NATIONAL VOCATIONAL

TRAINING INSTITUTE

TESTING DIVISION

REGULATIONS AND SYLLABUS

FOR

GENERAL ELECTRICAL

CERTIFICATE ONE

SYLLABUS FOR GENERAL ELECTRICAL GRADE CERTIFICATE ONE

A. INTRODUCTION

i. The review of this syllabus has been generally influenced by the demands of industries due to its continuous change as a result of technological advancement and the changing needs of society.

It was also influenced by the TVET reforms under the directions of the new educational reforms with the view to opening up further education and training opportunities to TVET graduates. The certificate ONE syllabus is designed to respond to the following level descriptors:

QUALIFICATION	KNOWLEDGE LEVEL	SKILLS AND ATTITUDE:
Certificate 1	1. To demonstrate a broad knowledge base incorporating some technical concepts. 2. To demonstrate knowledge of the theoretical basis of practical skills. 3. To demonstrate knowledge in numeracy, literally, IT and Entrepreneurial skills	1. Require a wide range of technical skills 2. Are applied in a variety of familiar and complex contexts with minimum supervision. 3. Require collaboration with others in a team

ii. The rational of this syllabus is to establish the level of knowledge and skills required by mechanics over a wide range of applications, including the development of an ability to diagnose faults, recommend by means of rectifying these faults and to test and analyze the performance of the vehicle after repairs or modification has been completed.

B. OBJECTIVES

The objectives of this course are to give the apprentices a systematic training both theoretically and practically. It is expected that much emphasis will be laid on the practical aspect of the training during in-school and on-the-job training. About 60% could be allocated to practical training centres and other institutions approved by the National Vocational Training Institute.

This training syllabus is prepared to serve as a guide for employers, instructors and other parties concerned with training in the preparation of their individual programmes. It is necessary that training become effectively planned and controlled as effectively as possible so that apprentices derive much benefit from their training.

C. THE COURSE COMPONENTS

Trade Theory
Science and Calculation
Trade Drawing
General Paper
Trade Practical

EXAMINATION: The candidates would be examined in the FIVE components listed in 'C' above.

Practical work must be carefully planned to illustrate application of the theory and to provide maximum opportunity for shop practice, laboratory work and demonstration.

D. KNOWLEDGE AND SKILLS REQUIREMENT

The prime objective of the programme is to provide knowledge and skills of the trade in a manner that will best meet the needs of the trade as well as industries using professional equipments

E. ENTRY TO THE COURSE

Minimum education : Must have passed JHS or SHS examination. However, the selection of the students for the course is within the discretion of the head of the institution.

F. ELIGIBILITY FOR ENTRY TO EXAMINATION

Candidates may enter for examination only as internal candidate; that is those who at the time of entry to the examination are undertaking (or) have already completed the course at an approved establishment.

G. EXTERNAL EXAMINERS

The practical work of candidates will be assessed by an external examiner appointed by the Trade Testing Commissioner.

H. EXAMINATION RESULTS AND CERTIFICATES

Each candidate will receive record of performance given the grade of performance for the components Taken. These are:

i) Distinction
ii) Credit
iii) Pass
iv) Referred/Failure

.

Certificates would be issued to candidates who pass in all the components.

I NOTE:

All Technical and Vocational trainees who aspire to take advantage of the opportunities opened to them in the educational reforms should NOTE that, for a trainee to progress to certificate Two (2) a pass in Certificate One (1) compulsory.

J. APPROVAL OF COURSE

Institutions or other establishments intending to prepare trainees for the Examination must apply to
THE COMMISSIONER
TESTING DIVISION
NVTI, HEAD OFFICE
P.O. BOX MB 21, ACCRA

K ACKNOWLEDGEMENT

NVTI wishes to acknowledge the preparatory material done by the team of Experts, which have been incorporated into this syllabus.

Government's desire to improve the lot of Technical/Vocational Training, which led to the preparation of this syllabus, is hereby acknowledged.

Recommended Test Books

1. AC/DC Principles (By Paul T. Shultz) Publishers

2. Electrical Wiring Residential (By: Ray C. Mullen) Publishers
3. Electrical Motors and Control System (By: Petruzella Publishers)
4. Electrical Installation and Practice
5. Electrical Principles and Technology (By:)
6. The Moltivate (By
7. Electricity (By: Herman Publishers)
8. Electrical Wiring Industrial (By: Smith Publishers)
9. Electrical Installation Work and Practice (By:…

10. IEE Regulations 16th Edition

RECOMMENDED TOOLS AND EQUIPMENT

1. Digital/Analogue A.V.O. Meter
2. Voltmeter
3. Ammeter
4. Wattmeter
5. Megger Tester
6. Oscilloscope
7. 3-phase Induction Motor
8. Single phase motor
9. Clamp-on-ammeter
10. Buchanan crimping tool
11. Set of screw drivers (star/flat)
12. Combination pliers
13. Side cutters
14. Long nose pliers
15. Spirit level
16. Drilling machine
17. Claw hammer
18. Hacksaw
19. Wire stripper
20. Adjustable wrench
21. 1/2" E.M.T. Bender
22. 1/16" x ¼
23. Electrician folding knife
24. Jimlet
25. Allen wrench set
26. Speed bore drill set
27. Steel tape measure
28. Tool box
29. Chisel
30. Punch
31. Conduit bending machine
32. Cordless drilling machine
33. Bench vice

TRADE TECHNOLOGY/REGULATION

TASK	CRITICAL POINTS	SUB - POINTS	INSTRUCTIONAL TECHNIQUES
1.0 HEALTH AND SAFETY	1.1 Applying relevant IEE Regulations 16th Edition concerning safety of live and property	1.2.1 Cause of accident at work place. 1.2.2 Methods of preventing accident including electric shock, artificial respiration.	1.3.1 Demonstrate artificial respiration
2.0 ELECTRICAL/ ELECTRONICS SYMBOLS	2.1 Identify Electrical/ Electronic Symbols	2.2 Resistors, capacitors, inductors, transformers, diodes, thyristors, triacs, etc	Assist trainees to identify electrical/electronic symbols
3.0 CABLE JOINTING AND TERMINATION	3.1 Preparing joints 3.1.1 Preparing termination of accessories. 3.1.2 Preparing joints using soldering iron. 3.1.3 Identify tools and materials	3.2 A carried joints and Tee joints. 3.2.1 Cable loops. 3.2.2 Cable lugs terminating. 3.2.3 Use pot and ladle, use pliers.	Discuss tools and equipment used in joint up and termination Show samples of insulating materials
4.0 TERMINATION AND JOINTING OF ARMONRED CABLE	4.1 Types of armonring cables. 4.1.2 Explain the necessity for armouring a cable and state the application. 4.1.3 Describe with aid of diagrams the constructional features of armoring cables. 4.1.4 Join and Terminate armored cable	4.2 Show different armoured materials 4.2.2 Apply appropriate insulation materials. 4.2.3 Draw and label the constructional parts of armouring cable. 4.2.4 Demonstrate how to join two lengths of armored cable	Discuss the reasons for armouring cables and apply appropriate insulation materials. Demonstrate how to terminate armoured cable e.g. on a Baslour Brainstorm the procedure for safety Assist trainees draw and label armoured cables

TASK	CRITICAL POINTS	SUB - POINTS	INSTRUCTIONAL TECHNIQUES
5.0 CONDUCTORS/ INSULATORS	**5.1** Identify different types of conductor 5.1.2 Identify insulator and their mechanical protection. 5.1.3 State the advantages and disadvantages of different conducting materials.	5.2.1 Copper 5.2.2 Aluminum 5.2.3 Zinc 5.2.4 PVC 5.2.5 Vulcanized Rubber Insulation (VRI)	5.3.1. Show with a prepared sketch of types of insulations. Identification with real objects.
6.0 Cables	6.1 Identify different types of cables. 6.1.2 Identify sizes of cables. 6.1.3 State the current rating of cables. 6.1.4 Describe insulated and sheathed cables and the use of the cord grids. 6.1.5 Colour identification of cables.	6.2.1 PVC, PILSWA, MICC, etc. 6.2.2 Using the IEE Regulations table calculate cable size. 6.2.3 List standard sizes of cables (eg 2.5mm, 4mm, 6mm^2, 10mm, 25mm^2). 6.2.4 Flexible cable, multi-cord. 6.2.5 L1 – Red phase, L2 – Blue phase, L3 - Yellow phase, N-Neutral Black 6.2.6 Single phase L-Red/Brown N-Blue/Black E-Yellow/Green	

TASK	CRITICAL POINTS	SUB - POINTS	INSTRUCTIONAL TECHNIQUES
7.0 Generation of Electricity supply	7.1 Explain briefly the generation of Electricity Supply. 7.1.2 State voltage values.	7.2.1 Describe the generation of AC voltage. 7.2.2 State the advantages of AC over DC	
8.0 Voltage Classification	8.1.1 Identify extra-low voltage. 8.1.2 Identify low voltage. 8.1.3 Identify medium voltage. 8.1.4 Identify High voltage 8.1.5 Identify extra high voltage.	8.2.1 State the values of extra low voltage, low voltage, medium voltage, high voltage and extra high voltage	
9.0 Transmission and distribution of Electrical Energy	9.1.1 Explain briefly the Transmission and Distribution of Electrical Energy. 9.1.2 State voltage values	9.2.1 Identify tools and equipment used in stinging overhead transmission and distribution cables. 9.2.2 Transport transmission materials and erect them at site. 9.2.3 Describe the functions of the stay wire. 9.2.4 Describe the procedure for spanning cable between poles.	

TASK	CRITICAL POINTS	SUB - POINTS	INSTRUCTIONAL TECHNIQUES
		9.2.5 Describe the uses of different types of cross arms used in high tension transmission.	
10.0 Circuit protective devices.	10.1.1 Identify common types of protective devices. 10.1.2 Explain the principles and application of circuit breakers and fuses in electrical installation. 10.1.3 State the regulations related to various types of protective devices.	10.2.1 Explain the principle of operation of the current and voltage – operated earth – leakage circuit breaker observing relevant regulations. 10.2.2 Select protective devices (circuit breaker, fuses) for single/Poly phase loads.	

TASK	CRITICAL POINTS	SUB - POINTS	INSTRUCTIONAL TECHNIQUES
11.0 Testing and Inspection	11.1.1 State statutory safety regulations for life, properties and the environment. 11.1.2 Inspect to ensure sound electrical and mechanical connections of an installation. 11.1.3 Explain polarity, earthing, insulation, Resistance tests continuity Test of an installation.	11.2.1 Explain the use of the Nagger (ohm meter) for testing an installation. 11.2.2 Show by sketch the internal parts of the Nagger (ohm meter).	
12.0 CONDUIT INSTALLATION	12.1.1 Describe the conduit system. 12.1.2 Identify different types of conduit (eg metallic and non-metallic, Steel/Plastic. 12.1.3 State the advantages and disadvantages of conduit in electrical installation. 12.1.4 Identify select and maintain tools and equipment used for conduit systems.		

TASK	CRITICAL POINTS	SUB - POINTS	INSTRUCTIONAL TECHNIQUES
	12.1.5 State earthing in terms of bonding of metal parts.	12.2.1 Explain how to bend, set, shape, file and fabricate accessories used in connection with conduit. 12.2.2 Explain how to join lengths of conduit using adhesive elbows, tees and counter. 12.2.3 Calculate conduit sizes and apply space factor. 12.2.4 List and explain the use of stock, tap and dies, hacksaw, etc. 12.2.5 Describe how the cables are drawn unto a conduit using fish tape or draw wire.	
13.0 EFFECT OF ELECTRIC CURRENT	13.1.1 Describe the heating effect of electric current. 13.1.2 Describe the Magnetic effect of electric current. 13.1.3 Describe the chemical effect of electric current.	13.2.1 Describe types of thermostats and their effects. 13.2.2 Give application of each thermostat in 13.2.2. 13.2.3 Explain electromagnetism. 13.2.4 Explain the use of the electrolyte	

TASK	CRITICAL POINTS	SUB - POINTS	INSTRUCTIONAL TECHNIQUES
14.0 LIGHTING	14.1.1 State the principle and construction of the fluorescent lamps. 14.1.2 State the principle and construction of the incandescent (Filament) lamps.	14.2.1 Explain the stroboscopic effect and how to minimize it. 14.2.2 Describe by using sketches the incandescent lamp and the Fluorescent lamp. 14.2.3 Explain cosine and inderse square laws, Brightness and photometer. 14.2.4 Apply lumen formula $L = \frac{E \times A}{Q \times CU \times MF}$	
15.0 AC AND DC MACHINES	15.1.1 Identify types of DC Motors and Generators. 15.1.2 Explain the principles of operation of a DC Machine. 15.1.3 Describe the construction features of DC Machine . 15.1.4 Identify types of AC Motors (single and three phase) 15.1.5 Describe the constructional features of AC Machines.	15.2.1 State the application of DC Machines. 15.2.2 State the application of each of the motors in 15.2.2. 15.2.3 Explain the use of multi-meter for testing open and short circuits on motor windings.	

TASK	CRITICAL SKILLS	SUB - SKILLS	INSTRUCTIONAL TECHNIQUES
16.0 PHASE DISTRIBUTION	16.1.1 State the purpose of the following: - TPN - FUSE BOARD - ISOLATOR - DOL STARTER	16.2.1 With the aid of a BLOCK LETTERS show the sequence of 3 phase supply system (Balance load). 16.2.2 Connect 3 phase supply from the TPN fuse board, Isolator and to a DOL Starter.	

PRINCIPLES

TASK	CRITICAL SKILLS	SUB - SKILLS	INSTRUCTIONAL TECHNIQUES
1.0 STRUCTURE OF MATTER	1.1 Define the following terms	1.2.1 Matter 1.2.2 Molecule 1.2.3 Atom 1.2.4 Electrons	
2.0 METHOD OF GENERAL ELECTRICITY	2.1 Description of basic methods of generating electricity.	2.2.1 Hydro 2.2.2 Thermal 2.2.3 Solar	
3.0 EFFECT OF ELECTRIC CURRENT	3.1 Description of the effect of electric current	3.2.1 Heating 3.2.2 Chemical 3.2.3 Magnetic	
4.0 OHM'S LAW	4.1.1 State Ohm's Law 4.1.2 Application of Ohm's law.	4.2.1 Mathematical derivation 4.2.2 V/R = I, V = IR 4.2.3 Determine current in series and parallel cut. 4.2.4 Determine Power Consumed by circuit.	
5.0 MAGNETISM	5.1.1 Description of Magnetism 5.1.2 Magnetic lints of force. 5.1.3 The law of magnetism 5.1.4 Magnetic materials 5.1.5 Magnetic circuit terms 5.1.6 Electromagnet	5.1.1.1 Definition 5.1.1.2 Types 5.1.1.3 Application 5.1.2.1 Uses 5.1.2.2 State laws 5.1.3.1 State the laws 5.1.4.1 Ferrous and Non Ferrous 5.1.5.1 Define terms 5.1.5.2 State unit of magnetism 5.1.6.1 Define 5.1.6.2 Uses 5.1.6.3 Force on conductor in a magnetic field.	

TASK	CRITICAL SKILLS	SUB - SKILLS	INSTRUCTIONAL TECHNIQUES
6.0 PRIMARY AND SECONDARY CELLS	6.1.1 Description of Primary and Secondary Cells.	6.1.1.1 Define Primary Cells. 6.1.1.2 Define Secondary Cells. 6.1.1.3 Differentiate between Primary and Secondary Cells construction	
	6.1.2 Calculation involving cells connected in series and parallel.	6.1.2.1 Calculate cells in series 6.1.2.2 Calculate cells in parallel 6.1.2.3 Calculate internal resistance of cells	
	6.1.3 Description of method of charging Batteries	6.1.3.1 Show by sketch how batteries are charged.	
7.0 CAPACITORS	7.1 Application of capacitors.	7.1.1 Definition. 7.1.2 Describe construction 7.1.3 Types and uses.	
	7.2 Calculation of capacitance valve	7.2.1 Identify series and parallel circuits. 7.2.2 Calculate equivalent value of each connection. 7.2.3 Show that CT = $\frac{C_1 + C_2}{C_1 + C_2}$ for series connection and CT = $C_1 + C_2$ for parallel connection.	

TASK	CRITICAL SKILLS	SUB - SKILLS	INSTRUCTIONAL TECHNIQUES
8.0 DETERMINATION OF ROOT MEAN SQUARE AND AVERAGE VALUES OF ALTERNATING CURRENT.	8.1 Describe generation of alternating current. 8.2 Calculation of root mean square values 8.3 Calculation of Average value.	8.1.1 Define alternating current. 8.1.2 Explain periodic time, maximum value, sinusoidal wave form generator, frequency. 8.2.1 Use sketch (graphical) to determine root mean square values. 8.2.2 Use alternative way that is Calculate Irms = Max Value x 0.707 for sinusoidal wave only. 8.3.1 Use sketch (graphical) to determine Average Value. 8.3.2 Use alternate way to calculate I(av) = Max value x 0.632 for sinusoidal wave only. 8.3.3 Explain why most. 8.3.4 Measuring instrument measure root mean square (rms) and not average values. 8.3.5 Use graph to determine rms and Average values of Alternating current.	

TASK	CRITICAL SKILLS	SUB - SKILLS	INSTRUCTIONAL TECHNIQUES
9.0 ELECTRICAL MEASURING INSTRUMENTS	9.1 Describe principles of construction of measuring instruments.	9.1.1 Define electrical measuring instrument – Analogue type/digital 9.1.2 List types 9.1.3 Label parts of instruments 9.1.4 Explain construction the following instrument a) Moving Coil b) Moving Iron c) Thermocouple d) Dynamometer e) Megger (Ohm meter)	
	9.2 Describe the principle of operation of instrument	9.2.1 Explain the principle of operation of 9.1.3.	
	9.3 Read scales on instrument both digital and analogue.	9.3.1 Compare scale of ohm meter and Ammeter or Voltmeter 9.3.2 Read values being measured 9.3.3 Compare Analogue and Digital reading of the same quantity being measured.	

TASK	CRITICAL SKILLS	SUB - SKILLS	INSTRUCTIONAL TECHNIQUES
10.0 TRANSFORMERS	10.1 Describe Transformers	10.1.1 Define Transformer 10.1.2 List types 10.1.3 List parts 10.1.4 Deduce transformation Ratio.	
	10.2 Describe transformer construction.	10.2.1 Explain method of construction.	
	10.3 Describe principle of operation.	10.3.1 Use sketches to explain the principle of operation. 10.3.2 Sketch phase diagram for transformer on no load and on load.	
11.0 RESISTIVITY	11.1 Describe resistivity of conductors.	11.1.1 Define resistivity of conduct. 11.1.2 List conductors used in the electrical industry and resistivities. 11.1.3 Explain the relationship R=SL/a and define each term and unit. 11.1.4 Solve more problem using the above formula	

TASK	CRITICAL SKILLS	SUB - SKILLS	INSTRUCTIONAL TECHNIQUES
12.0 EFFECT OF TEMPERATURE CHANGE ON A MATERIALS eg COOPER, ALUMINIUM, ETC.	12.1 Describe the effect of temperature change on conductors.	12.1.1 Define temperature and temperature change. 12.1.2 Define temperature. Co-efficient of Resistance for each material (ie Cooper, Aluminium, Carbon, Gold, etc 12.1.3 Use graph to explain the concept that when temperature increases Resistance increase R1 = R0 (1 + x R2) Define each term. 12.4 Solve more problem.	
13.0 HEAT	13.1 Describe Heat 13.2 Describe method of heat transfer.	13.1.1 Define heat 13.1.2 List method of heat production. 13.2.1 List 3 methods of heat transfer.	
14.0 ILLUMINATION	14.1 Explain Illumination. 14.2 Explain the measurement of Illumination.	14.1.1 Define Illumination, lumen, luminous intensity, inverse square law. 14.2.1 Explain measurement using flux meter.	

TASK	CRITICAL SKILLS	SUB - SKILLS	INSTRUCTIONAL TECHNIQUES
15.0 IDENTIFYING MATERIALS (CONDUCTORS, INSULATORS AND SEMI-CONDUCTORS)	15.1 Describe materials used in Electrical works. Conductors, Insulators and Semi-conductors. 15.2 Application of Materials.	15.1.1 Define the following materials: Conductor, Insulator and Semi-conductor. 15.1.2 List the properties 15.2.1 State the application of materials i) Conductors ii) Insulators and iii) Semi-conductors.	
16.0 ALTERNATING CURRENT CIRCUITS	16.1 Describe alternating current (A.C) circuits. 16.2 A.C. circuits terms. 16.3 Solve series and parallel circuits. 16.4 Explain Power Factor improvement.	16.1.1 Define AC circuits 16.2.1 Explain the following terms: Reactance, Impedance Phasor diagram, Current triangle, Voltage Triangle, Impedance triangle and Power triangle. 16.3.1 Determine for the cut: i) Inductive reactance. ii) Capacitor Reactance. iii) Impedance iv) Power factor v) Phase defense vi) Corresponding phasor diagram. 16.4.1 Use sketches to explain the following P.F. correction.	

TASK	CRITICAL SKILLS	SUB - SKILLS	INSTRUCTIONAL TECHNIQUES
17.0.1 ELECTRONICS	17.1 Describe electronic components.	17.1.1 Identify components. 17.1.2 List components, resistor LED, LDRs, diodes, transistors, thyristors, triacs and transformers. 17.1.3 Draw symbols listed components. 17.1.4 Determine characteristics of semi-conductor diodes, Zener diode.	
17.0.2 OPERATION OF COMPONENTS	17.2 Describe principle of operation of components	17.2.1 State functions or principles of operation of device mentioned in 17.1.2. 17.2.2 Show how it is tested using circuit diagrams.	
17.0.3 RECTIFICATION	17.3 Describe the half wave, 2 diode centre tap Full wave and 4 diode full wave rectification.	17.3.1 Define Rectification. 17.3.2 Draw and explain the circuit diagram for ½ wave and full wave rectification. 17.3.3 Use of the thermionic valve for ½ wave and full wave rectification.	

TASK	CRITICAL SKILLS	SUB - SKILLS	INSTRUCTIONAL TECHNIQUES
17.0.4 POWER SUPPLY SYSTEMS	17.4 Determine constant Power Supply System.	17.4.1 Define Power Supply System. 17.4.2 Apply filtering circuits to rectified current. 17.4.3 Apply zener diode as voltage stabilizer. 17.4.4 Draw block ding of Power Supply System.	

CERTIFICATE ONE – TRADE PRACTICALS

TASK	CRITICAL SKILLS	SUB - SKILLS	INSTRUCTIONAL GUIDE	EVALUATION
1.0 Workshop Practice	1.1 Demonstrate safety workshop practices.	1.1.1 Identify rules and regulation used in the workshop. 1.1.2 Explain safety rules and regulations.	- Present rules and regulation on safety to trainees. Write 5 rule and regulations on safety. - Demonstrate safety rules. How will you avoid accident in the workshop.	- Write 5 rule and regulations on safety. - How will you avoid accident in the workshop.
	1.2 Describe various parts of a hand tools (eg. Hacksaw) and their functions.	1.2.1 Draw hand tools label parts. 1.2.2 Indicate how tools are used.	- Trainees should put on protective gear during workshop practices. - Present tools to trainees for examination and identification. Draw the Hacksaw and label its parts and list its uses.	- Draw the Hacksaw and label its parts and list its uses.
	1.3 Identify tools and materials related to tasks (eg. Jointing)	1.3.1 Name tools required for eg. Stripping, jointing, etc.		- List tools used for a) jointing b) stripping, etc
	1.4 Demonstrate method of handling tools and Power tools.	1.4.1 Demonstrate how tool is used to trainees.	- List tools and its uses for various jobs.	
	1.5 Demonstrate the use of ladder.	1.5.1 Draw the ladder and label. 1.5.2 State types of ladder. 1.5.3 Demonstrate the work.	- Trainees handle tools whiles Teacher observe and correct. - Trainees use ladder as shown	- Drill a hole 13mm dia. - Climb ladder and remove lamp.

2.0 Preparing terminations	2.1 Demonstrate method of preparing Termination for accessories	2.1.1 Write steps of termination for memory. 2.1.2 Prepare termination for accessories	- Instruct trainees to terminate into accessories	- Terminate 2.5mm^2 PVC Insulated Cable

CERTIFICATE ONE TRADE SCIENEC AND CALCULATION

NO	TASK	CRITICAL - POINTS	SUB-POINTS	INSTRUCTIONAL TECHNIQUES
1.0	INTRODUCTION TO ELECTRICITY	Trainee should be able to: 1.1 Explain the structure of an atom i. Matter ii. Molecule iii. Atom	Explanation Matter: Any material which has weight and can occupy space Molecule: The smallest divisible particle of chemical compound Atom: The smallest particle of a matter.	Discuss or brainstorm with the aid of diagrams the structure of an atom to trainees.
		1.2 Define the above mentioned structures and state the three states of a matter. i. Solid state ii. Liquid state iii. Gas state	Solid state: Matter is said to be in solid state when it has fixed shape and fixed size. E.g. stone, table, book and pen. Liquid state: When it has a fixed size but do not have any fixed or definite shape. It takes the shape of the container into which is put. Gas state: When it has no fixed size or fixed shape. It also takes up the shape of ifs container into which it put. E.g. vapour, air, oxygen.	Discuss with the trainees the flow of both gas and liquid as compare to solid. State of a matter

TRADE SCIENEC AND CALCULATION

NO	SKILLS	CRITICAL - POINTS	SUB-POINTS	INSTRUCTIONAL TECHNIQUES
		1.3 Describe the rate of flow of electrons.	The measure of quantity of electrons passing through a conductor per second.	Discuss the rate of flow of electrons with the aid of diagram
		1.4 Explain the convectional and electron flow of current in a circuit.	Electron flow from the negative point to the positive point in a circuit, but current flows from the positive end to the negative end in a circuit	Explain the convectional and electrons flow of current in a circuit with the aid of a diagram with the trainees in groups.
		1.5. List and explain the different types of: i. Conductors ii. Insulators iii. Semi conductors	Conductors: Define and explain the uses of the following: a) Aluminium b) Carbon c) Brass d) Nichrome e) Tungsten f) Silver	Discuss and explain the functions and uses of various types of conductors with the aid of a real object.
			Insulation: Define and explain the uses of the following: a) P .V.C. b) Rubber c) Magnesium oxide d) Mica e) Bakelite f) Ceramic g) Porcelain h) Asbestos	Discuss and explain the functions and the uses of the various types of insulators with the aid of a real object to the trainees

NO	TASKS	CRITICAL - POINTS	SUB-POINTS	INSTRUCTIONAL TECHNIQUES
			Semi Conductors Germanium: Manufacture of electronics component. Silicon: Manufacture of electronics component. E.g. diode transistors. Description: The flow of current through a coil set up magnetic flux applications: Ball, motor Generator (Magnetic effect). Heating effect: The flow of current through a wire causes it to become red hot. Chemical effect: The flow of current through chemical solution causes chemical changes to take place. Application: Electroplanting	Explain to the trainees the basic functions of diodes Explain with the aid of diagram the effect of magnetic. Explain to the trainees the functions of an electric iron. Discuss with the trainees the effect of connecting a d.c. source to (spoon) to be electroplate place in a plastic container of a chemical solution.
2.0.	D.C. CIRCUIT	Trainees should be able to: 2.1. State the Ohm's law. 2.2. Solve problems involving resistors connected in series	Define the Ohm's law with respect to temperature and relationship between the voltage, current and resistance. In a series circuit, the total resistance is always greater than the largest individual resistor in the circuit: RT= R1+R2+R3	Discuss Ohm's law with trainees.

CERTIFICATE ONE - TRADE SCIENEC AND CALCULATION

NO	SKILLS	CRITICAL - POINTS	SUB-POINTS	INSTRUCTIONAL TECHNIQUES
		2.3 Solve problems involving resistors connected in parallel	Resistance are connected in parallel when same voltage is across them. The effective resistance RT is calculated from the equation. $\frac{1}{RT} \quad \frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3}$ RT = $\frac{R1 + R2}{R1 + R2}$ for two resistance Connected in parallel	
		2.4 Calculate the sum of the voltage drops in series circuit.	In series circuit the sum of the individual voltage drops is equal to the applied voltage. VT = V1 + V2 + V3	Solve problems involving resistors connected in series and their voltage drops.
		2.5 Calculate the sum of the individual current in parallel circuit.	In a parallel circuit the sum of the individual current in the branch circuit are equal to the total current of the circuit.	Explain the method of calculating the total current in a parallel circuit to trainees.
		2.6 Calculate by Ohm's law resistance, current and voltage in a) Series circuit b) Parallel circuit	The formular to use is I = V/R Where V= Applied voltage (Volts) I= Current (A)(amp) R = Resistance (ohm) ~	Explain how to calculate for current resistance and voltage using Ohms law to trainees

CERTIFICATE ONE - TRADE SCIENEC AND CALCULATION

NO	SKILLS	CRITICAL - POINTS	SUB-POINTS	INSTRUCTIONAL TECHNIQUES
		2.7 Solve problems involving power and energy.	Define power and energy and solve problems involving power by using $P = I^2 R$ (w) P=VxI $P=V^2/R$ Where P = Power in watts I = Current R = Resistance V = Voltage To calculate for energy is E = P x T Where E = Energy P = Power T = Time (sec) Unit of energy is joules	Explain how to calculate for power and energy in a circuit to trainees
		2.8 Quantity of electrical charges (Q)	Define electrical charge per second. Solve problems involving electrical charge by using the formular Q = I x t I = current T = time (sec)	Solve problems involving resistivity of a materials in Ohm's by using the formular R = PL/A
		2.9 Resistivity of a material or conductor	Define Provide the table or chart for resistivity of conductors Use the formular R = PL/A Where R = Resistance P = Resistivity of conductor L = Length A = Cross-sectional Area	

TRADE CERTIFICATE - TRADE SCIENECE AND CALCULATION

NO	SKILLS	CRITICAL - POINTS	SUB-POINTS	INSTRUCTIONAL TECHNIQUES
		2.10 Temperature co-efficient of a resistance.	Define temperature co-efficient of a material. Solve problems by using the formular: Rt = RO (1+σ t1 = for temperature increase from zero degree celsius and R1 = 1 + & t1 R2 1+& t2 for temperature increase due two intermediate temperatures.	Solve problems involving temperatures increasing from zero degree Celsius and two given intermediate temperatures with the trainees.
3.0	MAGNETISM	Trainees should be able to: 3.1. a) Define a magnet b) Identify types of magnet c) List the type of magnet d) State the law of magnetism e) Define line of force f) Differentiate between ferrous and non ferrous materials and state the unit of magnetism	Explanation: Types of magnet: Natural Permanent Temporal Law of magnetism: Like pole unlike poles attracts repels Ferrous materials: Can be attracted Non ferrous: Cannot be attracted	Discuss with the trainees with the aid of a real object the ferrous materials and non ferrous materials. Explain the principles of attractions and repulsion
		3.2 State magnetic units and their uses	Magnetic flux (Symbol Ø). The unit of magnetic flux is weber (wb) and may be taken as equal to one line of force. Sub-units = (mwb)	Brainstorm trainees with the magnetic units and symbols

CERTIFICATE ONE - TRADE SCIENECE AND CALCULATION

NO	SKILLS	CRITICAL - POINTS	SUB-POINTS	INSTRUCTIONAL TECHNIQUES
			Flux density (B): Flux density is measured in tesla (T) The flux density is a measure of the field strength since it indicated the density of the field. Magnetic motive force (F) mmf. It's the force which cause the magnetic flux to be established in coil. = Number of turns x current in the coil Magnetism force (H). It is the mmf per unit length of the magnetic circuit. $H = \frac{F(NI)}{L}$	Solve problems involving magnetic by using the formular.
		3.3. Solve problems on force on a conductor place in a magnetic field.	Problem solving use the formular BLI to solve problems. Where: B = Flux density I = Current L = Length of conduct NB: Force (N) Newton	Discuss the process to solve problems with trainees
4.0	ELECTRO MAGNETISM	4.1. Trainees should be able to: Understand the basic principles of a solenoid. Identify the magnetic field around conduction due to a current flowing through it.	Solenoid showing direction of current flux pattern. A loop of wire showing the direction of current flux pattern	Brainstorm trainees about the shape of the field and the direction of current in the loop.

CERTIFICATE ONE - TRADE SCIENECE AND CALCULATION

NO	SKILLS	CRITICAL - POINTS	SUB-POINTS	INSTRUCTIONAL TECHNIQUES
		4.2 State the application of electromagnetic devices. 4.3 Define electromagnetic induction	Application: Bell, relay, motor, contractor and generator. Definition: When there is a change of current through a coil it causes a magnetic field to set up an induced e.m.f. is established in itself or in another.	Discuss the application of bell, relay, motor and generator. Discuss the magnetic field and induced e.m.f. on both self and mutual inductance.
5.0	BATTERIES OR CELL'S	5.1 Define battery cell and list types of primary and secondary cells. 5.2. Describe methods of charging battery basically	Solve problems involving primary cells connected in series and parallel with their internal resistance Explanation: The constant voltage method and current method	Explain the method to trainees with the aid of diagram.
6.0	ELECTROSTATISC	Trainee should be able to: • Define capacitor • Identify types of capacitors • List types of capacitors • Describe types of capacitors • State the applications • Solve problems involving capacitor connected in series and parallel in a circuit	Definition of the following: • Capacitor • Capacitance • Farad Identify types of capacitors: Paper, mica, electrolytic. Perform calculations involving capacitor connected in series and parallel by using the formular Series: $\frac{CT}{I} = \frac{I}{C2} + \frac{I}{C2} + \frac{I}{C3}$ Parallel: CT = C1 + C2 + C3	Solve problems with trainees on both series and parallel connected capacitors in a.c. circuit.

CERTIFICATE ONE - TRADE SCIENCE AND CALCULATION

NO	SKILLS	CRITICAL - POINTS	SUB-POINTS	INSTRUCTIONAL TECHNIQUES
7.0	TRANSFORMERS	7.1 Trainees should be able to: i. Define transformer ii. Identify types of transformers iii. Explain the construction and operation of transformer iv. List types of transformers	a) Definitions of a transformer • Types of transformers Core and shell type b) Construction operation of i. Double wound ii. Auto transformer c) Perform calculations involving transformer ration by using the formular: $\frac{Vp}{VS} = \frac{Np}{Ns} = \frac{Is}{Ip}$	Discuss the types and the principles of a diagram to trainees. Solve problems involving transformer ration with respect to the primary and secondary voltage and current
8.0	MEASURING INSTRUMENT	Trainees should be able to: 8.1 Describe basic parts of measuring instruments. i.e. a) Moving coil b) Moving iron 8.2 Define measuring instrument 8.3 Basic construction and principles of measuring 8.4 Solve problems on extension of range using shunt or multiplier	Description: Operating device: Is usually an electron magnet formed by current in a coil. Controlling devices: Two types a) Gravity control b) Spring control Damping devices: Two types a) Oil dashpot damping and b) Eddy current damping Use the formular to solve problems on instrument	Explain with the aid of diagram the coil and the iron types of measuring instrument. Solve basic problems on extension of range on measuring instrument.

CERTIFICATE ONE - TRADE SCIENCE AND CALCULATION

NO	SKILLS	CRITICAL - POINTS	SUB-POINTS	INSTRUCTIONAL TECHNIQUES
9.0	ILLUMINATION	Trainees should be able to i. Define the following: • lumen • luminous intensity • inverse square-law	Solve problems involving illumination when the distance from light point and the floor area is given by using inverse square law	More calculations on inverse square law.
10.0	VOLTAGE DROP ON CABLE SIZES	Trainees should be able to: Define voltage drop in cable Solve problems involving voltage drop in a cable by using the formular	Definitions of voltage drop and cable size. Simple calculations on voltage drop in a cable by using $Vrd = \frac{Mv/A/M \times L \times I}{1000}$	Define the voltage drop and solve simple problems involving voltage drop
11.0	SINGLE PHASE MOTORS	Trainees should be able to: i. Define single phase motor ii. Identify types of single phase motors iii. List types and applications iv. Describe the construction and operations	Definition of single phase motor Identify the parts a) rotor b) stator c) end bearing d) shield e) windings f) centrifugal switch	Explain the basic construction and operation of a single phase motor with the aid of diagram. Discuss or solve simple calculation on single phase motors.

CERTIFICATE ONE – TRADE DRAWING

NB: Instructors must draw and explain to trainees using colour chalks on chalk board.

1. Draw the B.S. specification electrical symbols on accessories and devices.
2. Draw and label all parts of M.I.C.C. and P.I.L.S.W.A armoured cables
3. Draw a wiring diagram of simple lighting circuit using symbols and geographical symbols
4. Layout diagram for simple lighting circuit using 2-way switches and intermediates
5. PLAN drawing of simple lighting circuits, using symbols.
6. Single line diagrams on lighting circuit, using symbols
7. Sequence of supply equipment control showing internal connections
8. Sequence of supply equipment control using block diagram
9. Draw a complete wiring diagram of ring main circuit using 4 socket outlets – with one spur
10. Draw a complete wiring diagram of radial circuit using 4 socket outlet
11. Draw a complete wiring diagram of a single fluorescent lamp circuit controlling from THREE different point.
12. Drawing of the internal connections of both S.P.N and T.P.N. main switches
13. Draw a complete circuit diagram of electric bells e.g. single stroke, trembler bell

14. Draw a complete circuit diagram to show how to test for the following:
    - Polarity test
    - Insulation resistance
15. Draw a circuit diagram of bridge rectification system. Using four diodes
16. Drawing of distribution board showing internal connections
17. Draw a labeled all parts of various types of single-phase motors.

LEVEL – CERTIFICATE TWO – TEST SPECIFICATION TABLE

TRADE THEORY (OBJECTIVE)

NO	TOPIC	COGNITIVE KNOWLEDGE	AFFECTIVE UNDERSTANDING	PSYCHOMOTOR APPLICATION	TOTAL
1.	Health and safety	-	1	1	2
2.	Electrical symbol	-	2	1	3
3.	Cable joints	-	1	-	1
4.	Conductor and insulators	-	2	1	3
5.	Cables		1	-	1
6.	Generation of electrical	1	1	-	2
7.	Voltage classification		1	1	2
8.	Transmission and distribution	1	1	1	3
9.	Protective devices		1	1	2
10.	Testing and inspection	1	-	1	2
11.	Conduit installation	-	1	-	1
12.	Lighting	1	1	-	2
13.	A.C. and D.C. machine	1	1	-	2
14.	Single Phase dist	-	1	1	2
15.	Single phase distribution	1	1	1	3
					31

LEVEL – CERTIFICATE TWO – TEST SPECIFICATION TABLE

TRADE THEORY (SUBJECTIVE)

NO	TOPIC	COGNITIVE KNOWLEDGE	AFFECTIVE UNDERSTANDING	PSYCHOMOTOR APPLICATION	TOTAL
1.	Health and safety	1	-	1	2
2.	Electrical symbol	-	1	-	1
3.	Cable joints	-	1	1	2
4.	Conductor and insulators	1	1	1	3
5.	Cables	-	2	2	4
6.	Generation of electrical	-	1	1	2
7.	Voltage classification	-	1	1	2
8.	Transmission and distribution	1	1	-	2
9.	Protective devices	1	2	1	4
10.	Testing and inspection	-	2	1	3
11.	Conduit installation	-	1	1	2
12.	Lighting	-	2	1	3
13.	A.C. and D.C. machine	1	1	1	3
14.	Single Phase dist	1	1	-	2
15.	Single phase distribution	-	2	2	4
					39

LEVEL – CERTIFICATE TWO – TEST SPECIFICATION TABLE

TRADE SCIENCE AND CALCULATIONS

NO	TOPIC	COGNITIVE KNOWLEDGE	AFFECTIVE UNDERSTANDING	PSYCHOMOTOR APPLICATION	TOTAL
1.	Introduction of Electric	1	1	1	3
2.	D.C. circuit	1	2	1	4
3.	Magnetism	-	2	2	4
4.	Electromagnetism	-	2	2	4
5.	Electrostatics	-	1	1	2
6.	Transformers	1	1	1	3
7.	Measuring instrument	-	1	1	2
8.	Illumination	-	1	1	2
9.	Voltage drop on cable	-	1	1	2
10.	Single phase motors	1	1	2	4
					30

LEVEL – CERTIFICATE TWO – TEST SPECIFICATION TABLE

TRADE PRACTICALS

NO	TOPIC	COGNITIVE KNOWLEDGE	AFFECTIVE UNDERSTANDING	PSYCHOMOTOR APPLICATION	TOTAL
1.	Workshop practice	1	1	1	3
2.	Termination	1	2	1	4
3.	Cable jointing	-	1	1	2
4.	Wiring on boards	1	2	1	4
5.	Conduit and trunking	1	2	1	4
6.	Earthing arrangement	1	1	1	3
7.	Bell circuit	1	2	1	4
8.	Testing instrument	-	1	1	2
9.	Testing installation	-	1	1	2
10.	Domestic appliance	1	1	-	2
11.	Testing board	-	1	1	2
12.	Cooker unit	1	-	1	2
13.	Discharge lights	1	1	1	3
14.	Single phase motor	-	2	1	3
15.	3-phase motors	-	1	2	3
16.	3-phase distribution	1	1	1	3
					46

LEVEL – CERTIFICATE TWO – TEST SPECIFICATION TABLE

TRADE PRACTICALS

NO	TOPIC	COGNITIVE KNOWLEDGE	AFFECTIVE UNDERSTANDING	PSYCHOMOTOR APPLICATION	TOTAL
1.	B.S. Electrical symbols	-	2	-	2
2.	Cable	-	1	1	2
3.	Lighting layout	1	2	1	4
4.	Lighting plan	1	1	2	4
5.	Single line diagram	-	2	1	3
6.	Supply control arrangement	1	1	2	4
7.	Block diagram	-	1	-	1
8.	Ring circuit	-	1	-	1
9.	Radial circuit	-	1	-	1
10.	2-way switching	1	2	1	4
11.	Intermediate switching	1	2	1	4
12.	Fluorescent CCT	1	1	1	3
13.	S.P.N. Drawing	-	1	1	2
14.	T.P.N Drawing	1	1	-	2
15.	Polarity test drawing	-	1	-	1
16.	Insulation resistance test		1	2	3
17.	Single phase motor		2	-	2
18.	D.B. Drawing	1	-	1	2