

**REPUBLIC OF KENYA**

**COMPETENCY BASED CURRICULUM**

**FOR**

**ELECTRICAL INSTALLATION**

**LEVEL 4**



TVET CDACC

P.O BOX 15745-00100

NAIROBI

First published 2019

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# FOREWORD

The provision of quality education and training is fundamental to the Government’s overall strategy for social economic development. Quality education and training will contribute to achievement Kenya’s development blue print and sustainable development goals.

Reforms in the education sector are necessary for the achievement of Kenya Vision 2030 and meeting the provisions of the Constitution of Kenya 2010. The education sector had to be aligned to the Constitution and this resulted to the formulation of the Policy Framework for Reforming Education and Training (Sessional Paper No. 4 of 2016). A key feature of this policy is the radical change in the design and delivery of the TVET training. This policy document requires that training in TVET be competency based, curriculum development be industry led, certification be based on demonstration of competence and mode of delivery allows for multiple entry and exit in TVET programmes.

These reforms demand that Industry takes a leading role in curriculum development to ensure the curriculum addresses its competence needs. It is against this background that this Curriculum has been developed.

It is my conviction that this curriculum will play a great role towards development of competent human resource for the Electrical sector’s growth and sustainable development.

**PRINCIPAL SECRETARY, VOCATIONAL AND TECHNICAL TRAINING**

**MINISTRY OF EDUCATION**

# PREFACE

Kenya Vision 2030 aims to transform the country into a newly industrializing, “middle-income country providing a high-quality life to all its citizens by the year 2030”. Kenya intends to create a globally competitive and adaptive human resource base to meet the requirements of a rapidly industrializing economy through life-long education and training. TVET has a responsibility of facilitating the process of inculcating knowledge, skills and attitudes necessary for catapulting the nation to a globally competitive country, hence the paradigm shift to embrace Competency Based Education and Training (CBET).

The Technical and Vocational Education and Training Act No. 29 of 2013 and the Sessional Paper No. 4 of 2016 on Reforming Education and Training in Kenya, emphasized the need to reform curriculum development, assessment and certification. This called for a shift to CBET to address the mismatch between skills acquired through training and skills needed by industry as well as increase the global competitiveness of Kenyan labour force.

TVET Curriculum Development, Assessment and Certification Council (TVET CDACC), in conjunction with Electrical Engineering Sector Skills Advisory Committee (SSAC) have developed this curriculum.

This curriculum has been developed following the CBET framework policy; the CBETA standards and guidelines provided by the TVET Authority and the Kenya National Qualification Framework designed by the Kenya National Qualification Authority.

This curriculum has been developed following the CBET framework policy; the CBETA Standards and guidelines provided by the TVET Authority and the Kenya National Qualification framework designed by the Kenya National Qualification Authority.

This curriculum is designed and organized with an outline of learning outcomes; Suggested Methods of Instruction, training/learning resources and methods of assessing the trainee’s achievement. The curriculum is competency-based and allows multiple entry and exit to the course.

I am grateful to the Council Members, Council Secretariat, Electrical Engineering SSAC, expert workers and all those who participated in the development of this curriculum.

**CHAIRPERSON, TVET CDACC**

# ACKNOWLEDGEMENT

This curriculum has been designed for competency-based training and has independent units of learning that allow the trainee flexibility in entry and exit. In developing the curriculum, significant involvement and support was received from various organizations.

I recognize with appreciation the role of the Electrical Engineering Sector Skills Advisory Committee (SSAC) in ensuring that competencies required by the industry are addressed in the curriculum. I also thank all stakeholders in the Electrical sector for their valuable input and all those who participated in the process of developing this curriculum.

I am convinced that this curriculum will go a long way in ensuring that workers in Electrical Sector acquire competencies that will enable them to perform their work more efficiently.

**COUNCIL SECRETARY/CEO**

**TVET CDACC**

**TABLE OF CONTENTS**

[FOREWORD ii](#_Toc64712770)

[PREFACE iii](#_Toc64712771)

[ACKNOWLEDGEMENT iv](#_Toc64712772)

[ACRONYMNS AND ABBREVIATIONS v](#_Toc64712773)

[OVERVIEW viii](#_Toc64712774)

[BASIC UNITS OF LEARNING 1](#_Toc64712775)

[COMMUNICATION SKILLS 2](#_Toc64712776)

[DIGITAL LITERACY 5](#_Toc64712777)

[ENTREPRENEURIAL SKILLS 7](#_Toc64712778)

[EMPLOYABILITY SKILLS 11](#_Toc64712779)

[OCCUPATIONAL SAFETY AND HEALTH PRACTICES 17](#_Toc64712780)

[COMMON UNITS OF LEARNING 19](#_Toc64712781)

[ENGINEERING MATHEMATICS 20](#_Toc64712782)

[WORKSHOP TECHNOLOGY 23](#_Toc64712783)

[ELECTRICAL PRINCIPLES 26](#_Toc64712784)

[TECHNICAL DRAWING 30](#_Toc64712785)

[CORE UNITS OF LEARNING 33](#_Toc64712786)

[ELECTRICAL INSTALLATION 34](#_Toc64712787)

[ELECTRICAL INSTALLATION TESTING 39](#_Toc64712788)

[ELECTRICAL INSTALLATION BREAKDOWN MAINTENANCE 42](#_Toc64712789)

ACRONYMNS AND ABBREVIATIONS

CAD Computer Aided Design

CCTV Closed Circuit Tele Vision

CDACC Curriculum Development, Assessment and Certification Council

EHS Environment Health and Safety

IEE Institute of Electrical Engineers

HVAC Heating Ventilation and Air Conditioning

IBMS Integrated Building Management System

K.C.S.E Kenya Certificate of Secondary Education

KNQA Kenya National Qualification Authority

KNQF Kenya National Qualification Framework

KEBS Kenya Bureau of Standards

KPLC Kenya Power and Lighting Company

NCA National Construction Authority

NEMA National Environment Management Authority

OSHA Occupational Safety and Health Act

PPE Personal Protective Equipment

PV Photo Voltaic

TVET Technical and Vocational Education and Training

WIBA Work Injury Benefits Act

**KEY TO UNIT CODE**

 **ENG/CU/EI/BC/CO/CR/01/4/ A**

Industry or sector

Curriculum

Occupational area

Type of competency

Competency number

Competency level

Version control

# OVERVIEW

**Description of the course**

This course is designed to equip electrical Craft person with the competencies required to plan, install, test, maintain and repair different types of electrical installations. The activities involved include the installation types ranging from domestic to commercial of the single-phase type.

The course consists of basic, common and core units of learning as indicated below:

**Basic Units of Learning**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit Code** | **Unit Title** | **Duration in Hours** | **Credit factors** |
| ENG/CU/EI/BC/01/4/A | Communication skills | 20 | 2.0 |
| ENG/CU/EI/BC/02/4/A | Digital literacy | 30 | 3.0 |
| ENG/CU/EI/BC/03/4/A | Entrepreneurial skills | 60 | 6.0 |
| ENG/CU/EI/BC/04/4/A | Employability skills | 30 | 3.0 |
| ENG/CU/EI/BC/05/4/A | Environmental literacy | 20 | 2.0 |
| ENG/CU/EI/BC/06/4/A | Occupational safety and health practices | 20 | 2.0 |
| **Total** | **180** | 18.0 |

 **Common Units of Learning**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit Code** | **Unit Title** | **Duration in Hours** | **Credit Factors** |
| ENG/CU/EI/CC/01/4/A | Engineering Mathematics | 60 | 6.0 |
| ENG/CU/EI/CC/02/4/A | Workshop Technology | 45 | 4.5 |
| ENG/CU/EI/CC/03/4/A | Electrical principles | 45 | 4.5 |
| ENG/CU/EI/CC/04/4/A | Technical Drawing | 90 | 9.0 |
| **Total** | **240** | **24.0** |

**Core Units of Learning**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit Code** | **Unit Title** | **Duration in Hours** | **Credit factors** |
| ENG/CU/EI/CR/02/4/A | Perform Electrical Installation | 120 | 12.0 |
| ENG/CU/EI/CR/03/4/A | Testing of Electrical Installation | 30 | 3.0 |
| ENG/CU/EI/CR/05/4/A | Electrical Installation Breakdown Maintenance  | 90 | 9.0 |
|  | Industrial Attachment | 300 | 30.0 |
| **Total** | **540** | **54.0** |
| **GRAND TOTAL** | **960** | **96.0** |

The total duration of the course is **960** hours, inclusive of industrial attachment.

**Entry Requirements**

An individual entering this course should have any of the following minimum requirements:

1. Kenya Certificate of Secondary Education (K.C.S.E.) mean grade E

**Or**

1. Level 3 certificate in electrical installation with **one** year of continuous work experience

**Or**

1. Equivalent qualifications as determined by Kenya National Qualifications Authority (KNQA)

**Industrial attachment**

An individual enrolled in this course will be required to undergo an industrial attachment in an Electrical firm for a period of at least 300 hours. Attachment will be undertaken upon completion of the course or the unit of learning.

**Trainer qualification**

A trainer for this course should have a higher qualification than the level of this course

**Assessment**

The course will be assessed at two levels: internally and externally. Internal assessment is continuous and is conducted by the trainer who is monitored by an internal accredited verifier while external assessment is the responsibility of TVET/CDACC.

**Certification**

A candidate will be issued with a Record of Achievement on demonstration of competence in a unit of competency. To attain the qualification Electrical Artisan Level 4, the candidate must demonstrate competence in all the units of competency as given in qualification pack. These certificates will be issued by TVET CDACC in conjunction with training provider.

# BASIC UNITS OF LEARNING

## COMMUNICATION SKILLS

**UNIT CODE:** ENG/CU/EI/BC/01/4/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Demonstrate communication skills

**Duration of Unit:** 20 Hours

**Unit Description**

This unit describes the competencies required to lead in the dissemination and discussion of ideas, information and issues in the workplace.

**Summary of Learning Outcomes**

1. Obtain and convey workplace information
2. Complete relevant work-related documents
3. Communicate information about workplace processes
4. Lead workplace discussion
5. Identify and communicate issues arising in the workplace

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Obtain and convey workplace information
 | * Communication process
* Modes of communication
* Medium of communication
* Effective communication
* Barriers to communication
* Flow of communication
* Sources of information
* Types of questions
* Organizational policies
* Workplace etiquette
* Ethical work practices in handling communication
 | * Observation
* Interview
* Third party reports
 |
| 1. Complete relevant work-related documents
 | * Types and purposes of workplace documents and forms
* Methods used in filling forms and documents
* Recording workplace data
* Process of distributing workplace forms and documents
* Report writing
* Types of workplace reports
 | * Observation
* Interview
* Third party reports
 |
| 1. Communicate information about workplace processes
 | * Communication process
* Modes of communication
* Medium of communication
* Effective communication
* Barriers to communication
* Flow of communication
* Sources of information
* Organizational policies
* Organization requirements for written and electronic communication methods
* Report writing
* Effective questioning techniques (clarifying and probing)
* Workplace etiquette
* Ethical work practices in handling communication
 | * Observation
* Interview
* Portfolio
 |
| 1. Lead workplace discussion
 | * Methods of discussion e.g.
	+ Coordination meetings
	+ Toolbox discussion
	+ Peer-to-peer discussion
* Solicitation of response
 | * Observation
* Interview
* Third party reports
 |
| 1. Identify and communicate issues arising in the workplace
 | * Identification of problems and issues
* Organizing information on problems and issues
* Relating problems and issues
* Communication barriers affecting workplace discussions
 | * Observation
* Interview
* Portfolio
 |

**Suggested Methods of Instruction**

* Discussion
* Role play
* Brainstorming

**Recommended Resources**

* Desktop computers/laptops
* Internet connection
* Projectors
* Telephone
* Report writing templates

## DIGITAL LITERACY

**UNIT CODE:** ENG/CU/EI/BC/02/4/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Demonstrate digital literacy

**Duration of Unit:** 35 hours

**Unit Description**

This unit covers the competencies required to effectively demonstrate digital literacy in a working environment. It entails identifying and using digital devices such as smartphones, tablets, laptops and desktop PCs for purposes of communication and performing work related tasks at the work place.

**Summary of Learning Outcomes**

1. Identify computer hardware and software
2. Apply security measures to data, hardware and software
3. Apply computer software in solving tasks
4. Apply internet and email in communication at workplace

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Identify computer hardware and software
 | * Meaning of a computer
* Functions of a computer
* Components of a computer
* Classification of computers
 | * Written
* Oral
* Observation
 |
| 1. Apply security measures to data, hardware and software
 | * Data security and control
* Security threats and control measures
* Types of computer crimes
* Detection and protection against computer crimes
 | * Written tests
* Oral presentation
* Observation
* Projects
 |
| 1. Apply computer software in solving tasks
 | * Operating system
* Word processing
* Spread sheets
* Data base
 | * Oral questioning
* Observation
* Project
 |
| 1. Apply internet and email in communication at workplace
 | * Computer networks
* Uses of internet
* Electronic mail (e-mail) concept
 | * Oral questioning
* Observation
* Oral presentation
* Written report
 |

**Suggested Methods of Instruction**

* Instructor led facilitation of theory
* Demonstration by trainer
* Practical work by trainee
* Viewing of related videos
* Project
* Group discussions

**Recommended Resources**

* Desk top computers
* Laptop computers
* Other digital devices
* Printers
* Storage devices
* Internet access
* Computer software

## ENTREPRENEURIAL SKILLS

**UNIT CODE:** ENG/CU/EI/BC/03/4/A

**Relationship to occupational standards**

This unit addresses the unit of competency: Demonstrate entrepreneurial skills

**Duration of unit:** 60 hours

**Unit description**

This unit describes the competencies critical to demonstration of entrepreneurial skills. It includes creating and maintaining small scale business, establishing small scale business customer base, managing and growing a small business.

**Summary of Learning Outcomes**

1. Create and maintain small scale business
2. Establish small scale business customer base
3. Manage small scale business
4. Grow/ expand small scale business

 **Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Create and maintain small scale business
 | * Starting a small business
* Legal regulatory requirements in starting a small business
* SWOT/ PESTEL analysis
* Conducting market/industry survey
* Generation and evaluation of business ideas
* Matching competencies with business opportunities
* Forms of business ownership
* Location of a small business
* Legal and regulatory requirement
* Resources required to start a small business
* Common terminologies in entrepreneurship
* Entrepreneurship in national development
* Self-employment
* Formal and informal employment
* Entrepreneurial culture
* Myths associated with entrepreneurship
* Types, characteristics, qualities & role of entrepreneurs
* History, development and importance of entrepreneurship
* Theories of entrepreneurship
* Quality assurance for small businesses
* Policies and procedures on occupational safety and health and environmental concerns
 | * Observation
* Case studies
* Individual/group assignments
* projects
* Written
* Oral
 |
| 1. Establish small scale business customer base
 | * Good staff/workers and customer relations
* Marketing strategy
* Identifying and maintain new customers and markets
* Product/ service promotions
* Products / services diversification
* SWOT / PESTEL analysis
* Conducting a business survey
* Generating Business ideas
* Business opportunities
 | * Observation
* Case studies
* Individual/group assignments
* projects
* Written
* Oral
 |
| 1. Manage small scale business
 | * Organization of a small business
* Small business’ business plan
* Marketing for small businesses
* Managing finances for small business
* Production/ operation process for goods/services
* Small business records management
* Book keeping and auditing for small businesses
* Business support services
* Small business resources mobilization and utilization
* Basic business social responsibility
* Management of small business
* Word processing concepts in small business management
* Computer application software
* Monitoring and controlling business operations
 | * Oral
* Observation
* Case studies
* Individual/group assignments
* projects
* Written
 |
| 1. Grow/expand small scale business
 | * Methods of growing small business
* Resources for growing small business
* Small business growth plan
* Computer software in business development
* ICT and business growth
 | * Observation
* Case studies
* Individual/group assignments
* projects
* Written
 |

**Suggested Methods of Instruction**

* Instructor led facilitation of theory
* Demonstration by trainer
* Practice by trainee
* Role play
* Case study

**Recommended Resources**

* Case studies for small businesses
* Business plan templates
* Lap top/ desk top computer
* Internet
* Telephone
* Writing materials

## EMPLOYABILITY SKILLS

**UNIT CODE:** ENG/CU/EI/BC/04/4/A

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Demonstrate employability skills

**Duration of Unit:** 30 hours

**Unit Description**

This unit covers competencies required to demonstrate employability skills. It involves conducting self-management, demonstrating critical safe work habits, demonstrating workplace learning and workplace ethics.

**Summary of Learning Outcomes**

1. Conduct self-management
2. Demonstrate critical safe work habits
3. Demonstrate workplace learning
4. Demonstrate workplace ethics

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Conduct self-management
 | * Self-awareness
* Formulating personal vision, mission and goals
* Strategies for overcoming life challenges
* Emotional intelligence
* Assertiveness
* Expressing personal thoughts, feelings and beliefs
* Developing and maintaining high self-esteem
* Developing and maintaining positive self-image
* Articulating ideas and aspirations
* Accountability and responsibility
* Good work habits
* Self-awareness
* Self-development
* Financial literacy
* Healthy lifestyle practices
 | * Observation
* Written
* Oral interview
* Third party report
 |
| 1. Demonstrate critical safe work habits
 | * Stress and stress management
* Punctuality and time consciousness
* Interpersonal communication
* Sharing information
* Leisure
* Integratingpersonal objectives into organizational objectives
* Resources utilization
* Setting work priorities
* HIV and AIDS
* Drug and substance abuse
* Handling emerging issues
 | * Observation
* Written
* Oral interview
* Third party report
 |
| 1. Demonstrate workplace learning
 | * Personal training needs identification and assessment
* Managing own learning
* Contributing to the learning community at the workplace
* Cultural aspects of work
* Variety of learning context
* Application of learning
* Safe use of technology
* Identifying opportunities
* Workplace innovation
* Performance improvement
* Handling emerging issues
* Future trends and concerns in learning
 | * Observation
* Oral interview
* Written
* Third party report
 |
| 1. Demonstrate workplace ethics
 | * Meaning of ethics
* Ethical perspectives
* Principles of ethics
* Values and beliefs
* Ethical standards
* Organization code of ethics
* Common ethical dilemmas
* Organization culture
* Corruption, bribery and conflict of interest
* Privacy and data protection
* Diversity, harassment and mutual respect
* Financial responsibility/accountability
* Etiquette
* Personal and professional integrity
* Commitment to jurisdictional laws
* Emerging issues in ethics
 | * Observation
* Oral interview
* Written
* Third party report
 |

**Suggested Methods of Instruction**

* Instructor lead facilitation of theory
* Demonstrations
* Simulation/Role play
* Group Discussion
* Presentations
* Projects
* Case studies
* Assignments

**Recommended Resources**

* Computers
* Stationery
* Charts
* Video clips
* Audio tapes
* Radio sets
* TV sets
* LCD projectors

**ENVIRONMENTAL LITERACY**

**UNIT CODE:** ENG/CU/EI/BC/05/4/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency:Demonstrate environmental literacy

**Duration of Unit:** 20hours

**Unit Description**

This unit describes the competencies required to control environmental hazard, control environmental pollution, comply with workplace sustainable resource use and evaluate current practices in relation to resource usage.

**Summary of Learning Outcomes**

1. Control environmental hazard
2. Control environmental Pollution
3. Demonstrate sustainable resource use
4. Evaluate current practices in relation to resource usage

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Control environmental hazard
 | * Purposes and content of Environmental Management and Coordination Act 1999
* Purposes and content of Solid Waste Act
* Storage methods for environmentally hazardous materials
* Disposal methods of hazardous wastes
* Types and uses of PPE in line with environmental regulations
* Occupational Safety and Health Standards (OSHS)
 | * Written questions
* Oral questions
* Observation of work procedures
 |
| 1. Control environmental Pollution control
 | * Types of pollution
* Environmental pollution control measures
* Types of solid wastes
* Procedures for solid waste management
* Different types of noise pollution
* Methods for minimizing noise pollution
 | * Written questions
* Oral questions
* Observation of work procedures
* Role play
 |
| 1. Demonstrate sustainable resource use
 | * Types of resources
* Techniques in measuring current usage of resources
* Calculating current usage of resources
* Methods for minimizing wastage
* Waste management procedures
* Principles of 3Rs (Reduce, Reuse, Recycle)
* Methods for economizing or reducing resource consumption
 | * Written questions
* Oral questions
* Observation of work procedures
* Role play
 |
| 1. Evaluate current practices in relation to resource usage
 | * Collection of information on environmental and resource efficiency systems and procedures,
* Measurement and recording of current resource usage
* Analysis and recording of current purchasing strategies.
* Analysis of current work processes to access information and data
* Identification of areas for improvement
 | * Written questions
* Oral questions
* Observation of work procedures
* Role play
 |
| 1. Identify Environmental legislations/conventions for environmental concerns
 | * Environmental issues/concerns
* Environmental legislations /conventions and local ordinances
* Industrial standard /environmental practices
* International Environmental Protocols (Montreal, Kyoto)
* Features of an environmental strategy
 | * Written questions
* Oral questions
* Observation of work procedures
 |

**Suggested Methods of Instruction**

* Instructor led facilitation of theory
* Practical demonstration of tasks by trainer
* Practice by trainees/ role play
* Discussion
* Observations and comments and corrections by trainers

**Recommended Resources**

* Standard operating and/or other workplace procedures manuals
* Specific job procedures manuals
* Solid Waste Act
* Environmental Management and Coordination Act 1999
* Machine/equipment manufacturer’s specifications and instructions
* Personal Protective Equipment (PPE)

## OCCUPATIONAL SAFETY AND HEALTH PRACTICES

**UNIT CODE:** ENG/CU/EI/BC/06/4/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency:Demonstrate Safety and Health Practices

**Duration of Unit:** 20 hours

**Unit Description**

This unit describes the competencies required to practice safety and health, and comply with OSH requirements relevant to work.

**Summary of Learning Outcomes**

1. Observe workplaceprocedures forhazards and riskprevention
2. Participate inarrangements forworkplace safety and health maintenance

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment****Methods** |
| 1. Observe workplace procedures for hazards and risk prevention
 | * Arrangement of work area and items in accordance with Company housekeeping procedures
* Adherence to work standards and procedures
* Application of preventive and control measures, including use of safety gears/PPE
* Study and apply standards and procedures for incidents and emergencies.
 | * Oral questions
* Written questions
* Observation of work procedures
 |
| 1. Participate in arrangements for workplace safety and health maintenance
 | * Participating in orientations on OSH requirements/regulations of tasks
* Providing feedback on health, safety, and security concerns to appropriate personnel as required in a sufficiently detailed manner
* Practice workplace procedures for reporting hazards, incidents, injuries and sickness
* OSH requirements/ regulations and workplace safety and hazard control procedures are reviewed, and compliance reported to appropriate personnel
* Identification of needed OSH-related trainings are proposed to appropriate personnel
 | * Oral questions
* Written tests
* Practical test
* Observation of practical work by trainees
 |

**Suggested Methods of Instruction**

* Instructor led facilitation of theory
* Practical demonstration of tasks by trainer
* Practice by trainees/ role play
* Discussion
* Observations and comments and corrections by trainers

**Recommended Resources**

* Standard operating and/or other workplace procedures manuals
* Specific job procedures manuals
* Machine/equipment manufacturer’s specifications and instructions
* Personal Protective Equipment (PPE) e.g.
* Mask
* Face mask/shield
* Safety bootsn
* Safety harness
* Arm/Hand guard, gloves
* Eye protection (goggles, shield)
* Hearing protection (ear muffs, ear plugs)
* Hair Net/cap/bonnet
* Hard hat
* Face protection (mask, shield)
* Apron/Gown/coverall/jump suit
* Anti-static suits
* High-visibility reflective vest

# COMMON UNITS OF LEARNING

## ENGINEERING MATHEMATICS

**UNIT CODE:** ENG/CU/EI/CC/01/4/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Apply engineering mathematics

**Duration of Unit:** 30 hours

**Unit Description**

This unit describes the competencies required to apply engineering mathematics. Applying algebra, coordinate geometry, carrying out mensuration, applying matrix and vector vector.

**Summary of Learning Outcomes**

1. Apply Algebra
2. Apply Coordinate Geometry
3. Carry out Mensuration
4. Apply Matrix
5. Apply Vectors

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |
| --- |
| **Building Technology Curriculum** |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| * + 1. Apply Algebra
 | * Base and Index
* Law of indices
* Laws of logarithm
* Conversion of bases
* Use of calculator
* Algebraic expressions and equations
* Reduction of algebraic equations
* Solutions of simultaneous linear equations in two unknowns
* Solution of quadratic equation
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| * + 1. Apply Coordinate Geometry
 | * Polar equations
* Cartesian equation
* Graphs of polar equations
* Normal and tangents
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| * + 1. Carry out Mensuration
 | * Units of measurements
* Perimeter and areas of regular figures
* Volume of regular solids
* Surface area of regular solids
* Area and volume of irregular figures
* Areas and volumes using Pappus theorem
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| * + 1. Apply Matrix
 | * Matrix operation
* Determinant of 2x2 matrix
* Inverse of 2x2 matrix
* Solution of linear simultaneous equations in 2 unknowns
* Application of matrices
 | * Assignments
* Oral questioning
* Supervised exercises
* Written tests
 |
| * + 1. Apply Vector
 | * Vectors and scalar in two dimensions
* Operations on vectors: Addition and Subtraction
 | * Assignments
* Oral questioning
* Supervised exercises
* Written tests
 |

**Suggested Methods of Instruction**

* Group discussions
* Demonstration by trainer
* Exercises by trainee

**Recommended Resources**

* Scientific Calculators
* Rulers, pencils, erasers
* Charts with presentations of data
* Graph books
* Dice
* Computers with internet connection

## WORKSHOP TECHNOLOGY

**UNIT CODE:** ENG/CU/EI/CC/02/4/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Perform workshop processes

**Duration of Unit:** 20 hours

**Unit Description**

This unit covers the competencies required to perform workshop processes. Competencies include applying workshop safety, using workshop tools, equipment and materials, preparation of workshop for electrical installation, storage of tools, equipment and materials, troubleshoot and repair/replace workshop tools and equipment

**Summary of Learning Outcomes**

1. Apply workshop safety
2. Use of workshop tools, Instruments and equipment
3. Prepare workshop tools and instruments for an Electrical installation
4. Prepare the workshop for an Electrical installation
5. Store Electrical tools and materials
6. Troubleshoot and repair workshop tools and equipment

**Learning Outcomes, Content and Suggested Assessment Methods:**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Apply workshop safety
 | * Meaning of PPE
* Standard operating procedure in PPE
* Workshop rules
* Electrical hazards e.g.
* Electric shock.
* Fire
* Classes of fire
* Classes of fire
* Various methods of fire extinguishing
* First Aid
 | * Oral questioning
* Written tests
* Practical test
 |
| 1. Use of workshop tools, Instruments and equipment
 | * Meaning of workshop tools, instruments and equipment
* Classification of workshop tools and equipment
* Uses of workshop tools, Instruments and equipment
* Care and Maintenance of workshop tools and Instruments
 | * Oral questioning
* Practical tests
* Written tests
 |
| 1. Prepare workshop tools and instruments for an Electrical installation
 | * Tools and instruments for an Electrical practical
* Preparation of a list of tools and instruments for electrical practical.
* Issuing and confirmation of tools and instruments before and after practical
* Testing and configuring equipment
 | * Observation
* Oral questioning
* Practical tests
* Written tests
 |
| 1. Store tools and materials after installation
 | * Classification of workshop tools and instruments.
* Storage of workshop tools and equipment
* Waste disposal
 | * Observation
* Oral questioning
* Practical tests
* Written tests
 |
| 1. Troubleshoot and repair/replace workshop tools and equipment
 | * Meaning of troubleshooting
* Common faults in Electrical equipments

Fault diagnosis procedure* Repair/Replace of components in Electrical equipment
* Calibration and service of equipment
 | * Observation
* Oral questioning
* Practical tests
* Written tests
 |

**Suggested Methods of Instruction**

* Demonstration by trainer
* Practice by the trainee
* Field trips
* On-job-training
* Discussions

**Recommended Resources**

|  |  |
| --- | --- |
| **Tools** * Set of screw drivers
* Pliers
* Phase testers
* Multimeter
 | **Materials and supplies*** Stationery
* Cables
* Lubricants
* Service parts
 |
| **Equipment** * PPE –hand gloves, dust coat, dust masks
* Multimeter
* Clamp meter
* Earth electrode resistance meter
* Phase sequence meter
 | **Reference materials*** IEE regulations
* Organizational procedures manual
 |

## ELECTRICAL PRINCIPLES

**UNIT CODE:** ENG/CU/EI/CC/03/4/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Apply eelectrical principles skills

**Duration of Unit:** 40 hours

**Unit Description**

This unit describes the competencies required to apply electrical principles. It involvesusing the concept of basic electrical quantities, D.C and A.C circuits in electrical installation, single phase electrical machine, earthing in electrical installations and applying capacitance and inductance

**Summary of Learning Outcomes**

1. Use concept of basic electrical quantities
2. Use of D.C and A.C circuits in electrical installation
3. Use of single phase electrical machines
4. Perform earthing in Electrical installations
5. Apply capacitance and inductance

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| * + 1. Use the concept of basic Electrical quantities
 | * The meaning of SI unit
* SI unit of Electrical quantities
* Calculations involving various Electrical quantities e.g Charge, Power, Current, Voltage, Resistance
* Instruments used in measuring Electrical quantities
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| * + 1. Use of D.C and A.C circuits in electrical installation
 | * Meaning of terms
* Conductors and insulators
* Ohm’s law
* Resistance variation
* Resistors and color coding
* AC and DC circuits
* R-L, R-C, R-L-C circuits
* Series
* Parallel
* Parallel and series
* Parallel resonance and Q-factor
* Power factor improvement
* AC and DC network theorems e.g
* Kirchoff’s laws
* AC to DC and DC to AC Conversion
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| * + 1. Single phase electrical machines
 | * Single phase Electrical machines
* DC single phase motors and generators
* AC Single phase motors and generators
* Single phase transformers
* Application of AC and DC machines
* Motor starter
* DC Motor speed control
* Motor cooling
 | * Assignments
* Oral questioning
* Supervised exercises
* Written tests
* Practical tests
 |
| * + 1. Earthing in Electrical installations
 | * + Meaning of earthing
	+ Terms in earthing
	+ earthing systems
	+ earthing points in electrical installation
	+ IEE regulations
	+ Factors to consider in selecting an earthing system
	+ Testing an earthing system
	+ earthing improvement
 | * Assignments
* Supervised exercises
* Written tests
* Practical test
 |
| * + 1. Capacitance and inductance
 | * Meaning of electrostatic field
* Sources of electrostatic field
* Meaning of terms
* Electric field strength
* Capacitance
* Capacitors
* Electric flux density
* Permittivity
* Types capacitors
* Charging and discharging
* Capacitors connection
* Series
* Parallel
* Parallel and series
* Application of capacitors
* Calculations involving capacitors
* Magnetic circuits
* Magnetic fields
* Magnetic flux and flux density
* Magnetomotive force and magnetic field strength
* Permeability and B-H curves
* Hysteresis and hysteresis losses
* Force on current-carrying conductor
* Principle of operation of a simple DC motor
* Principle of operation of a moving coil instrument
* Electromagnetic field and electromagnets
* Electromagnetic induction
* Laws of electromagnetic induction
* Rotation of a loop in a magnetic field
* Inductance and inductors
* Inductor connections
* Series
* Parallel
* Parallel and series
* Applications of inductors
 | * Assignments
* Oral questioning
* Supervised exercises
* Written tests
 |

**Suggested Methods of Instruction**

* Group discussions
* Demonstration by trainer
* Exercises by trainee

**Recommended Resources**

* Scientific Calculators
* Relevant reference materials
* Stationeries
* Electrical workshop
* Relevant practical materials
* Dice
* Computers with internet connection

## TECHNICAL DRAWING

**UNIT CODE:** ENG/CU/EI/CC/04/4

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Prepare and interpret technical drawings

**Duration of Unit:** 20 hours

**Unit Description**

This unit covers the competencies required to prepare and interpret technical drawings. It involves competencies to select, use and maintain drawing equipment and materials. It also involves producing plain geometry drawings, solid geometry drawings, orthographic drawings of components and Electrical drawings.

**Summary of Learning Outcomes**

1. Use and maintenance of drawing equipment and materials
2. Produce plane geometry drawings
3. Produce solid geometry drawings
4. Produce and orthographic drawings
5. Produce Electrical drawings

**Learning Outcomes, Content and Suggested Assessment Methods:**

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Use and maintenance of drawing equipment and materials
 | * Identification and care of drawing equipment
* Identification and care of drawing materials
* Reference to manufacturer’s instructions and work place procedures on use and maintenance of drawing equipment and materials
* Reference to relevant environmental legislations
* Use of Personal Protective Equipment (PPEs)
 | * Observation
* Oral questioning
* Written tests
 |
| 1. Produce plane geometry drawings
 | * Types of lines in drawings
* Construction of geometric forms e.g. squares, circles
* Construction of different angles
* Measurement of different angles
* Bisection of different angles and lines
* Standard drawing conventions
 | * Oral questioning
* Practical tests
* Observation
 |
| 1. Produce solid geometry drawings
 | * Interpretation of sketches and drawings of patterns e.g. cylinders, prisms and pyramids
* Sectioning of solids e.g. prisms, cones
* Development and interpenetrations of solids e.g. cylinder to cylinder and cylinder to triangular, prism
 | * Observation
* Practical tests
* Oral questioning
 |
| 1. Produce orthographic drawings
 | * Meaning of pictorial and orthographic drawings
* Meaning of sectioning
* Meaning of symbols and abbreviations
* Drawing and interpretation of orthographic elevations
* Dimensioning of orthographic elevations
* Sectioning of views
* Assembly drawing
 | * Observation
* Practical tests
* Oral questioning
 |
| 1. Produce electrical drawings
 | * Electrical symbols and abbreviations
* Meaning of electrical drawings
* Drawing of electrical diagrams e.g. block, schematic, circuit, line and wiring
* Interpretation of electrical drawings
 | * Observation
* Oral questioning
* Practical tests
 |

**Suggested Methods of Instruction**

* Projects
* Demonstration by trainer
* Practice by the trainee
* Discussions

**Recommended Resources**

* Drawing room
* Drawing instruments e.g. T-squares, set squares, drawing sets
* Drawing tables
* Pencils, papers, erasers
* Masking tapes

# CORE UNITS OF LEARNING

## ELECTRICAL INSTALLATION

**UNIT CODE:** ENG/CU/EI/CR/01/4/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Perform Electrical Installation

**Duration of Unit:** 90 hours

**Unit Description**

This unit specifies the competencies required to perform electrical installation work for single phase systems. It focuses on the application of health, safety and environmental standards, preparation of working drawings, assemble tools, equipment, materials and drawing instruments, and Perform electrical installation

**Summary of Learning Outcomes**

1. Apply health, safety and environmental standards
2. Prepare working drawings
3. Assemble tools, equipment and materials
4. Perform electrical installation

**Learning Outcomes, Content and Suggested Assessment Methods:**

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Apply health, safety and environmental standards
 | * Relevant clauses in appropriate Acts e.g.
* Occupational safety and health act (OSHA)
* Work injury benefits act (WIBA)
* Environment management and coordination Act (EMCA)
* Relevant regulations:
* IEE regulations
* KPLC by-laws
* County by-laws
* Causes of accidents and sources of danger e.g burns, cuts, electric shock, falling from heights, falling objects, noise, dust, chemicals
* Meaning of PPE
* Purpose of PPE
* Types of PPE
* Safe and correct handling, use, maintenance and storage of different types of PPE
* Classes of fires and fire fighting equipment
* First aid procedures
* Rescuing electric shock victim
* Methods of resuscitation
 | * Written tests
* Oral questioning
 |
| 1. Prepare working drawings
 | * Meaning of working drawings
* Interpret electrical design drawings
* Reading and Interpretation of architectural drawings
* Relate architectural drawing to the work site
* Take actual measurements
* Liaise with other service providers
* Produce sketch drawing
* Produce final working drawing
 | * Observation
* Oral questioning
* Practical tests
* Written tests
 |
| 1. Assemble tools, equipment and materials
 | * Types, application, care, maintenance and storage of:
* Tools e.g.
* Cable strippers
* Pliers
* Screw drivers
* Hammers
* Chisels
* Allen keys
* Electrician knives
* Crimping tools
* Bending springs
* Steel tapes
* Draw wires
* Hack saws
* Drills
* Equipment e.g.
* Multimeter
* Earth tester
* Phase sequence meter
* Materials e.g.
* Cables
* Fittings
* Accessories
* Inventory management
 | * Observation
* Oral questioning
* Practical tests
* Written tests
 |
| 1. Perform electrical installation
 | * Meaning of terms
* Single phase systems
* Cables and cable joints
* Wiring systems and accessories
* Meaning of terms
* Types and applications e.g.
* Conduits
* Cable trays
* Cable ducts
* Trunkings
* Preparation of wiring systems
* Marking out, cutting, bending, threading, chiselling, trenching
* Laying of cable routes
* Installation of final circuits
* Lighting circuits
* One way, two way, intermediate
* Looping in methods at ceiling rose, joint boxes, switches
* Power circuits
* Radial circuits, ring circuits
* Water heating circuits
* Electric cooker circuits
* Bell and alarm circuits
* Electrical machines circuits e.g Single phase motors
* Relevant technical standards e.g.
* IEEregulations
* British standards
* Kenya bureau of standards (KEBS)
* Kenya power by-laws
* County by-laws
 | * Observation
* Oral questioning
* Practical tests
* Written tests
 |

**Suggested Methods of Instruction**

* Projects
* Demonstration by trainer
* Practice by the trainee
* Field trips
* On-job training
* Discussions

**Recommended Resources**

|  |  |
| --- | --- |
| **Tools and equipment*** Cable Strippers
* Pliers
* Screw drivers
* Hammers
* Chisels
* Allen keys
* Electrician knives
* Crimping tools
* Bending springs
* Bending machine
* Steel tapes
* Draw wires
* Hack saws
* Drilling tools
* Stock and die
* Bench vice
* Machine vice
* PPE – hand gloves, dust coats, dust masks, helmets, ear muffs, industrial boots
 | **Materials and supplies*** Stationery
* Cables
* Light fittings
* Accessories
* Conduits and fittings
* Cable trays
* Cable ducts
* Trunkings
* Computers
* Drawing instruments
* Screws
 |
| **Reference materials*** IEE regulations
* Occupational safety and health act (OSHA)
* Work injury benefits act (WIBA)
* Manufacturers’ catalogues
* British standards
* KEBS standards
 |  |

##  ELECTRICAL INSTALLATION TESTING

**UNIT CODE:** ENG/CU/EI/CR/02/4/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Perform Testing of Electrical Installation

**Duration of Unit:** 30 hours

**Unit Description**

This unit covers the competencies required to carry out inspection and testing of an electrical installation. It covers testing activities starting from verifying the installed fittings and accessories, identifying the type of tests, carrying out the tests and issuing test certificates.

**Summary of Learning Outcomes**

1. Conduct physical inspection
2. Identify the test to be carried out and test equipment
3. Perform the test
4. Issue installation test and wiring certificates

**Learning Outcomes, Content and Suggested Assessment Methods**

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Carry out physical inspection
 | * Inspection
* Reasons for inspection
* Physical and visual check
* Firmness
* Loose connections
* Damaged accessories and fittings
* Colour coding
* Cable management
 | * Observation
* Oral questioning
 |
| 1. Identify the tests to be carried out.
 | * Testing
* Meaning
* Purpose and reasons
* Types of tests
* Polarity
* Earth testing
* Insulation resistance
* Continuity test
* Earth loop impedance test
* Identification of test equipment
* Specification of test equipment
* Calibrate test equipment
* Test equipment care, storage and maintenance
 | * Observation
* Oral questioning
* Written tests
 |
| 1. Perform identified tests
 | * Reading and interpretation of appropriate manuals
* Identification of test equipment e.g.
* Continuity tester (ohmmeter)
* Insulation resistance tester
* Earth loop impedance tester
* Test lamp
* Procedure of conducting identified tests
* Polarity
* Effectiveness of earthing
* Insulation resistance
* Ring circuit continuity
* Recording and verification of results against appropriate standards
* Rectification of any anomalies
* Safety precautions
 | * Observation
* Oral questioning
* Practical tests
* Written tests
 |
| 1. Issue installation test results and wiring completion certificates
 | * Installation test results certificate
* Meaning terms
* Importance
* Wiring certificate
* Meaning
* Importance
* Types
* Issuing authority
 | * Written tests
* Oral questioning
 |

**Suggested Methods of Instruction**

* Demonstration by trainer
* Practice by the trainee
* Field trips
* Discussions

**Recommended Resources**

|  |  |
| --- | --- |
| * Test instruments
* Continuity tester (ohmmeter)
* Insulation resistance tester
* Earth loop impedance tester
* Test lamp
 | **Materials and supplies*** Stationery
* Wiring certificates
 |
| **Reference materials*** Manufacturers’ manuals
* Relevant catalogues
* IEE regulations
 |  |

## ELECTRICAL INSTALLATION BREAKDOWN MAINTENANCE

**UNIT CODE:** ENG/CU/EI/CR/03/4/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Conduct Electrical Installation Breakdown Maintenance

**Duration of Unit:** 40 hours

**Unit Description**

This unit specifies the competencies required to conduct breakdown maintenance of an electrical installation. It includes fault identification, repairing, testing and generating maintenance report.

**Summary of Learning Outcomes**

1. Identify system failure
2. Troubleshoot cause of failure
3. Repair the installation
4. Test the repaired system

**Learning Outcomes, Content and Suggested Assessment Methods:**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Identify installation failure
 | * Gathering information
* Principle of operation
* Visual inspection
* Interview of users
* Types of failures
* Partial
* Total
* Referring to as-built drawings and manuals
 | * Oral questioning
* Written tests
 |
| 1. Troubleshoot cause of failure.
 | * Conducting fault diagnosis e.g.
* Open circuit
* Short circuit
* Earth fault
* Mechanical faults
* Identification of tools, equipment and materials for repair/replace
* Specification of tools
* Recording of installation failure results
* Parameters e.g.
* Voltage
* Current
* Resistance
 | * Oral questioning
* Practical tests
* Written tests
 |
| 1. Repair the installation
 | * Repair/Replace
* Meaning
* Power isolation
* Conducting repair activities
* Recording repair activities
 | * Observation
* Oral questioning
* Practical tests
* Written tests
 |
| 1. Test the repaired system
 | * Identification of test and test points
* Test parameters e.g.
* Voltage
* Resistance
* Current
* Prepare and document maintenance report
 | * Observation
* Oral questioning
* Practical tests
* Written tests
 |

**Suggested Methods of Instruction**

* Demonstration by trainer
* Practice by the trainee
* Field trips
* On-job-training
* Discussions

**Recommended Resources**

|  |  |
| --- | --- |
| **Tools** * Set of screw drivers
* Pliers
* Phase testers
* Multimeter
 | **Materials and supplies*** Stationery
* Cables
* Lubricants
* Service parts
 |
| **Equipment** * PPE –hand gloves, dust coat, dust masks
* Multimeter
* Clamp meter
* Earth electrode resistance meter
* Phase sequence meter
 | **Reference materials*** IEE regulations
* Organizational procedures manual
 |