

**THE REPUBLIC OF KENYA**

**HARMONIZED NATIONAL OCCUPATIONAL STANDARDS**

**FOR**

**TELECOMMUNICATION TECHNICIAN**

**LEVEL 6**

**PROGRAMME CODE: 0714 554A**

**TABLE OF CONTENTS**

[BASIC UNITS OF COMPETENCY 1](#_Toc195701802)

[APPLY DIGITAL SKILLS 2](#_Toc195701803)

[APPLY COMMUNICATION SKILLS 12](#_Toc195701804)

[APPLY WORK ETHICS AND PRACTICES 16](#_Toc195701805)

[APPLY ENTREPRENEURIAL SKILLS 23](#_Toc195701806)

[COMMON UNITS OF COMPETENCY 29](#_Toc195701807)

[APPLY ENGINEERING TECHNICIAN MATHEMATICS 30](#_Toc195701808)

[PREPARE ENGINEERING DRAWINGS 35](#_Toc195701809)

[APPLY ELECTRICAL PRINCIPLES 40](#_Toc195701810)

[APPLY TELECOMMUNICATION PRINCIPLES 44](#_Toc195701811)

[CORE UNITS OF COMPETENCY 48](#_Toc195701812)

[INSTALL ELECTRICAL SYSTEMS 49](#_Toc195701813)

[INSTALL COMPUTER NETWORK 54](#_Toc195701814)

[INSTALL FIBER OPTICS NETWORKS 59](#_Toc195701815)

[MAINTAIN COMMUNICATION SYSTEMS 65](#_Toc195701816)

[FABRICATE ELECTRONIC CIRCUITS 70](#_Toc195701817)

[INSTALL BROADCASTING COMMUNICATION SYSTEMS 77](#_Toc195701818)

[INSTALL WIRELESS COMMUNICATION TRANSMISSION LINKS 83](#_Toc195701819)

[INSTALL SPECIALIZED POWER SYSTEMS 92](#_Toc195701820)

[FABRICATE EMBEDDED AND RF CIRCUITS 98](#_Toc195701821)

[INSTALL TELEPHONY SYSTEM 103](#_Toc195701822)

[INSTALL ENTERPRISE COMPUTER NETWORKS. 110](#_Toc195701823)

**OVERVIEW**

This course is designed to equip an Telecommunication Technician Level 6 with the competencies required to Install Electrical Systems, Install Computer Networks, Install Fiber Optics Networks, Maintain Communication systems, Fabricate Electronic Circuits, Install Broadcasting Communication systems Install Wireless communication transmission links, Install Specialized Power Systems, Fabricate Embedded and RF circuits, Install Telephony Systems and Intall Entreprise Computer Networks.

A telecommunications technician is responsible for repairing, installing, modifying, and upgrading companies’ telecommunications systems and related equipment. They identify technical faults through diagnostic testing, ensure that there are no exposed cables, and order replacement components as needed.

**Telecommunications Technician Responsibilities:**

* Establishing communications systems by installing, operating, and maintaining Telecommunicationation system power supply, Transmission link voice and data telecommunications network circuits and equipment.
* Planning communication system installations by studying customer orders, plans, manuals, and technical specifications.
* Running, pulling, terminating, and splicing cables; installing telecommunications equipment, routers, switches, multiplexors, cable trays, and alarm and fire-suppression systems.
* Verifying service by testing electronic communication system circuits, equipment, and alarms; and identifying, correcting, or escalating problems.
* Documenting network configurations and specifications.
* Troubleshooting and repairing outages, testing network backup procedures, and updating documentation.
* Maintaining customer repport by resolving concerns and answering questions.
* Ensuring a safe work environment by following codes, standards, and legal regulations.

**SUMMARY OF UNITS OF COMPETENCY**

|  |  |
| --- | --- |
| **UNIT CODE** | **UNIT TITLE** |
| **BASIC UNITS OF COMPETENCY** | |
| 0611 451 01B | APPLY DIGITAL SKILLS |
| 0031 441 02B | APPLY COMMUNICATION SKILLS |
| 0417 441 03B | APPLY WORK ETHICS AND PRACTICES |
| 0413 441 04B | APPLY ENTREPRENEURIAL SKILLS |
| **COMMON UNITS OF COMPETENCY** | |
| 0541 441 05A | APPLY ENGINEERING TECHNICIAN MATHEMATICS |
| 0732 441 06A | PREPARE ENGINEERING DRAWINGS |
| 0713 441 07A | APPLY ELECTRICAL PRINCIPLES |
| 0714 541 08A | APPLY TELECOMMUNICATION PRINCIPLES |
| **CORE UNITS OF COMPETENCY** | |
| 0714 451 09A | INSTALL ELECTRICAL SYSTEMS |
| 0612 451 10A | INSTALL COMPUTER NETWORKS |
| 0612 551 11A | INSTALL FIBER OPTICAL NETWORKS |
| 0714 551 12A | MAINTAIN COMMUNICATION SYSTEMS |
| 0714 451 13A | FABRICATE ELECTRONIC CIRCUITS |
| 0714 551 14A | INSTALL BROADCASTING COMMUNICATION SYSTEMS |
| 0714 551 15A | INSTALL WIRELESS TRANMISSION LINKS |
| 0714 451 16A | INSTALL SPECIALIZED POWER SYSTEMS |
| 0714 551 17A | FABRICATE EMBEDDED AND RF CIRCUITS |
| 0714 551 18A | INSTALL TELEPHONY SYSTEMS |
| 0612 551 19A | INSTALL ENTERPRISE COMPUTER NETWORKS |

# BASIC UNITS OF COMPETENCY

## APPLY DIGITAL SKILLS

**UNIT CODE:** 0611 441 01B

**UNIT DESCRIPTION:**

This unit covers the competencies required to demonstrate digital literacy. It involves operating computer devices, solving tasks using the Office suite, accessing online/offline data and information, performing online communication and collaboration, applying cybersecurity skills and performing jobs online. It also involves applying job entry techniques.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes that make up workplace functions | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements  ***(Bold and italicized terms are elaborated in the range)*** |
| --- | --- |
| 1. Operate computer devices | * 1. C***omputer device*** usage is determined as per workplace requirements.   2. ***Computer hardware*** is identified according to job requirements.   3. ***Computer software*** is identified according to workplace requirements.   4. Computer devices are turned on or off as per the correct workplace procedure.   5. ***Mouse techniques*** are applied in solving tasks as per workplace requirements.   6. Keyboardtechniques are applied in solving tasks as per workplace requirements.   7. Computer files and folders are created and managed as per workplace requirements.   8. ***Internet connection option***s are identified and applied in connecting computer devices to the Internet.   9. ***External devices*** are identified and connected to the computer devices as per the job requirement. |
| 1. Solve tasks using Office suite | 1. ***Word processing concepts***are applied in solving workplace tasks as per job requirements. 2. Worksheet data is entered and prepared in accordance with work procedures. 3. Worksheet data is built and edited in accordance with workplace procedures. 4. ***Data manipulation*** on a worksheet is undertaken in accordance with work requirements. 5. Worksheets are saved and printed in accordance with job requirements. 6. ***Electronic presentation concepts***are applied in solving workplace tasks as per job requirements. |
| 1. Manage data and information | * 1. Office ***internet services*** are identified and applied in accordance with office procedures.   2. ***Internet access applications*** are determined in accordance with office operation procedures.   3. Internet search is performed as per job requirements.   4. Online digital content is downloaded in accordance with workplace requirements.   5. Digital content is identified and backed up in accordance with workplace procedures. |
| 1. Perform online communication and collaboration | * 1. Netiquette principles are observed as per work requirements.   2. Electronic mail communication is executed in accordance with workplace policy.   3. Digital content copyright and licenses are identified and applied according to workplace policies and regulatory requirements.   4. ***Online*** ***collaboration tools*** are applied in accordance with workplace policies and regulatory requirements. |
| 1. Apply cybersecurity skills | * 1. ***Data protection*** and ***privacy*** is classified in accordance with workplace policies and regulatory requirements.   2. ***Internet security threats*** are identified as per workplace policies and regulatory requirements.   3. Computer threats and crimes are detected in accordance to Information Management security guidelines   4. ***Cybersecurity control measures*** are applied in accordance with workplace policies and regulatory requirements. |
| 1. Perform online jobs | * 1. ***Online job platforms*** are identified as per the job requirements.   2. Online accounts and profiles are created in accordance with the work requirements.   3. Online jobs are identified according to the bidder’s skillset.   4. Online digital identity is managed according to industry best practices.   5. Online job bidding is done as per the specific job requirements.   6. Online tasks are executed according to the job requirements.   7. Personal online payment account is managed in accordance with financial regulations. |
| 1. Apply job entry techniques | * 1. ***Job opportunities*** are sought based on competencies.   2. A winning resume/CV is developed as per job advertisement.   3. An application/cover letter is developed based on the job advertisement.   4. ***certificates and testimonials*** are organized as per resume.   5. ***Interview skills*** are demonstrated as per job advertisement. |

**RANGE**

This section provides a work environment and conditions to which the performance criteria apply. It allows for a different work environment and situations that will affect performance.

| **Variable** | **Range** |
| --- | --- |
| 1. Computer devices may include but are not limited to: | * Desktops * Laptops * Smartphones * Tablets * Smartwatches |
| 1. Computer hardware may include but are not limited to: | * The System Unit E.g. Motherboard, CPU, casing, * Input Devices e.g. Pointing, keying, scanning, voice/speech recognition, direct data capture devices. * Output Devices e.g. hardcopy output and softcopy output * Storage Devices e.g. main memory e.g. RAM, secondary storage (Solid state devices, Hard Drives, CDs & DVDs, Memory cards, Flash drives * Computer Ports e.g. HDMI, DVI, VGA, USB type C etc. |
| 1. Computer software may include but are not limited to: | * System software e.g. Operating System (Windows, Macintosh, Linux, Android, iOS) * Application Software e.g. Word Processors, Spreadsheets, Presentations etc. * Utility Software e.g. Antivirus programs |
| 1. External devices may include but are not limited to: | * Printers * Projectors * Smart Boards * Speakers * External storage drives * Digital/Smart TVs |
| 1. Word processing concepts may include but are not limited to: | * Creating word documents * Editing word documents * Formatting word documents * Saving word documents * Printing word documents |
| 1. Mouse techniques may include but are not limited to: | * Clicking * Double-clicking * Right-clicking * Drag and drop |
| 1. Internet connection options may include but are not limited to: | * Mobile Networks/Data Plans * Wireless Hotspots * Cabled (Ethernet/Fiber) * Dial-Up * Satellite * ISDN (Integrated Services Digital Network) |
| 1. Data manipulation may include but are not limited to: | * Use of formulae * Use of functions * Sorting * Filtering * Visual representation using charts |
| 1. Electronic presentation concepts may include but are not limited to: | * Creating slides * Editing slides * Formatting slides * Applying slide effects and transitions * Creating and playing slideshows * Saving presentations * Printing slides and handouts |
| 1. Internet services may include but are not limited to: | * Communication Services * Information Retrieval Services * File Transfer * World Wide Web Services * Web Services * Directory Services * Automatic Network Address Configuration * NewsGroup * Ecommerce |
| 1. Internet access applications/software may include but are not limited to: | * Browsers * Email Apps * eCommerce Apps |
| 1. Online collaboration tools may include but are not limited to: | * Online Storage * Online productivity applications * Online meetings, * Online learning environments, * Online calendars * Social networks |
| 1. Data protection and privacy may include but not limited to: | * Confidentiality of data/information * Integrity of data/information * Availability of data/information |
| 1. Internet security threats may include but not limited to: | * Malware attacks * Social engineering attacks * Software supply chain attacks * Advanced persistent threats (APT) * Distributed denial of service (DDoS) * Man-in-the-middle attack (MitM) * Password attacks * IoT Attacks * Phishing Attacks * Ransomware |
| 1. Security threats control measures may include but not limited to: | * Counter measures against cyber terrorism * Physical Controls * Technical/Logical Controls * Operational Controls |
| 1. Online job platforms may include but are not limited to: | * Remotask * Data annotation.tech * Cloudworker * Upwork * Oneforma * Appen |
| 1. Job opportunities may include but not limited to: | * Self employment * Service provision * product development * salaried employment |
| 1. Certificates and testimonialsmay include but not limited to: | * Academic credentials * Letters of previous employments/ services rendered * Letters of commendation * Certifications of participation * Awards |
| 1. Interview skills may include but not limited to: | * Listening skills * Grooming * Language command * Articulation of issues * Body language * Time management * Honesty * Generally knowledgeable in current affairs and technical area |

**REQUIRED KNOWLEDGE AND SKILLS**

This section describes the knowledge and skills required for this unit of competency.

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Computer Hardware and Software Concepts
* Computer Security Concepts (Data security and privacy)
* Cyber security threats and control measures
* Understanding Computer Crimes
* Detection and protection against computer crimes
* Laws governing protection of ICT in Kenya
* Digital Identity Management
* Netiquette Principles
* Fundamentals of Copyright and Licenses
* Word processing;

Functions and concepts of word processing;

Documents and tables creation and manipulations;

Document editing;

Document formatting;

Word processing utilities

* Spreadsheets;

Meaning, types and importance of spreadsheets;

Components of spreadsheets;

Functions, formulae, and charts, uses and layout;

Data formulation, manipulation and application to cells;

Editing & formatting spreadsheets;

* Presentation Packages;

Types of presentation Packages.

Creating, formulating, running, editing, printing and presenting slides and handouts

* Networking and Internet;

Internet connectivity.

Browser and digital content management;

Managing data, information, and digital content

Electronic mail and World Wide Web

* Fundamentals of Online Working;

Online Profile Management;

e-Portfolio Management;

Online Jobs Bidding;

Online Payment Systems;

* Job entry techniques

Job searching sites

Interview preparation skills

Interview handling

**Required skills**

The individual needs to demonstrate the following skills:

* Active listening
* Keyboard Skills
* Mouse Skills
* Analytical skills
* Creativity
* Interpretation Skills
* Communication
* Spreadsheet operations (applying fundamental operations such as addition, subtraction, division and multiplication)
* Computer Use Safety Skills
* Document Editing Skills
* Document Formatting Skills
* Document Printing Skills
* Netiquette Skills
* Internet Browsing Skills
* Problem Solving Skills
* Online Collaboration Skills
* Cybersecurity Skills
* CV writing
* grooming

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required knowledge, and skills range.

|  |  |
| --- | --- |
| 1. Critical aspects of competency | ***Assessment requires evidence that the candidate:***   * 1. Operated computer devices as per workplace policies and regulations.   2. Solved tasks using the office suite as per workplace policies and regulations.   3. Manage data and information as per workplace policies and regulations.   4. Performed online communication and collaboration as per workplace policies and regulations.   5. Applied cybersecurity skills in accordance with workplace policies and regulations.   6. Executed online tasks according to the job requirements.   7. Searched for job opportunity based on competencies.   8. Prepared job requirement documentations based on job opportunity.   9. Demonstrated interview skills based on the job opportunity. |
| 1. Resource implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work environments where assessment can take place.   3. Resources relevant to the proposed activities or task. |
| 1. Methods of assessment | Competency in this unit may be assessed through:   * 1. Observation   2. Oral assessment   3. Portfolio of evidence   4. Interviews   5. Third party report   6. Written assessment   7. Practical assessment   8. Projects |
| 1. Context of assessment | Competency may be assessed:   * 1. Workplace or simulated workplace. |
| 1. Guidance information for assessment | * 1. Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

## 

## APPLY COMMUNICATION SKILLS

**UNIT CODE:** 0031 441 02B

**UNIT DESCRIPTION**

This unit covers the competencies required to demonstrate communication skills. It involves applying communication channels, written, non-verbal, oral, and group communication skills.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes that make up workplace function | **PERFORMANCE CRITERIA**  These are assessable statements that specify the required level of performance for each of the elements.  ***Bold and italicized terms are elaborated in the Range*** |
| --- | --- |
| 1. Apply communication channels | 1. Specific communication channels are identified and applied based on workplace requirements. 2. Challenges are identified and addressed as per the operational standards of the organization. 3. Communication channels are evaluated to meet workplace needs. |
| 1. Apply written communication skills | * 1. Types of written communication are identified and applied according to the workplace requirements.   2. Written communication needs are identified and implemented according to workplace procedures.   3. Written communication guidelines are analyzed, evaluated, and revised based on workplace needs. |
| 1. Apply non-verbal communication skills | 3.1 Existing non-verbal communication techniques are identified and applied based on organization policy.  3.2 Non-verbal communication techniques are articulated and modeled to enhance inclusivity according to workplace requirements. |
| 1. Apply oral communication skills | 4.1 Types of oral communication are identified and established as per organization policy.  4.2 Pathways of oral communication are identified and established as per organization policy.  4.3 Pathways of oral communication are reviewed according to organization procedures.  4.4 Pathways of oral communication are maintained according to the organization standards. |
| 1. Apply group communication skills | 1. Group communication strategies are appliedbased on the workplace needs. 2. Groups are organized in accordance with workplace procedures. 3. Effective questioning, listening and non-verbal communication techniques are used as per needs.   5.4 Group communication challenges are identified and addressed according to the workplace needs. |

**RANGE**

This section provides the work environment and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

| **Variable** | **Range** |
| --- | --- |
| 1. Communication strategies may include but are not limited to: | * Language switch * Comprehension check * Repetition * Asking confirmation * Paraphrasing * Clarification request * Translation * Restructuring * Generalization |
| 1. Effective group interaction may include but not limited to: | * Identifying and evaluating what is occurring within an interaction in a non-judgmental way. * Using active listening. * Making decision about appropriate words, behavior. * Putting together response which is culturally appropriate. * Expressing an individual perspective. * Expressing own philosophy, ideology and background and exploring impact with relevance to communication |
| 1. Situations may include but are not limited to: | * Establishing rapport * Eliciting facts and information * Facilitating resolution of issues * Developing action plans |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

* Active listening
* Interpretation
* Negotiation
* Writing
* Oral skills
* Creative thinking
* Critical thinking
* Decision making
* Analytical
* Innovation
* Conflict skills
* Leadership
* Problem solving skills
* Management
* Organizational
* Teamwork

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Communication process
* Dynamics of groups
* Styles of group leadership
* Key elements of communications strategy
* Principles of effective communication
* Turn-taking techniques
* Conflict resolution techniques
* Work planning
* Work organization
* Company policies
* Company operations and procedure standards
* Fundamental rights at the workplace
* Personal hygiene
* Accountability
* Workplace problems and how to deal with them

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills, knowledge, and range.

|  |  |
| --- | --- |
| 1. Critical aspects of Competency. | Assessment requires evidence that the candidate:   * 1. Identified and applied specific communication channels based on workplace requirements.   2. Identified and applied specific written communication correspondence according to the workplace requirements.   3. Applied and developed non-verbal strategies to communicate in all areas of the workplace requirements.   4. Established pathways of oral communication as per workplace policy.   5. Applied group communication strategies based on workplace needs. |
| 1. Resource Implications | The following resources should be provided:   1. Access to relevant workplace where assessment can take place. 2. Appropriately simulated environment where assessment can take place. 3. Resources relevant to the proposed activity or tasks. |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   * 1. Observation   2. Oral assessment   3. Portfolio of evidence   4. Interviews   5. Third party report   6. Written assessment   7. Practical assessment   8. Projects |
| 1. Context of Assessment | Competency may be assessed:   1. On-the-job 2. In a simulated work environment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY WORK ETHICS AND PRACTICES

**UNIT CODE:** 0417 441 03B

**UNIT DESCRIPTION**

This unit covers competencies required to effectively apply work ethics and practices. It involves the ability to: conduct self-management, promote ethical work practices and values, promote teamwork, manage workplace conflicts, maintain professional and personal development, apply problem-solving and promote customer care.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***Bold and italicized terms are elaborated in Range*** |
| --- | --- |
| 1. Apply self-management skills | 1. Personal vision, mission and goals are formulated based on potential and concerning organization objectives and strategic plan 2. Self-esteem and a positive self-image are developed and maintained based on value 3. Emotional intelligence and stress management are demonstrated as per workplace requirements. 4. Assertiveness is developed and maintained based on the requirements of the job. 5. Accountability and responsibility for one's actions are demonstrated based on workplace instructions. 6. Time management, attendance and punctuality are observed as per the organization’s policy. 7. Personal goals are managed as per the organization’s objective 8. Self-strengths and weaknesses are identified based on personal objectives 9. Motivation, initiative and proactivity are utilized as per the organization policy 10. Individual performance is evaluated and monitored according to the agreed targets. |
| 1. Promote ethical work practices and values | 1. Integrity is demonstrated as per acceptable norms 2. Codes of conduct is applied as per the workplace requirements 3. Policies and guidelines are observed as per the workplace requirements 4. Professionalism is exercised in line with organizational policies |
| 1. Promote Team work | 3.1 ***Teams*** are formed to enhance productivity based on organization’s objectives  3.2 Duties are assigned to teams under the organization policy.  3.3 Team activities are managed and coordinated as per set objectives.  3.4 Team performance is evaluated based on set targets as per workplace policy.  3.5 ***Conflicts*** are resolved between team members in line with organization policy.  3.6 Gender and diversity-related issues are identified and mainstreamed in accordance with workplace policy.  3.7 Healthy ***relationships*** are developed and maintained in line with the workplace.  3.8 Adaptability and flexibility are applied in dealing with team members as per workplace policies |
| 1. Maintain professional and personal development | 4.1 ***Personal growth and development*** needs are identified and assessed in line with the requirements of the job.  ***4.2 Training and career opportunities*** are identified and utilized based on job requirements.  4.3 ***Resources*** for training are mobilized and allocated based on organizations and individual skills needs.  4.4 Licenses and certifications relevant to the job and career are obtained and renewed as per policy.  4.5 Recognitions are sought as proof of career advancement in line with professional requirements.  4.6 Work priorities and personal commitments are balanced and managed based on the requirements of the job and personal objectives.  4.7 Dynamism and on-the-job learning are embraced in line with the organization’s goals and objectives. |
| 1. Apply Problem solving skills | 5.1 ***Creative, innovative*** and practical solutions are developed based on the problem  5.2 Independence and initiative in identifying and solving problems are demonstrated based on the requirements of the job.  5.3 Team problems are solved as per the workplace guidelines  5.4 Problem-solving strategies are applied as per the workplace guidelines  5.5 Problems are analyzed and assumptions tested as per the context of data and circumstances |
| 1. Promote Customer Care | 6.1 Customers' needs are identified based on their characteristics  6.2 Customer ***feedback*** is allowed and facilitated in line with organization policies.  6.3 Customer concerns and complaints are analyzed and resolved in line with the set organizational culture.  6.4 Proactive customer outreach programs are implemented as per organizational policies  6.5 Customer retention strategies are developed and implemented in line with the organizational policy |

**RANGE**

This section provides work environment and conditions to which the performance criteria apply. It allows for different work environment and situations that will affect performance.

| **Variable** | **Range** |
| --- | --- |
| 1. Feedback may include but not limited to: | * Verbal * Written * Informal * Formal |
| 1. Conflicts include but are not limited to: | * Interpersonal Conflict. * Intrapersonal Conflict. * Intergroup Conflict. * Intragroup Conflict. |
| 1. Relationships may include but not limited to: | * Man/Woman * Trainer/trainee * Employee/employer * Client/service provider * Husband/wife * Boy/girl * Parent/child * Sibling relationships |
| 1. Team may include but not limited to: | * Small work group * Staff in a section/department * Inter-agency group * Virtual teams |
| 1. Personal growth may include but not limited to: | * Growth in the job * Career mobility * Gains and exposure the job gives * Net workings * Benefits that accrue to the individual as a result of noteworthy performance |
| 1. Personal objectives may include but not limited to: | * Long term * Short term * Broad * Specific |
| 1. Trainings and career opportunities may include but not limited to | * Participation in training programs * Serving as Resource Persons in conferences and workshops * Capacity building |
| 1. Resource may include may but not limited to: | * Human * Financial * Technology |
| 1. Creative and innovative may include but not limited to: | * New ideas * Original ideas * Different ideas * Methods/procedures * Processes * New tools |
| 1. Emerging issues may include but not limited to: | * Artificial Intelligence * Data confidentiality * National cohesion * Open offices |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

* Active listening
* Critical thinking
* Organizational
* Negotiation
* Monitoring
* Evaluation
* Problem solving
* Decision Making
* Leadership
* Creative/innovative thinking
* Adaptability
* Conflict management
* Emotional intelligence
* Teamwork

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Work values and ethics
* Company policies and procedures
* Company operations, procedures and standards
* Flexibility and adaptability
* Concept of time and leisure time
* Decision making
* Work planning
* Organizing work
* Monitoring and evaluation
* Record keeping
* Gender and diversity mainstreaming
* Drug and substance abuse
* Professional growth and development
* creativity
* Innovation
* problem solving
* customer care
* mentoring and coaching.
* Emerging issues

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical aspects of Competency | Assessment require evidence that the candidate:   * 1. Applied self-management skills as per organizational procedures.   2. Promoted ethical practices and values as per organizational procedures.   3. Promoted Teamwork as per workplace assignments.   4. Maintained professional and personal development as per organizational procedures.   5. Applied Problem-solving skills based on work requirements.   6. Identified customer needs based on their characteristics.   7. Gave back Customer feedback in line with organization policies. |
| 1. Resource Implications | The following resources should be provided:   1. Access to relevant workplace where assessment can take place 2. Appropriately simulated environment where assessment can take place. 3. Resources relevant to the proposed activity or tasks. |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   1. Observation 2. Oral questioning 3. Written test 4. Portfolio of Evidence 5. Interview 6. Third party report |
| 1. Context of Assessment | Competency may be assessed:   1. On-the-job 2. In a simulated work environment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY ENTREPRENEURIAL SKILLS

**UNIT CODE :** 0413 441 04B

**UNIT DESCRIPTION**

This unit covers the competencies required to demonstrate an understanding of entrepreneurship. It involves demonstrating an understanding of financial literacy, applying entrepreneurial concepts identifying entrepreneurship opportunities, applying business legal aspects, developing business innovative strategies, and developing business plans.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes that make up workplace function. | **PERFORMANCE CRITERIA**  These are assessable statements that specify the required level of performance for each of the elements.  ***Bold and italicized terms are elaborated in Range*** |
| --- | --- |
| 1. Apply Financial Literacy Skills | 1. **Sources of personal and business** ***funds*** are identified as per financial procedures and standards 2. Personal finances are managed as per financial procedures and standards 3. Savings are managed as per financial procedures and standards 4. Debts are managed as per financial procedures and standards 5. Investments are undertaken as per financial procedures and standards 6. Insurance services are procured as per financial procedures and standards |
| 1. Apply entrepreneurial concept | 1. Entrepreneurs and Business persons are distinguished as per principles of entrepreneurship 2. ***Types of entrepreneurs*** are identified as per principles of entrepreneurship 3. Ways of becoming an entrepreneur are identified as per principles of Entrepreneurship 4. ***Characteristics of Entrepreneurs*** are identified as per principles of Entrepreneurship 5. Salaried employment and self-employment are distinguished as per principles of entrepreneurship 6. ***Requirements for entry into self-employment*** are identified according to business procedures and standards 7. Roles of an Entrepreneur in an enterprise are determined according to business procedures and standards 8. **Contributions of entrepreneurship** to National development are identified as per business procedures and standards |
| 1. Identify entrepreneurial opportunities | 1. Business ideas are identified as per business procedures and standards 2. Factors to consider when evaluating business opportunity viability are explored based on business procedure and standards 3. Entrepreneurial opportunities are evaluated as per business procedures and standards 4. Business ideas and opportunities are generated as per business procedures and standards 5. Business life cycle is analysed as per business procedures and standards |
| 1. Apply business legal aspects | 1. ***Forms of business ownership*** are identified as per legal procedures and practices 2. Business Registration and Licensing processes are identified as per legal procedures and practices 3. Types of Contracts and Agreements are analysed as per legal procedures and practices 4. Employment Laws are identified as per legal procedures and practices 5. Taxation laws are identified as per legal procedures and practices |
| 1. Innovate Business strategies | 1. Business innovation strategies are determined by the organization standards 2. Creativity in business development is demonstrated in accordance with business standards 3. ***Innovative business standards***  are developed as per business principles 4. Linkages with other entrepreneurs are created as per best practice 5. ICT is incorporated in business growth and development as per best practice |
| 1. Develop Business Plan | 1. Business idea is described as per business procedures and standards 2. Business description is developed as per business plan format 3. Marketing plan is developed as per business plan format 4. Organizational/Management plan is prepared in accordance with business plan format 5. Production/operation plan is prepared in accordance with business plan format 6. Financial plan is prepared in accordance with the business plan format 7. Executive summary is prepared in accordance with business plan format 8. Business plan is presented as per best practice 9. Business ideas are incubated as per institutional policy. |

**RANGE**

This section provides work environment and conditions to which the performance criteria apply. It allows for different work environment and situations that will affect performance.

| **Variable** | **Range** |
| --- | --- |
| 1. Sources of personal funds mayinclude but not limited to: | * Salary/Wages * Investments * Savings * Inheritance * Government Benefits |
| 1. Sources of business finance mayinclude but not limited to: | * Equity Financing * Debt Financing, * Personal Savings/Investment * Retained Earnings * Grants and Subsidies * Crowdfunding * supplier Credit: * Leasing and Asset Financing: |
| 1. Types of entrepreneurs may include but not limited to: | * Innovators * Imitators * Craft * Opportunistic * Speculators |
| 1. Characteristics of Entrepreneurs may include but not limited to: | * Creative * Innovative * Planner * Risk taker * Networker * Confident * Flexible * Persistent * Patient * Independent * Future oriented * Goal oriented |
| 1. Requirements for entry into self-employment may include but not limited to | * Technical skills * Management skills * Entrepreneurial skills * Resources * Infrastructure |
| 1. Forms of businesses ownership may include but not limited to: | * Sole proprietorship * Partnership * Limited companies * Cooperatives |
| 1. Innovative business standards may include but not limited to: | * New products * New methods of production * New markets * New sources of supplies * Change in industrialization |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

* Analytical
* Management
* Problem-solving
* Root-cause analysis
* Communication

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Decision making
* Business communication
* Change management
* Competition
* Risk
* Net working
* Time management
* Leadership
* Factors affecting entrepreneurship development
* Principles of Entrepreneurship
* Features and benefits of common operational practices, e. g., continuous improvement (kaizen), waste elimination,
* Conflict resolution
* Health, safety and environment (HSE) principles and requirements
* Customer care standards
* Basic financial management
* Business strategic planning
* Impact of change on individuals, groups and industries
* Government and regulatory processes
* Local and international market trends
* Product promotion standards
* Market and feasibility studies
* Government and regulatory processes
* Local and international business environment
* Relevant developments in other industries
* Regional/ County business expansion standards

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   1. Identified Sources of personal and business finance as per financial procedures and standards 2. Managed Personal finances as per financial procedures and standards 3. Made Investment decisions as per financial procedures and standards 4. GeneratedBusiness ideas and opportunities based on business procedure and standards 5. Analysed business life cycle based on business procedure and standards 6. Determined business innovative standards as per business principles 7. Developed and presented a business plan as per regulatory framework. |
| 1. Resource Implications | The following resources should be provided:   1. Access to relevant workplace where assessment can take place 2. Appropriately simulated environment where assessment can take place |
| 1. Methods of Assessment | Competency may be assessed through:   1. Written tests 2. Oral questions 3. Third party report 4. Interviews 5. Portfolio |
| 1. Context of Assessment | Competency may be assessed:   1. On-the-job 2. In a simulated work environment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# COMMON UNITS OF COMPETENCY

## APPLY ENGINEERING TECHNICIAN MATHEMATICS

**UNIT CODE:** 0541 441 05A

**UNIT DESCRIPTION**

This unit describes competencies required to apply engineering technician mathematics in their work. Competencies include: carrying out binomial expansion, applying calculus, applying statistics and probability, applying vector theorem, applying algebra, applying trigonometry and hyperbolic functions, applying complex numbers, performing coordinate geometry and applying matrices.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***Bold and italicized terms are elaborated in the Range.*** |
| --- | --- |
| 1. Apply algebra | * 1. Calculations involving Indices are performed as per the concept.   2. Calculations involving Logarithms are performed as per the concept.   3. Scientific calculator is used in solving mathematical problems in line with manufacturer’s manual.   4. Simultaneous equations are performed as per the rules.   5. Quadratic equations are calculated as per the concept |
| 1. Apply trigonometry and hyperbolic functions | * 1. Calculations are performed as per trigonometric rules.   2. Triangle solutions are performed as per heron’s formula.   3. Calculations are performed as per hyperbolic functions |
| 1. Apply complex numbers | * 1. Complex numbers are represented as per Argand diagrams   2. Operations involving complex numbers are performed as per complex numbers concept.   3. Calculations involving complex numbers are performed as per De Moivre’s theorem |
| 1. Perform coordinates geometry | * 1. Polar equations are calculated as per coordinate geometry   2. Polar equations graphs are drawn as per the Cartesian plane.   3. Normal and tangents are determined as per coordinate geometry |
| 1. Carry out binomial expansion | * 1. Binomial theorem statements are obtained as per binomial expansion concept.   2. Roots of numbers are determined as per binomial theorem concept.   3. Errors and small changes are determined as per binomial theorem |
| 1. Apply calculus | 1. Derivatives of functions are determined as per differentiation concept. 2. Derivatives of hyperbolic functions are determined as per Differentiation concept. 3. Derivatives of inverse trigonometric functions are determined as per Differentiation. 4. Rate of change and small change are determined as per Differentiation concept. 5. Calculation involving stationery points of functions of two variables are performed as per differentiation concept. 6. Integrals of algebraic functions are determined as per integration concept. 7. Integrals of trigonometric functions are determined as per integration concept. 8. Integrals of logarithmic functions are determined as per integration concept. 9. Integrals of hyperbolic and inverse functions are determined as per integration concept. |
| 1. Apply statistics and probability | * 1. Data identification, Collection and Organization is performed as per statistics concept.   2. Data Interpretation, analysis and presentation is performed as per statistics concept.   3. Mean, median, mode and Standard deviation are obtained as per statistics concept.   4. Probability Calculations are performed based on Laws of probability.   5. ***Probability distributions***, mathematical expectation sampling distributions calculations are performed based on Probability concept.   6. Probability events are determined from dependent, independent and mutually exclusive based on probability concept. |
| 1. Apply vector theorem | 1. Calculations involving vector algebra, dot and cross products are obtained as per vector theory. 2. Gradient, Divergence and Curl are obtained are obtained as per vector theory. 3. Vector calculations are performed as per Green’s theorem. 4. Vector calculations are performed as per Stoke’s theorem. 5. Conservative vector fields and surface integrals are obtained as per Gauss’s theorem 6. Conservative vector fields and volume integrals are obtained as per Gauss’s theorem |
| 1. Apply matrices | 1. Determinant and inverse of 3x3 matrix are obtained as per Cramer’s’ theorem concept. 2. Solutions of simultaneous equations are obtained as per matrix concept. 3. Calculation involving Eigen values and Eigen vectors are performed as per matrix concept |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

|  |  |
| --- | --- |
| **Variable** | **Range** |
| * + 1. Arithmetic operationsinclude but not limited to: | * Addition * Subtraction * Multiplication * Division |
| * 1. Matrices Operations include but not limited to: | * Addition * Subtraction * Multiplication * Division |
| * 1. Measures of central tendencies include but not limited to: | * Mean * Median * Mode * Standard deviation * Variance |
| * 1. Data presentation include but not limited to: | * Pie chart * Line graphs * Bar charts * Pictograms * Histograms * Frequency polygons * Frequency distribution graph(ogive) |
| * 1. Trigonometry ratios include but not limited to: | * Sine * Cosine * Tangent * Sec * Cosec * Cotagent |
| * 1. Trigonometric rules | * sine rules * cosine rule |
| * 1. Inverse trigonometric ratios | * Inverse of sine * Inverse of cosine * Inverse of tangent |
| * 1. Trigonometric functions Integrals | * Sine * Cosine * Tangent |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

* Applying fundamental operations (addition, subtraction, division, multiplication)
* Using and applying mathematical formulas
* Logical thinking
* Problem solving
* Applying statistics
* Drawing graphs
* Using different measuring tools

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Fundamental operations (addition, subtraction, division, multiplication)
* Types of fractions
* Trigometric Ratios
* Types of tables and graphs
* Presentation of data in tables and graphs

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills, knowledge and range.

|  |  |
| --- | --- |
| 1. Critical aspects of Competency | Assessment requires evidence that the candidate:   * 1. Applied algebra as per mathematical methods   2. Applied trigonometry and hyperbolic functions as per mathematical methods   3. Applied complex numbers as per mathematical methods   4. Applied coordinates geometry as per mathematical methods   5. Applied calculus as per mathematical methods   6. Carried out binomial expansion as per mathematical methods   7. Applied statistics as per mathematical methods   8. Applied vector as per mathematical methods   9. Applied matrices as per mathematical methods |
| 1. Resource Implications | The following resources should be provided:   * 1. Access to relevant workplace or appropriately simulated environment where assessment can take place   2. Materials relevant to the proposed activity or tasks |
| 1. Methods of Assessment | **Competency may be assessed through:**   * Written tests * Practical Assessment * Projects |
| 1. Context of Assessment | Competency may be assessed in a workplace or a simulated workplace. |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## PREPARE ENGINEERING DRAWINGS

**UNIT CODE:** 0732 441 06A

**UNIT DESCRIPTION:** This unit covers competences required to prepare technical drawings. Competences include preparing drawing equipment and materials, producing plane geometry drawings, managing basic operations in AutoCAD, developing 2D Drawings in AutoCAD and Producing pictorial and orthographic drawings of components.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes which make up workplace function. | | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***(Bold and italicised terms are elaborated in the Range)*** | |
| --- | --- | --- | --- |
| 1. Prepare drawing equipment and materials | | 1. ***Drawing equipment*** are identified according to task requirements 2. ***Drawing materials*** are identified according to task requirements 3. Drawing equipment are used as per technical drawing standards 4. Drawing equipment are maintained as per technical drawing standards 5. Drawing materials are used as per workplace procedures 6. Waste materials are disposed in accordance with workplace procedures and environmental legislations | |
| 1. Produce plane geometry drawings | | 1. ***Drawing lines*** are applied according to technical drawing standards 2. Freehand sketching is carried out as per work requirement 3. ***Plane figures*** are drawn as per technical drawing standards. | |
| 1. Manage basic operations in AutoCAD | | * 1. CAD software ***Key features*** are identified as per software manual.   2. ***AutoCAD visual reference commands*** are operated as per software manual.   3. AutoCAD ***ribbon*** tools are used as per software manual.   4. AutoCAD ***status bar*** tools are used as per software manual.   5. AutoCAD navigation commands option is operated as per software manual.   6. AutoCAD drawing files are saved in proper format as per organisational procedures.   7. AutoCAD drawing work is printed as per software manual. | |
| 1. Develop 2D Drawings in AutoCAD | | 1. Drawing interface is set up as per required specifications. 2. CAD drawing Layout is created as per given specification. 3. 2D drawing is created as per given dimension. 4. 2D drawing is edited as per given requirement changes. 5. AutoCAD drawing is saved in CAD file format as per software manual. 6. AutoCAD 2D drawing work is printed as per software manual. | |
| 1. Produce pictorial and orthographic drawings of components | | 1. Symbols and abbreviations are identified applied as per technical drawing standards. 2. ***Pictorial drawings*** are produced as per work requirement 3. Orthographic drawings produced as per work requirement | |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

| **Variable** | **Range** |
| --- | --- |
| 1. ***Drawing equipment*** may include but not limited to: | * Drawing boards * T and set squares * Drawing set |
| 1. ***Drawing materials*** may include but not limited to: | * Drawing papers * Pencils * Erasers * Masking tapes * 2.5 Paper clips |
| 1. ***Drawing lines*** may include but not limited to | * Solid * Hidden * Dashed * Center * Dimension * Extension * Leaders * Break * Section. |
| 1. ***Plane figures*** may include but not limited to: | * Circles * Triangles * Rectangles * Parallelogram * Polygons * Pyramids * Conic sections * Prisms * Angles * Tangents * Points * Lines |
| 1. ***Key Features*** may include but not limited to: | * 2D drafting and drawing |
| 1. ***Pictorial drawings*** may include but not limited to: | * Isometric drawing * Free hand sketches * Oblique drawing |
| 1. ***AutoCAD visual reference commands*** may include but not limited to: | * Visual styles * Materials and textures * Writing * Rendering * View port |
| 1. ***Ribbon*** may include but not limited to: | * Draw panel * Modify panel * Annotation |
| 1. ***Status bar*** may include but not limited to: | * Snap * Grid * Ortho * Object snap * Polar tracking |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required skills**

The individual needs to demonstrate the following skills:

* Critical thinking
* Drawing
* Interpretation
* Drawing equipment handling
* Analysis and synthesis
* Basic computer skills
* Communication
* Inter personal

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Drawing equipment and materials
* Freehand sketching
* Lettering
* Geometrical constructions
* Types of drawings
* Types of lines
* Isometric drawing conventions, features, characteristics, components
* Orthographic drawing conventions, features, characteristics, components
* Sketches and drawings of simple patterns

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required knowledge and understanding and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   * 1. Applied Drawing lines according to technical drawing standards   2. Carried out Freehand sketching out as per work requirement   3. Drawn plane figures as per technical drawing standards.   4. Created CAD drawing Layout as per given specification.   5. Created 2D drawing as per given dimension.   6. Edited 2D drawing as per given requirement changes.   7. Saved AutoCAD drawing in CAD file format as per software manual.   8. Printed AutoCAD 2D drawing work as per software manual.   9. Identified Symbols and abbreviations are identified applied as per technical drawing standards.   10. Produced Pictorial drawings as per work requirement   11. Produced Orthographic drawings as per work requirement |
| 1. Resource Implications | The following resources should be provided:   * 1. Access to relevant workplace or appropriately simulated environment where assessment can take place   2. Resources appropriate for performance of assessment tasks |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   1. Project 2. Practical 3. Third party report 4. Portfolio of evidence 5. Written tests    1. Oral questioning |
| 1. Context of Assessment | This competency may be assessed in a workplace or in a simulated workplace. |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY ELECTRICAL PRINCIPLES

**UNIT CODE:** 0713 441 07A

**UNIT DESCRIPTION**

This unit describes the competencies required by a technician in order to apply a wide range of Electrical principles 1 in their work. It involves Applying Electrical quantities, Using cells and batteries, Apply Concepts of DC circuit, Applying magnetism and electromagnetism, Applying Electrostatics principles, Applying AC circuits and performing electrical measurements.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***Bold and italicized terms are elaborated in the Range.*** |
| --- | --- |
| 1. Apply Electrical quantities | 1. Electrical quantities and units are identified as per SI systems 2. Calculations involving various electrical quantities are performed as per formula. 3. Electrical quantities measuring instruments are identified as per IEC standards. |
| 1. Use cells and batteries | 1. Simple cells are constructed as per work procedure. 2. Types of cells and batteries are identified as per work requirement. 3. E.M.F and internal resistance of cells is determined as per the measurement. 4. Maintenance of batteries is carried out based on manufacturer’s specification 5. Applications of batteries are identified as per work requirement. |
| 1. Apply Concepts of DC circuit | * 1. Resistance and resistivity is determined in DC circuit as per IEC standards.   2. Calculations involving parallel and series circuits are performed based on DC circuit.   3. Calculations involving ***basic*** ***electrical laws*** are performed based on DC circuit. |
| 1. Apply magnetism and electromagnetism | * 1. Magnetic and non-magnetic materials are identified as per IEC standards.   2. Concepts of magnetic fields and field distribution are described as per magnetic laws   3. Concepts of electromagnetism are applied based on magnetic properties.   4. Laws of electromagnetic induction are identified based on magnetic fields   5. Concepts of self and mutual induction are applied as per electromagnetic laws |
| 1. Apply Electrostatics principles | * 1. Electrostatics quantities are identified as per type of charges.   2. Types of capacitors are identified as per application requirement.   3. Calculations involving capacitors in series and parallel are performed as per electrostatic quantities.   4. Capacitors are applied in electrical circuits as per application requirement.   5. Capacitors are tested as per IEC standards |
| 1. Apply AC circuits | * 1. AC fundamentals are applied as per working principles.   2. Calculation involving passive elements in AC circuits is performed based on the circuit requirement.   3. Concept of Power triangle is applied as per AC working principles.   4. Calculations involving power factor correction is performed as per working principles.   5. Methods of power factor correction are applied as per working principle. |
| 1. Perform electrical measurements | * 1. Types of instruments are identified as per work procedure.   2. Construction and operation of instruments is demonstrated as per work procedure.   3. Methods of range extension are applied as per work procedure.   4. Null-indicating instruments are identified as per work procedure.   5. Calculations involving electrical instruments are performed as per the formula.   6. Instrumental/systematic errors and mitigations are demonstrated as per work requirement.   7. Calculations involving systematic errors are performed as per the formula. |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Types of cells and batteries include but not limited to: | * + Dry cells   + Leclanche   + Mercury   + Lead-acid   + Alkaline   + Lithium |
| 1. Basic Electrical laws may include but not limited to: | * + Ohms law   + Kirchhoff’s theorem |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

* Apply basic Electrical formulas
* Use of basic Electrical instruments
* Perform various unit conversions of Electrical quantities
* Power factor correction
* Logical thinking
* Problem solving
* Applying statistics
* Drawing graphs
* Using different measuring tools

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Electrical power calculations
* Various laws in Electrical engineering
* Electrical formulas
* Power triangle
* SI units of various electrical parameters
* Selecting the correct type of electrical machines for various uses
* Types and purpose of measuring instruments
* Units of measurement and abbreviations

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical aspects of Competency | Assessment requires evidence that the candidate:   1. Performed calculations involving various electrical quantities as per formula 2. Constructed Simple cells as per work procedures 3. Identified types of cells and batteries as per work requirement 4. Identified applications of batteries as per work requirement 5. Carried out maintenance of batteries based on manufacturer’s specification 6. Applied concepts of DC circuit 7. Applied concepts of magnetism and electromagnetism 8. Applied principles of electrostatics 9. Applied concepts of A.C circuits 10. Performed electrical measurements |
| 1. Resource Implications | 1. Access to relevant workplace or appropriately simulated environment where assessment can take place 2. Measuring equipment 3. Materials relevant to the proposed activity or tasks |
| 1. Methods of Assessment | 1. Practical demonstration 2. Projects 3. Written tests 4. Oral test |
| 1. Context of Assessment | 1. Competency may be assessed in a workplace or a simulated workplace. |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY TELECOMMUNICATION PRINCIPLES

**UNIT CODE:** 0714 441 08A

**UNIT DESCRIPTION**

This unit covers the competencies required to apply telecommunication Principles. Competencies include applying knowledge of allocation of frequency and measuring instruments, applying transmission line principles and applying antenna principles.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace functions | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements  Bold and italicized terms are elaborated in the range  ***(Bold and italicised terms are elaborated in the Range)*** |
| 1. Apply knowledge of allocation of frequency and measuring instruments | * 1. Telecommunication ***measuring instruments*** are identified as per work requirement.   2. Telecommunication measuring techniques are conducted as per standard procedure.   3. Logarithmic units knowledge are applied as per type of communication systems   4. Concept of frequency allocation and licensing are applied as per standard procedure.   5. ***Telecommunication regulatory bodies*** are identified as per standard procedure. |
| 1. Apply transmission line principles | * 1. Basic components if ***transmission lines*** are identified as per work requirement.   2. Types of Telecommunication transmission lines are identified as per work requirement.   3. Transmission line testing is carried out as per work requirement. |
| 1. Apply antennas principles | * 1. Radio wave propagation mode is identified as per standard procedure.   2. Antenna working principle is applied as per work requirement.   3. Antenna Frequency spectrum concepts are applied as per work requirement.   4. Antenna ***parameters*** is identified as per design specification. |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

| **Variable** | **Range** |
| --- | --- |
| 1. Telecommunication Regulatory bodies may include but is not limited to: | * Communication Authority (CA) * International Telecommunication Union (ITU) |
| 1. Measuring instruments may include but is not limited to: | * Network analyser * Signal generator * Spectrum analyser * Frequency counter * Optical Time-Domain Reflectometer * Analogue signal generators * Bit error rate tester |
| 1. Transmission lines may include but not limited to: | * Coaxial cable * Microwave links * Optical fibre * Satellite link |
| 1. Antenna parameters may include but not limited to: | * Directivity * Polarity * Gain * Radiation pattern * Feeder |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

* The manufacturer's warranty requirements relating to Electromagnetics Field Theory and related components.
* Mathematical concepts in Laplace transforms
* The legal requirements relating to telecommunicationinstallations
* Kenyan legislation and workplace procedures relevant to:
* Health and safety;
* Environment (including waste disposal);
* Appropriate personal protective equipment (PPE).
* Work place communication;
* Time management
* Materials management
* Documentation and keeping records
* The relationship between time and costs

**FOUNDATION SKILLS**

* Communications (verbal and written);
* Proficient in logistic management;
* Time management;
* Meeting organization;
* Analytical
* Faults troubleshooting;
* Planning;
* Decision making;
* First aid;
* Report writing;
* Problem solving;
* Management

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required knowledge and understanding and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | **Assessment requires evidence that the candidate:**   1. Applied concept of frequency allocation and licensing as per standard procedure 2. Applied Logarithmic units’ knowledge as per type of communication systems 3. Identified types of Telecommunication transmission lines as per work requirement 4. Applied Transmission lines knowledge as per type of telecommunication system 5. Identified antenna ***parameters*** as per design specification |
| 1. Resource Implications | The following resources must be provided:   1. Appropriately simulated environment where assessment can take place. 2. Access to relevant workplace environment. 3. Resources relevant to the proposed activities or tasks |
| 1. Methods of Assessment | Competency may be assessed through:   1. Practical 2. Portfolio of evidence 3. Third party report 4. Oral questioning 5. Written tests |
| 1. Context of Assessment | Competency may be assessed in workplace or simulated workplace. |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# CORE UNITS OF COMPETENCY

## INSTALL ELECTRICAL SYSTEMS

**UNIT CODE:** 0714 451 09A

**UNIT DESCRIPTION**

This unit specifies competences required for installing telecommunication systems power supply. These include preparing power supply electrical drawings, performing electrical installation system sizing, setting up telecommunication mains utility power supply and testing power supply system.

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***(Bold and italicized terms are elaborated in the range).*** |
| 1. Prepare power supply electrical drawings | * 1. Power supply Site survey is conducted as per installation requirement   2. Power supply Installation is designed as per load demand   3. Installation electrical drawing is prepared as per designed specifications |
| 1. Perform Electrical installation system sizing | * 1. Power supply source is identified as per designed specifications   2. Cable sizes are selected as per power supply   3. Protection system is selected as per load demand   4. Electrical installation system sizing is performed as per load demand |
| 1. Set up Telecommunication mains utility power supply system | * 1. Electrical tools, equipment and materials are prepared as per work requirement   2. Cable laying ducts are prepared as per design specifications   3. Utility power supply cables are terminated on panels as per electrical drawing   4. Main utility power supply is tested as per design specifications |
| 1. Test electrical power supply system | 1. Types of ***electrical tests*** are determined as per power supply designed specifications 2. Tests are carried out as per ***IEEE standards*** 3. Test results are documented as per organization standard procedure |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

| **Variable** | **Range** |
| --- | --- |
| 1. Electrical tests may include but not limited to: | * Continuity Testing * Insulation Resistance Testing * Polarity Testing * Earth Fault Loop Impedance Tests * Prospective Fault Current Test (PFC Test) * Phase Sequence Test * Residual Current Device (RCD) Test |
| 1. IEEE standards may include but is not limited to: | * IEEE 802® Standards * IEEE P1941.1™ * IEEE P2872™ * ISO standards |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

1. The individual needs to demonstrate knowledge and understanding of:

* The manufacturer's warranty requirements relating to installation of Power Lines and related components.
* The legal requirements relating to commissioning activities for electrical power lines installations and components.

1. Legislation and workplace procedures relevant to:

* Environment, health and safety;
* Appropriate PPE (personal protective Equipment)

1. Observe County Government bylaws
   * + EPRA (Energy & Petroleum Regulatory Authority)
     + NEMA
     + KPLC Electrical Safety rules
2. Power Supply Technologies:
   * + Knowledge of current power supply technologies
     + Electrical circuit techniques.
3. Automatic Control:
   * + Understanding of automatic control systems used in power supply systems.
4. Grounding and Protection Techniques:
   * + Knowledge of techniques to ensure the safety and reliability of the power supply system.
5. Design of Battery and Grounding Installations:
   * + Ability to design and install batteries and grounding systems.
6. Telecommunications Industry:
   * + Broad understanding of the telecommunications industry and the role of power supply within it.
7. Relevant Standards:
   * + Familiarity with relevant IEEE standards and other industry regulations.
8. Uninterruptible Power Supplies (UPSs):
   * + Understanding of UPSs used in the telecommunications industry to provide communications continuity and reduce downtime.
9. The importance of documenting electrical machines installation information
10. The importance of working to agreed timelines
11. The relationship between time and costs
12. How to prepare, interpret and use sources of technical information for scheduled Electrical power lines construction works
13. The importance of using the correct sources of technical information.
14. The purpose of and how to use identification codes (e.g., colour codes).
15. How the power system operates
16. The operating specifications and tolerances for different types of power systems components
17. The hazards associated with operation of a power system.

**FOUNDATION SKILLS**

The individual needs to demonstrate the following additional skills:

* Communications (verbal and written);
* Proficient in ICT;
* Time management;
* Analytical
* Faults troubleshooting
* Problem solving;
* Planning;
* Decision making;
* First aid;
* Report writing;

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and understanding and range.

|  |  |
| --- | --- |
| * 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   * 1. Applied power supply installation design as per load demand.   2. Applied electrical installation system sizing as per load demand.   3. Applied utility power supply cable termination on panels as per electrical drawing.   4. Applied solar power supply cable termination at the power panels as per electrical drawing.   5. Applied UPS system cable termination at the power panels as per electrical drawing.   6. Applied tests as per IEEE standards. |
| * 1. Resource Implications | The following resources **must** be provided:   * 1. Access to relevant workplace where assessment can take place   2. Appropriately simulated environment where assessment can take place   3. Materials relevant to the proposed assessment activity or tasks |
| * 1. Methods of Assessment | Competency may be assessed through:   * 1. Practical assessment   2. Project   3. Written assessment   4. Observation   5. Oral questioning   6. Portfolio of evidence   7. Third party report |
| * 1. Context of Assessment | Competency may be assessed in a:   1. Workplace 2. Simulated workplace |
| * 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## INSTALL COMPUTER NETWORK

**UNIT CODE:** 0713 451 10A

**UNIT DESCRIPTION**

This unit specifies competencies required for installing communication network. These include: conducting computer network site preparation, preparing computer network technical drawings. , carrying out computer network structured cabling and installing small office/ home office (SOHO) networks.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace function | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***Bold and italicized terms are elaborated in the Range*** |
| 1. Conduct Computer Network Site preparation | * 1. ***Computer Network*** ***Site Preparation Tools*** and ***equipment*** are assembled as per work requirement   2. Communication network site is cleared as per work requirement   3. Communication network survey is demarcated as per work requirement. |
| 1. Prepare Computer Network Technical Drawings. | * 1. Network topology diagrams are identified as per design specifications.   2. Site floor plan is identified as per work requirement.   3. Cabling lay out diagram is drawn as per work requirement. |
| 1. Carry out Computer network structured cabling | * 1. Data Network ***structured cabling tools, equipment*** and ***materials*** are assembled as per work requirement   2. Data Network ***Cable routing*** is developed as per network design requirement.   3. Data Networkcabinets are mounted as per network design requirement   4. Data ***Network cables*** are laid as per network design requirement |
| 1. Install Small office/ Home office (SOHO) networks | * 1. ***SOHO*** network model is identified as per design specification.   2. ***Computer network protocol*** is selected as per design specification.   3. SOHO network is installed as per design requirement.   4. SOHO network is tested as per work requirement. |

**RANGE**

This section provides work environment and conditions to which the performance criteria apply. It allows for different work environment and situations that will affect performance.

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Communication Network Site preparation Tools and equipment includes but not limited to; | Tools and equipment:   * Safety Gear * Measuring and Marking Tools * Cable Installation Tools * Grounding and Bonding Tools * Concrete and Masonry Tools * Power Tools * Fasteners * Personal Protective Equipment (PPE) |
| 1. Structural cabling tools, equipment and materials includes but not limited to; | Tools:   * Cable cutters and strippers * Crimpers * Punch down tools * Cable testers * Heat guns (optional Labelling tools   Equipment:   * Cable ladders and trays * Conduit * Cable reels * Cable testers * Tone generators and probes   Materials:   * Copper cables (Cat5e, Cat6, etc * Fiber optic cables * Patch panels * Wall plates and jacks * Cable ties and straps |
| 1. Cable routing includes but not limited to; | * Cable ducts * Cable conduits * Cable channels * Cable trunking |
| 1. Network cables includes but not limited to; | * Ethernet Cable * Coaxial Cable * Fiber Optic Cable * Twisted Pair Cable |
| 1. Termination tools, equipment and materials includes but not limited to; | Tools:   * Crimping tool * Punch down tool * Wire stripping tool * Cable cutter * Cable tester   Equipment:   * Patch panels * Fiber optic termination boxes * Splicing equipment * Heat shrink tubing   Materials:   * Connectors * Patch cables * Cable ties * Cable labels * Adhesive-backed cable mounts |
| 1. Data Communication Network devices includes but not limited to | * Router * Switch * Access Point (AP) * Firewall * Network Interface Card (NIC) * Hub * Repeater * Bridge |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

The individual needs to demonstrate knowledge and understanding of:

* The manufacturer's warranty requirements relating to electrical installation systems and related components.
* The legal requirements relating to electricalinstallations
* Kenyan legislation and workplace procedures relevant to:
* Health and safety;
* Environment (including waste disposal);
* Appropriate personal protective equipment (PPE).
* Work place communication;
* Time management
* Materials management
* The importance of documentation and keeping records
* The relationship between time and costs
* The importance of using the correct sources of technical information.
* Interpreting circuits, drawings, specifications and instructions
* Preparing work plans in accordance with legislative and regulatory requirements and standard operating procedures and health and safety requirements
* Importance of contractual agreements
* Necessary insurance and policies including security bonds, performance bonds, contractors all risks
* Insurance of contractor’s work
* Financial knowledge
* Networking
* Optical communication;
* Internet protocol;
* Wireless;

**FOUNDATION SKILLS**

1. Communications (verbal and written);
2. Proficient in ICT;
3. Time management;
4. Problem solving;
5. Negotiation
6. Decision making;
7. First aid;
8. Report writing;
9. Planning;
10. Leadership;

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical aspects of Competency | Assessment requires evidence that the candidate:   * 1. Identified network topology diagrams as per design specifications   2. Mounted Data Networkcabinets as per network design requirement   3. Installed SOHO network as per design requirement. |
| 1. Resource Implications | The following resources must be provided:   1. Access to relevant workplace where assessment can take place 2. Appropriately simulated environment where assessment can take place 3. Material relevant to the proposed assessment activity or task |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   1. Practical assessment 2. Project 3. Observation 4. Oral questioning 5. Written assessment |
| 1. Context of Assessment | Competency may be assessed in a   1. Workplace 2. Simulated workplace |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## INSTALL FIBER OPTICS NETWORKS

**UNIT CODE:** 0612 551 11A

**UNIT DESCRIPTION**: This unit specifies competencies required for installing fiber optics networks. These include:. Conducting fiber optics network site survey, preparing fiber optics networks technical drawings, laying out fiber optics cables, terminating fiber optics cables, configuring fiber optics network devices and testing fiber optics network.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace function | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***(Bold and italicized terms are elaborated in the range)*** |
| 1. Conduct fiber optic network site survey | 1. ***Fiber optic network Site Survey Tools*** and equipment are assembled as per work requirement 2. Fiber optic network survey data is collected as per work requirement. 3. Fiber optic network site survey report is prepared as per workplace procedure |
| 1. Prepare fiber optic network technical Drawings | 1. Fiber optic ***drawing tools*** and equipment are assembled as per work requirement. 2. Fiber optic Site survey is conducted as per installation requirement 3. Fiber optic Installation is designed as per load demand 4. Fiber optic drawing is prepared as per designed specifications |
| 1. Lay fiber optic cables | * 1. Fiber optic network cables ***laying tools, equipment*** and ***materials*** are assembled as per work requirement   2. Fiber optic network cables route is constructed as per fiber optic network design   3. Fiber optic network cables are drawn as per fiber optic network design   4. Outdoor fiber optic network devices are mounted as per design specification   5. Indoor fiber optic network devices are mounted as per design specification |
| 1. Terminate fiber optic cables | * 1. ***Fiber optic cable termination tools, equipment*** and ***materials*** are assembled as per work requirement   2. Fiber optic cables are prepared as per termination requirement   3. Fiber optic cables are ***connected*** as per work requirement |
| 1. Configure fiber optic network devices | * 1. Fiber optic network devices are identified as per work requirement.   2. Fiber optic network devices are set up as per work requirement.   3. IP address is assigned as per work requirement.   4. Optical power level is set up as per load demand. |
| 1. Test fiber optic network | * 1. ***Fiber optic network testing tools, equipment and materials*** are assembled as per work requirement   2. Fiber optic network inspection is carried out as per design specifications   3. ***Fiber optic network tests*** are carried out as per work requirement   4. Fiber optic network tests are documented as per work requirement |

**RANGE**

This section provides work environment and conditions to which the performance criteria apply. It allows for different work environment and situations that will affect performance.

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Fiber optic Equipment, tools and materials includes but not limited to; | Tools   * fiber optic cable strippers * laser pen * Screwdrivers * Cable jacket slitter   Equipment:   * Splicing machine * Power meter * OTDR * Optical distribution frame * Fiber access terminal * Splitters * Splice box * Terminal boxes * Connectors * Media converters   Materials:   * Cleaning agents * Cable ties * Labels * Conduit * Fiber cables |
| 1. Fiber optic cable termination tools, equipment and materials includes but not limited to; | Termination tools   * Cleaver * Stripper * Crimping tool   Equipment   * Fusion splicer * Mechanical splicer * Heat oven   Materials   * Cleaning reagents * Connectors * Splice sleeves * Crimping sleeves |
| 1. Fiber optic network testing tools, equipment and materials includes but not limited to; | * Optical time domain reflectometer (OTDR) * Laser pen * Optical power meter (OPM) * Fiber identifier * Continuity tester * Return loss meter |
| 1. Fiber optic network tests includes but not limited to; | * Return loss tests * Visual inspection * Optical power test * OTDR testing * Performance tests |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required Skills**

The individual needs to demonstrate the following skills:

* Communication skills
* Listening skills
* Problem solving skills
* Organizational skills
* Time management
* Critical thinking
* Mathematical skills
* Geometrical skills
* Interpretation of information
* Technical reporting skills

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Entrepreneurship
* Environmental awareness
* Safety awareness
* Electrical measurements and units

**EVIDENCE** **GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   * 1. Mounted outdoor fiber optic network devices as per design specification   2. Mounted indoor fiber optic network devices as per design specification   3. Prepared fiber optic cables as per termination requirement   4. Connected fiber optic cables as per work requirement   5. Carried out fiber optic network tests as per work requirement |
| 1. Resource Implications | The following resources must be provided:   1. Access to relevant workplace where assessment can take place 2. Appropriately simulated environment where assessment can take place 3. Material relevant to the proposed assessment activity or task |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   1. Project 2. Practical assessment 3. Third party reports 4. Written assessment 5. Oral questioning |
| 1. Context of Assessment | Competency may be assessed in a   1. Workplace 2. Simulated workplace |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## MAINTAIN COMMUNICATION SYSTEMS

**UNIT CODE:** 0714 551 12A

**UNIT DESCRIPTION**

This unit specifies competencies required for maintaining communication systems. These include: applying workshop practice, preparing telecommunication system maintenance schedule, perform communication system routine maintenance and perform telecommunication system corrective maintenance.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace function | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***Bold and italicized terms are elaborated in the Range*** |
| 1. Apply workshop practice | * 1. Safe work environment is maintained as per workplace requirements   2. ***Workplace hazards*** are identified as per work requirements   3. Workplace hazards mitigation measures are applied as per work requirement   4. Workplace accidents and incidents response is carried out as per workplace procedures   5. ***Workshop Tools, equipment*** and ***materials*** are selected as per the task to be performed   6. Workshop tools and equipment are calibrated as per manufactures manual   7. Workshop tools are used as per work requirement   8. Tools and equipment are ***maintained*** as per the workplace procedures |
| 1. Prepare Telecommunication System maintenance schedule | * 1. Telecommunication system inventory is developed as per existing networks   2. Telecommunication system devices are assessed as per standard procedure   3. Telecommunication system preventive maintenance schedule is developed as per standard procedure |
| 1. Perform Communication System routine maintenance | * 1. Telecommunication system devices are assembled as per maintenance schedule   2. Telecommunication System tools, equipment and Materials are gathered as per work requirement   3. Telecommunication systems routine maintenance is executed as per maintenance schedule   4. Routine maintenance report is prepared as per standard format.   5. Maintained Telecommunication system is tested as per telecommunication network design |
| 1. Perform Telecommunication System corrective maintenance | * 1. Telecommunication system repair and maintenance procedure is identified as per work requirement.   2. Telecommunication system maintenance procedure is carried out as per work requirement.   3. Telecommunication system maintenance report is prepared as per standard procedure.   4. Maintained Telecommunication system is tested as per telecommunication network design |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

|  |  |
| --- | --- |
| **Variable** | **Range** |
| * + - 1. Communication System tools, equipment and Materials includes but not limited to; | Tools   * Wire cutters and strippers * Crimping tools * Punch down tools * Screwdrivers * Cable testers * Antenna installation tools * Cable testers   Equipment:   * Connectors * Patch panels * Switches * Routers   Materials:   * Cable ties * Labels * Conduit * Coaxial cables * Cables |
| * + - 1. Troubleshooting tools, equipment and Materials includes but not limited to; | * Cable tester * Network analyser * Wi-Fi analyser * Multimeter * Optical time-domain reflectometer (OTDR) * Documentation templates |

**REQUIRED SKILLS, KNOWLEDGE AND UNDERSTANDING**

The individual needs to demonstrate knowledge and understanding of:

* The manufacturer's warranty requirements relating to electrical installation systems and related components.
* The legal requirements relating to electricalinstallations
* Kenyan legislation and workplace procedures relevant to:
* Health and safety;
* Environment (including waste disposal);
* Appropriate personal protective equipment (PPE).
* Work place communication;
* Time management
* Materials management
* The importance of documentation and keeping records
* The relationship between time and costs
* The importance of using the correct sources of technical information.
* Interpreting circuits, drawings, specifications and instructions
* Preparing work plans in accordance with legislative and regulatory requirements and standard operating procedures and health and safety requirements
* Importance of contractual agreements
* Necessary insurance and policies including security bonds, performance bonds, contractors all risks
* Insurance of contractor’s work
* Financial knowledge
* Networking
* Optical communication;
* Internet protocol;
* Wireless;
* Installation

**FOUNDATION SKILLS**

1. Communications (verbal and written);
2. Proficient in ICT;
3. Time management;
4. Problem solving;
5. Negotiation
6. Decision making;
7. First aid;
8. Report writing;
9. Planning;
10. Leadership;

**EVIDENCE** **GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   * 1. Selectedworkshop tools and equipment as per work requirement   2. Developed Telecommunication system preventive maintenance schedule as per standard procedure   3. executed Telecommunication systems routine maintenance as per maintenance schedule |
| 1. Resource Implications | The following resources must be provided:   1. Access to relevant workplace where assessment can take place 2. Appropriately simulated environment where assessment can take place 3. Material relevant to the proposed assessment activity or task |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   1. Practical assessment 2. Project 3. Observation 4. Oral questioning 5. Written assessment |
| 1. Context of Assessment | Competency may be assessed in a   1. Workplace 2. Simulated workplace |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## FABRICATE ELECTRONIC CIRCUITS

**UNIT CODE:** 0714 451 13A

**UNIT DESCRIPTION**

This unit specifies competencies required for fabrication of electronic communication systems. These include; preparing electronic components, fabricating digital logic circuits, fabricating analogue circuits and fabricating PCB circuits.

| **ELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements  ***(Bold and italicised terms are elaborated in the Range)*** |
| --- | --- |
| * + - 1. Prepare Electronic Components | * 1. Communication system is designed as per system specifications   2. Circuit diagram is drawn as per system specifications   3. ***Electronic Components*** are identified as per circuit diagram   4. Electronic components are tested as per design specifications |
| * + - 1. Fabricate Digital Logic Circuits | * 1. Number systems conversion knowledge is applied as per digital system design   2. Binary numbers are represented into one’s and two’s complements knowledge is applied as per type of arithmetic operations   3. Binary arithmetic knowledge is applied as per type of arithmetic operations   4. Principles of logic gates are applied as per digital system design specifications.   5. logic gates operation knowledge is applied as per type digital system design specifications.   6. Boolean algebra concepts are applied as per digital system design specifications   7. Logic circuits concepts are applied as per digital system design specifications   8. combinational logic circuits principles are applied as per type of digital operation   9. transistor as a switch knowledge is applied as per type of digital operation   10. ***Logic families*** knowledge is applied as per digital system design specifications   11. ***flip flops circuits*** conceptsare applied as per type of digital operation   12. ***combination circuits*** operations knowledge is applied as per type of digital operation   13. Types of materials are identified in line with semiconductor theory   14. Semiconductor materials are identified as per electrical conductivity properties |
| * + - 1. Fabricate Analogue Circuits | * 1. Types of diodes are identified as per functionality   2. ***Diodes*** characteristics are determined as per properties   3. Forward and reverse bias characteristics are established as per properties of the semiconductor material   4. Rectification is performed as per operating procedure.   5. ***Transistors*** are identified as per characteristics   6. NPN and PNP are determined as per operation   7. P and N channels are identified as per operation   8. ***Biasing*** and determination of gain of transistors is performed as per standard operating procedure   9. Transistor configuration is performed as per application   10. Types of amplifiers are identified as per functions   11. Operational amplifier is identified as per its applications   12. Characteristics of operational amplifiers are determined   13. ***Oscillators*** are classified as per operation   14. Types of oscillators is determined as per applications   15. Damped and Undamped oscillation is performed as per oscillator operation   16. Wave shaping and pulse generation circuits are performed as per standard operating procedure |
| * + - 1. Fabricate PCB circuits | * 1. Electronic Tools, Equipment and Materials are assembled as per work requirement   2. Electronic components are mounted on the breadboard as per circuit diagram   3. Electronic circuit is tested as per design specifications |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

| **Variable** | **Range** |
| --- | --- |
| 1. Electronic components may include but not limited to: | * Resistors * Capacitors * Inductors * Diodes * Transistors * Integrated Circuits (ICs) * Relays * Transformers * Switches * Connectors * Oscillators * Potentiometers |
| 1. Electronic tools, equipment and materials may include but not limited to: | * Multimeter * Oscilloscope * Soldering Iron * Desoldering Pump * Soldering Wire * Soldering Paste * Solder Smoke Absorber * Helping Hand * Breadboard * Jumper Wires * Tweezers * Wire Stripper * Screwdriver * Electrical Tape * Alligator Clips * Hot Glue Gun * Heat Gun * Heat Sink * Magnifying Glass * Function Generator * Power Supply * Capacitance Meter * Inductance Meter * Anti-static Wrist Strap * Pliers * Digital Calliper |
| 1. Fabrication tools, equipment and materials may include but not limited to: | • Soldering Paste  • Solder Smoke Absorber  • Helping Hand  • Breadboard  • Jumper Wires  • Tweezers  • Wire Stripper  • Screwdriver  • Electrical Tape  • Alligator Clips  • Hot Glue Gun  • Heat Gun  • Heat Sink  • Magnifying Glass  • Function Generator |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

The individual needs to demonstrate knowledge and understanding of:

* The manufacturer's warranty requirements relating to electrical installation systems and related components.
* The legal requirements relating to electricalinstallations
* Kenyan legislation and workplace procedures relevant to:
* Health and safety;
* Environment (including waste disposal);
* Appropriate personal protective equipment (PPE).
* Work place communication;
* Time management
* Materials management
* The importance of documentation and keeping records
* The relationship between time and costs
* The importance of using the correct sources of technical information.
* Interpreting circuits, drawings, specifications and instructions
* Preparing work plans in accordance with legislative and regulatory requirements and standard operating procedures and health and safety requirements
* Importance of contractual agreements
* Necessary insurance and policies including security bonds, performance bonds, contractors all risks
* Insurance of contractor’s work
* Financial knowledge
* Electronics Fundamentals: Knowledge of basic electronic components and their functions.
* Circuitry: Skills in designing and creating electronic circuits.
* Signal Theory: Understanding signal processing and manipulation.
* Modulation Techniques: Familiarity with methods for encoding information onto carrier waves.
* Microcontroller Use: Proficiency in using microcontrollers for digital control.
* Networking Basics: Knowledge of data transmission and network protocols.
* Embedded Systems Design: Ability to create specialized computer systems for particular tasks.
* Assembly Skills: Competence in soldering and constructing electronic devices.
* Problem-Solving: Aptitude for identifying and resolving system malfunctions.
* Regulatory Compliance: Awareness of standards governing communication systems.

**FOUNDATION SKILLS**

1. Communications (verbal and written);
2. Proficient in ICT;
3. Time management;
4. Problem solving;
5. Negotiation
6. Decision making;
7. First aid;
8. Report writing;
9. Planning;
10. Electronics
11. circuit design
12. signal processing

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required knowledge and understanding and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   * 1. Assembled electronic components as per circuit diagram   2. Tested electronic components as per design specifications   3. Applied Principles of logic gates as per digital system design specifications.   4. Applied combinational logic circuits principles as per type of digital operation   5. Identified semiconductor materials as per electrical conductivity properties   6. Performed rectification as per operating procedure   7. Performed ***Biasing*** and determination of gain of transistors as per standard operating procedure   8. Mounted Electronic components on the breadboard as per circuit diagram |
| 1. Resource Implications | The following resources **must** be provided:   * 1. Access to relevant workplace where assessment can take place   2. Appropriately simulated environment where assessment can take place   3. Materials relevant to the proposed assessment activity or tasks |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Practical assessment   2. Project   3. Written assessment   4. Observation   5. Oral questioning   6. Portfolio of evidence   7. Third party report |
| 1. Context of Assessment | Competency may be assessed in a:   1. Workplace 2. Simulated workplace |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## INSTALL BROADCASTING COMMUNICATION SYSTEMS

**UNIT CODE:** 0714 551 14A

**UNIT DESCRIPTION**

This unit specifies competencies required for installing communication systems. These include; applying radio frequency broadcasting concepts, conducting broadcasting communication system site survey, preparing broadcasting communication system technical drawings and seting up broadcasting communication system.

| **ELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements  ***(Bold and italicised terms are elaborated in the Range)*** |
| --- | --- |
| 1. Apply radio frequency broadcasting concepts | * 1. Transmitterand Receiverblock diagrams are applied as per type of communication system   2. Transmitter and Receiver circuits are applied as per type of communication system   3. Transmitter and Receiversparameters measurements are measured as per type of signal   4. Transmission lines knowledge is applied as per type of telecommunication system   5. Antennaparameters knowledge is applied as per type of telecommunication system |
| 1. Conduct broadcasting communication system Site survey | * 1. ***Communication systems survey tools*** and ***equipment*** are assembled as per work requirements   2. ***Communication system*** site is surveyed as per type of installation   3. Communication system survey data is collected as per work requirements |
| 1. Prepare broadcasting communication system technical drawings | * 1. Communication system survey data is analysed as per installation requirement   2. Communication system is designed as per work requirement   3. Communication system technical drawing is prepared as per designed specifications. |
| 1. Set up Broadcasting Communication Systems | * 1. Broadcasting communication system support structure is erected as per design specifications   2. ***Broadcasting communication equipment*** are mounted as per Communication (CA) Authority license requirements   3. Broadcasting communication equipment are connected as per design specifications   4. Broadcasting communication system is configured as per Communication Authority license requirements   5. Broadcasting communication system alignment is performed as per design specifications   6. Broadcasting communication system tests are carried out as per International Telecommunication Union (ITU) standards |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

| **Variable** | **Range** |
| --- | --- |
| 1. Communication systems site preparation tools and equipment may include but is not limited to: | Tools and equipment:   * Safety Gear * Measuring and Marking Tools * Cable Installation Tools * Grounding and Bonding Tools * Concrete and Masonry Tools * Power Tools * Fasteners * Personal Protective Equipment (PPE) |
| 1. Communication system: may include but is not limited to: | * Transmitter * Communication Channel * Receiver * Information Source * Input Transducer * Amplifier * Modulator |
| 1. Broadcasting communication tools equipment and materials may include but is not limited to: | Tools:   * Microphones * Cameras * Audio mixer * Video switcher * Test and measurement equipment   Equipment:   * Broadcast transmitters * Broadcast servers * Satellite dishes * Broadcast routers * Studio lighting equipment   Materials:   * Broadcast media * Broadcast cables * Broadcast accessories |
| 1. Broadcasting communication equipment may include but is not limited to: | • Broadcast transmitters  • Broadcast servers  • Satellite dishes  • Broadcast routers  • Studio lighting equipment |
| 1. Communication systems survey tools and equipment | * Signal strength meter * Spectrum analyzer * Base transceiver station (BTS) * Mobile switching center (MSC) * Home Location Register (HLR) * GSM SIM cards * Coaxial cables |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

The individual needs to demonstrate knowledge and understanding of:

1. The manufacturer's warranty requirements relating to installation of automation systems related components.
2. The legal requirements relating to commissioning activities for electrical installation systems and components.
3. Legislation and workplace procedures relevant to:

* Environment, health and safety;
* Appropriate PPE (personal protective Equipment)

1. County Government bylaws
   * + EPRA (Energy & Petroleum Regulatory Authority)
     + NEMA
     + CA
2. Operational Activities and Techniques
   * + Understanding of the operational activities and techniques used by technicians in the communications industries for the installation of new or replacement communications equipment.
3. Planning Processes
   * + Knowledge of the planning processes that are required for the installation of communications technology equipment.
4. Installation of Racks, Cabinets, and Associated Overhead Cable Trays and Ironwork
5. Installation of Communications Equipment into Racks/Cabinets
6. Installation and Termination of Cable Links to Communications Technology Equipment
7. Use of Manufacturers’ Diagrams, Data Sheets, and Performance Specifications
8. Application of Current Legislation, Codes of Practice, and Safety Precautions
9. The importance of documenting automation system installation information
10. The importance of working to agreed timelines
11. The relationship between time and costs
12. How to prepare, interpret and use sources of technical information for scheduled automation system installation activities
13. The importance of using the correct sources of technical information.
14. The purpose of and how to use identification codes (e.g., colour codes).
15. How the system operates
16. The operating specifications and tolerances for different types of installed systems
17. The hazards associated with operating the system.
18. Identification of users to be trained

**FOUNDATION SKILLS**

The individual needs to demonstrate the following additional skills:

* Communications (verbal and written);
* Proficient in ICT;
* Time management;
* Analytical
* Faults troubleshooting
* Problem solving;
* Planning;
* Decision making;
* First aid;
* Report writing;
* Self-management

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and understanding and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   * 1. Measured ***Transmitter***  and ***Receivers parameters*** measurements as per type of signal.   2. Surveyed ***Communication system*** site as per type of installation   3. Mounted Broadcasting communication equipment as per Communication (CA) Authority license requirements   4. Configured Broadcasting communication system as per Communication Authority license requirements |
| 1. Resource Implications | The following resources **must** be provided:   * 1. Access to relevant workplace where assessment can take place   2. Appropriately simulated environment where assessment can take place   3. Materials relevant to the proposed assessment activity or tasks |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Practical assessment   2. Project   3. Written assessment   4. Observation   5. Oral questioning   6. Portfolio of evidence   7. Third party report |
| 1. Context of Assessment | Competency may be assessed in a:   1. Workplace 2. Simulated workplace |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## INSTALL WIRELESS COMMUNICATION TRANSMISSION LINKS

**UNIT CODE:** 0714 551 15A

**UNIT DESCRIPTION**

This unit specifies competencies required for installing communication transmission links. These include; conducting wireless transmission link site survey, preparing wireless transmission link technical drawings, preparing wireless transmission link equipment and installing microwave transmission link.

| **ELEMENT**  These describe the key outcomes which make up workplace functions | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements  ***(Bold and italicized terms are elaborated in the range)*** |
| --- | --- |
| **ELEMENT** | **PERFORMANCE CRITERIA**  ***(Bold and italicised terms are elaborated in the Range)*** |
| 1. Conduct wireless transmission link site survey | * 1. ***Communication link site preparation tools*** and ***equipment*** are assembled as per work requirements   2. ***Communication transmission link*** site is cleared as per work requirements   3. Communication transmission link site is demarcated as per work requirements |
| 1. Prepare wireless transmission link technical drawings | * 1. Communication transmission link survey data is analysed as per installation requirement   2. Communication transmission link is designed as per work requirement   3. Communication transmission link technical drawing is prepared as per designed specifications. |
| 1. Prepare wireless transmission link equipment | * 1. Communication transmission link list of tools, equipment and materials is developed as per communication system technical drawing   2. Communication transmission link tools and equipment are assembled as per work requirement   3. Communication transmission link equipment is prepared as per designed specification |
| 1. Install Microwave Transmission Link | * 1. Microwave Transmission Link support structure is erected as per design specifications   2. Microwave Transmission Link equipment are mounted as per Communication (CA) Authority license requirements   3. Microwave Transmission Link equipment are connected as per design specifications   4. Microwave Transmission Link is configured as per Communication Authority license requirements   5. Microwave Transmission Link alignment is performed as per design specifications   6. Microwave Transmission Link tests are carried out as per International Telecommunication Union (ITU) standards |
| 1. Install Satellite Transmission Link | * 1. Satellite Transmission Link support structure is erected as per design specifications   2. Satellite Transmission Link equipment are mounted as per Communication (CA) Authority license requirements   3. Satellite Transmission Link equipment are connected as per design specifications   4. Satellite Transmission Link is configured as per International Telecommunication Union (ITU) standards   5. Satellite Transmission Link alignment is performed as per design specifications   6. ***Satellite Transmission Link tests*** are carried out as per International Telecommunication Union (ITU) standards |
| 1. Install Radar Systems | * 1. Radar communication system components are identified as per work requirement   2. Radar communication tools and equipment are assembled as per work requirement   3. Radar communication system is installed as per work requirement.   4. Navigation radar technology is applied as per work requirement   5. Remote sensing radar technology is applied as per work requirement |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

| **Variable** | **Range** |
| --- | --- |
| 1. Communication link site preparation tools and equipment may include but not limited to: | Tools and equipment:   * Safety Gear * Measuring and Marking Tools * Cable Installation Tools * Grounding and Bonding Tools * Concrete and Masonry Tools * Power Tools * Fasteners * Personal Protective Equipment (PPE) |
| 1. Communication transmission link may include but is not limited to: | * Information Source * Transmitter * Channel * Receiver * Destination * Modulator * Demodulator |
| 1. Communication transmission Link Equipment, tools and materials may include but is not limited to: | Equipment:   * Network switches * Routers * Modems * Wireless access points (WAPs) * Network interface cards (NICs)   Tools:   * Cable testers * Crimping tool * Punch down tool * Multimeter * Cable management tools   Materials:   * Ethernet cables * Fiber optic cables * Coaxial cables * Connectors and adapters * Mounting hardware |
| 1. Satellite Communication transmission Equipment, tools and materials may include but is not limited to: | Equipment:   * Satellite dish * LNB (Low Noise Block downconverter) * Satellite modem * Upconverter * Downconverter   Tools:   * Satellite finder * Spectrum analyzer * Coaxial cable crimping tool   Materials:   * Coaxial cables * Mounting hardware * Weatherproofing materials * Grounding equipment |
| 1. Fibre optic laying Equipment, tools and materials may include but is not limited to: | Equipment:   * Fiber optic cable splicer * Fiber optic cable blowing machine * Optical time-domain reflectometer (OTDR) * Fiber optic fusion splicer * Trenching machine * Fiber optic cable blowing accessories * Cable pulling equipment   Tools:   * Fiber optic cleaver * Fiber optic stripper * Fusion splicing protection sleeve heater * Fiber optic termination kit   Materials:   * Fiber optic cables * Cable ducts or conduits * Cable markers * Cable lubricant * Cable ties and mounts |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

1. The individual needs to demonstrate knowledge and understanding of:

* The manufacturer's warranty requirements relating to installation of electrical machines and related components.
* The legal requirements relating to commissioning activities for electrical machines installations and components.

1. Legislation and workplace procedures relevant to:

* Environment, health and safety;
* Appropriate PPE (personal protective Equipment)

1. Observe County Government bylaws
   * + EPRA (Energy & Petroleum Regulatory Authority)
     + NEMA
     + CA
2. Understanding of Transmission Principles; this includes knowledge of the basics of microwave transmission, how antennas work, and the principles of transmission, wavelength, dBs, frequency, and modulation1.
3. Antenna Parameters:
   * + Understanding of link lengths
     + Propagation
     + Polarization
     + free space path loss
     + atmospheric absorption
     + antenna gain
     + antenna half power (3dB Bandwidth)
     + return loss
     + VSWR
     + radiation patterns
4. Choosing an Antenna:
   * + Knowledge of antenna selection
     + link requirements
     + electromagnetic environments capacity
     + feed assemblies
     + shields and radomes
     + high-performance antennas
     + high-capacity antennas
     + direct radio integration
     + antenna survival, and cost of ownership
5. Antenna Assembly and Installation these my Practical skills in site survey, declination, equipment check, antenna assembly, safety on site, antenna installation, hoisting, support steelwork, and wind force
6. Transmission Line and Pressurization Equipment:
   * + Understanding of transmission lines
     + types of waveguides
     + flanges
     + pressurization
     + dehydrators
     + waveguide installation
7. Transmission Line Fixings and Accessories:
   * + Knowledge of hoisting grips
     + Hangers
     + cable entry
     + grounding products
     + weatherproofing solutions
8. Antenna Path Alignment
   * + Skills in alignment
     + antenna path loss
     + transmission line loss
     + compass readings
     + azimuth markers
     + path alignment
9. Testing and Maintenance:
   * + Ability to complete the installation
     + understand VSWR
     + use test equipment
     + perform maintenance

**FOUNDATION SKILLS**

The individual needs to demonstrate the following additional skills:

* Communications (verbal and written);
* Proficient in ICT;
* Time management;
* Analytical
* Faults troubleshooting
* Problem solving;
* Planning;
* Decision making;
* First aid;
* Report writing;

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and understanding and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   * 1. Assembled Communication transmission Link Equipment, tools and materials as per work requirement   2. Erected Microwave Transmission Equipment as per Communication Authority (CA) license requirements   3. Connected Microwave Transmission Link equipment as per manufacturers specifications   4. Assembled Satellite Communication Transmission Equipment, tools and materials as per work requirement   5. Erected Satellite Transmission Equipment as per Communication Authority (CA) license requirements   6. Connected Satellite Transmission Equipment as per manufacturers specifications   7. Assembled Fibre optic laying Equipment, tools and materials as per work requirement   8. Laid Fibre optic transmission link PVC ducts as per technical drawing specifications   9. Blown Fibre optic cable as per International Electrotechnical Commission (IEC) 60794 standard |
| 1. Resource Implications | The following resources **must** be provided:   * 1. Access to relevant workplace where assessment can take place   2. Appropriately simulated environment where assessment can take place   3. Materials relevant to the proposed assessment activity or tasks |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Practical assessment   2. Project   3. Written assessment   4. Observation   5. Oral questioning   6. Portfolio of evidence   7. Third party report |
| 1. Context of Assessment | Competency may be assessed in a:   1. Workplace 2. Simulated workplace |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## INSTALL SPECIALIZED POWER SYSTEMS

**UNIT CODE:** **:** 0714 451 16A

**UNIT DESCRIPTION**

This unit specifies competencies required for installing telecommunication systems power supply. These include; installing solar power supply systems, seting up telecommunication UPS systems, installing power factor correction systems, installing HVAC systems and testing electrical power supply system.

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***(Bold and italicized terms are elaborated in the range).*** |
| 1. Install Solar power supply systems. | * 1. Electrical tools, equipment and materials are prepared as per work requirement   2. Support structure is erected as per designed specification   3. Cable laying ducts are prepared as per design specifications   4. Solar power supply cables are terminated at the power panels as per electrical drawing   5. Solar power supply is tested as per design specifications |
| 1. Set up Telecommunication UPS system | 1. Electrical Tools, equipment and materials are prepared as per work requirement 2. Support structure is erected as per designed specification 3. Cable laying ducts are prepared as per design specifications 4. UPS system cables are terminated at the power panels as per electrical drawing 5. UPS system is tested as per design specifications |
| 1. Install Power Factor Correction Systems | 1. Fundamentals of power factor and Power factor correction systems (PFC) are applied as per work requirement. 2. Power factor correction system is installed as per work requirement. 3. Power factor correction system is maintained as per work requirement. |
| 1. Install HVAC systems | 1. Fundamentals of Heating, Ventilation and Air Conditioning (HVAC) systems are determined as per design specifications. 2. HVAC installation techniques are identified as per design specifications. 3. HVAC system testing and commissioning is performed as per work requirement. |
| 1. Test electrical power supply system | 1. Types of ***electrical tests*** are determined as per power supply designed specifications 2. Tests are carried out as per ***IEEE standards*** 3. Test results are documented as per organization standard procedure |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

| **Variable** | **Range** |
| --- | --- |
| 1. **Electrical tests** may include but not limited to: | * Continuity Testing * Insulation Resistance Testing * Polarity Testing * Earth Fault Loop Impedance Tests * Prospective Fault Current Test (PFC Test) * Phase Sequence Test * Residual Current Device (RCD) Test |
| 1. ***IEEE standards*** may include but is not limited to: | * IEEE 802® Standards * IEEE P1941.1™ * IEEE P2872™ * ISO standards |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

1. The individual needs to demonstrate knowledge and understanding of:

* The manufacturer's warranty requirements relating to installation of Power Lines and related components.
* The legal requirements relating to commissioning activities for electrical power lines installations and components.

1. Legislation and workplace procedures relevant to:

* Environment, health and safety;
* Appropriate PPE (personal protective Equipment)

1. Observe County Government bylaws
   * + EPRA (Energy & Petroleum Regulatory Authority)
     + NEMA
     + KPLC Electrical Safety rules
2. Power Supply Technologies:
   * + Knowledge of current power supply technologies
     + Electrical circuit techniques.
3. Automatic Control:
   * + Understanding of automatic control systems used in power supply systems.
4. Grounding and Protection Techniques:
   * + Knowledge of techniques to ensure the safety and reliability of the power supply system.
5. Design of Battery and Grounding Installations:
   * + Ability to design and install batteries and grounding systems.
6. Telecommunications Industry:
   * + Broad understanding of the telecommunications industry and the role of power supply within it.
7. Relevant Standards:
   * + Familiarity with relevant IEEE standards and other industry regulations.
8. Uninterruptible Power Supplies (UPSs):
   * + Understanding of UPSs used in the telecommunications industry to provide communications continuity and reduce downtime.
9. The importance of documenting electrical machines installation information
10. The importance of working to agreed timelines
11. The relationship between time and costs
12. How to prepare, interpret and use sources of technical information for scheduled Electrical power lines construction works
13. The importance of using the correct sources of technical information.
14. The purpose of and how to use identification codes (e.g., colour codes).
15. How the power system operates
16. The operating specifications and tolerances for different types of power systems components
17. The hazards associated with operating construction and operation of a power system.
18. Identification of users to be training needs

**FOUNDATION SKILLS**

The individual needs to demonstrate the following additional skills:

* Communications (verbal and written);
* Proficient in ICT;
* Time management;
* Analytical
* Faults troubleshooting
* Problem solving;
* Planning;
* Decision making;
* First aid;
* Report writing;

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and understanding and range.

|  |  |
| --- | --- |
| * 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   * 1. Terminated Utility power supply cables on panels as per electrical drawing   2. Terminated Solar power supply cables at the power panels as per electrical drawing   3. Terminated UPS system cables at the power panels as per electrical drawing   4. Installed Power factor correction system as per work requirement.   5. Identified HVAC installation techniques as per design specifications.   6. Carried out Tests as per IEEE standards |
| * 1. Resource Implications | The following resources **must** be provided:   * 1. Access to relevant workplace where assessment can take place   2. Appropriately simulated environment where assessment can take place   3. Materials relevant to the proposed assessment activity or tasks |
| * 1. Methods of Assessment | Competency may be assessed through:   * 1. Practical assessment   2. Project   3. Written assessment   4. Observation   5. Oral questioning   6. Portfolio of evidence   7. Third party report |
| * 1. Context of Assessment | Competency may be assessed in a:   1. Workplace 2. Simulated workplace |
| * 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## FABRICATE EMBEDDED AND RF CIRCUITS

**UNIT CODE:** 0714 551 17A

**UNIT DESCRIPTION**

This unit specifies competencies required for fabrication of electronic communication systems. These include; designing printed circuit boards, constructing microcontroller-based systems, fabricating RF communication circuits and maintaining electronic circuits

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements  ***(Bold and italicised terms are elaborated in the Range)*** |
| 1. Design Printed Circuit Boards (PCBs) | * 1. Fundamentals of PCB design are applied as per design specification.   2. ***PCB design softwares*** are identified as per scope of study.   3. PCB project is designed as per work requirement.   4. PCB project is simulated as per design specification. |
| 1. Construct Microcontroller-based systems | * 1. Fundamentals of microcontroller systems are identified as per design specifications.   2. ***Microcontroller type*** is selected as per the work requirement.   3. Microcontroller ***programming language*** is identified as per design specifications.   4. Microcontroller based system is designed as per work requirement. |
| 1. Fabricate RF Communication Circuits | * 1. Electronic Tools, Equipment and Materials are assembled as per work requirement   2. Transmitter and receiver electronic components are transferred to PCB as per the circuit diagram   3. Electronic components are soldered as per IPC-A-610   4. Transmitter and receiver electronic circuit is inspected as per circuit diagram   5. Radio transmitter and receiver system is tested as per design specifications   6. ***Communication*** ***antenna parts*** are assembled as per design specifications   7. Communication antenna is erected as design specifications   8. Communication antenna is tested as per design specifications |
| 1. Maintain electronic circuits | * 1. Electronic faults are identified as per work requirement.   2. Electronic circuit maintenance is performed as per work requirement.   3. Electronic maintenance report is documented as per standard procedure. |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

| **Variable** | **Range** |
| --- | --- |
| 1. PCB design softwares may include but not limited to: | * Proteus * Multism * Circuit Wizard * LTSpice |
| 1. Microcontroller types may include but not limited to: | * Arduino * Raspberry pi * ESP |
| 1. Programming languages may include but not limited to: | * C * C++ * Python * Java |
| 1. Communication antenna parts may include but not limited to: | * Driven Element * Parasitic Element * Reflector * Director * Feed Line * Balun * Mounting Hardware * Radome |
| 1. Communication system components may include but not limited to: | * Transmitter * Receiver * Channel * Antenna * Amplifier * Modem (Modulator/Demodulator) * Filter * Mixer * Information Source |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

The individual needs to demonstrate knowledge and understanding of:

* The manufacturer's warranty requirements relating to electrical installation systems and related components.
* The legal requirements relating to electricalinstallations
* Kenyan legislation and workplace procedures relevant to:
* Health and safety;
* Environment (including waste disposal);
* Appropriate personal protective equipment (PPE).
* Work place communication;
* Time management
* Materials management
* The importance of documentation and keeping records
* The relationship between time and costs
* The importance of using the correct sources of technical information.
* Interpreting circuits, drawings, specifications and instructions
* Preparing work plans in accordance with legislative and regulatory requirements and standard operating procedures and health and safety requirements
* Importance of contractual agreements
* Necessary insurance and policies including security bonds, performance bonds, contractors all risks
* Insurance of contractor’s work
* Financial knowledge
* Electronics Fundamentals: Knowledge of basic electronic components and their functions.
* Circuitry: Skills in designing and creating electronic circuits.
* Signal Theory: Understanding signal processing and manipulation.
* Modulation Techniques: Familiarity with methods for encoding information onto carrier waves.
* Microcontroller Use: Proficiency in using microcontrollers for digital control.
* Networking Basics: Knowledge of data transmission and network protocols.
* Embedded Systems Design: Ability to create specialized computer systems for particular tasks.
* Assembly Skills: Competence in soldering and constructing electronic devices.
* Problem-Solving: Aptitude for identifying and resolving system malfunctions.
* Regulatory Compliance: Awareness of standards governing communication systems.

**FOUNDATION SKILLS**

1. Communications (verbal and written);
2. Proficient in ICT;
3. Time management;
4. Problem solving;
5. Negotiation
6. Decision making;
7. First aid;
8. Report writing;
9. Planning;
10. Electronics
11. circuit design
12. signal processing

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required knowledge and understanding and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   * 1. Designed PCB project as per work requirement.   2. Designed microcontroller-based system as per work requirement.   3. Transferred transmitter and receiver components to PCB as per circuit diagram.   4. Soldered electronic components as per IPC-A-610.   5. Erected communication antenna as per design specification.   6. Performed electronic circuit maintenance as per work requirement. |
| 1. Resource Implications | The following resources **must** be provided:   * 1. Access to relevant workplace where assessment can take place   2. Appropriately simulated environment where assessment can take place   3. Materials relevant to the proposed assessment activity or tasks |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Practical assessment   2. Project   3. Written assessment   4. Observation   5. Oral questioning   6. Portfolio of evidence   7. Third party report |
| 1. Context of Assessment | Competency may be assessed in a:   * 1. Workplace   2. Simulated workplace |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## INSTALL TELEPHONY SYSTEM

**UNIT CODE:** 0714 551 18A

**UNIT DESCRIPTION**

This unit specifies competencies required for installing communication transmission links. These include; conducting telephone system site survey, preparing telephone system technical drawings, preparing telephone system equipment, installing PABX systems, installinf VoIP systems and installing mobile communication systems

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***(Bold and italicized terms are elaborated in the range).*** |
| 1. Conduct Telephone System Site survey | * 1. ***Telephone system components*** are assembled as per work requirement.   2. Radio frequency (RF) site survey techniques are applied as per work requirement.   3. Telephone installation site is selected as per work requirement.   4. Data collected is documented as per standard procedure. |
| 1. Prepare Telephone System Technical Drawings | * 1. Telephone system lay out is identified as per work requirement.   2. Drawing tools and equipment are assembled as per work requirement.   3. Telephone system is designed as per work requirement. |
| 1. Prepare Telephone System Equipment | * 1. Telephone system equipment are identified as per work requirement.   2. Telephone system equipment are assembled as per work requirement.   3. Telephone system equipment are procured as per desired specifications. |
| 1. Install PABX (Private Automatic Branch Exchange) systems | * 1. PABX systems are identified as per work requirement.   2. PABX system is installed as per design specifications.   3. PABX systems are configured as per work requirement.   4. PABX system is maintained as per work requirement. |
| 1. Install VoIP systems | * 1. Fundamentals of VoIP systems are identified as per design specifications.   2. Mini-SIP server is set up as per work requirement.   3. Mini-SIP server is connected to VoIP providers network as per design specifications.   4. ***VoIP system tests*** are carried out as per work requirement. |
| 1. Install mobile Communication Systems | * 1. Fundamentals of GSM systems are identified as per design specifications.   2. Mobile communication system installation site planning is conducted as per work requirement.   3. Base Transreceiver station (BTS) is installed as per work requirement.   4. Base Station Controller (BSC) is installed as per work requirement.   5. Base Station Controller (BSC) is configured as per work requirement.   6. Mobile communication system is maintained as per work requirement. |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

| **Variable** | **Range** |
| --- | --- |
| 1. Telephone system equipment may include but not limited to: | * RF Wireless Site Survey Tools * Facility Diagrams * Google Maps/Google Earth * Base Station/Node-B/eNB/eNodeB * Antennas |
| 1. Telephone system components may include but is not limited to: | * Information Source * Transmitter * Channel * Receiver * Destination * Modulator * Demodulator |
| 1. VoIP system tests may include but is not limited to: | * Link 16 Network Entry Test * Space-to-Ground Laser Communication Test * Signal Strength Test * Data Rate Test * Error Rate Test * Interference Test |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

1. The individual needs to demonstrate knowledge and understanding of:

* The manufacturer's warranty requirements relating to installation of electrical machines and related components.
* The legal requirements relating to commissioning activities for electrical machines installations and components.

1. Legislation and workplace procedures relevant to:

* Environment, health and safety;
* Appropriate PPE (personal protective Equipment)

1. Observe County Government bylaws
   * + EPRA (Energy & Petroleum Regulatory Authority)
     + NEMA
     + CA
2. Understanding of Transmission Principles; this includes knowledge of the basics of microwave transmission, how antennas work, and the principles of transmission, wavelength, dBs, frequency, and modulation1.
3. Antenna Parameters:
   * + Understanding of link lengths
     + Propagation
     + Polarization
     + free space path loss
     + atmospheric absorption
     + antenna gain
     + antenna half power (3dB Bandwidth)
     + return loss
     + VSWR
     + radiation patterns
4. Choosing an Antenna:
   * + Knowledge of antenna selection
     + link requirements
     + electromagnetic environments capacity
     + feed assemblies
     + shields and radomes
     + high-performance antennas
     + high-capacity antennas
     + direct radio integration
     + antenna survival, and cost of ownership
5. Antenna Assembly and Installation these my Practical skills in site survey, declination, equipment check, antenna assembly, safety on site, antenna installation, hoisting, support steelwork, and wind force
6. Transmission Line and Pressurization Equipment:
   * + Understanding of transmission lines
     + types of waveguides
     + flanges
     + pressurization
     + dehydrators
     + waveguide installation
7. Transmission Line Fixings and Accessories:
   * + Knowledge of hoisting grips
     + Hangers
     + cable entry
     + grounding products
     + weatherproofing solutions
8. Antenna Path Alignment
   * + Skills in alignment
     + antenna path loss
     + transmission line loss
     + compass readings
     + azimuth markers
     + path alignment
9. Testing and Maintenance:
   * + Ability to complete the installation
     + understand VSWR
     + use test equipment
     + perform maintenance

**FOUNDATION SKILLS**

The individual needs to demonstrate the following additional skills:

* Communications (verbal and written);
* Proficient in ICT;
* Time management;
* Analytical
* Faults troubleshooting
* Problem solving;
* Planning;
* Decision making;
* First aid;
* Report writing;

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and understanding and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   * 1. Applied Radio frequency (RF) site survey techniques as per work requirement.   2. Designed Telephone system as per work requirement.   3. Installed PABX system as per design specifications.   4. Configured PABX systems as per work requirement   5. Set up Mini-SIP server up as per work requirement.   6. Connected Mini-SIP server to VoIP providers network as per design specifications.   7. Installed Base Trans receiver station (BTS) as per work requirement.   8. Installed Base Station Controller (BSC) as per work requirement.   9. Configured Base Station Controller (BSC) as per work requirement. |
| 1. Resource Implications | The following resources **must** be provided:   * 1. Access to relevant workplace where assessment can take place   2. Appropriately simulated environment where assessment can take place   3. Materials relevant to the proposed assessment activity or tasks |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Practical assessment   2. Project   3. Written assessment   4. Observation   5. Oral questioning   6. Portfolio of evidence   7. Third party report |
| 1. Context of Assessment | Competency may be assessed in a:   1. Workplace 2. Simulated workplace |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## INSTALL ENTERPRISE COMPUTER NETWORKS.

**UNIT CODE:** 0612 551 19A

**UNIT DESCRIPTION**

This unit specifies competencies required for installing communication network. These include: configuring enterprise computer network, conducting enterprise computer network risk assessment and planning, setting up network security controls, deploying cyber-security solutions, setting up computer network firewalls, setting up computer network monitoring tools and setting up computer network backup and disaster recovery

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace function | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***(Bold and italicized terms are elaborated in the range)*** |
| 1. Configure enterprise computer network | 1. ***Components of an enterprise*** network are assembled as per work requirement. 2. ***Type of enterprise network*** to be installed is identified as per work requirement. 3. Enterprise network is installed as per design specification. 4. Enterprise network is configured as per standard procedure. |
| 1. Conduct enterprise computer network risk assessment and planning | * 1. ***Common network risks*** are identified as per work requirement.   2. Risk assesement procedure is identified as per work requirement.   3. Risk assesement procedure is carried out as per work requirement. |
| 1. Set up Network Security Controls | * 1. Type of network security control is identified as per work requirement.   2. Security policy implementation components are identified as per standard procedure.   3. Network security control is set up as per work requirement. |
| 1. Deploy Cyber-security Solutions | * 1. Fundamentals of cybersecurity solutions are identified as per work requirement.   2. Cyber security method is selected as per work requirement.   3. Cybersecurity method is implemented as per work requirement. |
| 1. Set up computer network firewalls | * 1. Computer network firewall type is identified as per work requirement.   2. Computer network firewall is installed as per design specification.   3. Computer network firewall is configured as per work requirement. |
| 1. Set up computer network monitoring tools | * 1. Computer network monitoring tool type is identified as per work requirement.   2. Computer network monitoring tool is installed as per design specification.   3. Computer network monitoring tool is configured as per work requirement. |
| 1. Set up computer network backup and disaster recovery | * 1. Computer network back up strategy is identified as per work requirement.   2. Computer network back up procedure is carried out as per standard procedure.   3. Computer network disaster recovery procedure is carried out as per standard procedure. |

**RANGE**

This section provides work environment and conditions to which the performance criteria apply. It allows for different work environment and situations that will affect performance.

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Components of an enterprise network may include but not limited to: | * Servers * Cores witches * routers * Workstations * Storage |
| 1. Type of enterprise network may include but not limited to; | * Local Area Network (LAN) * Wide Area Network (WAN) * Metropolitan Area Network (MAN) |
| 1. Common network risks may include but not limited to: | * Hardware Failures * Software Vulnerabilities * Unauthorized Access * Insider Threats * Natural Disasters * Data Breaches * Service Downtime * Cloud Misconfiguration |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

The individual needs to demonstrate knowledge and understanding of:

* The manufacturer's warranty requirements relating to electrical installation systems and related components.
* The legal requirements relating to electricalinstallations
* Kenyan legislation and workplace procedures relevant to:
* Health and safety;
* Environment (including waste disposal);
* Appropriate personal protective equipment (PPE).
* Work place communication;
* Time management
* Materials management
* The importance of documentation and keeping records
* The relationship between time and costs
* The importance of using the correct sources of technical information.
* Interpreting circuits, drawings, specifications and instructions
* Preparing work plans in accordance with legislative and regulatory requirements and standard operating procedures and health and safety requirements
* Importance of contractual agreements
* Necessary insurance and policies including security bonds, performance bonds, contractors all risks
* Insurance of contractor’s work
* Financial knowledge
* Networking
* Optical communication;
* Internet protocol;
* Wireless;

**FOUNDATION SKILLS**

1. Communications (verbal and written);
2. Proficient in ICT;
3. Time management;
4. Problem solving;
5. Negotiation
6. Decision making;
7. First aid;
8. Report writing;
9. Planning;
10. Leadership;

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge and range.

|  |  |
| --- | --- |
| 1. Critical aspects of Competency | 1. Installed Enterprise network as per design specification. 2. Configured Enterprise network as per standard procedure 3. Carried out Risk assessment procedure out as per work requirement 4. Set up Network security control up as per work requirement 5. Implemented Cybersecurity method as per work requirement 6. Installed Computer network firewall as per design specification. 7. Configured Computer network firewall as per work requirement 8. Installed Computer network monitoring tool as per design specification 9. Carried out Computer network backup procedure as per standard procedure. |
| 1. Resource Implications | The following resources must be provided:   1. Access to relevant workplace where assessment can take place 2. Appropriately simulated environment where assessment can take place 3. Material relevant to the proposed assessment activity or task |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   1. Practical assessment 2. Project 3. Observation 4. Oral questioning 5. Written assessment |
| 1. Context of Assessment | Competency may be assessed in a   1. Workplace 2. Simulated workplace |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |