

**COMPETENCY BASED CURRICULUM**

**FOR THE TRADE OF**

**ELECTRICIAN**

**UNDER**

**CRAFTSMAN TRAINING SCHEME (CTS)**

**IN SEMESTER PATTERN**

**BY**



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

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## 1. INTRODUCTION

India is one of the youngest nations in the world. Our youth are our strength. However, a challenge facing the country is that of skilling our youth as per the demands of the industry. Recognizing the need for quickly coordinating the skill development and entrepreneurship efforts of all concerned stakeholders, the Government of India created the Ministry of Skill Development and Entrepreneurship on 9<sup>th</sup> November, 2014. To create further convergence between the Vocational Training System through Industrial Training Institutes (ITIs) and the new skill initiatives of the Government, the Training and Apprenticeship Training divisions from the Directorate General of Employment and Training (DGET) under the Ministry of Labour and Employment stand transferred to the Ministry of Skill Development and Entrepreneurship (MSDE) with effect from 16<sup>th</sup> April, 2015. This move brings over 11000 ITIs and scores of other institutions, and the Apprenticeship and Training divisions, under the Ministry.

The Ministry of Skill Development and Entrepreneurship is an apex organization for the development and coordination of the vocational training including Women's Vocational Training in our country. The Ministry conducts the vocational training programmes through the Craftsmen Training Scheme (CTS), Apprenticeship Training Scheme (ATS), Modular Employable Scheme (MES) under the Skill Development Initiative (SDI) Scheme, and Craftsmen Instructor Training Scheme (CITS) to cater the needs of different segments of the Labour market. The National Council for Vocational Training (NCVT) acts as a central agency to advise Government of India in framing the training policy and coordinating vocational training throughout India. The day-to-day administration of the ITIs rests with the State Governments/ Union Territories.

- Training courses under the CTS is being offered through a network of more than 11000 Government and Private Industrial Training Institutes (ITIs) located all over the country with a total seating capacity of more than 16 Lakhs with an objective to provide skilled workforce to the industry in 126 trades. Skill development courses exclusively for women are also being offered under CTS and other schemes through Government and Private ITIs and Regional Vocational Training Institutes (RVTIs) for Women.
- The Apprentices Act, 1961 was enacted with the objective of regulating the program of apprenticeship training in the industry by utilizing the facilities available within for imparting on-the-job training. The Act makes it obligatory for employers in specified industries to engage apprentices in designated trades to impart on the job training for school leavers, and ITI passed outs to develop skilled manpower for the industry.
- The Ministry is implementing the Employable Scheme (MES) under the Skill Development Initiative Scheme to provide vocational training to people to develop skilled manpower for the industry through a network of Vocational Training Providers (VTPs) located across the country.

Central Staff Training and Research Institute (CSTARI), Kolkata is the nodal institute for the development/revision of curricula under all vocational training schemes of the Ministry.

National Instructional Media Institute (NIMI), Chennai is to make available instructional material in various trades for the use of trainees and trainers to ensure overall improvement in the standard of institutional training under the CTS and ATS schemes. The institute is actively involved in the development, production and dissemination of instructional media Packages (IMPs) comprising of books on Trade Theory, Trade Practical, Test/Assignment, and Instructor's Guide.

The National Skills Qualification Framework (NSQF), published in the Gazette of India on 27<sup>th</sup> December, 2013, is a national framework that aims to integrate general and vocational streams of education and training. The main goal of the NSQF is to focus on competency-based qualifications, which in turn facilitate and enhance transparency, both within and between general and vocational streams. The National Skill Development Agency (NSDA) under the Ministry is responsible for anchoring and implementation of the Framework, by bringing together the key stakeholders through the National Skill Qualifications Committee (NSQC).

The competency-based framework organizes qualifications into ten levels, with the entry level being 1, and the highest level being 10. Each level of the NSQF is described by a statement of learning outcomes in five domains, known as level descriptors. These five domains are (1) Process, (2) Professional knowledge, (3) Professional skill, (4) core skill, and (5) Responsibility. The paradigm shift from learning focused on inputs to an outcome/competency-based education would help in the Recognition of Prior Learning (RPL), and simultaneously enable the alignment of the Indian qualifications with international ones. Government funding is expected to be on a preferential basis for NSQF compliant courses. The NSQF notification provides a Qualification Register, which is the official national database of all qualifications aligned to NSQF levels. Through this Register, learners can expect access to all NSQF compliant qualifications.

The Ministry has set up Mentor Councils to focus on courses under NCVT in various sectors with representation from thought leaders among different stakeholders viz., industries, innovative entrepreneurs who have proved to be game-changers, academic/professional institutions, and champion ITIs for each of the sectors. The Mentor Council for each sector reviews curriculum, admission criteria, course duration, and requirement of trainers and assessment/evaluation systems for the sector on a continuous basis and make recommendations regarding the same. Sector-wise Core Groups are formed to plan and prepare the documentation for the competency-based curricula for the courses under each sector.

## 1. JOB ROLES: Reference NOS & NCO

### **Brief description of Job roles:**

**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, Microphones, loud-speakers and other electrical equipment, fittings and lighting fixtures. Makes connections and solders terminals. Test 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** Electrician fits and assembles electrical machinery and equipment such as motors, transformers, generators, switchgears, fans etc., Studies drawings and wiring diagrams of fittings, wiring and assemblies to be made. Collects prefabricated electrical and mechanical components according to drawing and wiring diagrams and Check 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. Check 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 fitted in assembly. Erects various equipment's 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. Check, 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.

**Reference NCO & NOS:**

- i) NCO-2004: 7137.10(851.10)**
- ii) NCO-2004: 7241.20(851.30)**

### 3. NSQF COMPLIANCE BLOCK

#### **NSQF level for Electrician trade under CTS: Level 4**

As per notification issued by Govt. of India dated- 27.12.2013 on National Skill Qualification Framework total 10 (Ten) Levels are defined.

Each level of the NSQF is associated with a set of descriptors made up of five outcome statements, which describe in general terms, the minimum knowledge, skills and attributes that a learner needs to acquire in order to be certified for that level.

Each level of the NSQF is described by a statement of learning outcomes in five domains, known as level descriptors. These five domains are:

- a. Process
- b. professional knowledge,
- c. professional skill,
- d. core skill and
- e. Responsibility.

The Broad Learning outcome of Electrician trade under CTS mostly matches with the Level descriptor at Level- 4.

The NSQF level-4 descriptor is given below:

<b>LEVEL</b>	<b>Process required</b>	<b>Professional knowledge</b>	<b>Professional skill</b>	<b>Core skill</b>	<b>Responsibility</b>
Level 4	work in familiar, predictable, routine, situation of clear choice	factual knowledge of field of knowledge or study	recall and demonstrate practical skill, routine and repetitive in narrow range of application, using appropriate rule and tool, using quality concepts	language to communicate written or oral, with required clarity, skill to basic Arithmetic and algebraic principles, basic understanding of social political and natural environment	Responsibility for own work and learning.

#### **4. Learning outcome**

The following are minimum broad general learning outcome after completion of the Electrician course of 02 years duration:

##### **A. GENERIC OUTCOME**

1. Recognize & comply safe working practices, environment regulation and housekeeping.
2. Work in a team, understand and practice soft skills, technical English to communicate with required clarity.
3. Demonstrate knowledge of concept and principles of basic arithmetic, algebraic, trigonometric, and statistics and apply knowledge of specific area to perform practical operations.
4. Understand and explain basic science in the field of study including friction, simple machine and heat and temperature.
5. Read and apply engineering drawing for different application in the field of work.
6. Understand and explain the concept in productivity, quality tools and labour welfare legislation and apply such in day to day work to improve productivity & quality.
7. Explain energy conservation, global warming and pollution and contribute in day to day work by optimally using available resources.
8. Explain personnel finance, entrepreneurship and manage/organize related task in day to day work for personal & societal growth.
9. Understand and apply basic computer working, basic operating system and uses internet services to get accustomed & take benefit of IT developments in the industry.

##### **B. SPECIFIC OUTCOME**

10. Make good quality suitable for applications electrical wire joints for single and multistrand conductors, soldering and taking suitable care and safety.
11. Draw and set up DC and AC circuits including R-L-C circuits with accurate measurement of voltage, current, resistance, power, power factor and energy using ammeter, voltmeter, ohm-meter, watt-meter, energy meter, power factor meter and phase sequence tester with proper care and safety.
12. Make choices to carry out basic jobs of marking out the components for filing, drilling, and riveting, fitting and assembled using different components independently.
13. Identify the type of batteries, construction, working and application of Ni-cadmium, lithium cell, lead acid cell etc. Demonstrate their charging and discharging, choosing appropriate method and carry out the installation and routine maintenance with due care and safety.
14. a) Assemble, test, analyze and repair power supply using the following circuits:  
Half-wave, full-wave, and bridge rectifiers with filter & without filter.  
Switching circuit using the following:- UJT, JFET, IGBT, SCR, DIAC, TRIAC



- b) Measurement of voltage, frequency, time period using CRO.
  - c) Trouble shoot and maintenance of voltage stabilizer, inverter and UPS
15. Draw, estimate, wire up, test different type of domestic and industrial wiring circuits as per Indian Electricity rules and taking care of quality. Construction and working of MCB & ELCB. Test a domestic/industrial wiring installation using Megger.
  16. Plan and install Pipe & Plate earthing. Measure earthing resistance by earth tester.
  17. Understand the constructional features, working principles of DC machine. Starting with suitable starter, running, forward and reverse operation and speed control of DC motors. Conduct the load performance test of DC machine with due care and safety. Maintain and troubleshoot of DC machines.
  18. Understand the types, constructional features, working principles of transformer ( single & three phase). Maintenance and application of Transformer.
  19. Understand the constructional features, working principles of single phase and 3 phase AC motors. Starting with suitable starter, running, forward and reverse operation and speed control of AC motors. Conduct the load performance test of AC machine with due care and safety. Maintain and troubleshoot of AC motors.
  20. Understand the constructional features, working principles of Alternator and Motor-Generator set. Install, set-up and test synchronization of Alternator and Motor-Generator set with due care and safety. Maintain and troubleshoot of the machines.
  21. Test and perform Winding for small transformer, armature, field winding and machines.
  22. Plan and execute electrical illumination system viz. FL tube, HPMV lamp, HPSV lamp, etc.
  23. Select, assemble, test and wire-up control panel for three phase AC Motors.
  24. Identify parts, installation, service, troubleshoot and repair of electrical appliances viz. Electric iron, heater, kettle, automatic toaster, geyser, mixer & grinder, washing machine and fan with due care and safety.
  25. Prepare single line diagram and layout plan of electrical transmission & distribution systems and plants with knowledge of principles and processes. Make and test cable joints of underground cable, identify parts and troubleshoot circuit breakers with care and safety.

***NOTE: Learning outcomes are reflection of total competencies of a trainee. Each learning outcome may include multiple assessment components. However assessment will be carried out as per assessable outcome and assessment criteria.***

## 5. GENERAL INFORMATION

1. Qualification : **ELECTRICIAN**
2. Ref. N.C.O. /NOS Code No. : 7137.10(851.10), 7241.20(851.30)
3. NSQC Level : Level - IV
4. Duration of Craftsmen Training : 2 Years (4 Semesters each of six months duration)
5. Entry Qualification : Passed 10<sup>th</sup> class with Science and Mathematics under 10+2 system of Education or its equivalent.
6. Trainees per unit : 16 ( Max. supernumeraries seats : 5)

### **Distribution of training on Hourly basis:**

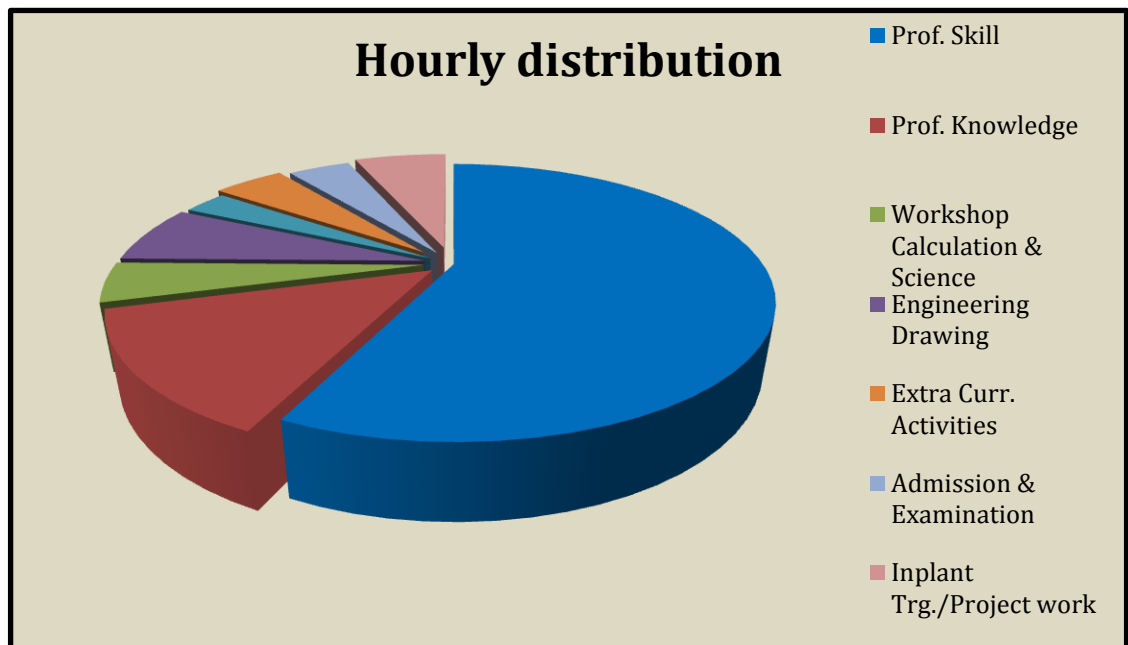
Total hours /week	Trade practical	Trade theory	Work shop Cal. & Sc.	Engg. Drawing	Employability skills	Extracurricular activity
40 Hours	25 Hours	6 Hours	2 Hours	3 Hours	2 Hours	2 Hours

## 6. COURSE STRUCTURE

1. Name of the Qualification :- ELECTRICIAN
2. Total duration of the course: - 24 Months
3. Training duration details :-

	COURSE ELEMENTS	HOURLY DISTRIBUTION
A	PROFESSIONAL SKILL	2200 HRS
B	PROFESSIONAL KNOWLEDGE	530 HRS
C	WORKSHOP CALCULATION & SCIENCE	180 HRS
D	ENGINEERING DRAWING	265 HRS
E	EMPLOYABILITY SKILLS	110 HRS
F	EXTRA CURRICULAR ACTIVITIES/LIB.	180 HRS
G	INPLANT TRG./PROJECT WORK	240 HRS
H	ADMISSION & EXAMINATION	160 HRS

### PIE-CHART



## **8. General Training Plan, Examination & Pass regulation**

### **General Training Plan**

The skills stated in Learning outcome are to be imparted in accordance with the instructions contained within Section 10 in respect of the content and time structure of the vocational education and training (General Training Plan).

### **Examination**

Each Semester examination is to take place after the end of the six months of training. The each semester examination encompasses such skills as are listed for that period of training (Detail in Section -10) and also includes theoretical knowledge, Core skills & E/S. The E/S will be covered in first two semesters only.

#### **Candidates are to demonstrate that they are able to:**

1. Read& interpret technical parameters/documentation, plan and organize work processes, identify necessary materials and tools;
2. Perform task with due consideration to safety rules, accident prevention regulations and environmental protection stipulations;
3. Apply professional knowledge, core skills & employability skills while performing the task.
4. Check the job as per drawing/assembly for functioning, identify and rectify errors in job/assembly.
5. Document the technical parameters related to the task undertaken.

The details of the examination and assessment standard are as per section - 11

### **Pass regulation**

For the purposes of determining the overall result, weighting of 25 percent is applied to each semester examination. The minimum pass percent for Practical is 60% & minimum pass percent for Theory subjects 40%.

## **9. ASSESSABLE OUTCOMES**

### **Assessable outcomes after completion of two years Electrician course**

#### **I. Generic:**

1. Apply safe working practices.
2. Comply environment regulation and housekeeping
3. Interpret & use Company terminology and technical communication
4. Demonstrate knowledge of concept and principles of basic arithmetic, algebraic, trigonometric, and statistics and apply knowledge of specific area to perform practical operations.
5. Understand and explain basic science in the field of study including friction, simple machine and heat and temperature.
6. Read and apply engineering drawing for different application in the field of work.
7. Understand and explain the concept in productivity, quality tools, and labour welfare legislation and apply such in day to day work to improve productivity & quality.
8. Explain energy conservation, global warming and pollution and contribute in day to day work by optimally using available resources.
9. Explain personnel finance, entrepreneurship and manage/organize related task in day to day work for personal & societal growth.
10. Understand and apply basic computer working, basic operating system and uses internet services to get accustomed & take benefit of IT developments in the industry.

#### **II. Specific:**

11. Make electrical wire joints & soldering.
12. Analyze, demonstrate and test basic electrical connection.
13. Prepare profile with an appropriate accuracy as per drawing.
14. Test, service, recharge & installation of batteries.
15. Plan and prepare Earthing installation.
16. Analyze, Assemble, check and repair electronic control circuit.
17. Assemble, install and test wiring system.
18. Install test and setup DC machines.
19. Install, test and commission of transformer.
20. Select and perform electrical/ electronic measurement.
21. Install, test and set up AC motors.
22. Install, test and setup alternator & MG set.
23. Analyze, test and perform winding.
24. Plan and execute electrical illumination system.
25. Assemble and wire switch cabinets for 3 phase AC motors.
26. Maintain, repair & test of domestic Appliances.
27. Analyze the power plant layout and power lines.

## 9. ASSESSABLE OUTCOME WITH ASSESSMENT CRITERIA

ASSESSABLE OUTCOME ALONGWITH ASSESSMENT CRITERIATO BE ACHIEVED AFTER EACH SEMESTER & COMPLETION OF QUALIFICATION

- i) The training shall be conducted as per syllabus defined in reference no: Section 10.
- ii) The trainee shall demonstrate the competencies which are defined below in assessable outcome and assessment criteria.
- iii) All the assessable outcomes are to be tested during formative assessment, Theory & Practical examinations, various observation and viva-voce.
- iv) Assessable outcome of Employability Skills, Workshop Calculation & Science and Engineering Drawing shall be tested separately and also be applied in Theory and Practical examinations.
- v) These assessable outcomes and assessment criteria will serve as guide lines for Trainers, Paper setters, Moderators and Assessors.

### GENERIC ASSESSABLE OUTCOME:

ASSESSABLE OUTCOMES	ASSESSMENT CRITERIA
1. Apply safe working practices	1.1 Follow and maintain procedures to achieve a safe working environment in line with occupational health and safety regulations and requirements and according to site policy.
	1.2 Recognize and report all unsafe situations according to site policy.
	1.3 Identify and take necessary precautions on fire and safety hazards and report according to site policy and procedures.
	1.4 Identify, handle and store / dispose off dangerous goods and substances according to site policy and procedures following safety regulations and requirements.
	1.5 Identify and observe site policies and procedures in regard to illness or accident.
	1.6 Identify safety alarms accurately.
	1.7 Report supervisor/ Competent of authority in the event of accident or sickness of any staff and record accident details correctly according to site accident/injury procedures.
	1.8 Identify and observe site evacuation procedures according to site policy.
	1.9 Identify Personal Productive Equipment (PPE) and use the same as per related working environment.
	1.10 Identify basic first aid and use them under different

	<p>circumstances.</p> <p>1.11 Identify different fire extinguisher and use the same as per requirement.</p>
2. Comply environment regulation and housekeeping	<p>2.1 Identify environmental pollution &amp; contribute to the avoidance of instances of environmental pollution.</p> <p>2.2 Deploy environmental protection legislation &amp; regulations</p> <p>2.3 Take opportunities to use energy and materials in an environmentally friendly manner</p> <p>2.4 Avoid waste and dispose waste as per procedure</p> <p>2.5 Recognize different components of 5S and apply the same in the working environment.</p>
3. Interpret & use company and technical communication	<p>3.1 Obtain sources of information and recognize information.</p> <p>3.2 Use and draw up technical drawings and documents.</p> <p>3.3 Use documents and technical regulations and occupationally related provisions.</p> <p>3.4 Conduct appropriate and target oriented discussions with higher authority and within the team.</p> <p>3.5 Present facts and circumstances, possible solutions &amp; use English special terminology.</p> <p>3.6 Resolve disputes within the team</p> <p>3.7 Conduct written communication.</p>
4. Demonstrate knowledge of concept and principles of basic arithmetic, algebraic, trigonometric, and statistics and apply knowledge of specific area to perform practical operations.	<p>4.1 Semester examination to test basic skills on arithmetic, algebra, trigonometry and statistics.</p> <p>4.2 Their applications will also be assessed during execution of assessable outcome and also tested during theory and practical examination.</p>
5. Understand and explain basic science in the field of study including friction, simple machine and heat and temperature	<p>5.1 Semester examination to test basic skills on science in the field of study including friction, simple machine and heat and temperature.</p> <p>5.2 Their applications will also be assessed during execution of assessable outcome and also tested during theory and practical examination.</p>
6. Read and apply engineering drawing for different application in the field of work.	<p>6.1 Semester examination to test basic skills on engineering drawing.</p> <p>6.2 Their applications will also be assessed during execution of assessable outcome and also tested during theory and practical examination.</p>
7. Understand and explain the concept in productivity, quality tools, and labour	<p>7.1 Semester examination to test the concept in productivity, quality tools and labour welfare legislation.</p> <p>7.2 Their applications will also be assessed during execution of</p>

welfare legislation and apply such in day to day work to improve productivity & quality.	assessable outcome.
8. Explain energy conservation, global warming and pollution and contribute in day to day work by optimally using available resources.	8.1 Semester examination to test knowledge on energy conservation, global warming and pollution. 8.2 Their applications will also be assessed during execution of assessable outcome.
9. Explain personnel finance, entrepreneurship and manage/organize related task in day to day work for personal & societal growth.	9.1 Semester examination to test knowledge on personnel finance, entrepreneurship. 9.2 Their applications will also be assessed during execution of assessable outcome.
10. Understand and apply basic computer working, basic operating system and uses internet services to get accustomed & take benefit of IT developments in the industry.	10.1 Semester examination to test knowledge on basic computer working, basic operating system and uses internet services. 10.2 Their applications will also be assessed during execution of assessable outcome.

### **SPECIFIC ASSESSABLE OUTCOME:**

#### **Semester-I**

<b>ASSESSABLE OUTCOMES</b>	<b>ASSESSMENT CRITERIA</b>
11. Make electrical wire joints & soldering.	11.1 Observe safety/ precaution during joints & soldering.
	11.2 Make simple straight twist and rat-tail joints in single strand conductors.
	11.3 Make married and 'T' (Tee) joint in stranded conductors.
	11.4 Prepare a Britannia straight and 'T' (Tee) joint in bare conductors.
	11.5 Prepare western union joint in bare conductor.
	11.6 Solder the finished copper conductor joints with precaution.
	11.7 Prepare termination of cable lugs by using crimping tool.
12. Analyze, demonstrate and test basic electrical connection.	12.1 Identify types of wires, cables and verify their specifications.
	12.2 Verify the characteristics of series, parallel and its combination circuit.
	12.3 Analyze the effect of the short and open in series and parallel circuits.



	12.4 Verify the relation of voltage components of R.L.C. series circuit in AC.
	12.5 Determine the power factor by direct and indirect methods in an AC single phase R, L, C parallel circuit.
	12.6 Identify the phase sequence of a 3 $\phi$ supply using a phase-sequence meter.
	12.7 Prepare / connect a lamp load in star and delta and determine relationship between line and phase values with precaution.
	12.8 Connect balanced and unbalanced loads in 3 phase star system and measure the power of 3 phase loads with safety/ precaution.
13. Prepare profile with an appropriate accuracy as per drawing.	13.1 Identify the trade hand tools; practice their uses with safety, care & maintenance.
	13.2 Prepare a simple half lap joint using firmer chisel with safety.
	13.3 Prepare tray using sheet metal with the safety
	13.4 Practice on fixing surface mounting type of accessories.
	13.5 Practice on connecting of electrical accessories.
	13.6 Make and wire up of a test board and test it.
14. Test, service, recharge & installation of batteries.	14.1 Assemble a DC source 6V/500 mA using 1.5V cells.
	14.2 Determine the internal resistance of cell and make grouping of cells.
	14.3 Identify the parts of a battery charger and test for its operation.
	14.4 Practice on charging of battery and test for its condition with safety/ precaution.
	14.5 Installation and maintenance of batteries.
	14.6 Maintain, service and trouble shoot a battery charger.
15. Plan and prepare Earthing installation.	15.1 Install the pipe earthing and test it.
	15.2 Install the plate earthing and test it.
	15.3 Measure the earth electrode resistance using earth tester.
	15.4 Carry out earth resistance improvement.

## Semester-II

ASSESSABLE OUTCOMES	ASSESSMENT CRITERIA
16. Analyze, Assemble, check and repair electronic control circuit.	16.1 Practice on soldering components on lug board with safety.
	16.2 Identify the passive /active components by visual appearance, Code number and test for their condition.
	16.3 Identify the control and functional switches in CRO and measure the D.C. & A.C. voltage, frequency and time period.
	16.4 Construct and test a half & full wave rectifiers with and without filter circuits.
	16.5 Use of transistor as a switch.
	16.6 Construct and test a UJT as relaxation oscillator & electronic timer.
	16.7 Construct and testing of Transistor, JFET and JFET as amplifiers.

	16.8 Construct and test lamp dimmer using TRIAC/DIAC with safety.
	16.9 Construct and test UJT, JFET, IGBT and apply for suitable operation with proper safety.
	16.10 Construct and test the universal motor speed controller using SCR with safety.
	16.11 Operation and maintenance of inverter.
	16.12 Troubleshoot, service and maintain a voltage stabilizer.
	16.13 Identify the parts, trace the connection and test the DC regulated power supply with safety.
	16.14 Troubleshoot and service a DC regulated power supply.
	16.15 Carryout the maintenance of UPS.
	16.16 Construct and test logic gate circuits.
17. Assemble, install and test wiring system.	17.1 Comply with safety & IE rules when performing the wiring.
	17.2 Prepare and mount the energy meter board.
	17.3 Draw and wire up the consumers main board with ICDP switch and distribution fuse box.
	17.4 Draw and wire up a bank/hostel/jail in PVC conduit.
	17.5 Identify the types of fuses their ratings and applications.
	17.6 Identify the parts of a relay, MCB & ELCB and check its operation.
	17.7 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.
	17.8 Estimate the requirement for metal conduit wiring (3 phase) and wireup.
	17.9 Estimate the materials and wireup the lighting circuit for a tunnel – Metal circuit.
	17.10 Estimate the materials and wireup a lighting circuit for a corridor in metal conduit.
	17.11 Test a domestic wiring installation by using Megger.
18. Install, test and setup DC machines.	18 .1 Plan work in compliance with standard safety norms related with DC machines.
	18.2 Determine the load performance of a different type of DC generator on load.
	18.3 Test a DC machine for continuity and insulation resistance.
	18.4 Connect, start, run and reverse a different type of DC motor.
	18.5 Maintain, service and trouble shoot the DC motor starter.
	18.6 Conduct the load performance test on different type of DC motor.
	18.7 Control the speed of a DC motor by different method.
	18.8 Control the speed of DC motor by using DC drive.
	18.9 Maintenance, troubleshooting & servicing of DC machines.
	18.10 Overhaul a DC machine.

19. Install, test and commission transformer.	19.1 Plan work in compliance with standard safety norms related with transformer.
	19.2 Identify the types of transformers and their specifications.
	19.3 Identify the terminals; verify the transformation ratio of a single phase transformer.
	19.4 Connect and test a single phase auto- transformer.
	19.5 Determine the losses (iron loss and copper loss) and the regulation of a single phase transformer at different loads.
	19.6 Measure the current and voltage using CT and PT.
	19.7 Test the transformer oil with oil testing kit.
	19.8 Connect 3 single phase transformers for 3 phase operation of - a) delta-delta b) delta-star c) star-star d) star-delta.
	19.9 Connect the given two single phase transformers a) parallel b) series(secondary only) and measure voltage.
	19.10 Connect & test 3 phase transformer in parallel.(Parallel operation)
20. Select and perform electrical/ electronic measurement.	20.1 Identify the type of electrical instruments.
	20.2 Determine the measurement errors while measuring resistance by voltage drop method.
	20.3 Extend the range of MC voltmeter and ammeter.
	20.4 Measure the power and energy in a single & three phase circuit using wattmeter and energy meter with CT and PT.
	20.5 Test single phase energy meter for its errors.
	20.6 Measure the value of resistance, voltage and current using digital multimeter.
	20.7 Measure the power factor in poly-phase circuit and verify the same with voltmeter, ammeter, wattmeter readings.
	20.8 Calibrate the analog multimeter.
	20.9 Measure the frequency by frequency meter.

### Semester-III

ASSESSABLE OUTCOMES	ASSESSMENT CRITERIA
21. Install, test and set up AC motors.	21.1 Plan work in compliance with standard safety norms related with AC motors.
	21.2 Draw circuit diagram and connect forward & reverse a 3 phase squirrel cage induction motor.
	21.3 Start, run and reverse an AC 3 phase squirrel cage induction motor by different type of starters.
	21.4 Measure the slip of 3 phase squirrel cage induction motor by tachometer for different output. Draw slip / load characteristics of the motor.
	21.5 Determine the efficiency of 3 phase squirrel cage induction



24.7 Prepare an emergency light.

## Semester-IV

ASSESSABLE OUTCOMES	ASSESSMENT CRITERIA
25. Assemble and wire switch cabinets for 3 phase AC motors.	25.1 Draw the layout diagram of 3 phase AC motor control cabinet.
	25.2 Mount the control elements & wiring accessories on the control panel.
	25.3 Practice wiring the control cabinet for local and remote control of induction motor.
	25.4 Draw & wire up the control panel for forward/ reverse operation of induction motor.
	25.5 Practice wiring the Automatic start delta starter.
	25.6 Draw & wire up control panel for sequential motor control for three motors.
	25.7 Draw & wire up the control panel for a given circuit diagram and connect the motor.
	25.8 Test the control panel for all the required logics.
26. Maintain, repair & test of domestic Appliances.	26.1 Plan work in compliance with standard safety norms related with domestic appliances.
	26.2. Service and Repair of calling bell/ buzzer/ Alarm.
	26.3 Service and repair an automatic iron.
	26.4 Repair and service an oven having multi-range heat control.
	26.5 Replace the heating element in a kettle and test.
	26.6 Service and repair an automatic toaster.
	26.7 Service and repair a geyser.
	26.8 Service and repair a mixer.
	26.9 Service and repair of washing machine.
	26.10 Install a pump set.
	26.11 Service and repair a table fan.
	26.12 Service, repair and install a ceiling fan.
27. Analyze the power plant layout and power lines.	27.1 Prepare layout plan, single line diagram of different type of power plant and project report of all equipment's and machineries of the visited plant.
	27.2 Draw an overhead and domestic service line.
	27.3 Erect an overhead service line pole for single phase 240v distribution system.
	27.4 Prepare the jumper and fix it.
	27.5 Make a different type of joint in underground cables.
	27.6 Test the underground cables for open & ground fault and also

	check insulation resistance.
	27.7 Prepare layout plan and single line diagram of transmission line /Distribution substation.
	27.8 Trouble shooting and servicing a circuit breaker.
	27.9 Erect overhead bus bars in a workshop.
	27.10 Connect feeder cable and service line to the bus bar.

## 10. SYLLABUS CONTENT WITH TIME STRUCTURE

### 10.1 SYLLABUS CONTENT FOR PROFESSIONAL SKILL & KNOWLEDGE

**First Semester**  
**(Semester Code no. ELE - 01)**

**Duration: Six Month**

#### **LEARNING OBJECTIVES OF 1<sup>ST</sup> SEMESTER**

1. Apply safe working practices.
2. Comply environment regulation and housekeeping
3. Interpret & use Company terminology and technical communication
4. To make simple wiring circuit with common electrical accessories with domestic electrical appliances for a specified voltage and current.
5. To carry out the necessary test for charging secondary battery individually, installation and grouping of batteries, care and maintenance of batteries.
6. To make a job profile according to the drawing.
7. Able to carry out earthing installation.

Week No.	Professional Skills	Professional Knowledge
	Trade Practical	Trade Theory
1	<p>Implementation in the shop floor of the various safety measures. Visit to the different sections of the Institute Demonstration on elementary first aid. Artificial Respiration. Practice on use of fire extinguishers.</p> <p><b>Occupational Safety &amp; Health Importance of housekeeping &amp; good shop floor practices.</b></p> <p>Health, Safety and Environment guidelines, legislations &amp; regulations as applicable. Disposal procedure of waste materials like cotton waste, metal chips/burrs etc. Basic safety introduction, Personal protective</p>	<p><b>Occupational Safety &amp; Health</b></p> <p>Basic safety introduction, Personal protection:- Basic injury prevention, Basic first aid, Hazard identification and avoidance, safety signs for Danger, Warning, caution &amp; personal safety message.</p> <p>Use of Fire extinguishers. Visit &amp; observation of sections. Various safety measures involved in the Industry. Elementary first Aid. Concept of Standard <b>Soft Skills:</b> its importance and Job area after completion of training. Introduction of First aid. Operation of electrical mains. Introduction of PPEs. Introduction to 5S concept &amp; its application. Response to emergencies eg; power failure, fire, and system failure.</p>

	<p>Equipment(PPE):-  Basic injury prevention, Basic first aid, Hazard identification and avoidance, safety signs for Danger, Warning, caution &amp; personal safety message.  Preventive measures for electrical accidents &amp; steps to be taken in such accidents.  Use of Fire extinguishers.</p>	
2	<p>Demonstration of Trade hand tools. Identification of simple types- screws, nuts &amp; bolts, chassis, clamps, rivets etc. Use, care &amp; maintenance of various hand tools. Familiarization with signs and symbols of Electrical accessories</p>	<p>Identification of Trade-Hand tools-Specifications</p>
3 - 4	<p>Practice in using cutting pliers, screw drivers etc. skinning the cables, and joint practice on single strand.  Demonstration &amp; Practice on bare conductors joints--such as rat tail, Britannia, straight, Tee, Western union. Joints</p>	<p>Fundamental of electricity. Electron theory- free electron, Fundamental terms, definitions, units &amp; effects of electric current</p>
5	<p>Practice in soldering &amp; brazing- Measurement of Resistant and Measurement of specific Resistant. Application of Wheatstone bridge in measurement of Resistance</p>	<p>Solders, flux and soldering technique. Resistors types of resistors &amp; properties of resistors.</p>
6	<p>Demonstration and identification of types of cables. Demonstration &amp; practice on using standard wire gauge &amp; micrometer. Practice on crimping thimbles, Lugs.  Examination and checking of cables and conductors and verification of materials according to the span.</p>	<p>Introduction of National Electrical Code 2011  Explanation, Definition and properties of conductors, insulators and semi-conductors. Voltage grading of different types of Insulators, Temp. Rise permissible  Types of wires &amp; cables standard wire gauge  Specification of wires &amp; Cables-insulation &amp; voltage grades  -Low , medium &amp; high voltage  Precautions in using various types of cables / Ferrules</p>



7	<p>Verification of Ohm's Law, Verification of Kirchoff's Laws.</p> <p>Verification of laws of series and parallel circuits.</p> <p>Verification of open circuit and closed circuit network.</p> <p><b>Measuring unknown resistance using Wheatstone bridge, voltage drop method.</b></p> <p>Experiment to demonstrate the variation of resistance of A metal with the change in temperature.</p>	<p>Ohm's Law - Simple electrical circuits and problems. Reading of simple Electrical Layout.</p> <p><b>Resistors</b> -Law of Resistance. Series and parallel circuits.</p> <p><b>Kirchoff's</b> Laws and applications. Wheatstone bridge principle And its applications. Effect of variation of temperature on resistance. Different methods of measuring the values of resistance</p>
8.	<p>Practice on installation and overhauling common electrical accessories as per simple Electrical circuit / Layout.</p> <p>. Fixing of switches, holder plugs etc. in T.W. boards.</p> <p>-Identification and use of wiring accessories concept of switching.</p>	<p>Common Electrical Accessories, their specifications in line with NEC 2011-Explanation of switches lamp holders, plugs and sockets. Developments of domestic circuits, Alarm &amp; switches, with individual switches, Two way switch .Security surveillance, Fire alarm, MCB, ELCB, MCCB.</p>
9	<p>Assembly of a Dry cell- Electrodes-Electrolytes.</p> <p>Grouping of Dry cells for a specified voltage and current, Ni cadmium &amp; Lithium cell.</p> <p>Practice on Battery Charging, Preparation of battery charging,</p> <p>Testing of cells, Installation of batteries, Charging of batteries by different methods.</p> <p>Practice on Electroplating and anodising, Cathodic protection.</p>	<p><b>Chemical</b> effect of electric current-Principle of electrolysis. Faraday's Law of electrolysis. Basic principles of Electro-plating and Electro chemical equivalents. Explanation of Anodes and cathodes. Lead acid cell-description, methods of charging-Precautions to be taken &amp; testing equipment, Ni-cadmium &amp; Lithium cell, Cathodic protection. Electroplating, Anodising. Different types of lead acid cells.</p>
10	<p>Routine care &amp; maintenance of Batteries</p>	<p>Rechargeable dry cell, description advantages and disadvantages.</p> <p>Care and maintenance of cells</p> <p>Grouping of cells of specified voltage &amp; current, Sealed Maintenance free Batteries, Solar battery.</p>

11	Charging of a Lead acid cell, filling of electrolytes- Testing of charging checking of discharged and fully charged battery	Inverter, Battery Charger, UPS-Principle of working. Lead Acid cell, general defects & remedies. Nickel Alkali Cell-description charging. Power & capacity of cells. Efficiency of cells.
12-13	Marking use of chisels and hacksaw on flats, sheet metal filing practice, filing true to line. Sawing and planning practice. Practice in using firmer chisel and preparing simple half lap joint.	<b>ALLIED TRADES:</b> Introduction of fitting trade. Safety precautions to be observed Description of files, hammers, chisels hacksaw frames & blades-their specification & grades. Care & maintenance of steel rule try square and files. Marking tools description & use. Description of carpenter's common hand tools such as saws planes, chisels mallet claw hammer, marking, dividing & holding tools-their care and maintenance.
14	Drilling practice in hand drilling & power drilling machines. Grinding of drill bits. Practice in using taps & dies, threading hexagonal & square nuts etc. cutting external threads on stud and on pipes, riveting practice.	Types of drills description & drilling machines, proper use, care and maintenance. Description of taps & dies, types in rivets & riveted joints. Use of thread gauge.
15	Practice in using snips, marking & cutting of straight & curved pieces in sheet metals. Bending the edges of sheets metals. Riveting practice in sheet metal. Practice in making different joints in sheet metal in soldering the joints.	Description of marking & cutting tools such as snubs shears punches & other tools like hammers, mallets etc. used by sheet metal workers. Types of soldering irons-their proper uses. Use of different bench tools used by sheet metal worker. Soldering materials, fluxes and process.
16-17	Trace the magnetic field. Assembly / winding of a simple electro magnet. Use of magnetic compass. Identification of different types of Capacitors. Charging and discharging of capacitor, Testing of Capacitors using DC voltage and lamp.	<b>Magnetism -</b> Classification of magnets, methods of magnetising, magnetic materials. Properties, care and maintenance. Para and Diamagnetism and Ferro magnetic materials. Principle of electro-magnetism, Maxwell's corkscrew rule, Fleming's left and right hand rules, Magnetic field of current carrying conductors, loop and solenoid. MMF, Flux density, reluctance. B.H. curve, Hysteresis, Eddy current. Principle of electro-magnetic Induction, Faraday's Law, Lenz's Law. Electrostatics: Capacitor- Different types, functions and uses.

18-19	Determine the characteristics of RL, RC and RLC in A.C. Circuits both in series and parallel. Experiment on poly phase circuits. Current, voltage, power and power factor measurement in single & poly- phase circuits. Measurement of energy in single and poly-phase circuits. - Use of phase sequence meter.	<b>Alternating Current</b> -Comparison and Advantages D.C and A.C. Related terms frequency Instantaneous value, R.M.S. value Average value, Peak factor, form factor. Generation of sine wave, phase and phase difference. Inductive and Capacitive reactance Impedance (Z), power factor (p.f). Active and Reactive power, Simple problems on A.C. circuits, single Phase and three-phase system etc. Problems on A.C. circuits. Power consumption in series and parallel, P.F. etc. Concept three-phase Star and Delta connection. Line and phase voltage, current and power in a 3 phase circuits with balanced and unbalanced load.
20	<b>Practice on Earthing</b> - different methods of earthing. Measurement of Earth resistance by earth tester. Testing of Earth Leakage by ELCB and relay.	<b>Earthing</b> - Principle of different methods of earthing. i.e. Pipe, Plate, etc Importance of Earthing. Improving of earth resistance Earth Leakage circuit breaker (ELCB). In absence of latest revision in respective BIS provision for Earthing it is recommended to follow IEC guidelines.
21	Determine the resistance by Colour coding Identification of active/passive components. <b>Diodes</b> -symbol - Tests - Construct & Test Half wave rectifier ckt. Full wave rectifier ckt. Bridge rectifier ckt.	<b>Basic electronics</b> - Semiconductor energy level, atomic structure 'P' type and 'N' type. Type of materials -P-N-junction. Classification of Diodes - Reverse and Forward Bias, Heat sink. Specification of Diode PIV rating. Explanation and importance of D.C. rectifier circuit. Half wave, Full wave and Bridge circuit. Filter circuits-passive filter.
22-23	(i) <b>Project work</b> (ii) <b>Industrial visit (optional)</b>	
24-25	<b>Examination</b>	
26	Semester Gap	

**Second Semester**  
**(Semester Code no. ELE - 02)**  
**Duration: Six Month**

**LEARNING OBJECTIVES OF 2<sup>nd</sup> SEMESTER**

1. Apply safe working practices.
2. Comply environment regulation and housekeeping
3. Interpret & use Company terminology and technical communication
4. Identify and trace the simple electronic circuits, test and troubleshoot.
5. To carry out wiring as per IE rule.
6. Identify DC machines and measure the resistance.
7. To build up voltage in a DC generator
8. Able to connect, test and run a DC motor.
9. To install and connect transformers, parallel connection, carryout necessary maintenance, able to connect and use CT and PT.
10. Able to install different measuring instruments with electrical circuits.

Week No.	Professional Skills	Professional Knowledge
	Trade Practical	Trade Theory
1-2	Different wave shapes of rectifiers and their values using C.R.O. Identification of terminals, construction & Testing of transistor. Assembly and testing of a single stage Amplifier and checking using an oscilloscope.	Working principle and uses of an oscilloscope. Explanation of principle of working of a transistor & configuration. Types of transistors & its application. Specification and rating of transistors. Explanation of transistor Amplifiers, Amplifiers. – class A,B and C Power amplifier
3-4	Measure Voltage, current & wave shape of oscillator using CRO. Simple circuits containing U.J.T. for triggering, FET as an amplifier and Power control circuits by S.C.R. and Diac, triac, I.G.B.T. Logic gates and circuits.	Explanation of oscillator-working principle Explanation of stages and types. Multivibrator – applications. Introduction of basic concept of ICs, U.J.T., F.E.T. Basic concept of power electronics devices e.g. S.C.R., Diac, Triac, power MOSFET, G.T.O and I.G.B.T. <b>Digital Electronics</b> -Binary numbers, logic gates and combinational circuits,
5-6	Practice in casing, Capping. Conduit wiring with minimum to more number of points. Use of two way switches.	<b>Electric wirings</b> , I.E. rules. Types of wirings both domestic and industrial. Specifications for wiring. Grading of cables and current ratings. Principle of

	<p>Testing of wiring installation by meggar.</p> <p>-Fixing of calling bells/buzzers.</p> <p>-Making of test boards &amp; extension boards</p> <p>Identification &amp; demonstration on conduits and accessories &amp; their uses, cutting, threading &amp; laying</p> <p>Installation, Testing, Maintenance and Repairing of wiring.</p>	<p>laying out in domestic wiring.</p> <p>Voltage drop concept.</p> <p><b>Wiring system</b> - P.V.C., concealed system.</p> <p>Maintenance and Repairing data sheet preparation.</p> <p>Specifications, standards for conduits and accessories</p> <p>- Power Wiring</p> <p>- Control Wiring</p> <p>- Information Communication</p> <p>- Entertainment Wiring.</p> <p>Testing of wiring installation by meggar.</p>
7	Application of fuses, relay, MCB, ELCB.	Study of Fuses, Relays, Miniature circuit breakers (MCB), ELCB, etc.
8-9	<p>Identification of the parts of a D.C. machine.</p> <p>Connection of shunt Generators</p> <p>Voltages build up in DC Shunt Generator (OCC) Measurement of voltages, Demonstration on field excitation.</p>	<p><b>D.C. Machines</b> - General concept of Electrical Machines.</p> <p><b>Principle of D.C. generator.</b> Use of Armature, Field Coil, Polarity, Yoke, Cooling Fan, Commutator, slip ring Brushes, Laminated core.</p> <p>Explanation of <b>D.C. Generators</b>-types, parts. <b>E.M.F.</b> equation-self excitation and separately excited Generators-Practical uses. Brief description of series, shunt and compound generators.</p>
10-11	<p>Connection of compound Generator, Voltage measurement, cumulative and differential –No Load and Load characteristics of Series, Shunt and Compound Generator.</p> <p>Controlling and protecting DC Generator.</p> <p>Practicing dismantling and assembling in D.C. Machine.</p>	<p>Explanation of Armature reaction, inter poles and their uses, connection of inter poles, Commutation. Losses &amp; Efficiency of D.C.Generator, Parallel Operation of D.C.Generator.</p> <p>Application of D.C. generators.</p> <p>Care, Routine &amp; preventive maintenance.</p>
12-13	<p>Identification of parts and terminals of DC motors.</p> <p>Connection, starting, running of DC motors using Starters.</p> <p>Characteristics curve of DC motors.</p> <p>Practical application of D.C. motors.</p>	<p><b>DC Motors</b> - Terms used in D.C. motor-Torque, Brake Torque, speed, Back-e.m.f. etc. and their relations, Types of D.C.Motor.</p> <p>Starters used in D.C. motors</p> <p>Related problems</p> <p>Characteristics of D.C.Motor, Losses &amp; Efficiency, Application of D.C. motors.</p> <p>Care, Routine &amp; preventive maintenance.</p>
14	Speed control of	Types of speed control of DC motors in industry.

	DC motors by voltage , field, armature & Word-Leonard system.	Control system. AC-DC, DC-DC control.
15-18	<p>Identification of types of transformers. Connection of transformers, Transformation ratio, OC (No-load) and SC (short circuit) tests, efficiencies of transformers, testing of transformer, parallel operation of transformer. Use of Current Transformer (C.T.) and Potential (Voltage) transformer (P.T.)</p> <p>Testing of single phase and Three Phase Transformers - Cleaning, maintenance, testing and changing of oil.</p> <p>Single and three phase connection.</p>	<p>Working principle of <b>Transformer</b>. classification C.T., P.T. Instrument and Auto Transformer(Variac), Construction, Single phase and Poly phase.</p> <p>E.M.F. equation, parallel operation of transformer, their connections.</p> <p>Regulation and efficiency.</p> <p>Type of Cooling for transformer.</p> <p>Protective devices.</p> <p>Specifications, simple problems on e.m.f. Equation, turn ratio, regulations and efficiency. Special transformers.</p> <p>Transformer –Classification of transformer. Components, Auxiliary parts i.e. breather, Conservator, buchholze relay, other protective devices. Transformer oil testing and Tap changer (off load and on load). Dry type transformer. Bushings and termination.</p>
19-21	<p>Identify the type of Instruments.</p> <p>Use of -PMMC , MI meter, Multi-meter(Digital/Analog) , Wattmeter, P F meter, Energy meter, Frequency meter, Calibration of - Multi-meter Phase sequence meter, Digital Instruments, etc</p> <p>Calibration of Energy meter.</p>	<p><b>Electrical Measuring Instruments -</b></p> <ul style="list-style-type: none"> <li>-types, indicating types. Deflecting torque, Controlling torque and Damping torque ,</li> <li>PMMC &amp; MI meter (Ammeter, Voltmeter)</li> <li>-Range extension</li> <li>-Multimeter(Digital/Analog)</li> <li>-Wattmeter</li> <li>- P.F. meter</li> <li>- Energy meter (Digital/analog)</li> <li>-Insulation Tester (Megger), Earth tester.</li> <li>-Frequency meter</li> <li>-Phase Sequence meter</li> <li>-Multimeter –Analog and Digital</li> <li>-Tong tester</li> <li>-Techometer.</li> </ul>
22-23	Implant training / Project work (work in a team)	
24-25	Revision	
26	Examination	

**Third Semester**  
**(Semester Code no. ELE - 03)**  
**Duration: Six Month**

**LEARNING OBJECTIVES OF 3<sup>rd</sup> SEMESTER**

1. Apply safe working practices.
2. Comply environment regulation and housekeeping
3. Interpret & use Company terminology and technical communication
4. Able to install different induction motors along with starters.
5. Able to carry out wiring, rewinding of single phase and three phase motors.
6. Able to install, start, running and maintenance of MG set.
7. To install different illumination system.

Week No.	Professional Skills	Professional Knowledge
	Trade Practical	Trade Theory
1-3	<p>Identification of parts and terminals of AC motors.            Connection, starting, running of AC motors using Starters.            Measurement of slip, P.F. at various loads.            Practice on connection of D.O.L Starter, Star /Delta starter, Autotransformer starter, Rotor resistance starter, etc            Speed control of Induction motors by various methods.            Practical application of A.C. motors.</p>	<p><b>Three phase Induction motor</b> –            Working principle –Production of rotating magnetic field, Squirrel Cage Induction motor, Slip-ring induction motor.            Construction , characteristics and Speed control, Slip &amp; Torque .            Control &amp; Power circuit of starters            D.O.L Starter, Star /Delta starter, Autotransformer starter, Rotor resistance starter, etc            Single phasing preventer.            Losses &amp; efficiency.            Application of Induction Motor            Care, Routine &amp; preventive maintenance.</p>
4-5	<p>Connection of single phase motor, identification, testing, running and reversing.</p> <p>Identification, connection, testing, running and reversing of universal motor. Repulsion motor, stepper motor.</p>	<p><b>Single phase induction motor-</b>            Working principle, different method of starting and running (capacitor start, permanent capacitor, capacitor start &amp; run, shaded pole technique).            FHP motors, Repulsion motor, stepper motor, Hysteresis motor, Reluctance motor.            Application of Single phase induction motor  <b>Universal motor</b>-advantages, Principle, characteristics, applications in domestic and industrial appliances,            Fault Location and Rectification.            Braking system of motor.</p>

		Application of Universal motor.
6-7	<p>Identification of parts and terminals of Alternator.            Connection, starting, running of Alternator.            Practical application of Alternator.            Practice on alternators, voltage Building, load characteristic, voltage regulation, Parallel operation.            Practice on installation, running and maintenance of Alternators.</p>	<p><b>Alternator</b>            Explanation of alternator, types of prime mover, efficiency, regulations, phase sequence, Parallel operation.            Specification of alternators and Brushless alternator.            Verify the effect of changing the field excitation and Power factor correction of Industrial load.</p>
8	<p>Identification of parts and terminals of Synchronous motor.            Connection, starting, running of Synchronous motor.            Plot V curve.            Practical application of Synchronous motor.</p>	<p><b>SYNCHRONOUS MOTOR -</b>            Working principle, effect of change of excitation and load.            V and anti V curve.              Cause of low power factor.            Method of power factor improvement.</p>
9	<p>Starting, running, building up voltage and loading of Motor Generator (MG) set.            Maintenance of MG Sets.            Solid state controller and Invertors- Operation and Use</p>	<p>Rotary Converter- Inverter, M.G. Set description, Characteristics, specifications-running and Maintenance.            Solid state controller and Invertors.</p>
10	<p>Practice on winding of small Transformers.</p>	<p><b>TRANSFORMER Winding</b> , Small Transformer winding techniques</p>
11-12	<p>Testing of burnt DC machine for rewinding – collection of data – developed diagram and connection – winding procedure            Making frame(forma), coil insulation, Slot insulation, Insertion of coils in slots, coil connection,            Practice on armature winding, Growler testing, Baking, Impregnation and Varnishing &amp; assembling.</p>	<p><b>DC machine Winding--</b> Armature winding terms, pole pitch, coil pitch, back pitch, front pitch , Lap and Wave winding , Progressive and retrogressive Winding, developed diagram.            Growler construction, working &amp; application.</p>
13-15	<p>Testing of burnt motor for rewinding – collection of data – developed diagram and connection – winding procedure</p>	<p><b>ACmachine Winding—</b>Motor winding terminology – classification of conducting and insulating materials used in winding – Types and methods of winding in single and three phase motors.</p>



	<p>Making frame(forma), coil insulation, Slot insulation, Insertion of coils in slots, coil connection, Practice on single &amp; double layer, concentric Winding, Winding of table &amp; ceiling fans, single phase and three phase motors – testing of wound motor Baking, impregnating and varnishing &amp; assembling.</p>	<p>Stator winding terms, coil side, end coil and grouping of coils. Connection to adjacent poles, connected stator winding, alternate pole connection, developed diagram.</p>
16-17	<p>Installation of - Mercury &amp; Sodium vapours (H.P. &amp; L.P.) Halogen Lamps Single FL tube and twin FL tube. Practice on decoration lighting Principle of layout of lighting installation. Practice on photo cells.</p>	<p><b>Illumination</b>, Laws of Illuminations, terminology used , Illumination factors, intensity of light – importance of light, human eye factor, , units. Types of illumination Type of lamps -Neon sign Halogen, Mercury vapour, sodium vapour, Fluorescent tube, CFL, LED, Solar lamp &amp; photo cell applications, Decoration lighting, Drum Switches, efficiency in lumens per watt, Calculations of lumens. Estimating placement of lights, fans and ratings.</p>
18-19	<p>Practice on wiring of electric motor, control panel, etc. Trace/Test of different circuit Breakers. Protective and control relays, contactors, etc. Operation and use of XLPE cables.</p>	<p><b>Industrial wiring</b>. Code of practice and relevant span. Wiring of electric motors, control panel, etc. Types, specifications, advantages of different types of circuit brackets construction and maintenance. Working principle and construction of domestic and agricultural appliances-their maintenance.</p>
20-21	<p>Practice of wiring Maintenance of institute, hostel, hotel, residential building. Layout and repairing of workshop electrical installation. Fault finding practice</p>	<p>Complete House-wiring layout. Splitting load wire in accordance with NEC I.E.E. Rules. Multi-storeyed system. Fault finding and trouble shooting.</p>
22-23	<p>Implant training/Project work/work in a team</p>	
24-25	<p>Revision</p>	
26	<p>Examination</p>	

**Fourth Semester**  
**(Semester Code no. ELE - 04)**  
**Duration: Six Month**

**LEARNING OBJECTIVES OF 4<sup>th</sup> SEMESTER**

1. Apply safe working practices.
2. Comply environment regulation and housekeeping
3. Interpret & use Company terminology and technical communication
4. Able to assemble and wire switch control cabinet for 3 phase induction motors.
5. Able to repair and maintenance of various domestic electrical appliances.
6. Able to prepare different types of power line diagram.

Week No.	Professional Skills	Professional Knowledge
	Trade Practical	Trade Theory
1-3	<p><b>Machine control cabinet /Control Panel Layout, Assembly &amp; Wiring:</b></p> <p>Practice Layout drawing of control cabinet , panel, power &amp; control circuits</p> <p>Preparing control cabinet / panel wiring for</p> <ol style="list-style-type: none"> <li>1. Local &amp; Remote control of Induction motor</li> <li>2. Forward &amp; Reverse operation of Induction motor</li> <li>3. Automatic Star Delta Starter</li> <li>4. Automatic star delta starter with change of direction of rotation</li> <li>5. Sequential control of three motors.</li> </ol> <p><b>Preparation of Control cabinet &amp; panel:</b> Necessary marking, cutting, filing, drilling, tapping etc.</p> <p><b>Mounting of control elements</b></p>	<p><b>Machine control cabinet /Control Panel Layout, Assembly &amp; Wiring:</b></p> <p>Layout of Control cabinet &amp; control panel</p> <p>Study &amp; Understand Layout drawing of control cabinet , panel, power &amp; control circuits.</p> <p><b>Control Elements:</b> Isolator, pushbutton switches, Indicating lamps, MCB, Fuse, Contactor, Relays, Overload Relay, Timers, Rectifier, Limit switches, control transformers.</p> <p>Wiring Accessories: Race ways/ cable channel, DIN Rail, Terminal Connectors, Thimbles, Lugs, Ferrules, cable binding strap &amp; buttons, nylon cable ties, sleeves, Gromats&amp; clips</p>

	<p><b>&amp; wiring Accessories:</b> Isolator, pushbutton switches, Indicating lamps, meters, MCB, Fuse, Contactor, Relays, Overload Relay, Timers, Rectifier, Limit switches, control transformers, Raceways/cable channel, Terminal connectors etc.</p> <p><b>Wiring of control cabinet/panel:</b> As per wiring diagram.</p> <p>Bunching of wires &amp; cables, channelling, tying etc.</p> <p>Checking / buzzing the wiring.</p> <p>Power connections &amp; motor connection &amp; testing.</p>	
4-6	<p>Repair &amp; Test of Calling Bell, Buzzer, Alarms, Electric Iron, Heater, Light.</p> <p>Maintenance and repair of domestic equipment – Electric Kettle, Heater / Immersion Heater, Hot Plate, Oven, Geyser, Cooking range, Mixer, Washing machine, , Motor Pump set, etc.</p>	<p><b>Domestic Appliances:</b> Working principles and circuits of common domestic equipment and appliances. – Calling Bell, Buzzer, Alarms, Electric Iron, Heater, Light.</p> <p>Electric Kettle, Heater / Immersion Heater, Hot Plate, Oven, Geyser, Cooking range, Mixer, Washing machine, , Motor Pump set, etc.</p> <p>Concept of Neutral and Earth.</p>
7	<p>Practice on Thermal power plant simulator (free version) or Plant visit.</p> <p>To prepare layout plan, single line diagram of the Thermal power system of generation.</p>	<p><b>POWER GENERATION :</b></p> <p>Generation sources of energy, Comparison of energy resources. Types of fuels. Advantages of liquid fuel &amp; solid fuel.</p> <p>Various ways of electrical power generation. • Thermal • Hydro electric • Nuclear • Non-Conventional</p> <p>Thermal</p> <p>Coal based, diesel based &amp; Gas based Turbine.</p> <p>Constituents in steam power station.</p>
8	<p>Practice on Hydro power plant simulator (free version) or Plant visit.</p> <p>To prepare layout plan, single line diagram of the Hydro</p>	<p><b>Hydro Electric:</b></p> <p>Schematic arrangement of Hydro-Electric Power Station. Constituents of Hydro Electric Plant. Types of Hydro Electric Power station. Advantages &amp; disadvantages.</p>

	electric power system of generation.	
9	Practice on Nuclear power plant simulator (free version) or Plant visit. To prepare layout plan, single line diagram of the Nuclear power system of generation.	<b>Nuclear:</b> Schematic arrangement of Nuclear Power Station. Composition of an atomic Nucleus. Advantages & disadvantages. Comparison of above Power Plant.
10-11	Practice on Non-conventional power plant simulator (free version) or Plant visit. To prepare layout plan, single line diagram of the non-conventional power system of generation.	<b>Non-Conventional</b> An introduction to Power generation through non-conventional power generation such as Solar, Bio-Gas, Wind energy and Micro-hydel, Tidal waves, etc. Basic principal, Advantages & disadvantages of each.
12	Identification and specification of different type of insulator used in HT line.  Binding of Pin type insulator, shackle type and suspension type insulators.  Fixing of jumper by crimping tool.	<b>TRANSMISSION OF ELECTRICAL POWER</b>  Electrical Supply System :  Comparison of AC and DC transmission. Advantages of High transmission voltage.  Introduction to Single phase , three phase-3 wire system in transmission lines  Overhead Lines:  Main components of overhead lines-Types of power line Low voltage line medium Voltage line & high voltage line Voltage standard Conductor materials, line supports, Insulators, types of Insulators
13	Skinning and dressing of cables.  Straight joint of different types of underground cables.  Test /check the insulation resistance of cables by using megger.  Locating the faults (open	<b>Under Ground Cable :</b>  Construction of cables. Material for cables, its insulation. Classification of cables, cables for 3-phase service, Laying of underground cable. Types of cable faults and their location.

	circuit, short circuit & leakage) in cables.	
14	To visit & prepare layout plan, single line diagram of Transmission /distribution Substation.  Installation of bus bar and bus coupler on LT line.  Replacement and testing of transformer oil.	<b>DISTRIBUTION OF POWER</b>  Function and equipment used in substation.  Classification of distribution system-AC distribution, Overhead v/s underground distribution system.  Essential features of switchgears. Isolator, Switch gear equipments, bus-bar arrangement, Short circuit, faults in power system.  <b>Circuit breakers</b> – Introduction & Classification of circuit breakers  lightening arrestors used in HT lines.
15-16	Speed control of DC motor : Connection, parameterization and speed control by Thyristor/ DC Drive.	Introduction, Construction & Working of power transistor, thyristor. Introduction, Construction, Working, Parameters & application of DC drive.
17-18	Speed control of AC motor : -Uses of SCR and other modern semiconductor devices in controlling speed of motors and in changing the direction of rotation of motors. Connection, parameterization and speed control by AC Drive.	Speed control of 3 phase induction motor by using VVVF/AC Drive. Introduction, Construction, Working, Parameters & application of AC drive
19-21	Break down, Routine & Preventive maintenance of DC/AC machines, Voltage stabilizer, Inverter, U.P.S. & Equipments.	Schedule of electrical preventive maintenance. Break down, Routine & Preventive maintenance of DC/AC machines, Voltage stabilizer, U.P.S. & Equipments.
22-23	Implant training / Project work (work in a team)	
24-25	Revision	
26	Examination	

## 10.2 SYLLABUS CONTENT OF CORE SKILLS

### **FirstSemester** **(Semester Code no. ELE - 01)**

**Duration: Six Month**

### **LEARNING OBJECTIVES OF 1<sup>ST</sup> SEMESTER**

1. Apply basic arithmetic to derive value of unknown quantity / variable.
2. Understand & apply engineering material, their classification, properties and applications in the day to day technical application.
3. Explain & apply speed, velocity, work, power & energy for application in field of work.
4. Understand & explain importance of engineering drawing, drawing instruments, their standard & uses.
5. Draw lines, geometrical figures, free hand sketches.
6. Understand and apply sizes & layout of drawing sheet, method of presentation of engineering drawing & symbolic representation as per BIS standards

Sl. No.	Professional Knowledge	Professional Knowledge & Skills
	Workshop Calculation and Science	Engineering Drawing
1.	<b>Unit:</b> Systems of unit- FPS, CGS, MKS/SI unit, unit of length, Mass and time, Conversion of units	Engineering Drawing: Introduction and its importance <ul style="list-style-type: none"> <li>- Relationship to other technical drawing types</li> <li>- Conventions</li> <li>- Viewing of engineering drawing sheets.</li> <li>- Method of Folding of printed Drawing Sheet as per BIS SP:46-2003</li> </ul>
2.	<b>Fractions</b> : Fractions, Decimal fraction, L.C.M., H.C.F., Multiplication and Division of Fractions and Decimals, conversion of Fraction to Decimal and vice versa. Simple problems using Scientific Calculator.	Drawing Instruments : their Standard and uses <ul style="list-style-type: none"> <li>- Drawing board, T-Square, Drafter (Drafting M/c), Set Squares, Protractor, Drawing Instrument Box (Compass, Dividers, Scale, Diagonal Scales etc.), Pencils of different Grades, Drawing pins / Clips.</li> </ul>
3.	<b>Square Root</b> : Square and Square Root, method of finding out square roots, Simple problem using calculator.	Lines : <ul style="list-style-type: none"> <li>- Definition, types and applications in Drawing as per BIS SP:46-2003</li> <li>- Classification of lines (Hidden, centre, construction, Extension, Dimension, Section)</li> <li>- Drawing lines of given length (Straight, curved)</li> <li>- Drawing of parallel lines, perpendicular line</li> </ul>

		- Methods of Division of line segment
4.	<b>Ratio &amp; Proportion</b> : Simple calculation on related problems.	Drawing of Geometrical Figures: Definition, nomenclature and practice of <ul style="list-style-type: none"> <li>- Angle: Measurement and its types, method of bisecting.</li> <li>- Triangle -different types</li> <li>- Rectangle, Square, Rhombus, Parallelogram.</li> <li>- Circle and its elements.</li> </ul>
5.	<b>Percentage</b> : Introduction, Simple calculation. Changing percentage to decimal and fraction and vice-versa.	Lettering and Numbering as per BIS SP46-2003: <ul style="list-style-type: none"> <li>- Single Stroke, Double Stroke, inclined, Upper case and Lower case.</li> </ul>
6.	<b>Material Science</b> : properties - Physical & Mechanical, Types – Ferrous & Non-Ferrous, difference between Ferrous and Non-Ferrous metals, introduction of Iron, Cast Iron, Wrought Iron, Steel, difference between Iron and Steel, Alloy steel, carbon steel, stainless steel, Non-Ferrous metals, Non-Ferrous Alloys.	Dimensioning: <ul style="list-style-type: none"> <li>- Definition, types and methods of dimensioning (functional, non-functional and auxiliary)</li> <li>- Types of arrowhead</li> <li>- Leader Line with text</li> </ul>
7.	<b>Mass, Weight and Density</b> : Mass, Unit of Mass, Weight, difference between mass and weight, Density, unit of density, specific gravity of metals.	Free hand drawing of <ul style="list-style-type: none"> <li>- Lines, polygons, ellipse, etc.</li> <li>- geometrical figures and blocks with dimension</li> <li>- Transferring measurement from the given object to the free hand sketches.</li> </ul>
8.	<b>Speed and Velocity</b> : Rest and motion, speed, velocity, difference between speed and velocity, acceleration, retardation, equations of motions, simple related problems.	Sizes and Layout of Drawing Sheets <ul style="list-style-type: none"> <li>- Basic principle of Sheet Size</li> <li>- Designation of sizes</li> <li>- Selection of sizes</li> <li>- Title Block, its position and content</li> <li>- Borders and Frames (Orientation marks and graduations)</li> <li>- Grid Reference</li> <li>- Item Reference on Drawing Sheet (Item List)</li> </ul>
9.	<b>Work, Power and Energy</b> : work, unit of work, power, unit of power, Horse power of engines, mechanical efficiency, energy, use of energy, potential and kinetic energy, examples of potential energy and	Method of presentation of Engineering Drawing <ul style="list-style-type: none"> <li>- Pictorial View</li> <li>- Orthogonal View</li> <li>- Isometric view</li> </ul>

	kinetic energy.	
10.	-----	<p>Symbolic Representation (as per BIS SP:46-2003) of :</p> <ul style="list-style-type: none"> <li>- Fastener (Rivets, Bolts and Nuts)</li> <li>- Bars and profile sections</li> <li>- Weld, brazed and soldered joints.</li> <li>- Electrical and electronics element</li> <li>- Piping joints and fittings</li> </ul>



**Second Semester**  
**(Semester Code no. ELE - 02)**

**Duration: Six Month**

**LEARNING OBJECTIVES OF 2<sup>ND</sup> SEMESTER**

1. Demonstrate basic algebraic, mensuration, trigonometric facts and formulas to derive value of unknown quantity / variable.
2. Apply the factual knowledge of basic heat & temperature, basic electricity for day to day practical application.
3. Explain & apply principles of simple machine & levers for mechanical advantage, efficiency for practical application.
4. Draw & practice dimensioning, construction of solid figures and projections as per IS specifications.

Sl. No.	Professional Knowledge	Professional Knowledge & Skills
	Workshop Calculation and Science	Engineering Drawing
1.	<b>Algebra</b> : Addition, Subtraction, Multiplication, Division, Algebraic formula, Linear equations (with two variables).	Construction of Scales and diagonal scale
2.	<b>Mensuration</b> : Area and perimeter of square, rectangle, parallelogram, triangle, circle, semi circle, Volume of solids – cube, cuboid, cylinder and Sphere. Surface area of solids – cube, cuboid, cylinder and Sphere.	Practice of Lettering and Title Block
3.	<b>Trigonometry</b> : Trigonometrical ratios, measurement of angles. Trigonometric tables	Dimensioning practice: - Position of dimensioning (unidirectional, aligned, oblique as per BIS SP:46-2003) - Symbols preceding the value of dimension and dimensional tolerance. - Text of dimension of repeated features, equidistance elements, circumferential objects.
4.	<b>Heat &amp; Temperature</b> : Heat and temperature, their units, difference between heat and temperature, boiling point, melting point, scale of temperature, relation between	Construction of Geometrical Drawing Figures: - Different Polygons and their values of included angles. Inscribed and Circumscribed polygons. - Conic Sections (Ellipse & Parabola)

	different scale of temperature, Thermometer, pyrometer, transmission of heat, conduction, convection, radiation.	
5.	<b>Basic Electricity:</b> Introduction, use of electricity, how electricity is produced, Types of current_ AC, DC, their comparison, voltage, resistance, their units. Conductor, insulator, Types of connections – series, parallel, electric power, Horse power, energy, unit of electrical energy	Drawing of Solid figures (Cube, Cuboids, Cone, Prism, Pyramid, Frustum of Cone and Pyramid.) with dimensions.
6.	<b>Levers and Simple Machines:</b> levers and its types. Simple Machines, Effort and Load, Mechanical Advantage, Velocity Ratio, Efficiency of machine, Relationship between Efficiency, velocity ratio and Mechanical Advantage.	Free Hand sketch of hand tools and measuring tools used in respective trades.
7.	-----	Projections: - Concept of axes plane and quadrant. - Orthographic projections - Method of first angle and third angle projections (definition and difference) - Symbol of 1st angle and 3rd angle projection as per IS specification
8.	-----	Drawing of Orthographic projection from isometric/3D view of blocks
9.	-----	Orthographic Drawing of simple fastener (Rivet, Bolts, Nuts & Screw)
10.	-----	Drawing details of two simple mating blocks and assembled view.

**Third Semester**  
**(Semester Code no. ELE - 03)**

**Duration: Six Month**

**LEARNING OBJECTIVES OF 3<sup>rd</sup> SEMESTER**

1. The trainee will acquire the knowledge, explain and apply the basic terms and law related with elasticity & materials, magnetism, pressure and heat treatment process.
2. The trainee will able to explain and solve the problem related to Laws of indices & Quadratic Equation.
3. The trainee will acquire knowledge of electrical circuit of capacitors, resistors and inductors for series and parallel operation and apply in the practical field of operation of electrical circuit in routine and repetitive in various range of applications.
4. The trainee will acquire knowledge about fundamental of AC waveforms for calculation of r.m.s, average, instantaneous value and peak value etc.
5. Able to draw & understand freehand sketch/ diagram of Alternating current, electronic component, wiring, earthing, DC machine, transformer and illumination and apply in routine work of electrical field.

Sl. No.	Professional Knowledge	Professional Knowledge & Skills
	Workshop Calculation and Science	Engineering Drawing
1.	<b>Elasticity:</b> Stress, strain, Modulus of elasticity, elastic limit, Hooks law, young's modulus.	<b><u>Sign &amp; Symbol Trade related</u></b> <b>Alternating Current</b> Drawing of simple electrical circuit using electrical symbols. Drawing of sine square & triangular waves. Diagram of battery charging circuit. Practice in reading typical example of circuit containing R, L & C. Reading of electrical drawing.
2.	<b>Material:</b> Introduction, types and properties. Uses of Conducting, Semi-conducting and insulating materials.	<b>Electronic components</b> Symbols for electronic components. Diode, Transistor, Zener diode, S.C.R., UJT, FET, I.C. Diac, Triac, Mosfet I.G.B.T etc. Drawing of half wave, Full wave and Bridge rectifier circuit. Drawing circuit for a single stage Amplifiers and Multi stage Amplifies and types of signals. Drawing of circuit containing UJT, FET & Simple power control circuits. Free hand drawing of Logic gates and circuits.
3.	<b>Magnetism:</b> Magnetic material, magnetic field, flux density, magnetic moment, m.m.f. Reluctance, permeability, susceptibility,	<b>Electric wirings &amp; Earthing</b> Detailed diagram of calling bell, & Buzzers etc Free hand sketching of Staircase wiring. Drawing the schematic diagram of plate and pipe

	electromagnet, solenoid and its practical applications.	earthing. Diagram for electroplating from A.C and D.C source.
4.	<b>Pressure:-</b> Pneumatic pressure, PSI, bar, atmospheric pressure, pressure gauge and absolute pressure, Heat treatment process.	<b>DC machines</b> Graphic symbols for Rotating machines. Sketching of brush and brush gear of D.C. machines. Sketching of D.C. 3-point and 4-point starter . Layout arrangement of D.C. Generators & motors, control panel. Exercises on connection to motors through Ammeter, voltmeter & K.W. meters of electrical wiring diagram. Drawing the schematic diagram of D.C. motor speed control by Thyristor / DC Drive.
5.	<b>Indices:</b> Laws of indices related problems.  <b>Quadratic Equation:</b> Introduction, solution of simple Quadratic equation and related problems.	<b>Transformer</b> Graphic symbols for Transformers. Free hand sketching of transformer and auxiliary parts and sectional views. Sketching a breather. Drawing the diagram of typical marking plate of a distribution transformer.
6.	Solution of simple A.C. circuit with R.L.C. Calculation of power factor etc.	<b>Illumination</b> Free hand sketching of Mercury vapour lamp, sodium vapour lamp, Fluorescent tube (Single & Twine), MHL lamp and their connection.
7.	<b>A.C Waveform Calculation:</b> Calculation of r.m.s, average, instantaneous value, peak value. Peak to peak value, Frequency and wavelength calculation and their relationship	-----
8.	<b>Series And Parallel Connection of Electrical and Electronic components:</b> 1. Calculation Series and parallel connection of Resistors. 2. Calculation Series and parallel connection of Capacitors. 3. Calculation Series and parallel connection of Inductors. 4. Calculation Series and parallel connection of Batteries. Conversion of power flow to H.P. Calculation of KVA.	-----

**Fourth Semester**  
**(Semester Code no. ELE - 04)**  
**Duration: Six Month**

**LEARNING OBJECTIVES OF 4<sup>th</sup> SEMESTER**

1. The trainee will acquire the knowledge friction, force and centre of gravity and their related terms for application in the practical field.
2. Able to explain and apply different types of Number system & conversions.
3. The trainee will acquire the knowledge of calculation on estimation and costing for requirement of materials in the field.
4. The trainee will acquire the knowledge of personnel finance by learning simple problems solution on Profit & Loss, simple and compound interest.
5. Able to draw freehand sketch/ diagram of 1 & 3 phase AC motors, alternators, synchronous motors, winding, control panel & distribution of power and apply in the routine work of electrical field.

Sl. No.	Professional Knowledge	Professional Knowledge & Skills
	Workshop Calculation and Science	Engineering Drawing
1.	<p><b><u>Friction:</u></b> - Laws of friction, coefficient of friction, angle of friction, simple problems related to friction. Lubrication</p> <p>Concept on terms like pressure, atmospheric pressure, gauge pressure.</p> <p>Heat treatment necessity difference methods.</p>	<p><b>Three phase Induction motor</b></p> <p>Free hand sketching of Slip-ring and Squirrel cage Induction motor.</p> <p>Typical wiring diagram for drum controller operation of A.C. wound rotor motor.</p> <p>Drawing the schematic diagram of Autotransformer starter, DOL starter and Star Delta Starter.</p> <p>Drawing the schematic diagram of A.C. motor speed control by SCR /AC Drive.</p>
2.	<p><b><u>Forces:</u></b> - Resolution and composition of forces. Representation of force by vectors, simple problems on lifting tackles like jib wall, crane-Solution of problems with the aid of vectors.</p> <p>General condition of equilibriums for series of forces on a body. Law of parallelogram, Triangle Law, Lami's theorem.</p>	<p><b>Alternator</b></p> <p>Tracing of panel wiring diagram of an alternator.</p> <p>Drawing the schematic diagram of automatic voltage regulators of A.C. generators.</p>
3.	<p><b><u>Centre of gravity:-</u></b> Centre of gravity concept and C.G. of different lamina. Equilibrium different kinds stable, unstable and neutral. Law of</p>	<p><b>Winding</b></p> <p>Drawing the development diagram for D.C. Simplex Lap &amp; Wave winding</p>

	parallelogram force. Triangle law, Lami's theorem stable, unstable and neutral equilibrium.	with brush position. Drawing the development diagram of A.C 3 – Phase, 4 Pole 24 slots single layer winding.
4.	<b>Number system:-</b> decimal and binary, Octal Hexa decimal. BCD code, conversion from decimal to binary and vice-versa, all other conversions. Practice on conversions.	<b>Control Panel</b>  Practice in reading panel diagram. Local & Remote control of Induction motor with inching. Forward & Reverse operation of Induction motor Automatic Star Delta Starter Automatic star delta starter with change of direction of rotation Sequential control of three motors.
5.	<b>Estimation &amp; costing:-</b> Simple estimation of the requirement of materials etc. as applicable to the trade. Problems on estimation and costing.  <b>Further Mensuration:-</b>  Volumes of frustums including conical frustums.  <b>Graph-</b> Basics, abscissa, co-ordinate etc.  $Y = mx$ and $Y = mx + c$ graph	<b>Distribution of Power</b> Types of insulator used in over head line. (Half sectional views) Different type of distribution systems and methods of connections. Layout diagram of a substation. Single line diagram of substation feeders.
6.	Simple Problems on Profit & Loss.  Simple and compound interest.	-----

# **11. EMPLOYABILITY SKILLS**

## **11.1 GENERAL INFORMATION**

1. **Name of the subject** : EMPLOYABILITY SKILLS
2. **Applicability** :
- CTS- Mandatory for all trades
  - ATS- Mandatory for fresher only
3. **Hours of Instruction** : 110 Hrs.
4. **Examination** : The examination will be held at the end of semesters.
5. **Instructor Qualification** :

**MBA OR BBA with two years experience OR Graduate in Sociology/ Social Welfare/ Economics with Two years experience OR Graduate/ Diploma with Two years experience and trained in Employability Skills from DGET institutes**  
**AND**  
**Must have studied English/ Communication Skills and Basic Computer at 12<sup>th</sup> / Diploma level and above**

**OR**

Existing Social Studies Instructors duly trained in Employability Skills from DGET institutes

6. **Instructor** :
- One full time instructor is required for 1000 seats and above
  - For seats less than 1000, the instructor may be out sourced/ hired on contract basis.

## 11.2 DISTRIBUTION OF TOPICS BETWEEN SEMESTERS FOR EMPLOYABILITY SKILL

Course Duration	Semester1	Semester2	Examination
	Topics	Topics	
01 Year (Two semesters)	1. English Literacy 2. I.T. Literacy 3. Communication Skills	4. Entrepreneurship Skills 5. Productivity 6. Occupational safety , Health and Environment Education 7. Labour Welfare Legislation 8. Quality Tools	Final examination at the end of second semester
02 Years (Four Semesters)	1. English Literacy 2. I.T. Literacy 3. Communication Skills	4. Entrepreneurship Skills 5. Productivity 6. Occupational safety , Health and Environment Education 7. Labour Welfare Legislation 8. Quality Tools	Final examination at the end of second semester



## 11.3 SYLLABUS CONTENT OF EMPLOYABILITY SKILL

### SEMESTER – I

#### LEARNING OBJECTIVES OF 1<sup>ST</sup> SEMESTER

1. Read, write and communicate in English language for day to day work.
2. Communicate in written and oral and with required clarity ensuring that the information communicated is clear, concise and accurate.
3. Understand and apply basic computer working, basic operating system and uses internet services to get accustomed & take benefit of IT developments in the industry.

<b>1. English Literacy</b> <b>Hours of Instruction: 20 Hrs.</b> <span style="float: right;"><b>Marks Allotted: 09</b></span>	
<b>Pronunciation</b>	Accentuation (mode of pronunciation) on simple words, Diction (use of word and speech)
<b>Functional Grammar</b>	Transformation of sentences, Voice change, Change of tense, Spellings.
<b>Reading</b>	Reading and understanding simple sentences about self, work and environment
<b>Writing</b>	Construction of simple sentences Writing simple English
<b>Speaking / Spoken English</b>	Speaking with preparation on self, on family, on friends/ classmates, on know, picture reading gain confidence through role-playing and discussions on current happening job description, asking about someone's job habitual actions. Cardinal (fundamental) numbers ordinal numbers. Taking messages, passing messages on and filling in message forms Greeting and introductions office hospitality, Resumes or curriculum vita essential parts, letters of application reference to previous communication.
<b>2. I.T. Literacy</b> <b>Hours of Instruction: 20 Hrs.</b> <span style="float: right;"><b>Marks Allotted: 09</b></span>	
<b>Basics of Computer</b>	Introduction, Computer and its applications, Hardware and peripherals, Switching on-Starting and shutting down of computer.
<b>Computer Operating System</b>	Basics of Operating System, WINDOWS, The user interface of Windows OS, Create, Copy, Move and delete Files and Folders, Use of External memory like pen drive, CD, DVD etc, Use of Common applications.
<b>Word processing and Worksheet</b>	Basic operating of Word Processing, Creating, opening and closing Documents, use of shortcuts, Creating and Editing of Text, Formatting the Text, Insertion & creation of Tables. Printing document.

	Basics of Excel worksheet, understanding basic commands, creating simple worksheets, understanding sample worksheets, use of simple formulas and functions, Printing of simple excel sheets
<b>Computer Networking and INTERNET</b>	Basic of computer Networks (using real life examples), Definitions of Local Area Network (LAN), Wide Area Network (WAN), Internet, Concept of Internet (Network of Networks), Meaning of World Wide Web (WWW), Web Browser, Web Site, Web page and SeARCh Engines. Accessing the Internet using Web Browser, Downloading and Printing Web Pages, Opening an email account and use of email. Social media sites and its implication. Information Security and antivirus tools, Do's and Don'ts in Information Security, Awareness of IT – ACT, types of cyber crimes.
<b>3. Communication Skills</b>	
<b>Hour of Instruction: 15 Hrs.</b>	
<b>Marks Allotted: 07</b>	
<b>Topic</b>	<b>Contents</b>
<b>Introduction to Communication Skills</b>	Communication and its importance
	Principles of Effective communication
	Types of communication – verbal, nonverbal, written, email, talking on phone.
	Nonverbal communication – characteristics, components-Para-language
	Body – language
	Barriers to communication and dealing with barriers.
<b>Listening Skills</b>	Handling nervousness/ discomfort.
	Listening-hearing and listening, effective listening, barriers to effective listening guidelines for effective listening.
	Triple- A Listening – Attitude, Attention & Adjustment.
<b>Motivational Training</b>	Active Listening Skills.
	Characteristics Essential to Achieving Success
	The Power of Positive Attitude
	Self-awareness
	Importance of Commitment
	Ethics and Values
<b>Facing Interviews</b>	Ways to Motivate Oneself
	Personal Goal setting and Employability Planning.
	Manners, Etiquettes, Dress code for an interview
	Do's & Don'ts for an interview

<b>Behavioral Skills</b>	Problem Solving
	Confidence Building
	Attitude

## **SEMESTER-II**

### **LEARNING OBJECTIVES OF 2<sup>ND</sup> SEMESTER**

1. Knowledge of business activities, ability to interact with consumers for development of businesses.
2. Understand and apply productivity, its benefits and factors affecting the productivity.
3. Follow and maintain procedures to achieve a safe working environment in line with occupational health, safety, environment regulations and Labour welfare legislation and requirements.
4. Understand and apply quality concepts as per ISO and BIS system and its importance.
5. Recognize different components of 5S and apply the same in the working environment.

<b>4. Entrepreneurship skill</b>	
<b>Hour of Instruction: 15 Hrs.</b>	
<b>Marks Allotted: 06</b>	
<b>Topic</b>	<b>Content</b>
<b>Business &amp; Consumer:</b>	Types of business in different trades and the importance of skill, Understanding the consumer, market through consumer behavior, market survey, Methods of Marketing, publicity and advertisement
<b>Self Employment:</b>	Need and scope for self-employment, Qualities of a good Entrepreneur (values attitude, motive, etc.), SWOT and Risk Analysis
<b>Govt. Institutions :</b>	Role of various Schemes and Institutes for self-employment i.e. DIC, SIDBI, MSME, NSIC, Financial institutions and banks
<b>Initiation Formalities :</b>	Project Formation, Feasibility, Legal formalities i.e., Shop Act, Estimation & Costing, Investment Procedure - Loan Procurement - Agencies - banking Process
<b>5. Productivity</b>	
<b>Hour of Instruction: 10 Hrs.</b>	
<b>Marks Allotted: 05</b>	
<b>Productivity</b>	Definition, Necessity, Meaning of GDP.

<b>Benefits</b>	Personal / Workman – Incentive, Production linked Bonus, Improvement in living standard. Industry Nation.
<b>Affecting Factors</b>	Skills, Working Aids, Automation, Environment, Motivation How improves or slows down.
<b>Comparison with developed countries</b>	Comparative productivity in developed countries (viz. Germany, Japan and Australia) in selected industries e.g. Manufacturing, Steel, Mining, Construction etc. Living standards of those countries, wages.
<b>Personal Finance Management</b>	Banking processes, Handling ATM, KYC registration, safe cash handling, Personal risk and Insurance.

### 6. Occupational Safety, Health & Environment

**Hour of Instruction: 15 Hrs.**

**Marks Allotted: 06**

<b>Safety &amp; Health :</b>	Introduction to Occupational Safety and Health and its importance at workplace
<b>Occupational Hazards :</b>	Occupational health, Occupational hygiene, Occupational Diseases/ Disorders & its prevention
<b>Accident &amp; safety :</b>	Accident prevention techniques- control of accidents and safety measures
<b>First Aid :</b>	Care of injured & Sick at the workplaces, First-aid & Transportation of sick person
<b>Basic Provisions :</b>	Idea of basic provisions of safety, health, welfare under legislation of India

### 7.Labour Welfare Legislation

**Hour of Instruction: 05 Hrs.**

**Marks Allotted: 03**

<b>Labour Welfare Legislation</b>	Benefits guaranteed under various acts- Factories Act, Apprenticeship Act, Employees State Insurance Act (ESI), Payment Wages Act, Employees Provident Fund Act, The Workmen"s Compensation Act
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### 8.Quality Tools

<b>Hour of Instruction: 10 Hrs.</b>		<b>Marks Allotted: 05</b>	
<b>Quality Consciousness :</b>	Meaning of quality, Quality Characteristic		
<b>Quality Circles :</b>	Definition, Advantage of small group activity, objectives of Quality Circle, Roles and Functions of Quality Circles in organisation, Operation of Quality Circle, Approaches to Starting Quality Circles, Steps for Continuation Quality Circles		
<b>Quality Management System:</b>	Idea of ISO 9000 and BIS systems and its importance in maintaining qualities.		
<b>House Keeping :</b>	Purpose of Housekeeping, Practice of good Housekeeping.5S Principles of Housekeeping: SEIRI – Segregation, SEITON – Arrangement, SEISO – Cleaning, SEIKETSU – maintenance of Standards, SHITSUKE - Discipline		

## **12. INFRASTRUCTURE**

1. Instructors Qualification : Degree in Electrical / Electrical and Electronics Engineering from recognized Engineering College/ university with one year experience in the relevant field  
**OR**  
Diploma in Electrical / Electrical and Electronics Engineering from recognized board of technical education with two years experience in the relevant field  
**OR**  
10<sup>th</sup> class examination and NTC/NAC in the Trade of “Electrician” With 3 years’ post qualification experience in the relevant field.
2. Desirable qualification : Preference will be given to a candidate with CIC (Craft Instructor Certificate) in Electrician trade.
3. Space norms : 98 Sq. metres.
4. Power norms : 5.2 KW (for two units in one shift)
5. Tools, Equipment & Machinery : ( As per Annexure – I)

### **Note:**

- (i) Out of two Instructors required for the unit of 2(1+1), one must have Degree/Diploma in the field.
- (ii) Instructor qualification for WCS and E.D, as per the training manual.
- (iii) The list of Tools, Equipment & General Machinery listed in Annexure – I are for a particular trade (Electrician) comprising of four semesters and not for single semester.

## **13.ASSESSMENT STANDARD**

### **13.1 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 assessment. Due consideration to be given while assessing for team work, avoidance/reduction of scrap/wastage and disposal of scarp/wastage as per procedure, behavioral attitude, sensitive to environment and regularity in training. The sensitivity towards OSHE and self-learning attitude to be considered while assessing competency.

Assessment will be evidence based comprising the following:

- i) Job carried out in labs/workshop
- ii) Record book/ daily diary
- iii) Answer sheet of assessment
- iv) Viva-voce
- v) Progress chart
- vi) Attendance and punctuality
- vii) Assignment
- viii) Project work

Evidence of internal assessment to be preserved until forthcoming semester examination for audit and verification by examination body.

The following marking pattern to be adopted while assessing:

**a)** Weightage in the range of 60-75% to be allotted during assessment under following performance level:

For this grade, the candidate with occasional guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of an acceptable standard of craftsmanship.

In this work there is evidence of:

- good skill levels in the use of hand tools, machine tools and workshop equipment
- many tolerances while undertaking different work are in line with those demanded by the component/job.
- a fairly good level of neatness and consistency in the finish
- occasional support in completing the project/job.

**b)** Weightage in the range of above75%- 90% to be allotted during assessment under following performance level:

For this grade, the candidate, with little guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of a reasonable standard of craftsmanship.

In this work there is evidence of:

- good skill levels in the use of hand tools, machine tools and workshop equipment
- the majority of tolerances while undertaking different work are in line with those demanded by the component/job.
- a good level of neatness and consistency in the finish
- little support in completing the project/job

c) Weightage in the range of above 90% to be allotted during assessment under following performance level:

For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship.

In this work there is evidence of:

- high skill levels in the use of hand tools, machine tools and workshop equipment
- tolerances while undertaking different work being substantially in line with those demanded by the component/job.
- a high level of neatness and consistency in the finish.
- minimal or no support in completing the project



### 13.2 INTERNAL ASSESSMENTS (FORMATIVE ASSESSMENT)

ASSESSABLE OUTCOME NO.	ASSESSABLE OUTCOME	Internal Assessment Marks
<b>GENERIC</b>		
1.	Apply safe working practices.	
2.	Comply environment regulation and housekeeping.	
3.	Interpret & use company and technical communication.	
4.	Demonstrate knowledge of concept and principles of basic arithmetic, algebraic, trigonometric, and statistics and apply knowledge of specific area to perform practical operations.	
5.	Understand and explain basic science in the field of study including friction, simple machine and heat and temperature	
6.	Read and apply engineering drawing for different application in the field of work.	
7.	Understand and explain the concept in productivity, quality tools, and labour welfare legislation and apply such in day to day work to improve productivity & quality.	
8.	Explain energy conservation, global warming and pollution and contribute in day to day work by optimally using available resources.	
9.	Explain personnel finance, entrepreneurship and manage/organize related task in day to day work for personal & societal growth.	
10.	Understand and apply basic computer working, basic operating system and uses internet services to get accustomed & take benefit of IT developments in the industry.	
<b>SPECIFIC</b>		
11.	Make electrical wire joints & soldering.	
12.	Analyze, demonstrate and test basic electrical connection.	

13.	Prepare profile with an appropriate accuracy as per drawing.	
14.	Test, service, charge & installation of batteries.	
15.	Plan & prepare Earthing installation.	
	<b>Sub-Total of Internal assessment for Semester- I</b>	100
16.	Analyze, Assemble, check and repair electronic control circuit.	
17.	Assemble, install and test wiring system.	
18.	Install test and setup DC machines.	
19.	Install, test & commissioning of transformer.	
20.	Select and perform electrical/ electronic measurement.	
	<b>Sub-Total of Internal assessment for Semester- II</b>	100
21.	Install, test and set up AC motors.	
22.	Install, test and set up alternator and MG set.	
23.	Analyze, test and perform winding.	
24.	Plan and execute electrical illumination system.	
	<b>Sub-Total of Internal assessment for Semester- III</b>	100
25.	Assemble and wire switch cabinets for 3 phase AC motors.	
26.	Maintain, repair & test of domestic Appliances.	
27.	Analyze the power plant layout and power lines.	
	<b>Sub-Total of Internal assessment for Semester- IV</b>	100
	<b>Total of Internal assessment</b>	<b>400</b>

### 13.3 FINAL ASSESSMENT- ALL INDIA TRADE TEST (SUMMATIVE ASSESSMENT)

- a) There will be a single objective type Examination paper for the subjects Engineering drawing and Workshop Calculation & Science.
- b) There will be a single objective type Examination paper for the subjects Trade Theory and Employability Skills.
- c) The two objective type Examination papers as mentioned above will be conducted by National Council for Vocational Training (NCVT), whereas examination for the subject Trade Practical will be conducted by the State Government. NCVT shall supply the Question Paper for the subject Trade Practical.

<b>Marking Pattern</b>		
<b>Sl. No.</b>	<b>Subject for the trade test</b>	<b>Maximum marks for the each subject</b>
<b>a)</b>	Practical	<b>300</b>
<b>b)</b>	Trade Theory	<b>200</b> Objective type Written test of 200 marks (Trade Theory 150 marks & Employability Skills 50 marks)
<b>c)</b>	Employability Skills	
<b>d)</b>	Work shop Calculation and Science.	<b>100</b> Objective Type Written test of 100 marks (Engineering Drawing 50 marks & Work shop Calculation and Science 50 marks)
<b>e)</b>	Engineering Drawing	
<b>f)</b>	Internal assessment	<b>100</b>
<b>TOTAL:</b>		<b>700</b>

## 14. LIST OF TRADE COMMITTEE MEMBERS

Sl. No.	Name	Organization	Mentor Council Designation
<b>Members of Sector Mentor council</b>			
1.	Dr. S.P. Gupta	Professor, IIT Roorkee,	Chairman
2.	Dr.P. Mahanto	Professor, IIT, Guwahati	Member
3.	K.K. Seth	Ex. Director, BHEL, Noida	Member
4.	N. Chattopadhyay	Sr. DGM, BHEL, Kolkatta	Member
5.	A K Gohshal	Professor, IIT, Guwahati	Member
6.	Dr. Bharat Singh Rajpurohit	Asst. Professor, IIT, Himachal Pradesh	Member
7.	Sunand Sharma	Chairman ALSTOM Projects India Ltd.	Member
8.	Dinesh Singhal	Rithani, Delhi road, Meerut	Member
9.	J S SRao	Principal Director, NTPC, Faridabad	Member
10.	Bhim Singh	Professor, IIT Delhi	Member
<b>Mentor</b>			
11.	Amrit Pal Singh	Dy. Director, DGET, New Delhi	Mentor
<b>Member of Core Group</b>			
12.	R. Senthil Kumar	Director, ATI, Chennai	Member
13.	R.N. Bandopadhyay	Director, CSTARI, Kolkata	Member
14.	S. Mathivanan	Dy. Director, ATI, Chennai,	Team Leader
15.	L K Mukherjee	Dy. Director, CSTARI, Kolkata	Member
16.	B.N. Sridhar	Dy Director, FTI, Bangalore	Member
17.	Ketan Patel	Dy Director, RDAT, Mumbai	Member
18.	B. Ravi	Dy Director, CTI, Chennai	Member
19.	A.S. Parihar	Dy Director, RDAT, Kolkata	Member
20.	NirmalyaNath	Asst Director, CSTARI, Kolkata	Member
21.	Parveen Kumar	Asst Director, ATI-EPI, Hyderabad	Member
22.	C.C. Jose	Trg Officer, ATI, Chennai	Member
23.	L.M. Pharikal	Trg Officer, ATI, Kolkata	Member
24.	C.M. Diggewadi	Trg Officer, RDAT, Mumbai	Member
25.	Mohan Raj	Trg Officer, NIMI Chennai	Member
26.	M. Asokan	Trg Officer, CTI, Chennai	Member
27.	U.K. Mishra	Trg Officer, ATI, Mumbai	Member
28.	Prasad U.M.	Voc Instructor, MITI, Calicut	Member
29.	D. Viswanathan	ATO. Govt ITI, North Chennai	Member
30.	B. Navaneedhan	ATO, ITI. North Chennai	Member
31.	R. Rajasekar	ATO, ITI, Ambattur, Chennai	Member
32.	K. Amaresan	ATO, Govt ITI, Guindy, Chennai	Member
<b>Other industry representatives</b>			
33.	SurenduAdhikari	OTIS Elevator Co. India Ltd, Kolkata	Member
34.	K. Raju	Consultant- Energy Area, ASCI, Hyderabad	Member

35.	Ravi G Deshmukh	Certified Energy Auditor, PPS Energy solutions,	Member
36.	R. Thiruppathi	JTS, IIT, Madras, Chennai	Member
37.	M.N. Krishnamurthy	Retd. Ex Engineer, TNEB, Chennai	Member
38.	S. Kirubanandam	Asst. Ex Engineer, TANTRANSCO, Chennai	Member
39.	R. Kasi,	Asst. Ex Engineer, TANTRANSCO, Chennai	Member
40.	L.R. Sundarajan	Jr. Works Manager, Heavy vehicles factory	Member
41.	B.S. Sudheendara	Consultant, VI micro systems pvt ltd, Chennai.	Member
42.	S. Ganesh	Manager, L&T , Chennai	Member
43.	G. Neethimani	Vice principal, Rane engine valves ltd, Chennai.	Member

**TRADE: ELECTRICIAN****LIST OF TOOLS & EQUIPMENTS FOR 16 TRAINEES + 1****A. TRAINEES TOOL KIT FOR 16 TRAINEES +1 INSTRUCTOR**

<b>TOOL KIT</b>			
<b>Sl. No.</b>	<b>Name of the items</b>	<b>Quantity</b>	<b>Remarks</b>
1	Steel Tape, 15 m length	17 Nos.	Sr. No. 1 to 18 tool kits to be Common for 1 to 4 semesters.
2	Plier Insulated, 150 mm	17 Nos.	
3	Plier Side Cutting, 150 mm	17 Nos.	
4	Screw Driver, 100 mm	17 Nos.	
5	Screw Driver, 150 mm	17 Nos.	
6	Electrician Connector, screw driver insulated handle thin stem, 100 mm	17 Nos.	
7	Heavy Duty Screw Driver , 200 mm	17 Nos.	
8	Electrician Screw Driver thin stem insulated handle, 250 mm	17 Nos.	
9	Punch Centre , 150 mm X 9 mm	17 Nos.	
10	Knife Double Bladed Electrician	17 Nos.	
11	Neon Tester	17 Nos.	
12	Steel Rule 300 mm	17 Nos.	
13	Hammer, cross peen with handle	17 Nos.	
14	Hammer, ball peen With handle	17 Nos.	
15	Gimlet 6 mm.	17 Nos.	
16	Bradawl	17 Nos.	
17	Scriber (Knurled centre position )	17 Nos.	
18	Pincer 150 mm	17 Nos.	
<b>NOTE: For 2nd Unit of the Trade, only Trainees Tool Kit (from Sl No- 1 to 18) is required additionally.</b>			

**B. SHOP TOOLS, INSTRUMENTS and MACHINERY**

1	C- Clamp 200 mm, 150 mm and 100 mm	2 Nos each	Common for 1 to 4 semesters.
2	Spanner Adjustable 150 mm,300mm	2 Nos each	
3	Blow lamp 0.5 ltr	1	
4	Melting Pot	1	
5	Ladel	1No	
6	Chisel Cold firmer 25 mm X 200 mm	2	Common for 1 to 4 semesters.
7	Chisel 25 mm and 6 mm	2 Nos each	
8	Hand Drill Machine	1	
9	Portable Electric Drill Machine 6 mm capacity	1	

10	Pillar Electric Drill Machine 12 mm capacity	1	
11	Allen Key	1 set	
12	Oil Can 0.12 ltr	1	
13	Grease Gun	1 No	
14	Out Side Micrometer	2	Common for 1 to 3 semesters.
15	Motorised Bench Grinder	1	Common for 1 to 4 semesters.
16	Rawl plug tool and bit	2 set	
17	Pully Puller	2	
18	Bearing Puller	2	
19	Pipe vice	4	
20	Thermometer 0 to 100 deg Centigrade	1 No.	
21	Scissors blade 150 mm	4 Nos.	Common for 1 & 3 semesters
22	Crimping Tool	2 sets	Common for 1 to 4 semesters.
23	Wire stripper 20 cm	2 Nos.	
24	Chisel Cold flat 12 mm	2 Nos.	
25	Mallet hard wood 0.50 kg	4 Nos.	
26	Hammer Extractor type 0.40 kg	4 Nos.	
27	Hacksaw frame 200 mm 300 mm adjustable	2 Nos.each	
28	Try Square 150 mm blade	4 Nos.	Common for 1 to 3 semesters
29	Outside and Inside Divider Calliper	2 Nos.each	
30	Pliers flat nose 150 mm	4 Nos.	Common for 1 to 4 semesters.
31	Pliers round nose 100 mm	4 Nos.	
32	Tweezers 100 mm	4 Nos.	
33	Snip Straight and Bent 150 mm	2 Nos.each	Common for 1, & 3 semesters.
34	D.E. metric Spanner	2 Nos.	Common for 1 to 4 semesters.
35	Drill hand brace	4 Nos.	
36	Drill S.S. Twist block 2 mm, 5 mm 6 mm set of 3	4 Set	
37	Plane, smoothing cutters 50 mm	2 Nos.each	
38	Gauge, wire imperial	2 Nos.	
39	File flat 200 mm 2nd cut	8 Nos.	
40	File half round 200 mm 2nd cut	4 Nos.	
41	File round 200 mm 2nd cut	4 Nos.	
42	File flat 150 mm rough	4 Nos.	
43	File flat 250 mm bastard	4 Nos.	
44	File flat 250 mm smooth	4 Nos.	
45	File Rasp, half round 200 mm bastard	4 Nos.	
46	Soldering Iron 25 watt, 65 watt, 125 watt	2 Nos.each	
47	Copper bit soldering iron 0.25 kg.	2 Nos.	

48	Desoldering Gun	4 Nos.	Common for 1 to 4 semesters.
49	Hand Vice 50 mm jaw	4 Nos.	
50	Table Vice 100 mm jaw	8 Nos.	
51	Pipe Cutter to cut pipes upto 5 cm. dia	4 Nos.	Common for 1, to 3 semesters.
52	Pipe Cutter to cut pipes above 5 cm dia	2 Nos.	
53	Stock and Die set for 20 mm to 50 mm G.I. pipe	1 set	
54	Stock and Dies conduit	1 No.	
55	Ohm Meter; Series Type & Shunt Type	2 Nos. each	Common for 1 to 4 semesters.
56	Multi Meter (analog) 0 to 1000 M Ohms, 2.5 to 500 V	2 Nos.	
57	Digital Multi Meter	6 Nos.	
58	A.C. Voltmeter M.I. 0 -500V A.C	1 No.	
59	Milli Voltmeter centre zero 100 - 0 - 100 m volt	1 No.	
60	D.C. Milli ammeter 0 -500m A	1 No.	
61	Ammeter MC 0-5 A, 0- 25 A	1 No. each	
62	A.C. Ammeter M.I. 0-5A, 0-25 A	1 No. each	
63	Kilo Wattmeter 0-1-3 kw	1 No.	
64	A.C. Energy Meter, Single phase 5 amp. Three Phase 15 amp	1 No. each	
65	Power Factor Meter	1 No.	
66	Frequency Meter	1 No.	
67	Flux meter	1 No.	
68	Wheat Stone Bridge with galvanometer and battery	1 No.	
69	Laboratory Type Induction Coil	1 No.	
70	DC Power Supply 0-30V, 2 amp	1 No.	Common for 1, to 3 semesters.
71	Rheostat 0 -1 Ohm, 5 Amp 0 -10 Ohm, 5 Amp 0- 25 Ohm, 1 Amp 0- 300 Ohm, 1 Amp	1 No. each	
72	1 Phase Variable Auto Transformer	1 No.	Common for 1 to 4 semesters.
73	Battery Charger	1 No.	
74	Hydrometer	1 No.	
75	Miniature Breaker 16 amp ( Raw Material)	1 No.	Common for 1 to 4 semesters.
76	Working Bench 2.5 m x 1.20 m x 0.75 m	4 Nos.	
77	Fire Extinguisher CO2, 2 KG	2 Nos.	
78	Fire Buckets	2 Nos.	
79	Tachometer	1 No.	Common for 2 to 4 semesters
80	Current Transformer 415 Volt, 50 Hz, CT Ratio 150 / 5 Amp, 5VA	1 No.	
81	Potential Transformer 415 Volt, 50Hz, PT Ratio 11KV/ 110V, 10VA	1 No.	
82	Growler	1 No.	Common for 2 to 4
83	Tong Tester / Clamp Meter 0 - 100 amp. AC	1 No.	



84	Megger 500 volts	1 No.	semesters
85	Contactorauxiliary contacts 3 phase, 440volt, 16amp (Raw Material)	1 No. each	
86	Contactorauxiliary contacts 3 phase, 440 volt, 32 amp. (Raw Material)	1 No. each	
87	Limit Switch (Raw Material)	1 No.	
88	Rotary Switch 16 A (Raw Material)	1 No.	
89	Load Bank 5 KW( Lamp / heater Type)	1 No.	
90	Brake Test arrangement with two spring balance 0 to 25 kg rating	1 No.	Common for 2 & 3 semesters
91	Knife Switch DPDT fitted with fuse terminals 16 amp (Raw Material)	4 Nos.	Common for 2 to 4 semesters
92	Knife Switch TPDT fitted with fuse terminals 16 amp(Raw Material)	4 Nos.	
93	Voltage StabiliserInput: 150 – 230 volt ACOutput: 220 volt AC	1 No.	
94	3- point D.C. Starter	1 No.	
95	4- point D.C. Starter	1 No.	
96	Electrical Machine Trainer – Suitable for demonstrating the construction and functioning of different types of DC machines and AC machines (single phase and three phase). Should be fitted with friction brake arrangement, dynamo meter, instrument panel and power supply unit	1 for 8 (4+4) Units	Common for 2 to 4 semesters
97	Motor-Generator (AC to DC) consisting of : Squirrel Cage Induction Motor with star delta starter and directly coupled to DC shunt generator and switch board mounted with regulator, air breaker, ammeter, voltmeter, knife blade switches and fuses, set complete with case iron and plate, fixing bolts, foundation bolts and flexible coupling. Induction Motor rating: 7 HP, 400V, 50 cycles, 3 phase DC Shunt Generator rating: 5 KW, 440V	1 No.	
98	Used DC Generators-series, shunt and compound type for overhauling practice	1 No. each	
99	D.C. Shunt Generator with control panel,2.5 KW, 220V	1 No.	
100	D.C. Compound Generator with control panel including fitted rheostat, voltmeter, ammeter and breaker, 2.5 KW, 220 V	1 No.	
101	Diesel Generator Set with change over switch, over current breaker and water-cooled with armature, star-delta connections AC 3 phase, 5 KVA, 240 volt	1 No.	Common for 2 to 4 semesters
102	DC Series Motor coupled with mechanical load 0.5 to 2 KW, 220 Volts	1 No.	Common for 2 & 4 semesters
103	DC Shunt Motor 2 to 2.5 KW, 220 volts	1 No.	
104	DC compound Motor with starter and switch 2 to 2.5 KW ,220 volts	1 No.	
105	Single phase Transformer, core type, air cooled 1 KVA , 240/415 V, 50 Hz	1 No.	
106	Three phase transformer, shell type oil cooled with all	1 No.	

	mounting 3 KVA , 415/240 V, 50 Hz , (Delta/Star)		
107	Oscilloscope Dual Trace, 30 MHZ	1 No.	
108	Function Generator	1 No.	
109	Discrete Component Trainer	1 No.	
110	Linear I.C. Trainer	1 No.	
111	Digital I.C. Trainer	1 No.	
112	Oil Testing Kit	1 No.	Common for 2 & 4 semesters
113	Hygrometer	1 set	
114	a. Cut out Relays b. Reverse current c. Over current d. Under voltage	1 No. each	Common for 3 & 4 semesters
115	Starters for 2 to 5 H.P. A.C Motors a. Resistance type starter b. Direct on line Starter c. Star Delta Starter- manual, semi-automatic and automatic d. Auto Transformer type	1 No. each	
116	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 : 5 HP, 440V AC Generator rating : 3-Phase, 4 wire, 3.5 KVA, 400/230 Volts, 0.8 pf, 50cycles	1 No.	
117	AC Squirrel Cage Motor with star delta starter and triple pole iron clad switch fuse. 2 to 3 HP, 3-phase ,400 volts, 50 cycles	1 No.	
118	AC phase-wound slip ring Motor with starter and switch 5 HP, 400 volts, 3-phase, 50 cycles	1 No.	
119	A.C. Series type Motor with mechanical load ¼ HP, 230V, 50 Hz	1 No.	
120	Single Phase Capacitor Motor with starter switch 1 HP 230 volt 50 cycles	1 No.	
121	Universal Motor with starter/switch 230 volt, 50 cycles ¼ HP	1 No.	
122	Stepper Motor with Digital Controller	1 No.	
123	Shaded Pole Motor	1 No.	
124	Bath Impregnating	1 No.	
125	Oven Stove	1 No.	
126	Synchronous motor 3 Phase, 3 HP, 415V, 50Hz, 4 Pole, with accessories.	1 no.	
127	Lux meter	1 no.	
128	Inverter- 1 KVA with 12 V Battery Input- 12 volt DC, Output- 220 volt AC	1 No.	
129	Domestic Appliances -		

	a. Electric Hot Plate 1500 watt b. Electric Kettle, 1500 watts c. Electric Iron 1500 watts d. Immersion Heater 1500 watt e. A.C. Fan f. Geyser (Storage type) 15 ltr minimum g. Mixture & Grinder	1 No. 1 No. 1 No. 1 No. 1 No. 1 No. 1 No.	
130	Thyristor /IGBT controlled D.C. motor drive with tachogenerator feedback arrangement 1 HP	1 No.	
131	Thyristor/IGBT controlled A.C. motor drive with VVVF control 3 Phase, 2 HP	1 No.	
132	Pentium IV Computer or latest (Server- Linux), 2.8 GHz & above, 1 GB RAM, 80 GB HDD, DVD Combo Drive, 15/17" Monitor, optical scroll mouse, multimedia key board, 32 bit LAN card with UPP port, necessary Drivers, etc.	2 Nos.	
133	Ink jet/ laser printer	1 No.	
134	Washing Machine	1 No.	
135	Motor Pump set 1 HP, 1 Phase, 240 V	1 No.	
136	Pin Type, shackle type & suspension type insulators (Raw Material)	2 Nos. each	
137	Pentium IV Computer or latest (Server- Linux), 2.8 GHz & above, 1 GB RAM, 80 GB HDD, DVD Combo Drive, 15/17" Monitor, optical scroll mouse, multimedia key board, 32 bit LAN card with UPP port, necessary Drivers, etc.	2 Nos.	
138	Ink jet/ laser printer	1 No.	
139	Washing Machine	1 No.	
140	Motor Pump set 1 HP, 1 Phase, 240 V	1 No.	
141	Pin Type, shackle type & suspension type insulators (Raw Material)	2 Nos. each	
<p><b>Note: The items which are available in the market nearest of the specification as mentioned above may be procured.</b>  <b>Sl no. 96 , Electrical Machine trainer up to 8 (4+4) units- one no.</b>  <b>Sl no. 97 to 141 for 4(2+2) units no additional items are required.</b></p>			

#### FURNITURE :

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

**GUIDELINES FOR INSTRUCTORS AND PAPER SETTERS**

1. All the questions of theory paper for the trade will be in objective type format.
2. Due care to be taken for proper & inclusive delivery among the batch. The following some method of delivery may be adopted:
  - A) LECTURE
  - B) LESSON
  - C) DEMONSTRATION
  - D) PRACTICE
  - E) GROUP DISCUSSION
  - F) DISCUSSION WITH PEER GROUP
  - G) PROJECT WORK
  - H) INDUSTRIAL VISIT
3. Maximum utilization of latest form of training viz., audio visual aids, integration of IT, etc. may be adopted.
4. The total hours to be devoted against each topic may be decided with due diligence to safety & with prioritizing transfer of required skills.
5. Questions may be set based on following instructions:-

Sl. No.	Question on different aspect	Weightage in %age	Key Words may be like
1	Information received	25	What, Who, When
2	Knowledge	50	Define, Identify, Recall, State, Write, List & Name
3	Understanding	15	Describe, Distinguish, Explain, Interpret & Summarize
4	Application	10	Apply, Compare, Demonstrate, Examine, Solve & Use

6. Due weightage to be given to all the topics under the syllabus while setting the question paper.