

**THE REPUBLIC OF KENYA**

**NATIONAL OCCUPATIONAL STANDARDS**

**FOR**

**SOLAR PV SYSTEM INSTALLER**

**KNQF LEVEL 5**

**OCCUPATIONAL STANDARD ISCED CODE: 0713 454 A**

# 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

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**OVERVIEW**

**SUMMARY OF UNITS OF COMPETENCY**

**BASIC UNITS OF COMPETENCY**

|  |  |
| --- | --- |
| **Unit Code** | **Unit Title** |
| 0031 441 01B | Apply Communication Skills |
| 0611 451 02B | Apply Digital Literacy |
| 0413 441 03B | Apply Entrepreneurial Skills |
| 0417 441 04B | Apply Work Ethics and Practices |

**COMMON UNITS OF COMPETENCY**

|  |  |
| --- | --- |
| **Unit Code** | **Unit Title** |
| 0541 441 05A | Apply Engineering Technician Mathematics |
| 0713 441 06A | Apply Electrical Principles |
| 0713 441 07A | Perform Workshop Processes |
| 0713 441 08A | Prepare Technical Drawings |
| 0714 441 09A | Fabricate Electronic Circuits |

**CORE UNITS OF COMPETENCY**

|  |  |
| --- | --- |
|  | |
| **CORE UNITS OF COMPETENCY** | |
| **Unit Code** | **Unit Title** |
| 0713 251 01A | Perform Electrical Installation |
| 0713 251 02A | Install DC Solar PV Systems |
| 0713 251 03 A | Install Solar Water Pump System |
|  | |
| **CORE UNITS OF COMPETENCY** | |
| 0713 351 04A | Perform Electrical Installation |
| 0713 351 05A | Install Solar PV Systems |
| 0713 351 06A | Install Solar Water Pump System |

|  |  |
| --- | --- |
| **Unit Code** | **Unit Title** |
| 0713 451 10A | Perform Electrical Installation I |
| 0713 451 10A | Perform Electrical Installation II |
| 0713 451 11A | Design Solar PV Systems |
| 0713 451 12A | Install Solar PV Systems |
| 0713 451 13A | Install Solar PV Pumps System |
| 0713 451 14A | Perform Security System Installation |

# BASIC UNITS OF COMPETENCY

## APPLY COMMUNICATION SKILLS

**UNIT CODE:** 0031 441 01B

**UNIT DESCRIPTION**

This unit covers the 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:   1. Access to relevant workplace where assessment can take place. 2. Appropriately simulated environment where assessment can take place. 3. Resources relevant to the proposed activity or tasks. |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   1. Observation 2. Oral assessment 3. Portfolio of evidence 4. Interviews 5. Third party report 6. Written assessment 7. Practical assessment 8. Projects |
| 1. Context of Assessment | Competency may be assessed:   1. On-the-job 2. In a simulated work environment |
| 1. Guidance information for assessment | 1. Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY DIGITAL LITERACY

**UNIT CODE:** 0611 451 02B

**UNIT DESCRIPTION:**

This unit covers the competencies required to apply digital literacy. It involves operating computer devices, solving tasks using the Office suite, managing data and information, performing online communication and collaboration, applying cyber-security skills, performing online jobs 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 cyber-security 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 testimonialsmay include but not limited to: | * Academic credentials * Letters of previous employments/ services rendered * Letters of commendation * Certifications of participation * Awards |
| 1. Interview skills may include but not limited to: | * Listening skills * Grooming * Language command * Articulation of issues * Body language * Time management * Honesty * Generally knowledgeable in current affairs and technical area |

**REQUIRED KNOWLEDGE AND SKILLS**

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

**Required knowledge**

The individual needs to demonstrate knowledge of:

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

Functions and concepts of word processing;

Documents and tables creation and manipulations;

Document editing;

Document formatting;

Word processing utilities

* Spreadsheets;

Meaning, types and importance of spreadsheets;

Components of spreadsheets;

Functions, formulae, and charts, uses and layout;

Data formulation, manipulation and application to cells;

Editing & formatting spreadsheets;

* Presentation Packages;

Types of presentation Packages.

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

* Networking and Internet;

Internet connectivity.

Browser and digital content management;

Managing data, information, and digital content

Electronic mail and World Wide Web

* Fundamentals of Online Working;

Online Profile Management;

e-Portfolio Management;

Online Jobs Bidding;

Online Payment Systems;

* Job entry techniques

Job searching sites

Interview preparation skills

Interview handling

**Required skills**

The individual needs to demonstrate the following skills:

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

**EVIDENCE GUIDE**

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

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

## APPLY ENTREPRENEURIAL SKILLS

**UNIT CODE :** 0413 441 03B

**UNIT DESCRIPTION**

This unit covers the competencies required to apply entrepreneurial skills. It involves applying financial literacy, applying entrepreneurial concepts, identifying entrepreneurship opportunities, applying business legal aspects, innovating business 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 | 1. 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 441 05A

**UNIT DESCRIPTION**

This unit describes the competencies required to apply a wide range of engineering technician mathematics. Competencies include: applying number systems, applying algebra, applying trigonometry and hyperbolic functions, performing coordinates geometry and carrying out binomial expansions.

**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 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 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. Calculations are performed as per trigonometric rules   2. Calculations are performed according to ***hyperbolic functions*** rules.   3. Trigonometric identities are applied according to Mathematical methods. |
| * + 1. Perform coordinates geometry | * 1. Polar equations are solved as per mathematical methods.   2. Polar equations graphs are drawn as per mathematical methods.   3. Normal and tangents are determined as per mathematical methods |
| * + 1. Carry out binomial expansion | * 1. Binomial series is determined as per mathematical methods.   2. Roots of numbers are determined as per mathematical methods.   3. Errors of small changes are determined as per mathematical methods. |

**RANGE**

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

| **Variable** | **Range** |
| --- | --- |
| * + 1. Arithmetic operationsinclude but not limited to: | * Addition * Subtraction * Multiplication * Division |
| * 1. Trigonometry ratios include but not limited to: | * Sine * Cosine * Tangent * Sec * Cosec * Cotagent |
| * 1. Trigonometric rules | * sine rules * cosine rule |
| * 1. Inverse trigonometric ratios | * Inverse of sine * Inverse of cosine * Inverse of tangent |
| * 1. Trigonometric functions Integrals | * Sine * Cosine * Tangent |
| * 1. Hyperbolic functions may include but not limited to: | * Sinh x * Cosh x * Cosec x * Tanh x * Sech x |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

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

**Required knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

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

## APPLY ENGINEERING TECHNICIAN MATHEMATICS II

**UNIT CODE:** 0541 441 05A

**UNIT DESCRIPTION**

This unit describes the competencies required to apply a wide range of engineering technician mathematics. Competencies include applying: calculus, statistics and probability, matrices, vector theory and complex numbers.

**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 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 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 vector theory | * 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 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 environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance.

| **Variable** | **Range** |
| --- | --- |
| * + - 1. Measures of central tendency may include but not limited to: | * Mean * Median * mode |
| * + - 1. 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 |
| * + - 1. Operations may include but not limited to: | * Addition * Subtraction * Multiplication * Division |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

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

**Required knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

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

|  |  |
| --- | --- |
| 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 ELECTRICAL PRINCIPLES I

**UNIT CODE:** 0713 441 06A

**UNIT DESCRIPTION**

This unit describes the competencies required by a technician in order to apply a wide range of electrical principles I as per work requirement. Competencies include: applying electrical quantities, using cells and batteries, applying concepts of DC circuit and applying magnetism and electromagnetism.

**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 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 |

**RANGE**

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

| **Variable** | **Range** |
| --- | --- |
| 1. Types of cells and batteries include but not limited to: | * + Dry cells   + Leclanche   + Mercury   + Lead-acid   + Alkaline   + Lithium |

**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 magnetism and electromagnetism |
| 1. Resource Implications | The following resources must 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 demonstration 2. Projects 3. Written tests 4. Oral test |
| 1. Context of Assessment | 1. Competency may be assessed in a workplace or a simulated workplace. |
| 1. Guidance information for assessment | 1. Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY ELECTRICAL PRINCIPLES II

**UNIT CODE:** 0713 441 07A

**UNIT DESCRIPTION**

This unit describes the competencies required by a technician in order to apply a wide range of electrical principles II as per work requirement. Competencies include: applying electrostatics principles, apply concepts of DC circuit 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 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 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. 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. Basic Electrical laws may include but not limited to: | * + Ohms law   + Kirchhoff’s theorem |
| 1. Transducers include but not limited to: | * + temperature   + pressure   + displacement   + flow |

**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 concepts of DC circuit   2. Applied principles of electrostatics   3. Performed electrical measurements |
| 1. Resource Implications | The following resources must 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 demonstration 2. Projects 3. Written tests 4. Oral test |
| 1. Context of Assessment | 1. Competency may be assessed in a workplace or a simulated workplace. |
| 1. Guidance information for assessment | 1. Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY ANALOGUE ELECTRONICS I

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

**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 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 italicized terms are elaborated in the Range)*** |
| --- | --- |
| 1. Understand 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 environment and conditions to which the performance criteria apply. It allows for different work environment and situations that will affect performance.

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

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

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

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Entrepreneurship
* Environmental awareness
* Electrical and electronics safety awareness
* Electrical and electronics measurements and units

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical aspects of Competency | **Assessment requires evidence that the candidate:**   1. 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 should be provided:   * 1. Appropriately simulated environment where assessment can take place   2. Access to relevant work environment   3. Resources relevant to the proposed activities or tasks |
| 1. Methods of assessment | Competency in this unit may be assessed through:   * 1. Practical assessment   2. Project   3. Portfolio of evidence   4. Third party reports   5. Written tests   6. Oral questioning |
| 1. Context of assessment | Competency may be assessed in a:   * 1. Workplace or   2. 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 ANALOGUE ELECTRONICS II

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

**UNIT DESCRIPTION**

This unit covers competences required to apply analogue electronics. Competences includes 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 italicized 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 Opto-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 environment and conditions to which the performance criteria apply. It allows for different work environment and situations that will affect performance.

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

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

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

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Entrepreneurship
* Environmental awareness
* Electrical and electronics safety awareness
* Electrical and electronics measurements and units

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| * + - 1. Critical aspects of Competency | **Assessment requires evidence that the candidate:**   * 1. 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 should be provided:   * 1. Appropriately simulated environment where assessment can take place   2. Access to relevant work environment   3. Resources relevant to the proposed activities or tasks |
| 1. Methods of assessment | Competency in this unit may be assessed through:   * 1. Practical assessment   2. Project   3. Portfolio of evidence   4. Third party reports   5. Written tests   6. Oral questioning |
| 1. Context of assessment | Competency may be assessed in a:   * 1. Workplace or   2. 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 DIGITAL ELECTRONICS I

**UNIT CODE: 0714 541 13A**

**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.

**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) |

**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. |
| 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 13A**

**UNIT DESCRIPTION**

This unit describes competences required to apply digital electronics. Competences include applying knowledge of 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:   * 1. applied Logic circuits concepts as per digital system design specifications.   2. Applied ***Logic families*** knowledge as per digital system design specifications.   3. Applied ***flip flops circuits*** conceptsas per type of digital operation.   4. Applied Manufacture’s datasheets and catalogues knowledge to identify ICs as per work requirement.   5. Applied principles of operations of ***arithmetic logic circuits*** as per type of arithmetic operations.   6. Applied Operation principles of ***digital converters circuits*** as per digital system requirements.   7. Applied ***computer memories o***peration knowledge as per memory design specifications. |
| 1. Resource Implications | The following resources must be provided:   * 1. Access to relevant workplace where assessment can take place.   2. Appropriately simulated environment where assessment can take place.   3. Materials relevant to the proposed assessment activity or tasks. |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Observation   2. Written test   3. Practical   4. Demonstration   5. Oral questioning   6. 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. |

## PREPARE TECHNICAL DRAWINGS

**UNIT CODE:** 0713 441 08A

**UNIT DESCRIPTION**

This unit covers the competencies required to prepare technical drawing. Its competencies include: preparing drawing equipment and materials, producing plane geometry drawings, managing basic operations in AutoCAD, developing 2D drawings in AutoCAD and producing pictorial and orthographic drawings of components.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes which make up workplace function. | | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***(Bold and italicised terms are elaborated in the Range)*** | |
| --- | --- | --- | --- |
| 1. Prepare drawing equipment and materials | | 1. ***Drawing equipment*** are identified according to task requirements 2. ***Drawing materials*** are identified according to task requirements 3. Drawing equipment are used as per technical drawing standards 4. Drawing equipment are maintained as per technical drawing standards 5. Drawing materials are used as per workplace procedures 6. Waste materials are disposed in accordance with workplace procedures and environmental legislations | |
| 1. Produce plane geometry drawings | | 1. 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. | |

**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 | * Drawing boards * T and set squares * Drawing set |
| 1. Drawing materials | * Drawing papers * Pencils * Erasers * Masking tapes * 2.5 Paper clips |
| 1. Geometric figures | * Circles * Triangles * Rectangles * Parallelogram * Polygons * Pyramids * Conic sections * Prisms |
| 1. Tangents | * Exterior tangents to a circle * Interior tangents to a circle |
| 1. Key Features | * 2D drafting and drawing |
| 1. Pictorial drawings | * Isometric drawing * Free hand sketches * Oblique drawing |
| 1. AutoCAD visual reference commands | * Visual styles * Materials and textures * Writing * Rendering * View port |
| 1. Ribbon | * Draw panel * Modify panel * Annotation |
| 1. Status bar | * Snap * Grid * Ortho * Object snap * Polar tracking |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required skills**

The individual needs to demonstrate the following skills:

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

**Required knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   1. Used drawing equipment as per technical drawing standards 2. Used drawing materials as per workplace procedures 3. Identified different types of lines used in drawing and their meanings according to technical drawing standards 4. Constructed different types of angles as per technical drawing standards 5. Constructed different types ofTangents according to technical drawing standards 6. Constructed different types of geometric figures as per required dimensions 7. Operated AutoCAD visual reference commands as per software manual. 8. Used AutoCAD ribbon tools as per software manual. 9. Used AutoCAD status bar tools as per software manual. 10. Operated AutoCAD navigation commands option as per software manual. 11. Printed AutoCAD drawing work as per software manual 12. Printed AutoCAD 2D drawing work as per software manual 13. Edited 2D drawing as per given requirement changes. 14. Created 2D drawing as per given dimension 15. Produced pictorial sketches and pictorial drawings of components as per technical drawing standards. 16. Produced First and third angle orthographic sketches and drawings of components as per technical drawing standards. 17. Freehand sketched different types of geometric forms, tools and equipment as per technical drawing standards |
| 1. Resource Implications | The following resources must be provided:   1. Drawing room 2. Drawing equipment and materials 3. Computers 4. CAD packages 5. Drawing software |
| 1. Methods of Assessment | Competency may be assessed through:   1. Practical demonstration 2. Projects 3. Written tests 4. Oral test |
| 1. Context of Assessment | 1. Competency may be assessed in a workplace or a simulated workplace. |
| 1. Guidance information for assessment | 1. Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# CORE UNITS OF COMPETENCY

## 

## PERFORM ELECTRICAL INSTALLATION

**UNIT CODE:** **0713 251 01A**

**UNIT DESCRIPTION**

This unit specifies competences required for performing electrical installation. The competences include identifying electrical installation components, installing electrical system and maintaining 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. Identify electrical installation components | * 1. Electrical symbols are identified as per installation drawing.   2. Materials for electrical installation are prepared as per installation drawing.   3. Electrical route is identified as per installation drawing | |
| 1. Install electrical system | * 1. Safety Procedures are applied as per work requirement.   2. ***Tools*** and ***equipment*** are assembled as per work plan.   3. ***Materials*** are assembled as per work plan   4. ***Cable management system*** is installed as per IEC standards   5. ***Protection devices*** are installed as per IEC standards   6. Accessories are installed as per working drawing and IET regulations.   7. ***Housekeeping practice*** is performed as per work requirement. | |
| 1. Maintain electrical installation | * 1. Electrical equipment and system is inspected as per IET regulations.   2. Materialsandtools are assembled as per work requirement.   3. Maintenance is carried out as per work requirement.   4. Maintenance report is prepared as per work procedure. | |

**RANGE**

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

| **Variable** | **Range** |
| --- | --- |
| 1. Conflicts include but are not limited to: | * Interpersonal conflict * Intrapersonal conflict * Intergroup conflict * Intragroup conflict |
| 1. Team include but are not limited to: | * Small workgroup * Staff in a section/department * Inter-agency group * Virtual teams |
| 1. Creative and innovative include but are not limited to: | * New ideas * Original ideas * Different ideas * Methods/procedures * Processes * New tools |
| 1. Customer include but are not limited to: | * Loyal * Discount * Impulse * Need-based * Wandering |
| 1. Tools and equipment include but is not limited to: | * Fixing tools * Cutting tools * Measuring tools * Holding tools * Power tools * Multimeter * Hydrometer * Inclinometer * Compass |
| 1. Materials include but is not limited to: | * Cables * Accessories |
| 1. Cable management systems include but is not limited to: | * Cable duct * Sheath/surface * Conduits * Trunking |
| 1. Protection devices include but is not limited to: | * Circuit breakers * Fuses |
| 1. Housekeeping practiceinclude but is not limited to: | * Waste disposal * Recycle * Reuse * Reduce |

**REQUIRED KNOWLEDGE**

The individual needs to demonstrate knowledge of:

* Electrical tools and equipment
* Work safety requirements
* IEE regulations
* solar energy
* Electrical building codes

**FOUNDATION SKILLS**

* Communication skills
* Negotiation skills
* Work ethics
* Waste disposal
* Work safety

**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. Executed group discussion strategies as per workplace policy. 2. Promoted team work as per workplace requirements 3. Promoted work ethical practices and values as per work place requirements 4. Identified Electrical symbols as per installation drawing. 5. Installed electrical system as per work plan. 6. Assembled Materialsandtools as per work requirement. 7. Carried out Maintenance as per work requirement. |
| 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 in this unit may be assessed through:   * 1. Project   2. practical   3. Portfolio of evidence   4. Third party report   5. Written assessment   6. Oral assessment |
| 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 DC SOLAR PV SYSTEMS

**UNIT CODE:** **0713 251 04A**

**UNIT DESCRIPTION**

This unit covers competences required in installing solar PV systems. The competences include Applying Entrepreneurial skills, constructing DC solar PV support structures, installing DC solar PV system components and maintaining DC 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. Construct DC Solar PV support structures | | * 1. Safety procedures are applied as per work requirements.   2. Solar PV module structure is constructed as per design requirement.   3. solar PV batteries structures is constructed as per design requirement. | |
| 1. Install DC Solar PV system components | | * 1. ***Solar PV module*** is mounted as per work layout   2. Charger controller is mounted as per work layout   3. ***Solar PV battery*** is installed as per work layout   4. Cables are joined as per work layout.   5. ***Lightening arrestor*** is installed as per work layout   6. ***Housekeeping practice*** is performed as per work requirement. | |
| 1. Maintain DC Solar PV System | | * 1. Maintenance materials are prepared as per work requirement.   2. ***Maintenance*** iscarried out as per IET regulations   3. Maintenance report is prepared as per work procedure. | |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Sources of personal finance include but are not limited to: | * Salary/Wages * Investments * Savings * Inheritance * Government Benefits |
| 1. Sources of business finance include but not limited to: | * Equity Financing * Debt Financing, * Personal Savings/Investment * Retained Earnings * Grants and Subsidies * Crowdfunding * Supplier credit: * Leasing and Asset Financing: |
| 1. Characteristics of Entrepreneurs include but are 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 include but not limited to | * Technical skills * Management skills * Entrepreneurial skills * Resources * Infrastructure |
| 1. Legal requirements when starting a small business include but not limited to: | * Business Registration * Business Name Registration * Business Permits and Licenses * Tax Registration * Compliance with Employment Laws |
| 1. Solar PV module may include but is not limited to: | * Mono crystalline * Poly crystalline * Amorphous * Single module up to 300 wp |
| 1. Solar PV batteries may include but is not limited to: | * Maintenance free * Flooded type * Single battery 12V |
| 1. Lightening arrestor may include but is not limited to: | * Rod gap arrester * Earth Rod * Surge arrestor (SPD) |
| 1. Housekeeping practicemay include but is not limited to: | * Waste disposal * Recycle * Reuse * Reduce |
| 1. Maintenance may include but is not limited to: | * Cleaning the modules * Cleaning battery terminals * Applying jelly/grease on battery terminals * Checking states of electrolytes |

**REQUIRED KNOWLEDGE**

The individual needs to demonstrate knowledge of:

* Electrical tools and equipment
* Work safety requirements
* IEE regulations
* solar energy
* Electrical building codes

**FOUNDATION SKILLS**

* Communication skills
* Negotiation skills
* Work ethics
* Waste disposal
* Work safety

**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. Budgeted Personal finance as per financial procedures and standards   2. Developed culture of Saving as per personal goals   3. Identified sources of personal and business finance as per financial procedures and standards   4. Undertook business planning as per resource implications and regulatory framework   5. Constructed DC Solar PV support structures as per work requirement.   6. Mounted Solar PV module as per work layout   7. Mounted Charger controller as per work layout   8. Installed Solar PV battery as per work layout   9. Joined Cables as per work layout.   10. Performed Housekeeping practiceas per work requirement. |
| 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 in this unit may be assessed through:   * 1. Project   2. practical   3. Portfolio of evidence   4. Third party report   5. Written assessment   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. |

## INSTALL SOLAR WATER PUMP SYSTEM

**UNIT CODE:** **0713 251 05A**

**UNIT DESCRIPTION**

This unit covers competences required in install solar water pump system. The competences include Applying Communication Skills, constructing solar PV module system support structures, installing solar water pump system components and maintaining solar water pump 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. Construct Solar PV module system support structures | | * 1. Safety procedures are applied as per work requirements.   2. Solar PV module mounting structures are constructed as per design requirement.   3. Solar PV water pump mounting structures are constructed as per design requirement. |
| 1. Install Solar water pump system components | | * 1. ***Solar PV module*** is mounted as per layout   2. ***Solar PV water pump*** is installed as per layout   3. Cables are jointed as per system layout.   4. Lightening arrestor is installed as per design   5. ***Housekeeping practice*** is performed as per work requirement. |
| 1. Maintain solar water pump system | | * 1. ***Materials*** for solar water pump are prepared as per system requirement.   2. Solar PV water pump system is tested as per IET regulations.   3. ***Maintenance activities*** are carried out as per IET regulations.   4. Maintenance report is prepared as per work procedure. |

**RANGE**

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

| **Variable** | **Range** |
| --- | --- |
| 1. Written communication includes but not limited to: | * Memos * Letters * Notices * SMS |
| 1. Non-verbal strategies include and not limited to: | * Posture * Gestures * Eye contact * Facial expressions * Dressing/Grooming |
| 1. Oral communication pathways include and not limited to: | * Telephone calls * Face-to-face * Meetings   Interviews |
| 1. Group communication strategies may include but not limited to: | * Body language * Active listening * Concise language |
| 1. Solar PV module may include but is not limited to: | * Mono crystalline * Poly crystalline * Amorphous * Single panel up to 300 wp |
| 1. Solar PV water pump may include but is not limited to: | * Surface/submersible Single phase water pump |
| 1. Housekeeping practicemay include but is not limited to: | * Waste disposal * Recycle * Reuse * Reduce |
| 1. Material may include but is not limited to: | * Cables * Cable ties * Accessories * Grease |
| 1. Maintenance activity may include but is not limited to: | * Cleaning module * Removal of silt |

**REQUIRED KNOWLEDGE**

The individual needs to demonstrate knowledge of:

* Electrical tools and equipment
* Work safety requirements
* IEE regulations
* solar energy
* Electrical building codes

**FOUNDATION SKILLS**

* Communication skills
* Negotiation skills
* Work ethics
* Waste disposal
* Work safety

**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. Effected written communication as per workplace requirements.   2. Exercised non-verbal communication as per workplace requirements.   3. Constructed Solar PV module system support structures as per layout   4. Mounted Solar PV module as per layout.   5. Installed Solar PV water pump as per layout.   6. Joined Cables as per work requirement.   7. Maintained solar water pump system as per layout. |
| 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 in this unit may be assessed through:   * 1. Project   2. practical   3. Portfolio of evidence   4. Third party report   5. Written assessment   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 351 07A**

**UNIT DESCRIPTION**

This unit specifies competences required for performing electrical installation. The competences include Producing electrical drawings, interpreting electrical installation drawing, installing electrical system, testing electrical installation and maintaining 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. Produce electrical drawings | * 1. Electrical symbols meaning are interpreted according to BS 3939   2. Electrical drawings are produced in accordance with BS 3939   3. Electrical symbols and abbreviations are used as per job requirement. | |
| 1. Interpret electrical installation drawing | * 1. Electrical symbols are identified as per installation drawing   2. Wiring diagram is prepared as per work procedure.   3. Materials are listed as per installation drawing | |
| 1. Install electrical system | * 1. Safety Procedures are applied as per work requirements.   2. ***Tools, equipment*** and ***materials*** are assembled as per work plan.   3. ***Cable management system*** is installed as per work requirement   4. ***Earthing and protection system*** is installed as per IEEE regulations   5. Accessories are installed as per working drawing   6. ***Housekeeping practice*** is performed as per work requirement. | |
| 1. Test electrical installation | * 1. Electrical installation conditions are ***visually inspected*** as per IET regulations.   2. Continuity test is carried out as per IET regulation   3. Polarity test is carried out as per IET regulations.   4. Insulation resistance test is carried out as per IET regulations. | |
| 1. Maintain electrical installation | * 1. Electrical equipmentis inspected as per IET regulations.   2. Maintenance materials and tools are assembled as per work requirement.   3. ***Maintenance activities*** is carried out as per IET regulations.   4. System tests are carried out as per IET regulations.   5. Maintenance report is recorded as per work procedure. | |

**RANGE**

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

| **Variable** | **Range** |
| --- | --- |
| 1. Tools, equipment and materials include but is not limited to: | * Fixing tools * Cutting tools * Measuring tools * Holding tools * Power tools * Multimeter * Hydrometer * Inclinometer * Compass * Cables * Accessories |
| 1. Cable management systems include but is not limited to: | * Cable duct * Sheath/surface * Conduits * Trunking |
| 1. Earthing and protection system include but is not limited to: | * IT * TNC * TNS * TT * TNCS/PME/PEN/CNE * Circuit breakers * Fuses * ELCBs/RCD |
| 1. Housekeeping practiceinclude but is not limited to: | * Waste disposal * Recycle * Reuse * Reduce |
| 1. Visually inspected include but is not limited to: | * Color code * Firmness * Level * Neatness |
| 1. Maintenance activities include but is not limited to: | * Faulty lamps * Faulty accessories |

**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 knowledge and understanding and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   1. Produced electrical drawings in accordance with BS 3939 2. Interpreted electrical installation drawing as per work requirement 3. Installed electrical system as per work requirement. 4. Tested electrical installation as per IET regulations. 5. Carried out maintenance as per IET regulations. |
| 1. Resource implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work environments.  1. Resources relevant to the proposed activities or task. |
| 1. Methods of assessment | Competency in this unit may be assessed through:   * 1. Project   2. practical   3. Portfolio of evidence   4. Third party report   5. Written assessment  1. Oral assessment |
| 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 SOLAR PV SYSTEMS

**UNIT CODE: 0713 351 08A**

**UNIT DESCRIPTION**

This unit covers the competences required in Install Solar PV Systems. Competences include; applying electrical principles, constructing solar PV support structures, installing Solar PV system components, 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. Apply electrical concepts | | * 1. ***Electrical fundamental principles*** are applied according to circuit network requirements | |
| 1. Construct Solar PV support structures | | * 1. Safety procedures are applied as per work requirements.   2. solar PV module structure is constructed as per design requirement.   3. Solar PV batteries structures is constructed as per design requirement. | |
| 1. Install Solar PV system components | | * 1. ***Solar PV module*** is mounted as per layout   2. Charger controller is mounted as per layout   3. ***Solar PV batteries*** are installed as per layout   4. Inverter is installed as per layout   5. Cables are jointed as per system layout.   6. ***Lightening arrestor*** is installed as per design   7. ***Housekeeping practice*** is performed as per work requirement. | |
| 1. Maintain Solar PV System | | * 1. Materials are prepared as per work requirement.   2. ***Solar PV system test*** is performed as per IET regulations.   3. ***Maintenance*** iscarried out as per IET regulations   4. Maintenance report is prepared as per work procedure. | |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. ***Electrical fundamental principles*** include but not limited to: | * Ohms law * DC and AC current principles |
| 1. Solar PV module may include but is not limited to: | * Mono crystalline * Poly crystalline * Amorphous * Series connection up to 1000 wp * Parallel connection up to 1000 wp * Series-parallel connection up to 1000 wp |
| 1. Solar PV batteries may include but is not limited to: | * Maintenance free * Flooded type * Series connection up to 24v * Parallel connection up to 24v * Series-parallel connection up to 24v |
| 1. Lightening arrestor may include but is not limited to: | * Rod gap arrester * Earth Rod * Surge arrestor (SPD) |
| 1. Housekeeping practicemay include but is not limited to: | * Waste disposal * Recycle * Reuse * Reduce |
| 1. Solar PV system test may include but is not limited to: | * Short circuit systems (Isc) * Open circuit voltage (Voc) * Battery voltage * Battery current |
| 1. Maintenance may include but is not limited to: | * Cleaning the modules * Cleaning battery terminals * Applying jelly/grease on battery terminals * Checking states of electrolytes |

**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. Applied electrical fundamental principles as per work requirement   2. Constructed Solar PV support structures   3. Mounted Solar PV module as per layout   4. Mounted Charger controller as per layout   5. Installed Solar PV batteries as per layout   6. Installed Inverter as per layout   7. Joined Cables as per system layout   8. Maintained Solar PV System |
| 1. Resource Implications | The following resources must be provided:  Resources same as that of workplace are advised to be applied  including   1. Measuring tools 2. Cutting tools 3. Fastening tools 4. PPE 5. Accessories and cables |
| 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. |

## INSTALL SOLAR WATER PUMP SYSTEM

**UNIT CODE:** **0713 351 09A**

**UNIT DESCRIPTION**

This unit covers the competences required in Install Solar Water Pump System. Competences include; Managing electrical workshop, Constructing Solar PV module system support structures, Installing Solar water pump system components, Maintaining solar water pump 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. Manage electrical workshop | | * 1. Safety procedures are applied as work requirement   2. ***Workplace hazards*** mitigation measures are applied as per work requirement   3. ***Workplace accidents*** and incidents response is carried out as per workplace procedures   4. Safe handling of materials is carried out as per work requirements   5. ***Engineering materials*** are used as per work requirement   6. Engineering material wastes are disposed as per work requirement |
| 1. Construct Solar PV module system support structures | | 1. Safety procedures are applied as per work requirements. 2. Solar PV module mounting structures are constructed as per design requirement. 3. Solar PV water pump mounting structures are constructed as per design requirement. |
| 1. Install Solar water pump system components | | 1. ***Solar PV module*** is mounted as per layout 2. ***Solar PV water pump*** is installed as per layout 3. Cables are jointed as per system layout. 4. Lightening arrestor is installed as per design 5. ***Housekeeping practice*** is performed as per work requirement. |
| 1. Maintain solar water pump system | | * 1. materials are prepared as per system requirement.   2. Solar PV water pump system is tested as per IET regulations.   3. Maintenance is carried out as per IET regulations.   4. Maintenance report is prepared as per work procedure. |

**RANGE**

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

| **Variable** | **Range** |
| --- | --- |
| 1. Workplace hazards may include but not limited to: | * Physical * Biological * Chemical * Ergonomics * Electrical |
| 1. Workplace accidents may include but not limited to: | * cuts and bleeds * fracture * fainting * electric shock * fire * pinch |
| 1. Engineering materials may include but not limited to: | * metals * polymers * composites * ceramic |
| 1. Solar PV module may include but is not limited to: | * Mono crystalline * Poly crystalline * Amorphous * Series connection up to 1000 wp * Parallel connection up to 1000 wp * Series-parallel connection up to 1000 wp |
| 1. Solar PV water pump may include but is not limited to: | * Surface/submersible Single phase water pump |
| 1. Housekeeping practicemay include but is not limited to: | * Waste disposal * Recycle * Reuse * Reduce |

**REQUIRED KNOWLEDGE**

The individual needs to demonstrate knowledge of:

* 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. Applied workplace hazards mitigation measures as per work requirement   2. Carried out workplace accidents and incidents response as per workplace procedures   3. Disposed waste engineering materials as per work requirement   4. Constructed Solar PV module system support structures   5. Mounted Solar PV module as per layout.   6. Installed Solar PV water pump as per layout.   7. Joined Cables as per system layout.   8. Maintained solar water pump system. |
| 1. Resource Implications | The following resources must be provided:  Resources same as that of workplace are advised to be applied  including   * 1. Measuring tools   2. cutting tools   3. fastening tools   4. PPE   5. accessories and cables |
| 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. |

## PERFORM ELECTRICAL INSTALLATION I

**UNIT CODE:** 0713 451 10A

**UNIT DESCRIPTION**

This unit specifies the competencies required to perform electrical installation. Competencies include: performing installation system sizing and installing electrical 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. 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. | |
| 1. Install electrical system | | 1. Health and safety procedures are adhered to in accordance with work requirements.. 2. Wiring diagrams are prepared as per schematic diagram. 3. Tools, equipment and materials are acquired as per work plan. 4. ***Cable management systems*** are installed as per IEC standards 5. Earthing and protection systems are installed as per IEC standards 6. Cables and conductors are installed as per IET regulations 7. Cables are jointed as per IET regulations 8. Cables are terminated using proper ***termination techniques*** as per IET regulations 9. Cables are labelled as per IET regulations 10. Accessories are installed as per working drawing and IET regulations 11. As-built drawing is prepared as per installation deviations 12. ***Housekeeping practices*** are performed according to 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. Cable management systems may include but is not limited to: | * Conduit * Cable trays * Cable duct * Bus-bars |
| 1. Termination techniques may include but is not limited to: | * Cable lugs * Cable cladding * Cable joints |
| 1. Housekeeping practices may include but is not limited to: | * Disposal of waste * Cleaning * Tools storage * Reusing and recycling |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

The individual needs to demonstrate knowledge and understanding of:-

* The legal requirements relating to activities for electrical 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 installation works
* 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 electrical installation components
* The hazards associated with operating construction and operation of electrical system.
* Identification of users to be trained

**FOUNDATION SKILLS**

* Communications (verbal and written);
* Proficient in ICT;
* Time management;
* Problem solving;
* Negotiation
* Decision making;
* First aid;
* Report writing;
* 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 in accordance work requirements. 2. Estimated Load as per client requirements. 3. Determined Protective devices as per IET regulations 4. Identified Accessories ratings as per IET regulations 5. Installed Earthing and protection systems as per acceptable standards 6. Installed Cables and conductors as per acceptable standards 7. Terminated cables as per IET regulations 8. Installed accessories as per working drawing and IET regulations |
| 1. Resource Implications | The following resources must be provided:  Resources same as that of workplace are advised to be applied  including   1. Measuring tools 2. cutting tools 3. fastening tools 4. PPE 5. accessories and cables |
| 1. Methods of Assessment | Competency may be assessed through:   1. Practical demonstration 2. Projects 3. Written tests 4. 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 | 1. Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## PERFORM ELECTRICAL INSTALLATION II

**UNIT CODE:** 0713 451 10A

**UNIT DESCRIPTION**

This unit specifies the competencies required to perform electrical installation. Competencies include: Install electrical system, testing electrical installation and maintaining 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. Install electrical system | | * 1. Health and safety procedures are adhered to in accordance with work requirements..   2. Wiring diagrams are prepared as per schematic diagram.   3. Tools, equipment and materials are acquired as per work plan.   4. ***Cable management systems*** are installed as per IEC standards   5. Earthing and protection systems are installed as per IEC standards   6. ***Electrical machines*** are installed as per IET regulations   7. Cables and conductors are installed as per IET regulations   8. Cables are jointed as per IET regulations   9. Cables are terminated using proper ***termination techniques*** as per IET regulations   10. Cables are labelled as per IET regulations   11. Accessories are installed as per working drawing and IET regulations   12. As-built drawing is prepared as per installation deviations   13. ***Housekeeping practices*** are performed according to work requirements. | |
| 1. Test electrical installation | | * 1. Electrical installation conditions are ***visually inspected*** as per IET regulations.   2. Continuity test is performed 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   6. Earth loop impedance tests are carried out as per IET regulations | |
| 1. Maintain electrical installation | | * 1. Maintenance schedule is prepared as per organization procedures   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. System 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. Electrical machines may include but is not limited to: | * 3 phase motors * Direct Online (DOL) * Star Delta |
| 1. Cable management systems may include but is not limited to: | * Conduit * Cable trays * Cable duct * Bus-bars |
| 1. Termination techniques may include but is not limited to: | * Cable lugs * Cable cladding * Cable joints |
| 1. Housekeeping practices may include but is not limited to: | * Disposal of waste * Cleaning * Tools storage * Reusing and recycling |
| 1. Visually inspected may include but is not limited to: | * Color codes * Labelling * Termination |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

The individual needs to demonstrate knowledge and understanding of:-

* The legal requirements relating to activities for electrical 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 installation works
* 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 electrical installation components
* The hazards associated with operating construction and operation of electrical system.
* Identification of users to be trained

**FOUNDATION SKILLS**

* Communications (verbal and written);
* Proficient in ICT;
* Time management;
* Problem solving;
* Negotiation
* Decision making;
* First aid;
* Report writing;
* 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 in accordance work requirements.   2. Determined Protective devices as per IET regulations   3. Identified Accessories ratings as per IET regulations   4. Installed Earthing and protection systems as per acceptable standards   5. Installed Cables and conductors as per acceptable standards   6. Terminated cables as per IET regulations   7. Installed accessories as per working drawing and IET regulations   8. Performed electrical installation testing per IET regulations   9. Prepared Maintenance schedule as per organisation procedures   10. Carried out Maintenance activities as per IET regulations.   11. Updated maintenance records as per maintenance strategy |
| 1. Resource Implications | The following resources must be provided:  Resources same as that of workplace are advised to be applied  including   1. Measuring tools 2. cutting tools 3. fastening tools 4. PPE 5. accessories and cables |
| 1. Methods of Assessment | Competency may be assessed through:   1. Practical demonstration 2. Projects 3. Written tests 4. 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 | 1. Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## DESIGN SOLAR PV SYSTEMS

**UNIT CODE:** 0713 451 11A

**UNIT DESCRIPTION**

This unit covers the competencies required to design solar PV systems. Competencies include: surveying solar PV system site, sizing DC and AC components, sizing cables, bus bars and earth strips and also preparing solar PV drawings and bill of quantities.

**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. Survey Solar PV System Site | | * 1. Health and safety procedures are adhered to in accordance to work requirements.   2. Site conditions are assessed as per mapped location.   3. Tools and equipment are identified as per site condition.   4. ***Solar PV system components*** are identified as per the drawing.   5. Solar PV system components mounting points are marked on the site as per the drawing. | |
| 1. Size DC and AC components | | * 1. Peak sun hours are determined based on-site insolation.   2. Total kilowatt demand is calculated based on user needs.   3. Solar PV module rating is calculated as per load requirements   4. Number of solar PV modules is determined as per load demand.   5. Charge controller size is determined as per load requirement   6. Battery bank capacity is determined as per user requirement.   7. Inverter capacity is determined as per load demand   8. Dc protective device is determined as per maximum power point current   9. Ac protective device is determined as per load current | |
| 1. Size cables, bus bars and earth strips | | * 1. Load current is determined as per system requirement   2. Cable and bus bars sizes are calculated according to IET regulations.   3. Type of earthing system(s***)*** is selected according to IET regulations. | |
| 1. Prepare Solar PV drawings and Bill of Quantities | | * 1. Single line diagram is prepared using a design software as per solar PV system design   2. Schematic diagram is prepared using design software as per solar PV system design   3. Wiring diagram is drawn as per solar PV system design   4. Bill of quantities is prepared based on solar PV system design | |

**RANGE**

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

| **Variable** | **Range** |
| --- | --- |
| 1. Solar PV system components may include but is not limited to: | * Solar PV module * Battery bank * Charge controllers * Inverters * Protective devices |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

The individual needs to demonstrate knowledge and understanding of:-

* The legal requirements relating to activities for electrical 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 installation works
* 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 electrical installation components
* The hazards associated with operating construction and operation of electrical 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. Adhered to health and safety procedures in accordance to work requirements.. 2. Assessed Site conditions as per mapped location. 3. Marked Solar PV system components mounting points on the site as per the drawing. 4. Determined peak sun hours based on site insolation. 5. Calculated total kilowatt demand based on user needs. 6. Determined number of solar PV modules as per load demand. 7. Determined charge controller size as per load requirement 8. Determined battery bank capacity as per user requirement. 9. Determined inverter capacity as per load demand 10. Determined Dc protective device as per maximum power point current 11. Determined Ac protective device as per load current 12. Calculated cable and bus bars sizes according to IET regulations. 13. Wiring diagram is drawn as per solar PV system design 14. Bill of quantities is prepared based on solar PV system design |
| 1. Resource Implications | The following resources should be provided:   1. Tools and equipment. 2. Installation Materials including calculator, stationery, appropriate software for designing 3. Copy of IET regulations 4. Manufacturer’s manual |
| 1. Methods of Assessment | Competency may be assessed through:   1. Practical demonstration 2. Projects 3. Written test |
| 1. Context of Assessment | 1. Competency may be assessed in a work place or a simulated work place. |
| 1. Guidance information for assessment | 1. Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## INSTALL SOLAR PV SYSTEMS

**UNIT CODE:** 0713 451 12A

**UNIT DESCRIPTION**

This unit covers the competencies required to install solar PV systems. Competencies include: constructing solar PV support structures, installing solar PV system components, testing solar PV system components 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. Construct Solar PV support structures | | 1. Safety procedures are adhered to as per work requirements. 2. Outdoor solar PV system mounting structures are constructed as per design requirement. 3. Indoor solar PV system mounting structures are constructed as per design requirement. | |
| 1. Install system component | | * 1. Solar PV module is mounted as per layout reticulation   2. Charger controller is mounted as per layout reticulation   3. Solar PV batteries are installed as per layout reticulation   4. Inverters are installed as per layout reticulation   5. Changeover switch is installed as per layout reticulation   6. Lightening arrestors base are installed as per design   7. Earth strips mounting brackets are installed as per type of installation   8. Earth pits are prepared as per IEC standards. | |
| 1. Test solar PV System | | * 1. Solar PV system conditions are visually inspected as per IET regulations.   2. Continuity test is conducted as per IET regulation   3. Insulation resistance test is conducted as per IET regulations.   4. Polarity test is conducted as per IET regulations.   5. Earth resistance tests are conducted as per IET regulations   6. Earth loop impedance tests are conducted as per IET regulations   7. Solar PV system is commissioned as per IEC standards | |
| 1. Maintain solar PV system | | * 1. Maintenance schedule is prepared as per the system requirement   2. Solar PV system is tested as per IET regulations.   3. Maintenance materials are prepared as per the maintenance requirement.   4. ***Maintenance activities*** are carried out as per IET regulations.   5. ***Maintenance records*** are documented 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. Maintenance activities may include but not limited to: | * Cleaning dusty modules * Topping up distilled water in batteries * Replacing old batteries * Replacing damaged modules * Tightening loose connections |
| 1. Maintenance records may include but not limited to: | * Maintenance checklist * Maintenance reports |

**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
    - Communication Authority (CA)
* The importance of working to agreed timelines
* How to prepare, interpret and use sources of technical information for scheduled system installation activities
* 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. Adhered health and safety procedures in accordance to work requirements.. 2. Mounted Solar PV module as per layout reticulation 3. Mounted charger controller as per layout reticulation 4. Installed Solar PV batteries as per layout reticulation 5. Installed Inverters as per layout reticulation 6. Installed lightening arrestor’s base as per design. 7. Visually inspected Solar PV system conditions as per IET regulations. 8. Prepared maintenance schedule as per the system requirement 9. Tested Solar PV system as per IET regulations. 10. Carried out maintenance activities as per IET regulations |
| 1. Resource Implications | The following resources should be provided:   1. Tools and equipment. 2. Solar PV module 3. Inverters 4. Charge controllers 5. Batteries 6. Protective devices 7. Copy of IET regulations 8. Manufacturer’s manual |
| 1. Methods of Assessment | Competency may be assessed through:   1. Practical demonstration 2. Observation 3. Written assessments 4. 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 | 1. Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## INSTALL SOLAR PV PUMPS SYSTEM

**UNIT CODE:** 0713 451 13A

**UNIT DESCRIPTION**

This unit covers the competencies required to install solar PV pumps system. Competencies include: surveying solar PV system site, sizing solar PV pump system, constructing solar PV pump system support structures, installing solar PV pump system components, testing solar PV pump system and maintaining solar PV pump 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. Survey Solar PV System Site | | * 1. Health and Safety Procedures are adhered to in accordance to Work requirements.   2. ***Site parameters*** are assessed as per mapped location.   3. Tools and equipment are identified as per site condition.   4. ***Solar PV pump system components*** are identified as per the drawing.   5. Solar PV pump system components mounting points are marked on the site as per the drawing. | |
| 1. Size solar PV pump system | | 1. Peak sun hours are determined based on-site insolation. 2. Total kilowatt demand is calculated based on user needs. 3. Solar PV module rating is calculated as per load requirements 4. Number of solar PV modules is determined as per load demand. 5. Dc protective device is determined as per maximum power point current 6. Solar PV pump is sized as per load requirements. | |
| 1. Construct Solar PV pump system support structures | | 1. Safety procedures are adhered to as per work requirements. 2. Solar PV module mounting structures are constructed as per design requirement. 3. Solar PV pump mounting structures are constructed as per design requirement. | |
| 1. Install Solar PV pump system components | | 1. Solar PV module is mounted as per layout reticulation 2. Solar PV pump is installed as per layout reticulation 3. DC-DC converter is installed as per layout reticulation 4. Lightening arrestors base are installed as per design 5. Earth strips mounting brackets are installed as per type of installation 6. Earth pits are prepared as per IEC standards. | | |
| 1. Test solar PV pump system | | * 1. Electrical installation conditions are visually inspected as per IET regulations.   2. Continuity test is performed 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 solar PV pump system | | * 1. Maintenance schedule is prepared as per the system requirement   2. Solar PV pump system is tested as per IET regulations.   3. Maintenance materials are prepared as per system requirement.   4. Maintenance activities are carried out as per IET regulations.   5. Maintenance records are documented 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. Site parameters may include but is not limited to: | * Irradiance * Orientation * Sun hours / insolation |
| 1. Solar PV pump system components may include but is not limited to: | * Solar PV pump * Solar PV module * Protective devices |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

The individual needs to demonstrate knowledge and understanding of:

* The manufacturer's warranty requirements relating to installation of Solar PV systems related components.
* The legal requirements relating to commissioning activities for Solar PV 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 Solar PV system installation information
* The importance of working to agreed timelines
* How to prepare, interpret and use sources of technical information for scheduled Solar PV installation activities
* 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 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 in accordance to work requirements. 2. Assessed site conditions as per mapped location. 3. Identified tools and equipment as per site condition. 4. Identified solar PV pump system components as per the drawing. 5. Determined DC protective device as per maximum power point current 6. Sized solar PV pump as per load requirements. 7. Mounted solar PV module as per layout reticulation 8. Installed solar PV pump as per layout reticulation 9. Installed lightening arrestors base as per design 10. Prepared maintenance schedule as per the system requirement 11. Tested solar PV pump system as per IET regulations. 12. Carried out maintenance activities as per IET regulations. 13. Documented maintenance records as per maintenance strategy |
| 1. Resource Implications | The following resources should be provided:   1. Solar installation tool kit 2. Solar PV pump 3. Solar PV module 4. Testing equipment 5. Measuring equipment   Resources the same as that of workplace are advised to be applied |
| 1. Methods of Assessment | Competency may be assessed through:   1. Practical demonstration 2. Projects 3. Written tests 4. Oral test |
| 1. Context of Assessment | 1. Competency may be assessed in a workplace or a simulated workplace. |
| 1. Guidance information for assessment | 1. Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## PERFORM SECURITY SYSTEM INSTALLATION

**UNIT CODE:** 0713 451 14A

**UNIT DESCRIPTION**

This unit covers the competencies required to perform security system installation. Competencies include: installing security systems, testing security system installation 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. Install security systems | | 1. Health and Safety Procedures are adhered in accordance to Work requirements. 2. ***Security system*** installation drawing is interpreted as per the design. 3. List of materials, tools and equipment is prepared as per design. 4. Work site is prepared for accessibility of utilities as per installation requirement 5. Installation points and zones are identified as per design parameters 6. Cables are laid and segregated as per IET regulations 7. ***Security system components*** are installed as per design 8. Security system is configured as per system functionality 9. Cables are labelled as per the IET regulations 10. Housekeeping practices are performed according work requirements. | |
| 1. Test security system installation | | 1. Security system conditions are visually inspected as per IET regulations. 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. 6. Security system is commissioned as per IEC standards. | |
| 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 is not limited to: | * CCTV (Burglar alarm) * Fire alarm * Electric fence |
| 1. Security system components may include but is not limited to: | * Control panel * Siren * Bell * CCTV * Sensors |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

The individual needs to demonstrate knowledge and understanding of:

* The manufacturer's warranty requirements relating to installation of Security systems related 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 installation of Security systems information
* The importance of working to agreed timelines
* How to prepare, interpret and use sources of technical information for scheduled installation of Security systems activities
* 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.

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| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   1. Adhered to Health and Safety Procedures in accordance to work requirements. 2. Interpreted security system installation drawing as per the design 3. Identified installation points and zones as per design parameters 4. Laid and segregated Cables as per IET regulations 5. Installed Security system components as per design 6. Configured security system as per system functionality 7. Tested security system installation 8. Prepared Maintenance schedule as per OEMs and organization procedures. 9. Rectified Faults as per service manual. 10. Prepared Maintenance report as per organization requirements. |
| 1. Resource Implications include but not limited to | The following resources should be provided:   1. Tools and Testing equipment 2. Electrical power 3. Stationery 4. Cameras 5. Monitor 6. Buzzer 7. Bell 8. Siren 9. Sensors |
| 1. Methods of Assessment | Competency may be assessed through:   1. Practical demonstration 2. Projects 3. Written tests 4. Oral test |
| 1. Context of Assessment | 1. Competency may be assessed in a work place or a simulated work place. |
| 1. Guidance information for assessment | 1. Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |