NATIONAL VOCATIONAL TRAINING INSTITUTE

TESTING DIVISION

TRADE TESTING REGULATIONS AND SYLLABUS

TRADE: CONSTRUCTION ELECTRICAL

LEVEL: CERTIFICATE ONE

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 Knowledge in the safe use of electrical tools, equipment and materials. Wiring systems, occupational drawing, Installation of earthing systems, sequence of supply control, installation of Protective devices,

Inspection and testing, Lighting and Power circuits, trade drawing (circuit drawing), troubleshooting and

repairs of electrical wiring and related equipment in building and other structures, Preparation of planning and estimating of materials, trade science and calculations and Relevant IEE – Regulations.

B. GENERAL OBJECTIVES

On completion of this course the trainee should be able to:

i) Understand the importance of electrical safety precaution at workshop.
ii) Identify and use of correct tools and equipment.
iii) Perform surface wiring, conduit wiring system and Trunking System.
iv) Read and interpret occupational drawing (Blue Print)
v) Install earthing system.
vi) Select and arrange supply control in correct sequence.
vii) Select and Install different types of protective devices.
viii) Carry out visual Inspection and testing.
ix) Wire lighting and Power circuit.
x) Interpret and draw circuit diagrams.
xi) Know how to diagnose fault in electrical installation and equipment.
xii) Know the need for estimating electrical project.
xiii) Understand the importance of trade science and calculation.

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 equipment.

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/Fail
v)

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

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) is compulsory.

I. 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

J. ACKNOWLEDGEMENT

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

- Mr. David Annan Tetteh (E.E.T. Part III)
- Mr. William Matey (E.E.T. Part III, C.Ed)

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

K. 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. Gimlet
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

Recommended Text 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. 10. IEE Regulations 16th Edition

CERTIFICATE ONE – TRADE THEORY

ITEM	TASK	CRITICAL-POINTS	SUB-POINTS	INSTRUCTIONAL TECHNIQUES
1.0.	HEALTH AND SAFETY	• Construction- health protection • Control of substances hazardous to health • Use of work equipment directive • The workplace directive	• Provision of helmet by employers to employees • Make rules as to when and where hard hats are be worn • Provide the necessary instruction and training to all trainees the nature of risk and measures to be adopted to ensure safe control and operation • Provision of safe equipments for safe operation/use • Precautions to cover control devices • Carry out regular cleaning/maintenance • Rectify defects that could be possible hazards • Keep emergency exit and	Brainstorm the trainees on the Act and explain the importance of the Act 1974. Discuss the following Regulations and the act to the trainees. a. Electricity supply Regulation 1988 b. Electricity at work Regulation 1989 c. Regulation for Electrical Installation 1991 (16th Edition I.E.E.) Discuss with the trainees protection against electrical equipment, shock,

		• Use of personal protective	escape routs clear • Provision for use of safety boots and goggles • Assess the health risk associated with any work activity involving hazards • Monitor the place of work to establish if a problem exist •	risk of fire and excess current Show with the aid of a real object.
	HEALTH AND SAFETY	The health and safety at work ACT 1974 Safety Regulations: a. Necessity for the wiring Regulation b. Purpose of the following Regulation 1. Electricity Supply Regulation 1988 2. Electricity at work Regulation 1989 3. Regulation for electrical installation 1991 (I.E.E. Regulation 16th) <u>Electrical Safety</u> 1. The importance of	State the health and safety at work Act 1974 and explain. The Regulation from a relevant I.E.I. Regulation The importance of earthing` and	Explanation and discussion with trainees Discussion with explanation Discussion with

		earthing 2. Protection of electrical equipment against a) Excess current b) Earth leakage c) Mechanical damage d) 3. The need and the use of circuit protective conductor 4. Protection against shock and risk of fire and corrosion	the need of protection against electrical equipment. The types of protective devices for excess current and earth leakage protection. Types of protective wears or cloth and tools for working under live conductors	explanation Discussion with explanation

ITE	TASK	CRITICAL-POINTS	SUB-POINTS	INSTRUCTIONAL TECHNIQUES

M				
2.0.	TYPES OF CABLES USE IN AN INSTALLATION	Types of cables: 1. P.V.C. cable 2. P.V.C./P.V.C. Insulated and sheathed 3. Tough Rubber Sheath 4. P.L..S.W.A. 5. P.V.C. Armoured Cable 2. Application and Relevant I.E.E. Regulation 3. Current carrying capacitor of a cable from: 1.5mm^2 to 16mm^2	The construction of the following cables: P.V.C. cab;e 2. P.V.C./O.V.C. Tough Rubber Sheath P.I.L.S.W.A. P.V.C. Armoured X.L.P.E. <u>Explanation</u> Regulation I.E.E. Regulation	Identify/Discuss with the trainees the construction and applications of the listed cables P.V.C. cable P.V.C./P.V.C. Tough Rubber Sheathed P.I.L.S.W.A. P.V.C. Armoured X.L.P.E. Discuss/explain with the trainees by means of a chart show in the maximum and minimum current carrying capacity of cables
3.0.	COLOUR CODING OF A CABLE	1. The importance of colour coding 2. Connection colour coded cable to appropriate terminals 3. Identify colour coding for	Colour coding cable according to terminals eg. Red → Live Black → Neutral Yellow/Green → Earth	Discuss with the trainees colours which represents Live, neutral and earth

		cores of cable, with Relevant IEE Regulations. 4. Cable for fixed wiring 5. Flexible cords and cables	The types a. Cores cables b. Flexible cable	Explain with the aid of a chart or real object colour coding of the following cables a. 3-core cable b. 4-core cable
4.0.	CABLE JOINTING	1. Types of cables joints a. Married joint b. Tee joint c. Joint using – connectors	The various joints a. Married b. Tee c. Joint using connectors 2. Application for: a. Married joint b. Tee joint c. Connector joints	Explain with the trainees the systematic approach to make the following joints. a. Married b. Tee joint c. Connected joint
5.0.	INSTALATION OF CIRCUIT	The importance of : a. Lighting circuit b. Socket outlet cct c. Electric cooker – control circuit d. Bathroom installation e. Air-condition circuit with Relevant I.E.E. Regulations	1. Maximum lighting circuits on a final sub circuit with it ratings 2. Rated final sub circuit for socket outlets 3. Rating for cooker control unit depending on the size 4. Ratings of A/C unit depending on the H.P. or KW	Explain to the trainees the following areas and its applications and size of cables to be use on each circuit.
6.0.	IDENTIFICATIO N OF TYPES OF	Types of termination a. Eye loop termination b. Spade termination	Types: a. Eye loop type b. Spade type	Explain with the aid of a chart or real object the types, the methods

	TERMINATION	c. Claw type termination d. Crimped termination 1. Method of Termination a. Pillar method b. Stud nut method c. Shredded connector d. Cable lig by – crimping	c. Claw type d. Crimped type Methods of the following: a. Pillar method b. Stud and nut method c. Cable lig method d. Shruded method	and application of the following: a. spade type b. claw type c. eye loop d. crimped type
7.0.	CONDUIT NON METALLIC	Non metallic conduits. 1. P.V.C. rigid conduit 2. Flexible conduit (Corrugated) Conduit sizes: a. 16mm^2 b. 20mm^2 c. 25mm^2 d. 32mm^2 3. Apply space factor with simple calculations on conduit 4. Conduit fittings and accessories. a. saddle b. coupler c. Tee box d. Four-way e. Trough way	Define non metallic conduit 2. Application for a. P.V.C. rigid conduit b. flexible conduit Conduit accessories a. Saddle b. Coupler c. Four-way box d. Tee box e. Through way	Explain to the trainees the size, lengths for each, and the area of use. Discuss with trainees how to bend and make offsets, and to make end socket of a P.V.C. conduit with relevant I.E.E. Regulation

8.0.	P.V.C. TRUNKING	P.V.C. trunking sizes a. 16mm x 16mm b. 16mm x 25mm c. 25mm x 40mm d. 16mm x 32mm e. 25mm x 50mm	Application or the area of use of the P.V.C. trunking sixes 16mm x 16mm 16mm x 25mm 16mm x 32mm 25mm x 40mm 25mm x 50mm	Explain to the trainees the types of installation for trunking systems and the Space factor to be applied
9.0.	CONSUMER CONTROL INTAKE	The positions of the consumer accessories a. Main switch gear b. Distribution board c. Splitter unit d. Service cut-out e. Service cable f. Consumer Control Unit	The functions of the consumer accessories a. Main switch gear b. Distribution Board c. Splitter Unit d. Service cut-out fuse e. Service cable f. Consumer Control Unit with the relevant I.E.E. Regulation	Discuss with the trainee the sequence of arrangement and the operation with relevant I.E.E. Regulation

ITEM	TASK	CRITICAL-POINTS	SUB-POINTS	INSTRUCTIONAL TECHNIQUES

10.0	EARTHING ARRANGEMENT	The importance of –earthing arrangement. a. Electrical Installation b. Frames of appliances e.g. heaters c. The use of C.P.C. and earthing conductor d. Types of earth electrode e.g. Rod and plate Describe the above mention item in (d) i.e. Rod and plate	The sizes of cables to be use with respect to the Installation 2. The sequence of connections from the final sub circuit to consumer control unit to the earth – electrode	Discuss with the trainee the importance of earthing arrangement and the process of burying earth electrode or plate.
11.0.	VOLTAGE CLASSIFICATION	Voltage ranges or classification with respect of the I.E.E. Regulations. a. Extra low voltage b. Low voltage c. Medium voltage d. High voltage e. Extra high voltage	The applications of the voltage classification a. Extra low voltage b. Low voltage c. Medium voltage d. High voltage e. Extral high voltage	Discuss with the trainees by means of a chart showing the – classifications and the types of cables for each class
12.0	TRANSMISSION AND DISTRIBUTION	1. Types of transmission poles a. Concrete poles reinforcement cement concrete pole b. Steel pole c. Pylons pole 2. Substation a. Indoor b. Out door	Application for the transmission poles a. Concrete poles b. Steel poles c. Pylons poles The constructions of the substation a. Indoor station	Discuss with the trainees the definitions of transmission and distribution with the relevant I.E.E. Regulation Explain the working performance of the

			b. Outdoor station	indoor or outdoor station

ITEM	TASK	CRITICAL-POINTS	SUB-POINTS	INSTRUCTIONAL TECHNIQUES
13.0	SINGLE PHASE DISTRIBUTION	The importance of the final sub circuit on a single phase distribution system. a. Lighting final circuit b. Socket outlet either in ring or radial c. Water heater circuit d. Electric cooker control unit e. Bell circuit f. Aircondition circuit	Specific locations of the following final sub circuits a. Lighting final circuit b. Socket outlets c. Water heater d. Electric heater e. Electric bell f. Aircondition circuit	Discuss with the trainees the importance of determine the fuse rating of a final sub circuit using the I.E.E. regulation
14.0.	3-PHASE 4-WIRE DISTRIBUTION SYSTEM	1. The distribution systems a. Single phase distribution system b. 3-phase 3-wire distribution system c. 3-phase 4-wire distribution	Application of the distribution systems. a. Single phase distribution b. 3-phase 3-wire distribution c. 3-phase 4-wire distribution	Explain to trainees the following distribution systems and the need of applying diversity factor and growth – factors.

		system 2. Balancing of single-phase load on 3-phase 4-wire distribution system 3. Simple explanation on a. Diversity factor and b. Growth factor	Applications of the factors a. Diversity factors b. Growth factors	
15.0.	OVER CURRENT PROTECTIVE DEVICES	Types of fuses and circuit breaking. 1. Types of fuses a. Semi enclose or re-wireable fuse b. Cartridge fuses and H.B.C. fuses	The advantages and disadvantages of both semi-enclose fuse and cartridge fuses	Explain the principle of operation on both semi-enclose and cartridge fuses

ITEM	TASK	CRITICAL-POINTS	SUB-POINTS	INSTRUCTIONAL TECHNIQUES
		2. Construction of both semi- enclose fuses and cartridge fuses	Applications on both semi-enclose fuses and cartridge fuses	Application for H.B.C. and rewireable fuse with respect to the relevant IEE Regulation
	OVER CURRENT	Types of circuit breakers	Ratings of both miniature circuit breaker and moulded case circuit	Discuss with the trainees the principles

	PROTECTIVE DEVICES	a. Miniature circuit breaker b. Moulded case circuit breaker 2. Application for both miniature circuit breaker and moulded case circuit breaker 3. Discrimination of over current protective devices with a simple explanations	Breaker 2. Advantages and disadvantages on both miniature circuit breaker and moulded case circuit breaker. 3. A simple discrimination of protective devices on chalk board	and operation of the types of circuit breakers mentioned Explain to the trainees the need of discriminate circuits of a different categories with relevant I.E.E. Regulations
16.0.	LIGHTING SYSTEM	The lighting systems a. incandescent lamp circuit e.g. filament bulb b. Discharge lamp circuit e.g. fluorescent lamp circuit 2. To minimize stroboscopic effect and its methods	Define both incandescent lamp and fluorescent lamp The parts of a complete fluorescent lamp set. To minimize stroboscopic effect and its method under single phase and 3-phae supply system	Discuss with the trainees the construction and operation of both incandescent lamp and fluorescent lamp circuit. Explain to trainees the applications on both incandescent and fluorescent lamp circuit using real objects.

17.0	SINGLE PHASE MOTORS	Single phase motors. a. Capacitor start motor b. Capacitor start and run c. Repulsion motor d. Universal series motors e. Shade pole motor	Circuit diagram of: a. Repulsion motor b. Capacitor start motor c. Capacitor start and run d. Universal series motor e. Shaded pole motor	Explain to the trainees the construction and principle of operation of the following single phase a.c. motors a. Repulsion motor b. Universal series c. Capacitor start d. Capacitor start and run motor e. Shaded pole motor
18.0.	MOUNTING AND INSTALLATION OF SINGLE PHASE MOTORS	The importance of preparing form work for motor	The tools and materials needed for the formwork	Discuss with the trainees the step to be taken when preparing a form work for single phase motor mounting

ITEM	TASK	CRITICAL-POINTS	SUB-POINTS	INSTRUCTIONAL TECHNIQUES
19.0.	TESTING AND INSPECTION OF SINGLE PHASE MOTORS	Inspection and testing for: a. Continuity of windings b. Insulation resistance test on windings c. Insulation resistance test between windings and earth d. Open circuit test on winding e. Short circuit test between windings	Measuring Instrument needed for the test e.g. multimeter megger tester To check for free rotation of shaft bearing	Explain to the trainees the sequence of test to be conducted and the expected reading on each test with respect to the relevant I.E.E. Regulation
20.0	TESTING AND INSPECTION OF AN INSTALLATION	The sequence of testing and inspection in an installation a. Verification of polarity b. Earthing test c. Earth electrode test d. Insulation resistance test e. Test of ring circuit continuity NB: Apply relevant I.E.E. Regulation	Types of measuring instrument for the various test Importance of the test a. Earthing test b. Earth electrode test c. Insulation resistance test d. Test for ring circuit continuity e. Verification of polarity	Explain to the trainees the sequence of test to be conducted with its specific readings. Apply relevant I.E.E. Regulation
21.0	PLANNING AND	Prepare or list materials requisition for a simple	The importance of preparing a	Discuss with the trainees how to

	ESTIMATING	project Prepare or design a requisition format	requisition for a particular project	prepare requisition for a simple project.

CONSTRUCTION ELECTRICAL - CERTIFICATE ONE TRADE SCIENCE AND CALCULATION

			INSTRUCTIONAL

TASK		CRITICAL POINTS	SUB-POINTS	TECHNIQUE
1.0	INTRODUCTION TO ELECTRICITY	1.1 .1 The structure of the following a) Matter b) Molecule c) Atom 1.1.2 The rate of flow of Electrons 1.1.1 The conventional and electrons flow of current in a circuit. 1.1.2 Methods of generating Electricity. - Electromagnetic induction - Chemical energy - Solar energy	1.2.1 Definition a) Matter b) Molecule c) Atom 1.2.4a Electromagnetic induction coil 1.2.4b Define chemical energy . - effect of two dissimilar metals immersed in a liquid called Electrolyte. 1.2.4c Define solar energy and explain. Example sun rays heat up a radiation panel which generate electricity and store it batteries (eg. Solar Panel).	Brainstorm with the aid of diagram the structure of an atom to trainees. 1.3.2 Discuss the rate of flow of electrons with the aid of diagram to trainees. 1.3.3 Discuss the conventional flow of current in a circuit with the aid of diagram with trainees. 1.3.4 Lecture the trainees with the aid of a diagrams methods of generating electricity.

TASK		CRITICAL POINTS	SUB-POINTS	TECHNIQUE
1.0		1.1.3 Definition of Conductor Types of conductor Application of Each Conductor List and explain the functions of different types of • Conductors • Insulators • Semi conductors	1.2.5a Conductor: Definition and the uses of the following; a) Copper b) Aluminum c) Carbon d) Tungsten e) Nichrome f) Brass 1.2.5b Insulators**:** Definition and the uses of the following a) P.V.C. b) Rubber c) Magnesium Oxide d) Mica e) Porcelain f) Asbestos	1.3.5a Discuss the function of conductor with the trainees in groups. 1.3.5b Discuss function of Insulators with trainees in groups

CONSTRUCTION ELECTRICAL - CERTIFICATE ONE TRADE SCIENCE AND CALCULATION

TASK		CRITICAL SKILLS	SUB-SKILLS	INSTRUCTIONAL TECHNIQUE
1.0		The functions of different types of: • Conductors • Insulators • Semi conductors 1.1.6 Magnetic, Heating and Chemical effects of electric current and its application	1.2.5c) Semi Conductors: Definition • Germanium • Silicon eg Diode transistor 1.2.6 Definition: • Magnetic effect • Heating effect • Chemical effect Application of EACH of the above	1.3.5c Discuss the function of Insulators with trainees using real objects. 1.3.6 Demonstrate to trainees the effect of connecting electric pressing iron to a source of supply by using a real object.
2.0	D.C. CIRCUIT	2.1.1 Trainees should be able to ; a) State Ohm's Law b) Solve problems on resistors connected in series. c) Solve problems on Resistors connected in parallel. 2.1.2 $\frac{1}{RT} = \frac{1}{R1} + \frac{1}{R2}$ …….	2.2.1b In series circuit Total Resistance is always greater than the largest individual resistor. 2.2.1c In parallel circuit the total resistance is the reciprocal of the	2.3.1a Discuss Ohm's Law with the trainees. 2.3.1b Explain the method of calculating resistors connected in series to trainees. 2.3.1c Explain the method of calculating resistors in parallel to the trainees.

		2.1.3RT= $\frac{R1 + R1}{R1 + R2}$ for two Resistance in parallel	individual resistance.	
2.0		2.1.4 The sum of Voltage drop in series. 2.1.5 The sum of Individual current in a parallel circuit. 2.1.6 Finding by Ohm's Law Resistance, current and voltage in ; • Series circuit • Parallel circuit • Series and parallel combination 2.1.7 Solve problems involving power and energy.	2.2.4 Total Voltage Drop VT = V1 + V2 + V3 2.2.5 Total Current $I_T = I_1 + I_2 + I_3$ 2.2.6 The formula to use is: $I = \frac{V}{R}$ A Where: V = Applied Voltage I = Current (A) R = Resistance (R) 2.2.7 To calculate for power: $P = I^2 \times R$ $P = V \times I$	2.3.4 Explain the method of calculating the voltage drop in a series circuit to trainees. 2.3.5 Explain the method of calculating the total current in a parallel circuit to trainees. 2.3.6 Explain how to calculate for current, Resistance and Voltage using Ohm's Law to trainees. 2.3.7 Explain how to calculate power and energy in a circuit to trainees

			$P = V^2/R$ Where P = Power (W) I = Current (A) R = Resistance ® V = Voltage (V)	
2.0		2.1.8 To calculate for energy is: E = P x T Where : E = Energy (J) P = Power (W) T = Time (Sec)	2.2.1 Explain the Law of Conservation of Energy	
3.0	MAGNETISM	3.1.1 Define a Magnet 3.1.2 Types of Magnet • Natural • Permanent • Temporal 3.1.3 Types of Magnetic Materials.	3.2.1 Definition of a magnetic material and its properties. 3.2.2 The difference between types of magnet to trainees. 3.2.3 Types of magnetic materials; a) Iron b) Steel c) Cobalt	3.3.1 Explain to trainees the ability of a magnet to attract other materials by using one to attract a nail. 3.3.2 Show the types to trainees and explain. 3.3.3. Explain to trainees the field battery of magnetic lines of force.

		3.1.4 Magnetic lines of Force	3.2.4a Magnetic lines of force. 3.2.4b The direction of the lines of flux from north pole to south pole. 3.2.4c Magnetic compass and iron fillings to show the magnetic lines on a piece of paper.	3.3.4 Laboratory experiment
3.0		3.1.5 Properties of magnetic lines of force and the laws of attraction and repulsion. 3.1.6 State magnetic units and their uses.	3.2.5 The five (5) characteristics of lines of Magnetic flux 3.2.6a Magnetic flux (symbol) The unit of magnetic flux is the Weber (wb). 3.2.6b Flux density (B) Flux density is	3.3.5 Discussions in a group form the law of attraction to trainees. 3.3.6a Brainstorm trainees the magnetic units and symbols. 3.3.6b Calculate magnetic problem with trainees using formulas.

		3.1.7 Magneto motive force (F) Magnetic flux to be established in a coil = Number of turns X Current in the Coil = N1 ampere turn Magnetism force (H): It is the m.m.f. per unit length of the magnetic circuit. Therefore H = F (N1) L	measured in tesla (T) 3.2.7 Compare Magnetic circuit to Electric circuit eg mmf = Voltage Flux (□)= Reluctance =Resistance	
4.0	ELECTRO MAGNETISM	4.1.1 Trainees should be able to; Draw a magnetic field around a conductor due to a current flowing through it.	4.2 .1 A straight conductor showing direction of current. Magnetic flux around the conductor. A loop of wire showing the direction of current of flux – pattern. A solenoid showing direction of current flux pattern.	4.3 Explain to trainees the shape of the magnetic field and the direction of current in a straight conductor with a diagram and a real objects. Brainstorm trainees about the shape of the field and the direction of the current to loop.

CONSTRUCTION ELECTRICAL - CERTIFICATE ONE TRADE SCIENCE AND CALCULATION

TASK		CRITICAL POINTS	SUB-POINTS	INSTRUCTIONAL TECHNIQUE
4.0		- Define electromagnetic induction.	Application - Bell - Relay - Contactor - Motor - Generator	Discuss the application of bell, Relay, contactor, motor and generator to trainees.
		Application of electromagnetic devices.	4.2.2 State factors upon which the strength of electromagnet depends on.	Discuss the magnetic field and the induced e.m.f. established in the coil with the trainees.
		Definition: - Self Induction	Define: 1) Self Induction Unit = Henry (H) Symbol = L	Explain self and mutual induction to the trainees

		- Mutual Induction	2) Mutual Induction Unit = Henry (H) Symbol = M	

CONSTRUCTION ELECTRICAL - CERTIFICATE ONE TRADE SCIENCE AND CALCULATION

TASK		CRITICAL POINTS	SUB-POINTS	INSTRUCTIONAL TECHNIQUE
5.0	MEASURING INSTRUMENT	5.1 Basic parts of an Instrument.	5.2 1) Operating devices. 2) Controlling device: a) Gravity Control b) Spring Control 3) Damping device: a) Oil dashpot damping b) Eddy Current damping	5.3 Discuss and explain the operating, controlling and damping devices to trainees.

		The principles of operation of the moving coil instrument.	4) The construction and operations. • Advantages and disadvantages. A complete circuit for a moving coil instrument.	Discuss with the trainees the moving coil instrument using sketches to show parts as well as real objects.
5.0	MEASURING INSTRUMENT	Moving iron instrument. Extensions of range of measuring instruments.	Repulsion types which depends on mutual repulsion and attraction type which depends on the attraction of an iron. Advantages and Disadvantages. Shunt Resistor connections. Multiplier connections Solve problems on extensions of range of instrument. Circuit diagram of connection to extend	Discussion with trainees both the repulsion and attraction types of moving iron instrument using real objects. In groups discuss connection diagrams with trainees on the use of shunt and the multiplier. Solve problems on extension of range with trainees.

			ranges of Instrument using the shunt and the multiplier.	
6.0	ALTERNATING CURRENT (A.C) (PRINCIPLES)	6.1 The AC wave form and advantages. Explain the meaning of the following terms; • Cycle • Frequency • Periodic Time • Mechanical degrees • Electrical degrees The meaning of the following a) Instantaneous Values b) Average Values c) Maximum Values d) Root Mean Square Value	6.2 Description: b) Advantages.	6.3 Explain to trainees on how the A.C sine wave is obtained. Explain the meaning of a cycle to trainees using a diagram of a sine wave. Explain and discuss with the trainees the meaning of the terms in association with AC sine wave.

TASK		CRITICAL POINTS	SUB-POINTS	INSTRUCTIONAL TECHNIQUE
6.0		The phasor representative diagram of alternating voltage and current. a) Resistive circuit. b) Inductive circuit c) Capacitive circuit Solve problems involving; a) Maximum Value b) Average Value c) Root Mean Square value Define the following: • Inductance • Inductive Reactance in an AC Circuit	Drawing: a) Resistive current in phase with voltage. b) Inductive current in respect to the voltage c) Capacitive circuit in respect to the voltage Calculation a) Maximum Value b) Average Value c) Root mean square value Define and Explain a) Measure and ability of a circuit to produce magnetic field and stored.	Draw the phasor diagram on chalk board and explain to trainees. Explain the definition of Inductance in an AC Circuit Symbol = XL

			b) The position of pure inductive circuit in an AC supply.	Unit = Ohm
6.0		State the factors affecting inductance in an AC Circuit. Explain the meaning of impedance and solve problems involving resistance and inductance in an AC circuit. Explain the meaning of a Capacitance in A C circuits	Statement: a) Circuit containing inductive load. b) Induced voltage in series connected inductive load. c) Inductive load in AC circuit. Explanation: Impedance is the total opposition offered to the flow of electric current Symbol = Z Unit = Ohm Formula = $Z=\sqrt{R^2 + XL^2}$ Define Capacitance and explain: 1) Capacitance Reactance Symbol = Xc Unit = Ohm (Ω)	Explain to the trainees factors affecting inductance in an AC circuit. Discuss the meaning of impedance with the trainees. Explain the meaning and factors affecting capacitive Reactance in

			2) Solve simple calculations on capacitance in an AC circuit. 3) The phasor diagram of a pure capacitive load.	relation to phasors to the trainees
6.0		State the factors involving capacitance in an AC circuits. Solve problems involving resistance and capacitance in an AC circuit	Statement: a) The capacitance reactance decreases with increase in frequency. b) Increase in Reactance result in decrease in current Calculate for a) parallel circuit b) series circuit formula = $Z=\sqrt{R^2 + Xc^2}$ symbol = Xc Unit = Ohm (Ω)	Explain the methods of solving problems

7.0	ELECTROSTATICS	7.1 Trainee should be able to Explain Electric charge and Electric field in DC circuits Define a capacitor	7.2 Define electro static The charge stored in an electric field is measured in coulombs that is the product of current flow and time which it flows Q=IT(C) Where I = Current (A) T = Time (Sec) Q = Quantity (C) Define and state the unit.	7.3 Explain to the trainees electric charge and solve electric charge problems Explain the definition of capacitor to the trainees

CONSTRUCTION ELECTRICAL - CERTIFICATE ONE TRADE SCIENCE AND CALCULATION

TASK		CRITICAL SKILLS	SUB-SKILLS	INSTRUCTIONAL TECHNIQUE
7.0		List the types of capacitors Describe types of capacitors and state its	List the types a) Paper b) Mica c) Ceramic d) Electrolytic Description and application	Explain types of capacitors to trainees. Discuss types of capacitors with trainees

		application. Solve problems involving capacitors connected in series and parallel. Explain how to test a capacitor	a) Paper b) Mica c) Ceramic d) Electrolytic Calculation: Use formula i.e. = CT = $1/C_1+1/C_2+1/C_3$ for series and CT=C1 + C2 + C3 for parallel. Explanation 1) Connect Instrument to it and read out the value directly 2) Charge the capacitor by connecting it to a supply and after disconnection, short the ends of the capacitor	using real objects. Solve problems with trainees using the formula. Explain and demonstrate the testing of capacitors to trainees using real object
8.0	SINGLE PHASE MOTORS	8.1 DEFINE A SINGLE phase motor and list the types.	8.2 Definition and types: 1. Split phase 2. Permanent split phase	Discuss with the trainees the definition and the types.

			3. Capacitor start 4. Shaded pole 5. Repulsion 6. Universal series	
		Identify main part of a single phase motor.	Identification a) Starter b) Rotor c) End shield d) Bearing e) Centrifugal	Show part of a single phase motor to the trainees.
		Explain how the rotating magnetic field is produce.	Detail explanations	Explain to the trainees how the rotating magnetic field is produce
		Explain the characteristics of each types of motor • Universal • Split phase • Repulsion • Shaded pole	Detail explanations	Explain to the trainees the characteristics of each type of motor.

TASK		CRITICAL SKILLS	SUB-SKILLS	INSTRUCTIONAL TECHNIQUE
8.0		State types of faults in single phase motor Identify and rectify fault in a single phase motor	State the following • Open circuit • Short circuit • Grounded winding • Centrifugal switch • Worn or tight bearing. a) Open circuit test (multimeter) b) Short circuit test (multimeter) c) Grounded Winding (Insulation Resistance Test)	Discuss with the trainees the various types of faults on a single phase motor. Explain to the trainees the various types of rectifying fault in a single phase motor.
9.0	TRANSFORMERS	9.1 Explain the meaning of a transformer. Describe the principles of operation of a transformer. Construction of a	9.2 Define and give a detail explanations. Description and operation of a transformer.	9.3 Discuss the meaning of a transformer with trainees. Explain to the trainees the construction and operation by using chart or real object.

		transformer. Explain the types of transformers.	Descriptions of a transformer. Explanation on a) Double wound transformer b) Auto transformer	Discuss types of transformers with the trainees.
9.0		**Explain the use** of transformers	**Applications of** the types a) Double Wound b) Auto transformer	Mention few areas of use to the trainees
10.0	BASIC ELECTRONICS	10.1 Trainees should be able to: Define and list types of themistors and Resistors and their Ratings. List types electronic Capacitors. Define and list types of Semi-Conductor materials.	10.2 Definition and reading of Resistor value by using the colour codings. Definition and list types a) Air b) Silver Mica c) Polypropylene d) Tantalum Definition and list types a) Silicon	10.3 Explain the types and how to read Values by the colour Code. Discuss with the trainees the types and its applications. Explain the types of application to the trainees.

		Describe the P & N type of semi-conductors Describe the construction and operations of the following a) Zener diode b) Rectifier diode c) Thyristor d) Transistors	b) Germanium Applications Applications of the following: a) Zener diode b) Rectifier diode c) Thyristor d) Transistors	Explain the types to the trainees with its application.
11.0	POWER SUPPLY	11.1 Trainees should be able to draw a complete block diagram for power supply unit. Describe the construction and principles of operations of a simple power supply unit. Application of power supply unit.	11.2 Draw and labellel simple block diagram of a power supply unit. Explanation on the make-ups and its operations.	11.3 Draw the power supply unit on board and explain to the trainees. Explain the construction and Operation to trainees. Discuss with the trainees the applications and area of use.

CONSTRUCTION ELECTRICAL - CERTIFICATE ONE TRADE DRAWING

TASK		CRITICAL SKILLS	SUB-SKILLS	INSTRUCTIONAL TECHNIQUE
1.0	ARCHITECTURAL AND LOCATION SYMBOLS TO (BS3939) PART II	1.1 Interpretation of symbol	1.2 The architectural symbols.	Use chart to explain to trainee Trainee practice on symbols drawings
2.0	LAY OUT DRAWING FOR INSTALLATION WIRING	2.1.1a Block diagram of simple lighting and power circuit. 2.1.1b Circuit diagram of simple lighting and power in circuit. 2.1.1c Line diagram of simple lighting and power circuit. 2.1.2a Developing a layout diagram of a simple lighting and power circuit. 2.1.2b Layout diagram to develop an actual wiring diagram.		Facilitator guides trainee to develop a simple lighting and power circuit

TASK		CRITICAL SKILLS	SUB-SKILLS	INSTRUCTIONAL TECHNIQUE
3.0	THE USE AND APPLICATION OF SCALE	3.2 By calculation method determine scale factor (conversion of actual dimension to a given scale)	3.2.5 Reading of tape dimensions. Measure dimensions example • Classroom • Workshop 3.2.6 Conversion of actual measurement to the following scale: • 1:100 • 1:80 • 1:50 Enlargement and reduction of sizes using given scale for • Classroom • Workshop	Explanation, discussions and practicing with trainees methods determining scale factor, conversion of actual measurement to scale

PRACTICALS – CERTIFICATE ONE

TASK		CRITICAL SKILLS	SUB-SKILLS	INSTRUCTIONAL TECHNIQUE
1.0	WORKSHOP SAFETY	1.1.3 Personal safety practices 1.1.4 Artificial respiration	1.2.1 The use of protective gears. • Mouth to mouth method. • Holger Neilson method.	1.3.1 Explain and demonstrate to trainees, the correct way to wear and use the protective gears using real objects. 1.3.2 Explain and demonstrate to trainees the correct method and sequence of applying artificial respiration
2.0	TOOLS AND EQUIPMENT	2.1 Basic electrical hand tools and work piece eg. Ladders, scaffold		2.3 Explain and demonstrate the care and use of the tools using the real objects.
3.0	METHOD OF PREPARING TERMINATION	3.1 Termination of cable into accessories.	3.2.1 Preparation of cable loop for • Pillar terminal • Stud and nut terminal	3.3.1 Demonstrate to trainees how to prepare termination of cables using real objects.

			• Shrouded terminal 3.2.2 Terminate cables into cable lugs by crimping method.	3.3.2 Demonstrate to trainees using real object
4.0	JOINING OF CONDUCTORS	4.1 Joining of cables	4.2 Joining of cables by means of; • Married Joint • Tee Joint • Connector Terminal	4.3 Explain and demonstrate to trainees.
5.0	PREPARATION AND INSTALLATION OF P.V.C. CONDUIT	5.1.1 Preparation of PVC conduit. Bending 90° Make offset. Make end socket on conduit. 5.1.2 Installation of PVC Conduit.	5.2.1 Materials and tools. 5.2.2 Marking out tools. 5.2.3 Cutting tools. • Develop the 90° bend. • Develop an offset bend. • Make and socket on the conduit. • Fix PVC conduit and boxes on board. 5.2.4 Materials and tools. a) Mark out on	5.3.1 Demonstrate the procedure to the trainees with real object 5.3.2 Explain and demonstrate the procedure to the trainees with real object.

			board. b) Erect conduit with saddles. c) Fix boxes. Test for firmness of conduit and boxes.	
6.0	PREPARATION AND INSTALLATION OF P.V.C. TRUNKING	6.1 Preparation of PVC trunking. a) Tee Joints b) Mitre Joints	6.2 Materials and tools to; • Marking out trunking with a tape. • Fabricate Tee Joint. • Fabricate Mitre Joint. • Fixing trunking and patress boxes on board.	6.3 Explain and demonstrate the procedure to the trainees using real object.
7.0	WIRING OF BELL CIRCUIT	7.1.1 Accessories; • Bell • Bell push • D.C. Battery ✓	7.2 Materials and tools for the bell circuit. • 8 to 12v step down bell transformer or battery.	7.3 Explain and demonstrate the procedure to trainees with real object

			• 8 to 12v electric bell. • Bell pushes. • Wiring the circuit.	
8.0	WIRING ON BOARDS AND WALLS	8.1.1 Surface wiring a) Circuits: • One-way switching • Two-way switching • Intermediate switching. b) To control one or two lamps.	8.2.1a Select materials and tools. 8.2.1b Marking 8.2.1c Circuit 8.2.1d Fixing accessories	8.3.1 Explain and demonstrate the procedure of the wiring to trainees using real object.

PRACTICALS – CERTIFICATE ONE

TASK		CRITICAL SKILLS	SUB-SKILLS	INSTRUCTIONAL TECHNIQUE
8.0		8.1.2 Conduit wiring: • One-way switching. • Two-way switching. • Intermediate switching. b) To control one or two lamps. 8.1.3 Surface wiring (Socket Outlets). 1) Circuits; • 3 or 4 socket outlets in ring and radial. 8.1.4 Circuit in PVC conduit pipes; • 3 or 4 socket outlets in a ring and radial. • 3 or 4 socket outlet in a ring with 1 or 2 spur	8.2.2 Select materials and tools; • Marking out on board. • Bend angles and offset according to the wire. • Saddle conduit and draw-in-cables. • Fix accessories 8.2.3 Materials and tools, • Marking out on board Circuit wiring • Fix accessories 8.2.4 Materials and tools. • Marking out on board. • Bend angles and	8.3.2 Explain and demonstrate the procedure of the wiring to trainees with real object. 8.3.3 Explain and demonstrate the procedure of the wiring to trainees. 8.3.4 Explain and demonstrate the procedure of the wiring to trainees using real object.

			offset according to wiring. • Saddle conduit pipes and drawn-in-cables. • Fixing accessories	

PRACTICALS – CERTIFICATE ONE

TASK		CRITICAL SKILLS	SUB-SKILLS	INSTRUCTIONAL TECHNIQUE
8.0		8.1.5 Trunking Wiring PVC trunking. • One-way switching • Two-way switching • Intermediate switching b) To control one or two lamps.	8.2.5 Tools and materials. • Marking out on board. • Fabricate Tee and Mitre joint. • Fix trunking on board by using screws.	8.3.5 Demonstrate to trainees with real object.

		8.1.6 Trunking wiring for socket outlets. a) Using PVC trunking wire the following circuit. • or 4 socket outlet in ring with a spur. • 3 or 4 socket outlets in a radial.	• Lay in cable • Fixing accessories 8.2.6 Materials and tools, • Marking out on board. • Circuit wiring • Fixing accessories	8.3.6 Explain and demonstrate the procedure to trainees using real object.
9.0	INSTALLATION OF SERVICE POSITION EQUIPMENT	9.1 The sequence of supply arrangement on meter board. a) Service cut-out b) Connection for the meter c) Main switch d) Distribution Board or consumer units	9.2.1 Materials and tools. ❖ Marking out position for accessories. ❖ Fixing accessories on board ❖ Wiring accessories	9.3 Explain and demonstrate the procedure to trainees using real objects
10.0	EARTHING ARRANGEMENT	10.1.1 Earthing of an Installation . Rod and plate types of electrode. 10.1.2 Method of burying earth electrode.	10.2 Tools and materials a) Size of CPC/earthing cable (depending on the size of Installation).	10.3 Explain and demonstrate the process to trainees with real object

			b) Inspection chamber. c) Burying earth electrode in the inspection chamber. d) Connecting the earthing conductor to electrode by earth clamp. e) Connecting earthing lead to the earthing bar on the consumer unit.	Demonstration
11.0	TESTING OF AN INSTALLATION	11.1 Types of installation test; a) Polarity test b) Continuity test c) Earthing test d) Insulation resistance test	11.2 Procedures for an installation test; a) Polarity test b) Continuity test c) Earthing test d) Insulation resistance test	11.3 Demonstrate the various method of testing to the trainees with real object
12.0	DISCHARGE LIGHTING	1.1.1 Parts of fluorescent light circuit • Choke • Starter • Lamp holders • Capacitor	12.2.1 Draw a circuit diagram. a) With the aid of the circuit diagram Wire the fluorescent light circuit using the listed accessories.	12.3.1 Explain the procedure for wiring a circuit to the trainees. 12.3.2 Explain the

		1.1.2 List the parts of sodium vapour lamp circuit • Ballast/Transformer • Screw lamp holder • Igniter • Capacitor	12.2.2 Circuit diagram. 12.2.3 Circuit diagram.	procedure for wiring the lamp circuit with real object.
13.0	SINGLE PHASE DISTRIBUTION SYSTEM	13.1 Wiring and testing a complete Installation to the distribution board. • Lighting final circuit • Socket outlet either in ring or radial • Water heater circuit • Electric cooker unit • Bell circuit • Air-condition circuit •	13.2 Materials and tools. • Correct size of cable. • Developing wiring circuit. • Wiring the Installation as per-drawing. • Testing the complete Installation.	13.3 a. Explain the procedure of the wiring to trainees. b. Facilitator guides the trainee to wire and test the installation

PRACTICALS – CERTIFICATE ONE

TASK		CRITICAL SKILLS	SUB-SKILLS	INSTRUCTIONAL TECHNIQUE
14.0	SINGLE PHASE ELECTRIC MOTORS	14.1 The various types of single phase motors. • Capacitor start • Capacitor start and run • Shaded pole motor • Universal series motor • Repulsion motor	14.2 Connecting single phase motor to the supply. • Capacitor start. • Capacitor start and run. • Shaded pole motor. • Universal series motor. • Repulsion motor.	14.3 Explain the process of the wiring or the connection to the supply using real object.
15.0	MOUNTING AND INSTALLATION OF SINGLE PHASE MOTORS	15.1.1 Design frame work. 15.1.2 Construct cement foundation for motor stand.	15.2.1 Fixing template and Bolt. 15.2.2 Fixing machine directly on concrete floor or bed.	15.3 Explain the procedure for mounting and fixing of single phase motor using real object.
16.0	TESTING AND INSPECTION OF SINGLE PHASE MOTORS	16.1 Testing procedure for: a) Continuity of windings. b) Insulation	16.2 Appropriate measuring instrument for testing. Example, megger tester, multi-meter (AVO)	16.3 Explain the procedure and demonstrate to trainees using real object

		Resistance between windings. c) Insulation resistance between winding and earth. d) Open circuit in windings e) Short circuit between windings		

PRACTICALS – CERTIFICATE ONE

TASK		CRITICAL SKILLS	SUB-SKILLS	INSTRUCTIONAL TECHNIQUE
17.0	BASIC ELECTRONICS	17.1.1 Resistors by their colour code : • Black - 0 • Brown - 1 • Red - 2 17.1.2 Types of diodes example • Rectifier diode • Zener diode	17.2.1 A.V.O. Meter to find the value of coloured coded resistor value. 17.2.2 Use A.V.O. Meter to find polarity of a diode example • Rectified diode • Zener diode	17.3.1 Explain and demonstrate a colour coded resistor to trainees. Using real object 17.3.2 Explain and demonstrate diode polarity position (+)

		17.1.3 Types of transistors example • P.N.P. Transistors • N.P.N. Transistors 17.1.4 Transistors terminals or pin example • Emitter pin • Collector pin • Base pin	17.2.4 Use AVO Meter to identify transistor pin or terminal example • Emitter pin • Collector pin • Base pin	Negative (-) to trainees. Using real object 17.3.3 Explain and demonstrate or show transistor pin to trainees. Using real object