

12.1.0 ELECTRICAL INSTALLATIONS TECHNOLOGY I

12.1.0.1 Introduction

This module unit is designed to equip the trainee with knowledge, skills and attitude necessary to carry out electrical installation work in domestic premises and related environments.

12.1.0.2 General Objectives

By the end of the module unit, the trainee should be able to:

- a) understand the operations of final circuits
- b) demonstrate safety awareness when handling electrical tools and equipment
- c) appreciate the correct use of tools and equipment
- d) determine appropriate types of cables for a particular purpose
- e) outline the distribution network in power systems
- f) apply relevant principles to operate electrical machines
- g) provide maintenance and service to electrical tools, equipment, cabling and accessories

12.1.0.3 Module Unit Summary and Time Allocation

Electrical Installation I

Code	Sub-Module Unit	Content	Time Hrs
12.1.1	Electrical Final Circuits	<ul style="list-style-type: none"> • Definition of final circuit • Description of sequence of control • Connection of lighting circuits • Ring and radial final circuits • Procedure for testing and inspection • Types of accessories and equipment • I.E.E. regulations 	44
12.1.2	Electrical Power Supply	<ul style="list-style-type: none"> • Authorities for supply systems • Types of power supply systems 	37

		<ul style="list-style-type: none"> • Outline of electrical power supply system 	
12.1.3	Cables	<ul style="list-style-type: none"> • Types and sizes • Construction • Cable sizing • Factors affecting cable ratings 	23
12.1.4	Protection And Earthing Of Electrical Installations	<ul style="list-style-type: none"> • Reason for earthing • Terminologies • Types of fuses • Earthing of an electrical installation • Earth current protection • Methods of earthing • Parts of earth • Testing for earth 	33
12.1.5	Electrical Machines I	<ul style="list-style-type: none"> • Construction of ac machines • Construction of dc machines 	33
Total Time			170

12.1.1 ELECTRICAL FINAL CIRCUITS

Theory

12.1.1T0 *Specific Objectives*

By the end of the sub-module unit, the trainee should be able to:

- a) define a final circuit
- b) describe the sequence of control equipment at the consumer's intake point.
- c) Explain the connection of lighting circuit using joint boxes
- d) explain ring and radial final circuits
- e) state procedure for testing a final circuit
- f) describe the different types of accessories
- g) state the relevant IEE regulations

Competence

The trainee should have the ability to:

- i) Interpret electrical layout diagrams for final circuits
- ii) Draw wiring diagrams for final sub-circuits
- iii) Install lighting circuits
- iv) Install power circuits

- v) Apply manipulative skills to come up with lighting circuits for various purposes
- vi) performing electrical tests on an installation
- vii) performing inspection a completed domestic installation
- viii) Estimate materials for electrical installation work

Content

12.1.1T 1 Final Circuit

- i) Definition
- ii) Different type of final circuits
- iii) Relevant I.E.E regulations

12.1.1T 2 Sequence of control

- i) Description of equipment at intake point
- ii) Consumers' equipment
- iii) Power supply's equipment
- iv) Correct sequence of connection
- v) Relevant I.E.E regulations

12.1.1T 3 Lighting circuits

- i) Loop in method
- ii) Use of ceiling roses
- iii) Use of joint boxes
- iv) One way switching

- v) Two way switching
- vi) Two way and intermediate switching

12.1.1T 4 Ring and radial Power circuit

- i) Socket outlet (3A)
- ii) Protective devices
- iii) Relevant I.E.E regulations requirements
- iv) Water heater circuits
- v) Instantaneous water heater
- vi) Non instantaneous water heater
- vii) Astern type water heater
- viii) Relevant I.E.E regulations requirements

12.1.1T 5 Testing and inspection

- i) Visual inspection
- ii) Verification of polarity
- iii) Earthing tests
- iv) Insulation resistance test
- v) Continuity of ring continuity test
- vi) I.E.E regulations for tests and inspection of an electrical installation

12.1.1T 6 Accessories and equipment

- i) Definition
- ii) Accessory
- iii) switch plug

- iv) Socket outlet
- v) joint box
- vi) distribution board
- vii) Types of accessories for lighting circuits
- viii) Switches
- ix) Lamp holders
- x) Ceiling roses
- xi) joint boxes
- xii) (relevant I.E.E regulations)
- xiii) Clock connections
- xiv) Electric shaver sockets

12.1.1T 7 Relevant I.E.E.

- regulations
- i) Other types of accessories
- ii) Consumers control unit
- iii) Distribution board
- iv) Observe the relevant IEE regulations

Practice

12.1.1P0 Specific Objectives

By the end of the sub-module unit, the trainee should be able to:

- a) interpret electrical drawings and complete install lighting final circuits
- b) install ring and radial final circuits
- c) inspect and test final circuits

- d) state the relevant IEE regulations in each case
- e) observe safety, standards and good workmanship while performing electrical installation work.
- f) estimate material requirements for an installation work
- g) carry out quality control checks

Content

- 12.1.1P1 Interpretation of electrical drawings
 - i) Symbols
 - ii) Dimensions and tolerance
 - iii) Lay out
 - iv) Special conditions
- 12.1.1P2 Installation of ring and radial final circuits
 - i) Taking measurements
 - ii) Level, tight and neat fixing of components
- 12.1.1 P3 Inspection and tests of final circuits
- 12.1.1P4 Testing and inspection
 - i) Visual inspection
 - ii) Testing procedures for all the tests
 - iii) Verification of polarity
 - iv) Earthing tests
 - v) Insulation resistance test

- vi) Continuity of ring continuity test
- vii) Expected readings
- 12.1.1P5 I.E.E regulations for tests and inspection of an electrical installation
- 12.1.1P6 Safety observation in electrical work
 - i) Safety of self
 - ii) Safety of others
 - iii) Safety of tools and equipment
- 12.1.1P7 Material estimate
 - i) Measured items
 - ii) Numbered items
 - iii) Fixes
- 12.1.1P8 Quality control checks
 - i) Correct usage of tools and measuring instruments
 - ii) Good quality finish and appearance
 - iii) Correct measurements and accuracy
 - iv) Application of set test procedures and
 - v) Performance as per specifications of the design

Suggested teaching and learning resources

- i) Electrical tool kit
- ii) PVC conduits
- iii) PVC sheathed cable
- iv) PVC mini-trunking
- v) Various cable sizes

- vi) Vertical wooden boards, masonry walls
- vii) Ohmmeter
- viii) Test lamp
- ix) Multi-tester for continuity and insulation resistance tests

12.1.2 ELECTRICAL POWER SUPPLY

12.1.2T0 *Specific Objectives*

- By the end of the sub-module unit, the trainee should be able to:
- a) explain the main work of the authorities for power production in Kenya
 - b) describe various types of power supply systems
 - c) describe the outline of the various power transmission and distribution systems from generation to the consumer
 - d) describe different transmission and distribution systems
 - e) compare A.C. and D.C. systems of transmission

Competence

The trainee should have the ability to select and carry out installation for

a typical distribution system for a small plant

Contents

- 12.1.2T1 Authorities of power production
 - i) Kenya Power and Lighting Company (K.P.L.C)
 - ii) Ken Gen
 - iii) Independent power producer
 - iv) The electricity board
 - v) The development authorities
- 12.1.2T2 Power supply systems
 - i) Typical layout diagrams
 - ii) Types of generating stations
 - iii) Transmission stage
 - iv) Distribution stage
- 12.1.2T3 Transmission and distribution systems
 - i) D.C two wire
 - ii) D.C three wire
 - iii) A.C two wire
 - iv) A.C. four wire
 - v) Radial and ring distribution
- 12.1.2T4 AC and DC systems
 - i) Advantages of each
 - ii) Disadvantages of each
- 12.1.2T5 AC and DC power systems

Practice

- 12.1.2P0 *Specific Objectives*

By the end of the sub-module unit, the trainee should be able to:

- a) select and carry out installation for a typical distribution system for small industrial plant
- b) observe the IEEE regulations on transmission and distribution

- b) describe the construction of cables
- c) calculate the correct size of cable for a given load using appropriate tables and rating factors
- d) explain the factors affecting cable ratings
- e) explain the methods of joining metals and their applications

Content

- 12.1.2P1 Electrical installation
 - 3 phase, 4 wire distribution system with single phase loads
- 12.1.2P2 Safety observation
 - i) Personal safety
 - ii) Safety for others

Contents

- 12.1.3T1 Types and sizes of cables
 - i) Types of conductors
 - ii) Copper
 - iii) Copper properties
 - iv) Aluminum
 - v) Aluminum properties
 - vi) Cable sizes
 - vii) Determine the size of a cable given the strand diameter
 - viii) Applications of cable types

Suggested teaching and learning resources

- i) 3 phase distribution board
- ii) Consumer control units
- iii) Planned industrial visit

12.1.3 CABLES

Theory

12.1.3T0 *Specific Objectives*

By the end of the sub-module unit, the trainee should be able to:

- a) state types and sizes of cables

- 12.1.3T2 Construction
 - i) Armoured
 - ii) Non-armoured
 - iii) Purposes of stranding

- 12.1.3T3 Cable size calculations
 - Cable ratings

- 12.1.3T4 Factors affecting cable rating

- 12.1.3T45 Cable joints and terminations
- i) Cable joints
 - ii) Soldering twisted tee joints using blow lamp
 - iii) Soldering joints using pot and ladle
 - iv) Cable terminations
 - v) Clamping method
 - vi) Crimping method
 - vii) Regulations regarding joints
 - viii) Dangers of poor joints
 - ix) dry joint
 - x) high resistance in joints

Practice

- 12.1.3P0 *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to:
- a) make various cable joints such that they are electrically and mechanically sound
 - b) solder the joints effectively
 - c) perform cable terminations
 - d) perform tests on cable joints

Content

- 12.1.3P1 Performance of cable joints
- 12.1.3P2 Soldering procedure

- i) Soldering by use of pot and ladle
 - ii) Soldering by use of electric soldering iron
 - iii) Soldering by use of blow lamp
- 12.1.3P3 Cable terminations
- IEE regulations on cable joints
- 12.1.3P4 Tests on cable joints

Suggested Learning Resources

- i) Chalkboard
- ii) Books
- iii) Various types of cables
- iv) I.E.E regulations table for cable data
- v) Pot and ladle
- vi) Soldering gun
- vii) Crimping tool

12.1.4T0 PROTECTION AND EARTHING OF ELECTRICAL INSTALLATIONS

Theory

- 12.1.4T0 *Specific Objectives*
By the end of the sub-module unit, the trainee should be able to:
- a) explain the reason for earthing
 - b) define various terminologies used in earthing and protection of electrical installations

- c) describe the different types of fuses
- d) define terms applied to earthing of an installation
- e) explain the different methods of earth current protection
- f) explain the different methods of earthing
- g) explain parts of an earthing system
- h) describe the tests for an earthing system

Competence

The trainee should have the ability to:

- i) Select and use circuit protection
- ii) Earth a domestic installation
- iii) Test the operation of various protective devices
- iv) Perform earth loop impedance tests

Content

12.1.4T1 Reasons for earthing

12.1.4T12 Definition of terms

- i) Over current
- ii) Short circuit
- iii) Earth leakage
- iv) Close excess current protection
- v) Coarse excess current protection
- vi) Discrimination
- vii) Fusing factor

viii) Fusing current

12.1.4T3 Types of fuses

- i) Rewirable fuses
- ii) Cartridge fuses
- iii) High rupturing capacity fuses
- iv) Construction and operation of various types of fuses
- v) Application of various fuses

12.1.4T4 Earthing terminologies

- i) Earth
- ii) Earthed
- iii) Solidly earthed
- iv) Earth electrode
- v) Earthing lead
- vi) Earth continuity conductor
- vii) Live metal work
- viii) Protective Multiple Earthing (PME)
- ix) Earth resistivity
- x) Earth resistance

12.1.4T5 Methods of earth currents protection

- i) Fuses
- ii) Circuit breakers
- iii) operation of excess current and earth leakage protection devices

12.1.4T6 Methods of earthing

- i) Connection of metal work to the supply earth conductor
- ii) Continuous Earth Wire (CEW)

- iii) The earth electrode
- iv) Protective Multiple Earthing (PME)
- v) Automatic fault protection
- vi) Miniature circuit breakers
- vii) Current operated earth leakage circuit breaker
- viii) Voltage operated earth leakage circuit breaker

- 12.1.4T7 Parts of an earthing system
- i) Earth Continuity Conductor (E.C.C)
 - ii) Earthing lead
 - iii) Earth electrode

- 12.1.4T8 Tests
- i) Earth continuity
 - ii) Earth loop impedance
 - iii) Earth loop resistance

Practice

12.1.4P0 Specific Objectives

- By the end of the sub-module unit, the trainee should be able to:
- a) perform earthing of domestic installation
 - b) install residual current circuit breakers
 - c) measure earth loop impedance
 - d) measure of earth resistance area

- e) carry out various earthing tests

Contents

- 12.1.4P1 Protection of domestic installations
- 12.1.4P2 Installation of residual current circuit breaker
 - i) Tests on the circuit breaker
 - ii) Installation of the circuit breaker
- 12.1.4P3 Measurement of earth loop impedance
 - i) Determination of the loop
 - ii) Identification of the test instrument

Suggested teaching and learning resources

- i) High Breaking Capacity(HBC) fuse
- ii) Cartridge fuse
- iii) Miniature Circuit Breaker
- iv) Consumer control unit
- v) Distribution board
- vi) Rewireable fuses
- vii) Earthing rods
- viii) Earth continuity conductor
- ix) Residue current devices
- x) Voltage operated Earth Leakage Circuit Breaker (E.L.C.B)

- xi) Institutes installation network
- xii) Insulation and continuity tester
- xiii) Earth resistance and Neutral Earth loop impedance tester

12.1.5 ELECTRICAL MACHINES I

Theory

12.1.5 T0 *Specific Objectives*

By the end of the sub-module unit, the trainee should be able to:

- a) draw and label the constructional parts of ac machines
- b) draw and label the constructional parts of dc machines

Competence

The trainee should have the ability to:

- i) Dismantle a.c. and d.c. motors
- ii) Assemble a.c. and d.c. motors
- iii) Inspect a.c. and d.c. motors
- iv) Test a.c. and d.c. motors
- v) Carry out quality control checks

Content

12.1.5 T1 Constructional parts of different types of ac machines

- i) Single – phase motors
- ii) Split – phase motor
- iii) Capacitor start motor
- iv) Capacitor start and run motor
- v) Capacitor start, capacitor run motor
- vi) Shaded – pole motor

12.1.5 T2 Constructional parts of dc motors

- i) Series motor
- ii) Shunt motor
- iii) Compound motor
- iv) Universal motor

Practice

12.1.5 P0 *Specific Objectives*

By the end of the sub-module unit, the trainee should be able to:

- a) dismantle single phase motors
- b) assemble single phase motors
- c) dismantle direct current motors
- d) assemble direct current motors
- e) inspect single phase and D.C motors for
- f) proper operation
- g) Carry out control checks at every stage

Content

- 12.1.5 P1 Dismantling of single phase motors
 - i) Single – phase motors
 - ii) Split – phase motor
 - iii) Capacitor start motor
 - iv) Capacitor start and run motor
 - v) Capacitor start, capacitor run motor
 - vi) Shaded – pole motor
- 12.1.5 P1 Assembly of single phase motors
 - i) Single – phase motors
 - ii) Split – phase motor
 - iii) Capacitor start motor
 - iv) Capacitor start and run motor

- v) Capacitor start, capacitor run motor
- vi) Shaded – pole motor
- 12.1.5 P1 Dismantling of direct current motors
- 12.1.5 P1 Assembly of direct current motors
 - i) Series motor
 - ii) Shunt motor
 - iii) Compound motor
 - iv) Universal motor
 - v) Inspection of single phase motors and d.c. motors for proper operations

Suggested Learning Resources

- i) Single phase motors
- ii) dc motors
- iii) Tools including
- iv) Markers
- v) Field visits