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

COMPETENCY BASED CURRICULUM

WIREMAN

(Duration: Two Years)

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 4

SECTOR – POWER

Directorate General of Training

WIREMAN

(Engineering Trade)

(Revised in 2019)

Version: 1.2

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 4

Developed By

Ministry of Skill Development and Entrepreneurship

Directorate General of Training

CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE

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Kolkata – 700 091

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7. TRADE SYLLABUS

SYLLABUS FOR WIREMAN TRADE			
FIRST YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 125 Hrs; Professional Knowledge 35 Hrs	Make good quality electrical wire joints for single and multi strand conductors suitable for applications with soldering following electrical safety precautions.	1. Implementation in the shop floor of the various safety measures. (2 hrs.) 2. Visit to the different sections of the Institute. (3 hrs.) 3. Demonstration on elementary first aid. Artificial Respiration. (2 hrs.) 4. Practice on use of fire extinguishers. (3 hrs.) 5. Occupational Safety & Health Importance of housekeeping & good shop floor practices. (3 hrs.) 6. Health, Safety and Environment guidelines, legislations & regulations as applicable. Disposal procedure of waste materials like cotton waste, metal chips/burrs etc. (4 hrs.) 7. Basic safety introduction, Personal protective Equipment (PPE):- Basic injury prevention, Basic first aid, Hazard identification and avoidance, safety signs for Danger, Warning, caution &	**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. Concept of Standard Operation of electrical mains. Introduction of PPEs. Introduction to 5S concept & its application. Response to emergencies eg; power failure, fire, and system failure. (07 Hrs)

		personal safety message. (3 hrs.) 8. Preventive measures for electrical accidents & steps to be taken in such accidents. (5 hrs.)	
		9. Demonstration of Trade hand tools. (6 hrs.) 10. Identification of simple types-screws, nuts & bolts, chassis, clamps, rivets etc. (7 hrs.) 11. Use, care & maintenance of various hand tools. Familiarization with signs and symbols of Electrical accessories. (12 hrs.)	Identification of Trade-Hand tools-Specifications. (07 hrs)
		12. Practice in using cutting pliers, screw drivers etc. skinning the cables, and joint practice on single strand. (20 hrs.) 13. Demonstration & Practice on bare conductors joints--such as rat tail, Britannia, straight, Tee, Western union Joints. (30 hrs.)	Fundamental of electricity. Electron theory- free electron, Fundamental terms, definitions, units & effects of electric current. (14 hrs)
		14. Practice in soldering & brazing- measurement of Resistant and measurement of specific resistant. (15 hrs.) 15. Application of Wheatstone bridge in measurement of resistance. (10 hrs.)	Solders, flux and soldering technique. Resistors types of resistors & properties of resistors. (07 hrs)
Professional Skill 50 Hrs; Professional Knowledge	Draw and set up DC and AC circuits including R-L-C circuits with accurate	16. Demonstration and identification of types of cables. (6 hrs.) 17. Demonstration & practice on using standard wire gauge &	Introduction of National Electrical Code 2011 Explanation, Definition and properties of conductors, insulators and semi-conductors. Voltage grading of different types

14 Hrs	measurement of voltage, current, resistance, power, power factor and energy using ammeter, voltmeter, ohm-meter, watt-meter, energy meter, power factor meter and phase sequence tester with proper care and safety.	micrometer. (6 hrs.) 18. Practice on crimping thimbles, Lugs. (5 hrs.) 19. Examination and checking of cables and conductors and verification of materials according to the span. (8 hrs.)	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. (07 hrs)
		20. Verification of Ohm's Law. (2 hrs.) 21. Verification of Kirchhoff's Laws. (3 hrs.) 22. Verification of laws of series and parallel circuits. (4 hrs.) 23. Verification of open circuit and closed circuit network. (3 hrs.) 24. Measuring unknown resistance using Wheatstone bridge, voltage drop method. (6 hrs.) 25. Experiment to demonstrate the variation of resistance of a metal with the change in temperature. (7 hrs.)	**Ohm's Law -** Simple electrical circuits and problems. Reading of simple Electrical Layout. **Resistors** -Law of Resistance. Series and parallel circuits. **Kirchhoff's** Laws and applications. Wheatstone bridge principle and its applications. Effect of variation of temperature on resistance. Different methods of measuring the values of resistance. (07 hrs)
Professional Skill 25 Hrs; Professional Knowledge 07 Hrs	Plan, draw, estimate material, wire up and test different type of domestic wiring circuits as per Indian Electricity rules and taking care of quality. Construction and working of MCB &	26. Practice on installation and overhauling **common electrical accessories** as per simple Electrical circuit / Layout. (10 hrs.) 27. Fixing of switches, holder plugs etc. in T.W. boards. (8 hrs.) 28. Identification and use of **wiring** accessories concept of switching. (7 hrs.)	**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. (07 hrs)

	ELCB. Test a domestic wiring installation using Megger.		
Professional Skill 75 Hrs; Professional Knowledge 21 Hrs	Identify the type of batteries, construction, working and application of Ni-cadmium, lithium cell, lead acid cell etc. Demonstrate their charging and discharging, choosing appropriate method and carryout the installation and routine maintenance with due care and safety.	29. Assembly of Dry cell-Electrodes-Electrolytes. (4 hrs.) 30. Grouping of Dry cells for a specified voltage and current, Ni cadmium & Lithium cell. (4 hrs.) 31. Practice on Battery Charging, preparation of battery charging. (4 hrs.) 32. Testing of cells, Installation of batteries, Charging of batteries by different methods. (8 hrs.) 33. Practice on Electroplating and anodizing, Cathodic protection. (5 hrs.)	**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, Anodizing. Different types of lead acid cells. (07 hrs)
		34. Routine care & maintenance of Batteries. (25 hrs.)	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. (07 hrs)
		35. Charging of a Lead acid cell, filling of electrolytes- Testing of charging checking of discharged and fully charged battery. (25 hrs.)	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. (07 hrs)
Professional Skill 100 Hrs; Professional	Make choices to carry out basic jobs of marking out the components for	36. Marking use of chisels and hacksaw on flats, sheet metal filing practice, filing true to line. (26 hrs.)	**ALLIED TRADES:** Introduction of fitting trade. Safety precautions to be observed Description of files, hammers,

Knowledge 28 Hrs	filing, drilling, and riveting, fitting and assembled using different components independently.	37. Sawing and planning practice. Practice in using firmer chisel and preparing simple half lap joint. (24 hrs.)	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. (14 hrs)
		38. Drilling practice in hand drilling & power drilling machines. Grinding of drill bits. (8 hrs.) 39. Practice in using taps & dies, threading hexagonal & square nuts etc. (8 hrs.) 40. Cutting external threads on stud and on pipes, riveting practice. (9 hrs.)	Types of drills description & drilling machines, proper use, care and maintenance. Description of taps & dies, types in rivets & riveted joints. Use of thread gauge. (07 hrs)
		41. Practice in using snips, marking & cutting of straight & curved pieces in sheet metals. (6 hrs.) 42. Bending the edges of sheets metals. (6 hrs.) 43. Riveting practice in sheet metal. Practice in making different joints in sheet metal in soldering the joints. (13 hrs.)	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. (07 hrs)
Professional Skill 100 Hrs; Professional Knowledge	Draw and set up DC and AC circuits including R-L-C circuits with accurate measurement of	44. Trace the magnetic field. (8 hrs.) 45. Assembly / winding of a simple electro magnet. (12 hrs.) 46. Use of magnetic compass. (6	**Magnetism –** Classification of magnets, methods of magnetising, magnetic materials. Properties, care and maintenance. Para and Diamagnetism and

28 Hrs	voltage, current, resistance, power, power factor and energy using ammeter, voltmeter, ohm-meter, watt-meter, energy meter, power factor meter and phase sequence tester with proper care and safety.	hrs.) 47. Identification of different types of Capacitors. (10 hrs.) 48. Charging and discharging of capacitor. (8 hrs.) 49. Testing of Capacitors using DC voltage and lamp. (8 hrs.)	Ferro magnetic materials. Principle of electro-magnetism, Maxwell's corkscrew rule, Fleming's left and right hand rules, Magnetic field of current carrying conductors, loop and 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 and uses. (14 hrs)
		50. Determine the characteristics of RL, RC and RLC in A.C. Circuits both in series and parallel. (13 hrs.) 51. Experiment on poly phase circuits. (8 hrs.) 52. Current, voltage, power and power factor measurement in single & poly- phase circuits. (15 hrs.) 53. Measurement of energy in single and poly-phase circuits. (8 hrs.) 54. Use of phase sequence meter. (6 hrs.)	**Alternating Current -**Comparison and Advantages D.C and A.C. Related terms frequency Instantaneous value, R.M.S. value Average value, Peak factor, form factor. Generation of sine wave, phase and phase difference. Inductive and Capacitive reactance Impedance (Z), power factor (p.f). Active and Reactive power, Simple problems on A.C. circuits, single Phase and three-phase system etc. Problems on A.C. circuits. Power consumption in series and parallel, P.F. etc. Concept three-phase Star and Delta connection. Line and phase voltage, current and power in a 3 phase circuits with balanced and unbalanced load. (14 hrs)

Professional Skill 25 Hrs; Professional Knowledge 07 Hrs	Plan and install Pipe & Plate earthing. Measure earth resistance by earth tester.	55. **Practice on Earthing** – different methods of earthing.(13 hrs.) 56. Measurement of Earth resistance by earth tester.(6 hrs.) 57. Testing of Earth Leakage by ELCB and relay. (6 hrs.)	**Earthing**- Principle of different methods of earthing. i.e. Pipe, Plate, etc Importance of Earthing. Improving of earth resistance Earth Leakage circuit breaker (ELCB). In absence of latest revision in respective BIS provision for Earthing it is recommended to follow IEC guidelines. (07 hrs)
Professional Skill 75 Hrs; Professional Knowledge 21 Hrs	Select and perform electrical/ electronic measurements with appropriate instrument.	58. Determine the resistance by Colour coding. (4 hrs.) 59. Identification of active/passive components. (5 hrs.) 60. **Diodes**-symbol - Tests - Construct & Test Half wave rectifier ckt. (8 hrs.) 61. Full wave rectifier ckt. Bridge rectifier ckt. (8 hrs.)	**Basic electronics**- Semiconductor energy level, atomic structure 'P' type and 'N' type. Type of materials –P-N-junction. Classification of Diodes – Reverse and Forward Bias, Heat sink. Specification of Diode PIV rating. Explanation and importance of D.C. rectifier circuit. Half wave, Full wave and Bridge circuit. Filter circuits-passive filter. (07 hrs)
		ELECTRICAL MEASURING INSTRUMENTS- 62. Measurement of voltage, current & resistance in different circuits. (5 hrs.) 63. Direct & indirect measurement of electrical power & energy. (6 hrs.) 64. Calibration of energy meters. (6 hrs.) 65. Measurement of current and voltage using CT & PT, Measurement of 3 Phase energy using CT & PT. Phase	Type of measuring instruments – MC & MI, Construction & working principles of Ammeter, Voltmeter, Ohm-meter ,Wattmeter, Energy meter, P.F. meter, frequency meter, multi meter, clamp meter, Megger & earth tester. Introduction of Digital meters. CT & PT. Tong tester / Clip on Meter. (14 hrs)

		sequence meter, measure current and voltage using Tong tester. (12 hrs.) 66. Power measurement by Two & Three watt meter method Insulation resistance test by Megger. (7 hrs.) 67. Measurement of earth resistance by earth tester. (4 hrs.) 68. Calibration of indicating type analogue instruments: voltmeter, ammeter, and wattmeter. Measurement of soil conductivity. Introduction of Digital meters. (10 hrs.)	
Professional Skill 150 Hrs; Professional Knowledge 42 Hrs	Plan, draw, estimate material, wire up and test different type of domestic wiring circuits as per Indian Electricity rules and taking care of quality. Construction and working of MCB & ELCB. Test a domestic wiring installation using Megger.	**DOMESTIC WIRING - METHODS, INSTALLATION & TESTING-** 69. Demonstration & Practice on connecting **common electrical accessories** in circuits and testing them in series board. (8 hrs.) 70. Demonstration on Testing & replacement of different types of fuses. (6 hrs.) 71. Identification of different **wiring** materials and their specifications. (6 hrs.) 72. Removing of insulation from assorted wires and cables. (10 hrs.) 73. Demonstration and practice crimping thimbles/lugs of various sizes. (8 hrs.) 74. Jointing practice with single and multi-stranded conductors of different wires	Introduction and explanation of electrical **wiring** systems, cleat wiring, casing & Capping, CTS, Conduit and concealed etc., I. E. Rules. Related to **wiring**, National Building codes for house **wiring**, specification and types, rating & material. (07 hrs)

		and cables. (12 hrs.)	
		75. Layout on **wiring** boards. (5 hrs.) 76. Practice in P.V.C. insulated cable **wiring** on wood buttons with distribution board and number of points. (10 hrs.)	Branching of circuits with respect to loads such as lighting and power. CTS/PVC Conduit-surface and concealed/ metal conduit/ PVC casing and capping. IE rules regarding clip distance. Fixing of screws, cable bending etc. (07 hrs)
		77. Practice of **wiring**: A) One lamp controlled by one SP switch, (B) Two lamps controlled by two independent switches, (C) One lamp controlled by two 2way switches (Staircase **wiring**), (D)One lamp controlled by intermediate switch from three different locations, (E)Hospital wiring, (F)Tunnel/ Godown wiring, (G)Hostel wiring, (H)Bell Buzzer Indicator wiring, (I)Domestic wiring practice. (15 hrs.)	Description of different electrical fittings and accessories such as lamp holders, switches, plugs brackets, ceiling rose, cut out etc. IS 732- 1863.Wiring materials used for P.V.C. cables I.E. rules, Indian standards regarding the above wiring such as-clip distance fixing of screws, cable bending etc. (07 hrs)
		78. Demonstration and practice of using Rowel tools. (8 hrs.) 79. Demonstration and practice of casing and capping wiring. (10 hrs.) 80. Testing of wiring installation by using Megger. (7 hrs.)	Description of Rowel tools and Rowel plugs, their sizes, plugging, compound, plugs- wall jumper and their sizes and uses. Introduction to estimation procedure, P.V.C. casing and capping materials, sizes and grades etc. (07 hrs)
		81. Demonstration and practice in cutting and threading conduit pipes. (6 hrs.) 82. Cold and hot bending of pipes. (6 hrs.)	Conduit pipe wiring materials and accessories, types and sizes of conduit. (07 hrs)

		83. Fitting of conduit accessories. (13 hrs.)	
		84. Preparation of conduit threads using different fittings and use of running threads wiring in conduit, using metal clad 3 pin plug, Earthing the conduit using earth clips and earth wire. (20 hrs.)	Layout of Light points, fan points etc. Layout of heating leads etc.- their controls, main switches, distribution boards as per **I.E. rules.** I. E. Rules for earthing conduits using earth clips and earth wire as per IS 732-1863. (07 hrs)
Professional Skill 25 Hrs; Professional Knowledge 07 Hrs	Plan and execute electrical illumination system viz. FL tube, HPMV lamp, HPSV lamp, Halogen & metal halide lamp, CFL, LED lamp etc.	**ILLUMINATION:-** 85. Installation of - Neon Sign tube, Mercury vapour (H.P. & L.P.), Sodium vapour, Halogen Lamps, single tube, double tube, Metal halide lamps. Emergency light. (9 hrs.) 86. Practice on decoration lighting. (7 hrs.) 87. Practice on using LUX Meter. (4 hrs.) 88. Installation and testing of CFL Lamps and LED Lamps (5 hrs.)	Introduction of Illumination- Terms & definitions, laws of illumination, illumination factors, intensity of light –importance of light, colour available. Construction, working & applications of – Incandescent lamp, Fluorescent tube, CFL, Neon sign, Halogen, Mercury vapour and types, sodium vapour etc. Decoration lighting, Drum Switches etc. (07 hrs)
Professional Skill 75 Hrs; Professional Knowledge 21 Hrs	Plan, draw, estimate material, wire up and test different type of industrial wiring circuits as per Indian Electricity rules and taking care of quality.	**INDUSTRIAL WIRING-** 89. Tests on insulating materials. (15 hrs.) 90. Measurement of insulation resistance, of commercial and industrial installation Additional practice in conduit wiring. (30 hrs.) 91. Industrial power wiring involving single phase & 3phase motors with switches & starters. (30 hrs.)	Connections of different types of motors used in industry, their normal methods of wiring, Control , starting and protection devices-their connections, layouts and earthing Code practice for earthing of Industrial Wiring. Wiring methods & types in workshop & factories. (21 hrs)
Professional Skill 75 Hrs;	Plan, draw, estimate material, wire up and test	**COMMERCIAL WIRING-** 92. Inverter wiring./ Control panel wiring / multi-storeyed	Wiring in commercial building- their special precautions as per I.E. rules.

Professional Knowledge 21 Hrs	different type of commercial and computer networking wiring circuits as per Indian Electricity rules and taking care of quality.	building wiring. (15 hrs.) 93. Introduction to LAN wiring. (7 hrs.)	Introduction to LAN wiring. (07 hrs)
		94. Installation of 1 ph. and 3 ph. on line / off line UPS wiring. (15 hrs.) 95. Testing of Industrial wiring and UPS wiring installation. (20 hrs.)	Power drives - Introduction, types, advantages & disadvantages. UPS- Introduction, types, Load calculation, Backup time calculation. (07 hrs)
		96. Straight and cross crimping of RJ-45 cable. (08 hrs.) 97. Crimping of co-axial cable, proper installation of co-axial cable from dish antenna to Television set. (10 hrs.)	Computer networking - Identification of network hardware / component. CAT-6 cable, RJ-45. DTH- Introduction of direct to home system, Music channel wiring/interconnecting couplers. (07 hrs)
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Plan, draw, estimate material, wire up and test different type of industrial wiring circuits as per Indian Electricity rules and taking care of quality.	98. Industrial wiring installations for mixed load, both light and power. (9 hrs.) 99. Layout of L.V. AC/DC machines and their panels. (3 hrs.) 100. Wiring of Low power A.C./ D.C. machines in metal conduit system as per I.E. Rules. (10 hrs.) 101. Testing of wiring installation. (3 hrs.)	General idea of fixing meter boards & taking service connection. Sealing of I.C. cut out & meters as per I.E. Rules, General Electric Appliances using heating effect – their capacities, voltage ranges, Calculation of current. (07 hrs)
		102. Wiring of different circuit using Single core cable use for 2 ways, intermediate master switches etc. (20 hrs.) 103. Testing of wiring installation. (5 hrs.)	Explanation of inter connection wiring circuits in the main building and auxiliary blocks, meter boards and its locations. Study of layout symbols in the preparation of layout diagrams. (07 hrs)
Professional	Plan, draw, estimate material,	**COMPUTER AWARENESS:** 104. Identification of Computer	Block diagram of computer, main parts inside the system unit, ports

Skill 50 Hrs; Professional Knowledge 14 Hrs	wire up and test different type of commercial and computer networking wiring circuits as per Indian Electricity rules and taking care of quality.	Parts, Switching ON/OFF of PC, Safety Precautions. (5 hrs.) 105. Identifying and using Windows, like folders, files, Editing and saving. (12 hrs.) 106. Windows Explorer, Notepad, Paint and calculator. (12 hrs.) **OFFICE PACKAGE& INTERNET:** 107. Using /Practicing WORD, EXCEL, POWER POINT for communication. (16 hrs.) 108. Documentation. (2 hrs.) 109. Internet Practicing – Browsing/ Creating Email, Downloading. (3 hrs.)	& connectors, of PC parts & peripherals associated with PC like-keyboard, Mouse, Printers, Scanners, Camera, Modem, External Storage Devices & UPS. Features of Operating System like M.S. Windows, Components of Windows- Calculator, Notepad, Paint, Windows Explorer. **INTERNET:** Websites, Browsing, Downloading Creating and Using E-mail ID's Using it for Communications. (14 hrs)
In plant training / Project work			

SYLLABUS FOR WIREMAN TRADE			
SECOND YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 100 Hrs; Professional Knowledge 36 Hrs	Construct and test Half–wave, full-wave, and bridge rectifiers with filter & without filter. Trouble shoot and service of DC regulated power supply.	110. Identify the terminals of LED, Diode, transistor, Zener diode, UJT, SCR, regulator ICs and test it. (25 hrs.)	LED, Diode, types of transistor, UJT, SCR, regulator ICs and Zener diode uses and its application. (09 hrs)
		111. Construct and test variable DC power supply and trouble shoot the defects in a simple power supply. (25 hrs.)	IC- voltage regulator pin configurations and applications. (09 hrs)
		112. Construction & testing of various electrical circuits with different accessories. (15 hrs.) 113. Connection of Calling Bell, Buzzer, Electric Iron, Heater, Light & Fan etc. (15 hrs.) 114. Practice in **soldering** and brazing by following Indian Electricity rules. (20 hrs.)	**Common Electrical Accessories**, their specifications-Explanation of switches, lamp holders, plugs and sockets etc. Development of domestic circuits using switches, fuse, MCB, sockets, lamp, fan, calling bell/buzzer, Two way switch, I.C.T.P, I.C.D.P, MCCB, ELCB, RCCB etc. Importance of Neutral, effect of opening of neutral wire. **Soldering**- Solders, flux and soldering techniques. Types of soldering irons-their proper use. (18 hrs)
Professional Skill 150 Hrs; Professional Knowledge 54 Hrs	Interpret the constructional features, working principles of DC machine. Starting with suitable starter, running,	**D.C. GENERATORS,** 115. Identification of the parts of D.C. Generators. (5 hrs.) 116. Testing and measuring the field and Armature resistances. (5 hrs.) 117. Dismantle the D.C.	Introduction to D.C Generators and working principle, parts of D.C. Generator. Classification of Generators- Self excited and separately excited-their application in practical field. (09 hrs)

	forward and reverse operation and speed control of DC motors. Conduct the load performance test of DC machine with due care and safety. Maintain and troubleshoot of DC machines.	Generator and Reassemble and test for its working. (15 hrs.)	
		118. Identification of different parts of generators testing fields & Apparatus. (12 hrs.) 119. Insulation resistance measurements. (8 hrs.) 120. Building up of voltage and loading generators. (10 Hrs.) 121. Servicing of generators including replacing of carbon brushes. (20 hrs.)	Types and characteristics of D.C. Generators – Series, Shunt and compound, their applications. Explanation of Armature reaction, interlopes, commutation and EMF equation of DC generators. Parallel operation of Generators. (18 hrs)
		MOTORS & STARTER: 122. Practice in connecting generators- Generators- Testing of D.C. Machines by Megger. (12 hrs.) 123. General maintenance of D.C. machines. (13 hrs.)	**I**ntroduction to D.C. Motor- Working principle, types of motors Explanation of terms used Torque, speed, Back E.M.F. etc. Characteristics, Speed control of DC motors. (09 hrs)
		124. Testing of D.C. Motors - connect run and change direction of rotation. (12 hrs.) 125. Study of DC starters- 2 point 3 point and 4 point speed control of D.C. Motors and speed measurement. (13 hrs.) 126. Use Revolution counter. (6 hrs.) 127. Trouble shooting and fault rectification. Identify and test different types of D.C motors. (19 hrs.)	Necessity of starter- Types of starters, 2 point 3 point and 4 point starters, Protective devices used. Methods of speed control, advantages, disadvantages & Industrial applications. Trouble shooting and fault rectification. (18 hrs)
Professional Skill 50 Hrs;	Interpret the constructional features, working	128. Tests on 3 phase circuit. (10 hrs.) 129. Current and voltage	Introduction to A.C. Poly phase systems- advantages, 3 phase star delta. Terms used in 3Ø systems,

Professional Knowledge 18 Hrs	principles of single phase and 3 phase AC motors. Starting with suitable starter, running, forward and reverse operation and speed control of AC motors with due care and safety.	measurement in star and delta connections. (12 hrs.) 130. Measurement A.C. 3 ph. power. (18 hrs.) 131. Determine the V and I relation in Star/Delta connections in a 3-Ph motor. (10 hrs.)	connection and their relations w.r.t. current and voltage. Principle of measurement of A.C. 3 ph. Power. Simple calculation of A.C. 3 phase circuit parameter - I, V, Z & P.F. etc (18 hrs)
Professional Skill 50 Hrs; Professional Knowledge 18 Hrs	Interpret the constructional features, working principles of Alternator set. Test, Wire-up and run alternator. Synchronization of Alternator with due care and safety.	**A.C. GENERATORS, MOTORS & STARTERS** 132. Identification of Alternator of parts. (10 hrs.) 133. Running of Alternator by prime mover and loading it to find out regulation at different loads. Testing of alternators (IR tests). (28 hrs.) 134. Connect and test Parallel operation of alternators. (12 hrs.)	Parts and construction of Alternators, principle of working, types of Alternators, EMF equation. Various applications and power rating of alternators. General idea of loading and regulation of Alternator. Parallel operation of Alternators, synchronising methods. (18 hrs)
Professional Skill 175 Hrs; Professional Knowledge 63 Hrs	Interpret the constructional features, working principles of single phase and 3 phase AC motors. Starting with suitable starter, running, forward and reverse operation and speed control of AC motors with due care and safety.	135. Demonstration and practice on A.C single phase motors starting and running for specific requirements. (25 hrs.)	Introduction to A.C single phase motors and types. Capacitors start/run- start and run. FHP motors and their uses. Various application of A.C single phase motors. (09 hrs)
		136. Constructional details of three phase squirrel cage induction motor and slip ring induction motor. (12 hrs.) 137. Determination of slip and efficiency. (8 hrs.) 138. Familiarization of DOL	**Three phase Induction motor: -** Construction, Principle of operation of Three phase induction motor. Squirrel cage induction motor and slip ring induction motor. Rotor slip, rotor frequency and rotor torque. Factors affecting torque.

		starter, Star- delta starter, Autotransformer starter and slip ring IM starter. (15 hrs.) 139. Phase sequence test on three phase IM motors, Single phasing preventer. (14 hrs.) 140. Identification of A.C and D.C motors (identify motors from the stock/scrap). (8 hrs.) 141. Construction of simple control circuits using push button and contactors. (18 hrs.)	Effect of variation in applied voltage. Starting methods. Speed control methods. Importance of phase sequence in three phase induction motor. Single phasing preventer. (27 hrs)
		142. Connect and run the A.C single phase and 3-Ph motors by using starters. (25 hrs.)	Starters - DOL starter, Star – delta starter and Auto transformer starter. (09 hrs)
		143. A.C. motor panel wiring (slip ring Induction type) (13 hrs.) **POWER WIRING FOR DC & AC MOTORS** 144. Practice power and control circuits on boards. (10 hrs.) 145. Assembly & testing of the frame for a panel – suitable for motor generator set. I.S. 3072 Part-II of 1861. (15 hrs.) 146. Erection of panel board, fixing of controlling and starting equipment, necessary meters. (12 hrs.)	Description of starter delta starter (manual, semi and Auto). Formative arrangement of a motor resistance starter for slip ring induction motor. Motor control circuit and starting devices. Power and control wiring circuits of AC motors. (18 hrs)
Professional Skill 75 Hrs; Professional	Interpret the types, constructional features, working principles of	147. Identification of types of transformers. (15 hrs.) 148. Test / check the polarity of single phase transformer.	**TRANSFORMERS –** Power Transformer – Its construction, working, performance, parallel operation of

Knowledge 27 Hrs	transformer (single & three phase) Connect and test Transformer.	(10 hrs.) 149. Insulation testing of single phase and Three Phase. (10 hrs.) 150. Conducting No-load/O.C. & short circuit tests. (10hrs.) 151. Connection of transformers, efficiencies of transformers, parallel operation of transformer. (20 hrs.) 152. Ratio test and voltage regulation. (10 hrs.)	transformer, their connections. Cooling of transformer, S.C. & O.C. tests. Regulation and efficiency, Specifications, problems on e.m.f. Equation, transformation ratio. Characteristics of ideal transformer. Construction of core, winding shielding, auxiliary parts breather, conservator. Buchholz's relay, other protective devices. Transformer oil testing and Tap changing off load and on load. Transformer bushings and termination. Auto transformer- Its construction, working, performance & uses. (27 hrs)
Professional Skill 225 Hrs; Professional Knowledge 81 Hrs	Prepare single line diagram and layout plan of electrical transmission & distribution systems and power plants with knowledge of principle applied. Make and test power connection to substation equipments with care and safety.	153. Familiarize and practice operation of OH line components. (20 hrs.) 154. Visit to generating station (Thermal/ Hydro/Nuclear) Visit to a sub-station to familiarize OH line components. (41 hrs.) 155. Prepare a line diagram of the institute/ ITI supply system. (20 hrs.)	**GENERATION, TRANSMISSION AND DISTRIBUTION OF ELECTRICAL POWER** Generation of Electricity and their types. General idea about overhead transmission, distribution (LV, MV & HV) and their types of accessories used. General arrangement and maintenance of outdoor type of substation. Explanation of overhead bus bar, side by bar. Bus trunking and rising mains. I.E. rules regarding panel erection, bus bar, spacing bus bar chamber, danger boards. Connection of high voltage metering equipment used with bus bar. (27 hrs)
		156. Demonstration, testing and use of line protecting	Types of Distribution, Explanation of line protecting devices and

		devices as per I.E. Rules. (10 hrs.) 157. Visit to Distribution - station. (15 hrs.)	their general principle. Brief description of connection of places of use. (09 hrs)
		158. Familiarization and operation of various CBs ACB, VCB, SF6, OCB etc. (15 hrs.) 159. Visit to sub-station. (20 hrs.) 160. Demonstration and Tests on Multi range switches, Rotary switches. (12 hrs.) 161. Cooker control Panel, Power circuit switches Thermostats. Mercury switches, visit/in plant training in a industry. (12 hrs.)	**SUBSTATION EQUIPMENTS** Switchgear-CBs – ACB, VCB, SF6, OCB etc. protection schemes, CT/PT-Protective relays, lightning arrestors, Explanation of different types of switches and switches gears multi Range switches, rotary switches, cooker control panels, power circuit switches, thermostat, mercury switches etc. (27 hrs)
		162. Familiarize the parts of substations low and high voltages. (20 hrs.)	**TYPES OF SUBSTATIONS - INDOOR, OUTDOOR & POLE MOUNTING** Substation construction: i. Outdoor and Indoor substation. ii. E.H.T. substation iii. H.T. substation iv. Medium & low voltage substation (Pole mounting type) (09 hrs)
		163. Demonstration and practice in terminating an U.G. cable to a bus bar chamber. (20 hrs.) 164. Crimping lugs to the conductors of U.G. cable and connection to bus bar Loop connection for other circuit. (20 hrs.)	**U.G. CABLE** Construction of cable, Types , Application & methods of jointing UG cable & testing General idea of laying method and jointing precautions to be observed and different accessories used for medium voltage termination. (18 hrs)

Professional Skill 25 Hrs; Professional Knowledge 09 Hrs	Interpret the constructional features, working principles of Alternator set. Test, Wire-up and run alternator. Synchronization of Alternator with due care and safety.	**Synchronizing** 165. Building up the alternator output voltage, synchronizing of bus bar voltage with generated voltage. (25 hrs.)	Need of Synchronizing, various methods, precautions to be observed while Synchronizing. (09 hrs)
Professional Skill 75 Hrs; Professional Knowledge 27 Hrs	Select, assemble, test and wire-up control panel.	**Control panel wiring** 166. Preparation of control panel board and its layout fixing of indicating meters /Instruments, Control devices, Protection devices. (35 hrs.) 167. Fixing of cable entry and exit points (15 hrs.)	Control Panel elements, types and specifications. Layout and installation of panel board, Panel board wiring methods, colour coding of cables for its easy identification. Grouping and numbering of cables by using ferrules. (09 hrs)
		168. Preventive maintenance and routine tests. (8 hrs.) 169. Fault location and remedy practice both in domestic and industrial wirings. (10 hrs.) 170. Practice in fixing conduit along with the girder, steel structures station etc. (7 hrs.)	Importance and advantages of maintenance. Points to be observed to maintain the installation, preventive maintenance and routine tests. Common faults, causes and remedies in domestic and industrial wiring installation, Methods of Locating faults. (09 hrs)
Professional Skill 75 Hrs; Professional Knowledge 27 Hrs	Plan, estimate and costing of different types of wiring system as per Indian Electricity rule.	**Planning, Estimation and Costing of Wiring-** 171. Planning and Preparation of layout for domestic, commercial, Multi storied building wiring and workshop electrical wiring. (50 hrs.)	Concept and Principle of plan, estimation and cost. Preparation of complete house wiring layout, industrial wiring, commercial wiring for office Lodge, Hospital, Bank, Hotels etc. I.E. rules for Multi-storied buildings. (27 hrs)

		172. Estimation and costing of Labour, materials and accessories as per layout. (25 hrs.)	

Project Work (work in a team)

(i) Over hauling and Testing of 3 phase Induction motor

(ii) Over hauling and testing of Ceiling / Table Fan.

(iii) Preparation of series test board with indicating digital metres.

(iv) Construction and test regulated power supply of 6-12 Volt DC.

(v) Construct and Test Decorative running LED lamp assembly.

(vi) Installation of Pump set.

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

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