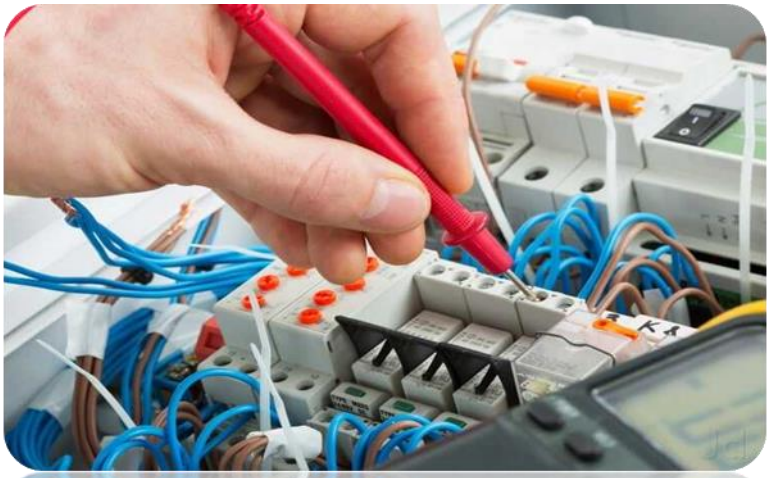
ELECTRICIAN

NSQF LEVEL - 5



SECTOR- POWER

COMPETENCY BASED CURRICULUM

CRAFT INSTRUCTOR TRAINING SCHEME (CITS)

GOVERNMENT OF INDIA
Ministry of Skill Development & Entrepreneurship
Directorate General of Training
CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE
EN-81, Sector-V, Salt Lake City, Kolkata – 700091

ELECTRICIAN

Also Applicable for – WIREMAN

(Engineering Trade)

SECTOR – POWER

(Revised in 2023)

Version 2.0

CRAFT INSTRUCTOR TRAINING SCHEME (CITS)

NSQF LEVEL - 5

Developed By
Government of India
Ministry of Skill Development and Entrepreneurship
Directorate General of Training
CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE
EN-81, Sector-V, Salt Lake City,
Kolkata – 700 091
www.cstaricalcutta.gov.in

CONTENTS

1. COURSE OVERVIEW

The Craft Instructor Training Scheme is operational since inception of the Craftsmen Training Scheme. The first Craft Instructor Training Institute was established in 1948. Subsequently, 6 more institutes namely, Central Training Institute for Instructors (now called as National Skill Training Institute (NSTI)), NSTI at Ludhiana, Kanpur, Howrah, Mumbai, Chennai and Hyderabad were established in 1960 by DGT. Since then the CITS course is successfully running in all the NSTIs across India as well as in DGT affiliated institutes viz. Institutes for Training of Trainers (IToT). This is a competency based course for instructors of one year duration. “Electrician” CITS trade is applicable for Instructors of “Electrician” and “Wireman” CTS Trades.

The main objective of Craft Instructor training programme is to enable Instructors explore different aspects of the techniques in pedagogy and transferring of hands-on skills so as to develop a pool of skilled manpower for industries, also leading to their career growth & benefiting society at large. Thus promoting a holistic learning experience where trainee acquires specialized knowledge, skills & develops attitude towards learning & contributing in vocational training ecosystem.

This course also enables the instructors to develop instructional skills for mentoring the trainees, engaging all trainees in learning process and managing effective utilization of resources. It emphasizes on the importance of collaborative learning & innovative ways of doing things. All trainees will be able to understand and interpret the course content in right perspective, so that they are engaged in & empowered by their learning experiences and above all, ensure quality delivery.

2. TRAINING SYSTEM

2.1 GENERAL

CITS courses are delivered in National Skill Training Institutes (NSTIs) &DGT affiliated institutes viz., Institutes for Training of Trainers (IToT). For detailed guidelines regarding admission on CITS, instructions issued by DGT from time to time are to be observed. Further complete admission details are made available on NIMI web portal http://www.nimionlineadmission.in. The course is of one-year duration. It consists of Trade Technology (Trade skills and Trade knowledge), Training Methodology and Engineering Technology/ Soft skills. After successful completion of the training programme, the trainees appear in All India Trade Test for Craft Instructor. The successful trainee is awarded NCIC certificate by DGT.

2.2 COURSE STRUCTURE

Table below depicts the distribution of training hours across various course elements during a period of one year:

S No.	Course Element	Notional Training Hours
1.	**Trade Technology**	
	Professional Skill (Trade Practical)	480
	Professional Knowledge (Trade Theory)	270
2.	**Training Methodology**	
	TM Practical	270
	TM Theory	180
	Total	**1200**

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

3	On the Job Training (OJT)/ Group Project	150
4	Optional Course	240

Trainees can also opt for optional courses of 240 hours duration.

2.3 PROGRESSION PATHWAYS

- Can join as a Technical Instructor in A Vocational Training Institute/ Technical Institute.

- Can join as a supervisor in Industries.

2.4 ASSESSMENT & CERTIFICATION

The CITS trainee will be assessed for his/her Instructional skills, knowledge and attitude towards learning throughout the course span and also at the end of the training program.

a) The Continuous Assessment (Internal) during the period of training will be done by Formative Assessment Method to test competency of instructor with respect to assessment criteria set against each learning outcomes. The training institute has to maintain an individual trainee portfolio in line with assessment guidelines. The marks of internal assessment will be as per the formative assessment template provided on www.bharatskills.gov.in

b) The **Final Assessment** will be in the form of **Summative Assessment Method**. The All India Trade Test for awarding National Craft Instructor Certificate will be conducted by DGT at the end of the year as per the guidelines of DGT. The learning outcome and assessment criteria will be the basis for setting question papers for final assessment**.** The external examiner during final examination will also check the individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

2.4.1 PASS CRITERIA

Allotment of Marks among the subjects for Examination:

The minimum pass percent for Trade Practical, TM practical Examinations and Formative assessment is 60% & for all other subjects is 40%. There will be no Grace marks.

2.4.2 ASSESSMENT GUIDELINE

Appropriate arrangements should be made to ensure that there will be no artificial barriers to assessment. The nature of special needs should be taken into account while undertaking the assessment. While assessing, the major factors to be considered are approaches to generate solutions to specific problems by involving standard/non-standard practices.

Due consideration should also be given while assessing for teamwork, avoidance/reduction of scrap/wastage and disposal of scrap/waste as per procedure, behavioral attitude, sensitivity to the environment and regularity in training. The sensitivity towards OSHE and self-learning attitude are to be considered while assessing competency.

Assessment will be evidence based comprising of the following:

- Demonstration of Instructional Skills (Lesson Plan, Demonstration Plan)
- Record book/daily diary

- Assessment Sheet
- Progress chart
- Video Recording
- Attendance and punctuality
- Viva-voce
- Practical work done/Models
- Assignments
- Project work

Evidences and records of internal (Formative) assessments are to be preserved until forthcoming yearly examination for audit and verification by examining body. The following marking pattern to be adopted while assessing:

Performance Level	Evidence
(a) Weightage in the range of 60%-75% to be allotted during assessment	
For performance in this grade, the candidate should be well versed with instructional design, implement learning programme and assess learners which demonstrates attainment of an ***acceptable standard*** of crafts instructorship with ***occasional*** **guidance** and engage students by demonstrating good attributes of a trainer.	• Demonstration of ***fairly good*** skill to establish a rapport with audience, presentation in orderly manner and establish as an expert in the field. • Average engagement of students for learning and achievement of goals while undertaking the training on specific topic. • A fairly good level of competency in expressing each concept in terms the student can relate, draw analogy and summarize the entire lesson. • Occasional support in imparting effective training.
(b) Weightage in the range of 75%-90% to be allotted during assessment	
For performance in this grade, the candidate should be well versed with instructional design, implement learning programme and assess learners which demonstrates attainment of a ***reasonable standard*** of crafts instructorship with ***little*** **guidance** and engage students by demonstrating good attributes of a trainer.	• Demonstration of ***good*** skill to establish a rapport with audience, presentation in orderly manner and establish as an expert in the field. • Above average in engagement of students for learning and achievement of goals while undertaking the training on specific topic. • A ***good*** level of competency in expressing each concept in terms the student can relate, draw analogy and summarize the

	entire lesson. • Little support in imparting effective training.
©Weightage in the range of more than 90% to be allotted during assessment	
For performance in this grade, the candidate should be well versed with instructional design, implement learning programme and assess learners which demonstrates attainment of a ***high standard*** of crafts instructorship with ***minimal or no support*** and engage students by demonstrating good attributes of a trainer.	• Demonstration of ***high*** skill level to establish a rapport with audience, presentation in orderly manner and establish as an expert in the field. • Good engagement of students for learning and achievement of goals while undertaking the training on specific topic. • A ***high*** level of competency in expressing each concept in terms the student can relate, draw analogy and summarize the entire lesson. • Minimal or no support in imparting effective training.

3. GENERAL INFORMATION

Name of the Trade	**ELECTRICIAN – CITS**
Trade Code	DGT/ 4001
Reference NCO 2015	2356.0100,7411.0100, 7412.0200, 7411.0301, 3122.6000, 3123.0400
NOS Covered	PSS/N9415, PSS/N9416, PSS/N9417, PSS/N9418, PSS/N9419, PSS/N9420 PSS/N9421, PSS/N9422, PSS/N9423, PSS/N9414, PSS/N9424, PSS/N9425, PSS/N9411, PSS/N9412
NSQF Level	Level-5
Duration of Craft Instructor Training	One Year
Unit Strength (No. Of Student)	25
Entry Qualification	Degree in Electrical/ Electrical and Electronics Engineering from AICTE/ UGC recognized Engineering College / University. OR 03 years Diploma in Electrical/ Electrical and Electronics Engineering after class 10th from AICTE/ recognized board of technical education. OR Ex-serviceman from Indian Armed forces with 15 years of service in related field as per equivalency through DGR. OR 10th Class with 02 year NTC/NAC passed in the trade of "Electrician" + 1 year of related experience.
Minimum Age	18 years as on first day of academic session.
Space Norms	140 Sq. m
Power Norms	5.2 KW
Instructors Qualification for	
1. Electrician - CITS Trade	B.Voc/Degree in Electrical / Electrical &Electronics Engineering from AICTE/UGC recognized University with two years experience in relevant field. OR 03 years Diploma in Electrical/ Electrical & Electronics Engineering from AICTE/recognized University/ board or relevant Advanced Diploma (Vocational) from DGT with five years experience in relevant field. OR Ex-serviceman from Indian Armed forces with 15 years of service in related field as per equivalency through DGR. Candidate should have undergone methods of instruction course or minimum 02 years of experience in technical training institute of Indian Armed forces. OR NTC/ NAC passed in Electrician trade with seven years experience in relevant field.

	Essential Qualification: National Craft Instructor Certificate (NCIC) in Electrician trade, in any of the variants under DGT.
2. Workshop Calculation &Science	B.Voc/Degree in any Engineering from AICTE/ UGC recognized Engineering College/ university with two years experience in relevant field. **OR** 03 years Diploma in any Engineering AICTE /recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with five years experience in relevant field. **OR** NTC/ NAC in any Engineering trade with seven years experience in relevant field. **Essential Qualification:** National Craft Instructor Certificate (NCIC) in relevant trade **OR** NCIC in RoDA or any of its variants under DGT
3. Engineering Drawing	B.Voc/Degree in Engineering from AICTE/ UGC recognized Engineering College/ university with two years experience in relevant field. OR 03 years Diploma in Engineering from AICTE /recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with five years' experience in the relevant field. OR NTC/ NAC in any one of the 'Electrical group (Gr-II) trades categorized under Engg. Drawing'/ D'man Mechanical / D'man Civil' with seven years experience. **Essential Qualification:** National Craft Instructor Certificate (NCIC) in relevant trade **OR** NCIC in RoDA / D'man (Mech /civil) or any of its variants under DGT
4. Training Methodology	B.Voc/Degree in any discipline from AICTE/ UGC recognized College/ university with two years experience in training/ teaching field. **OR** Diploma in any discipline from recognized board / University with five years experience in training/teaching field. **OR** NTC/ NAC passed in any trade with seven years experience in training/ teaching field. **Essential Qualification:** National Craft Instructor Certificate (NCIC) in any of the variants under DGT / B.Ed /ToT from NITTTR or equivalent.
5. Minimum Age for Instructor's	21 Years

4. JOB ROLE

Brief description of job roles:

Manual Training Teacher/Craft Instructor; instructs students in ITIs/Vocational Training Institutes in respective trades as per defined job role. Imparts theoretical instructions for the use of tools &equipments of related trades and related subjects. Demonstrate process and operations related to the trade in the workshop; supervises, assesses and evaluates students in their practical work. Ensures availability & proper functioning of equipment and tools in stores.

Electrician General; installs, maintains and repairs electrical machinery equipment and fittings in factories, workshops power house, business and residential premises etc. Studies drawings and other specifications to determine electrical circuit, installation details etc. Positions and installs electrical motors, transformers, switchgears. Switchboards and other electrical equipment, fittings and lighting fixtures. Makes connections and solders terminals. Tests electrical installations and equipment and locates faults using megger, test lamps etc. Repairs or replaces defective wiring, burnt out fuses and defective parts and keeps fittings and fixtures in working order. May do armature winding, draw wires and cables and do simple cable jointing. May operate, attend and maintain electrical motors, pumps etc.

Electrical Fitter; fits and assembles electrical machinery and equipment such as motors, transformers, generators, switchgears, fans etc., studies drawings, wiring diagrams of fittings, wiring and assemblies to be made. Collects prefabricated electrical and mechanical components according to drawing and wiring diagrams and checks them with gauges, megger etc. to ensure proper function and accuracy. Fits mechanical components, resistance, insulators, etc., as per specifications, doing supplementary tooling where necessary. Follows wiring diagrams, makes electrical connections and solders points as specified. Checks for continuity, resistance, circuit shorting, leakage, earthing, etc. at each stage of assembly using megger, ammeter, voltmeter and other appliances and ensures stipulated performance of both mechanical and electrical components filled in assembly. Erects various equipment such as bus bars, panel boards, electrical posts, fuse boxes switch gears, meters, relays etc. using non-conductors, insulation hoisting equipment as necessary for receipt and distribution of electrical current to feeder lines. Installs motors, generators, transformer etc. as per drawings using lifting and hoisting equipment as necessary, does prescribed electrical wiring, and connects to supply line. Locates faults in case of breakdown and replaces blown out fuse, burnt coils, switches, conductors etc. as required. Checks, dismantles, repairs and overhauls electrical units periodically or as required according to scheduled procedure. May test coils. May specialize in repairs of particular equipment manufacturing, installation or power house work and be designated accordingly.

Wireman, Light and Power; installs various kinds of electrical wiring such as cleat, conduit, casing, concealed etc. in houses, factories, workshops and other establishments for light and power supply. Studies diagram and plan of wiring and marks light, power and other points accordingly. Fixes wooden pegs, sizes tubes, saws casings, etc. by common carpentry fitting and other processes, according to type of wiring needed. Erects switch boards and fixes switch box casings cleats, conduits ceiling roses, switches, meters etc. according to type and plan of wiring. Draws wire in two way or three way wiring system as prescribed and makes electrical connections through plugs and switches to different points exercising great care for safety and avoiding short circuit and earthing at any stage of wiring. Fixes fuses and covers as per diagram and insulates all naked wire sat diversions and junctions to eliminate chances of short circuit and earthing. Fits light brackets, holders, shades, tube and mercury lights, fans etc. and makes electrical connection as necessary. Tests checks installed wiring for leakage and continuity using megger, removes faults ifany and certifies wiring as correct for connecting mains. Checks existing wiring for defects and restores current supply by replacing defective switches, plug sockets, blown fuse etc. or removing short circuits and faulty wiring as necessary. May repair simple electrical domestic appliances.

Electrical Supervisor, Wiring plans, prepares, estimates and supervises installation of commercial, industrial and domestic wiring in factories, establishments and residential buildings. Visits site, decides number of points to be fixed and estimates costs according to type of wiring to be installed. Plans and prepares wiring diagram according to building layout, power and light points to be fixed, equal distribution of load, minimum exposure to weather, easy access for repairs and other factors as necessary to suit customer's requirements. Marks location of points, cut-outs, ceiling roses junction boxes etc., and explains circuit to be drawn to Wireman. Arranges for materials, supervises installation of wiring and guides workers as necessary to ensure conformity with safety and electricity rules. Tests whole wiring systems with merger on completion of work to ensure continuity and proper installation. Connects to main switch fixed at convenient place and certifies on prescribed form that there is no leakage and wiring has been done in accordance with electricity act. May supervise installation of temporary wiring. May supervise installation of geyser, air-conditioners, booster pumps and other domestic appliances.

Line Supervisor, Electrical; supervises installation and drawing of overhead and underground electrical line for street lighting and power supply. Studies diagrams and details of line to be drawn. Visits area, determines electrical towers and poles to be installed and/or underground cables to be laid and explains working details to linemen. Marks locations of poles and tower or earth to be dug and gets them installed or set according to electricity act ensuring proper earthing. Gets brackets and other accessories fitted according to specifications. Informs power house or appropriate authority to switch off electric supply in area in which working, if necessary. Directs linemen and other workers to draw electric line as scheduled ensuring safety and minimum sagging. Guides joining of cables, fuses, junction boxes, etc., as appropriate and ensures continuity and proper installation. May do lead

burning and join cables. May take charge of particular area and maintain power supply line by conducting repairs and replacements as necessary.

Reference NCO-2015:

a) 2356.0100 - Manual Training Teacher/Craft Instructor
b) 7411.0100 - Electrician General
c) 7412.0200 - Electrical Fitter
d) 7411.0301 - Wireman, Light and Power
e) 3122.6000 - Line Supervisor, Electrical
f) 3123.0400 - Electrical Supervisor, Wiring

Reference NOS:

i) PSS/N9415
ii) PSS/N9416
iii) PSS/N9417
iv) PSS/N9418
v) PSS/N9419
vi) PSS/N9420
vii) PSS/N9421
viii) PSS/N9422
ix) PSS/N9423
x) PSS/N9414
xi) PSS/N9424
xii) PSS/N9425
xiii) PSS/N9411
xiv) PSS/N9412

5. LEARNING OUTCOME

Learning outcomes are a reflection of total competencies of a trainee and assessment will be carried out as per the assessment criteria.

5.1 TRADE TECHNOLOGY

1. Ensure implementation of safe working practices, environment regulation and housekeeping. (NOS: PSS/9415)
2. Explain verification & measurement of different characteristics of electrical circuits. (NOS: PSS/9416)
3. Demonstrate installations, testing and maintenance of batteries & solar cells. (NOS: PSS/9417)
4. Train to estimate, assemble, install and test various wiring systems, winding and Insulating materials. (NOS: PSS/9418)
5. Explain verification & measurement of different characteristics of Magnetic effect of electric current, parts of DC Generator, DC motor and Power factors. (NOS: PSS/9416)
6. Evaluate testing, performance and maintenance of transformer. (NOS: PSS/9419)
7. Monitor testing, check connections, verify errors, calibrate various instruments and electrical Illumination systems. (NOS: PSS/9420)
8. Assess construction of simple electronic circuits and test for functioning. (NOS: PSS/9421)
9. Demonstrate planning, execution, commissioning and performance of various AC motors & Alternator/ MG set. (NOS: PSS/9422)
10. Analyse detection of faults and troubleshooting of inverter, stabilizer, UPS etc. (NOS: PSS/9423)
11. Demonstrate estimation, testing, servicing & troubleshooting components of various domestic/industrial programmable systems & their control circuits. (NOS: PSS/N9414)
12. Evaluate planning, execution, commissioning & evaluate performance of various conventional/non-conventional power generation, transmission & distribution components. (NOS: PSS/9424)
13. Demonstrate installation and troubleshooting of Electric Vehicle charging stations. (NOS: PSS/9425)
14. Read and apply engineering drawing for different application in the field of work. (NOS: PSS/N9411)
15. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: PSS/N9412)

6. COURSE CONTENT

SYLLABUS FOR ELECTRICIAN - CITS TRADE			
TRADE TECHNOLOGY			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical)**	**Professional Knowledge (Trade Theory)**
Practical 15 Hrs Theory 06 Hrs	Ensure implementation of safe working practices, environment regulation and housekeeping.	**Safety Practices** • Demonstrate fires in electrical Circuits &Precautions. • Identify fire extinguishers & its types, General Safety of Tools Equipment. • Rescue a person who is in contact with live wire and treat a person for electric shock/ injury. • Use of discharge rod.	General Safety, Fire Fighting. Safely handling Tools & Equipment. Use of proper Tools &Equipment & its maintenance. Rescue of person who is in contact with live wire. Treat a person for electric shock/ injury. Personal Protective Equipment
Practical 15 Hrs Theory 06 Hrs	Explain verification & measurement of different characteristics of electrical circuits.	**Basic Electricity** • Verify Ohm's Law. • Measure current & voltage in series and parallel circuits. • Measure Resistance using Wheat- stone bridge. • Verify Kirchhoff's Laws. • Check bare conductor joint. • Test PVC wire joints. • Check Crimping of lugs. • Demonstrate Soldering.	Fundamentals, Ohm' Law, Kirchhoff's Laws, Series & Parallel combination of Resistors, Inductors & Capacitors. Laws of Resistance, Wheatstone bridge, PVC wires, Conductors &cables. Wire joints, Soldering.
Practical 25 Hrs Theory 10 Hrs	Demonstrate Installations, testing and maintenance of batteries & solar cells.	**Effects of Electric current** • Connect heating elements & solenoid coil. • Prepare electrolyte. • Measure specific gravity. • Perform grouping of Cells. • Test the battery with High rate discharge tester& Hydrometer. • Apply different methods of battery charging with due Care & Maintenance. • Determine the number of solar cells in series/ parallel	Heating, lighting, magnetic & chemical effect of electric current. Joule's law. Electrolysis & its laws Cells and Batteries- Primary & secondary cells, their construction & working. Lead Acid battery in detail- Hybrid cell, Alkaline cell, Charging Methods. Care & Maintenance of Battery. Principle and operation of solar cell.

		for given power requirement.	
Practical 25 Hrs Theory 10 Hrs	Train to estimate, assemble, install and test various wiring systems, winding & Insulating materials.	**Wiring systems and types –** • Apply method of using wire gauge and micrometer. • Demonstrate PVC Casing-capping, Conduit wiring, Testing, Maintenance and repairing of wiring. • Apply fuse, MCB, ELCB relays. • Demonstrate multi-storied building wiring. • Measure Earth resistance by Earth tester. • Protective multiple earthing (PME),	National Electrical Code, SWG, common electrical Accessories - MCB, ELCB, MCCB, RCCB etc. Comparison between different types of wirings. Installation, Testing methods – Wiring estimations &cost. Earthing, types, methods, improving earth resistance, Earth tester. Protective multiple earthing (PME), concept of chemical earthing
Practical 70 Hrs Theory 28 Hrs	Explain verification & measurement of different characteristics of Magnetic effect of electric current, parts of DC Generator, DC motor and Power factors.	**Magnetism, Alternating current & Poly phase system** • Check preparation of electromagnet. • Test different types of capacitor. • Measure R, L, C, Z, Power, Power Factor, Energy by different methods – Single Phase & 3Phase. • Measure the line & phase values of voltage & current in star & Delta connection.	Terminology used in magnetic circuit. Permanent Magnet, Principle of electromagnet Capacitor & its types. Faraday's laws of Electromagnetic Induction. Fleming's rule, B-H Curve. Fundamental terms. Solving RLC circuit –series & parallel resonance. Star & Delta connections. Three phase three wires & three phase four wires system. Three phase Power.
		DC Generator • Check different parts of DC generator. • Build up the voltage on Shunt Generator. • Connect Compound Generator & Build up voltage. • Test and verify characteristics of series, Shunt and Compound generator. • Demonstrate dismantling & reassembling of DC Generator.	Construction & Principle. Types-Series, Shunt & Compound Generator. EMF equation, Characteristics (OCC &LCC). Armature reactions, commutation Efficiency, regulation& Applications. Parallel operations Care and maintenance & Trouble shooting. Compensating winding, interpoles and voltage control method.

		• Manual voltage control	
		DC Motor • Identify different parts of DC motor. • Demonstrate starting and running of series, shunt & compound Motors.	Construction & Principle. Types- Series, Shunt & Compound Motors. Characteristics curve.
		Work, Power, Energy& Power factor • Measure the power & Power Factor in a balanced & unbalanced load by two wattmeter method and by using Power Factor meter. • Improve the power factor of a circuit using static capacitor. • Measure Energy in single phase Load.	Active& Reactive Power. Simple calculation for Work, Power &Energy. Definition, significance Causes & effects of low power factor. Methods of Improving power factor. Calculation of capacitor banks. Automatic power factor correction (APFC)Panels. Smart meters, Automated meter readers.
Practical 25 Hrs Theory 10 Hrs	Evaluate testing, performance and maintenance of transformer.	**Transformer** • Test and measure different transformation ratio. • Demonstrate Open Circuit (OC) Test, Short Circuit (SC) test. • Measure efficiency & load Regulation • Demonstrate parallel Operation. • Demonstrate connection of star and Delta. • Test and assess different transformer Oils. • Detect faults and troubleshoot transformers. • Verify the voltage of autotransformer with different tapings. • Measure high current & voltage using CT and PT.	Principle, Construction. Classification of Transformers EMF equation, rating Loading, Losses & Efficiency Regulation. Parallel Operation Cooling methods, Transformer oil testing. Care and maintenance, Protective devices. Tap Changer –ON load and OFF load. Auto transformer, Instrument Transformer- CT & PT. Welding Transformer.
Practical 50 Hrs Theory 20 Hrs	Monitor testing, check connections, verify errors and calibrate various instruments and	**Electrical Measuring instruments** • Identify different types of electrical instruments. • Determine errors using	Types –PMMC, MI Meters. Principle and construction. Digital meters. Megger & Earth tester. Calibrations of meters. Electronic measuring

	electrical Illumination systems.	PMMC and MI meters. • Test and calibrate different meters including Energy meter. • Measure insulation resistance.	instruments & sensors
		Illumination • Connect& Install all kinds of lamps. • Connect single & twin tube light fittings. • Connect HPMV & HPSV lamp. • Construct and design Decorative Light. • Use Lux- meter. • Repairing of LED Bulbs.	Laws of Illumination. Terminology used in Illumination. Types of Lamps-Incandescent Lamp and Discharge Lamp-fluorescent, HPMV, HPSV Lamps. Drum Switch, Lighting calculations. Energy efficient lighting systems (CFL, LED etc.)
Practical 25 Hrs Theory 10 Hrs	Assess Construction of simple electronic circuits and test for functioning.	**Basic Electronics** • Identify different colour coding of Resistors. • Construct Rectifier circuits. • Check the different wave shape using CRO. • Test the Transistor Single stage Amplifier circuit. • Design Simple circuit containing power diode & power transistor. • Construct UJT triggering circuit. • Use FET & MOSFET as an amplifier. • Assess construction of control circuits for – SCR, DIAC, TRIAC, IGBT. • Assemble different OP-AMP circuits using IC 741. • Verify truth tables of Logic gates.	Semi-conductor diodes, Characteristics Zener diode Rectifiers & filter circuits. Working principle and use of CRO. Transistor, Amplifier & types. Introduction to Oscillator. Basic concept of Power diode, power transistor, Introduction to- UJT, FET, SCR, DIAC, TRIAC, MOSFET, IGBT. Introduction to Operational Amplifiers (IC-741). Digital Electronics –Number System, Logic gates.
Practical 70 Hrs Theory 28 Hrs	Demonstrate Planning, execution, commissioning and performance of various AC motors & Alternator/ MG set.	**Three phase Induction motor** • Analyse connection of various starters. • Start, run & load ac 3 phase Squirrel cage & Wound rotor Induction motors for performance testing. • Check the change of	Squirrel Cage & Wound Rotor: - Construction, parts, working principle.Concept of rotating magnetic field Applications. Types of starters-DOL, Star delta, Auto transformer starter etc. Rotor resistance type starter. Introduction to Speed control of 3

		direction of rotation. • Measure speed, torque, slip, current, power, PF etc.	phase Induction motor. Torque-speed characteristics. Losses & efficiency. Doubly Fed Induction Generators (DFIG) & its applications in renewable energy.
		Single phase & Special type of motors • Demonstrate starting and running of single phase motors & change DOR (direction of rotation). • Check dismantling and reassembling of different types of 1-Ø motors.	Classification, Construction, Working Principle & uses. Methods of starting. - Stepper motor, servo motor etc.
		Alternator • Install an alternator and identify various parts and terminals of the same. • Demonstrate build up voltage, excitation, loading Characteristics. • Calculate load regulation &performance efficiency. • Synchronise (by Parallel Operation) Alternators by Different Methods. • Start and Run, build up voltage and load MG set.	Types- Hydro & Turbo Construction, Working Principle. Excitation methods, EMF Equation, Phase sequence, loading and characteristics. Efficiency &Voltage regulation. Parallel operations, conditions for Synchronisation. Brushless alternator. AVR (Automatic voltage regulator). MG set – Description, specifications & Characteristics.
		Synchronous Motor • Identify different parts of Synchronous Motor. • Connect, Start and Run the Synchronous Motor. • Demonstrate Plotting of V-curve. • Demonstrate different applications of synchronous motor. • Check and correct Power factor.	Construction, Working Principle, Starting Method. Effect of change of excitation on load. V-curve and Inverted V -curve. Power factor correction. Applications of synchronous motors, damper winding.
		Winding and Insulating materials • Demonstrate small transformer winding. • Test burnt out	Small transformer winding technique. DC machine winding, various types and methods, development diagram, winding procedure.

		DC machine for re-winding. • Demonstrate Winding procedure. • Check small armature winding, impregnation, baking.	
		AC motor stator Re-winding • Test burnt stator and demonstrate rewinding procedure. • Check single & double layer winding. • Demonstrate Impregnations, Varnishing, Baking & Assembling.	AC Motor stator Re-winding- Single phase & Three phase winding development diagram. Winding procedure.
Practical 15 Hrs Theory 06 Hrs	Analyze detection of faults and troubleshooting of inverter, stabilizer, UPS etc.	**Basic Rectifiers and Inverter circuits** • Check Basic Rectifiers and Inverter ckt. • Demonstrate Speed control of DC Motor using DC Drive. • Verify speed control of AC Motor (Induction Motor) using AC Drive. • Demonstrate maintenance of AC/DC machines, voltage stabiliser, UPS, Inverter & Drives.	Working principle, Construction, parameterization, Speed control. DC drive. AC drive. Preventive& Break down Maintenance of DC / AC machines, Voltage stabilizer, UPS, Inverter.
Practical 65 Hrs Theory 28 Hrs	Demonstrate estimation, testing, servicing &troubleshooting components of various domestic/industrial programmable systems & their control circuits.	**Industrial Wiring** • Demonstrate wiring of motors. • Test and service protective devices, control panel etc. • Check wiring on UPS & Inverter. • Demonstrate control cabinet/ control panel assembly, wiring, checking/buzzing & testing for the following exercises on 3 Ø induction motor. i) DOL starter with push button control. ii)Forward / Reverse starter Automatic Star/Delta starter.	Wiring of Electrical Motor and Control Panel. Machine control cabinet /control panel layout, assembly& wiring – Power & control circuits, control elements- Push button switches, contactor, overload Relay etc. Selection of cables (Size & length) for industrial applications.

		Domestic appliances • Repair and test various domestic appliances and equipments. • Demonstratedismantling, servicing, re-assembling &testing. • Demonstrate Care &Maintenance of Domestic appliances.	Working principle and circuits of common domestic equipment and appliances: - Heaters, geysers, electric iron, domestic Mixer, Hair drier, UPS Inverter, Microwave Oven, Induction Heater, Washing Machine etc. Concept of neutral and earth. Concept of Energy efficiency & energy efficient equipments. BEE Star Ratings, Labelling & Standardisation.
		Planning, Estimation & Costing of Wiring: • Plan and carry out Domestic, Industrial, Commercial and Multi-storeyed building Workshop. • Demonstrate estimation and costing labour/ Materials-accessories as per layout.	Concept-Principle of plan-estimation and cost-preparation of wiring layout domestic/Industrial/Commercial. Safety Regulation 2010for multi-storeyed building.
Practical 60 Hrs Theory 24 Hrs	Evaluate planning, execution, commissioning & performance of various conventional/non-conventional power generation, transmission & distribution components.	**Power Generation** • Visit and Prepare layout plan/ single line diagram of the Thermal /Hydro /Nuclear power plant. • Prepare layout plan for Non-conventional power plant. • Prepare layout plan and identify different elements of solar power system. • Assemble and connect solar panel for illumination.	Block diagram of Hydro, Thermal & Nuclear Power plants. Non-conventional energy: - Introduction, various types of non-conventional energy resources –Wind, Solar, Small Hydro and Bio-mass. Principle and operation of solar panel.
		Transmission of electric power, UG cables & Distribution of power: • Identify different types of insulators and binding insulators, fix jumper by crimping tool. • Check various joints in UG cables. • Visit HT/LT Substation; identify various parts of relay and ascertain the	Single Line Diagram of Substations. Electric supply system-comparison of EHVAC and HVDC transmission. Advantages of high voltage transmission Overhead lines: - Poles& Towers, bushings, Insulators & its types. Corona effect, Bundle-conductors, Sag, Skin effect& Ferranti effect. Fault studies. Construction, material, insulation, classification. 3 phase service-

		operation. • Demonstrate setting of pick up current and time setting multiplier for relay operation. • Identify the parts of circuit breaker and check its operation. • Test tripping characteristic of circuit breaker for over current and short circuit current. • Demonstrate repair and maintenance of circuit breaker.	cable fault. Sub- Station HT/LT – Function, equipment, types of distribution system accessories- protective relays, Types of relays and its operation, Types of circuit breakers, their applications and functioning, circuit breakers- lightning arrestor used in HT line.
Practical 20 Hrs Theory 04 Hrs	Demonstrate installation and troubleshooting of Electric Vehicle charging system.	**EV Charging System:** • Demonstrate installation of EV charging Station for Public places. • Demonstrate installation of Home EV charging stations. • Demonstrate troubleshooting of EV charging stations.	EV scenario in India and upcoming growth. EV Charging standards.
ENGINEERING DRAWING: 40 HRS.			
Theory ED- 40 Hrs.	Read and apply engineering drawing for different application in the field of work.	**CIRCLES, TANGENTS AND ELLIPSE:** Practical applications procedure for constructing tangent to given circle-lines- loop pattern--tangential circles- external tangents- internal tangents ellipse **PARABOLIC CURVES, HYPERBOLA:** Involutes - Properties and their application. Procedure for constructing parabolic curve-hyperbolic curve-in volute curve. epicycloids, hypocycloid, Involutes, spiral & Archimedes spiral **TECHNICAL DRAWING/ SKETCHING OF COMPONENTS' PARTS:** Views of object Importance of technical sketching-types of sketches-Isometric drawing sketching- Oblique drawing sketching. **PROJECTIONS:** Theory of projections (Elaborate theoretical instructions), Reference planes, orthographic projections concept 1st Angle and 3rd Angle, Projections of points, Projections of Lines– determination of true lengths & inclinations. Projections of plane, determination of true shape. Exercises on missing surfaces and views. Orthographic drawing or interpretation of views. Introduction to first angle projections of solids. **ISOMETRIC VIEWS**: Fundamentals of isometric projections (Theoretical Projections) Isometric views from 2 to 3 given orthographic views. Preparation of simple working drawing of Furniture items like table, stool and any job prepared in the	

		workshop. **FASTENERS:** Sketches of elements of screw threads, Sketches of studs, cap screws machine screws, set screws, Locking devices, bolts, Hexagonal & square nuts & nut bolt & washer assembly. Sketches of plain spring lock, toothed lock, washers, cap nut, check nut, slotted nut, cassel nut, sawn nut, wing nut, eye blot, tee bolt & foundation bolt. Sketches of various types of rivet heads (snap– pan–conical– countersunk) Sketches of keys (sunk, flat, saddle, gib head, woodruff) Sketches of hole &shaft assembly. Sign and Symbols of Electrical, Electronics and related trades Electrical and Electronics or trade related wiring diagram/ Layout diagram Electrical, Electronics/ trade related circuit diagram Block diagram of Instruments/ equipment of related trades Practice of blue print reading on Electrical / Electronics / Computer or IT related drawing etc., ISO Standards.
WORKSHOP CALCULATION & SCIENCE: 40 Hrs.		
Theory WCS- 40 Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	**Fraction:** Concept of Fraction, Numbers, Variable, Constant, **Ratio & Proportion**: - Trade related problems **Percentage:** Definition, changing percentage to decimal and fraction and vice versa. Applied problems related to trade. Estimation and cost of product. **Algebra:** Fundamental Algebraic formulae for multiplication and factorization. Algebraic equations, simple & simultaneous equations, quadratic equations and their applications. **Mensuration 2D:** Concept on basic geometrical definitions, basic geometrical theorems. Determination of areas, perimeters of triangles, quadrilaterals, polygons, circle, sector etc. **Mensuration 3D:** Determination of volumes, surface areas of cube, cuboids cylinders, hollow cylinder, sphere prisms, pyramids cone spheres, frustums etc. Mass, Weight, Volume, Density, Viscosity, Specific gravity and related problems. **Trigonometry:** Concept of angles, measurement of angles in degrees, grades and radians and their conversions. Trigonometrical ratios and their relations. Review of ratios of some standard angles (0, 30,45,60,90 degrees), Height & Distances, Simple problems. **Graphs:** basic concept, importance. Plotting of graphs of simple linear equation. Related problems on ohm's law, series-parallel combination. **Statistics:** Frequency tables, normal distribution, measure of central tendency – Mean, Median & Mode. Concept of probability. Charts like pie chart, bar chart, line diagram, Histogram and frequency polygon. **WORKSHOP SCIENCE:**

		Units and Dimensions: Conversions between British & Metric system of Units. Fundamental and derived units in SI System, Dimensions of Physical Quantities (MLT)-Fundamental & Derived. **Engineering Materials:** Classification properties and uses of ferrous metals, non-ferrous metals, alloys etc. Properties and uses of non-metals such as wood, plastic, rubber, ceramics industrial adhesives. **Heat & Temperature:** Concepts, differences, effects of heat, different units, relation, specific heat, thermal capacity, latent heat, water equivalent, mechanical equivalent of heat. Different Temperature measuring scales and their relation. Transference of heat, conduction, convection and radiation. Thermal Expansion related calculations. **Force and Motion**: Newton's laws of motion, displacement, velocity, acceleration, retardation, rest & motion such as linear, angular. Force – units, different laws for composition and resolution of forces. Concept on centre of gravity and equilibrium of forces in plane. Concept of moment of inertia and torque. **Work, power & energy**: Definitions, units, calculation & application. Concept of HP, IHP, BHP and FHP – related calculations with mechanical efficiency. S.I. unit of power and their relations. **Friction:** Concept of friction, laws of friction, limiting friction, coefficient of friction and angle of friction. Rolling friction & sliding friction with examples. Friction on inclined surfaces **Stress & Strain:** Concepts of stress, strain, modulus of elasticity. Stress- strain curve. Hook's law, different module of elasticity like Young's modulus, modulus of rigidity, bulk modulus and their relations. Poisson's ratio. **Simple machines:** Concept of Mechanical Advantage, Velocity Ratio, Efficiency and their relations. Working principles of inclined plane, lever, screw jack, wheel and axle, differential wheel and axle, worm and worm wheel, rack and pinion. Gear train. **Electricity:** Basic definitions like emf, current, resistance, potential difference, etc. Uses of electricity. Difference between ac and dc. Safety devices. Difference between conductors and semiconductors and resistors, Materials used for conductors, semiconductors and resistors.

		Ohm's Law. Series, parallel and series-parallel combination of resistances. Concept, definitions and units of electrical work, power and energy with related problems. **Fluid Mechanics:** Properties of fluid (density, viscosity, specific weight, specific volume, specific gravity) with their units. Concept of atmospheric pressure, gauge pressure, absolute pressure, vacuum and differential pressure.

SYLLABUS FOR CORE SKILLS
1. Training Methodology (Common for all trades) (270 Hrs + 180 Hrs)

Learning outcomes, assessment criteria, syllabus and Tool List of Core Skills subjects which is common for all the CITS trades, provided separately in www.bharatskills.gov.in./ www.dgt.gov.in

7. ASSESSMENT CRITERIA

LEARNING OUTCOME	ASSESSMENT CRITERIA
TRADE TECHNOLOGY	
1. Ensure implementation of safe working practices, environment regulation and housekeeping. (NOS: PSS/9415)	Explain procedures to achieve a safe working environment in line with occupational health and safety regulations and requirements and according to site policy.
	Check and report all unsafe situations according to site policy.
	Demonstrate necessary precautions on fire and safety hazards and report according to site policy and procedures.
	Classify, handle and store / dispose off dangerous goods and substances according to site policy and procedures following safety regulations and requirements.
	Evaluate and observe site policies and procedures in regard to illness or accident.
	Demonstrate basic first aid and use them under different circumstances.
	Explain different fire extinguisher and use the same as per requirement.
2. Explain verification & measurement of different characteristics of electrical circuits. (NOS: PSS/9416)	Explain verification of characteristics of series, parallel and its combination circuit using Ohm`s law and Kirchhoff's Laws.
	Analyze the effect of the short and open in series and parallel circuits.
	Explain verification of relation of voltage components of RLC series circuit in AC.
	Identify the phase sequence of a 3 ø supply using a phase-sequence meter.
	Group the given capacitors to get the required capacity and voltage rating.
3. Demonstrate Installations, testing and maintenance of batteries & solar cells. (NOS: PSS/9417)	Demonstrate assembling a DC source 6V/500 mA using 1.5V cells.
	Determine the internal resistance of cell and make grouping of cells.
	Appraise installation and maintenance of batteries.
	Determine total number of cells required for a given power requirement.
4.Train to estimate, assemble, install and test various wiring systems, winding and Insulating	Ensure Compliance with Safety Regulation 2010 when performing the wiring.
	Plan Preparation and mounting of the energy meter board.
	Evaluate drawing and wire up the consumers main board with

materials. (NOS: PSS/9418)	ICDP switch and distribution fuse box.
	Assess the types of fuses their ratings and applications.
	Check the parts of a relay, MCB & ELCB and 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.
	Check testing of burnt out DC machine for re- winding.
5. Explain verification & measurement of different characteristics of Magnetic effect of electric current, parts of DC Generator, DC motor and Power factors. (NOS: PSS/9416)	Explain measurement of the power and energy in a single & three phase circuit using wattmeter and energy meter with CT and PT.
	Determine the power factor by direct and indirect methods in an AC single phase RLC parallel circuit.
	Explain construction of solenoid and determine its polarity for the given direction of current.
	Monitor a connection of lamp load in star and delta and determine relationship between line and phase values with precaution.
	Explain connection of balanced and unbalanced loads in 3 phase star system and to measure the power of 3 phase loads.
	Evaluate measurement of electrical parameters using tong tester in three phase circuits.
	Determine the load performance of different types of DC generator on load.
	Explain to connect, start, run and reverse direction of rotation of different types of DC motors.
	Review the load performance tests on different type of DC motor.
	Explain controlling the speed of a DC motor by different method.
	Plan to maintain, service and trouble shoot the DC motor starter.
6. Evaluate testing, performance and maintenance of transformer. (NOS: PSS/9419)	Plan work in compliance with standard safety norms related with transformer.
	Explain the types of transformers and their specifications.
	Verify the transformation ratio of a single phase transformer.
	Evaluate connection and testing of a single phase auto-transformer.

	Determine the losses (iron loss and copper loss) and the regulation of a single phase transformer at different loads.
	Assess measurement of the current and voltage using CT and PT.
	Plan to carry out winding for small transformer of 1KVA rating.
	Test the transformer oil with oil testing kit.
	Check connection of 3 single phase transformers for 3 phase operation of - a) delta-delta b) delta-star c) star-star d) star-delta.
	Plan to connect the given two single phase transformers a) parallel b) series (secondary only) and measure voltage.
	Assess connection& testing of3 phase transformer in parallel.(Parallel operation).
7. Monitor testing, check connections, verify errors, calibrate various instruments and electrical Illumination systems. (NOS: PSS/9420)	Monitor calibration of different meters viz. PMMC, MI etc.
	Plan connection & installation of all kinds of lamps.
	Assess connection of single & twin tube light fittings.
	Monitor connection, installation and testing the HPMV & HPSV lamp with accessories.
	Monitor testing of a decorative serial lamp set for 240 V using 6V bulb and flasher.
	Monitor installation of light fitting for show case window lighting.
8. Assess Construction of simple electronic circuits and test for functioning. (NOS: PSS/9421)	Monitor soldering on components, lug and board with safety.
	Identify the passive /active components by visual appearance, Code number and check testing for their condition.
	Identify the control and functional switches in CRO and assess measurement of the D.C. & A.C. voltage, frequency and time period.
	Assess construction and review testing of half &full wave rectifiers with and without filter circuits.
	Monitor construction of circuit by using transistor as a switch.
	Evaluate construction and testing of a UJT as relaxation oscillator & electronic timer.
	Assess construction of amplifier circuit using Transistor, FET and JFET and testing.
	Plan to Construct and test lamp dimmer using TRIAC/DIAC.
	Test IGBT and use in circuit for suitable operation.
	Plan to construct and test the universal motor speed controller using SCR with safety.
	Appraise construction and testing of logic gate circuits.
9. Demonstrate Planning, execution, commissioning and performance of various AC motors& Alternator/ MG	Assess circuit diagram drawing and connection of forward & reverse 3 phase squirrel cage induction motor.
	Plan to start, run and reverse an AC 3 phase squirrel cage induction motor by different type of starters.

set. (NOS: PSS/9422)	Evaluate measurement of the slip of 3 phase squirrel cage induction motor by tachometer for different output. Check Drawing of 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.
	Monitor speed control of 3 phase induction motor.
	Demonstrate planning to connect, start and run a 3 phase synchronous motor.
	Demonstrate planning to connect start, run, control speed and reverse the DOR of different type of single phase motors.
	Assess installation of a single phase AC motor.
	Test continuity and insulation of various AC motors.
	Assess maintenance, service and troubleshooting of the AC motor&starter.
	Ensure planned work in compliance with standard safety norms related with Alternator & MG set.
	Demonstrate planning to connect start and run an alternator and build up the voltage.
	Determine the load performance of a 3 phase alternator.
	Assess starting and loading of a MG set with 3 phase induction motor coupled to DC shunt generator and build up the voltage.
	Evaluate alignment of MG set.
	Appraise preventive and breakdown Maintenance of alternator / MG set.
	Explain the effect of excitation current in terms of V-curves of synchronous motor.
10. Analyse detection of faults and troubleshooting of inverter, stabilizer, UPS etc. (NOS: PSS/9423)	Analyse operation and maintenance of inverter.
	Evaluate planning to troubleshoot, service and maintain a voltage stabilizer.
	Assess the parts, trace the connection and test the DC regulated power supply with safety.
	Evaluate troubleshooting and servicing a DC regulated power supply.
	Monitor battery charger for its operation.
	Evaluate preparation of an emergency light.
	Appraise maintenance of UPS.
11. Demonstrate estimation, testing, servicing & troubleshooting components of various domestic/industrial	Evaluate the parts, trace the connection and test the control panels of the equipments.
	Assess assembling of the various parts of control panels.
	Explain the wiring as per the drawings including terminations.

programmable systems & their control circuits. (NOS: PSS/N9414)	Assess troubleshooting and servicing of various controls in the panels.
	Explain battery connections and maintenance.
	Test battery charger for its operation.
	Evaluate planning of work in compliance with standard safety norms related with domestic appliances.
	Monitor service and Repair of calling bell/ buzzer/ Alarm.
	Explain service and repair an automatic iron.
	Assess repair and service of oven having multi-range heat control.
	Check replacing the heating element in a kettle and test.
	Appraise service and repair of an induction heater.
	Monitor service and repair of a geyser.
	Assess service and repair of a mixer.
	Evaluate service and repair of washing machine.
	Monitor service and repair of table fan.
	Demonstrate service, repair and installation of ceiling fan.
	Ensure Compliance with Safety Regulation 2010 when performing the Industrial wiring.
	Monitor wire-up PVC Conduit wiring for lighting circuit & 3 phase motor circuit with due care and safety.
	Estimate the material required for the given layout for metal conduit wiring for 3 phase 3 HP squirrel cage induction motor & wire-up as per Safety Regulation 2010.
	Ensure termination to the feeder cable in bus bar & to service cable through plug-in box with due care and safety.
	Assess erection of a bus bar chamber on an angle iron board and wire-up for 3 phase induction motor with due care and safety.
	Determine the size of cable for main & distribution board of a workshop.
	Evaluate testing of an industrial wiring installation by using Megger.
12. Evaluate planning, execution, commissioning & performance of various conventional/non-conventional power generation, transmission & distribution components. (NOS: PSS/9424)	Assess preparation of single line diagram of thermal, hydel, solar and wind power plants.
	Monitor preparation of layout plan and single line diagram of transmission line.
	Evaluate drawing of overhead and domestic service line.
	Assess erection of an overhead service line pole for single phase 240v distribution system.
	Explain different types of insulators used in HT and LT line.
	Assess connection of feeder cable with domestic service line.
	Ensure plans to work in compliance with solar panel installation norms.

	Assess combination of solar cells for given power requirement.
	Explain assembling and installation of solar panel.
	Evaluate the functionality of solar panel.
	Demonstrate preparation of layout plan and single line diagram of Distribution substation.
	Illustrate application of relays in control circuits and examine its operation.
	Judge identification of parts of circuit breaker and check its operation.
13. Demonstrate installation and troubleshooting of Electric Vehicle charging stations. (NOS: PSS/9425)	Demonstrate installation of EV charging Station for Public places/ Home.
	Demonstrate troubleshooting of EV charging stations.
14. Read and apply engineering drawing for different application in the field of work. (NOS: PSS/N9411)	Read & interpret the information on drawings and apply in executing practical work.
	Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
15. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: PSS/N9412)	Solve different mathematical problems
	Explain concept of basic science related to the field of study

8. INFRASTRUCTURE

LIST OF TOOLS AND EQUIPMENT FOR ELECTRICIAN (CITS)			
For batch of 25 candidates			
S No.	**Name of the Tool & Equipment**	**Specification**	**Quantity**
A. TRAINEES TOOL KIT			
1.	Steel Tape	10 mtr length	25+1 nos.
2.	Plier Insulated	150 mm	25+1 nos.
3.	Plier Side Cutting	150 mm	25+1 nos.
4.	Screw Driver	100 mm	25+1 nos.
5.	Screw Driver	150 mm	25+1 nos.
6.	Electrician Connector, screw driver insulated handle thin stem	100 mm	25+1 nos.
7.	Heavy Duty Screw Driver	200 mm	25+1 nos.
8.	Electrician Screw Driver thin stem insulated handle	250 mm	25+1 nos.
9.	Punch Centre	150 mm X 9 mm	25+1 nos.
10.	Knife Double Bladed Electrician		25+1 nos.
11.	Neon Tester		25+1 nos.
12.	Steel Rule	300 mm	25+1 nos.
13.	Hammer, cross peen with handle		25+1 nos.
14.	Hammer, ball peen With handle		25+1 nos.
15.	Gimlet	6 mm.	25+1 nos.
16.	Bradawl		25+1 nos.
17.	Scriber (Knurled centreposition)		25+1 nos.
18.	Pincer	150 mm	25+1 nos.
19.	Wire Stripper		25+1 nos.
20.	Tennon Saw	250 mm	25+1 nos.
21.	Firmer chisel wood	12mm	25+1 nos.
B. INSTRUMENT AND GENERAL SHOP OUTFIT			
22.	C- Clamp	200 mm, 150 mm and 100 mm	2 Nos each
23.	Spanner Adjustable	150 mm, 15 degree	2 Nos
24.	Blow lamp	0.5 ltr	2Nos
25.	Melting Pot		1No
26.	Ladel		2Nos
27.	Chisel Cold firmer	25 mm X 200 mm	2 Nos

28.	Chisel	25 mm & 6 mm	4 Nos each
29.	Hand Drill Machine	0 to 6 mm capacity	1No
30.	Portable Electric Drill Machine	6 mm capacity	1No
31.	Pillar Electric Drill Machine	12 mm capacity	1No
32.	Allen Key		1 set
33.	Oil Can	0.12 ltr	2 Nos
34.	Grease Gun		1 No
35.	Out Side Micrometer	0 to 25 mm	1No
36.	Motorized Bench Grinder		1No
37.	Rawl plug tool & bit		2 sets
38.	Pulley Puller	3 legs 250 mm adjustable	2Nos
39.	Bearing Puller le	3 legs 120 mm flexi	2Nos
40.	Hydrometer		2 sets
41.	Thermometer	0 to 100 deg Centigrade	1 No
42.	Scissors blade	150 mm	4 Nos
43.	Crimping Tool		1 set
44.	Crimping Tools Heavy duty		2 Nos
45.	Chisel Cold flat	12 mm	2 Nos
46.	Mallet hard wood	0.50 kg	4 Nos
47.	Hammer Exeter type	0.40 kg	8 Nos
48.	Hacksaw frame	200 mm 300 mm adjustable	4 Nos
49.	Try Square	150 mm blade	4 Nos
50.	Outside & Inside Divider Caliper		2 Nos. each
51.	Pliers flat nose	100 mm	4 Nos.
52.	Pliers round nose	100 mm	4 Nos.
53.	Plier longnose	150 mm	4 Nos.
54.	Tweezers	100 mm	4 Nos
55.	Snip Straight & Bent	150 mm	2 Nos. each
56.	Spanner D.E. metric standard		4 Nos.
57.	Drill hand brace	0 to 100 mm	4 Nos.
58.	Drill S.S. Twist block	2 mm, 5 mm 6 mm set of 3	4 sets
59.	Plane, smoothing cutters	50 mm	4 Nos.
60.	Gauge, wire imperial(SWG)		4 Nos.
61.	File flat	200 mm 2ndcut	8 Nos.
62.	File half round	200mm2nd cut	4 Nos.

63.	File round	200 mm 2nd cut	4 Nos.
64.	File flat	150 mm rough	4 Nos.
65.	File flat	250 mm bastard	4 Nos.
66.	File flat	250 mm smooth	4 Nos.
67.	File Rasp, half round	200 mm bastard	4 Nos.
68.	Soldering Iron	25 watt, 65 watt, 125 watt	4 Nos. each
69.	Copper bit soldering iron	0.25 kg.	4 Nos.
70.	De soldering Gun		4 Nos.
71.	Hand Vice	50 mm jaw	4 Nos.
72.	Table Vice	100 mm jaw	8 Nos.
73.	Pipe Cutter to cut pipes	up to 5 cm. dia	2 Nos.
74.	Pipe Cutter to cut pipes	above 5 cm dia	1 No
75.	Stock and Die set for	20 mm to 50 mm G.I. pipe	1 No
76.	Ohm Meter; Series Type & Shunt Type		1 No each
77.	Stock and Dies conduit		4 Nos.
78.	Multi Meter (analog)	0 to 1000 M Ohms, 2.5 to 500 V	1 No
79.	Digital Multi Meter	3 ½ digit	8 Nos.
80.	A.C. Voltmeter	M.I. 0 –500V A.C	1 No
81.	Milli Voltmeter		6 Nos.
82.	D.C. Milliammeter	0 -500m A (Digital+ Analog)	1 No
83.	Ammeter	MC 0-1A, 0-5 A, 0- 25 A	1 No
84.	A.C. Ammeter		2 Nos. each
85.	A.C. Ammeter	M.I 0-10 -20 A, 0-15-25 A	2 Nos. each
86.	Kilo Wattmeter	0-5 kw (CC-0-5-10 A,PC-0-250-500V)	2 Nos.
87.	A.C. Energy Meter,	Single phase 5 amp. Three Phase 15 amp	2 Nos.
88.	Power Factor Meter	single phse-230 volt (Analog+ Digital)	1 No each
89.	Frequency Meter (Analog & Digital)	Analog & Digital	1 No each
90.	Tachometer with stop watch	Analog & Digital	1 No each
91.	Current Transformer Primary-	0-10-20 A, Sec- 5 A)	2 Nos
92.	Potential Transformer	0-230-400V/110V	2 Nos
93.	Growler Internal+ External		1 No each
94.	Tong Tester / Clamp Meter	0 – 100 amp. AC Analog+ Digital)	1No
95.	Megger	500 volts	1No
96.	Wheat Stone Bridge with galvanometer		1No

	& battery		
97.	Earth Tester	0-30 Ohm	2 Nos
98.	Contactor & auxiliary contacts	3 phase, 440 volt, 32 amp.	1 No each
99.	Load Bank5 KW (Lamp / heater Type)		1No
100.	Brake Test arrangement with two spring balance 0 to 25 kg rating		2 sets
101.	DC Power Supply 0-440v , 15A		2 Nos
102.	Inverter- Input- 12 volt DC, Output- 220 volt AC	1 KVA with 12 V Battery	1No
103.	Voltage Stabilizer Input: AC Output:	150 – 230 volt 220 volt AC, 1 KVA	1 No
104.	Rheostat	0 -1 Ohm, 5 Amp 0 -10 Ohm, 5 Amp 0- 25 Ohm, 10Amp 0-300Ohm,3Amp	2 Nos each
105.	Flux meter		2 Nos
106.	Laboratory Type Induction Coil		1 No
C. MACHINERIES			
107.	Used DC Generators-series, shunt and compound type for overhauling practice		2 Nos
108.	D.C. Shunt Generator with control panel,	2.5 KW, 230 V	1No
109.	D.C. Compound Generator with control panel including fitted rheostat, voltmeter, ammeter and breaker	2.5KW,230V	1No
110.	DC Series Motor coupled with mechanical load	0.5 to 2 HP, 220 Volts	1No
111.	DC Shunt Motor	2 to 3 HP, 220 volts	1No
112.	DC compound Motor with starter and switch	2 to 3 HP, 220 volts	1No
113.	**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, dynamometer, instrument panel and power supply unit.		1No
114.	**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,	7 HP, 400V, 50 cycles, 3 phase 5 KW, 440V	1No

	foundation bolts and flexible coupling. Induction Motor rating: DC Shunt Generator rating:		
115.	**Motor Generator(DC to AC) set consisting of-** Shunt Motor with starting compensator and switch directly coupled to AC generator with exciter and switch board mounted with regulator, breaker, ammeter, voltmeter frequency meter, knife blade switch and fuses etc. Set complete with cast iron bed plate, fixing bolts, foundation bolts and flexible coupling. Shunt Motor rating: AC Generator rating:	5 HP, 440V 3-Phase, 4 wire, 3.5 KVA, 400/230 Volts, 0.8 pf, 50cycles	2 Nos.
116.	Thyristor /IGBT controlled D.C. motor drive with Tacho–generator feedback arrangement.	2 HP	1 No
117.	Thyristor /IGBT controlled A.C. motor drive with VVVF control	3 Phase, 2 HP	1 No
118.	Diesel Generator Set with change-over switch, over current breaker and water-cooled with armature, star-delta connections AC.	3phase,5KVA, 230 volt	1No
119.	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	2Nos
120.	AC phase-wound slip ring Motor with starter and switch.	5 HP, 400 volts, 3-phase, 50 cycles	1No
121.	A.C. Series type Motor with mechanical load.	¼ HP, 230V, 50 cycles	1No
122.	Single Phase Capacitor Motor with starter switch.	1 HP 230 volt 50 cycles	1No
123.	Universal Motor with starter/switch	230 volt, 50 cycles ¼ HP	1No
124.	Stepper Motor with Digital Controller		1No
125.	Shaded Pole Motor		1No
126.	Servo Motor with Control		1 No
127.	Cut model	3 phase induction motor	1 No
128.	Cut model of watermill and hydro power		1 No each
D. GENERAL INSTALLATIONS			
129.	Oscilloscope Dual Trace,	30 MHZ	1No
130.	Function Generator		1No

131.	Discrete Component Trainer		1No
132.	3- point D.C. Starter		2 Nos
133.	4- point D.C. Starter		2 Nos
134.	Single phase Transformer, core type, air cooled		3 Nos
135.	Three phase transformer, shell type oil cooled		1 No
136.	Variable Auto Transformer		1 No
137.	Linear I.C.Trainer		1No
138.	Digital I.C.Trainer		1 No
139.	Bath Impregnating		1 No
140.	Oven Stove		1 No
141.	Oil Testing Kit		1 No
142.	Battery	12 v	1 No
143.	Battery Charger		1 No
144.	Solar panel with Battery	18watt	1 set
145.	Hygrometer		1 No
146.	Domestic Appliances- a. Electric Hot Plate b. Electric Kettle, c. Electric Iron d. Immersion Heater e. A.C. Fan f. Geyser (Storage type) g. Mixture &Grinder. h. Microwave Oven i. Washing Machine j. Hair Drier k. Induction Heater	1500 watt,220v with temp. control 1750 watts,230v 1500 watts,230v with temp. Control 750/1000/1500 watt,230V 230v 25 ltrminimum,230V 20 Ltr convection 6.5 kg fully automatic	2Nos 2Nos 2Nos 2Nos 1 No 2 Nos 2Nos 1 No 2 Nos
147.	Relays- a. Cutout b. Reverse current c. Overcurrent d. Under voltage		1 no. each
148.	Starters for - a. Resistance type starter b. Direct on-line Starter c. Star Delta Starter-manual, semi-automatic and automatic d. Auto Transformer type	2 to 5 H.P. A.C Motors	1 No each
149.	Synchronous scope Meter		2 Nos
150.	Phase Sequence Meter		2 Nos
151.	Component of Typical small hydro power unit		1 set
152.	Component of Typical water mill		1 set

153.	EV Charger	3 phase input	1 No.
154.	EV Charger (Home)	1 Phase input	1 No.


कौशलं बलम्