

**REPUBLIC OF KENYA**

**OCCUPATIONAL STANDARDS**

**FOR**

**INSTRUMENTATION AND CONTROL TECHNICIAN LEVEL 5**

**KNQF LEVEL 5**

**PROGRAMME CODE: 0714 451A**

**ABBREVIATI0N AND ACRONYMS**

**AC** – Alternating Current

**BJT** – Bipolar Junction Transistor

**CAD** – Computer-Aided Design

**CD** – Compact Disc

**CPU** – Central Processing Unit

**CV** – Control Valve

**DC** – Direct Current

**DOL** – Direct Online Starter

**DVD** – Digital Versatile Disc

**DVI** – Digital Visual Interface

**EHS** – Environment, Health, and Safety

**EPRA** – Energy and Petroleum Regulatory Authority

**FET** – Field-Effect Transistor

**HDMI** – High-Definition Multimedia Interface

**HMI** – Human-Machine Interface

**HSE** – Health, Safety, and Environment

**ICT** – Information and Communication Technology

**IEC** – International Electrotechnical Commission

**IEE** – Institution of Electrical Engineers

**IET** – Institution of Engineering and Technology

**ISCED** – International Standard Classification of Education

**ISDN** – Integrated Services Digital Network

**NEMA** – National Electrical Manufacturers Association

**OEMs** – Original Equipment Manufacturers

**OS** – Occupational Standard

**OSHA** – Occupational Safety and Health Administration

**PC** – Personal Computer

**PID** – Proportional-Integral-Derivative

**PLC** – Programmable Logic Controller

**PPE** – Personal Protective Equipment

**RAM** – Random Access Memory

**SI** – International System of Units

**SMS** – Short Message Service

**TV** – Television

**USB** – Universal Serial Bus

**VGA** – Video Graphics Array

Contents

[SUMMARY OF UNITS OF COMPETENCY 4](#_Toc195689124)

[BASIC UNITS OF COMPETENCY 5](#_Toc195689125)

[APPLY DIGITAL LITERACY 6](#_Toc195689126)

[APPLY COMMUNICATION SKILLS 15](#_Toc195689127)

[APPLY WORK ETHICS AND PRACTICES 19](#_Toc195689128)

[APPLY ENTREPRENEURIAL SKILLS 26](#_Toc195689129)

[APPLY BASIC MATHEMATICS 33](#_Toc195689130)

[APPLY ELECTRICAL PRINCIPLES 37](#_Toc195689131)

[FABRICATE ELECTRONIC CIRCUITS 41](#_Toc195689132)

[PREPARE ENGINEERING DRAWING AND DESIGN 46](#_Toc195689133)

[INSTALL ELECTRICAL MACHINES 50](#_Toc195689134)

[CORE UNITS OF COMPETENCY 54](#_Toc195689135)

[PERFORM ELECTRICAL INSTALLATION 55](#_Toc195689136)

[OPERATE INSTRUMENTATION AND CONTROL SYSTEM 59](#_Toc195689137)

[MAINTAIN INSTRUMENTATION AND CONTROL SYSTEMS 63](#_Toc195689138)

[INSTALL INSTRUMENTATION AND CONTROL SYSTEM COMPONENT 68](#_Toc195689139)

[INSTALL LOGIC CONTROLLERS 71](#_Toc195689140)

[INSTALL HYDRAULIC AND PNEUMATIC SYSTEM 77](#_Toc195689141)

# SUMMARY OF UNITS OF COMPETENCY

|  |  |
| --- | --- |
| **BASIC UNITS OF COMPETENCY** | |
| **UNIT CODE** | **UNIT TITLE** |
| 0611 451 01A | Apply digital literacy |
| 0031 451 02B | Apply communication skills |
| 0417 451 03B | Work ethics and practices |
| 0413 451 04B | Apply entrepreneurial skills |
| **COMMON UNITS OF COMPETENCY** | |
| 0541 451 05A | Apply Basic Mathematics |
| 0732 451 06A | Prepare Engineering Drawing and Design |
| 0713 451 07A | Apply Electrical Principles |
| **CORE UNITS OF COMPETENCY** | |
| 0713 351 13A | Perform electrical installation |
| 0714 351 14A | Install instrumentation and control system component |
| 0714 351 15A | Operate instrumentation and control system |
| 0714 351 16A | Maintain Instrumentation and Control Systems |
| 0714 451 17A | Install Logic Controllers |
| 0714 451 18A | Fabricate Electronics circuit |
| 0714 451 19A | Install Hydraulic and Pneumatic System |
| 0713 441 20A | Install electrical machines |

# BASIC UNITS OF COMPETENCY

## APPLY DIGITAL LITERACY

**UNIT CODE: 0611 451 01A**

**UNIT DESCRIPTION:**

This unit covers the competencies required to apply digital literacy. It involves operating computer devices, solving tasks using office suite, accessing online/offline data and information, managing data and information, performing online communication and collaboration, applying cyber security skills, performing jobs online and applying for job entries.

**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. ***Computer 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. ***Cyber security 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 include but are not limited to: | * Desktops * Laptops * Smartphones * Tablets * Smart watches |
| 1. Computer hardware 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 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 include but are not limited to: | * Printers * Projectors * Smart Boards * Speakers * External storage drives * Digital/Smart TVs |
| 1. Word processing concepts include but are not limited to: | * Creating word documents * Editing word documents * Formatting word documents * Saving word documents * Printing word documents |
| 1. Mouse techniques include but are not limited to: | * Clicking * Double-clicking * Right-clicking * Drag and drop |
| 1. Internet connection options 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 include but are not limited to: | * Use of formulae * Use of functions * Sorting * Filtering * Visual representation using charts |
| 1. Electronic presentation concepts 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 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 * News Group * Ecommerce |
| 1. Internet access applications/software include but are not limited to: | * Browsers * Email Apps * E Commerce Apps |
| 1. Online collaboration tools 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 include but not limited to: | * Confidentiality of data/information * Integrity of data/information * Availability of data/information |
| 1. Internet security threats 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 include but not limited to: | * Counter measures against cyber terrorism * Physical Controls * Technical/Logical Controls * Operational Controls |
| 1. Online job platforms include but are not limited to: | * Remotask * Data annotation.tech * Cloudworker * Upwork * Oneforma * Appen |
| 1. Job opportunities include but not limited to: | * Self-employment * Service provision * product development * salaried employment |
| 1. Certificates and testimonialsinclude but not limited to: | * Academic credentials * Letters of previous employments/ services rendered * Letters of commendation * Certifications of participation * Awards |
| 1. Interview skills 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. Prepared job requirement documentations based on job opportunity.   8. Demonstrated interview skills based on the job opportunity. |
| 1. Resource implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work environments where assessment can take place.   3. Resources relevant to the proposed activities or task. |
| 1. Methods of assessment | Competency in this unit may be assessed through:   * 1. Observation   2. Oral assessment   3. Portfolio of evidence   4. Interviews   5. Third party report   6. Written assessment   7. Practical assessment   8. Projects |
| 1. Context of assessment | Competency may be assessed:   * 1. Workplace or simulated workplace. |
| 1. Guidance information for assessment | * 1. Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

## APPLY COMMUNICATION SKILLS

**UNIT CODE: 0031 451 02B**

**UNIT DESCRIPTION**

This unit covers the competencies required to apply communication skills. It involves applying communication channels, written communication skills, non-verbal skills, oral communication skills 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 to enhance inclusivity according to workplace requirements.  3.3 Non-verbal communication techniques are 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.

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

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

**Required Knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

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

## APPLY WORK ETHICS AND PRACTICES

**UNIT CODE: 0417 451 03B**

**UNIT DESCRIPTION**

This unit covers competencies required to apply work ethics and practices. It involves applying self-management skills, promoting ethical practices and values, promoting teamwork, maintaining professional and personal development, applying problem-solving skills, and promoting customer care.

**ELEMENTS AND PERFORMANCE CRITERIA**

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

**RANGE**

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

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

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

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

**Required Knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

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

## APPLY ENTREPRENEURIAL SKILLS

**UNIT CODE : 0413 451 04B**

**UNIT DESCRIPTION**

This unit covers the competencies required to apply entrepreneurial skills. It involves applying financial literacy, entrepreneurial concepts, identifying entrepreneurship opportunities, applying business legal aspects, innovating business strategies and developing a business plan.

**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 include but 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. Types of entrepreneurs include but not limited to: | * Innovators * Imitators * Craft * Opportunistic * Speculators |
| 1. Characteristics of Entrepreneurs 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 include but not limited to | * Technical skills * Management skills * Entrepreneurial skills * Resources * Infrastructure |
| 1. Forms of businesses ownership include but not limited to: | * Sole proprietorship * Partnership * Limited companies * Cooperatives |
| 1. Innovative business standards include but not limited to: | * New products * New methods of production * New markets * New sources of supplies * Change in industrialization |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

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

**Required Knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

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

# COMMON UNITS

## APPLY BASIC MATHEMATICS

**UNIT CODE: 0541 451 05A**

**UNIT DESCRIPTION**

This unit describes the competencies required to apply engineering technician mathematics. It involves applying algebra, matrices, trigonometry and statistics.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***(Bold and italicized terms are elaborated in the Range)*** |
| --- | --- |
| * + 1. Apply algebra | * 1. Solutions of linear, quadratic, and simultaneous equations are obtained as per algebraic concepts.   2. Laws of indices and exponential rules are applied as per algebraic principles.   3. Algebraic expressions are simplified and rearranged as per the concept.   4. Binomial expansion and small change approximations are carried out as per algebraic methods. |
| * + 1. Apply matrices | * 1. ***Matrices Operations*** is carried out as per the concept   2. Determinant and inverse of 3x3 matrix are obtained as per the concept.   3. Solutions of simultaneous equations are obtained as per matrix concept. |
| * + 1. Apply trigonometry | * 1. Problems involving right and oblique triangles are solved using sine, cosine, and tangent rules as per trigonometric concepts.   2. ***Trigonometric identities*** and ***inverse trigonometric functions*** are applied as per mathematical methods.   3. ***Trigonometric ratios*** are applied as per mathematical methods   4. ***Hyperbolic functions*** and inverse hyperbolic functions are applied in technical contexts as per trigonometric concepts |
| 4.Apply Statistics | 1. Data collection is performed as per statistics concept 2. ***Measures of central tendencies*** are obtained as per statistics concept. 3. ***Measures of dispersion*** are obtained as per statistics concept. 4. ***Data presentation*** is carried out as per statistics concept 5. Data interpretation is carried out as per statistics concept |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| * 1. Matrices Operations include but not limited to: | * Addition * Subtraction * Multiplication * Division |
| * 1. Measures of central tendencies include but not limited to: | * Mean * Median * Mode * Standard deviation * Variance |
| * 1. Measures of dispersion | * Range * Interquartile range * Standard deviation * Variance |
| * 1. Data presentation includes but not limited to: | * Pie chart * Line graphs * Bar charts * Histograms * Frequency polygons |
| * 1. Trigonometry ratios include but not limited to: | * Sine * Cosine * Tangent * Sec * Cosec * Cot |
| * 1. Inverse trigonometric ratios | * Inverse of sine * Inverse of cosine * Inverse of tangent |
| * 1. Hyperbolic functions | * Sinh x * Cosh x * Cosec x * Tanh x * Sech x |
| * 1. Trigonometric functions Integrals | * Sine * Cosine * Tangent |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

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

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Fundamental operations (addition, subtraction, division, multiplication)
* Types of fractions
* 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. Performed simultaneous equations as per rules.   2. Performed quadratic equations as per concept.   3. Carried out binomial expansion as per mathematical methods   4. Carried out matrices operations as per concept.   5. Obtained determinant and inverse of 3x3 matrix as per concept.   6. Obtained solutions of simultaneous equations as per matrix concept.   7. Applied trigonometry and hyperbolic functions as per mathematical methods   8. Obtained measures of central tendencies as per statistics concept.   9. Obtained measures of dispersion as per statistics concept.   10. Carried out data presentation as per statistics concept. |
| 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 may be assessed through:**   1. Written tests 2. Practical Assessment 3. Projects |
| 1. Context of Assessment | Competency may be assessed in a workplace or a simulated workplace. |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY ELECTRICAL PRINCIPLES

**UNIT CODE: 0713 451 07A**

**UNIT DESCRIPTION**

This unit describes the competencies required to apply electrical principles. It involves applying electrical quantities, using cells and batteries, applying concepts of dc circuit, magnetism and electromagnetism, electrostatics principles, and ac circuits.

**ELEMENTS AND PERFORMANCE CRITERIA**

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

**RANGE**

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

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

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

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

**Required knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

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

## PREPARE ENGINEERING DRAWING

**UNIT CODE: 0732 451 06A**

**UNIT DESCRIPTION**

This unit covers the competencies required to prepare engineering drawings. It involves 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. Manage basic operations in AutoCAD | | * 1. ***Key features*** of CAD software are identified as per software manual.   2. ***AutoCAD visual reference commands*** are operated as per software manual.   3. AutoCAD navigation commands option is operated as per software manual.   4. AutoCAD ***ribbon*** tools are used as per software manual.   5. AutoCAD ***status bar*** tools are used as per software manual.   6. AutoCAD drawing files are saved in proper format as per organisational procedures   7. AutoCAD drawing work is printed as per software manual. |
| 1. Develop 2D Drawings in AutoCAD | | 1. Drawing interface is set up as per required specifications. 2. Layout is created as per given specification. 3. 2D drawing is created as per given dimension. 4. 2D drawing is edited as per given requirement changes. 5. AutoCAD drawing is saved in CAD file format as per software manual. 6. AutoCAD 2D drawing work is printed as per software manual. |
| 1. Produce pictorial and orthographic drawings of components | | **3.1** Differences between pictorial and orthographic drawings are explained as per technical drawing standards.  **3.2** Orthographic elevations are drawn and interpreted using CAD as per technical drawing standards.  **3.3** Orthographic elevations are dimensioned accurately as per technical drawing standards.  **3.4** The 3D CAD user interface is navigated as per software manual.  **3.5** 3D commands are applied as per software manual.  **3.6** 3D Cartesian workspace is utilized as per work requirements.  **3.7** Basic 3D solids are created as per technical drawing standards.  **3.8** Pictorial drawings are produced as per technical drawing standards.  **3.10** 3D drawings are documented as per workplace procedures. |
| 1. Develop electrical schematic drawings using simulation software | | * 1. Schematic drawing software (e.g., Circuit Wizard, Multisim) is identified and launched as per user manual.   2. Electrical and electronic components are selected and placed as per circuit diagram requirements.   3. Circuit connections are created accurately using appropriate wiring tools.   4. Component values and labels are assigned as per circuit specifications.   5. Circuit simulation is run to verify functionality as per design intent.   6. Errors in the schematic are identified and corrected using software diagnostics.   7. Schematic files are saved in appropriate formats as per organizational procedures.   8. Schematic diagrams are printed or exported as per workplace 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. ***Key features*** may include but not limited to: | * 2D drafting and drawing * 3D drafting and drawing |
| 1. ***AutoCAD visual reference commands*** mayinclude but not limited to: | * Visual styles * Materials and textures * Writing * Rendering * View port |
| 1. ***Ribbon*** may include but not limited to: | * Draw panel * Modify panel * Layer * Annotation |
| 1. ***Status bar*** may include but not limited to: | * Snap * Grid * Ortho * Object snap * Polar tracking * Isometric drafting |

**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. Operated AutoCAD visual reference commands as per software manual. 2. Used AutoCAD ribbon tools as per software manual. 3. Used AutoCAD status bar tools as per software manual. 4. Operated AutoCAD navigation commands option as per software manual. 5. Printed AutoCAD drawing work as per software manual 6. Printed AutoCAD 2D drawing work as per software manual 7. Edited 2D drawing as per given requirement changes. 8. Created 2D drawing as per given dimension 9. Basic 3D solids created as per technical drawing standards 10. Constructed a schematic circuit using appropriate software such as Circuit Wizard, Multisim or any other appropriate schematic software. |
| 1. Resource Implications | * 1. Drawing room   2. Drawing equipment and materials   3. Computers   4. CAD packages   5. Drawing softwares |
| 1. Methods of Assessment | 1. Practical demonstration 2. Projects 3. Written tests 4. Oral test |
| 1. Context of Assessment | Competency may be assessed in a workplace or a simulated workplace. |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# CORE UNITS OF COMPETENCY

## INSTALL ELECTRICAL MACHINES

**UNIT CODE: 0713 451 20A**

**UNIT DESCRIPTION**

This unit covers competences required to install electrical machines. It involves installing electrical machines, testing electrical machine installations, and maintaining electrical machine installations.

**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 machine | | * 1. Safety procedures are adhered to as per work requirements.   2. Wiring diagrams are prepared as per schematic diagram.   3. Materials, tools and equipment are assembled as per scope of installation.   4. Electrical machine support is constructed/set up as per design.   5. Mounting of the machine is carried out as per load, size and functionality.   6. ***Control gear*** is installed as per machine design.   7. Conduits, trunks, enclosures and support systems are installed as per layout diagram and IET regulations.   8. Cables and conductors are installed as per acceptable standards.   9. Cable termination is performed as per IEC standards.   10. Cables are labelled as per IET regulations.   11. ***Housekeeping practices*** are performed according to EHS and OSHA. | |
| 1. Test electrical machine installation | | * 1. Type of tests are identified as per IET regulations   2. Electrical Machine installation conditions are visually inspected as per IET regulations   3. Firmness of the installation is verified as per IET regulations   4. Insulation resistance test is carried out as per IET regulations   5. Continuity test is carried out as per IET regulation   6. Earthling tests are carried out as per IET regulations   7. On load and off load tests are carried out as per the manufacturer’s manual.   8. Test results are documented as per workplace requirements. | |
| 1. Maintain electrical machine installation | | * 1. Maintenance schedule is prepared as per OEMS and organization procedures.   2. System maintenance check list is prepared as per tasks and manufacturer’s manual.   3. Maintenance tools and equipment are selected as per scheduled maintenance.   4. Inspection and tests are carried out as per OEMS.   5. Faults are diagnosed as per service manual.   6. Faults are rectified as per service manual.   7. Maintenance report is prepared as per organization requirements***.*** | |

**RANGE**

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

| **Variable** | **Range** |
| --- | --- |
| 1. ***Control gear*** may include but not limited to: | * DOL * Star delta * Forward reverse * Disconnect switches * Circuit breaker |
| 1. ***Housekeeping practices*** may include but not limited to: | * Disposal of waste * Cleaning * Tools storage * Reusing and recycling |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

The individual needs to demonstrate knowledge and understanding of:

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

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

1. County/ Government bylaws
   * + EPRA (Energy & Petroleum Regulatory Authority)
     + NEMA
     + Communication Authority (CA)
2. The importance of working to agreed timelines
3. How to prepare, interpret and use sources of technical information for scheduled system installation activities
4. The purpose of and how to use identification codes (e.g., colour codes).
5. The operating specifications and tolerances for different types of installed systems
6. The hazards associated with operating the system.
7. Identification of users to be trained

**FOUNDATION SKILLS**

The individual needs to demonstrate the following additional skills:

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

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   1. Adhered to Health and Safety Procedures as per work requirements. 2. Constructed Electrical machine support as per design. 3. Carried out Mounting of the machine as per load, size and functionality. 4. Installed Control gear as per machine design. 5. Installed Cables and conductors as per acceptable standards. 6. Tested electrical machine installation. 7. Prepared Maintenance schedule as per OEMS and organization procedures. 8. Rectified Faults as per service manual. |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work environments.   3. Resources relevant to the proposed activities or task. |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Practical demonstration   2. Observation   3. Written assessments   4. Oral questioning |
| 1. Context of Assessment | Competency may be assessed in a work place or a simulated work place. |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## PERFORM ELECTRICAL INSTALLATION

**UNIT CODE**: **0713 351 13A**

**UNIT DESCRIPTION**

This unit specifies the competencies required for performing electrical installation. It involves preparing a list of tools equipment and materials, performing piping, and laying of cables, installing of electrical components, terminating of electrical installation, and inspecting and testing the installation and documenting an 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 italicized terms are elaborated in the Range)*** |
| --- | --- |
| 1. Prepare a list of tools equipment and materials | * 1. Tools, equipment and materials are identified, and list prepared as per established procedure   2. ***Tools, equipment and materials specifications*** are checked for as per their functionality   3. Tools, equipment and materials are assembled and stored as per established procedure |
| 1. Perform piping and laying of cables | * 1. Safety procedures are observed in adherence to OSHA   2. Piping is performed as per working drawing   3. Piping is performed in line with standard operating procedure   4. Number and size of cables are laid in a conduit as per the IEE regulations   5. Cables, conduits, enclosures and support systems are installed as per the working drawing   6. Cables are drawn-in in line with standard operating procedures |
| 1. Install electrical components | * 1. Components are installed in line with the design   2. Components to be installed are identified as per installation requirements   3. Components are installed in adherence to IEE regulations |
| 1. Terminate Electrical Installation | * 1. Cable lugging is performed as per the standards operating procedure.   2. Cables are terminated as per the IEE regulations   3. Labelling of the cables is performed as per the complexity of the job. |
| 1. Inspect and test installation | * 1. Types of tests are identified according to the nature of the installation   2. Testing is conducted according to the IEE regulations   3. Test parameters are recorded in line with the workplace procedures   4. Testing instruments are identified as per the type of testing expected to be carried out |
| 1. Document an Electrical installation | * 1. Report is prepared in accordance with the industry best practices   2. Report is shared with the relevant parties as per the installation contract   3. Report is filed in adherence to the organization filing system |

**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 specifications may include but not limited to : | * Make / model * Size * Class |

**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:

* Communications (verbal and written)
* Time management
* Problem solving
* Decision making
* First aid
* Planning
* Negotiation

**Required knowledge**

The individual needs to demonstrate knowledge of:

* The manufacturer's warranty requirements relating to electrical installation systems and related components.
* The legal requirements relating to electrical installations
* Kenyan legislation and workplace procedures relevant to:
  + - Health and safety
    - Environment (including waste disposal)
    - Appropriate personal protective equipment (PPE).
* Workplace procedures for:
  + - Workplace communication
    - Time management
    - Materials management
* The use of technical information including:
  + - The importance of using the correct sources of technical information.
* Interpreting circuits, drawings, specifications and instructions

**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. Prepared a list of tools, equipment and materials as per established procedure   2. Checked tools, equipment and materials for specifications and functionality as per the standard operating procedure   3. Laid number and size of cables in a conduit as per the IEE regulations   4. Drawn-in cables line with standard operating procedures   5. Mounted components in accordance to the working drawings   6. Terminated cables as per the IEE regulations   7. Performed labelling of the cables as per the complexity of the job.   8. Identified types of tests according to the nature of the installation   9. Conducted testing according to the IEE regulations   10. Prepared Report in accordance with the industry best practices |
| 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. Observation 2. Oral questioning 3. Practical demonstration 4. Written tests |
| 1. Context of Assessment | Competency may be assessed   1. On the job 2. Off the job 3. During industrial attachment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## OPERATE INSTRUMENTATION AND CONTROL SYSTEM

**UNIT CODE: 0714 351 15A**

**UNIT DESCRIPTION**

This unit covers competencies required to operate instrumentation and control system. The competences includes performing instrumentation and control system start up, performing instrumentation and control system changeover and running instrumentation and control system

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| ELEMENT  These describe the key outcomes which make up workplace functions | PERFORMANCE CRITERIA  These are assessable statements which specify the required level of performance for each of the elements  ***(Bold and italicized terms are elaborated in the range)*** |
| 1. Perform instrumentation and control system start up | 1. Safety procedures are applied as per manufacturer’s manual 2. Instrumentation and control system ***inspection*** is carried out as per manufacturer’s specifications 3. Instrumentation and control system is initialized as per manufacturer’s specifications 4. Instrumentation and control system active ***alarms*** are reset as per manufacturer’s specifications 5. Instrumentation and control system dry run is carried out manufacturer’s specifications |
| 1. Perform instrumentation and control system changeover | 1. ***Instrumentation and control system dies*** are identified as per job requirement 2. Instrumentation and control system tools and equipment are assembled as per job requirements 3. Instrumentation and control system die changeover is carried out as per job requirement 4. Instrumentation and control system dies are ***tested*** as per job requirement |
| 1. Run instrumentation and control system | 1. Instrumentation and control system ***raw materials*** are loaded as per job requirement 2. Instrumentation and control system recipe is selected as per job requirements. 3. Instrumentation and control system parameters are adjusted as per job requirements. 4. Instrumentation and control system monitoring is carried out as per job requirements. 5. Instrumentation and control system ***documentation*** is carried out as per job requirements. 6. Identified ***written communication methods*** are applied based on the workplace 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. inspection include but not limited to: | * + Firmness   + Tightness   + Gauges   + Levels   + Safety interlocks |
| 1. Instrumentation and control SYSTEM dies include but not limited to: | * + Moulds   + Star wheels   + Guide ways   + Worm wheels |
| 1. raw materials include but not limited to: | * + caps   + bottles   + preforms   + labels   + product |
| 1. documentation include but not limited to: | * + installation manuals   + maintenance manuals   + maintenance schedule   + checklist |
| 1. Written communication includes but not limited to: | * Memos * Letters * Notices * SMS |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required skills**

The individual needs to demonstrate the following skills:

* Troubleshooting
* data capture
* Interpretation of electrical drawing
* Problem solving
* Use of electrical & mechanical tools
* First aid
* Planning
* Time management
* Decision making

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Control system components
* MS Word & Excel
* Safety procedures and practices
* Electrical symbols and their meanings
* Electrical measurement
* Electrical tools and equipment

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   1. Applied safety procedures as per work requirement 2. Carried out instrumentation and control system inspection per manufacturer’s specifications 3. Reset Instrumentation and control system active alarms as per manufacturer’s specifications 4. Changed Instrumentation and control system dies as per job requirement 5. Loaded Instrumentation and control system raw materials as per job requirement 6. Selected Instrumentation and control system recipe as per job requirements. 7. Adjusted Instrumentation and control system parameters as per job requirements. 8. Carried out Instrumentation and control system monitoring as per job requirements. 9. Effected written communication based on workplace requirements |
| 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 may be assessed through:   * 1. Project   2. Practical   3. Portfolio of evidence   4. Third party reports   5. Oral questions   6. Written test |
| 1. Context of Assessment | Competency may be assessed individually in the actual workplace or simulated setting of the actual work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## MAINTAIN INSTRUMENTATION AND CONTROL SYSTEMS

**ISCED UNIT CODE: 0714 351 16A**

**UNIT DESCRIPTION**

This unit covers the competencies required to install instrumentation system skills. It involves Preparing instrumentation and control systems maintenance schedule, conducting instrumentation and control systems preventive maintenance, conducting instrumentation and control systems corrective maintenance, Testing and Commissioning instrumentation and control system

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| ELEMENT  These describe the key outcomes which make up workplace functions | PERFORMANCE CRITERIA  These are assessable statements which specify the required level of performance for each of the elements  Bold and italicized terms are elaborated in the range |
| 1. Prepare instrumentation and control systems maintenance schedule | * 1. Instrumentation and control systems maintenance manuals are interpreted as per manufacturer’s specifications.   2. ***Type of maintenance*** is identified as per manufacturer’s specifications   3. Instrumentation and control systems maintenance work plan is prepared as per work procedure   4. Instrumentation and control systems ***maintenance documents*** are prepared as per work procedure |
| 1. Conduct instrumentation and control systems preventive maintenance | * 1. Health and safety procedures are applied in accordance to work procedure   2. Instrumentation and control system components due for maintenance are identified as per manufacturer’s specifications.   3. Instrumentation and control system maintenance activities are performed as per maintenance manuals.   4. Instrumentation and control systems preventive maintenance is carried out as per manufacturer’s specifications. |
| 1. Conduct instrumentation and control systems corrective maintenance | 1. Health and safety procedures are applied in accordance to work procedure 2. Instrumentation and control system troubleshooting is performed as per manufacturer’s specifications. 3. Instrumentation and control system faulty components are identified as per job specifications. 4. Instrumentation and control system faulty components are rectified as per manufacturer’s specifications. |
| 1. Test and Commission instrumentation and control system | * 1. Health and safety procedures are applied in accordance to work procedure   2. Basic ***SI units*** in electrical are identified based on scope of work   3. ***Quantities*** of charge, force, work and power are identified as per Work requirement   4. Calculations involving ***electrical quantities*** are performed based on Work requirement   5. Calculations involving parallel and series circuits are performed as per Work requirement   6. Instrumentation and control systems ***Electrical tests*** are performed as per IEE regulations   7. Instrumentation and control system is test-run to ensure optimum functionality as per manufacturer’s specifications.   8. Instrumentation and control system housekeeping is carried out according to work procedure.   9. Instrumentation and control system maintenance report is prepared as per work procedure   10. End user is trained in accordance with standard operating procedure   11. Instrumentation and control system is handed over as per work procedure   12. Instrumentation and control system ***Commissioning documents*** are disseminated in accordance with work procedure |

**RANGE**

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

|  |  |
| --- | --- |
| Variable | Range |
| 1. *Type of maintenance* may include but not limited to: | * + Preventive maintenance   + Predictive maintenance   + Corrective maintenance   + Condition based maintenance   + Predetermined maintenance   + reactive maintenance |
| 1. SI unit include but is not limited to: | * + Power – Watts (W)   + Current – Amperes (A)   + Resistance – Ohms(Ω)   + Voltage – Volts (V) |
| 1. Quantities include but is not limited to: | * + Charge   + Force   + Work   + Power |
| 1. *electrical tests* may include but not limited to: | * + Polarity test   + Earth loop impedance test   + Insulation resistance test   + Earth electrode resistance test |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required skills**

The individual needs to demonstrate the following skills:

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

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Electrical power calculations
* Various laws in electrical engineering
* Control system components
* Safety procedures and practices
* Electrical symbols and their meanings
* Network Components and devices
* Electrical standards
* Power protection
* Measurement
* Types of maintenance

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   * 1. Applied health and safety procedures in accordance to work procedure   2. Prepared Instrumentation and control systems maintenance work plan as per work procedure   3. Prepared Instrumentation and control systems maintenance documents as per work procedure   4. Performed Instrumentation and control system maintenance activities as per maintenance manuals.   5. Carried out Instrumentation and control systems preventive maintenance as per manufacturer’s specifications.   6. Performed Instrumentation and control system troubleshooting as per manufacturer’s specifications.   7. Rectified Instrumentation and control system faulty components as per manufacturer’s specifications   8. Performed Instrumentation and control systems Electrical tests as per IEE regulations   9. Test-run Instrumentation and control system to ensure optimum functionality as per manufacturer’s specifications.   10. Identified basic SI units in Electrical based on scope of work   11. Identified Quantities of Charge, force, work and power as per work requirement   12. Performed calculations involving parallel and series circuits 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 environment 3. Resources relevant to the proposed activities or tasks |
| 1. Methods of Assessment | Competency may be assessed through:   1. Observation 2. Oral questioning 3. Written assessment 4. Practical demonstration 5. Report writing 6. Project 7. Portfolio of evidence 8. Third-party reports |
| 1. Context of Assessment | Competency may be assessed individually in the actual workplace or simulated setting of the actual work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## INSTALL INSTRUMENTATION AND CONTROL SYSTEM COMPONENT

**UNIT CODE**: **0714 351 14A**

**UNIT DESCRIPTION**

This unit covers the competencies required to install instrumentation and control system component. Competences includes: Preparing for installation of instrumentation and control system component, set-up instrumentation and control system component and testing instrumentation and control system component.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| ELEMENT  These describe the key outcomes which make up workplace functions | PERFORMANCE CRITERIA  These are assessable statements which specify the required level of performance for each of the elements  ***(Bold and italicized terms are elaborated in the range)*** |
| 1. Prepare for installation of instrumentation and control system component. | * 1. Health and safety procedures are applied as per work place procedure   2. ***Site conditions and installation*** requirements for instrumentation and control system component are assessed according to manufacturer’s specifications.   3. Instrumentation and control system component specifications are verified according to design requirements   4. Instrumentation and control system ***Tools, equipment and materials*** are selected as per job requirements.   5. Housekeeping is carried out according to workplace procedures. |
| 1. Set-up instrumentation and control system components | 1. Health and safety procedures are applied as per work place procedure 2. Instrumentation and control system component is mounted as per job requirement 3. Cable laying is performed as per IEE regulations 4. Instrumentation and control system component is terminated as per manufacturer’s specifications 5. Housekeeping is carried out according to workplace procedures. |
| 1. Test instrumentation and control system component | 1. Health and safety procedures are applied as per work place procedure 2. Electrical tests are performed as per IEE regulations 3. Instrumentation and control system is test run as per manufacturer’s specifications. 4. Instrumentation and control system documentation is carried out as per job requirements. 5. Housekeeping is carried out according to workplace procedure. |

**RANGE**

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

|  |  |
| --- | --- |
| Variable | Range |
| 1. site conditions include but not limited to: | * + temperature   + humidity   + distance   + dust   + light intensity   + pressure |
| 1. Tools, equipment and materials include but not limited to: | * + Hand tools   + Multimeters |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required skills**

The individual needs to demonstrate the following skills:

* Electrical Installation
* Wiring system
* Troubleshooting
* Interpretation of electrical drawing
* Use of electrical & mechanical tools
* Time management
* Decision making

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Various laws in electrical engineering
* Basic control system components
* MS Word & Excel
* Safety procedures and practices
* Electrical symbols and their meanings
* Power protection
* Measurement

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   * 1. Applied health and safety procedures as per work place procedure   2. Assessed site conditions and installation requirements for instrumentation and control system components according to manufacturer’s specifications.   3. Verified instrumentation and control system components specifications according to design requirements   4. Mounted instrumentation and control system components as per job requirements   5. Performed electrical tests as per IEE regulations   6. Test run instrumentation and control system as per manufacturer’s specifications. |
| 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 may be assessed through:   * 1. Project   2. Practical   3. Portfolio of evidence   4. Third party reports   5. Oral questions   6. Written test |
| 1. Context of Assessment | Competency may be assessed individually in the actual workplace or simulated setting of the actual work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## INSTALL LOGIC CONTROLLERS

**UNIT CODE: 0714 451 17A**

**UNIT DESCRIPTION**

This unit describes the competencies required to install logic controllers. It involves conducting logic controllers site survey, installing logic controller hardware, interfacing logic controller hardware, installing logic controller software, performing logic controller programming, and testing and commissioning logic controller system.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| ELEMENT  These describe the key outcomes which make up workplace functions | PERFORMANCE CRITERIA  These are assessable statements which specify the required level of performance for each of the elements  Bold and italicized terms are elaborated in the range |
| 1. Conduct logic controllers site survey | * 1. Health and safety procedures are applied in accordance to work procedure   2. Logic controllers’ installation location is determined as per manufacturer’s specification   3. Logic controllers ***Site condition****s* are evaluated as per manufacturer’s specification   4. Logic controllers Installation layout is prepared as per job specification.   5. Logic controllers Layout measurements are recorded as per job specification   6. Logic controllers Survey report is prepared as per work procedure |
| 1. Install logic controller hardware | * 1. Health and safety procedures are applied in accordance to work procedure   2. Logic controller hardware is selected based on job specification   3. logic controller hardware is mounted based logic controller hardware project design   4. logic controller hardware is connected to the power supply as per manufactures specifications   5. logic controller hardware ***I/O modules*** are connected as per manufactures specifications   6. Logic controller Hardware setup is verified as per manufacturer’s manual.   7. Logic controller Hardware is configured based on process control system requirements   8. Logic controller Hardware is tested based on manufacturers specifications |
| 1. Interface logic controller hardware | 1. logic controller hardware I/O module is selected as per the job specification 2. logic controller hardware ***Input devices*** are connected to I/O module as per job specification 3. logic controller hardware ***Output devices*** are connected to I/O module based on the job specification 4. logic controller hardware I/O module is linked with logic controller based on manufactures requirements. |
| 1. Install logic controller software | 1. logic controller *PC* ***software*** is obtained based on the type of the controller job specification 2. logic controller PC Software installer is run based on manufacturer’s specification 3. Logic controller software is run as per manufacturer’s specification 4. Logic controller Communication settings are configured based on job specifications 5. Logic controller software is tested based on manufacturer’s specification 6. Logic controller software is documented as per work requirements |
| 1. Perform logic controller programming | 1. Logic controller process requirements are recorded based on job specifications 2. Logic controller program language is chosen based on manufacturer’s specification 3. Logic controller program is developed as per job specifications 4. Logic controller program is compiled based on job specifications 5. Logic controller program is debugged in accordance to job specifications 6. Logic controller program is simulated based on job specifications 7. Logic controller program is installed /uploaded as per manufacturer’s specification |
| 1. Perform logic controller system Test and commissioning | 1. Logic controller system electrical test is performed as per job specifications 2. Logic controller system functionality test is performed as per job specifications 3. Logic controller system end users are trained as per workplace procedures 4. Logic controller system documentation is performed as per workplace procedures 5. Logic controller system is handed over in accordance to workplace procedures 6. Logic controller system ***Commissioning documents*** are disseminated in accordance with work procedure |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required skills**

The individual needs to demonstrate the following skills:

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

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Electrical power calculations
* Various laws in electrical engineering
* Control system components
* Safety procedures and practices
* Electrical symbols and their meanings
* Network Components and devices
* Electrical standards
* Power protection
* Measurement
* Types of maintenance

**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. *site conditions* may include but not limited to: | * + temperature   + humidity   + distance   + dust   + light intensity   + pressure |
| 1. *electrical tests* may include but not limited to: | * + Polarity test   + Earth loop impedance test   + Insulation resistance test   + Earth electrode resistance test |
| 1. *functionality tests* may include but not limited to: | * + accuracy test   + precision test   + linearity test   + sensitive test   + resolution test   + response time test   + drift test   + calibration test   + functional integration test |
| 1. *Commissioning documents* may include but not limited to: | * Commissioning plan * Test procedures and checklist * Instrumentation data sheet * Calibration certificate * Start up and shutdown procedures * Safety documentation * Training materials * Commissioning reports * Handover report * Test results * As-built drawings |
| 1. *PC software* may include but not limited to: | * Windows software * Linux software * TIA Portal * Gx Programmer * Logo Soft comfort * WinCC * Simulators |
| 1. *Logic controller hardware* may include but not limited to: | * PLC * HMI * Variable speed drives * Servo drives * PID controllers * Temperature controllers |
| 1. *I/O modules* may include but not limited to: | * Digital I/O modules * Analogue I/O modules |
| 1. *Input devices* may include but not limited to: | * Sensors * Switches |
| 1. *Output devices* may include but not limited to: | * Pumps * Indicator lamps * Motors * Valves * Servo motors |

**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 | * 1. Applied Health and safety procedures in accordance to work procedure   2. Mounted logic controller hardware as per work specification   3. connected logic controller hardware I/O modules as per manufacturer’s specifications   4. connected logic controller hardware to the power supply as per manufacturer’s specifications   5. Configured Logic controller hardware based on job requirements   6. Tested Logic controller Hardware is based on manufacturers specifications   7. Linked logic controller hardware I/O module with logic controller based on manufactures requirements.   8. Configured logic controller communication settings based on job specifications   9. Developed logic controller program as per job specifications   10. Tested logic controller software based on manufacturer’s specification   11. Logic controller program language is chosen based on manufacturer’s specification   12. Simulated logic controller program based on job specifications   13. Installed /uploaded logic controller program as per manufacturer’s specification   14. Performed logic controller system electrical test as per job specifications   15. Performed logic controller system functionality test as per job specifications |
| 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 may be assessed through:  3.1 Observation  3.2 Oral questioning  3.3 Written assessment  3.4 Practical demonstration  3.5 Report writing  3.6 Project  3.7 Portfolio of evidence  3.8 Third-party reports |
| 1. Context of Assessment | Competency may be assessed individually in the actual workplace or simulated setting of the actual work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## FABRICATE ELECTRONIC CIRCUITS

**UNIT CODE: 0714 451 18A**

**UNIT DESCRIPTION**

This unit covers the competencies required to fabricate electronic circuits. It involves building logic gate circuits, fabricating semiconductor diode circuits, building amplifier circuits, fabricating signal generators, signal filter circuits and microprocessor-based systems.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace function | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***(Bold and italicized terms are elaborated in the Range)*** |
| 1. Build logic gate circuits | * 1. ***Digital number systems*** are applied as per work requirement   2. ***Logic gate*** circuit ***construction components, tools and equipment*** are assembled as per work requirement   3. ***Combinational logic circuits*** are built as per circuit design   4. Combinational logic circuitsare tested as per work requirement   5. ***Sequential logic circuits*** are built as per circuit design   6. Sequential logic circuitsare tested as per work requirement |
| 1. Fabricate semiconductor diode circuits | * 1. ***Semiconductor diode*** circuit construction components, tools and equipment are assembled as per work requirement   2. Semiconductor diode circuitsare built as per circuit design   3. Semiconductor diode circuitsare tested as per work requirement |
| 1. Build amplifier circuits | * 1. ***Amplifier*** circuit construction components, tools and equipment are assembled as per work requirement   2. Amplifier circuitsare built as per circuit design   3. Amplifier circuitsare tested as per work requirement |
| 1. Fabricate signal generators | * 1. ***Signal generator*** construction components, tools and equipment are assembled as per work requirement   2. Signal generator circuits are built as per circuit design   3. Signal generator circuitsare tested as per work requirement |
| 1. Fabricate signal filter circuits | * 1. ***Signal filter*** circuit construction components, tools and equipment are assembled as per work requirement   2. Signal filter circuits are built as per circuit design   3. Signal filter circuitsare tested as per work requirement |
| 1. Fabricate microcontroller-based systems | * 1. ***Microprocessor*** based systems construction components, tools and equipment are assembled as per work requirement   2. Microprocessor based systems are built as per work requirement   3. Microprocessor based systems are tested as per work requirement |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. ***Digital number systems*** include but not limited to: | * Decimal * Binary * Octal * Hexadecimal |
| 1. ***Logic gate*** includes but not limited to: | * + OR   + AND * NOT * NOR * NAND * XOR * X-NOR |
| 1. ***Construction components, tools and equipment*** include but not limited to: | * Components * Resistors * Capacitors * Logic gates * Transistors * BJTs * FETs * Push buttons * Oscillators * Sensors * Diodes * Microprocessors * Tools and equipment * Combination pliers * Long nose pliers * Side cutter * Electronic tool kit * Soldering gun * Soldering gun stand * Rework station * Digital multimeters * PPE * Digital oscilloscopes * Variable DC power supply * Signal generators * Microprocessor kit |
| 1. ***Combinational logic circuits*** include but not limited to: | * Multiplexers * Decoders * Adders |
| 1. ***Sequential logic circuits*** include but not limited to: | * Latches * Flip flops * Counters * Shift registers |
| 1. ***Semiconductor diode*** includes but not limited to: | * Power diode * Varactor diode * Light emitting diode * Photodiode * Zener diode * Schottky diode * Laser diode * PIN diode |
| 1. ***Amplifier*** include but not limited to: | * Operational amplifiers * Classical amplifier |
| 1. ***Signal generator*** includes but not limited to: | * Function generator * Radio Frequency generator * Pulse generator |
| 1. ***Signal filter*** includes but not limited to: | * Band pass filters * Low pass filters * High pass filters |
| 1. ***Microprocessor*** include but not limited to: | * Microcontrollers such as Arduino   ESP, Raspberry-Pi. |

**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. Built Combinational logic circuits as per circuit design   2. Tested Combinational logic circuits as per work requirement   3. Built Sequential logic circuits as per circuit design   4. Tested Sequential logic circuits as per work requirement   5. Built Semiconductor diode circuits as per circuit design   6. Tested Semiconductor diode circuits as per work requirement   7. Built amplifier circuits as per circuit design   8. Tested Amplifier circuits as per work requirement   9. Built Signal generator circuits are as per circuit design   10. Tested Signal generator circuits as per work requirement   11. Built signal filter circuits as per circuit design   12. Built Microprocessor based systems as per work requirement   13. Tested Microprocessor based systems 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 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 | Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

## INSTALL HYDRAULIC AND PNEUMATIC SYSTEM

**UNIT CODE: 0714 451 19A**

**UNIT DESCRIPTION**

This unit describes the competencies required to install hydraulic and pneumatic systems. It involves conducting hydraulic and pneumatic system site survey, preparing for installation of hydraulic and pneumatics, mounting hydraulic system, mounting pneumatic systems, testing and commissioning hydraulic and pneumatic systems.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| ELEMENT  These describe the key outcomes which make up workplace functions | PERFORMANCE CRITERIA  These are assessable statements which specify the required level of performance for each of the elements  Bold and italicized terms are elaborated in the range |
| 1. Conduct hydraulic and pneumatic system site survey | * 1. Health and safety procedures are applied in accordance to work procedure   2. Hydraulic and pneumatic system Installation location is determined as per manufacturer’s specification   3. Hydraulic and pneumatic system ***site conditions*** are evaluated as per manufacturer’s specification   4. Hydraulic and pneumatic system installation layout is prepared as per job specification   5. Hydraulic and pneumatic system layout measurements are recorded as per job specification   6. Hydraulic and pneumatic system survey report is prepared as per work procedure |
| 1. Prepare for installation of hydraulic and pneumatics | * 1. Hydraulic and pneumatic system Installation manuals are interpreted as per manufacturer’s specifications.   2. Hydraulic and pneumatic system Work plan is prepared as per work procedure   3. Hydraulic and pneumatics system components are selected as per job specifications.   4. Hydraulic and pneumatic system ***Installation documents*** are prepared as per work procedure |
| 1. Mount hydraulic system | * 1. Health and safety procedures are applied in accordance to work procedure   2. Hydraulic systemTools and equipment are selected as per work requirement   3. Hydraulic system device components are fixed as per schematic drawing   4. Hydraulic system piping is performed as per design specifications |
| 1. Mount pneumatic systems | * 1. Health and safety procedures are applied in accordance to work procedure   2. Pneumatic systems Tools and equipment are selected as per work requirement   3. Pneumatic system device components are fixed as per schematic drawing   4. Pneumatic system piping is performed as per design specifications |
| 1. Test and commission hydraulic and pneumatic systems | * 1. Health and safety procedures are applied in accordance to work procedure   2. Hydraulic and pneumatic systems***Electrical tests*** are performed as per IEE regulations   3. Hydraulic and pneumatic systems are test run to ensure optimum functionality as per manufacturer’s specifications.   4. Housekeeping is carried out according to work procedure.   5. Hydraulic and pneumatic systems maintenance report is written as per work procedure   6. End user is trained in accordance with work procedure   7. Hydraulic and pneumatic system is handed over as per work procedure   8. Hydraulic and pneumatic system ***Commissioning documents*** are disseminated in accordance with work procedure |

**RANGE**

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

|  |  |
| --- | --- |
| Variable | Range |
| 1. *site conditions* may include but not limited to: | * + temperature   + humidity   + distance   + dust   + light intensity   + pressure |
| 1. *electrical tests* may include but not limited to: | * + Polarity test   + Earth loop impedance test   + Insulation resistance test   + Earth electrode resistance test |
| 1. *Installation documents* may include but not limited to: | * + Installation schedule   + Installation manual   + Installation checklist   + Installation reports |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required skills**

The individual needs to demonstrate the following skills:

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

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Electrical power calculations
* Various laws in electrical engineering
* Control system components
* Safety procedures and practices
* Electrical symbols and their meanings
* Network Components and devices
* Electrical standards
* Power protection
* Measurement
* Types of maintenance

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   * 1. Applied health and safety procedures in accordance to work procedure   2. Evaluated Hydraulic and pneumatic system ***site conditions*** as per manufacturer’s specification   3. Recorded Hydraulic and pneumatic system layout measurements as per job specification   4. Prepared Hydraulic and pneumatic system Work plan as per work procedure   5. Fixed Hydraulic system device components as per schematic drawing   6. Performed Hydraulic system piping as per design specifications   7. Performed Hydraulic and pneumatic systemsElectrical tests as per IEE regulations   8. Test run Hydraulic and pneumatic systems to ensure optimum functionality as per manufacturer’s specifications. |
| 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 may be assessed through:   1. Observation 2. Oral questioning 3. Written assessment 4. Practical demonstration 5. Report writing 6. Project 7. Portfolio of evidence 8. Third-party reports |
| 1. Context of Assessment | Competency may be assessed individually in the actual workplace or simulated setting of the actual work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |