

**THE REPUBLIC OF KENYA**

**HARMONISED OCCUPATIONAL STANDARDS**

**FOR**

**ELECTRICAL INSTALLER**

**LEVEL 6**

**PROGRAMME CODE:** **0713 554A**

**First published 2023**

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# FOREWORD

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

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

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

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

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**MINISTRY OF EDUCATION**

# PREFACE

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

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

Industry experts in conjunction with experienced trainers from Nyandarua National Polytechnic developed this curriculum.

This curriculum is designed and organized with an outline of learning outcomes; suggested delivery methods, training/learning resources and methods of assessing the trainee’s achievement. It also allows multiple entry and exit to the course.

I am grateful to the Council Members, Council Secretary, industrial experts in Electrical and Electronics Engineering, experienced trainers and all those who participated in the development of this curriculum.

# ACKNOWLEDGEMENT

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

I recognize with appreciation the role of industry experts in Electrical Engineering in ensuring that competencies required by the industry are addressed in the curriculum. I also thank the experienced trainers for their valuable input and all those who participated in the process of developing this curriculum.

In addition, I thank TVET Authority (TVETA) for providing guidance on the development of this curriculum.

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

# ACRONYMS

BOQ Bill of Quantities

CAD Computer Aided Design

CCTV Closed Circuit Television

EHS Environment, Health and Safety

HVAC Heating, Ventilation and Air Conditioning

IET Institute of Electrical and electronics Engineers

KEBS Kenya Bureau of Standards

KP Kenya Power

SOP Standard operating procedure

NCA National Construction Authority

OSHA Occupational Safety and Health Act

PPE Personal Protective Equipment

PV Photo Voltaic

TVET Technical and Vocational Education and Training

WIBA Work injury benefits Act

# KEY TO UNIT CODE



# TABLE OF CONTENT

[FOREWORD iv](#_Toc195791716)

[PREFACE vi](#_Toc195791717)

[ACKNOWLEDGEMENT viii](#_Toc195791718)

[ACRONYMS x](#_Toc195791719)

[KEY TO UNIT CODE xi](#_Toc195791720)

[TABLE OF CONTENT xii](#_Toc195791721)

[BASIC UNITS OF COMPETENCY 4](#_Toc195791722)

[APPLY COMMUNICATION SKILLS 5](#_Toc195791723)

[APPLY DIGITAL SKILLS 10](#_Toc195791724)

[APPLY ENTREPRENEURIAL SKILLS 21](#_Toc195791725)

[APPLY WORK ETHICS AND PRACTICES 30](#_Toc195791726)

[COMMON UNITS OF COMPETENCY 39](#_Toc195791727)

[APPLY ENGINEERING TECHNICIAN MATHEMATICS I 40](#_Toc195791728)

[APPLY ENGINEERING TECHNICIAN MATHEMATICS II 46](#_Toc195791729)

[**APPLY ENGINEERING TECHNICIAN MATHEMATICS III** 51](#_Toc195791730)

[**APPLY ENGINEERING TECHNICIAN MATHEMATICS IV** 54](#_Toc195791731)

[BASIC ELECTRICAL PRINCIPLES 58](#_Toc195791732)

[APPLY ELECTRICAL PRINCIPLES I 65](#_Toc195791733)

[APPLY ELECTRICAL PRINCIPLES II 68](#_Toc195791734)

[APPLY CONTROL SYSTEMS 73](#_Toc195791735)

[PREPARE TECHNICAL DRAWINGS 77](#_Toc195791736)

[APPLY ANALOGUE ELECTRONICS I 84](#_Toc195791737)

[APPLY ANALOGUE ELECTRONICS II 89](#_Toc195791738)

[APPLY DIGITAL ELECTRONICS I 93](#_Toc195791739)

[APPLY DIGITAL ELECTRONICS II 98](#_Toc195791740)

[APPLY MICRO CONTROL SYSTEMS 104](#_Toc195791741)

[PERFORM ELECTRICAL MEASUREMENT AND FAULT DIAGNOSIS 109](#_Toc195791742)

[APPLY RESEARCH METHODS 115](#_Toc195791743)

[**SUPERVISE ELECTRICAL PROJECT** 119](#_Toc195791744)

[CORE UNITS OF COMPETENCY 124](#_Toc195791745)

[**INSTALL PVC SHEATHED CABLE SYSTEM** 125](#_Toc195791746)

[**INSTALL TRUNKING SYSTEM** 128](#_Toc195791747)

[**INSTALL CONDUIT SYSTEM** 133](#_Toc195791748)

[**INSTALL STAND-ALONE SOLAR PV SYSTEMS** 137](#_Toc195791749)

[**PERFORM BELL AND ALARM INSTALLATION** 141](#_Toc195791750)

[**WIND ELECTRICAL MACHINE** 145](#_Toc195791751)

[PERFORM ELECTRICAL INSTALLATION 148](#_Toc195791752)

[INSTALL ELECTRICAL POWER LINES 156](#_Toc195791753)

[**PERFORM ELECTRICAL MACHINE INSTALLATION** 162](#_Toc195791754)

[PERFORM SECURITY SYSTEM INSTALLATION 170](#_Toc195791755)

[**FABRICATE POWER ELECTRONIC CIRCUITS** 175](#_Toc195791756)

[**AUTOMATE ELECTRICAL SYSTEMS** 179](#_Toc195791757)

**OVERVIEW**

This course is designed to equip an Electrical Technician Level 6 with the competencies required to Perform Electrical Installation, fabricate electronic circuits,Install power systems,Install electrical machine,Automate Electrical systems,Maintain electrical system,Install Security Systems and Manage Electrical Projects.

Electrical Technician is a person who will carry out electrical work using a given design and customer’s requirements. This work demands the technician to design, read and interpret electrical drawings so that the technician can install the system according to the national and international standards. Moreover, the size and quantity of all materials, cables, control equipment and accessories and speciﬁcations for the items necessary to install the electrical systems will largely be determined by the project owner and electrical technician. Therefore, an electrical technician is a well-trained person who can carry out these responsibilities

**SUMMARY OF UNITS OF COMPETENCY**

**BASIC UNITS OF COMPETENCY**

|  |  |
| --- | --- |
| **Unit Code** | **Unit Title** |
| 0031 541 01B | Apply Communication Skills |
| 0611 551 02B | Apply Digital skills |
| 0413 541 03B | Apply Entrepreneurial Skills |
| 0417 441 04B | Apply Work ethics and Practices |

**COMMON UNITS OF COMPETENCY**

|  |  |
| --- | --- |
| **Unit Code** | **Unit Title** |
| 0541 541 05A | Apply Engineering Technician Mathematics I |
| 0541 541 06A | Apply Engineering Technician Mathematics II |
| 0541 541 07A | Apply Engineering Technician Mathematics III |
| 0541 541 08A | Apply Engineering Technician Mathematics IV |
| 0713 541 09A | Apply Electrical Principles |
| 0713 541 10A | Apply Electrical Principles |
| 0713 541 11A | Apply Electrical Principles |
| **0714 541 12A** | Apply Control Systems |
| 0732 541 13A | Prepare Technical Drawings |
| 0732 541 14A | Prepare Computer Aided Drawings and Design |
| 0714 541 15A | Apply Analogue Electronics I |
| 0714 541 16A | Apply Analogue Electronics II |
| 0714 541 17A | Apply Digital Electronics I |
| 0714 541 18A | Apply Digital Electronics II |
| 0714 541 19A | Apply Micro control Systems |
| **0713 541 20A** | Perform Electrical Measurements and Fault Diagnosis |
| **0111 541 21A** | Apply Research Methods |
| **0713 551 22A** | Supervise Electrical Projects |

**CORE UNITS OF COMPETENCY**

|  |  |
| --- | --- |
| **Unit Code** | **Unit Title** |
| 0713 551 23A | Install PVC Sheathed Cable System |
| 0713 551 24A | Install Trunking System |
| 0713 551 25A | Install Conduit System |
| 0713 551 26A | Install Stand-Alone Solar PV Systems |
| 0714 551 27A | Perform Bell and Alarm Installation |
| 0713 551 28A | Wind Electrical Machine |
| 0713 551 29A | Perform Electrical Installation |
| 0713 551 30A | Install Electrical Power lines |
| 0713 551 31A | Perform Electrical Machine Installation |
| 0713 451 32A | Install Solar PV Systems |
| 0714 551 33A | Perform Security Systems Installation |
| 0713 551 34A | Install Electrical Power Systems |
| **0714 551 35A** | Fabricate Power Electronics Circuits |
| 0714 551 36A | Automate Electrical Systems |

# BASIC UNITS OF COMPETENCY

## APPLY COMMUNICATION SKILLS

**UNIT CODE:** 0031 541 01B

**UNIT DESCRIPTION**

This unit covers competencies required to apply 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 |

**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:   * Access to relevant workplace where assessment can take place. * Appropriately simulated environment where assessment can take place. * 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:   * On-the-job * 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 DIGITAL SKILLS

**UNIT CODE:** 0611 551 02B

**UNIT DESCRIPTION:**

This unit covers competences required to apply digital literacy. Competences include operating competences computer devices, solving tasks using the Office suite, accessing online/offline data and information, performing online communication and collaboration, applying cybersecurity skills, applying performing jobs online and 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](https://onlinedegrees.sandiego.edu/top-cyber-security-threats/#phishing-attacks) * [Ransomware](https://onlinedegrees.sandiego.edu/top-cyber-security-threats/#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 testimonials*** may 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 in:   * 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 ENTREPRENEURIAL SKILLS

**UNIT CODE :** 0413 541 03B

**UNIT DESCRIPTION**

This unit covers competences required to apply entrepreneurship. Competences include applying financial literacy skills, 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. |

## APPLY WORK ETHICS AND PRACTICES

**UNIT CODE:** 0417 441 04B

**UNIT DESCRIPTION**

This unit covers competencies required to apply work ethics and practices. Competencies include applying self-management skills, promoting ethical work practices and values, promoting teamwork, maintaining professional and personal development, applying problem-solving and promoting 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*** mayinclude 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. |

# COMMON UNITS OF COMPETENCY

## APPLY ENGINEERING TECHNICIAN MATHEMATICS I

**UNIT CODE:** 0541 541 05

**UNIT DESCRIPTION**

This unit describes competences required to apply engineering technician mathematics. Competences include applying number system, algebra, matrices, statistics, trigonometry and calculus.

**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 thse Range.*** |
| --- | --- |
| * + 1. Apply number systems | * 1. Calculations involving various types of numbers are performed as per the concept.   2. ***Arithmetic operations*** on integers are carried out as per the concept.   3. Mathematical problems are solved as per concepts. |
| * + 1. Apply algebra | * 1. Indices calculations are performed as per the concept.   2. ***Simultaneous equations*** involving 2 and 3 unknowns are performed as per the rules.   3. Mathematical problems are solved as per concepts.   4. Quadratic equations are calculated as per the concept |
| * + 1. Apply Trigonometry and Hyperbolic functions | * 1. Triangle sides and angles are calculated as per trigonometric ratios.   2. Triangle sides and angles are calculated as per trigonometric rules.   3. Triangle areas are calculated as per Hero’s formula.   4. ***Trigonometric functions*** for given arguments are evaluated as per the concept.   5. Conversion of Trigonometric and hyperbolic identities are performed as per Osborn’s rule   6. ***Hyperbolic functions*** for given arguments are evaluated as per the concept. |
| * + 1. Perform Coordinates geometry | * 1. Convert polar equations to Cartesian equations as per the concept   2. Convert Cartesian equation to polar equation as per the concept   3. Plot graphs of polar equations as per the concept   4. ***Determine normal and tangents*** using co-ordinate geometry. |
| * + 1. Carry out binomial expansion | * 1. Derive power series of simple functions using binomial expansion   2. Estimate errors of small changes using binomial expansion   3. ***Estimate roots of numbers*** using binomial expansion |

**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 operations***include but not limited to: | * Addition * Subtraction * Multiplication * Division |
| * 1. ***Simultaneous equations*** include but not limited to: | * Substitution * Elimination * Graphical |
| * 1. ***Trigonometric and hyperbolic functions*** include but not limited to: | * Trigonometric equations * Trigonometric identities * Osborn’s Rule * series expansion of coshx, sinhx,tanhx * Inverse hyperbolic functions * Hyperbolic log forms * Hyperbolic equations |
| * 1. ***normal and tangents*** include but not limited to: | * polar equations * Cartesian equations * Normal and tangents |
| * 1. ***roots of numbers*** include but not limited to: | * Power series using binomial theorem * Roots of numbers using binomial 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:

* 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)
* Trigonometric Ratios
* Hyperbolic ratios
* Types of tables and graphs
* Indices and logarithms
* Quadratic equations
* Binomial theorem

**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. Carried out arithmetic operations on integers as per concept.   2. Solved Indices calculations as per concept.   3. Solved simultaneous equations involving 2 and 3 unknowns as per rules.   4. Solved quadratic equations as per concept.   5. Solved trigonometric equations as per the concept   6. Proved trigonometric identities   7. Carried out series expansion of coshx, sinhx, tanhx   8. Carried out inverse hyperbolic functions   9. Carried out hyperbolic log form operations   10. Solved hyperbolic equations as per the concept   11. Solved polar equations   12. Solved Cartesian equations   13. Solved normal and tangents   14. Carried out power series expansion using binomial theorem   15. Solved roots of numbers using binomial theorem   16. Carried out Matrices Operations as per concept.   17. Obtained determinant and inverse of 2x2 matrix as per concept.   18. Obtained solutions of simultaneous equations as per matrix concept.   19. Obtained Measures of central tendencies as per statistics concept.   20. Carried out Data presentation as per statistics concept.   21. Determined derivatives of functions as per first principle.   22. Determined rate of change and small change as per differentiation concept.   23. Determined algebraic function Integrals as per integration rules   24. Determined trigonometric functions Integrals as per integration rules. |
| 2.Resource Implications | The following resources should be provided:  2.1Access to relevant workplace or appropriately simulated environment where assessment can take place  2.2Materials relevant to the proposed activity or tasks |
| 3.Methods of Assessment | Competency may be assessed through:   * 1. Written tests   2. Practical Assessment   3. Projects |
| 4.Context of Assessment | Competency may be assessed in a workplace or a simulated workplace. |
| 5.Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY ENGINEERING TECHNICIAN MATHEMATICS II

**UNIT CODE:** 0541 541 06A

**UNIT DESCRIPTION:** This unit describes the competencies required by a technician in order to apply engineering technician mathematics. It enables the learner to; apply algebra, apply trigonometry and hyperbolic functions, apply complex numbers perform coordinates geometry, carry out binomial expansion, apply calculus, carry out mensuration, apply statistics, apply vector theorem and apply 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 italicised terms are elaborated in the Range)*** |
| --- | --- |
| 1. Apply calculus | 1. Derivatives of functions are determined as per mathematical methods. 2. Differentiation is applied as per mathematical methods. 3. Integrals of functions are determined as per mathematical methods. 4. Integration is applied as per mathematical methods |
| 1. Apply statistics and probability | * 1. ***Measures of central tendency*** are obtained as per mathematical methods.   2. ***Measures of dispersion*** are obtainedas per mathematical methods.   3. Laws of probability are applied as per mathematical methods.   4. ***Probability distribution*** methods are applied as per mathematical methods.   5. Sampling distribution methods are applied as per mathematical methods. |
| 1. Apply vector theorem | * 1. Vectors and scalar quantities are defined as per mathematical methods   2. ***Operations*** on vectors are performed as per mathematical methods   3. Position vectors are determined as per mathematical methods   4. Resolution of vectors is performed as per mathematical methods   5. Vector and scalar products are obtained as per mathematical methods |
| 1. Apply matrices | * 1. Matrices operations are performed as per mathematical methods   2. Inverse of matrices are obtained as per mathematical methods   3. Simultaneous equations are solved using matrices as per mathematical methods. |
| 1. Apply complex numbers | * 1. Complex numbers are represented on Argand diagrams as per Mathematical methods   2. ***Operations*** involving complex numbers are performed as per mathematical methods   3. De Moivre’s theorem is applied as per mathematical methods |

**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** |
| --- | --- |
| Measures of central tendency may include but not limited to: | * Mean * Median * mode |
| Measures of dispersion may include but not limited to | * Co-efficient of Range. * Co-efficient of Variation. * Co-efficient of Standard Deviation. * Co-efficient of Quartile Deviation. * Co-efficient of Mean Deviation |
| Probability distributions may include but not limited to: | * Binomial distribution * Poisson distribution * Normal distribution |
| Operations may or include but not limited to; | * Addition * Subtraction * Multiplication * Division |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

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 and understanding of:

* Algebra
* Linear algebra
* Basic calculus
* Geometry
* Fundamental operations (addition, subtraction, division, multiplication)
* Calculating area and volume
* Types and purpose of measuring instruments
* Units of measurement and abbreviations
* Rounding techniques
* Types of fractions
* Types of tables and graphs
* Presentation of data in tables and graphs
* Vector operations
* Matrix operations

**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 complex numbers as per mathematical methods 2. Applied calculus as per mathematical methods 3. Applied statistics as per mathematical methods 4. Applied concept of probability as per mathematical methods 5. Applied vector as per mathematical methods 6. Applied matrices as per mathematical methods |
| 1. Resource implications | The following resources should be provided:   1. Mathematical tables 2. Whiteboards 3. Marker 4. Scientific calculator 5. Measuring equipment |
| 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, workplace and job role is recommended |

**APPLY ENGINEERING TECHNICIAN MATHEMATICS III**

**UNIT CODE:** 0541 541 07A

**UNIT DESCRIPTION:** This unit describes the competencies required by a technician in order to apply engineering technician mathematics. It enables the learner to; apply algebra, apply trigonometry and hyperbolic functions, apply complex numbers perform coordinates geometry, carry out binomial expansion, apply calculus, carry out mensuration, apply statistics, apply vector theorem and apply 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 italicised terms are elaborated in the Range)*** |
| --- | --- |
| 1. Solve Partial differential equations | 1. Differential equations involving partially derivatives are performed based on the first principle. 2. Differential equations involving functions of two or more variables are performed as per partial derivative concept. 3. Problems involving small changes or errors are solved as per partial derivatives concept. 4. Stationary points of functions of two variables are obtained as per partial derivative concept. |
| 1. Solve ordinary differential Equations | 1. ***First order and second order differential equations*** are applied as per the method of undetermined coefficients. 2. First order differential equations are applied from given boundary conditions. 3. Differential equations are solved as per D- operator method 4. Differential equations are applied in electrical problems |
| 1. Apply Laplace transforms | * 1. Laplace transforms are solved using initial and final value theorems   2. Inverse Laplace transforms are solved using partial fractions   3. Differential equations are solved using Laplace transforms |

**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** |
| --- | --- |
| First order and second order differential equations may include but not limited to: | * Homogeneous equations * First order variable separable * First order linear * Undetermined co-efficients |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

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 and understanding of:

* Algebra
* Linear algebra
* Basic calculus
* Geometry
* Fundamental operations (addition, subtraction, division, multiplication)
* Calculating area and volume
* Types and purpose of measuring instruments
* Units of measurement and abbreviations
* Rounding techniques
* Types of fractions
* Types of tables and graphs
* Presentation of data in tables and graphs
* Vector operations
* Matrix operations

**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. Performed Differential equations involving functions of two or more variables are as per partial derivative concept. 2. Obtained Stationary points of functions of two variables as per partial derivative concept. 3. Applied First order differential equations from given boundary conditions. 4. Applied Differential equations in electrical problems 5. Solved Differential equations using Laplace transforms |
| 1. Resource implications | The following resources should be provided:   1. Mathematical tables 2. Whiteboards 3. Marker 4. Scientific calculator 5. Measuring equipment |
| 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, workplace and job role is recommended |

**APPLY ENGINEERING TECHNICIAN MATHEMATICS IV**

**UNIT CODE:** 0541 541 08A

**UNIT DESCRIPTION:** This unit describes the competencies required by a technician in order to apply engineering technician mathematics. It enables the learner to; apply Fourier series, apply multiple Integrals, apply complex variables, apply numerical methods and apply matrices II

**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. Apply Fourier Series | * 1. **Fourier series** coefficients are obtained using Fourier series techniques   2. Fourier series for 2π to T is are obtained using Fourier series techniques   3. Fourier series for odd and even functions are obtained using Fourier series techniques   4. Harmonic analysis is performed using numerical methods |
| 1. Multiple Integrals | * 1. Double and multiple integrals are defined as per integral rules   2. Double and triple integrals are applied in polar, cylindrical and spherical coordinates.   3. Triple integrals are used in solving problems |
| 1. Matrices II | * 1. Matrice operations are performed as per Eigen principles   2. Jordan form of a matrix are defined as per the concept   3. continuous time transition matrix for a linear time varying system are performed as per State transition matrix operations |
| 1. Apply Complex Variables | 1. Complex analysis is performed as per complex variable concept. 2. Complex variable Calculations are performed as per Cauchy-Riemann equations concept. 3. Complex variables functions are Differentiated as per the concept. |
| 1. Apply Numerical methods | 1. Roots of polynomials are obtained using iterative numerical methods 2. Interpolation and extrapolation are performed using numerical methods 3. Interpolation and extrapolation are applied as per the concept |

**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** |
| --- | --- |
| Fourier Series may include but not limited to: | * Odd and Even functions * Numerical harmonics |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

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 and understanding of:

* Algebra
* Linear algebra
* Basic calculus
* Geometry
* Fundamental operations (addition, subtraction, division, multiplication)
* Calculating area and volume
* Types and purpose of measuring instruments
* Units of measurement and abbreviations
* Rounding techniques
* Types of fractions
* Types of tables and graphs
* Presentation of data in tables and graphs
* Vector operations
* Matrix operations

**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. Obtained Fourier series for 2π to T using Fourier series techniques   2. Obtained Fourier series for odd and even functions using Fourier series techniques   3. Applied Double and triple integrals in polar, cylindrical and spherical coordinates.   4. Performed continuous time transition matrix for a linear time varying system as per State transition matrix operations   5. Performed Complex variable Calculations as per Cauchy-Riemann equations concept.   6. Performed Interpolation and extrapolation using numerical methods |
| 1. Resource implications | The following resources should be provided:   1. Mathematical tables 2. Whiteboards 3. Marker 4. Scientific calculator 5. Measuring equipment |
| 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, workplace and job role is recommended |

## BASIC ELECTRICAL PRINCIPLES

**UNIT CODE:** 0713 541 09A

**UNIT DESCRIPTION**

This unit describes competences required to apply 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*** may include but not limited to: | * + Dry cells   + Leclanché   + Mercury   + Lead-acid   + Alkaline   + Lithium |
| 1. ***Basic Electrical laws*** may include but not limited to: | * + Ohms law   + Kirchhoff’s theorem |
| 1. ***Magnetic and non-magnetic materials*** may include but not limited to: | * + Magnetic materials   + Non-magnetic materials   + Laws of electromagnetic induction   + Self and mutual induction   + Hysteresis loop   + Series and parallel magnetic circuit calculations |
| 1. ***Types of capacitors*** may include but not limited to: | * + Paper   + Ceramic   + Electrolytic   + Aluminium foil   + Polyester   + Tantalum   + Multiplate |
| 1. ***Calculations involving***   ***capacitors*** | * + Series   + Parallel   + Series parallel |
| 1. ***AC fundamentals*** | * + Waveforms   + Period   + Frequency   + Instantaneous value   + Amplitude   + Average value   + R.M.S value |
| 1. ***Methods of power factor correction*** | * + Capacitor bank |
| 1. ***Methods of range extension*** | * + Shunt and ammeter method   + Universal shunt method   + Multi-range voltmeter method   + D.C valve voltmeter. |

**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 | The following resources should be provided:  2.1 Appropriately simulated environment where assessment can take place.   * 1. Access to relevant work environments.   2.3 Resources relevant to the proposed activities or task. |
| 1. Methods of Assessment | * 1. Practical demonstration   2. Projects   3. Written tests   4. Oral test |
| 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. |

## APPLY ELECTRICAL PRINCIPLES I

**UNIT CODE:** 0713 541 10A

**UNIT DESCRIPTION**

This unit describes competences required to apply electrical principles II. Competences include applying electrical machines, applying three phase power supply and applying transients in dc circuits.

**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 machines | * 1. Electrical machines are identified as per work requirement.   2. Operations involving ***electrical machines*** are applied as per machine type.   3. Generator e.m.f equation is derived as per AC working principles.   4. Electrical machines are controlled as per work procedure.   5. Calculations involving electrical machines are performed based on formula.   6. Applications of electrical machines are identified as per work requirement. |
| 1. Apply three phase power supply | * 1. Principles of three phase power generation is demonstrated as per AC fundamentals.   2. Connections of three phase power supply are performed as per load requirement.   3. Calculations involving three phase power supply connections are performed as per the circuit theories.   4. Three phase power is measured as per IET regulation. |
| 1. Apply transients in DC Circuits | * 1. Growth and decay equations are derived in R-L and R-C circuits as per working principles.   2. Growth and decay curves in R-L and R-C circuits are sketched as per equation.   3. Calculations involving Growth and decay in R-L and R-C are performed based on the time constants.   4. Effect of time constant in switching inductive and capacitive loads is applied as per work procedure.   5. Passive and active filters are analyzed as per the applications. |

**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 machines*** may include but not limited to: | * + DC motors   + DC generators   + AC single phase motors   + AC three phase machines: Induction, Synchronous   + Transformers |

**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. Applied Operations involving ***electrical machines*** as per machine type.   2. Performed Calculations involving electrical machines based on formula.   3. Demonstrated Principles of three phase power generation as per AC fundamentals.   4. Performed Calculations involving three phase power supply connections as per the circuit theories.   5. Performed Calculations involving Growth and decay in R-L and R-C based on the time constants.   6. Applied Effect of time constant in switching inductive and capacitive loads as per work procedure. |
| 1. Resource Implications | The following resources should be provided:   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 | Competency may be assessed through:   1. Practical 2. Project 3. Third party report 4. Portfolio of evidence 5. Written tests 6. Oral questioning |
| 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. |

## APPLY ELECTRICAL PRINCIPLES II

**UNIT CODE:** 0713 541 11A

**UNIT DESCRIPTION**

1. This unit describes competences required to apply Electrical principles. Competences include; conducting system earthing and protection, apply illumination principles, apply two ort networks and apply electromagnetic field.

**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 system earthing and protection | * 1. System and equipment **protection principles** are applied as per the IEC and IET standards.   2. **Protection system design** is performed as per the IEC standard.   3. **Earthing system is designed** as per the IEC standards.   4. **Test on an earthing system** is performed as per the applicable IEC and IET standards.   5. Types of lightning strikes are identified based on Benjamin Franklin recommendations.   6. **Lightning system design** is performed as per the applicable IEC and IET standards. |
| 1. Apply illumination principles | 1. Laws of lighting are applied as per lighting area. 2. Light requirements are calculated as per laws of lighting. 3. Electric luminaires are selected as per application. 4. Lighting schemes are designed as per lighting area. |
| 1. Apply two port networks | 1. Basic passive networks are analysed based on the black box technique. 2. Characteristic impedance is determined based on based on the frequency. 3. ABCD constants are derived based on formula. 4. Cascaded networks are applied as per network parameters. 5. Types of transmission lines and their applications are analysed based on the telegrapher equations. |
| 1. Apply Electromagnetic field Theory | * 1. Electromagnetic radiation sources are identified as per EN 300386 v1.6.1   2. Detectors of Electromagnetic radiations are identified as per EN 300386 v1.6   3. Electromagnetic waves are applied as per EN 300386 v1.6.1   4. Electromagnetics Laws are Identified based on Maxwell’s equation.   5. ***Electromagnetic wave parameters*** are calculated based on Maxwell’s equation.   6. Behaviors and effects of Electromagnetic waves are established as per the media.   7. Electrostatics terms are identified as per the IET standards.   8. Magneto statics terms are identified as per the IET standards.   9. Electrodynamics laws are identified based on the applications.   10. Energy conservation theorem is identified as per the Internal energy.   11. Electromagnetic Energy flow is calculated as per the Maxwell’s equations.   12. Energy flow in an antenna is calculated as per the E-H propagation. |

**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. ***Protection principles*** may include but not limited to: | * + Protection zones   + Protection systems |
| 1. ***Protection system design*** may include but not limited to: | * + Protection system Drawings   + Protection system Device sizing   + Protection system Location |
| 1. ***Earthing system*** **is designed** may include but not limited to: | * + TT   + TNC   + TNCS   + IT   + TNS |
| 1. ***Test on an earthing system*** may include but not limited to: | * + Earth resistance test   + Earth loop impedance test |
| 1. ***Lightning system design*** may include but not limited to: | * + Lightning arrestors   + Lightning design drawing   + Size of lightning system |
| 1. ***Electromagnetic wave parameters*** may include but not limited to: | * + Wavelength   + Velocity   + Frequency |

**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 Protection system design as per the IEC standard. 2. Designed Earthing system as per the IEC standards 3. . Calculated Light requirements as per laws of lighting. 4. Selected Electric luminaires as per application 5. Derived ABCD constants based on formula. 6. Applied Cascaded networks as per network parameters. 7. Calculated Electromagnetic wave parameters based on Maxwell’s equation. 8. Calculated Electromagnetic Energy flow as per the Maxwell’s equations. |
| 1. Resource Implications | The following resources should be provided:   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 | Competency may be assessed through:   1. Practical 2. Project 3. Third party report 4. Portfolio of evidence 5. Written tests 6. Oral questioning |
| 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. |

## APPLY CONTROL SYSTEMS

**UNIT CODE:** **0714 541 12A**

**UNIT DESCRIPTION**

This unit covers competences required to apply control systems. Competences include applying basic concepts of control systems, system modelling, system performance, system compensation and servo systems.

**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 basic concepts of control systems | * 1. ***Control systems*** are identified based on functionality.   2. Open and closed loops systems are applied based on system functionality.   3. Systems are presented using block diagrams as per job specification.   4. Block diagrams are simplified based on design of system.   5. Signal flow graphs are derived as per canonical rules. |
| 1. Apply system modelling | * 1. System modelling needs are identified as per design.   2. Transfer functions are determined as per system model.   3. ***Practical systems*** are modelled as per system functionality. |
| 1. Apply system performance | 1. Test signals are applied as per system design. 2. Dynamic responses are analysed as per design. 3. Damping methods are applied based on the design. 4. System stability is determined based on the system performance. |
| 1. Apply system compensation | 1. System compensation needs are identified as per functionality of system. 2. Transfer functions for compensating networks are derived based on system design. 3. Compensating networks are designed as per work requirement. |
| 1. Apply servo systems | * 1. ***Servo mechanisms*** are identified as per control system.   2. Alternating Current (AC) and Direct Current (DC) servo amplifiers are applied as per control system.   3. Stepper motors are applied as per control systems.   4. Servo motors’ characteristic curves are sketched based on its’ functional parameters. |

**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. ***Control systems*** may include but not limited to: | * Man-made systems * Natural systems * Hybrid system * Open loop control systems * Closed loop control systems |
| 1. ***Practical systems*** may include but is not limited to: | * Generators * Motors * Temperature control systems |
| 1. ***Servo mechanisms*** may include but not limited to: | * Position * Speed * acceleration |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

* The manufacturer's warranty requirements relating to control systems and related components.
* Mathematical concepts in Laplace transforms
* 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
* 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
* Financial statements

**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. Differentiated open loop and closed loop control systems as per system functionality. 2. Simplified block diagrams as per design of the system. 3. Derived signal flow graphs from block diagrams as per design of the system. 4. Applied system modelling in deriving transfer functions of systems as per the system model. 5. Derived transfer function of compensating networks as per the system model. 6. Applied servo mechanisms in operating servo motors and stepper motors as per control system. |
| 1. Resource Implications | The following resources should be provided:  2.1 Appropriately simulated environment where assessment can take place.  2.2 Access to relevant work environments.  2.3 Resources relevant to the proposed activities or task. |
| 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 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 TECHNICAL DRAWINGS

**UNIT CODE:** 0732 541 13A

**UNIT DESCRIPTION**

This unit covers competences required to prepare technical drawings. Competences include preparing drawing equipment and materials, producing plane geometry drawings, Producing pictorial and orthographic drawings of components, Manage basic operations in AutoCAD, Develop Drawings in AutoCAD and Produce electrical drawings.

**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. Different types of lines used in drawing and their meanings are identified according to technical drawing standards 2. Freehand printing of letters and numbers carried out as per technical drawing standards 3. Borderlines and title blocks are drawn as per technical drawing standards. 4. Different types of angles are constructed as per technical drawing standards 5. Different types of ***geometric figures*** are constructed as per required dimensions 6. Different types of ***Tangents*** are constructed according to technical drawing standards. | |
| 1. Produce pictorial and orthographic drawings of components | | 1. Different symbols and abbreviations are identified, and their meaning interpreted as per technical drawing standards. 2. Pictorial sketches and ***pictorial drawings*** of components are interpreted and produced as per technical drawing standards. 3. First and third angle orthographic sketches and drawings of components are interpreted and produced as per technical drawing standards. 4. Different types of geometric forms, tools and equipment is freehand sketched as per technical drawing standards. | |
| 1. Manage basic operations in AutoCAD | | * 1. Key features of CAD software are identified as per software manual.   2. AutoCAD visual reference commands are operated as per software manual.   3. AutoCAD navigation commands option is operated as per software manual.   4. AutoCAD ribbon tools are used as per software manual.   5. AutoCAD status bar tools are used 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 Drawings in AutoCAD | | 1. Drawing interface is set up as per required specifications. 2. 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. 7. Pictorial and orthographic drawings are Produced using AutoCAD software as per software manual | |
| 1. Produce electrical drawings | | * 1. Electrical symbols and abbreviations are identified according to BS 3939 standards.   2. Electrical schematic diagrams are drawn as per installation requirement.   3. Electrical wiring diagrams are drawn as per installation requirement.   4. Electrical and Electronic drawings are produced using appropriate CAD software as per software manual.   5. Electrical installation components are placed on a building plan using AutoCAD as per required design.   6. Electrical and electronic drawings are simulated as per software manual. | |

**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: | 1. Drawing boards 2. T and set squares 3. Drawing set |
| 1. ***Drawing materials*** may include but not limited to: | 1. Drawing papers 2. Pencils 3. Erasers 4. Masking tapes 5. 2.5 Paper clips |
| 1. ***Geometric figures*** may include but not limited to: | 1. Circles 2. Triangles 3. Rectangles 4. Parallelogram 5. Polygons 6. Pyramids 7. Conic sections 8. Prisms |
| 1. ***Tangents*** may include but not limited to: | 1. Exterior tangents to a circle 2. Interior tangents to a circle |
| 1. ***Pictorial drawings*** may include but not limited to: | 1. Isometric drawing 2. Free hand sketches 3. Oblique drawing |
| 1. ***Key features*** may include but not limited to: | 1. 2D drafting and drawing 2. 3D drafting and drawing |
| 1. ***AutoCAD visual reference commands*** mayinclude but not limited to: | 1. Visual styles 2. Materials and textures 3. Writing 4. Rendering 5. View port |
| 1. ***Ribbon*** may include but not limited to: | 1. Draw panel 2. Modify panel 3. Layer 4. Annotation |
| 1. ***Status bar*** may include but not limited to: | 1. Snap 2. Grid 3. Ortho 4. Object snap 5. Polar tracking 6. Isometric drafting |
| 1. ***Electrical and Electronic drawings*** include but not limited to: | 1. Block 2. Wiring diagram 3. schematic 4. PCB |

**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. Constructed different types of angles as per technical drawing standards. 2. Constructed different types ofTangents according to technical drawing standards. 3. Constructed different types of geometric figures as per required dimensions. 4. Produced pictorial sketches and pictorial drawings of components as per technical drawing standards. 5. Produced First and third angle orthographic sketches and drawings of components as per technical drawing standards. 6. Freehand sketched different types of geometric forms, tools and equipment as per technical drawing standards 7. Operated AutoCAD navigation commands option as per software manual. 8. Created 2D drawing as per given dimension. 9. Produced ***Pictorial and orthographic drawings*** using AutoCAD software as per software manual. 10. Produced Electrical and Electronic drawings using appropriate CAD software as per software manual. 11. Placed Electrical installation components on a building plan using AutoCAD as per required design. |
| 1. Resource Implications | The following resources should be provided:  2.1 Appropriately simulated environment where assessment can take place.  2.2 Access to relevant work environments.  2.3 Resources relevant to the proposed activities or task. |
| 1. Methods of Assessment | * 1. Practical demonstration   2. Projects   3. Written tests   4. Oral test |
| 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. |

## APPLY ANALOGUE ELECTRONICS I

**UNIT CODE:** 0714 541 15A

**UNIT DESCRIPTION**

This unit covers competences required to apply analogue electronics. Competences includes applying semiconductor theory, applying semiconductor diodes, applying transistors, applying special semiconductor devices and performing rectification.

**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. Apply semiconductor theory | * 1. Types of ***materials*** are identified in line with semiconductor theory.   2. Semiconductor materials are identified as per electrical conductivity properties. |
| 1. Apply semiconductor diodes | * 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. |
| 1. Apply transistors | * 1. ***Transistors*** are identified as per characteristics.   2. NPN and PNP are determined as per operation.   3. P and N channels are identified as per operation.   4. ***Biasing*** and determination of gain of transistors is performed as per standard operating procedure.   5. Transistor configuration is performed as per application. |
| 1. Apply special semiconductor devices | * 1. Special semiconductor devices are identified as per operation.   2. Special semiconductors are applied as per standard operating procedure.   3. Types of special semiconductor devices are identified. |
| 1. Perform rectification | * 1. Types of rectifiers are identified as per functions.   2. Classes of rectifiers are identified as per input voltage.   3. Applications of rectifiers are established.   4. Converters are identified as per functions.   5. Applications of converters are established as per functions. |

**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. ***Materials*** may include but not limited to: | * Insulators * Conductors * Semiconductors |
| 1. ***Diodes*** mayinclude but not limited to: | * Photo diodes * Laser * Zener diodes * Light emitting diode * Schottky diodes |
| 1. ***Transistors*** may include but not limited to: | * BJTs * FETs |
| 1. ***Biasing*** mayinclude but not limited to: | * Forward bias * Reverse bias |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

* The manufacturer's warranty requirements relating to electronics 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
* Contractual agreements
* Necessary insurance and policies including security bonds, performance bonds, contractors all risks
* Insurance of contractor’s work
* Keeping records of income
* Financial statements

**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. Identified different semiconductor material as per work procedure. 2. Applied diodes in electronic circuits as per work procedure. 3. Applied transistors in basic electronic circuits as per work procedure. 4. Identified special semiconductor devices as per work procedure. 5. Performed rectification of ac power to dc power as per work procedure. |
| 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 test   2. Third Party Report   3. Portfolio of evidence   4. Written test   5. Oral questioning |
| 1. Context of Assessment | Competency may be assessed in actual 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. |

## APPLY ANALOGUE ELECTRONICS II

**UNIT CODE:** 0714 541 16A

**UNIT DESCRIPTION**

This unit covers competences required to apply analogue electronics. Competences includes understanding semiconductor theory, applying semiconductor diodes, demonstrating understanding of transistors, applying special semiconductor devices, performing rectification, applying amplifiers, use of oscillators and application of Opto-electronics.

**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. Apply amplifiers | * 1. Types of ***amplifiers*** are identified as per functions.   2. Operational amplifier is identified as per its applications.   3. Characteristics of operational amplifiers are determined. |
| 1. Use oscillators | * 1. ***Oscillators*** are classified as per operation.   2. Types of oscillators is determined as per applications.   3. Damped and Undamped oscillation is performed as per oscillator operation.   4. Wave shaping and pulse generation circuits are performed as per standard operating procedure |
| 1. Apply opto-electronics | * 1. Types of Opt-electronics semiconductors are identified as per operation characteristics.   2. Lasers and masers are identified as per operations   3. Drive requirements are determined as per display. |

**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. ***Amplifiers*** may include but not limited to: | * RC coupled amplifiers * Small signal amplifiers * Power amplifiers * Tuned amplifier * Wide band amplifiers * Op-Amp amplifiers |
| 1. ***Oscillators*** may include but not limited to: | * Tuned collector * RC phase shift * Colpits * Hartley * Crystal * Blocking |
| 1. ***Lasers*** may ***i***nclude but not limited to | * Gaseous lasers * Solid lasers |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

* The manufacturer's warranty requirements relating to electronics 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
* Contractual agreements
* Necessary insurance and policies including security bonds, performance bonds, contractors all risks
* Insurance of contractor’s work
* Keeping records of income
* Financial statements

**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. Identified operational amplifiers as per application as per work procedure. 2. Used oscillators in wave shaping and pulse generation circuits as per work procedure. 3. Identified various types of opto-electronics semiconductors as per applications and work procedure. |
| 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 test   2. Third Party Report   3. Portfolio of evidence   4. Written test   5. Oral questioning |
| 1. Context of Assessment | Competency may be assessed in actual 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. |

## APPLY DIGITAL ELECTRONICS I

**UNIT CODE:** 0714 541 17A

**UNIT DESCRIPTION**

This unit describes competences required to apply digital electronics. Competences include applying knowledge of number systems, applying knowledge of binary code, applying logic gates and Boolean algebra concepts, constructing digital logic circuits, constructing advance digital logic circuits, applying knowledge of converters (ADC and DAC) and managing computer memories.

**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. Apply knowledge of number systems | * 1. Number system knowledge is applied as per digital system design.   2. Number systems conversion knowledge is applied as per digital system design.   3. Binary numbers are represented into one’s and two’s complements knowledge is applied as per type of ***arithmetic operations.***   4. Binary arithmetic knowledge is applied as per type of arithmetic operations. |
| 1. Apply knowledge of binary codes | * 1. Binary code concepts knowledge is applied as per digital system design.   2. Decimal numbers are represented in binary coded decimal (BCD) knowledge is applied as per circuit design specifications.   3. Binary numbers are represented in gray codes knowledge is applied as per circuit design specifications.   4. Alphanumeric techniques knowledge is applied as per digital system design.   5. Error detection and correction knowledge is applied as per digital system design. |
| 1. Apply Logic gates and Boolean algebra concepts | * 1. Principles of ***logic gates*** are applied as as per digital system design specifications.   2. logic gates operation knowledge is applied as per type digital system design specifications.   3. Boolean algebra concepts are applied as per digital system design specifications.   4. Logic circuits concepts are applied as per digital system 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. ***arithmetic operations*** may include but not limited to: | * + Addition (+)   + Subtraction (-)   + Multiplication (x)   + Division (/) |
| 1. ***logic gates*** may include but not limited to: | * + AND Gate   + OR Gate   + NOT Gate   + NAND Gate   + NOR Gate   + XOR Gate (Exclusive OR)   + XNOR Gate (Exclusive NOR or Equivalence) |
| 1. ***Logic families*** may include but not limited to: | Bipolar Families:   * + Diode Logic (DL)   + Resistor Transistor Logic (RTL)   + Diode Transistor Logic (DTL)   + Transistor-Transistor Logic (TTL)   + Emitter Coupled Logic (ECL) or Current Mode Logic (CML)   + Integrated Injection Logic (IIL)   MOS Families:   * + P-MOS Family   + N-MOS Family   + Complementary-MOS Family   Hybrid Family:   * + Bi-CMOS Family |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

* + - * Proficiency in software, efficiency in programming, command of several computer languages, computer-aided drafting tools, and circuit simulators1.
      * Practical experience of different circuits and electrical embedding1.
      * Knowledge of electronic components, circuits, semiconductors, electromechanical machine design, communications systems, and signal systems2.
      * Basic Math.
      * Electrical Safety
      * Electrical Theory
      * Electrical Components
      * Circuit Boards.
      * Circuit Analysis
      * Instrumentation and Electrical Measurements

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Electrical power calculations
* Various laws in Electrical engineering
* Electrical formulas
* SI units of various electrical parameters
* Selecting the correct type of electrical machines for various uses
* 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:   * + applied Number systems conversion knowledge as per digital system design.   + applied Number systems conversion knowledge as per digital system design.   + applied knowledge Decimal numbers represented in binary coded decimal (BCD) as per circuit design specifications.   + applied Error detection and correction knowledge as per digital system design.   + applied logic gates operation knowledge as per type digital system design specifications.   + applied Logic circuits concepts as per digital system design specifications. |
| 1. Resource Implications | The following resources must be provided:   * + Access to relevant workplace where assessment can take place.   + Appropriately simulated environment where assessment can take place.   + Materials relevant to the proposed assessment activity or tasks. |
| 1. Methods of Assessment | Competency may be assessed through:   * Observation * Written test * Practical * Demonstration * Oral questioning * Third party report |
| 1. Context of Assessment | Competency may be assessed in a 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. |

## APPLY DIGITAL ELECTRONICS II

**UNIT CODE:** 0714 541 18A

**UNIT DESCRIPTION**

This unit describes competences required to apply digital electronics. Competences include applying knowledge of number systems, applying knowledge of binary code, applying logic gates and Boolean algebra concepts, constructing digital logic circuits, constructing advance digital logic circuits, applying knowledge of converters (ADC and DAC) and managing computer memories.

**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. Apply knowledge of digital logic circuits | * 1. combinational logic circuits principles are applied as per type of digital operation.   2. transistor as a switch knowledge is applied as per type of digital operation.   3. ***Logic families*** knowledge is applied as per digital system design specifications.   4. ***flip flops circuits*** conceptsare applied as per type of digital operation.   5. ***combination circuits*** operations knowledge is applied as per type of digital operation. |
| 1. Apply knowledge of advance digital logic and converter circuits | * 1. Principles of operation of shift registers are applied as per digital system design specifications.   2. Manufacture’s datasheets and catalogues knowledge is applied to identify ICs as per work requirement.   3. Operation principles of synchronous and asynchronous counters are applied as per circuit design.   4. Operation of feedback register knowledge is applied as per circuit design.   5. Principles of operations of ***arithmetic logic circuits*** are applied as per type of arithmetic operations.   6. Operational amplifier as a comparator knowledge is applied as per type of digital operation.   7. Operation principles of ***digital converters circuits*** are applied as per digital system requirements. |
| 1. Manage computer memories | * 1. Memory categories knowledge is applied as per system design specifications.   2. ***computer memories o***peration knowledge is applied as per memory design specifications.   3. Memory map and organization knowledge is applied as per system 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. ***Logic families*** may include but not limited to: | Bipolar Families:   * + Diode Logic (DL)   + Resistor Transistor Logic (RTL)   + Diode Transistor Logic (DTL)   + Transistor-Transistor Logic (TTL)   + Emitter Coupled Logic (ECL) or Current Mode Logic (CML)   + Integrated Injection Logic (IIL)   MOS Families:   * + P-MOS Family   + N-MOS Family   + Complementary-MOS Family   Hybrid Family:   * + Bi-CMOS Family |
| 1. ***Fllip flops*** circuits may include but not limited to: | * + Coulomb’ law   + Gauss law   + Faraday’s laws   + Amperes law   + Lenz’ law |
| 1. ***Combination circuits*** may include but not limited to: | * + SR Flip Flop   + JK Flip Flop   + D Flip Flop   + T Flip Flop |
| 1. ***Arithmetic logic circuits*** may include but not limited to: | * + Adder   + Subtractor   + Multiplier   + Divider   + Incrementer   + Decrementer   + Comparator   + Shifter/Rotator |
| 1. ***Digital converters circuits*** may include but not limited to | * + Analog to Digital Converter (ADC)   + Digital to Analog Converter (DAC) |
| 1. ***Computer memories*** may include but not limited to | * + RAMs   + ROMs   + EEPROMs   + EPROMs |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

* + - * Proficiency in software, efficiency in programming, command of several computer languages, computer-aided drafting tools, and circuit simulators1.
      * Practical experience of different circuits and electrical embedding1.
      * Knowledge of electronic components, circuits, semiconductors, electromechanical machine design, communications systems, and signal systems2.
      * Basic Math.
      * Electrical Safety
      * Electrical Theory
      * Electrical Components
      * Circuit Boards.
      * Circuit Analysis
      * Instrumentation and Electrical Measurements

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Electrical power calculations
* Various laws in Electrical engineering
* Electrical formulas
* SI units of various electrical parameters
* Selecting the correct type of electrical machines for various uses
* 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:   * + applied Number systems conversion knowledge as per digital system design.   + applied Number systems conversion knowledge as per digital system design.   + applied knowledge Decimal numbers represented in binary coded decimal (BCD) as per circuit design specifications.   + applied Error detection and correction knowledge as per digital system design.   + applied logic gates operation knowledge as per type digital system design specifications.   + applied Logic circuits concepts as per digital system design specifications.   + Applied ***Logic families*** knowledge as per digital system design specifications.   + Applied ***flip flops circuits*** conceptsas per type of digital operation.   + Applied Manufacture’s datasheets and catalogues knowledge to identify ICs as per work requirement.   + Applied principles of operations of ***arithmetic logic circuits*** as per type of arithmetic operations.   + Applied Operation principles of ***digital converters circuits*** as per digital system requirements.   + Applied ***computer memories o***peration knowledge as per memory design specifications. |
| 1. Resource Implications | The following resources must be provided:   * + Access to relevant workplace where assessment can take place.   + Appropriately simulated environment where assessment can take place.   + Materials relevant to the proposed assessment activity or tasks. |
| 1. Methods of Assessment | Competency may be assessed through:   * Observation * Written test * Practical * Demonstration * Oral questioning * Third party report |
| 1. Context of Assessment | Competency may be assessed in a 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. |

## APPLY MICRO CONTROL SYSTEMS

**UNIT CODE:** 0714 541 19A

**UNIT DESCRIPTION**

This unit covers competences required to apply micro control systems. Competences include Establishing complexity of the task, selecting micro control device, selecting micro control programming software, performing controller programming, interfacing micro control system, performing controller system test and inspection.

**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. Establish complexity of the task | * 1. Intended task is determined as per job specification.   2. Cost is determined as per job requirement.   3. ***Micro control device*** to be usedis determined as per job requirement. |
| 1. Select Micro control device | 1. Operating system requirement is determined as per job specification. 2. User interface is determined as per job specification. 3. Controller’s communication system is determined as per manufacturer’s specifications. 4. Controller is customized as per job specification, 5. Power rating of the controller is determined as per manufacturer’s specifications. |
| 1. Select micro control programming software | 1. ***Personal Computer (PC) software*** is obtained based on selected controller program specification. 2. PC Software installer is run based on manufacturer’s manual. 3. Selected controller software is run as per manufacturer’s manual. 4. Communication settings are configured based on job specifications. |
| 1. Perform controller Programming | 1. Controller process requirements are defined based on job specifications. 2. Controller ***program language*** is determined based on job specification. 3. Controller program is developed as per job specifications. 4. Controller program is compiled based on job specifications. 5. Controller program is debugged in accordance to job specifications. 6. Controller program is documented based on job specifications. |
| 1. Interface micro control system | 1. Input/ Output (I/O) module for controller hardware is identified as per work requirement. 2. ***Input device*** is connected to I/O module as per system design. 3. ***Output device*** is connected to I/O module as per system design. 4. I/O module is linked with controller based on manufactures specification. |
| 1. Perform controller system test and inspection | 1. Visual inspection is performed based on system design. 2. Electrical test is performed as per IEE regulations. 3. Controller system functionality test is carried out as per design specification. 4. ***Controller system*** commissioning is performed as per manufacturer’s 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. ***Micro control device*** may include but not limited to: | * micro controllers: Arduino, ESP. * microprocessors: Raspbery PI, Intel I5, AMD, |
| 1. ***Personal Computer (PC) software*** may include but not limited to: | * Arduino IDE * VSCODE * Espressif IDE |
| 1. ***Programming Languages*** may include but not limited to: | * Python * C++ * C# * NodeRed * Java |
| 1. ***I/O Modules*** may include but not limited to: | * Input cards * Output cards * Sensors * Relays |
| 1. ***Linking interface*** may include but not limited to: | * Ethernet * Profibus * Modbus * WiFi * Bluetooth * LoRa |
| 1. ***Controller system test*** may include but not limited to: | * Continuity * Polarity * Earth-loop * System response |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

* Digital literacy
* The manufacturer's warranty requirements relating to micro control 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;
* Materials management
* 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
* Financial statements

**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. Determined micro control deviceto be usedas per job requirement.   2. Customized controller as per job specification.   3. Ran selected controller software as per manufacturer’s manual.   4. Performed controller programming based on job requirement.   5. Interfaced micro control system.   6. Performed controller system test and inspection. |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work environments.   3. Resources relevant to the proposed activities or task |
| 1. Methods of Assessment | Competency may be assessed through:   1. Practical Test 2. Project 3. Third party report 4. Portfolio of evidence 5. Written tests 6. Oral Questioning |
| 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. |

## PERFORM ELECTRICAL MEASUREMENT AND FAULT DIAGNOSIS

**UNIT CODE: 0713 541 20A**

**UNIT DESCRIPTION**

This unit covers competences required to perform electrical measurement and fault diagnosis. Competences include applying electrical measurement instruments, applying waveform analysing instruments, applying sensors and transducers and calibrating measurement instruments.

**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. Apply electrical measurement instruments | 1. Health and safety procedures are applied in accordance to work requirement. 2. ***Electrical quantities*** are recorded based on job specifications 3. Electrical units are selected as per the instruments operating standards. 4. Measurement standards are applied as per international bureau of weights and standards. 5. Measuring instruments are selected based on their functionality. 6. Electrical measuring instruments are applied as per job requirements. 7. Analogue to digital converters is applied based on their job specifications. 8. measurement is recorded as per the instrument’s reading. 9. ***Performance characteristics*** are recorded based on job specifications. |
| 1. Apply waveform analysing instruments | * 1. Health and safety procedures are applied in accordance to work requirement.   2. Waveforms are identified based on job specifications.   3. ***Waveforms Analyzing instruments*** are selected as per job specifications.   4. Operation of waveforms analyzing instruments is performed based on manufacturer’s specifications.   5. Performance of a waveforms analyzing instruments is determined based on its operation. |
| 1. Apply sensors and transducers | * 1. ***Sensors and transducers*** are selected as per their functionality.   2. Sensors and transducers are applied in line with their specifications.   3. Signal processors are selected based on their processing ratings.   4. Signal processors are applied as per work procedure.   5. Obtained data is applied as per job specification. |
| 1. Calibrate measurement instruments | * 1. Health and safety procedures are applied in accordance to work requirement.   2. Measuring instrument initial values are recorded per work procedure.   3. ***Measuring instrument*** is integrated with calibration instrument as per work procedure   4. Physical variable is sourced from calibrator in accordance to work procedure.   5. Measuring instrument current Physical variable values are recorded per work procedure.   6. ***Measurement Error*** is calculated from the readings as per work procedure.   7. Reading from the calibrated instrument is reset to zero error in accordance to work procedure.   8. Reading from the calibrated instrument is reset to span error in accordance to work procedure.   9. ***Calibration documentations*** are prepared as per work specification. |

**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. ***Measurement Quantities*** may include but not limited to: | * Flow rate * Pressure * Temperature * Level * Mass * Time * Frequency * Speed * Energy |
| 1. ***Calibrator*** may include but not limited to: | * Signal generators * Decade box * Dead weight tester * Pressure calibrator * Oscilloscope * Temperature Path * Data Logger |
| 1. ***Calibration documentations*** may include but not limited: | * Traceability table * Repeatability table * Calibration Certificate * Equipment tag |
| 1. ***Measuring instrument*** may include but not limited: | * Voltmeter * Ammeter * Galvanometer * Multimeter |
| 1. ***Sensors and transducers*** may include but not limited: | * Proximity * Inductive * Thermocouple * Resistant temperature detector * Piezo Electric transmitters * Load cells * Linear voltage differential transmitter * Encoders |
| 1. ***Waveforms Analyzing instruments*** may ***i***nclude but not limited to: | * Oscilloscope * Spectrum Analyzer |
| 1. ***Performance characteristics*** may include but not limited to: | * Precision * Accuracy * Resolution * Tolerance |
| 1. ***Measurement standards*** may include but not limited to: | * SI * MKS |
| 1. ***Electrical quantities*** may include but not limited to: | * Current * Voltage * Power * Resistance * Capacitance * Inductance |
| 1. ***Measurement Error*** may include but not limited to: | * Parallax * Relative * Systematic * Instrumental * Environmental * Random * Absolute |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required skills**

The individual needs to demonstrate the following skills:

* Electrical Installation
* Wiring systems
* Troubleshooting
* Survey and data capture
* Electrical system testing
* Interpretation of maintenance manuals
* Problem solving
* Use of electrical & mechanical tools
* Analytical
* First aid
* Planning
* Communications
* Digital literacy
* Time management
* Report writing
* Decision making
* Soldering

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Various laws in electrical engineering
* Safety procedures and practices
* Electrical symbols and their meanings
* Electrical standards
* Digital and analogue instruments
* Analogue electronics
* Digital electronics
* Instrumentation and calibration
* Sensors and transducers
* Physical quantities
* Measurement

**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 health and safety procedures in accordance to work requirement.   2. Applied Electrical measuring instruments as per job requirements.   3. Performed operation of waveforms analyzing instruments based on manufacturer’s specifications.   4. Applied sensors and transducers are in line with their specifications.   5. Applied signal processors as per work procedure.   6. Integrated measuring instrument with calibration instrument as per work procedure.   7. Reset reading from the calibrated instrument in accordance to work procedure. |
| 1. Resource Implications | The following resources must be provided:   * 1. Access to relevant assessment environment   2. Resources relevant to the proposed assessment activity or tasks |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Practical demonstration   2. Written assessment   3. Report writing   4. Project   5. Portfolio of evidence   6. Third-party reports |
| 1. Context of Assessment | Competency may be assessed individually in the actual workplace or simulated setting of the actual work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY RESEARCH METHODS

**UNIT CODE: 0111 541 21A**

**UNIT DESCRIPTION**

This unit covers competences required to apply research methods. Competences includes identifying research problem, conducting literature review, developing research methodology, analysing collected data and preparing research report.

**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. Identify research problem | * 1. Background information is developed as per identified research problem   2. Statement of problem is developed as per background information   3. Research variables are identified as per research problem   4. Objectives are stated as per goals of research   5. Research questions are derived as per research objectives   6. Significance of research is derived from goals of research   7. Scope of study is established as per identified limitations |
| 1. Conduct literature review | * 1. Sources of literature review are identified as per research objectives   2. Key words and phrases are listed based on literature review guidelines.   3. Proposed references are summarized as per ethical research guidelines   4. Collected literature is organized and reported as per ethical research guidelines |
| 1. Develop Research Methodology | * 1. Research designs are identified as per organization research policy   2. Study population is identified based on research gaps   3. Sampling procedures are determined based on scope of the study   4. Sample population is attained for the study as per scope of the study   5. Required tools are developed according to organization research policy   6. Tools are tested according to ethical research guidelines   7. Research proposal is prepared as per National Research Fund Policy   8. Research proposal budget is prepared as per the organization   9. Certificates are obtained as per NACOSTI guidelines |
| 1. Analyze collected data | * 1. Respondents are oriented to data collection methods organization research policy   2. Data collection methods are identified and designed as per organizational research guidelines   3. Data collection is carried out based on organizational research guidelines   4. Data is cleaned as per organizational research guidelines   5. ***Data analysis tool*** is prepared as per organization research policy   6. Data analysis is conducted as per organization research policy   7. Analyzed data is presented as per research findings. |
| 1. Prepare research report | * 1. Research findings are discussed as per research questions   2. Conclusions are drawn based on the findings for each objective   3. Recommendations are derived from research findings   4. Cited References are listed as per ***referencing systems.***   5. Appendices are attached as per research guidelines   6. Report is shared or disseminated as per organization research policy |

**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. ***Data analysis tools*** may include but not limited to: | * Excel * Tableau * R * SQL |
| * + - 1. ***Referencing systems*** may include but not limited to: | * APA * MLA * Havard |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

* Types of research
* Communications (verbal and written);
* Proficient in logistic management;
* Time management;
* Meeting organization;
* Analytical
* Planning;
* Decision making
* Report writing;
* Problem solving;
* Management
* Digital literacy

**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. Identified research problem. 2. Conducted literature review. 3. Developed research Methodology. 4. Analyzed collected data. 5. Prepared research report. |
| 1. Resource Implications | The following resources should be provided:   1. Appropriately simulated environment where assessment can take place. 2. Access to relevant work environments. 3. Resources relevant to the proposed activities or task. |
| 1. Methods of Assessment | Competency may be assessed through:   1. Practical 2. Demonstration 3. Projects 4. Written tests 5. Oral test |
| 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. |

**SUPERVISE ELECTRICAL PROJECT**

**UNIT CODE:** **0713 551 22A**

**UNIT DESCRIPTION**

This unit covers competences required to manage an electrical project. Competences include preparing work schedule, preparing safety work plan, leading project teams, supervising materials tools and equipment, monitoring project implementation and commissioning electrical project.

**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 work schedule | | * 1. Scope of the work is determined as per the project work plan.   2. Required ***resources*** are identified as per project work plan.   3. Tasks are identified as per the project work plan.   4. Project logistics are identified as per project work plan.   5. Project organization structure is developed as per project work plan.   6. Policies are developed as per organization procedures.   7. Time span is determined as per complexity of the project. | |
| 1. Prepare safety work plan | | * 1. Risks are identified as per the nature of the project.   2. Risk analysis is conducted as per the nature of the project.   3. Risk mitigation plans are determined as per nature of the project. | |
| 1. Lead Project teams | | * 1. Project team is identified as per project work plan and area of specialization.   2. Job descriptions of the team are developed as per project work plan.   3. Objectives of the project are communicated to the team as per project policies.   4. Project activities are delegated in line with organization procedure.   5. OSHA and EHS are adhered to as per nature of the project.   6. Project team is trained on project activities as per nature of the project.   7. Teams are directed on the expected output as per work schedule and project requirements. | |
| 1. Supervise materials, tools and equipment | | * 1. Tools, materials and equipment are identified as per project activities.   2. Auditing of tools, materials and equipment is performed as per scope of the project.   3. Tools, material and equipment inventory system is developed as per nature of the project.   4. Tools, materials and equipment’s are classified as per project activities.   5. Tools, materials and equipment are maintained in line with project policies.   6. EHS standards are adhered to in line work place procedures | | |
| 1. Monitor project implementation | | * 1. Monitoring tools are prepared as the project work plan.   2. Project activities are monitored as per project monitoring tools.   3. Quality of work is assessed as per project requirements.   4. Short range action steps are planned for as per project activities.   5. Project progress is evaluated as per project work plan.   6. Monitoring report is prepared as the project progress. | | |
| 1. Commission electrical project | | * 1. Commissioning panel is constituted as per the project requirement.   2. Commissioning program is developed as per the project requirement.   3. Safety procedures are adhered to as per OSHA standards.   4. Documents are prepared as per organization procedures.   5. Report is shared with relevant parties as per organization procedures.   6. End-user is trained as per electrical system manuals. | | |

**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***. Resources*** may include but is not limited to: | * Finance * Personnel * Consultancy * Materials * Tools * Storage facilities * Buildings |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

The individual needs to demonstrate knowledge and understanding of:

* Organizational and legislative requirements including:
  + The manufacturer's warranty requirements relating to project management activities
  + The legal and statutory requirements relating to project management.
* Workplace procedures relevant to:
  + health and safety;
  + the environment (including waste disposal);
  + appropriate personal and protective equipment;
* Workplace procedures for:
  + Appropriate use of tools and equipment;
  + Recording project activities
  + Project quality control evaluation process
  + Reporting of technical challenges
* The importance of documenting project implementation report
* The importance of working within agreed timelines and sharing progress reports.
* The relationship between time and costs.
* The importance of reporting anticipated delays to relevant parties promptly.
* The use of technical information including:
  + How to find, interpret and use sources of technical information for project activities
  + The importance of using the correct sources of technical information.

**FOUNDATION SKILLS**

The individual needs to demonstrate the following foundation skills:

* Communications (verbal and written);
* Proficient in ICT;
* Time management;
* Analytical
* Faults troubleshooting;
* Problem solving;
* Planning;
* Decision making;
* First aid;
* Report writing;
* Project 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. Identified required resources as per project work plan. 2. Determined Time span as per complexity of the project. 3. Prepared safety work plan 4. Developed Job descriptions of the team as per project work plan. 5. Trained Project team on project activities as per nature of the project. 6. Directed Teams on the expected output as per work schedule and project requirements. 7. Identified tools, materials and equipment as per project activities. 8. Developed Tools, material and equipment inventory system as per nature of the project. 9. Maintained Tools, materials and equipment in line with project policies. 10. Prepared Monitoring tools as the project work plan. 11. Project activities are monitored as per project monitoring tools. 12. Evaluated Project progress is per project work plan. 13. Prepared Monitoring report as the project progress. 14. Developed commissioning program as per the project requirement. 15. Prepared commissioning documents as per organization procedures. |
| 1. Resource Implications | The following resources should be provided:  2.1 Appropriately simulated environment where assessment can take place.  2.2 Access to relevant work environments.  2.3 Resources relevant to the proposed activities or task. |
| 1. Methods of Assessment | Competency may be assessed through:   1. Practical demonstration 2. Projects 3. Written tests 4. Oral test |
| 1. Context of Assessment | Competency may be assessed individually in the actual workplace or through a simulated work place setting |
| 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 PVC SHEATHED CABLE SYSTEM**

**UNIT CODE:** **0713 551 23A**

**UNIT DESCRIPTION**

This unit specifies competences required for installing PVC sheathed cable system. The competences include identifying cables and accessories, making cable joints, Interpreting electrical symbols and fixing electrical accessories.

**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. Identify cables and accessories | * 1. Safety measures are applied as per OSHA and EHS standards.   2. Electrical cable colour code is identified as per IEC standards.   3. Electrical ***cable sizes*** are identified as per IEC standards   4. ***Electrical accessories*** are identified as per IEC standards. | |
| 1. Make cable joints | * 1. Safety measures are applied as per OSHA and EHS standards.   2. Electrical tools and equipment are selected as per work requirement.   3. ***Electrical cable joints*** are prepared as per IEC standards.   4. ***Housekeeping activities*** are performed as per the work requirement. | |
| 1. Interpret electrical symbols | * 1. Electrical symbols are sketched as per established standards.   2. Wiring diagrams are drawn as per the work requirement   3. Electrical components are identified as per the drawing | |
| 1. Fix electrical accessories | * 1. Safety measures are applied as per OSHA and EHS standards.   2. Electrical single-phase intake point is installed as per IET regulation.   3. ***Electrical final circuits*** are installed as per design requirement.   4. ***Housekeeping activities*** are performed as per the 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. Electrical cable joints include but is not limited to: | * Britannia * Married * Tee * Straight twist * Scarf |
| 1. Electrical accessories and fittings include but is not limited to: | * Sockets * Switches * Lamp holders * Junction boxes * Pattress * Couplers * Circuit breakers * Plugs |
| 1. Cable sizes may include but not limited to: | * 1.0mm2 * 1.5 mm2 * 2.5 mm2 * 4.0 mm2 * 6.0 mm2 |
| 1. Electrical final circuits may include but is not limited to: | * Lighting * Power |
| 1. Housekeeping activities may include but not limited to: | * General cleanliness * Tools and equipment storage |

**REQUIRED KNOWLEDGE**

The individual needs to demonstrate knowledge of:

* Units of measurement and abbreviations
* Work sequence
* Electrical materials
* Tools and equipment

**REQUIRED SKILLS**

* Communication skills
* Negotiation skills
* Digital literacy
* Waste disposal
* Occupational safety and health practices

**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. Identified electrical cable colour code as per IEC standards. 2. Identified electrical cable sizes as per IEC standards 3. Identified electrical accessories as per IEC standards 4. Applied safety measures as per OSHA and EHS standards. 5. Selected electrical tools and equipment as per work requirement. 6. Drew Wiring diagrams as per the work requirement 7. Prepared electrical cable joints as per IEC standards. 8. Installed electrical single-phase intake point as per IET regulation. 9. Installed electrical final circuits as per design requirement. |
| 1. Resource Implications | The following resources should be provided:  2.1 Appropriately simulated environment where assessment can take place.  2.2 Access to relevant work environments.  2.3 Resources relevant to the proposed activities or task |
| 1. Methods of Assessment | Competency may be assessed through:  3.1 Practical  3.2 Projects  3.3 Written tests  3.4 Oral questions  3.5 Portfolio of evidence  3.6 Third party evidence |
| 1. Context of Assessment | * + 1. Competency may be assessed in a work place or a simulated work place. |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

**INSTALL TRUNKING SYSTEM**

**UNIT CODE:** **0713 551 24A**

**UNIT DESCRIPTION**

This unit covers competences required in installing trunking system. The competences include identifying trunking accessories, preparing trunking work pieces, mounting trunking work pieces and installing electrical cables and accessories.

**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. Identify trunking accessories | * 1. ***Trunking types*** are identified as per IEC standards.   2. ***Trunking sizes*** are identified as per IEC standards.   3. Trunking accessories are identified as per IEC standards |
| 1. Prepare trunking work pieces | * 1. Safety measures are applied as per OSHA and EHS standards   2. ***Electrical tools*** ***and equipment*** are selected as per work requirement   3. Measurements are taken as per work requirement.   4. Trunking work pieces are cut as per the measurements.   5. ***Housekeeping activities*** are performed as per the work requirement. |
| 1. Mount trunking work pieces | * 1. Safety measures are applied as per OSHA and EHS standards.   2. Mounting points are marked out as per IEC standards   3. Trunking work pieces are mounted as per the IEC standards.   4. ***Housekeeping activities*** are performed as per the work requirement. |
| 1. Install electrical cables and accessories | * 1. Safety measures are applied as per OSHA and EHS standards.   2. Electrical cable colour code is identified as per IEC standards.   3. Electrical ***cable sizes*** are identified as per IEC standards.   4. Cables are laid as per the IEC standards.   5. Accessories are fixed as per IEC standards.   6. ***Housekeeping activities*** are performed as per the work requirement. |
| 1. Perform Tests and Inspection | * 1. Visual inspection is performed as per work requirements   2. Continuity test is performed as per IEC standards   3. polarity test is performed as per IEC standards |
| 1. Promote Ethical Work Practices and Values | * 1. Personal management is demonstrated through self-awareness, self-esteem, emotional intelligence, stress management and assertiveness based on scope of work.   2. Policies and guidelines are observed as per the workplace requirement.   3. Self-worth and professionalism is exercised in line with personal goals and organizational policies   4. Code of conduct is observed as per the workplace requirement.   5. Teamwork is applied as per work place rConflicts are resolved between team members in line with organization policy. |

**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. Trunking types may include but not limited to: | * PVC * Metallic * Galvanized iron |
| 1. Trunking sizes may include but not limited to: | * 16mm x 16mm * 25mm x 16mm * 25mm x 25mm * 40mm x 25mm |
| 1. Electrical tools and equipment may include but is not limited to: | * Cutting tools * Fastening tools * Measuring tools * Marking tools * Measuring instruments |
| 1. Cable sizes may include but not limited to: | * 1.0mm2 * 1.5 mm2 * 2.5 mm2 * 4.0 mm2 * 6.0 mm2 |
| 1. Housekeeping activities may include but not limited to: | * General cleanliness * Tools and equipment storage |

**REQUIRED KNOWLEDGE**

The individual needs to demonstrate knowledge of:

* Units of measurement and abbreviations
* Work sequence
* Electrical materials
* Tools and equipment

**REQUIRED SKILLS**

**•** Communication skills

• Negotiation skills

• Digital literacy

• Waste disposal

• Occupational safety and health practices

**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. Identified trunking types as per IEC standards. 2. Applied safety measures as per OSHA and EHS standards 3. Cut trunking work pieces as per the measurements. 4. Mounted trunking work pieces as per the IEC standards. 5. Laid cables as per the IEC standards. 6. Fixed accessories as per IEC standards. 7. Performed Continuity test as per IEC standards 8. Code of conduct is observed as per the workplace requirement. |
| 1. Resource Implications | The following resources should be provided:  2.1 Appropriately simulated environment where assessment can take place.   * 1. Access to relevant work environments.   2.3 Resources relevant to the proposed activities or task. |
| 1. Methods of Assessment | Competency may be assessed through:   * Practical * Projects * Written tests * Oral questions * Portfolio of evidence * Third party evidence |
| 1. Context of Assessment | Competency may be assessed in a work place or a simulated work place. |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

**INSTALL CONDUIT SYSTEM**

**UNIT CODE:** **0713 551 25A**

**UNIT DESCRIPTION**

This unit covers competences required in installing conduit system. The competences include identifying conduit accessories, preparing conduit work pieces, mounting conduit work pieces and installing electrical cables and accessories.

**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. Identify conduit accessories | * 1. ***Conduit types*** are identified as per IEC standards.   2. ***Conduit sizes*** are identified as per IEC standards.   3. Conduit accessories are identified as per IEC standards |
| 1. Prepare conduit work pieces | * 1. Safety measures are applied as per OSHA and EHS standards   2. ***Electrical tools and equipment*** are selected as per work requirement   3. Measurements are taken as per work requirement.   4. Conduit work pieces are cut as per the measurements.   5. ***Housekeeping activities*** are performed as per the work requirement. |
| 1. Mount conduit work pieces | * 1. Safety measures are applied as per OSHA and EHS standards.   2. Mounting points are marked out as per IEC standards.   3. Conduit work pieces are mounted as per the IEC standards.   4. ***Housekeeping activities*** are performed as per the work requirement. |
| 1. Install electrical cables and accessories | * 1. Safety measures are applied as per OSHA and EHS standards.   2. Electrical cable colour code is identified as per IEC standards.   3. Electrical ***cable sizes*** are identified as per IEC standards.   4. Cables are drawn as per the IEC standards.   5. Accessories are fixed as per IEC standards.   6. ***Housekeeping activities*** are performed as per the work requirement. | |
| 1. Perform Tests and Inspection | * 1. Visual inspection is performed as per work requirements   2. Continuity test is performed as per IEC standards   3. Polarity test is performed as per IEC standards | |
| 1. Apply Entrepreneurial Skills | 1. Personal finances are managed as per financial procedures and standards 2. Savings are managed as per financial procedures and standards 3. Sources of personal and business funds are identified as per financial procedures and standards 4. Salaried employment and self-employment are distinguished as per principles of entrepreneurship 5. Requirements for entry into self-employment are identified according to business procedures and standards 6. Regulatory requirements when starting a small business are identified as per business procedures and standards   Business planning is undertaken as per resource implications and regulatory framework | |

**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. Conduit types may include but not limited to: | * Metallic * PVC |
| 1. Conduit sizes may include but not limited to: | * 20mm2 * 25mm2 * 32mm2 |
| 1. Electrical tools and equipment may include but is not limited to: | * Cutting tools * Fastening tools * Measuring tools * Marking tools * Measuring instruments |
| 1. Cable sizes may include but not limited to: | * 1.0mm2 * 1.5 mm2 * 2.5 mm2 * 4.0 mm2 * 6.0 mm2 |
| 1. Housekeeping activities may include but not limited to: | * General cleanliness * Tools and equipment storage |

**REQUIRED KNOWLEDGE**

* The individual needs to demonstrate knowledge of:
* Units of measurement and abbreviations
* Work sequence
* Electrical materials
* Tools and equipment

**REQUIRED SKILLS**

• Communication skills

• Negotiation skills

• Digital literacy

• Waste disposal

• Occupational safety and health practices

**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. Identified conduit types as per IEC standards. 2. Identified conduit accessories as per IEC standards. 3. Applied safety measures as per OSHA and EHS standards. 4. Cut conduit work pieces as per the measurement. 5. Mounted conduit work pieces as per the IEC standards. 6. Drawn cables as per the IEC standards. 7. Fixed accessories as per IEC standards 8. Performed Continuity test as per IEC standards 9. Identified Sources of personal and business funds as per financial procedures and standards |
| 1. Resource Implications | The following resources should be provided:   1. Appropriately simulated environment where assessment can take place. 2. Access to relevant work environments. 3. Resources relevant to the proposed activities or task |
| 1. Methods of Assessment | Competency may be assessed through:  3.1 Practical  3.2 Projects  3.3 Written tests  3.4 Oral questions  3.5 Portfolio of evidence  3.6 Third party evidence |
| 1. Context of Assessment | Competency may be assessed in a work place or a simulated work place. |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

**INSTALL** **STAND-ALONE SOLAR PV SYSTEMS**

**UNIT CODE:** 0713 551 26A

**UNIT DESCRIPTION**

This unit covers competences required in installing stand-alone solar PV system. Competences include Applying basic electrical concepts, interpreting stand-alone solar PV Installation drawings, installing stand-alone Solar PV components, installing electrical wiring system, testing stand-alone solar PV system installation.

**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. Apply basic electrical concepts | | * 1. Basic SI units in Electrical are identified based on scope of work.   2. Quantities of Charge, force, work and power are identified as per IEC standards.   3. Calculations involving Ohm’s law i.e. Current, Resistance and voltage are performed as per IEC standards.   4. Calculations involving various electrical quantities are performed based on IEC standards. | |
| 1. Interpret stand-alone Solar PV Installation drawings | | * 1. Electrical symbols are identified as per IEC standards.   2. Wiring system is mapped as per design.   3. Final circuits drawing is interpreted as per design requirement. | |
| 1. Install stand-alone Solar PV Components | | * 1. Safety measures are applied as per work requirement.   2. Electrical tools and equipment are selected as per work requirement.   3. ***Solar PV system components*** are identified as per design requirement.   4. Solar PV system components are mounted as per design requirement. | |
| 1. Install electrical wiring system | | 1. ***Electrical cable joints*** and termination are prepared as per design requirement. 2. ***Electrical accessories and fittings*** are identified as per design requirement. 3. ***Cable management systems*** are installed as per design requirement. 4. ***Electrical final circuits*** are installed as per design requirement. 5. Solar PV system components are terminated as per design requirement. | |
| 1. Test stand-alone solar PV system installation | | 1. Solar PV system conditions are visually inspected as per IET regulations. 2. Continuity test is carried out as per IET regulation. 3. Insulation resistance test is carried out as per IET regulations. 4. Polarity test is carried out as per IET regulations. 5. Earth resistance tests are carried out as per IET regulations. | |
| 1. Maintain stand-alone Solar PV system | | 1. Solar PV system is inspected as per IET regulations. 2. Maintenance materials and tools are prepared as per the maintenance strategy requirement. 3. ***Solar pv system maintenance activities*** are carried out as per IEC standards. 4. Solar PV system tests are carried out as per IEC standards. 5. Maintenance records are updated as per maintenance strategy. | |

**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. ***Solar PV system components*** may include but not limited to: | * PV module * Charge controller * Solar batteries * Solar inverters |
| 1. ***Electrical cable joints*** may include but not limited to: | * Britannia * Married * Tee * Straight twist * scarf |
| 1. **Electrical accessories and fittings** may include but not limited to: | * Sockets * Switches * Lamp holders * Junction boxes * Pattress * Couplers * Circuit breakers * Plugs |
| 1. ***Cable management systems*** may include but not limited to: | * Cable trays * Cable duct * Bus-bars * Sheath/surface * Conduits * Trunking |
| 1. ***Electrical final circuits*** may include but not limited to: | * Lighting * Power |
| 1. ***Solar pv system maintenance activities*** may include but not limited to | * Cleaning * Topping up batteries * Loose connections |

**REQUIRED KNOWLEDGE**

The individual needs to demonstrate knowledge of:

* Technical drawing
* Numeracy skills
* Workshop technology
* IEE regulations
* Electrical Technology
* Renewable energy
* Building codes

**FOUNDATION SKILLS**

* Communication skills
* Digital literacy
* Entrepreneurial skills
* Employability skills
* Environmental literacy
* Occupational safety and health practices
* Interpret electrical drawing
* Identification and proper use of electrical tools

**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. Performed Calculations involving various electrical quantities based on IEC standards. 2. Interpreted final circuits drawing as per design. 3. Applied Safety measures as per work requirement. 4. Mounted solar PV system components as per design requirement. 5. Installed Cable management system as per design requirement. 6. InstalledElectrical final circuitsas per design requirement. 7. Terminated solar PV system components as per design requirement. 8. Installed Earthing and protection systems as per acceptable standards. 9. Carried out electrical installation testing as per IET regulations. 10. Carried out Maintenance activities as per IET regulations. |
| 1. Resource Implications | The following resources should be provided:  2.1 Appropriately simulated environment where assessment can take place.  2.2 Access to relevant work environments.  2.3 Resources relevant to the proposed activities or task |
| 1. Methods of Assessment | Competency may be assessed through:   * Practical demonstration * Projects * Written tests * Oral test |
| 1. Context of Assessment | Competency may be assessed in a work place or a simulated work place. |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

**PERFORM BELL AND ALARM INSTALLATION**

**UNIT CODE:** 0714 551 27A

**UNIT DESCRIPTION**

This unit covers the competencies required in perform bell and alarm installation. Competencies include interpreting bell and alarm installation drawings, installing bell and alarm wiring system, installing bell and alarm components, testing bell and alarm installation and maintaining bell and alarm installation.

**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. Interpret Bell and alarm Installation drawings | | 1. Bell and alarm symbols are identified as per IEC standards. 2. Wiring system is mapped as per design. 3. Bell and alarm circuits drawing is interpreted as per design requirement. |
| 1. Install bell and alarm wiring system | | * 1. Safety measures are applied as per work requirements.   2. Electrical tools and equipment are selected as per work requirement.   3. ***Electrical cable joints*** and termination are prepared as per design requirement.   4. ***Bell and alarm accessories and fittings*** are identified as per design requirement.   5. ***Cable management system*** is installed as per design requirement.   6. Bell and alarm systems are installed as per design requirement. |
| 1. Install Bell and Alarm Components | | 1. ***Bell and alarm components*** are identified as per design requirement. 2. Electrical power supply is installed as per design requirement. 3. Bell and alarm components are installed as per design requirement. |
| 1. Test Bell and Alarm installation | | * 1. Bell and alarm system conditions are visually inspected as per IET regulations.   2. Continuity test is carried out as per IET regulation.   3. Insulation resistance test is carried out as per IET regulations.   4. Polarity test is carried out as per IET regulations.   5. Earth resistance tests are carried out as per IET regulations. | |
| 1. Maintain Bell and Alarm installation | | * 1. Bell and alarm systems are inspected as per IET regulations.   2. Maintenance materials and tools are prepared as per the maintenance strategy requirement.   3. ***Bell and alarm system Maintenance activities*** are carried out as per IET regulations.   4. System tests are carried out as per IET regulations.   5. Maintenance records are updated as per maintenance strategy. | |

**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 cable joints*** may include but not limited to: | * Britannia * Married * Tee * Straight twist * scarf |
| 1. ***Bell and alarm components*** may include but not limited to: | * Bell transformers * Indicator board * Bell bushes * Bell relays * Control panel * Sounders * Buzzers * Bell * Hooters * Sirens |
| 1. ***Bell and alarm accessories and fittings*** may include but not limited to: | * Switches * Junction boxes * Pattress * Couplers * Circuit breakers * Plugs |
| 1. ***Cable management systems*** may include but not limited to: | * Cable trays * Cable duct * Bus-bars * Sheath/surface * Conduits * Trunking |
| 1. ***Bell and alarm system Maintenance activities*** may include but not limited to: | * Cleaning * Loose connections |

**REQUIRED KNOWLEDGE**

The individual needs to demonstrate knowledge of:

* Technical drawing
* Numeracy skills
* Workshop technology
* IEE regulations
* Electrical Technology
* Renewable energy
* Building codes

**FOUNDATION SKILLS**

* Communication skills
* Digital literacy
* Entrepreneurial skills
* Employability skills
* Environmental literacy
* Occupational safety and health practices
* Interpret electrical drawing
* Identification and proper use of electrical tools

**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. Interpreted Bell and alarm circuits drawing as per design requirement 2. Applied safety measures as per work requirement. 3. Installed cable management system as per design requirement. 4. Identified bell and alarm components as per design requirement. 5. Installed bell and alarm systemsas per design requirement. 6. Installed electrical power supply as per design requirement. 7. Installed bell and alarm componentsas per design requirement. 8. Carried out electrical installation testing as per IET regulations. 9. Carried out Maintenance activities as per IET regulations. |
| 1. Resource Implications | The following resources should be provided:  2.1 Appropriately simulated environment where assessment can take place.  2.2 Access to relevant work environments.  2.3 Resources relevant to the proposed activities or task |
| 1. Methods of Assessment | Competency may be assessed through:   1. Practical demonstration 2. Projects 3. Written tests 4. Oral test |
| 1. Context of Assessment | Competency may be assessed in a work place or a simulated work place. |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

**WIND ELECTRICAL MACHINE**

**UNIT CODE:** 0713 551 28A

**UNIT DESCRIPTION**

This unit specifies the competencies required for winding electrical machines. The competencies include; Disassembling rotating electrical machines, Installing Machine winding, assembling rotating electrical machines and performing electrical machine testing

**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. Disassemble rotating electrical machine | * 1. Safety measures are applied as per work requirement.   2. Winding data is recorded as per machine design   3. ***Machine parts*** are disassembled as per work procedure. | |
| 1. Install machine winding | * 1. Safety measures are applied as per work requirement.   2. Rotating machine parts are cleaned as per work procedure.   3. Coil windings are prepared as per work requirement.   4. Coil windings are laid in stator slots as per work requirement.   5. Stator windings are***cured*** as per IEC standards. | |
| 1. Assemble rotating electrical machine | * 1. Rotor and stator are aligned as per machine design   2. Bolts and nuts are fastened as per the machine design   3. Bearings are fitted as per machine design   4. Bearing are lubricated as per work requirements | |
| 1. Perform electrical machine testing | * 1. Continuity test is performed as per IEC standards   2. Polarity test is performed as per IEC standards   3. Insulation resistance test is performed as per IEC standards   4. Voltage and current balance test is performed as per IEC standards   5. ***Housekeeping activities*** are carried as per work requirements | |

**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. Machine parts include but is not limited to: | * End caps * Fan * Rotor * Armature * Stator * Conductors * Bearings |
| 1. Cure include: | * Dry * Varnish * Bake |
| 1. Housekeeping activities may include but not limited to: | * General cleanliness * Tools and equipment storage |

**REQUIRED KNOWLEDGE**

The individual needs to demonstrate knowledge of:

* Units of measurement and abbreviations
* Work sequence
* Electrical materials
* Tools and equipment

**REQUIRED SKILLS**

• Communication skills

• Negotiation skills

• Digital literacy

• Waste disposal

• Occupational safety and health practices

**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 safety measures as per work requirement. 2. Disassembled machine parts as per work procedure. 3. Cured static machine windings as per IEC standards 4. Laid Coil windings in stator slots as per work requirement. 5. Assembled rotating electrical machine 6. Performed electrical tests as per IEC standards. |
| 1. Resource Implications | The following resources should be provided:  2.1 Appropriately simulated environment where assessment can take place.  2.2 Access to relevant work environments.  2.3 Resources relevant to the proposed activities or task. |
| 1. Methods of Assessment | Competency in this unit may be assessed through:  3.1 Project  3.2 Practical  3.3 Portfolio of evidence  3.4 Third party report  3.5 Written assessment  3.6 Oral assessment |
| 1. Context of Assessment | Competency may be assessed in a work place or a simulated work place. |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## PERFORM ELECTRICAL INSTALLATION

**UNIT CODE:** 0713 551 29A

**UNIT DESCRIPTION**

This unit specifies competences required for performing electrical installation. Competences include conducting site survey, preparing electrical drawings, performing installation system sizing, installing electrical system, performing electrical installation testing, performing electrical installation maintenance and commissioning electrical installation.

**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. Conduct site survey | | 1. Health and Safety Procedures are adhered to as per work requirement. 2. Client needs are gathered as per organization requirements. 3. Site condition is assessed according to the established procedures. 4. Installation route is identified as per the standard operating procedure. 5. Survey report is prepared according to the established procedures. 6. Site survey report is shared with relevant parties as per organization procedures. | |
| 1. Prepare electrical drawings | | 1. Electrical symbols are applied as per ***established standards.*** 2. ***Wiring system*** is selected as per client’s need and site condition. 3. Final circuits concept/preliminary drawing is prepared as per client requirement and electrical convention standards. 4. Electrical drawing is submitted for approval as per organization procedures. | |
| 1. Perform installation system sizing | | 1. Load is estimated as per client requirements. 2. Protective devices are determined as per IET regulations. 3. Cable sizes are calculated according to IET regulations. 4. Accessories ratings are identified as per IET regulations. 5. Phase balancing is determined as per load requirement. 6. Working drawing is prepared as per the design. 7. BOQ is prepared according to the design. 8. Contract documents are prepared as per organization requirements | |
| 1. Install electrical system | | 1. Health and Safety Procedures are adhered to as per work requirement. 2. Tools, equipment and materials are acquired as per work plan. 3. ***Cable management systems*** are installed as per work requirement***.*** 4. Earthing and protection systems are installed as per work requirement***.*** 5. Cables and conductors are installed as perwork requirement***.*** 6. Cable lugging, glanding and termination is performed as per work requirement***.*** 7. Cables are labelled as per IET standards. 8. Accessories are installed as per working drawing and IET regulations. 9. Deviations are captured in as built drawing and shared with relevant parties. 10. ***Housekeeping practices*** are performed according to EHS and OSHA. | |
| 1. Perform electrical installation testing | | * 1. ***Visual inspection*** is conducted per IET regulations.   2. Firmness of the installation is confirmed.   3. Continuity test is performed as per IET regulation   4. Insulation resistance test is carried out as per IET regulations.   5. Polarity test is carried out as per IET regulations.   6. Earth resistance tests are carried out as per IET regulations.   7. Earth loop impedance tests are carried out as per IET regulations. | |
| 1. Perform electrical installation maintenance | | * 1. ***Maintenance strategy*** is developedas persystem functionality.   2. Maintenance schedule is prepared as per organization procedures.   3. Electrical equipment and system are inspected as per IET regulations.   4. Maintenance materials and tools are prepared as per the maintenance strategy requirement.   5. Maintenance activities are carried out as per IET regulations.   6. System tests are carried out as per IET regulations.   7. Maintenance records are updated as per maintenance strategy. | |
| 1. Commission electrical installation | | 1. ***Commissioning panel*** is constituted as per the project requirement. 2. ***Commissioning program*** is developed as per the project requirement. 3. Safety procedures are adhered to as per OSHA standards. 4. Functionality tests are carried out as per IET regulations. 5. ***Commissioning documents*** are prepared and shared with the relevant parties. 6. End-user is trained as per electrical system manuals. | |

**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. ***Established standards*** may include but not limited to: | * IEC Standards * IET regulations * IEEE standards |
| 1. ***Wiring system*** may include but not limited to: | * Sheath/surface * Conduits * Trunking * Duct |
| 1. ***Cable management systems*** may include but not limited to: | * Cable trays * Cable duct * Bus-bars |
| 1. ***Design*** may include but not limited to: | * Illumination * Generation of load schedule |
| 1. ***Housekeeping practices*** may include but not limited to: | * Disposal of waste * Cleaning * Tools storage * Reusing and recycling |
| 1. ***Visual inspection*** may include but not limited to: | * Color codes * Labelling * Termination |
| 1. ***Maintenance strategy*** may include but not limited to: | * Preventive/pro active * Breakdown/corrective/reactive * Scheduled |
| 1. ***Commissioning panel*** may include but not limited to: | * Client * Project managers * Technical engineer * Contractor * Other stakeholders e.g. supply authority |
| 1. ***Commissioning program*** may include but not limited to: | * Pre- commissioning inspection * Off load commissioning test program * Pre-energisation inspection * Post commissioning program |
| 1. ***Commissioning documents*** may include but not limited to: | * Management activities * Test reports * Commissioning report |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

The individual needs to demonstrate knowledge and understanding of: .

1. The legal requirements relating to activities for electrical power lines installations and components.
2. Legislation and workplace procedures relevant to:

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

1. Observe Country Government bylaws
   * + EPRA (Energy & Petroleum Regulatory Authority)
     + NEMA
     + KPLC Electrical Safety rules
2. The importance of documenting electrical systems installation information
3. The importance of working to agreed timelines
4. How to prepare, interpret and use sources of technical information for scheduled Electrical power lines construction works
5. The importance of using the correct sources of technical information.
6. The purpose of and how to use identification codes (e.g., colour codes).
7. Power system operation
8. The operating specifications and tolerances for different types of power systems components
9. The hazards associated with operating construction and operation of a power system.
10. Identification of users to be trained

**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;

**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. Adhered to health and safety procedures as per work requirement. 2. Assessed site condition according to the established procedures. 3. Prepared survey report according to the established procedures. 4. Applied electrical symbols as per established standards. 5. Selected wiring system as per client’s need and site condition. 6. Estimated load as per client requirements. 7. Determined protective devices as per IET regulations. 8. Identified accessories ratings as per IET regulations. 9. Prepared Working drawing as per the design. 10. Installed Earthing and protection systems as per acceptable standards. 11. Installed cables and conductors as per acceptable standards. 12. Performed electrical installation testing as per IEC standards. 13. Developed Maintenance strategy as per system functionality. 14. Carried out Maintenance activities as per IET regulations. 15. Developed Commissioning program as per the project requirement. 16. Prepared Commissioning documents and shared with the relevant parties. |
| 1. Resource Implications | The following resources should be provided:  2.1 Appropriately simulated environment where assessment can take place.  2.2 Access to relevant work environments.  2.3 Resources relevant to the proposed activities or task. |
| 1. Methods of Assessment | Competency may be assessed through:   1. Practical 2. Projects 3. Third party report 4. Portfolio of evidence 5. Written tests 6. Oral questioning |
| 1. Context of Assessment | * + 1. Competency may be assessed in a work place or a simulated work place. |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## INSTALL ELECTRICAL POWER LINES

**UNIT CODE:** 0713 551 30A

**UNIT DESCRIPTION**

This unit covers competences required in installing power system. Competences include conducting site survey, constructing electrical power lines, testing electrical power line and maintaining electrical power lines.

**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. Conduct site survey | | * 1. Health and Safety Procedures are adhered to as per work requirement.   2. Site conditions are assessed as per mapped location.   3. Tools and equipment are identified as per site condition.   4. ***Power line elements*** are identified as per the drawing.   5. Pole points are marked on the ground as per the drawing. | |
| 1. Design electrical power lines | | 1. Design Concept is developed as per load requirements. 2. Design concept is presented to client as per agreement. 3. Detailed drawing is developed as per load requirements. 4. BOQ is prepared as per design. 5. Contract documents are prepared as per organization requirements. | |
| 1. Construct electrical power lines | | * 1. Health and Safety Procedures are adhered to as per work requirement.   2. ***Power line supports*** are erected as per IEC standards.   3. Line fittings are mounted as per design   4. Line protection devices are installed as per design   5. Power line conductors are mounted as per design   6. Line terminations are carried out as per IEC standards   7. Earthing is carried out as per design.   8. Housekeeping practices are performed according to EHS and OSHA | |
| 1. Test electrical power lines | | * 1. Power line conditions are visually inspected as per IET regulations.   2. Line integrity is verified as per design specifications.   3. Earth resistance tests are conducted as per IET regulations | |
| 1. Maintain electrical power lines | | * 1. Maintenance scheduleis preparedas persystem requirement.   2. Electrical equipment and system is inspected as per IET regulations.   3. Maintenance materials and tools are prepared as per the maintenance strategy requirement.   4. Maintenance activities are carried out as per IET regulations.   5. Electrical power line tests are carried out as per IET regulations.   6. Maintenance records are updated as per maintenance strategy | |

**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. ***Power line elements*** may include but not limited to: | * Conductors * Insulators * Line supports * Cross arms * D-iron * Damper * Bolt and nuts |
| 1. ***Power line supports*** may include but not limited to: | * Wooden poles * Concrete (RRC) * Steel |
| 1. ***Line integrity*** may include but not limited to: | * Tension * Sag * Span size * Clearance/wayleave requirements |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

The individual needs to demonstrate knowledge and understanding of:-

1. The legal requirements relating to activities for electrical power lines installations and components.
2. Legislation and workplace procedures relevant to:

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

1. Observe Country Government bylaws
   * + EPRA (Energy & Petroleum Regulatory Authority)
     + NEMA
     + KPLC Electrical Safety rules
2. The importance of documenting electrical power line installation information
3. The importance of working to agreed timelines
4. How to prepare, interpret and use sources of technical information for scheduled Electrical power lines construction works
5. The importance of using the correct sources of technical information.
6. The purpose of and how to use identification codes (e.g., colour codes).
7. The operating specifications and tolerances for different types of power line construction components
8. The hazards associated with operating construction and operation of power line.
9. 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;

**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. Adhered to Health and Safety Procedures as per work requirement.   2. Assessed site conditions as per mapped location.   3. Detailed drawing is developed as per load requirements.   4. Erected Power line supports are as per IEC standards.   5. Mounted line elements as per design.   6. Installed Line protection devices as per design.   7. Carried out Earthing as per design.   8. Tested electrical power lines.   9. Prepared maintenance schedule as per system requirement.   10. Carried maintenance activity as per IET regulations.   11. Updated records as per maintenance strategy. |
| 1. Resource Implications | The following resources should be provided:  2.1 Appropriately simulated environment where assessment can take place.  2.2 Access to relevant work environments.  2.3 Resources relevant to the proposed activities or task. |
| 1. Methods of Assessment | Competency may be assessed through:   * Practical demonstration * Projects * Written test |
| 1. Context of Assessment | Competency may be assessed in a work place or a simulated work place. |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

**PERFORM ELECTRICAL MACHINE INSTALLATION**

**UNIT CODE:** 0713 551 31A

**UNIT DESCRIPTION**

This unit covers competences required in performing electrical machine installation. Competences include conducting site survey, installing electrical machine, testing electrical machine installation, commissioning electrical machine installation and maintaining electrical machine installation.

**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. Conduct site survey | | * 1. Health and Safety Procedures are adhered to as per work requirement.   2. ***Security issues*** are identified as per environment.   3. ***Utility services*** are identified as per existing design.   4. Work plan is prepared in accordance with regulatory requirements and organization procedures.   5. Machine installation layout is prepared as per site.   6. ***Cable management system*** is established as per IET regulations.   7. BOQ is prepared as per design.   8. Site survey report is prepared and shared with relevant parties according to the established procedures. | |
| 1. Install electrical machine | | * 1. Safety procedures are adhered to as per work requirement.   2. Materials, tools and equipment are assembled as per scope of installation.   3. Electrical machine support is constructed/set up as per design.   4. Mounting of the machine is carried out as per load, size and functionality.   5. ***Control gear*** is installed as per machine design.   6. Conduits, trunks, enclosures and support systems are installed as per layout diagram and IET regulations.   7. Cables and conductors are installed as per acceptable standards.   8. Cable lugging, glanding and termination is performed as per acceptable standards.   9. Cables are labelled as per IET standards.   10. ***Housekeeping practices*** are performed according to EHS and OSHA. | |
| 1. Test electrical machine installation | | * 1. Type of tests are identified as per IET regulations.   2. Visual inspection is carried out as per IET regulations.   3. Firmness of the installation is verified as per IET regulations.   4. Insulation resistance test is carried out as per IET regulations.   5. Continuity test is carried out as per IET regulations.   6. Earthling tests are carried out as per IET regulations.   7. On load and off load tests are carried out as per the manufacturer’s manual.   8. Test results are documented as per workplace requirements. | |
| 1. Maintain electrical machine installation | | * 1. ***Maintenance schedule*** is prepared as per OEMS and organization procedures.   2. System maintenance check list is prepared as per tasks and manufacturer’s manual.   3. Maintenance tools and equipment are selected as per scheduled maintenance.   4. Inspection and tests are carried out as per OEMS.   5. Faults are diagnosed as per service manual.   6. Faults are rectified as per service manual.   7. Maintenance report is prepared as per organization requirements***.*** | | |
| 1. Commission electrical machine installation | | * 1. End-user is trained as per system design functionality.   2. Operating manuals are handed over to the end user.   3. Report is prepared and shared with relevant parties.   4. Certificates are issued as per the national regulation. | | |

**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. ***Security issues*** may include but not limited to: | * Theft * Vandalism |
| 1. ***Utility services*** may include but not limited to: | * Electricity * Water * Road |
| 1. ***Cable management systems*** may include but not limited to: | * Cable trays * Cable ducts * Busbars |
| 1. ***Control gear*** may include but not limited to: | * DOL * Star delta * Forward reverse * Disconnect switches * Circuit breaker |
| 1. ***Housekeeping practices*** may include but not limited to: | * Disposal of waste * Cleaning * Tools storage * Reusing and recycling |
| 1. ***Maintenance schedule*** may include but not limited to: | * Preventive/pro active * Breakdown/corrective/reactive * Scheduled |

**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. The importance of documenting automation system installation information
3. The importance of working to agreed timelines
4. How to prepare, interpret and use sources of technical information for scheduled automation system installation activities
5. The importance of using the correct sources of technical information.
6. The purpose of and how to use identification codes (e.g., colour codes).
7. The operating specifications and tolerances for different types of installed systems
8. The hazards associated with operating the system.
9. 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;

**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. Adhered Health and Safety Procedures as per work requirement. 2. Prepared Machine installation layout as per site. 3. Established Cable management system as per IET regulations. 4. Constructed Electrical machine support as per design. 5. Carried out Mounting of the machine as per load, size and functionality. 6. Installed Control gear as per machine design. 7. Installed Cables and conductors as per acceptable standards. 8. Tested electrical machine installation. 9. Prepared and shared report with relevant parties. 10. Prepared Maintenance schedule as per OEMS and organization procedures. 11. Diagnosed Faults as per service manual. 12. Rectified Faults as per service manual. |
| 1. Resource Implications | The following resources should be provided:  2.1 Appropriately simulated environment where assessment can take place.  2.2 Access to relevant work environments.  2.3 Resources relevant to the proposed activities or task. |
| 1. Methods of Assessment | Competency may be assessed through:   1. Practical 2. Projects 3. Third party report 4. Portfolio of evidence 5. Written tests 6. Oral questioning |
| 1. Context of Assessment | Competency may be assessed in a work place or a simulated work place. |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

**INSTALL SOLAR PV SYSTEMS**

**UNIT CODE:** **0713 451 32A**

**UNIT DESCRIPTION**

This unit covers competences required to install solar PV systems. Competences include conducting solar PV site survey, designing solar PV system installation, installing solar PV components, testing solar PV system installation, commissioning solar PV system and maintaining solar PV system.

**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. Conduct Solar PV site survey | | * 1. Health and Safety Procedures are adhered to as per work requirement.   2. End user needs are gathered as per organization procedures.   3. ***Type of installation*** is determined as per user requirements.   4. ***Site conditions*** are assessed as per geographical location.   5. Installation plan is developed as per the expected installation.   6. Site survey report is prepared according to the organization procedures.   7. Site survey report is shared with relevant parties as per organization procedures. | |
| 1. Size solar PV system installation | | * 1. ***Load requirements*** are determined as per site survey report.   2. Concept/Preliminary electrical design drawings are developed as per load requirements.   3. ***Solar PV system*** sizing is carried out as per load requirements.   4. Concept/preliminary mechanical design drawings are developed as per load requirements.   5. Mechanical structures are determined as per the design   6. BOQ is prepared as per design.   7. Contract documents are prepared as per organization requirements. | |
| 1. Install Solar PV Components | | * 1. Health and Safety Procedures are adhered to as per work requirement.   2. Tools, equipment and materials are selected as per work requirement and IEC standard.   3. Mechanical structures are mounted as per design specifications.   4. Solar PV components are mounted as per the design.   5. ***Wiring system*** is installed as per working drawing and IET regulations.   6. Accessories are installed as per working drawing and IET regulations.   7. Deviations are captured in as built drawing and shared with relevant parties.   8. Housekeeping practices are performed according to EHS and OSHA. | |
| 1. Test solar PV system installation | | * 1. Visual inspection is conducted as per IET regulations.   2. Firmness of the installation is verified as per IET regulations.   3. Continuity test is conducted as per IET regulation.   4. Insulation resistance test is conducted as per IET regulations.   5. Polarity test is conducted as per IET regulations.   6. Earth resistance tests are conducted as per IET regulations.   7. Earth loop impedance tests are conducted as per IET regulations. | | |
| 1. Maintain Solar PV system | | * 1. Establish maintenance strategy as per system functionality.   2. Prepare maintenance schedule as per the maintenance schedule.   3. Inspect, test electrical equipment and system per IET regulations.   4. Prepare Maintenance materials as per the maintenance requirement.   5. Perform maintenance activities as per IET regulations.   6. Conduct system tests as per IET regulations.   7. Document Maintenance records as per maintenance strategy. | | |

**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. ***Type of installation*** may include but not limited to: | * Solar home systems stand alone * Hybrid * Grid tie |
| 1. ***Site conditions*** may include but not limited to: | * Irradiance * Orientation * Sun hours / insolation |
| 1. ***Load requirements*** may include but not limited to: | * Utility bills * Daily load demand * System losses |
| 1. ***Solar PV system*** may include but not limited to: | * PV modules * Batteries * Charge controllers * Inverters * Cables * Electrical fittings |
| 1. ***Wiring system*** may include but not limited to: | * Sheath/surface * Conduits * Trunking * Duct |
| 1. ***Solar PV Functionality tests*** may include but not limited to: | * Short circuit current * Open circuit voltage * Current at maximum power point * Output maximum power |

**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. The importance of documenting automation system installation information
3. The importance of working to agreed timelines
4. How to prepare, interpret and use sources of technical information for scheduled automation system installation activities
5. The importance of using the correct sources of technical information.
6. The purpose of and how to use identification codes (e.g., colour codes).
7. The operating specifications and tolerances for different types of installed systems
8. The hazards associated with operating the system.
9. Identification of users to be trained

**FOUNDATION SKILLS**

The individual needs to demonstrate the following foundation 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 knowledge and understanding and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | **Assessment requires evidence that the candidate:**   1. Adhered to health and safety procedures as per work requirement. 2. Determined type of installation as per user requirements. 3. Assessed site conditions as per geographical location. 4. Prepared site survey report according to the organization procedures. 5. Determined load requirements as per site survey report. 6. Carried out Solar PV system sizing as per load requirements. 7. Determined mechanical structures as per the design. 8. Mounted solar PV components as per the design. 9. Installed wiring system as per working drawing and IET regulations. 10. Installed Accessories as per working drawing and IET regulations. 11. Performed Housekeeping practices according to EHS and OSHA. 12. Tested solar PV system installation. 13. Prepared commissioning report as per organization procedures. 14. Established maintenance strategy as per system functionality. 15. Performed maintenance activities as per IET regulations. 16. Documented Maintenance records as per maintenance strategy. |
| 1. Resource Implications | The following resources should be provided:  2.1 Appropriately simulated environment where assessment can take place.  2.2 Access to relevant work environments.  2.3 Resources relevant to the proposed activities or task. |
| 1. Methods of Assessment | Competency may be assessed through:   1. Practical 2. Projects 3. Third party report 4. Portfolio of evidence 5. Written tests 6. Oral questioning |
| 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. |

## PERFORM SECURITY SYSTEM INSTALLATION

**UNIT CODE:** 0714 451 33A

**UNIT DESCRIPTION**

This unit covers competences required in performing security system installation . Competences include conducting site survey, designing security system, installing security systems, testing security system installation, commissioning security system and maintaining security system installation.

**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. Apply health and safety measures | | 1. PPE are applied as per work requirement. 2. Workshop safety rules are applied as per work procedure. 3. First Aid is carried out as per work procedure. 4. Workshop safety hazards are prevented as per work procedure. 5. Workshop safety risk assessment is conducted as per work procedure. 6. Fire drills are carried out as per workplace procedure. | |
| 1. Install security Systems | | 1. Health and Safety Procedures are adhered as per work requirement. 2. List of materials, tools and equipment is prepared as per design. 3. Work site is prepared for accessibility of utilities. 4. Marking points and zones are identified as per design parameters. 5. Cables are laid and segregated as per IET regulations. 6. ***Security system components*** are installed as per design. 7. Security system is coded as per system functionality. 8. Cables are labelled as per the IET regulations. 9. Housekeeping practices are performed according to EHS and OSHA. | |
| 1. Test security system installation | | 1. Visual inspection is carried out as per the design. 2. Continuity test is carried out as per the design. 3. Polarity test is carried out as per the design. 4. Functionality test is carried out as per the design. 5. Test results are documented as per workplace requirements. | | |
| 1. Maintain security system installation | | 1. Maintenance schedule is prepared as per OEMS and organization procedures. 2. System maintenance check list is prepared as per tasks and manufacturer’s manual. 3. Maintenance tools and equipment are selected as per scheduled maintenance. 4. Inspection and tests are carried out as per OEMS. 5. Faults are diagnosed as per service manual. 6. Faults are rectified as per service manual. 7. Maintenance report is prepared as per organization requirements. | | |

**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. ***Security system*** may include but not limited to: | * CCTV (Burglar alarm) * Fire alarm * Electric fence |
| 1. ***Utility services*** may include but not limited to: | * Water * Electricity * Roads |
| 1. ***Security system components*** may include but not limited to: | * Control panel * Siren * Bell * CCTV * Sensors |

**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. The importance of documenting automation system installation information
3. The importance of working to agreed timelines
4. How to prepare, interpret and use sources of technical information for scheduled automation system installation activities
5. The importance of using the correct sources of technical information.
6. The purpose of and how to use identification codes (e.g., colour codes).
7. The operating specifications and tolerances for different types of installed systems
8. The hazards associated with operating the system.
9. 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;

**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. Prevented Workshop safety hazards as per work procedure 2. Prepared List of materials, tools and equipment as per design. 3. Installed***Security system components*** as per design. 4. Coded Security system as per system functionality 5. Carried out functionality test as per the design |
| 1. Resource Implications include but not limited to | The following resources should be provided:  2.1 Appropriately simulated environment where assessment can take place.  2.2 Access to relevant work environments.  2.3 Resources relevant to the proposed activities or task. |
| 1. Methods of Assessment | Competency may be assessed through:   1. Practical 2. Projects 3. Third party report 4. Portfolio of evidence 5. Written tests 6. Oral questioning |
| 1. Context of Assessment | Competency may be assessed in a work place or a simulated work place. |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

**FABRICATE POWER ELECTRONIC CIRCUITS**

**UNIT CODE:** **0714 551 35A**

**UNIT DESCRIPTION**

This unit covers competences required in fabricating power electronic circuits. Competences include designing power converter circuit, fabricating power converter circuit, testing power converter circuit and maintaining power converter circuit.

**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. Design power converter circuit | | * 1. Need for power conversion is identified as per user requirement.   2. System analysis is carried out as per intended functionality with set parameters.   3. ***Power conversion technology*** is determined as per work requirement.   4. Modelling, prototyping and simulation are conducted as per the design specifications.   5. BoQ is prepared as per design specifications. | |
| 1. Fabricate power converter circuit | | 1. Health and Safety Procedures are adhered to as per work requirement. 2. Tools, materials and equipment are assembled as per work requirement. 3. Printing technique is identified as per intended circuit. 4. Circuit Board layout is printed as per printing technique. 5. PCB is etched as per printing technique. 6. Components are mounted as per design. 7. Components are soldered as per design. 8. Power converter circuit is powered as per safety regulations. | |
| 1. Test power converter circuit | | 1. Unit test is conducted as per circuit component functionality. 2. Output tests are conducted as per circuit requirements. 3. Fault diagnosis is conducted as per circuit requirement. 4. Fault is rectified as per system functionality. | |
| 1. Maintain power converter circuit | | 1. Maintenance schedule is prepared as per OEMS and organization procedures. 2. System maintenance check list is prepared as per tasks and manufacturer’s manual. 3. Maintenance tools and equipment are selected as per scheduled maintenance. 4. Inspection and tests are carried out as per OEMS. 5. Faults are diagnosed as per service manual. 6. Faults are rectified as per service manual. 7. Maintenance report is prepared as per organization requirements. | | |

**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. ***Power conversion technology*** include but is not limited to: | * AC to AC Conversion * AC to DC Conversion * DC to AC Conversion * DC to DC Conversion |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

The individual needs to demonstrate knowledge and understanding of: .

* The legal requirements relating to activities for electrical power lines installations and components.
* Legislation and workplace procedures relevant to:
* Environment, health and safety;
* Appropriate PPE (personal protective Equipment)
* Observe Country Government bylaws
  + - EPRA (Energy & Petroleum Regulatory Authority)
    - NEMA
    - KPLC Electrical Safety rules
* The importance of documenting electrical systems installation information
* The importance of working to agreed timelines
* How to prepare, interpret and use sources of technical information for scheduled Electrical power lines construction works
* The importance of using the correct sources of technical information.
* The purpose of and how to use identification codes (e.g., colour codes).
* Power system operation
* The operating specifications and tolerances for different types of power systems components
* The hazards associated with operating construction and operation of a power system.
* 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;

**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. Designed power converter circuit 2. Fabricated power converter circuit 3. Tested power converter circuit 4. Prepared Maintenance schedule as per OEMS and organization procedures. 5. Diagnosed Faults as per service manual. 6. Rectified Faults as per service manual. 7. Prepared Maintenance report as per organization requirements. |
| 1. Resource Implications | The following resources must be provided:   1. Tools and Printing equipment 2. PCB board 3. Design software |
| 1. Methods of Assessment | Competency may be assessed through:   1. Practical 2. Projects 3. Third party report 4. Portfolio of evidence 5. Written tests 6. Oral questioning |
| 1. Context of Assessment | Competency may be assessed in a work place or a simulated work place. |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

**AUTOMATE ELECTRICAL SYSTEMS**

**UNIT CODE:** 0714 551 36A

**UNIT DESCRIPTION**

This unit covers competences required in automating electrical systems. Competences include; designing automation system, installing automation components, programming automation system, commissioning automation system, monitoring automation system and maintaining automation system.

**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. Design automation system | | * 1. Need for automation is identified as per user requirement.   2. System analysis is conducted as per intended functionality with set parameters.   3. ***Automation technology*** is determined as per work requirement.   4. System design plan is developed *as* per work requirement.   5. Modelling, simulation and prototyping are carried out as per design.   6. BoQ is prepared as per design specifications. | |
| 1. Install automation components | | * 1. Safety procedures are adhered to as per work requirement.   2. Tools, materials and equipment are assembled as per job requirement.   3. Conduits, trunks, enclosures and support systems are installed as per layout diagram and IET regulations.   4. ***Automation components*** are installed as per IET regulations and manufacturer’s manual.   5. Cables and conductors are installed as per acceptable standards.   6. Cable lugging, glanding and termination is performed as per acceptable standards.   7. Cables are labelled as per IET standards.   8. ***Electrical Tests*** are performed as per IET regulations. | |
| 1. Program automation system | | * 1. Application software and drivers are installed as per the original equipment manufacturer’s specifications (OEMS).   2. Program is developed as per ***programming language.***   3. Program is debugged as per work requirement.   4. Program is uploaded to the controller as per OEMS.   5. Control parameters are configured as per automation. system requirements/commissioning data. | |
| 1. Commission Automation System | | * 1. Unit test is conducted as per OEMS, IEE and KEBS standards.   2. Functional tests are conducted as per system requirements.   3. System integration tests are conducted as per system requirements and OEMS.   4. Documentation is maintained as per the system requirements.   5. End user training is conducted as per the system requirements.   6. Final inspection and validation is conducted as per design specifications, safety standards and regulatory requirements.   7. Automation system is handed over to the end user as per organization requirement. | |
| 1. Monitor automation system | | 1. Monitoring and diagnostic tools are developed as per system requirements. 2. Monitoring and diagnostic tools are integrated as per system requirements 3. Data is extracted based on user monitoring requirements. 4. Data is stored as per user monitoring requirements. 5. Data is analyzed based on system optimization to yield metrics. 6. System optimization is carried out as per yielded metrics | |
| 1. Maintain automation system | | 1. Monitoring and diagnostic tools are developed as per system requirements. 2. Monitoring and diagnostic tools are integrated as per system requirements. 3. Data is extracted based on user monitoring requirements. 4. Data is stored as per user monitoring requirements. 5. Data is analyzed based on system optimization to yield metrics. 6. System optimization is carried out as per yielded metrics. | |

**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. ***Automation technology*** may include but not limited to: | * PLC * Microcontroller |
| 1. ***Automation components*** may include but not limited to: | * Sensors * actuators |
| 1. ***Electrical Tests*** may include but not limited to: | * Continuity tests * Insulation resistance test * Polarity test |
| 1. ***Programming language*** may include but not limited to: | * Ladder diagram * Instruction list * Functional block diagram * Python |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

The individual needs to demonstrate knowledge and understanding of:

* The manufacturer's warranty requirements relating to installation of automation systems related components.
* The legal requirements relating to commissioning activities for electrical installation systems and components.
* Legislation and workplace procedures relevant to:
* Environment, health and safety;
* Appropriate PPE (personal protective Equipment)
* County Government bylaws
  + - EPRA (Energy & Petroleum Regulatory Authority)
    - NEMA
    - CA
* The importance of documenting automation system installation information
* The importance of working to agreed timelines
* How to prepare, interpret and use sources of technical information for scheduled automation system installation activities
* The importance of using the correct sources of technical information.
* The purpose of and how to use identification codes (e.g., colour codes).
* The operating specifications and tolerances for different types of installed systems
* The hazards associated with operating the system.
* 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;

**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. Developed system design plan as per work requirement. 2. Carried out modelling, simulation and prototyping as per design. 3. Installed conduits, trunks, enclosures and support systems as per layout diagram and IET regulations. 4. Installed automation components as per IET regulations and manufacturer’s manual. 5. Performed cable lugging, glanding and termination as per acceptable standards. 6. Developed program as per programming language. 7. Uploaded program to the controller as per OEMS. 8. Configured Control parameters as per automation system requirements/commissioning data. 9. Conducted Functional tests as per system requirements. 10. Handed over Automation system to the end user as per organization requirement. 11. Maintained Documentation as per the system requirements. 12. Integrated Monitoring and diagnostic tools as per system requirements. 13. Prepared System maintenance check list as per tasks and manufacturer’s manual. 14. Diagnosed Faults as per service manual. |
| 1. Resource Implications | The following resources should be provided:  2.1 Appropriately simulated environment where assessment can take place.   * 1. Access to relevant work environments.   2. Resources relevant to the proposed activities or task. |
| 1. Methods of Assessment | Competency may be assessed through:   1. Practical 2. Projects 3. Third party report 4. Portfolio of evidence 5. Written tests 6. Oral questioning |
| 1. Context of Assessment | Competency may be assessed in a work place or a simulated work place. |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |