	Steel Tape, 10 m length	17 Nos.
2	Plier Insulated, 150 mm	17 Nos.
3	Plier Side Cutting, 150 mm	17 Nos.
4	Screw Driver, 100 mm	17 Nos.
5	Screw Driver, 150 mm	17 Nos.
6	Electrician Connector, screw driver insulated handle thin stem, 100 mm	17 Nos.
7	Heavy Duty Screw Driver , 200 mm	17 Nos.
8	Electrician Screw Driver thin stem insulated handle, 250 mm	17 Nos.
9	Punch Centre , 150 mm X 9 mm	17 Nos.
10	Knife Double Bladed Electrician	17 Nos.
11	Neon Tester	17 Nos.
12	Steel Rule 300 mm	17 Nos.
13	Hammer, cross peen with handle	17 Nos.
14	Hammer, ball peen With handle	17 Nos.
15	Gimlet 6 mm.	17 Nos.
16	Bradawl	17 Nos.
17	Scriber (Knurled centre position)	17 Nos.
18	Pincer 150 mm	17 Nos.

B. SHOP TOOLS, INSTRUMENTS & MACHINERY

1	C- Clamp 200 mm, 150 mm and 100 mm	2 Nos each
2	Spanner Adjustable 150 mm, 15 degree	2 Nos each
3	Blow lamp 0.5 ltr	1 No
4	Melting Pot	1 No
5	Ladel	1No
6	Chisel Cold firmer 25 mm X 200 mm	2 Nos
7	Chisel 25 mm & 6 mm	2 Nos each
8	Hand Drill Machine 0 to 6 mm capacity	1 No
9	Portable Electric Drill Machine 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 ltr	1 No
13	Grease Gun	1 No
14	Out Side Micrometer 0 to 25 mm	2 Nos
15	Motorised Bench Grinder	1 No
16	Rawl plug tool & bit	2 set
17	Pully Puller	2 Nos
18	Bearing Puller	2 Nos
19	Hygrometer	1 set
20	Thermometer 0 to 100 deg Centigrade	1 No
21	Scissors blade 150 mm	4 Nos
22	Crimping Tool	2 sets
23	Wire stripper 20 cm	2 Nos
24	Chisel Cold flat 12 mm	2 Nos
25	Mallet hard wood 0.50 kg	4 Nos
26	Hammer Exeter type 0.40 kg	4 nos

27	Hacksaw frame 200 mm 300 mm adjustable	2 Nos each
28	Try Square 150 mm blade	4 nos
29	Outside & Inside Divider Calliper	2 Nos each
30	Pliers flat nose 150 mm	4 Nos
31	Pliers round nose 100 mm	4 Nos each
32	Tweezers 100 mm	4Nos
33	Snip Straight & Bent 150 mm	2 Nos each
34	D.E. metric Spanner	2 Nos
35	Drill hand brace 0 to 100 mm	4 Nos
36	Drill S.S. Twist block 2 mm, 5 mm 6 mm set of 3	4 set
37	Plane, smoothing cutters 50 mm	4 Nos.
38	Gauge, wire imperial	2 Nos
39	File flat 200 mm 2nd cut	8 Nos.
40	File half round 200 mm 2nd cut	4 Nos
41	File round 200 mm 2nd cut	4 Nos.
42	File flat 150 mm rough	4 Nos.
43	File flat 250 mm bastard	4 Nos.
44	File flat 250 mm smooth	4 Nos.
45	File Rasp, half round 200 mm bastard	4 Nos
46	Soldering Iron 25 watt, 65 watt, 125 watt	4 Nos each
47	Copper bit soldering iron 0.25 kg.	4 Nos.
48	Desoldering Gun	4 Nos
49	Hand Vice 50 mm jaw	4 Nos
50	Table Vice 100 mm jaw	8 Nos
51	Pipe Cutter to cut pipes upto 5 cm. dia	4 Nos
52	Pipe Cutter to cut pipes above 5 cm dia	2 Nos
53	Stock and Die set for 20 mm to 50 mm G.I. pipe	1 set
54	Ohm Meter; Series Type & Shunt Type	2 Nos each
55	Stock and Dies conduit	1 No
56	Multi Meter (analog) 0 to 1000 M Ohms, 2.5 to 500 V	2 Nos
57	Digital Multi Meter	6 Nos
58	A.C. Voltmeter M.I. 0 –500V A.C	1 No
59	Milli Voltmeter centre zero 100 – 0 – 100 m volt	1 No
60	D.C. Milliammeter 0 -500m A	1 No
61	Ammeter MC 0-5 A, 0- 25 A	1 No each
62	A.C. Ammeter M.I.. 0-5A, 0-25 A	1 No each
63	Kilo Wattmeter 0-1-3 kw	1 No
64	A.C. Energy Meter,Single phase 5 amp. Three Phase 15 amp	1No each
65	Power Factor Meter	1 No
66	Frequency Meter	1 No
67	Tachometer with watch	1 No
68	Current Transformer	1 No
69	Potential Transformer	1 No
70	Growler	1 No
71	Tong Tester / Clamp Meter 0 – 100 amp. AC	1 No
72	Megger 500 volts	1 No
73	Wheat Stone Bridge with galvanometer & battery	1 No
74	Contactor & auxiliary contacts 3phase, 440volt, 16amp	1 No each
75	Contactor & auxiliary contacts 3 phase, 440 volt, 32 amp.	1 No each
76	Limit Switch	1 No
78	Rotary Switch 16 A	1 No
79	Load Bank5 KW(Lamp / heater Type)	1 No
80	Brake Test arrangement with two spring balance 0 to 25 kg rating	1 No
81	Knife Switch DPDT fitted with fuse terminals 16 amp	4 Nos
82	Knife Switch TPDT fitted with fuse terminals 16 amp	4 Nos

83	DC Power Supply	1 No
84	Inverter- 1 KVA with 12 V Battery Input- 12 volt DC, Output- 220 volt AC	1 No
85	Voltage Stabiliser Input: 150 – 230 volt AC Output: 220 volt AC	1 No
86	Rheostat 0 -1 Ohm, 5 Amp 0 -10 Ohm, 5 Amp 0- 25 Ohm, 1 Amp 0- 300 Ohm, 1 Amp	1 Nos. Each
87	Domestic Appliances – a. Electric Hot Plate 1500 watt b. Electric Kettle, 100 watts c. Electric Iron 1200 watts d. Immersion Heater 500/100/2000 watt e. A.C. Fan f. Geyser (Storage type) 15 ltr minimum g. Mixture & Grinder	 1 No 1 No 1 No 1 No 1 No 1 No 1 No
88	Flux meter	1 No
89	Laboratory Type Induction Coil	1 no
90	3- point D.C. Starter	1 no
91	4- point D.C. Starter	1 no
92	Relays- a. Cut out b. Reverse current c. Over current d. Over load e. Under voltage	1 No each
93	Starters for 2 to 5 H.P. A.C Motors- a. Resistance type starter b. Direct on line Starter c. Star Delta Starter- manual, semi-automatic and automatic d. Auto Transformer type	1 No each
94	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 units	1 for 8 (4+4) Units
95	Motor-Generator (AC to DC) consisting of : 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 HP, 400V, 50 cycles, 3 phase DC Shunt Generator rating: 5 KW, 440V	1 No
96	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,	1 No

	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	
97	Used DC Generators-series, shunt and compound type for overhauling practice	1No each
98	D.C. Shunt Generator with control panel, 2.5 KW, 230 V	1 No
99	D.C. Compound Generator with control panel including fitted rheostat, voltmeter, ammeter and breaker, 2.5 KW, 230 V	1 No
100	Diesel Generator Set with change over switch, over current breaker and water-cooled with armature, star-delta connections AC 3 phase, 5 KVA, 230 volt	1 No
101	DC Series Motor coupled with mechanical load 0.5 to 2 HP, 220 Volts	1 No
102	DC Shunt Motor 2 to 3 HP, 220 volts	1 No
103	DC compound Motor with starter and switch 2 to 3 HP, 220 volts	1 No
104	AC Squirrel Cage Motor with star delta starter and triple pole iron clad switch fuse. 2 to 3 HP, 3-phase ,400 volts, 50 cycles	1 No
105	AC phase-wound slip ring Motor with starter and switch 5 HP, 400 volts, 3-phase, 50 cycles	1 No
106	A.C. Series type Motor with mechanical load ¼ HP, 230V, 50 cycles	1 No
107	Single Phase Capacitor Motor with starter switch 1 HP 230 volt 50 cycles	1 No
108	Universal Motor with starter/switch 230 volt, 50 cycles ¼ HP	1 No
109	Stepper Motor with Digital Controller	1 No
110	Shaded Pole Motor	1 No
111	Single phase Transformer, core type, air cooled	1 No
112	Three phase transformer, shell type oil cooled	1 No
113	Variable Auto Transformer	1 No
114	Oscilloscope Dual Trace,30 MHZ	1 No
115	Function Generator	1 No
116	Discrete Component Trainer	1 No
117	Linear I.C.Trainer	1 No
118	Digital I.C.Trainer	1 No
119	Bath Impregnating	1 No
120	Oven Stove	1 No
121	Oil Testing Kit	1 No
122	Battery Charger	1 No
123	Hydrometer	1 No
124	Air Breaker 5 KVA	1 No
125	Miniature Breaker 16 amp	1 No
126	Thyristor/IGBT controlled D.C. motor drive with tacho-generator feedback arrangement. 1 HP	1 No
127	Thyristor/IGBT controlled A.C. motor drive with VVVF control 3 Phase, 2 HP	1 No

128	Working Bench 2.5 m x 1.20 m x 0.75 m	4 Nos
129	Fire Extinguisher	2 Nos
130	Fire Buckets	2 Nos

C.WORKSHOP FURNITURE:

Sl. No.	Name of the items	Quantity
1	Instructor's table	1 No
2	Instructor's chair	2 Nos
3	Metal Rack 100cm x 150cm x 45cm	4 Nos
4	Lockers with 16 drawers standard size	2 Nos
5	Almirah 2.5 m x 1.20 m x 0.5 m	1 No
6	Black board/white board	1 No

NOTE :

1. For 2nd Unit of the Trade, only Trainees Tool Kit (from Sl No- 1 to 18) is required additionally.

2. Sl no- 94, Electrical Machine Trainer up to 8 (4+4) units- ONE no.

3. Sl no- 95 to 130, for 4 (2+2) units no additional items are required