ITI Electrician Syllabus and Subjects

Semester 1

1. Electrician Theory	– Occupational Safety and Health – Conductor, semiconductors – Insulator and electric cables – Tools for an Electrician – Soldering and D.C theory – Basic Electricity – Electrical accessories – Electro-chemical effect and chemical cell – Magnetism and electromagnetism – Alternating current theory – Earthing and Basic electronics.
2. Engineering Drawing	– Engineering drawing – Drawing instruments – Lines, Drawing of geometrical figures – Lettering and numbering, dimensioning – Drawing sheets, Freehand drawing – Presentation of engineering drawing – And Symbolic representation.
3. Employability Skills	– English literacy – Information technology literacy – Communication skills.
4. Workshop calculation and Science	– Units, Fraction, Square root – Ratio and proportion – Percentage, Material science – Mass, weight, and density – Speed and velocity, Work – power and energy.
5. Electrical Practical	– Trade safety and first aid – Tools, wire, and joints – Allied trades, Resistor, and capacitor – Alternating current (A.C.) circuit – Cell and battery, Magnetic field – Earthing and Semi-conductor diode.

Semester 2

1. Electrician Theory	– Transistor, Amplifiers, Oscillators – Specific solid-state devices – Digital electronics, Electrical wiring – Direct current generator – Direct current motor – Transformer and Electrical measuring instruments
2. Engineering Drawing	– Construction of scales – Lettering and title block – Dimensioning practice – Construction of geometrical drawing figures, Drawing of solid shapes – Freehand sketch and measuring tools – Projection and Drawing details.
3. Employability Skills	– Entrepreneurship skill – Productivity, Occupational safety – Health and environmental education – Labour welfare legislation and Quality tools.
4. Workshop Calculation and Science	– Algebra, Mensuration – Trigonometry, Heat, and temperature – Basic electricity – Levers and simple machines.
5. Electrical practical	– Electrical measuring instruments – Transformer, Direct current (D.C.) machines – Electrical wiring, Transistor – Logic gates and their circuits.

Semester 3

1. Electrician Theory	– 3-Phase induction motors – Single-phase induction motors – Alternator, Synchronous motor – Converters, D.C. machine, and short transformer winding – A.C. machine winding – Illumination, Industrial wiring – House wiring layout.
2. Engineering Drawing	– Alternating current based electrical circuit drawing – Electronic circuit and auxiliary component – Electrical wiring and earthing – Freehand sketch of D.C. machines – Transformer, Illumination.
3. Workshop calculation and science	– Indices, Quadratic equation – Calculations related to A.C. waveforms – Electrical connections, Elasticity – Materials, Magnetism – Pressure, Heat treatment.
4. Electrical Practical	– Winding-rewinding – Alternator, Synchronous motor – Alternating current motor – Converters, Electric lamp, and lightening decoration – Industrial wiring.

Semester 4

1. Electrician Theory	– Machine control panel – Electrical instrument – Electrical power generation – Electrical power transmission – Underground cables, Power distribution – Speed control and maintenance o electric machines – Electronic theory and communication
2. Engineering Drawing	– Three-phase induction motor – Alternator, Winding diagram – Control panel, Distribution of power
3. Workshop Calculation and Science	– Number system – Estimation and cost – Mensuration, Graph – Profit and loss – Simple and compound interest – Friction, Pressure, Heat treatment – Force, Center of gravity
4. Electrical Practical	– Machine control – Electrical controlling components – Wiring related practical applications – Domestic electrical appliances – Power production – Electric power transmission – Power distribution – Speed control and maintenance of appliances

COURSE STRUCTURE

Table below depicts the distribution of training hours across various course elements during a period of two-years: -

S No.	Course Element	Notional Training Hours	
		1st Year	2nd Year
1	Professional Skill (Trade Practical)	1000	1000
2	Professional Knowledge (Trade Theory)	280	360
3	Workshop Calculation & Science	80	80
4	Engineering Drawing	80	80
5	Employability Skills	160	80
	Total	**1600**	**1600**

ASSESSMENT & CERTIFICATION

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

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

b) The final assessment will be in the form of summative assessment. The All India Trade Test for awarding NTC will be conducted by Controller of examinations, DGT as per the guidelines. The pattern and marking structure is being notified by DGT from time to time. **The learning outcome and assessment criteria will be basis for setting question papers for final assessment. The examiner during final examination will also check** individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

Distribution of training on Hourly basis: (Indicative only)						
Year	**Total Hrs. /week**	**Trade Practical**	**Trade Theory**	**Workshop Cal. & Sc.**	**Engg. Drawing**	**Employability Skills**
1st	40 Hours	25 Hours	7 Hours	2 Hours	2 Hours	4 Hours
2nd	40 Hours	25 Hours	9 Hours	2 Hours	2 Hours	2 Hours

LEARNING OUTCOMES (TRADE SPECIFIC)

FIRST YEAR

1. Prepare profile with an appropriate accuracy as per drawing following safety precautions.
2. Prepare electrical wire joints; carry out soldering, crimping and measure insulation resistance of underground cable.
3. Verify characteristics of electrical and magnetic circuits.
4. Install, test and maintenance of batteries and solar cell.
5. Estimate, Assemble, install and test wiring system.
6. Plan and prepare Earthing installation.
7. Plan and execute electrical illumination system and test.
8. Select and perform measurements using analog / digital instruments.
9. Perform testing, verify errors and calibrate instruments.
10. Plan and carry out installation, fault detection and repairing of domestic appliances.
11. Execute testing, evaluate performance and maintenance of transformer.

SECOND YEAR

12. Plan, execute commissioning and evaluate performance of DC machines.
13. Execute testing, and maintenance of DC machines and motor starters.
14. Plan execute commissioning and evaluate performance of AC motors.
15. Execute testing, and maintenance of AC motors and starters.
16. Plan, execute testing, evaluate performance and carry out maintenance of Alternator / MG set.
17. Execute parallel operation of alternators.
18. Distinguish, organise and perform motor winding.
19. Assemble simple electronic circuits and test for functioning.
20. Assemble accessories and carry out wiring of control cabinets and equipment.
21. Perform speed control of AC and DC motors by using solid state devices.

22. Detect the faults and troubleshoot inverter, stabilizer, battery charger, emergency light and UPS etc.
23. Plan, assemble and install solar panel.
24. Erect overhead domestic service line and outline various power plant layout.
25. Examine the faults and carry out repairing of circuit breakers.

LEARNING OUTCOMES	ASSESSMENT CRITERIA
FIRST YEAR	
1. Prepare profile with an appropriate accuracy as per drawing.	Identify the trade tools; demonstrate their uses with safety, care & maintenance.
	Prepare a simple half lap joint using firmer chisel with safety.
	Prepare tray using sheet metal with the safety.
	Demonstrate fixing of surface mounting type of accessories.
	Perform connections of electrical accessories.
	Make and wire up of a test board and test it.
2. Prepare electrical wire joints, carry out soldering, crimping and measure insulation resistance of underground cable.	Observe safety/ precaution during joints & soldering.
	Make simple straight twist and rat-tail joints in single strand conductors.
	Make married and 'T' (Tee) joint in stranded conductors.
	Prepare a Britannia straight and 'T' (Tee) joint in bare conductors.
	Prepare western union joint in bare conductor.
	Solder the finished copper conductor joints with precaution.
	Prepare termination of cable lugs by using crimping tool.
	Make straight joint in different types of underground cables.
	Measure insulation resistance of underground cable.
3. Verify characteristics of electrical and magnetic circuits.	Identify types of wires, cables and verify their specifications.
	Verify the characteristics of series, parallel and its combination circuit.
	Analyze the effect of the short and open in series and parallel circuits.
	Verify the relation of voltage components of RLC series circuit in AC.
	Determine the power factor by direct and indirect methods in an AC single phase RLC parallel circuit.
	Identify the phase sequence of a 3 ø supply using a phase-sequence meter.
	Prepare/ connect a lamp load in star and delta and determine relationship between line and phase values with precaution.
	Connect balanced and unbalanced loads in 3 phase star system and measure the power of 3 phase loads.
	Make the solenoid and determine its polarity for the given direction of current.
	Group the given capacitors to get the required capacity and voltage

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

	Prepare and test a decorative serial lamp set for 240 V using 6V bulb and flasher.
	Install light fitting for show case window lighting.
8. Select and perform measurements using analog / digital instruments	Identify the type of electrical instruments.
	Extend the range of MC voltmeter and ammeter.
	Measure the frequency by frequency meter.
	Measure the power and energy in a single & three phase circuit using wattmeter and energy meter with CT and PT.
	Measure the value of resistance, voltage and current using digital multimeter.
	Measure the power factor in poly-phase circuit and verify the same with voltmeter, ammeter, watt-meter readings.
9. Perform testing, verify errors and calibrate instruments.	Test single phase energy meter for its errors.
	Determine the measurement errors while measuring resistance by voltage drop method.
	Calibrate the analog multimeter.
10. Plan and carry out installation, fault detection and repairing of domestic appliances.	Plan work in compliance with standard safety norms related with domestic appliances.
	Service and Repair of calling bell/ buzzer/ Alarm.
	Service and repair an automatic iron.
	Repair and service of oven having multi-range heat control.
	Replace the heating element in a kettle and test.
	Service and repair an induction heater.
	Service and repair a geyser.
	Service and repair a mixer.
	Service and repair of washing machine.
	Install a pump set.
	Service and repair of table fan.
	Service, repair and install a ceiling fan.
11. Execute testing, evaluate performance and maintenance of transformer.	Plan work in compliance with standard safety norms related with transformer.
	Identify the types of transformers and their specifications.
	Identify the terminals; verify the transformation ratio of a single-phase transformer.

	Connect and test a single-phase auto- transformer.
	Determine the losses (iron loss and copper loss) and the regulation of a single-phase transformer at different loads.
	Measure the current and voltage using CT and PT.
	Carry out winding for small transformer of 1KVA rating.
	Test the transformer oil with oil testing kit.
	Connect 3 single phase transformers for 3 phase operation of delta-delta /delta-star /star-star /star-delta.
	Connect the given two single phase transformers in parallel /series (secondary only) and measure voltage.
	Connect & test 3 phase transformer in parallel.
SECOND YEAR	
12. Plan, execute commissioning and evaluate performance of DC machines.	Plan work in compliance with standard safety norms related with DC machines.
	Determine the load performance of a different type of DC generator on load.
	Connect, start, run and reverse direction of rotation of different types of DC motors.
	Conduct the load performance tests on different type of DC motor.
	Control the speed of a DC motor by different method.
13. Execute testing, and maintenance of DC machines and motor starters.	Test a DC machine for continuity and insulation resistance.
	Maintenance, troubleshooting & servicing of DC machines.
	Test armature by using growler.
	Maintain, service and troubleshoot the DC motor starter.
14. Plan, execute commissioning and evaluate performance of AC motors.	Plan work in compliance with standard safety norms related with AC motors.
	Draw circuit diagram and connect forward & reverse a 3-phase squirrel cage induction motor.
	Start, run and reverse an AC 3 phase squirrel cage induction motor by different type of starters.
	Measure the slip of 3 phase squirrel cage induction motor by tachometer for different output. Draw slip/ load characteristics of the motor.
	Determine the efficiency of 3 phase squirrel cage induction motor by no load test/ blocked rotor test and brake test.
	Plot the speed torque (Slip/Torque) characteristics of slip ring

	induction motor.
	Demonstrate speed control of 3 phase induction motor.
	Connect, start and run a 3-phase synchronous motor.
	Connect start, run, control speed and reverse the DOR of different type of single-phase motors.
	Install a single-phase AC motor.
15. Execute testing, and maintenance of AC motors and starters.	Test continuity and insulation of various AC motors.
	Maintain, service and troubleshoot of three phase AC motors.
	Maintain, service and troubleshoot of different types of single-phase AC motors.
	Maintain, service and troubleshoot the AC motor starter.
16. Plan, execute testing, evaluate performance and carry out maintenance of Alternator / MG set.	Plan work in compliance with standard safety norms related with Alternator & MG set.
	Connect start and run an alternator and build up the voltage.
	Determine the load performance of a 3-phase alternator.
	Start and load a MG set with 3 phase induction motor coupled to DC shunt generator and build up the voltage.
	Perform/ Explain alignment of MG set.
	Preventive and breakdown maintenance of alternator / MG set.
	Explain the effect of excitation current in terms of V-curves of synchronous motor.
17. Execute parallel operation of alternators.	Demonstrate parallel operation of an alternator Bright lamp method/ Dark lamp method/ Bright and dark lamp method
	Parallel operation of an alternator by using synchro scope.
18. Distinguish, organise and perform motor winding.	Rewind the field coil /armature winding/ table fan /ceiling fan.
	Draw winding diagram & rewind a single-phase split type motor (Concentric coil winding).
	Draw winding diagram & rewind a 3-phase squirrel cage induction motor (single layer distributed winding).
	Draw winding diagram & rewind a 3-phase induction motor (single layer concentric type half coil connection).
	Draw winding diagram & rewind a 3-phase squired cage induction motor. (Double layer distributed type winding)

19. Assemble simple electronic circuits and test for functioning.	Perform soldering on components/ lug / board with safety.
	Identify the passive /active components by visual appearance, code number and test for their condition.
	Identify the control and functional switches in CRO and measure the D.C. & A.C. voltage, frequency and time period.
	Construct and test a half &full wave rectifier with and without filter circuits.
	Construct circuit by using transistor as a switch.
	Construct and test a UJT as relaxation oscillator & electronic timer.
	Construct amplifier circuit using Transistor, FET and JFET and test.
	Construct and test lamp dimmer using TRIAC/DIAC.
	Test IGBT and use in circuit for suitable operation.
	Construct and test the universal motor speed controller using SCR with safety.
	Construct and test logic gate circuits.
20. Assemble accessories and carry out wiring of control cabinets and equipment.	Draw the layout diagram of 3 phase AC motor control cabinet.
	Mount the control elements & wiring accessories on the control panel.
	Carry out wiring in control cabinet for local and remote control of induction motor.
	Draw & wire up the control panel for forward/ reverse operation of induction motor.
	Perform wiring for automatic start delta starter.
	Draw & wire up control panel for sequential motor control for three motors.
	Draw & wire up the control panel for a given circuit diagram and connect the motor.
	Test the control panel for all the required logics.
21. Perform speed control of AC and DC motors by using solid state devices.	Control the speed of DC motor by using DC drive.
	Speed control of universal motor by using SCR.
	Control speed and reverse the direction of rotation of different type of three phase induction motors using VVVF control /AC drive

22. Detect the faults and troubleshoot inverter, stabilizer, battery charger, emergency light and UPS etc.	Operation and maintenance of inverter.
	Troubleshoot and service a voltage stabilizer.
	Identify the parts, trace the connection and test the DC regulated power supply with safety.
	Troubleshoot and service a DC regulated power supply.
	Test battery charger for its operation.
	Prepare an emergency light.
	Carryout maintenance of UPS.
23. Plan, assemble and install solar panel.	Plan work in compliance with solar panel installation norms.
	Combination of solar cells for given power requirement.
	Assemble and install solar panel.
	Check the functionality of solar panel.
24. Erect overhead domestic service line and outline various power plant layout.	Prepare single line diagram of thermal/ hydel/ Solar /Wind power plants.
	Prepare layout plan and single line diagram of transmission line.
	Draw an overhead and domestic service line.
	Explain erection of an overhead service line pole for single phase 240V distribution system.
	Identify different type of insulator used in HT and LT line.
	Fasten jumper in insulators.
	Connect feeder cable with domestic service line.
25. Examine the faults and carry out repairing of circuit breakers.	Prepare layout plan and single line diagram of Distribution substation.
	Illustrate application of relays in control circuits and examine its operation.
	Identify parts of circuit breaker and check its operation.

SYLLABUS FOR ELECTRICIAN TRADE			
FIRST YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 150 Hrs.; Professional Knowledge 42 Hrs.	Prepare profile with an appropriate accuracy as per drawing following safety precautions.	1. Visit various sections of the institutes and location of electrical installations. (03hrs.) 2. Identify safety symbols and hazards. (02Hrs.) 3. Preventive measures for electrical accidents and practice steps to be taken in such accidents. (03hrs.) 4. Practice safe methods of fire fighting in case of electrical fire. (02hrs.) 5. Use of fire extinguishers. (05 Hrs.)	Scope of the electrician trade. Safety rules and safety signs. Types and working of fire extinguishers. (07 hrs.)
		6. Practice elementary first aid. (03hrs.) 7. Rescue a person and practice artificial respiration. (02Hrs.) 8. Disposal procedure of waste materials. (02Hrs.) 9. Use of personal protective equipment. (03hrs.) 10. Practice on cleanliness and procedure to maintain it. (05 hrs.)	First aid safety practice. Hazard identification and prevention. Personal safety and factory safety. Response to emergencies e.g. power failure, system failure and fire etc. (07 hrs.)
		11. Identify trade tools and machineries. (05Hrs.) 12. Practice safe methods of lifting and handling of tools	Concept of Standards and advantages of BIS/ISI. Trade tools specifications. Introduction to National

		& equipment. (05 Hrs.) 13. Select proper tools for operation and precautions in operation. (05 Hrs.) 14. Care & maintenance of trade tools. (05 Hrs.)	Electrical Code-2011. (07 hrs.)
		15. Operations of allied trade tools. (05 Hrs.) 16. Workshop practice on filing and hacksawing. (10Hrs.) 17. Prepare hand coil winding assembly. (5 Hrs.) 18. Practice on preparing T-joint, straight joint and dovetail joint on wooden blocks. (15Hrs.) 19. Practice sawing, planing, drilling and assembling for making a wooden switchboard. (15Hrs.)	Allied trades: Introduction to fitting tools, safety precautions. Description of files, hammers, chisels hacksaw frames, blades, their specification and grades. Marking tools description and use. Types of drills, description & drilling machines. Various wooden joints. (07 hrs.)
		20. Practice in marking and cutting of straight and curved pieces in metal sheets, making holes, securing by screw and riveting. (10 Hrs.) 21. Workshop practice on drilling, chipping, internal and external threading of different sizes. (20Hrs.) 22. Practice of making square holes in crank handle. (5 Hrs.) 23. Prepare an open box from metal sheet. (15 Hrs.)	Marking tools; calipers Dividers, Surface plates, Angle plates, Scribers, punches, surface gauges Types, Uses, Care and maintenance. Sheet metal tools: Description of marking & cutting tools. Types of rivets and riveted joints. Use of thread gauge. Description of carpenter's tools Care and maintenance of tools.(14hrs.)
Professional Skill 125 Hrs.; Professional	Prepare electrical wire joints, carry out soldering, crimping and measure	24. Prepare terminations of cable ends (02 hrs.) 25. Practice on skinning, twisting and crimping. (15	Fundamentals of electricity, definitions, units & effects of electric current. Conductors and insulators.

Knowledge 35Hrs.	insulation resistance of underground cable.	Hrs.) 26. Identify various types of cables and measure conductor size using SWG and micrometer. (8 Hrs.)	Conducting materials and their comparison. (07 hrs.)
		27. Make simple twist, married, Tee and western union joints. (18 Hrs.) 28. Make britannia straight, britannia Tee and rat tail joints. (18 Hrs.) 29. Practice in Soldering of joints / lugs. (14 Hrs.)	Joints in electrical conductors. Techniques of soldering. Types of solders and flux. (14 hrs.)
		30. Identify various parts, skinning and dressing of underground cable. (15 Hrs.) 31. Make straight joint of different types of underground cable. (15 Hrs.) 32. Test insulation resistance of underground cable using megger. (05 hrs.) 33. Test underground cables for faults and remove the fault. (15 Hrs.)	Underground cables: Description, types, various joints and testing procedure. Cable insulation & voltage grades Precautions in using various types of cables. (14 hrs.)
Professional Skill 200Hrs.; Professional Knowledge 56Hrs.	Verify characteristics of electrical and magnetic circuits.	34. Practice on measurement of parameters in combinational electrical circuit by applying Ohm's Law for different resistor values and voltage sources and analyse by drawing graphs. (10Hrs.) 35. Measure current and voltage in electrical circuits to verify Kirchhoff's Law (10 Hrs.)	Ohm's Law; Simple electrical circuits and problems. Kirchoff's Laws and applications. Series and parallel circuits. Open and short circuits in series and parallel networks. (07 hrs.)

		36. Verify laws of series and parallel circuits with voltage source in different combinations. (05Hrs.) 37. Measure voltage and current against individual resistance in electrical circuit (10 hrs.) 38. Measure current and voltage and analyse the effects of shorts and opens in series circuit. (05 Hrs.) 39. Measure current and voltage and analyse the effects of shorts and opens in parallel circuit. (05 Hrs.)	
		40. Measure resistance using voltage drop method. (03Hrs.) 41. Measure resistance using wheatstone bridge. (02 Hrs.) 42. Determine the thermal effect of electric current. (03Hrs.) 43. Determine the change in resistance due to temperature. (02Hrs.) 44. Verify the characteristics of series parallel combination of resistors. (5 Hrs.)	Laws of Resistance and various types of resistors. Wheatstone bridge; principle and its applications. Effect of variation of temperature on resistance. Different methods of measuring the values of resistance. Series and parallel combinations of resistors. (07 hrs.)
		45. Determine the poles and plot the field of a magnet bar. (05Hrs.) 46. Wind a solenoid and determine the magnetic effect of electric current. (05Hrs.) 47. Measure induced emf due to change in magnetic field.	Magnetic terms, magnetic materials and properties of magnet. Principles and laws of electro-magnetism. Self and mutually induced EMFs. Electrostatics: Capacitor-Different types, functions,

		(05hrs.) 48. Determine direction of induced emf and current. (05hrs.) 49. Practice on generation of mutually induced emf. (05hrs.) 50. Measure the resistance, impedance and determine inductance of choke coils in different combinations. (05Hrs.) 51. Identify various types of capacitors, charging / discharging and testing. (05 Hrs.) 52. Group the given capacitors to get the required capacity and voltage rating. (05 Hrs.)	grouping and uses. (14 hrs.)
		53. Measure current, voltage and PF and determine the characteristics of RL, RC and RLC in AC series circuits. (08 Hrs.) 54. Measure the resonance frequency in AC series circuit and determine its effect on the circuit. (07 hrs.) 55. Measure current, voltage and PF and determine the characteristics of RL, RC and RLC in AC parallel circuits. (08 Hrs.) 56. Measure the resonance frequency in AC parallel circuit and determine its effects on the circuit. (07 hrs.)	Inductive and capacitive reactance, their effect on AC circuit and related vector concepts. Comparison and Advantages of DC and AC systems. Related terms frequency, Instantaneous value, R.M.S. value Average value, Peak factor, form factor, power factor and Impedance etc. Sine wave, phase and phase difference. Active and Reactive power. Single Phase and three-phase system. Problems on A.C. circuits. (14 hrs.)

		57. Measure power, energy for lagging and leading power factors in single phase circuits and compare characteristic graphically. (08 Hrs.) 58. Measure Current, voltage, power, energy and power factor in three phase circuits. (07 hrs.) 59. Practice improvement of PF by use of capacitor in three phase circuit.(05 Hrs.)	
		60. Ascertain use of neutral by identifying wires of a 3-phase 4 wire system and find the phase sequence using phase sequence meter. (10 Hrs.) 61. Determine effect of broken neutral wire in three phase four wire system.(05 hrs.) 62. Determine the relationship between Line and Phase values for star and delta connections. (10Hrs.) 63. Measure the Power of three phase circuit for balanced and unbalanced loads. (15 Hrs.) 64. Measure current and voltage of two phases in case of one phase is short-circuited in three phase four wire system and compare with healthy system.(10 hrs.)	Advantages of AC poly-phase system. Concept of three-phase Star and Delta connection. Line and phase voltage, current and power in a 3 phase circuits with balanced and unbalanced load. Phase sequence meter. (14 hrs.)
Professional	Install, test and	65. Use of various types of cells.	Chemical effect of electric

Skill 50 Hrs.; Professional Knowledge 14 Hrs.	maintenance of batteries and solar cell.	(08 Hrs.) 66. Practice on grouping of cells for specified voltage and current under different conditions and care. (12 Hrs.) 67. Prepare and practice on battery charging and details of charging circuit. (12 Hrs.) 68. Practice on routine, care/ maintenance and testing of batteries. (08 Hrs.) 69. Determine the number of solar cells in series / parallel for given power requirement. (10 Hrs.)	current and Laws of electrolysis. Explanation of Anodes and cathodes. Types of cells, advantages / disadvantages and their applications. Lead acid cell; Principle of operation and components. Types of battery charging, Safety precautions, test equipment and maintenance. Basic principles of Electro-plating and cathodic protection Grouping of cells for specified voltage and current. Principle and operation of solar cell. (14 hrs.)
Professional Skill 175 Hrs.; Professional Knowledge 49 Hrs.	Estimate, Assemble, install and test wiring system.	70. Identify various conduits and different electrical accessories. (8 Hrs.) 71. Practice cutting, threading of different sizes & laying Installations. (17 Hrs.) 72. Prepare test boards / extension boards and mount accessories like lamp holders, various switches, sockets, fuses, relays, MCB, ELCB, MCCB etc. (25 Hrs.)	I.E. rules on electrical wiring. Types of domestic and industrial wirings. Study of wiring accessories e.g. switches, fuses, relays, MCB, ELCB, MCCB etc. Grading of cables and current ratings. Principle of laying out of domestic wiring. Voltage drop concept. (14 hrs.)
		73. Draw layouts and practice in PVC Casing-capping, Conduit wiring with minimum to more number of points of minimum 15 mtr length. (15 Hrs.)	PVC conduit and Casing-capping wiring system. Different types of wiring - Power, control, Communication and entertainment wiring.

		74. Wire up PVC conduit wiring to control one lamp from two different places. (10 Hrs.) 75. Wire up PVC conduit wiring to control one lamp from three different places. (10 Hrs.) 76. Wire up PVC conduit wiring and practice control of sockets and lamps in different combinations using switching concepts. (15 Hrs.)	Wiring circuits planning, permissible load in sub-circuit and main circuit. (14 hrs.)
		77. Wire up the consumers main board with ICDP switch and distribution fuse box. (10 Hrs.) 78. Prepare and mount the energy meter board. (10 Hrs.) 79. Estimate the cost/bill of material for wiring of hostel/ residential building and workshop. (10 Hrs.) 80. Practice wiring of hostel and residential building as per IE rules. (15 Hrs.) 81. Practice wiring of institute and workshop as per IE rules. (15 Hrs.) 82. Practice testing / fault detection of domestic and industrial wiring installation and repair. (15 Hrs.)	Estimation of load, cable size, bill of material and cost. Inspection and testing of wiring installations. Special wiring circuit e.g. godown, tunnel and workshop etc. (21 hrs.)
Professional Skill 25 Hrs.; Professional	Plan and prepare Earthing installation.	83. Prepare pipe earthing and measure earth resistance by earth tester / megger. (10 Hrs.)	Importance of Earthing. Plate earthing and pipe earthing methods and IEE regulations.

Knowledge 07 Hrs.		84. Prepare plate earthing and measure earth resistance by earth tester / megger. (10 Hrs.) 85. Test earth leakage by ELCB and relay. (5 Hrs.)	Earth resistance and earth leakage circuit breaker. (07 hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 14 Hrs.	Plan and execute electrical illumination system and test.	86. Install light fitting with reflectors for direct and indirect lighting. (10 Hrs.) 87. Group different wattage of lamps in series for specified voltage. (5 Hrs.) 88. Practice installation of various lamps e.g. fluorescent tube, HP mercury vapour, LP mercury vapour, HP sodium vapour, LP sodium vapour, metal halide etc. (18 Hrs.) 89. Prepare decorative lamp circuit using drum switches. (5 Hrs.) 90. Prepare decorative lamp circuit to produce rotating light effect/running light effect. (6 Hrs.) 91. Install light fitting for show case lighting. (6 Hrs.)	Laws of Illuminations. Types of illumination system. Illumination factors, intensity of light. Type of lamps, advantages/ disadvantages and their applications. Calculations of lumens and efficiency. (14 hrs.)
02 Weeks (Professional Skill 50 Hrs.; Professional Knowledge 14 Hrs.)	Select and perform measurements using analog / digital instruments	92. Practice on various analog and digital measuring Instruments. (5 Hrs.) 93. Practice on measuring instruments in single and three phase circuits e.g. multi-meter, Wattmeter, Energy meter, Phase sequence meter and Frequency meter etc. (15 Hrs.)	Classification of electrical instruments and essential forces required in indicating instruments. PMMC and Moving iron instruments. Measurement of various electrical parameters using different analog and digital instruments. Measurement of energy in

		94. Measure power in three phase circuit using two wattmeter methods. (8 Hrs.) 95. Measure power factor in three phase circuit by using power factor meter and verify the same with voltmeter, ammeter and wattmeter readings. (12 Hrs.) 96. Measure electrical parameters using tong tester in three phase circuits. (10 Hrs.)	three phase circuit. (14 hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 07 Hrs.	Perform testing, verify errors and calibrate instruments.	97. Practice for range extension and calibration of various measuring instruments. (10 Hrs.) 98. Determine errors in resistance measurement by voltage drop method. (8 Hrs.) 99. Test single phase energy meter for its errors. (7 Hrs.)	Errors and corrections in measurement. Loading effect of voltmeter and voltage drop effect of ammeter in circuits. Extension of range and calibration of measuring instruments. (07 hrs.)
Professional Skill 75 Hrs.; Professional Knowledge 21 Hrs.	Plan and carry out installation, fault detection and repairing of domestic appliances.	100. Dismantle and assemble electrical parts of various electrical appliances e.g. cooking range, geyser, washing machine and pump set. (25 Hrs.) 101. Service and repair of bell/ buzzer. (5 Hrs.) 102. Service and repair of electric iron, electric kettle, cooking range and geyser. (12 Hrs.) 103. Service and repair of induction heater and oven. (10 Hrs.)	Working principles and circuits of common domestic equipment and appliances. Concept of Neutral and Earth. (21 hrs.)

		104. Service and repair of mixer and grinder. (10 Hrs.) 105. Service and repair of washing machine. (13Hrs.)	
Professional Skill 75 Hrs.; Professional Knowledge 21 Hrs.	Execute testing, evaluate performance and maintenance of transformer.	106. Verify terminals, identify components and calculate transformation ratio of single-phase transformers. (8 Hrs.) 107. Perform OC and SC test to determine and efficiency of single-phase transformer. (12Hrs.) 108. Determine voltage regulation of single-phase transformer at different loads and power factors. (12 Hrs.) 109. Perform series and parallel operation of two single phase transformers. (12 Hrs.) 110. Verify the terminals and accessories of three phase transformer HT and LT side. (6Hrs.)	Working principle, construction and classification of transformer. Single phase and three phase transformers. Turn ratio and e.m.f. equation. Series and parallel operation of transformer. Voltage Regulation and efficiency. Auto Transformer and instrument transformers (CT & PT). (14 hrs.)
		111. Perform 3 phase operation (i) delta-delta (ii) delta-star (iii) star-star (iv) star-delta by use of three single phase transformers. (6 Hrs.) 112. Perform testing of transformer oil. (6 Hrs.) 113. Practice on winding of	Method of connecting three single phase transformers for three phase operation. Types of Cooling, protective devices, bushings and termination etc. Testing of transformer oil. Materials used for winding and winding wires in small transformer. (07 hrs.)

		small transformer. (8 Hrs.) 114. Practice of general maintenance of transformer. (5 Hrs.)	

Project work / Industrial visit

Broad Areas:

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

SYLLABUS FOR ELECTRICIAN TRADE			
SECONDYEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 50 Hrs.; Professional Knowledge 18 Hrs.	Plan, execute commissioning and evaluate performance of DC machines.	115. Identify terminals, parts and connections of different types of DC machines. (10 Hrs.) 116. Measure field and armature resistance of DC machines. (10 Hrs.) 117. Determine build up voltage of DC shunt generator with varying field excitation and performance analysis on load. (15 Hrs.) 118. Test for continuity and insulation resistance of DC machine. (5 Hrs.) 119. Start, run and reverse direction of rotation of DC series, shunt and compound motors. (10 Hrs.)	General concept of rotating electrical machines. Principle of DC generator. Use of Armature, Field Coil, Polarity, Yoke, Cooling Fan, Commutator, slip ring and Brushes, Laminated core etc. E.M.F. equation Separately excited and self-excited generators. Series, shunt and compound generators.(18 hrs.)
Professional Skill 100 Hrs.; Professional Knowledge 36 Hrs.	Execute testing, and maintenance of DC machines and motor starters.	120. Perform no load and load test and determine characteristics of series and shunt generators. (12 Hrs.) 121. Perform no load and load test and determine characteristics of compound generators (cumulative and differential). (13 Hrs.) 122. Practice dismantling and assembling in DC shunt	Armature reaction, Commutation, inter poles and connection of inter poles. Parallel Operation of DC Generators. Load characteristics of DC generators. Application, losses & efficiency of DC Generators. Routine & maintenance. (18hrs.)

		motor. (12 Hrs.) 123. Practice dismantling and assembling in DC compound generator. (13 Hrs.)	
		124. Conduct performance analysis of DC series, shunt and compound motors. (15 Hrs.) 125. Dismantle and identify parts of three point and four-point DC motor starters. (10 Hrs.) 126. Assemble, Service and repair three point andfour-point DC motor starters. (15 Hrs.) 127. Practice maintenance of carbon brushes, brush holders, Commutator and sliprings. (10 Hrs.)	Principle and types of DC motor. Relation between applied voltage back e.m.f., armature voltage drop, speed and flux of DC motor. DC motor Starters, relation between torque, flux and armature current. Changing the direction of rotation. Characteristics, Losses & Efficiency of DC motors. Routine and maintenance. (18hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 18Hrs.	Distinguish, organise and perform motor winding.	128. Perform speed control of DC motors - field and armature control method. (10 Hrs.) 129. Carry out overhauling of DC machines. (15 Hrs.) 130. Perform DC machine winding by developing connection diagram, test on growler and assemble. (25 Hrs.)	Methods of speed control of DC motors. Lap and wave winding and related terms. (18hrs.)
Professional Skill 100 Hrs.; Professional Knowledge 36 Hrs.	Plan, Execute commissioning and evaluate performance of AC motors. Execute testing, and	131. Identify parts and terminals of three phase AC motors. (5 Hrs.) 132. Make an internal connection of automatic star-delta starter with three contactors. (10 Hrs.)	Working principle of three phase induction motor. Squirrel Cage Induction motor, Slip-ring induction motor; construction, characteristics, Slip and Torque. Different types of starters for

	maintenance of AC motors and starters.	133. Connect, start and run three phase induction motors by using DOL, star-delta and auto-transformer starters. (20 Hrs.) 134. Connect, start, run and reverse direction of rotation of slip-ring motor through rotor resistance starter and determine performance characteristic. (15 Hrs.)	three phase induction motors, its necessity, basic contactor circuit, parts and their functions. (18hrs.)
		135. Determine the efficiency of squirrel cage induction motor by brake test. (8 Hrs.) 136. Determine the efficiency of three phase squirrel cage induction motor by no load test and blocked rotor test. (8 Hrs.) 137. Measure slip and power factor to draw speed-torque (slip/torque) characteristics. (14 Hrs.) 138. Test for continuity and insulation resistance of three phase induction motors. (5 Hrs.) 139. Perform speed control of three phase induction motors by various methods like rheostatic control, autotransformer etc. (15 Hrs.)	Single phasing prevention. No load test and blocked rotor test of induction motor. Losses & efficiency. Various methods of speed control. Braking system of motor. Maintenance and repair. (18hrs.)
Professional Skill 25 Hrs.; Professional	Distinguish, organise and perform motor winding.	140. Perform winding of three phase AC motor by developing connection diagram, test and	Concentric/ distributed, single/ double layer winding and related terms.(09Hrs.)

Knowledge 09 Hrs.		assemble. (20 Hrs.) 141. Maintain, service and troubleshoot the AC motor starter. (05 Hrs.)	
Professional Skill 50 Hrs.; Professional Knowledge 18 Hrs.	Plan, Execute commissioning and evaluate performance of AC motors. Execute testing, and maintenance of AC motors and starters.	142. Identify parts and terminals of different types of single-phase AC motors. (5 Hrs.) 143. Install, connect and determine performance of single-phase AC motors. (15 Hrs.) 144. Start, run and reverse the direction of rotation of single-phase AC motors. (10 Hrs.) 145. Practice on speed control of single phase AC motors. (10 Hrs.) 146. Compare starting and running winding currents of a capacitor run motor at various loads and measure the speed. (10 Hrs.)	Working principle, different method of starting and running of various single phase AC motors. Domestic and industrial applications of different single phase AC motors. Characteristics, losses and efficiency. (18hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 18 Hrs.	Distinguish, organise and perform motor winding.	147. Carry out maintenance, service and repair ofsingle-phase AC motors. (10 Hrs.) 148. Practice on single/double layer and concentric winding for AC motors, testing and assembling. (25 Hrs.) 149. Connect, start, run and reverse the direction of rotation of universal motor. (10 Hrs.) 150. Carry out maintenance and servicing of universal	Concentric/ distributed, single/ double layer winding and related terms. Troubleshooting of single phase AC induction motors and universal motor. (18hrs.)

		motor. (05 Hrs.)	
Professional Skill 100Hrs.; Professional Knowledge 36Hrs.	Plan, execute testing, evaluate performance and carry out maintenance of Alternator / MG set. Execute parallel operation of alternators.	151. Install an alternator, identify parts and terminals of alternator. (10 Hrs.) 152. Test for continuity and insulation resistance of alternator. (5 Hrs.) 153. Connect, start and run an alternator and build up the voltage. (10 Hrs.) 154. Determine the load performance and voltage regulation of three phase alternator. (10 Hrs.) 155. Parallel operation and synchronization of three phase alternators. (15 Hrs.)	Principle of alternator, e.m.f. equation, relation between poles, speed and frequency. Types and construction. Efficiency, characteristics, regulation, phase sequence and parallel operation. Effect of changing the field excitation and power factor correction. (18hrs.)
		156. Install a synchronous motor, identify its parts and terminals. (10 Hrs.) 157. Connect, start and plot V-curves for synchronous motor under different excitation and load conditions. (15 Hrs.)	Working principle of synchronous motor. Effect of change of excitation and load. V and anti V curve. Power factor improvement. (09hrs.)
		158. Identify parts and terminals of MG set. (5 Hrs.) 159. Start and load MG set with 3 phase induction motor coupled to DC shunt generator. (20 Hrs.)	Rotary Converter, MG Set description and Maintenance. (09hrs.)
Professional Skill 150 Hrs.; Professional Knowledge 54 Hrs.	Assemble simple electronic circuits and test for functioning.	160. Determine the value of resistance by colour code and identify types. (10 Hrs.) 161. Test active and passive electronic components and	Resistors – colour code, types and characteristics. Active and passive components. Atomic structure and semiconductor theory. (09hrs.)

		its applications. (10Hrs.)	
		162. Determine V-I characteristics of semiconductor diode. (10 Hrs.) 163. Construct half wave, full wave and bridge rectifiers using semiconductor diode. (10 Hrs.) 164. Check transistors for their functioning by identifying its type and terminals. (10 Hrs.) 165. Bias the transistor and determine its characteristics. (05Hrs.) 166. Use transistor as an electronic switch and series voltage regulator. (05Hrs.)	P-N junction, classification, specifications, biasing and characteristics of diodes. Rectifier circuit - half wave, full wave, bridge rectifiers and filters. Principle of operation, types, characteristics and various configuration of transistor. Application of transistor as a switch, voltage regulator and amplifier. (18hrs.)
		167. Operate and set the required frequency using function generator. (10Hrs.) 168. Make a printed circuit board for power supply. (10 Hrs.) 169. Construct simple circuits containing UJT for triggering and FET as an amplifier. (10Hrs.) 170. Troubleshoot defects in simple power supplies. (15Hrs.)	Basic concept of power electronics devices. IC voltage regulators Digital Electronics - Binary numbers, logic gates and combinational circuits. (09hrs.)
		171. Construct power control circuit by SCR, Diac, Triac and IGBT. (15 Hrs.) 172. Construct variable DC stabilized power supply	Working principle and uses of oscilloscope. Construction and working of SCR, DIAC, TRIAC and IGBT. Principle, types and applications

		using IC. (10 Hrs.) 173. Practice on various logics by use of logic gates and circuits. (10Hrs.) 174. Generate and demonstrate wave shapes for voltage and current of rectifier, single stage amplifier and oscillator using CRO. (10 Hrs.)	of various multivibrators. (18hrs.)
Professional Skill 100 Hrs.; Professional Knowledge 36 Hrs.	Assemble accessories and carry out wiring of control cabinets and equipment.	175. Design layout of control cabinet, assemble control elements and wiring accessories for: (i) Local and remote control of induction motor. (15 Hrs.) (ii) Forward and reverse operation of induction motor. (10 Hrs.) (iii) Automatic star-delta starter with change of direction of rotation. (15 Hrs.) (iv) Sequential control of three motors. (10 Hrs.)	Study and understand Layout drawing of control cabinet, power and control circuits. Various control elements: Isolators, pushbuttons, switches, indicators, MCB, fuses, relays, timers and limit switches etc. (18hrs.)
		176. Carry out wiring of control cabinet as per wiring diagram, bunching of XLPE cables, channeling, tying and checking etc. (15 Hrs.) 177. Mount various control elements e.g. circuit breakers, relays, contactors and timers etc. (10 Hrs.) 178. Identify and install required measuring instruments and sensors in	Wiring accessories: Race ways/ cable channel, DIN rail, terminal connectors, thimbles, lugs, ferrules, cable binding strap, buttons, cable ties, sleeves, gromats and clips etc. Testing of various control elements and circuits. (18hrs.)

		control panel. (10 Hrs.) 179. Test the control panel for its performance. (15 Hrs.)	
Professional Skill 50 Hrs.; Professional Knowledge 18Hrs.	Perform speed control of AC and DC motors by using solid state devices.	180. Perform speed control of DC motor using thyristors / DC drive. (18 Hrs.) 181. Perform speed control and reversing the direction of rotation of AC motors by using thyristors / AC drive. (18 Hrs.) 182. Construct and test a universal motor speed controller using SCR. (14 Hrs.)	Working, parameters and applications of AC / DC drive. Speed control of 3 phase induction motor by using VVVF/AC Drive. (18hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 18Hrs.	Detect the faults and troubleshoot inverter, stabilizer, battery charger, emergency light and UPS etc.	183. Assemble circuits of voltage stabilizer and UPS. (10 Hrs.) 184. Prepare an emergency light. (10 Hrs.) 185. Assemble circuits of battery charger and inverter. (10Hrs.) 186. Test, analyze defects and repair voltage stabilizer, emergency light and UPS. (05Hrs.) 187. Maintain, service and troubleshoot battery charger and inverter. (07Hrs.) 188. Install an Inverter with battery and connect it in domestic wiring for operation. (08Hrs.)	Basic concept, block diagram and working of voltage stabilizer, battery charger, emergency light, inverter and UPS. Preventive and breakdown maintenance. (18hrs.)
Professional Skill 25 Hrs.; Professional	Erect overhead domestic service line and outline various power plant	189. Draw layout of thermal power plant and identify function of different layout elements. (5 Hrs.)	Conventional and non-conventional sources of energy and their comparison. Power generation by thermal and

Knowledge 09 Hrs.	layout.	190. Draw layout of hydel power plant and identify functions of different layout elements. (5 Hrs.) 191. Visit to transmission / distribution substation. (10 Hrs.) 192. Draw actual circuit diagram of substation visited and indicate various components. (5 Hrs.)	hydel power plants. (09hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 09 Hrs.	Plan, assemble and install solar panel.	193. Prepare layout plan and Identify different elements of solar power system. (05 Hrs.) 194. Prepare layout plan and Identify different elements of wind power system. (05 Hrs.) 195. Assemble and connect solar panel for illumination. (15 Hrs.)	Various ways of electrical power generation by non-conventional methods. Power generation by solar and wind energy. Principle and operation of solar panel. (08 hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 18 Hrs.	Erect overhead domestic service line and outline various power plant layout.	196. Practice installation of insulators used in HT/LT line for a given voltage range. (5 hrs.) 197. Draw single line diagram of transmission and distribution system. (5 Hrs.) 198. Measure current carrying capacity of conductor for given power supply. (5 hrs.) 199. Fasten jumper in pin, shackle and suspension type insulators. (10 Hrs.)	Transmission and distribution networks. Line insulators, overhead poles and method of joining aluminum conductors. (09hrs.)
		200. Erect an overhead service line pole for single phase	Safety precautions and IE rules pertaining to domestic service

		230V distribution system in open space. (10 Hrs.) 201. Practice on laying of domestic service line. (10 Hrs.) 202. Install bus bar and bus coupler on LT line. (5 Hrs.)	connections. Various substations. Various terms like – maximum demand, average demand, load factor, diversity factor, plant utility factor etc. (09hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 09 Hrs.	Examine the faults and carry out repairing of circuit breakers.	203. Identify various parts of relay and ascertain the operation. (5 Hrs.) 204. Practice setting of pick up current and time setting multiplier for relay operation. (5 hrs.) 205. Identify the parts of circuit breaker, check its operation. (5Hrs.) 206. Test tripping characteristic of circuit breaker for over current and short circuit current. (5 hrs.) 207. Practice on repair and maintenance of circuit breaker. (5 hrs.)	Types of relays and its operation. Types of circuit breakers, their applications and functioning. Production of arc and quenching. (09hrs.)
Project work / Industrial visit: a) Battery charger/Emergency light b) Control of motor pump with tank level c) DC voltage converter using SCRs d) Logic control circuits using relays e) Alarm/indicator circuits using sensors			

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