



REPUBLIC OF KENYA

NATIONAL OCCUPATIONAL STANDARDS

FOR

ELECTRONICS TECHNICIAN

LEVEL 6



TVET CDACC
P.O BOX 15745-00100
NAIROBI

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FOREWORD

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

Reforms in the education sector are necessary for the achievement of Kenya Vision 2030 and meeting the provisions of the Constitution of Kenya 2010. The education sector had to be aligned to the Constitution and this resulted in the formulation of the Policy Framework for Reforming Education and Training. A key feature of this policy is the radical change in the design and delivery of the TVET training. This policy document requires that training in TVET be competency based, Curriculum development be industry led, certification be based on demonstration of competence and mode of delivery allows for multiple entry and exit in TVET programmes.

These reforms demand that Industry takes a leading role in Curriculum development to ensure the Curriculum addresses its competence needs. It is against this background that these Occupational Standards was developed for the purpose of developing a competency-based Curriculum for Electronics Technology level 6. These Occupational Standards will also be the basis for assessment of an individual for competence certification.

It is my conviction that these Occupational Standards will play a great role towards development of competent human resource for the Engineering Sector's growth and sustainable development.

**PRINCIPAL SECRETARY, VOCATIONAL AND TECHNICAL TRAINING
MINISTRY OF EDUCATION**

PREFACE

The TVET Curriculum Development, Assessment and Certification Council (TVET CDACC), in conjunction with Electrical and electronic Sector Skills Advisory Committee (SSAC) have developed these Occupational Standards for an Electronics technician. These standards will be the basis for development of a competency-based Curriculum for Electronics Technology level 6. These Standards will also be the basis for assessment of an individual for competence certification.

The Occupational Standards are designed and organized with clear performance criteria for each element of a unit of competency. These standards also outline the required knowledge and skills as well as evidence guide.

I am grateful to the Council Members, Council Secretariat, Electrical and Electronic SSAC, expert workers and all those who participated in the development of these Occupational Standards.

CHAIRPERSON, TVET CDACC

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ACKNOWLEDGMENT

These Occupational Standards were developed through combined effort of various stakeholders from private and public organizations. I am sincerely thankful to the management of these organizations for allowing their staff to participate in this course. I wish to acknowledge the invaluable contribution of industry players who provided inputs towards the development of these Standards.

I thank TVET Curriculum Development, Assessment and Certification Council (TVET CDACC) for providing guidance on the development of these Standards. My gratitude goes to the Electrical and Electronics Sector Skills Advisory Committee (SSAC) members for their contribution to the development of these Standards. I thank all the individuals and organizations who participated in the validation of these Standards.

I acknowledge all other institutions which in one way or another contributed to the development of these Standards.

**CHAIRPERSON ELECTRONIC SECTOR SKILLS ADVISORY
COMMITTEE**

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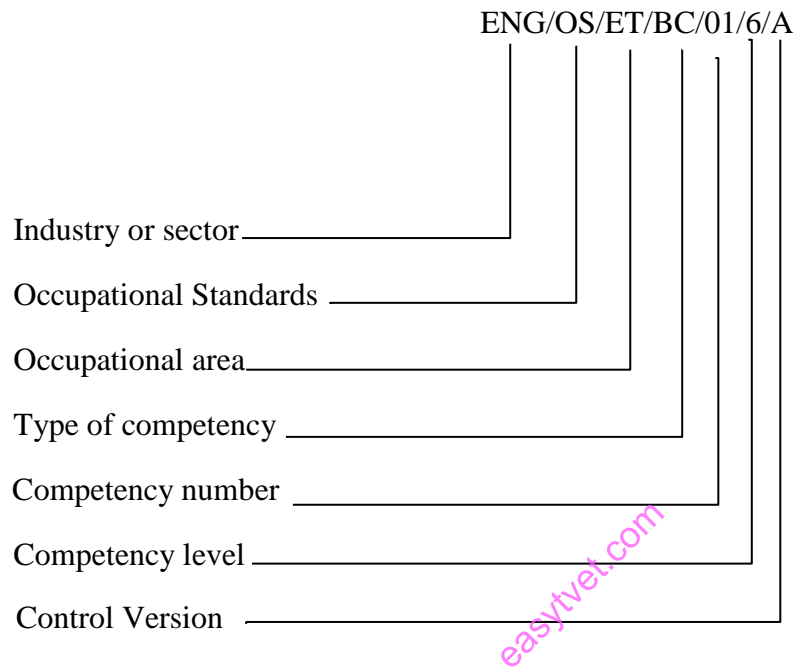
TABLE OF CONTENT

FOREWORD	iii
PREFACE.....	iv
ACKNOWLEDGMENT	v
TABLE OF CONTENT.....	vi
ABBREVIATIONS AND ACRONYMS.....	vii
KEY TO UNIT CODE	viii
OVERVIEW.....	ix
BASIC UNITS OF COMPETENCY.....	1
DEMONSTRATE COMMUNICATION SKILLS.....	2
DEMONSTRATE DIGITAL LITERACY	7
DEMONSTRATE ENTREPRENEURIAL SKILLS.....	12
DEMONSTRATE EMPLOYABILITY SKILLS	18
DEMONSTRATE ENVIRONMENTAL LITERACY.....	25
DEMONSTRATE OCCUPATIONAL SAFETY AND HEALTH PRACTICES.....	30
COMMON UNITS OF COMPETENCY	35
APPLY ENGINEERING MATHEMATIC	36
DEMONSTRATE UNDERSTANDING OF ELECTRONICS.....	43
PERFORM WORKSHOP PROCESSES.....	48
APPLY ELECTRICAL PRINCIPLES	53
PREPARE AND INTERPRET TECHNICAL DRAWINGS	57
CORE UNITS OF COMPETENCY	61
PERFORM ELECTRICAL INSTALLATION.....	62
INSTALL POWER SUPPLY SYSTEMS	70
INSTALL ELECTRICAL MACHINE CONTROL SYSTEMS	74
APPLY ELECTRICAL INSTRUMENTATION	81
PERFORM INDUSTRIAL AUTOMATION	88
MAINTAIN AUTOMATION AND RADIO FREQUENCY SYSTEMS	95

ABBREVIATIONS AND ACRONYMS

A	Control Version
BC	Basic Competencies
CC	Common Competencies
CDACC	Curriculum Development, Assessment and Certification Council
CR	Core Competencies
EHS	Environment, Health and Safety
ENG	Engineering
ET	Electronics Technician
IBMS	Integrated Building Management System
IEE	Institute of Electrical Engineers
KEBS	Kenya Bureau of Standards
NCA	National Construction Authority
OS	Occupational Standards
OSHA	Occupational Safety and Health Act
PPE	Personal Protective Equipment
TVET	Technical and Vocational Education and Training
WIBA	Work injury benefits Act

KEY TO UNIT CODE



OVERVIEW

Electronics Technician Level 6 qualification consists of competencies that a person must achieve to enable him/her to be certified as an Electronic Technician

Electronics Technician is a person who will carry out electrical and electronic installation and maintenance duties. This work demands that the technician designs, read and interpret electrical drawings so that he/she can install the electrical and electronic system according to the national and international standards. Thus, the units of competency for Electronic Technician level 6 qualifications include the following basic, common and core competencies:

BASIC UNITS OF COMPETENCY

Unit of Competency Code	Unit of Competency Title
ENG/OS/ET/BC/01/6/A	Demonstrate communication skills
ENG/OS/ET/BC/02/6/A	Demonstrate Digital Literacy
ENG/OS/ET/BC/03/6/A	Demonstrate entrepreneurial skills
ENG/OS/ET/BC/04/6/A	Demonstrate employability skills
ENG/OS/ET/BC/05/6/A	Demonstrate environmental literacy
ENG/OS/ET/BC/06/6/A	Demonstrate occupational safety and health practices

COMMON UNITS OF COMPETENCY

Unit of Competency Code	Unit of Competency Title
ENG/OS/ET/CC/01/6/A	Apply engineering mathematics
ENG/OS/ET/CC/02/6/A	Demonstrate understanding of electronics
ENG/OS/ET/CC/03/6/A	Perform workshop processes
ENG/OS/ET/CC/04/6/A	Apply electrical principles
ENG/OS/ET/CC/05/6/A	Prepare and interpret technical drawing

CORE UNITS OF COMPETENCY

Unit of Competency Code	Unit of Competency Title
ENG/OS/ET/CR/01/6/A	Perform electrical installation
ENG/OS/ET/CR/02/6/A	Install power supply systems
ENG/OS/ET/CR/03/6/A	Install electrical machine control systems
ENG/OS/ET/CR/04/6/A	Apply electrical instrumentation
ENG/OS/ET/CR/05/6/A	Perform industrial automation
ENG/OS/ET/CR/06/6/A	Maintain automation and radio frequency systems

BASIC UNITS OF COMPETENCY

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DEMONSTRATE COMMUNICATION SKILLS

UNIT CODE: ENG/OS/ET/BC/01/6/A

UNIT DESCRIPTION

This unit covers the competencies required to demonstrate communication skills. It involves meeting communication needs of clients and colleagues, developing communication strategies, establishing and maintaining communication pathways, conducting interviews, facilitating group discussion and representing the organization.

ELEMENTS AND PERFORMANCE CRITERIA

ELEMENT	PERFORMANCE CRITERIA
These describe the key outcomes which make up workplace function	These are assessable statements which specify the required level of performance for each of the elements. <i>Bold and italicized terms are elaborated in the Range</i>
1. Meet communication needs of clients and colleagues	1.1 Specific communication needs of clients and colleagues are identified and met based on workplace requirements 1.2 Different communication approaches are identified and applied according to clients' needs 1.3 Conflict is identified and addressed as per the standards of the organization
2. Develop communication strategies	2.1 Strategies for effective internal and external dissemination of information are developed as per organization's requirements 2.2 Special communication needs are considered in developing strategies according workplace procedures 2.3 <i>Communication strategies</i> are analyzed, evaluated and revised based the workplace needs
3. Establish and maintain communication pathways	3.1 Pathways of communication are established as per organization policy 3.2 Pathways are maintained and reviewed according to organization procedures
4. Promote use of communication strategies	4.1 Information is provided to all areas of the organization as per strategy requirements 4.2 Effective communication techniques are articulated and modeled according work requirements 4.3 Personnel are given guidance about adapting communication strategies as per organization procedures
5. Conduct interview	5.1 A range of appropriate communication strategies are employed in <i>interview situations</i> based on the workplace requirements 5.2 Records of interviews are made and maintained in accordance with organizational procedures 5.3 Effective questioning, listening and nonverbal communication techniques are used as per needs

6. Facilitate group discussion	6.1 Mechanisms to enhance <i>effective group interaction</i> are identified and implemented according to workplace requirements 6.2 Strategies to encourage group participation are identified and used as per organizations' procedures 6.3 Meetings objectives and agenda are set and followed based on workplace requirements 6.4 Relevant information is provided and feedback obtained according to set protocols 6.5 Evaluation of group communication strategies is undertaken in accordance with workplace guidelines 6.6 Specific communication needs of individuals are identified and addressed as per individual needs
7. Represent the organization	5.1 Relevant presentation are researched and presented based on internal or external communication forums requirements 5.2 Presentation is delivered in a clear and sequential manner as per the predetermined time 5.3 Presentation is made as per appropriate media 5.4 Difference views are respected based on workplace procedures 5.5 Written communication is done as per organizational standards 5.6 Inquiries are responded according to organizational standard

RANGE

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

Variable	Range
1. Communication strategies may include but not limited to:	<ul style="list-style-type: none"> • Language switch • Comprehension check • Repetition • Asking confirmation • Paraphrase • Clarification request • Translation • Restructuring • Approximation • Generalization
2. Effective group interaction may include but not	<ul style="list-style-type: none"> • Identifying and evaluating what is occurring within an interaction in a nonjudgmental way • Using active listening

limited to:	<ul style="list-style-type: none"> • Making decision about appropriate words, behavior • Putting together response which is culturally appropriate • Expressing an individual perspective • Expressing own philosophy, ideology and background and exploring impact with relevance to communication
3. Situations may include but not limited to:	<ul style="list-style-type: none"> • Establishing rapport • Eliciting facts and information • Facilitating resolution of issues • Developing action plans • Diffusing potentially difficult situations

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
- Active listening
- Interpretation
- Negotiation
- Writing

Required Knowledge

The individual needs to demonstrate knowledge of:

- Communication process
- Dynamics of groups
- Styles of group leadership
- Key elements of communications strategy

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	<p>Assessment requires evidence that the candidate:</p> <p>1.1 Developed communication strategies to meet the organization requirements and applied in the workplace</p> <p>1.2 Established and maintained communication pathways for effective communication in the workplace</p> <p>1.3 Used communication strategies involving exchanges of complex oral information</p>
2. Resource	The following resources should be provided:

Implications	2.1 Access to relevant workplace or appropriately simulated environment where assessment can take place 2.2 Materials relevant to the proposed activity or tasks
3. Methods of Assessment	Competency in this unit may be assessed through: 3.1 Direct observation 3.2 Oral questioning 3.3 Written texts
4. Context of Assessment	Competency may be assessed: 4.1 On-the-job 4.2 Off-the –job 4.3 During Industrial attachment
5. Guidance information for assessment	Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.

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DEMONSTRATE DIGITAL LITERACY

UNIT CODE: ENG/OS/ET/BC/02/6/A

UNIT DESCRIPTION

This unit describes competencies required to demonstrate digital literacy. It involves, identifying computer software and hardware, applying security measures to data, hardware, and software in automated environment, applying computer software in solving task, applying internet and email in communication at workplace, applying desktop publishing in official assignments and preparing presentation packages.

ELEMENTS AND PERFORMANCE CRITERIA

ELEMENT	PERFORMANCE CRITERIA
These describe the key outcomes which make up workplace function	These are assessable statements which specify the required level of performance for each of the elements. <i>Bold and italicized terms are elaborated in the Range</i>
1. Identify appropriate computer software and hardware	1.1 Concepts of ICT are determined in accordance with computer equipment 1.2 Classifications of computers are determined in accordance with manufacturers specification 1.3 Appropriate computer software is identified according to manufacturer's specification 1.4 Appropriate computer hardware is identified according to manufacturer's specification 1.5 Functions and commands of operating system are determined in accordance with manufacturer's specification
2. Apply security measures to data, hardware, software in automated environment	2.1 <i>Data security and privacy are classified</i> in accordance with the prevailing technology 2.2 <i>Security threats</i> reidentified <i>and control measures</i> are applied in accordance with laws governing protection of ICT 2.3 Computer threats and crimes are detected in accordance to Information Management security guidelines 2.4 Protection against computer crimes is undertaken in accordance with laws governing protection of ICT
3. Apply computer software in solving tasks	3.1 <i>Word processing concepts</i> are applied in resolving workplace tasks, report writing and documentation as per the job requirements 3.2 <i>Word processing utilities</i> are applied in accordance with workplace procedures 3.3 Worksheet layout is prepared in accordance with work

	<p>procedures</p> <p>3.4 Worksheet is built and data manipulated in the worksheet in accordance with workplace procedures</p> <p>3.5 Continuous data manipulated on worksheet is undertaken in accordance with work requirements</p> <p>3.6 Database design and manipulation is undertaken in accordance with office procedures</p> <p>3.7 Data sorting, indexing, storage, retrieval and security is provided in accordance with workplace procedures</p>
4. Apply internet and email in communication at workplace	<p>4.1 Electronic mail addresses are opened and applied in workplace communication in accordance with office policy</p> <p>4.2 Office internet functions are defined and executed in accordance with office procedures</p> <p>4.3 Network configuration is determined in accordance with office operations procedures</p> <p>4.4 Official World Wide Web is installed and managed according to workplace procedures</p>
5. Apply Desktop publishing in official assignments	<p>5.1 Desktop publishing functions and tools are identified in accordance with manufactures specifications</p> <p>5.2 Desktop publishing tools are developed in accordance with work requirements</p> <p>5.3 Desktop publishing tools are applied in accordance with workplace requirements</p> <p>5.4 Typeset work is enhanced in accordance with workplace standards</p>
6. Prepare presentation packages	<p>6.1 Types of presentation packages are identified in accordance with office requirements</p> <p>6.2 Slides are created and formulated in accordance with workplace procedures</p> <p>6.3 Slides are edited and run-in accordance with work procedures</p> <p>6.4 Slides and handouts are printed according to work requirements</p>

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. Appropriate computer hardware may	<p>Collection of physical parts of a computer system such as:</p> <ul style="list-style-type: none"> • Computer case, monitor, keyboard, and mouse

include but not limited to:	<ul style="list-style-type: none"> • All the parts inside the computer case, such as the hard disk drive, motherboard and video card
2. Data security and privacy may include but not limited to:	<ul style="list-style-type: none"> • Confidentiality of data • Cloud computing • Integrity -but-curious data surfing
3. Security and control measures may include but not limited to:	<ul style="list-style-type: none"> • Counter measures against cyber terrorism • Risk reduction • Cyber threat issues • Risk management • Pass-wording
4. Security threats may include but not limited to:	<ul style="list-style-type: none"> • Cyber terrorism • Hacking

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 skills
- Interpretation
- Typing
- Communication
- Computing (applying fundamental operations such as addition, subtraction, division and multiplication)
- Using calculator
- Basic ICT skills

Required Knowledge

The individual needs to demonstrate knowledge of:

- Software concept
- Functions of computer software and hardware
- Data security and privacy
- Computer security threats and control measures
- Technology underlying cyber-attacks and networks
- Cyber terrorism
- Computer crimes
- Detection and protection of computer crimes
- Laws governing protection of ICT
- Word processing;
 - ✓ Functions and concepts of word processing.

- ✓ Documents and tables creation and manipulations
 - ✓ Mail merging
 - ✓ Word processing utilities
- Spread sheets;
 - ✓ Meaning, formulae, function and charts, uses and layout
 - ✓ Data formulation, manipulation and application to cells
 - ✓
- Database;
 - ✓ Database design, data manipulation, sorting, indexing, storage retrieval and security
- Desktop publishing;
 - ✓ Designing and developing desktop publishing tools
 - ✓ Manipulation of desktop publishing tools
 - ✓ Enhancement of typeset work and printing documents
- Presentation Packages;
 - ✓ Types of presentation Packages
 - ✓ Creating, formulating, running, editing, printing and presenting slides and handouts
- Networking and Internet;
 - ✓ Computer networking and internet.
 - ✓ Electronic mail and world wide web
- Emerging trends and issues in ICT;
 - ✓ Identify and integrate emerging trends and issues in ICT
 - ✓ Challenges posed by emerging trends and 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 requires evidence that the candidate: <ol style="list-style-type: none"> 1.1 Identified and controlled security threats 1.2 Detected and protected computer crimes 1.3 Applied word processing in office tasks 1.4 Designed, prepared work sheet and applied data to the cells in accordance to workplace procedures 1.5 Opened electronic mail for office communication as per workplace procedure 1.6 Installed internet and World Wide Web for office tasks in accordance with office procedures 1.7 Integrated emerging issues in computer ICT applications 1.8 Applied laws governing protection of ICT
2. Resource Implications	The following resources should be provided: <ol style="list-style-type: none"> 2.1 Access to relevant workplace where assessment can take place 2.2 Appropriately simulated environment where assessment

	can take place
3. Methods of Assessment	Competency may be assessed through: <ul style="list-style-type: none"> 3.1 Observation 3.2 Oral questioning 3.3 Written test 3.4 Portfolio of Evidence 3.5 Interview 3.6 Third party report
4. Context of Assessment	Competency may be assessed: <ul style="list-style-type: none"> 4.1 On-the-job 4.2 Off-the-job 4.3 During Industrial attachment
5. Guidance information for assessment	Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.

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DEMONSTRATE ENTREPRENEURIAL SKILLS

UNIT CODE : ENG/OS/ET/BC/03/6/A

UNIT DESCRIPTION

This unit covers the competencies required to demonstrate understanding of entrepreneurship. It involves demonstrating understanding of an entrepreneur, entrepreneurship, and self-employment, identifying entrepreneurship opportunities, creating entrepreneurial awareness, applying entrepreneurial motivation, developing business innovative strategies and developing business plan.

ELEMENTS AND PERFORMANCE CRITERIA

ELEMENT	PERFORMANCE CRITERIA
<p>1. Demonstrate understanding of an Entrepreneur</p>	<p>1. 1 Entrepreneurs and Business persons are distinguished as per principles of entrepreneurship</p> <p>1. 2 <i>Types of entrepreneurs</i> are identified as per principles of entrepreneurship</p> <p>1. 3 Ways of becoming an Entrepreneur are identified as per principles of Entrepreneurship</p> <p>1. 4 <i>Characteristics of Entrepreneurs</i> are identified as per principles of Entrepreneurship</p> <p>1. 5 Factors affecting Entrepreneurship development are explored as per principles of Entrepreneurship</p>
<p>2. Demonstrate understanding of Entrepreneurship and self-employment</p>	<p>2. 1 Entrepreneurship and self-employment are distinguished as per principles of entrepreneurship</p> <p>2. 2 Importance of self-employment is analysed based on business procedures and strategies</p> <p>2. 3 <i>Requirements for entry into self-employment</i> are identified according to business procedures and strategies</p> <p>2. 4 Role of an Entrepreneur in business is determined according to business procedures and strategies</p> <p>2. 5 Contributions of Entrepreneurs to National development are identified as per business procedures and strategies</p> <p>2. 6 Entrepreneurship culture in Kenya is explored as per business procedures and strategies</p> <p>2. 7 Born or made Entrepreneurs are distinguished as per entrepreneurial traits</p>

<p>3. Identify Entrepreneurship opportunities</p>	<p>3.1 Sources of business ideas are identified as per business procedures and strategies</p> <p>3.2 Business ideas and opportunities are generated as per business procedures and strategies</p> <p>3.3 Business life cycle is analysed as per business procedures and strategies</p> <p>3.4 Legal aspects of business are identified as per procedures and strategies</p> <p>3.5 Product demand is assessed as per market strategies</p> <p>3.6 Types of business environment are identified and evaluated as per business procedures</p> <p>3.7 Factors to consider when evaluating business environment are explored based on business procedure and strategies</p> <p>3.8 Technology in business is incorporated as per best practice</p>
<p>4. Create entrepreneurial awareness</p>	<p>4.1 Forms of businesses are explored as per business procedures and strategies</p> <p>4.2 Sources of business finance are identified as per business procedures and strategies</p> <p>4.3 Factors in selecting source of business finance are identified as per business procedures and strategies</p> <p>4.4 Governing policies on Small Scale Enterprises (SSEs) are determined as per business procedures and strategies</p> <p>4.5 Problems of starting and operating SSEs are explored as per business procedures and strategies</p>
<p>5. Apply entrepreneurial motivation</p>	<p>5.1 Internal and external motivation factors are determined in accordance with motivational theories</p> <p>5.2 Self-assessment is carried out as per entrepreneurial orientation</p> <p>5.3 Effective communications are carried out in accordance with communication principles</p> <p>5.4 Entrepreneurial motivation is applied as per motivational theories</p>
<p>6. Develop innovative business strategies</p>	<p>6.1 Business innovation strategies are determined in accordance with the organization strategies</p> <p>6.2 Creativity in business development is demonstrated in accordance with</p>

	<p>business strategies</p> <p>6.3 <i>Innovative business strategies</i> are developed as per business principles</p> <p>6.4 Linkages with other entrepreneurs are created as per best practice</p> <p>6.5 ICT is incorporated in business growth and development as per best practice</p>
7. Develop Business Plan	<p>7.1 Identified Business is described as per business procedures and strategies</p> <p>7.2 Marketing plan is developed as per business plan format</p> <p>7.3 Organizational/Management plan is prepared in accordance with business plan format</p> <p>7.4 Production/operation plan in accordance with business plan format</p> <p>7.5 Financial plan is prepared in accordance with the business plan format</p> <p>7.6 Executive summary is prepared in accordance with business plan format</p> <p>7.7 Business plan is presented as per best practice</p>

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. Types of entrepreneurs may include but not limited to:	<ul style="list-style-type: none"> • Innovators • Imitators • Craft • Opportunistic • Speculators
2. Characteristics of Entrepreneurs may include but not limited to:	<ul style="list-style-type: none"> • Creative • Innovative • Planner • Risk taker • Networker • Confident • Flexible • Persistent • Patient • Independent • Future oriented

	<ul style="list-style-type: none"> • Goal oriented
3. Requirements for entry into self-employment may include but not limited to	<ul style="list-style-type: none"> • Technical skills • Management skills • Entrepreneurial skills • Resources • Infrastructure
4. Internal and external motivation may include but not limited to:	<ul style="list-style-type: none"> • Interest • Passion • Freedom • Prestige • Rewards • Punishment • Enabling environment • Government policies
5. Business environment may include but not limited to:	<ul style="list-style-type: none"> • External • Internal • Intermediate
6. Forms of businesses may include but not limited to:	<ul style="list-style-type: none"> • Sole proprietorship • Partnership • Limited companies • Cooperatives
7. Governing policies may include but not limited to:	<ul style="list-style-type: none"> • Increasing scope for finance • Promoting cooperation between entrepreneurs and private sector • Reducing regulatory burden on entrepreneurs • Developing IT tools for entrepreneurs
8. Innovative business strategies may include but not limited to:	<ul style="list-style-type: none"> • 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 strategies
- 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 strategies
- Market and feasibility studies
- Government and regulatory processes
- Local and international business environment
- Relevant developments in other industries
- Regional/ County business expansion strategies

EVIDENCE GUIDE

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

<p>1. Critical Aspects of Competency</p>	<p>1. 1 Assessment requires evidence that the candidate:</p> <p>1. 2 Distinguished entrepreneurs and businesspersons correctly</p> <p>1. 3 Identified ways of becoming an entrepreneur appropriately</p> <p>1. 4 Explored factors affecting entrepreneurship development appropriately</p> <p>1. 5 Analysed importance of self-employment</p>
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	<p>accurately</p> <p>1. 6 Identified requirements for entry into self-employment correctly</p> <p>1. 7 Identified sources of business ideas correctly</p> <p>1. 8 Generated Business ideas and opportunities correctly</p> <p>1. 9 Analysed business life cycle accurately</p> <p>1. 10 Identified legal aspects of business correctly</p> <p>1. 11 Assessed product demand accurately</p> <p>1. 12 Determined Internal and external motivation factors appropriately</p> <p>1. 13 Carried out communications effectively</p> <p>1. 14 Identified sources of business finance correctly</p> <p>1. 15 Determined Governing policy on small scale enterprise appropriately</p> <p>1. 16 Explored problems of starting and operating SSEs effectively</p> <p>1. 17 Developed Marketing, Organizational/Management, Production/Operation and Financial plans correctly</p> <p>1. 18 Prepared executive summary correctly</p> <p>1. 19 Determined business innovative strategies appropriately</p> <p>1. 20 Presented business plan effectively</p>
2. Resource Implications	<p>The following resources should be provided:</p> <p>2.1 Access to relevant workplace where assessment can take place</p> <p>2.2 Appropriately simulated environment where assessment can take place</p>
3. Methods of Assessment	<p>3.1 Written tests</p> <p>3.2 Oral questions</p> <p>3.3 Third party report</p> <p>3.4 Interviews</p> <p>3.5 Portfolio of Evidence</p>
4. Context of Assessment	<p>Competency may be assessed</p> <p>4.1 On-the-job</p> <p>4.2 Off-the –job</p> <p>4.3 During Industrial attachment</p>
5. Guidance information for assessment	<p>Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.</p>

DEMONSTRATE EMPLOYABILITY SKILLS

UNIT CODE: ENG/OS/ET/BC/04/6/A

UNIT DESCRIPTION

This unit covers competencies required to demonstrate employability skills. It involves conducting self-management, demonstrating interpersonal communication, critical safe work habits, leading a workplace team, planning and organizing work, maintaining professional growth and development, demonstrating workplace learning, problem solving skills and managing ethical performance.

ELEMENTS AND PERFORMANCE CRITERIA

ELEMENT	PERFORMANCE CRITERIA
These describe the key outcomes which make up workplace function.	These are assessable statements which specify the required level of performance for each of the elements. <i>Bold and italicized terms are elaborated in the Range</i>
1. Conduct self-management	1.1 Personal vision, mission and goals are formulated based on potential and in relation to organization objectives 1.2 Emotional intelligence is demonstrated as per workplace requirements. 1.3 Individual performance is evaluated and monitored according to the agreed targets. 1.4 Assertiveness is developed and maintained based on the requirements of the job. 1.5 Accountability and responsibility for own actions are demonstrated based on workplace instructions. 1.6 Self-esteem and a positive self-image are developed and maintained based on values. 1.7 Time management, attendance and punctuality are observed as per the organization policy. 1.8 Goals are managed as per the organization's objective 1.9 Self-strengths and weaknesses are identified based on personal objectives
2. Demonstrate interpersonal communication	2.1 Writing skills are demonstrated as per communication policy 2.2 Negotiation and persuasion skills are demonstrated as per communication policy 2.3 Internal and external stakeholders' needs are identified and interpreted as per the communication policy 2.4 Communication networks are established based on workplace policy

	2.5 Information is shared as per communication policy
3. Demonstrate critical safe work habits	<p>3.1 Stress is managed in accordance with workplace policy.</p> <p>3.2 Punctuality and time consciousness is demonstrated in line with workplace policy.</p> <p>3.3 Personal objectives are integrated with organization goals based on organization's strategic plan.</p> <p>3.4 Resources are utilized in accordance with workplace policy.</p> <p>3.5 Work priorities are set in accordance to workplace goals and objectives.</p> <p>3.6 Leisure time is recognized and utilized in line with personal objectives.</p> <p>3.7 Drugs and substances of abuse are identified and avoided based on workplace policy.</p> <p>3.8 HIV and AIDS prevention awareness is demonstrated in line with workplace policy.</p> <p>3.9 Safety consciousness is demonstrated in the workplace based on organization safety policy.</p> <p>3.10 Emerging issues are identified and dealt with in accordance with organization policy.</p>
4. Lead a workplace team	<p>4.1 Performance targets for the team are set based on organization's objectives</p> <p>4.2 Duties are assigned in accordance with the organization policy.</p> <p>4.3 Forms of communication in a team are established according to organization's policy.</p> <p>4.4 Team performance is evaluated based on set targets as per workplace policy.</p> <p>4.5 Conflicts are resolved between team members in line with organization policy.</p> <p>4.6 Gender related issues are identified and mainstreamed in accordance workplace policy.</p> <p>4.7 Human rights and fundamental freedoms are identified and respected as Constitution of Kenya 2010.</p> <p>4.8 Healthy relationships are developed and maintained in line with workplace.</p>
5. Plan and organize work	<p>5.1 Work plans are prepared based on activities and budget.</p> <p>5.2 Assigned tasks are interpreted and expectations identified as per the workplace instructions.</p> <p>5.3 Task occupational safety and health requirements are identified and observed regulations.</p> <p>5.4 Work resources are identified, mobilized, allocated and</p>

	<p>utilized based on organization work plans.</p> <p>5.5 Work activities are monitored and evaluated in line with work plans and workplace policy.</p> <p>5.6 Work plans are reviewed based on target and available resources.</p>
6. Maintain professional growth and development	<p>6.1 Personal training needs are identified and assessed in line with the requirements of the job.</p> <p>6.2 Training and career opportunities are identified and utilized based on job requirements.</p> <p>6.3 Resources for training are mobilized and allocated based organizations and individual skills needs.</p> <p>6.4 Licenses and certifications relevant to job and career are obtained and renewed as per policy.</p> <p>6.5 Work priorities and personal commitments are balanced and managed based on requirements of the job and personal objectives.</p> <p>6.6 Recognitions are sought as proof of career advancement in line with professional requirements.</p>
7. Demonstrate workplace learning	<p>7.1 Learning opportunities are sought and managed based on job requirement and organization policy.</p> <p>7.2 Improvement in performance is demonstrated based on courses attended.</p> <p>7.3 Application of learning is demonstrated in both technical and non-technical aspects based on requirements of the job</p> <p>7.4 Time and effort is invested in learning new skills based on job requirements</p> <p>7.5 Initiative is taken to create more effective and efficient processes and procedures in line with workplace policy.</p> <p>7.6 New systems are developed and maintained in accordance with the requirements of the job.</p> <p>7.7 Awareness of personal role in workplace innovation is demonstrated based on requirements of the job.</p>
8. Demonstrate problem solving skills	<p>8.1 Creative, innovative and practical solutions are developed based on the problem</p> <p>8.2 Independence and initiative in identifying and solving problems is demonstrated based on requirements of the job.</p> <p>8.3 Team problems are solved as per the workplace guidelines</p> <p>8.4 Problem solving strategies are applied as per the workplace guidelines</p> <p>8.5 Problems are analyzed and assumptions tested as per the context of data and circumstances</p>
9. Manage ethical	<p>9.1 Policies and guidelines are observed as per the</p>

performance	workplace requirements 9.2 Self-worth and professionalism is exercised in line with personal goals and organizational policies 9.3 Code of conduct is observed as per the workplace requirements 9.4 Integrity is demonstrated as per legal requirement
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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. Drug and substance abuse may include but not limited to:	Commonly abused <ul style="list-style-type: none"> • Alcohol • Tobacco • Miraa • Over-the-counter drugs • Cocaine • Bhang • Glue
2. Feedback may include but not limited to:	<ul style="list-style-type: none"> • Verbal • Written • Informal • Formal
3. Relationships may include but not limited to:	<ul style="list-style-type: none"> • Man/Woman • Trainer/trainee • Employee/employer • Client/service provider • Husband/wife • Boy/girl • Parent/child • Sibling relationships
4. Forms of communication may include but not limited to:	<ul style="list-style-type: none"> • Written • Visual • Verbal • Non verbal • Formal and informal
5. Team may include but not limited to:	<ul style="list-style-type: none"> • Small work group • Staff in a section/department • Inter-agency group

6. Personal growth may include but not limited to:	<ul style="list-style-type: none"> • 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
7. Personal objectives may include but not limited to:	<ul style="list-style-type: none"> • Long term • Short term • Broad • Specific
8. Trainings and career opportunities may includes but not limited to	<ul style="list-style-type: none"> • Participation in training programs • Serving as Resource Persons in conferences and workshops
9. Resource may include may but not limited to:	<ul style="list-style-type: none"> • Human • Financial • Technology
10. Innovation may include but not limited to:	<ul style="list-style-type: none"> • New ideas • Original ideas • Different ideas • Methods/procedures • Processes • New tools
11. Emerging issues may include but not limited to:	<ul style="list-style-type: none"> • Terrorism • Social media • National cohesion • Open offices
12. Range of media for learning may include but not limited to:	<ul style="list-style-type: none"> • Mentoring • peer support and networking • IT and courses

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:

- Interpersonal
- Communication
- Critical thinking
- Organizational
- Negotiation
- Monitoring
- Evaluation
- Record keeping

- Problem solving
- Decision Making
- Resource utilization
- Resource mobilization

Required Knowledge

The individual needs to demonstrate knowledge of:

- Work values and ethics
- Company policies
- Company operations, procedures and standards
- Occupational Health and safety procedures
- Fundamental rights at work
- Workplace communication
- Concept of time
- Time management
- Decision making
- Types of resources
- Work planning
- Organizing work
- Monitoring and evaluation
- Record keeping
- Gender mainstreaming
- HIV and AIDS
- Drug and substance abuse
- Professional growth and development
- Technology in the workplace
- Innovation
- Emerging issues

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EVIDENCE GUIDE

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

<p>1. Critical aspects of Competency</p>	<p>Assessment requires evidence that the candidate:</p> <ul style="list-style-type: none"> 1.1 Conducted self-management 1.2 Demonstrated interpersonal communication 1.3 Demonstrated critical safe work habits 1.4 Demonstrated the ability to lead a workplace team 1.5 Planned and organized work 1.6 Maintained professional growth and development 1.7 Demonstrated workplace learning 1.8 Demonstrated problem solving skills 1.9 Demonstrated the ability to manage performance ethically
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2. Resource Implications	<p>The following resources should be provided:</p> <ul style="list-style-type: none"> 2.1 Access to relevant workplace where assessment can take place 2.2 Appropriately simulated environment where assessment can take place
3. Methods of Assessment	<p>Competency in this unit may be assessed through:</p> <ul style="list-style-type: none"> 3.1 Observation 3.2 Oral questioning 3.3 Written test 3.4 Portfolio of Evidence 3.5 Interview 3.6 Third party report
4. Context of Assessment	<p>Competency may be assessed:</p> <ul style="list-style-type: none"> 4.1 On-the-job 4.2 Off-the –job 4.3 During Industrial attachment
5. Guidance information for assessment	<p>Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.</p>

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DEMONSTRATE ENVIRONMENTAL LITERACY

UNIT CODE: ENG/OS/ET/BC/04/6/A

UNIT DESCRIPTION

This unit specifies the competencies required to demonstrate environmental literacy. It involves, controlling environmental hazard and environmental pollution, demonstrating sustainable resource use, evaluating current practices in relation to resource usage, identifying environmental legislations/conventions for environmental concerns, implementing specific environmental programs, monitoring activities on environmental protection/Programs , analyzing resource use and developing resource conservation plans

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. <i>Bold and italicized terms are elaborated in the Range</i>
1. Control environmental hazard	1.1 Storage methods for environmentally hazardous materials are strictly followed according to environmental regulations and OSHS. 1.2 Disposal methods of hazardous wastes are followed according to environmental regulations and OSHS. 1.3 PPE is used according to OSHS.
2. Control environmental Pollution	2.1 Environmental pollution control measures are implemented in accordance with international protocols. 2.2 Procedures for solid waste management are observed according Environmental Management and Coordination Act 1999 2.3 Methods for minimizing noise pollution is complied with based on <i>Noise and Excessive Vibration Pollution and Control Regulations, 2009</i>
3. Demonstrate sustainable resource use	3.1 Methods for minimizing wastage are complied with based on organizational waste management guide 3.2 Waste management procedures are employed following principles of 3Rs (Reduce, Reuse, Recycle) 3.3 Methods for economizing and reducing resource consumption are practiced as per the Constitution

	of Kenya 2010 Article 69 .
4. Evaluate current practices in relation to resource usage	<p>4.1 Information on resource efficiency systems and procedures are collected and provided as per work groups/sector</p> <p>4.2 Current resource usage is measured and recorded as per work group</p> <p>4.3 Current purchasing strategies are analyzed and recorded according to industry procedures.</p> <p>4.4 Current work processes to access information and data is analyzed following enterprise protocol.</p>
5. Identify environmental legislations/conventions for environmental concerns	<p>5.1 Environmental legislations/conventions and local ordinances are identified according to the different environmental aspects/impact</p> <p>5.2 Industrial standard/environmental practices are described according to the different environmental concerns</p>
6. Implement specific environmental programs	<p>6.1 Programs/Activities are identified according to organizations policies and guidelines.</p> <p>6.2 Individual roles/responsibilities are determined and performed based on the activities identified.</p> <p>6.3 Problems/constraints encountered are resolved in accordance with organizations' policies and guidelines</p> <p>6.4 Stakeholders are consulted based on company guidelines</p>
7. Monitor activities on Environmental protection/Programs	<p>7.1 Activities are periodically monitored and Evaluated according to the objectives of the environmental program</p> <p>7.2 Feedback from stakeholders are gathered and considered in Proposing enhancements to the program based on consultations</p> <p>7.3 Data gathered are analyzed based on Evaluation requirements</p> <p>7.4 Recommendations are submitted based on the findings</p> <p>7.5 Management support systems are set/established to sustain and enhance the program</p> <p>7.6 Environmental incidents are monitored and reported to</p> <p>7.7 concerned/proper authorities</p>
8. Analyze resource use	<p>8.1 All resource consuming processes are Identified as per the organizational work plan</p> <p>8.2 Quantity and nature of resource consumed is determined based on processes</p> <p>8.3 Resource flow is analyzed as per different parts of</p>

	the process. 8.4 Wastes are classified according to NEMA regulations on waste management.
9. Develop resource Conservation plans	9.1. Efficiency of use/conversion of resources is determined according to industry protocol. 9.2. Causes of low efficiency of use of resources are Determined based on industry protocol. 9.3. Plans for increasing the efficiency of resource use are developed based on findings.

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. PPE may include but not limited to	<ul style="list-style-type: none"> • Mask • Gloves • Goggles • Safety hat • Overall • Hearing protector
2. Control measures may include but not limited to	<ul style="list-style-type: none"> • Methods for minimizing or stopping spread and ingestion of airborne particles • Methods for minimizing or stopping spread and ingestion of gases and fumes • Methods for minimizing or stopping spread and ingestion of liquid wastes

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:

- Measuring
- Recording
- Analytical
- Monitoring
- Communication
- Writing

Required Knowledge

The individual needs to demonstrate knowledge of:

- PPEs
- Environmental regulations
- OSHS
- Pollution
- Waste management
- Principle of 3Rs
- Types of resources
- Techniques in measuring current usage of resources
- Environmental hazards
- Regulatory requirements

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: 1.1 Controlled environmental hazard 1.2 Controlled environmental pollution 1.3 Demonstrated sustainable resource use 1.4 Evaluated current practices in relation to resource usage 1.5 Demonstrated knowledge of environmental legislations and local ordinances according to the different environmental issues /concerns. 1.6 Described industrial standard environmental practices according to the different environmental issues/concerns. 1.7 Resolved problems/ constraints encountered based on management standard procedures 1.8 Implemented and monitored environmental practices on a periodic basis as per company guidelines 1.9 Recommended solutions for the improvement of the program 1.10 Monitored and reported to proper authorities any environmental incidents
2. Resource Implications	The following resources should be provided: 2.1 Workplace with storage facilities 2.2 Tools, materials and equipment relevant to the tasks (e.g. Cleaning tools, cleaning materials, trash bags) 2.3 PPE, manuals and references 2.4 Legislation, policies, procedures, protocols and local ordinances relating to environmental protection 2.5 Case studies/scenarios relating to environmental Protection

3 Methods of Assessment	Competency in this unit may be assessed through: 3.1 Observation 3.2 Oral questioning 3.3 Written test 3.4 Portfolio of Evidence 3.5 Interview 3.6 Third party report
4 Context of Assessment	Competency may be assessed 4.1 On-the-job 4.2 Off-the –job 4.3 During Industrial attachment
5 Guidance information for assessment	Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.

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DEMONSTRATE OCCUPATIONAL SAFETY AND HEALTH PRACTICES

UNIT CODE: ENG/OS/ET/BC/01/6/A

UNIT DESCRIPTION

This unit specifies the competencies required to demonstrate occupational health and safety practices. It involves identifying workplace hazards and risks, identifying and implementing appropriate control measures to hazards and risks and implementing OSH programs, procedures and policies/guidelines.

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. <i>Bold and italicized terms are elaborated in the Range</i>
1. Identify workplace hazards and risk	1.1 <i>Hazards</i> in the workplace are identified <i>based their indicators</i> 1.2 Risks and hazards are evaluated based on legal requirements. 1.3 <i>OSH concerns</i> raised by workers are addressed as per legal requirements.
2. Control OSH hazards	2.1 Hazard prevention <i>and control measures</i> are implemented as per legal requirement. 2.2 Risk assessment is conducted and a risk matrix developed based on likely impact. 2.3 <i>Contingency measures</i> , including <i>emergency procedures</i> during workplace <i>incidents and emergencies</i> are recognized and established in accordance with organization procedures.
3. Implement OSH programs	3.1 Company OSH program are identified, evaluated and reviewed based on legal requirements. 3.2 Company OSH programs are implemented as per legal requirements. 3.3 Workers are capacity built on OSH standards and procedures as per legal requirements 3.4 <i>OSH-related records</i> are maintained as per legal 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. Hazards may include but not limited to:	<ul style="list-style-type: none"> • Physical hazards – impact, illumination, pressure, noise, • vibration, extreme temperature, radiation • Biological hazards- bacteria, viruses, plants, parasites, mites, molds, fungi, insects • Chemical hazards – dusts, fibers, mists, fumes, smoke, gasses, vapors • Ergonomics • Psychological factors – over exertion/ excessive force, awkward/static positions, fatigue, direct pressure, • varying metabolic cycles • Physiological factors – monotony, personal relationship, work out cycle • Safety hazards (unsafe workplace condition) – confined space, excavations, falling objects, gas leaks, electrical, poor storage of materials and waste, spillage, waste and debris • Unsafe workers’ act (Smoking in off-limited areas, Substance and alcohol abuse at work)
2. Indicators may include but not limited to:	<ul style="list-style-type: none"> • Increased of incidents of accidents, injuries • Increased occurrence of sickness or health complaints/ symptoms • Common complaints of workers related to OSH • High absenteeism for work-related reasons
3. OSH concerns may include but not limited to:	<ul style="list-style-type: none"> • Workers’ experience/observance on presence of work hazards • Unsafe/unhealthy administrative arrangements (prolonged work hours, no break time, constant overtime, scheduling of tasks) • Reasons for compliance/non-compliance to use of PPEs or other OSH procedures/policies/guidelines
4. Safety gears /PPE (Personal Protective Equipment) may include but not limited to:	<ul style="list-style-type: none"> • Arm/Hand guard, gloves • Eye protection (goggles, shield) • Hearing protection (ear muffs, ear plugs) • Hair Net/cap/bonnet • Hard hat • Face protection (mask, shield) • Apron/Gown/coverall/jump suit • Anti-static suits • High-visibility reflective vest

<p>5. Appropriate risk controls may include but not limited to:</p>	<ul style="list-style-type: none"> • Appropriate risk controls in order of impact are as follows: • Eliminate the hazard altogether (i.e., get rid of the dangerous machine) • Isolate the hazard from anyone who could be harmed (i.e., keep the machine in a closed room and operate it remotely; barricade an unsafe area off) • Substitute the hazard with a safer alternative (i.e., replace the machine with a safer one) • Use administrative controls to reduce the risk (i.e., train workers how to use equipment safely; train workers about the risks of harassment; issue signage) • Use engineering controls to reduce the risk (i.e., attach guards to the machine to protect users) • Use personal protective equipment (i.e., wear gloves and goggles when using the machine)
<p>6. Contingency measures may include but not limited to:</p>	<ul style="list-style-type: none"> • Evacuation • Isolation • Decontamination • (Calling designed) emergency personnel
<p>7. Incidents and emergencies may include but not limited to:</p>	<ul style="list-style-type: none"> • Chemical spills • Equipment/vehicle accidents • Explosion • Fire • Gas leak • Injury to personnel • Structural collapse • Toxic and/or flammable vapors emission.
<p>8. OSH-related Records may include but not limited to:</p>	<ul style="list-style-type: none"> • Medical/Health records • Incident/accident reports • Sickness notifications/sick leave application • OSH-related trainings obtained

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
- Interpersonal
- Presentation
- Risk assessment

- Evaluation
- Critical thinking
- Problem solving
- Negotiation

Required Knowledge

The individual needs to demonstrate knowledge of:

- General OSH Principles
- Occupational hazards/risks recognition
- OSH organizations providing services on OSH evaluation and/or work environment measurements (WEM)
- National OSH regulations; company OSH policies and protocols
- Systematic gathering of OSH issues and concerns
- General OSH principles
- National OSH regulations
- Company OSH and recording protocols, procedures and policies/guidelines
- Training and/or counseling methodologies and strategies

EVIDENCE GUIDE

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

<p>1. Critical Aspects of Competency</p>	<p>Assessment requires evidence that the candidate:</p> <ul style="list-style-type: none"> 1.1 Identified hazards in the workplace based their indicators 1.2 Evaluated workplace hazards based on legal requirements. 1.3 Addressed OSH concerns raised by workers as per legal requirements. 1.4 Implemented hazard prevention and control measures as per legal requirement. 1.5 Conducted risk assessment as per legal requirement. 1.6 Developed risk matrix based on likely impact. 1.7 Recognized and established contingency measures in accordance with organization procedures. 1.8 Identified, evaluated and reviewed company OSH program based on legal requirements. 1.9 Implemented company OSH programs as per legal requirements. 1.10 Capacity built workers on OSH standards and procedures as per legal requirements 1.11 Maintained OSH-related records as per legal requirements.
<p>2. Resource Implications</p>	<p>The following resources should be provided:</p> <ul style="list-style-type: none"> 2.3 Access to relevant workplace where assessment can take place 2.4 Appropriately simulated environment where assessment

	can take place
3. Methods of Assessment	Competency in this unit may be assessed through: 3.1 Observation 3.2 Oral questioning 3.3 Written test 3.4 Portfolio of Evidence 3.5 Interview 3.6 Third party report
4. Context of Assessment	Competency may be assessed: 4.1 On-the-job 4.2 Off-the –job 4.3 During Industrial attachment
5. Guidance information for assessment	Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.

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COMMON UNITS OF COMPETENCY

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APPLY ENGINEERING MATHEMATIC

UNIT CODE:ENG/OS/ET/CC/01/6/A

This unit describes the competencies required by an Electrical Technician to apply a wide range of engineering mathematics in their work. This includes applying algebraic functions, trigonometry and hyperbolic functions, complex numbers, coordinate geometry, binomial expansion, calculus, ordinary differential equations, Laplace transforms, power series, Statistics, Fourier series, vector theory, matrix, numerical methods, probability, commercial calculations, estimations and measurements in solving problems

ELEMENTS AND PERFORMANCE CRITERIA ELEMENT	PERFORMANCE CRITERIA
These describe the key outcomes which make up workplace function.	These are assessable statements which specify the required level of performance for each of the elements. <i>Bold and italicized terms are elaborated in the Range.</i>
1. Apply Algebra	1.1 Calculations involving Indices are performed as per the concept 1.2 Calculations involving Logarithms are performed as per the concept 1.3 Scientific calculator is used in solving mathematical problems in line with manufacturer's manual 1.4 Simultaneous equations are performed as per the rules 1.5 Quadratic equations are calculated as per the concept
2. Apply Trigonometry and hyperbolic functions	2.1 Calculations are performed using trigonometric rules 2.2 Calculations are performed using <i>hyperbolic functions</i>
3. Apply complex numbers	3.1 Complex numbers are represented using Argand diagrams 3.2 Operations involving complex numbers are performed 3.3 Calculations involving complex numbers are performed using De Moivre's theorem
4. Apply Coordinate Geometry	1.1 Polar equations are calculated using coordinate geometry 1.2 Graphs of given polar equations are drawn using the Cartesian plane 1.3 Normal and tangents are determined using coordinate geometry
5. Carry out Binomial Expansion	5.0 Roots of numbers are determined using binomial theorem

	5.1 Errors of small changes are determined using binomial theorem
6. Apply Calculus	<p>6.0 Derivatives of functions are determined using Differentiation</p> <p>6.1 Derivatives of hyperbolic functions are determined using Differentiation</p> <p>6.2 Derivatives of inverse trigonometric functions are determined using Differentiation</p> <p>6.3 Rate of change and small change are determined using Differentiation.</p> <p>6.4 Calculation involving stationery points of functions of two variables are performed using differentiation.</p> <p>6.5 Integrals of algebraic functions are determined using integration</p> <p>6.6 Integrals of trigonometric functions are determined using integration</p> <p>6.7 Integrals of logarithmic functions are determined using integration</p> <p>6.8 Integrals of hyperbolic and inverse functions are determined using integration</p>
7. Solve Ordinary differential equations	<p>7.0 First order and second order differential equations are solved using the method of undetermined coefficients</p> <p>7.1 First order and second order differential equations are solved from given boundary conditions</p>
8. Apply Laplace transforms	<p>8.1 Laplace transforms are solved using initial and final value theorems</p> <p>8.2 Inverse Laplace transforms are solved using partial fractions</p> <p>8.3 Differential equations are solved using Laplace transforms</p>
9 Apply Power Series	<p>9.1 Power series are obtained using Taylor's Theorem</p> <p>9.2 Power series are obtained using Maclaurin's theorem</p>

10 Apply Statistics	<p>10.1 Identification, Collection and Organization of data is performed</p> <p>10.2 Interpretation, analysis and presentation of data in appropriate format is performed</p> <p>10.3 Mean, median ,mode and Standard deviation are obtained from given data</p> <p>10.4 Calculations are performed based on Laws of probability</p> <p>10.5 Calculation involving probability distributions , mathematical expectation sampling distributions are performed</p>
11. Apply Fourier Series	<p>11.1 Fourier series coefficients are obtained using Fourier series techniques</p> <p>11.2 Fourier series for 2π to T is are obtained using Fourier series techniques</p> <p>11.3 Fourier series for odd and even functions are obtained using Fourier series techniques</p> <p>11.4 Harmonic analysis is performed using numerical methods</p>
12. Apply Vector theory	<p>12.1 Calculations involving vector algebra, dot and cross products using vector theory</p> <p>12.2 Gradient, Divergence and Curl are obtained</p> <p>12.3 Vector calculations are performed using Green's theorem</p> <p>12.4 Vector calculations are performed using Stoke's theorem</p> <p>12.5 Conservative vector fields and line and surface integrals are obtained using Gauss's theorem</p>
13. Apply Matrix	<p>13.1 Determinant and inverse of 3x3 matrix are obtained</p> <p>13.2 Solutions of simultaneous equations are obtained</p> <p>13.3 Calculation involving Eigen values and Eigen vectors are performed</p>
14. Apply Numerical methods	<p>14.1 Roots of polynomials are obtained using iterative numerical methods</p> <p>14.2 Interpolation and extrapolation are performed using numerical methods</p>
15. Apply concepts of probability for work	<p>15.1 Probability events are determined from dependent, independent and mutually exclusive</p> <p>15.2 Counting is done using permutation, combination, tree diagrams and Venn diagrams techniques</p>

16. Perform commercial calculations	16.1 Exchange rate calculations are done using devaluation and revaluation 16.2 Sales, stock turnover and profit and loss are determined 16.3 Incomes, salaries and wages are calculated
17. Perform estimations, measurements and calculations of quantities	17.1 Measurement information in workplace is extracted and interpreted 17.2 Appropriate workplace measuring tools and equipment are identified and selected 17.3 Conversions are performed between units of measurement 17.4 Measurements are estimated and taken 17.5 Length, width, height, perimeter, area and angles of <i>figures</i> are calculated 17.6 Volume and surface area of figures are calculated 17.7 Information is recorded using mathematical language and symbols appropriate for the task

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. Hyperbolic functions may include but not limited to:	<ul style="list-style-type: none"> • Sinh x • Cosh x • Cosec x • Coth x • Tanh x • Sech x
2. Figures may include but not limited to:	<ul style="list-style-type: none"> • Triangles • Squares • Rectangles • Circles • Spheres • Cylinders • Cubes • Polygons • Cuboids • Pyramids
3. Quantities may include but not limited to:	<ul style="list-style-type: none"> • Weight, • Mass • Area

	<ul style="list-style-type: none"> • Volume • Length • Width • Depth • Perimeter
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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)
- Calculating area and volume
- Types and purpose of measuring instruments
- Units of measurement and abbreviations
- Rounding techniques
- Types of fractions
- Types of tables and graphs
- Presentation of data in tables and graphs
- Vector operations
- Matrix operations

EVIDENCE GUIDE

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

1. Critical aspects of Competency	Assessment requires evidence that the candidate: <ul style="list-style-type: none"> 1.1 Applied Trigonometry and hyperbolic functions 1.2 Applied complex numbers 1.3 Determined angles and length in triangles 1.4 Applied Calculus 1.5 Solved Ordinary differential equations 1.6 Applied Laplace transforms
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	<ul style="list-style-type: none"> 1.7 Applied Power Series 1.8 Applied Fourier Series 1.9 Applied Vector theory 1.10 Applied Matrix 1.11 Identified and selected measuring equipments 1.12 Collected, Analyzed and presented data 1.13 Applied Numerical methods
2.0 Resource Implications	<p>The following resources should be provided:</p> <ul style="list-style-type: none"> 2.1 Access to relevant workplace or appropriately simulated environment where assessment can take place 2.2 Measuring equipment 2.3 Materials relevant to the proposed activity or tasks
3.0 Methods of Assessment	<p>Competency in this unit may be assessed through:</p> <ul style="list-style-type: none"> 3.1 Direct Observation 3.2 Oral Questioning 3.3 Written tests
Context of Assessment	<p>Competency may be assessed</p> <ul style="list-style-type: none"> 4.1 On job 4.2 Off job 4.3 During Industrial Attachment
Guidance information for assessment	<p>Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.</p>

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DEMONSTRATE UNDERSTANDING OF ELECTRONICS

UNIT CODE: ENG/OS/ET/CC/02/6/A

UNIT DESCRIPTION

This unit covers the competencies required to demonstrate understanding of Electronics. Competencies includes; Apply semiconductor theory, Applying semiconductor diodes, demonstrating understanding of transistors, Applying special semiconductor devices, performing rectification and demonstrating understanding of digital electronics.

ELEMENTS AND PERFORMANCE CRITERIA

ELEMENT These describe the key outcomes which make up workplace function	PERFORMANCE CRITERIA These are assessable statements which specify the required level of performance for each of the elements <i>(Bold and italicised terms are elaborated in the Range)</i>
1. Apply semiconductor theory	1.1 Types of <i>materials</i> are established in line with semiconductor theory 1.2 Semiconductor materials are identified as per their electrical conductivity properties
2. Apply semiconductor diodes	2.1 Types of diodes are identified as per their functionality 2.2 <i>Diodes</i> characteristics are determined as per their properties 2.3 Forward and reverse bias characteristics are established as per the properties of the semiconductor material
3. Demonstrate understanding of transistors	3.1. <i>Transistors</i> are identified as per their characteristics 3.2. NPN and PNP are determined as per their operation 3.3. P and N channels are identified as per their operation 3.4. <i>Biasing</i> and determination of gain of transistors is performed as per their standard operating procedure 3.5. Transistor configuration is performed as per their application
4. Apply special semiconductor devices	4.1. Special semiconductor devices are identified as per their operation 4.2. Special semiconductors are applied as per their standard operating procedure 4.3. Types of special semiconductor devices are identified
5. Perform rectification	5.1. Types of rectifiers are identified as per their functions 5.2. Classes of rectifiers are identified as per their input

ELEMENT	PERFORMANCE CRITERIA
These describe the key outcomes which make up workplace function	These are assessable statements which specify the required level of performance for each of the elements <i>(Bold and italicised terms are elaborated in the Range)</i>
	voltage 5.3. Applications of rectifiers are established
6. Apply digital electronics	6.1. Number systems and their base conversions are determined as per standard operating procedure 6.2. Number system representation are performed in line with standard operating procedure 6.3. Boolean algebra is performed in accordance with established procedures 6.4. Logic gates are determined in line with standard operating procedures 6.5. Combination of logical circuits is performed as per in accordance with standard operating procedures 6.6. Flip flops are identified as their functionality 6.7. Registers are identified in accordance with their functionality 6.8. Counters are identified in line with standard operating procedure 6.9. Memories and programmable logic controllers are identified as per their functionality 6.10. Data communication is performed in line with communication requirements

RANGE

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

Variable	Range
1. Materials may include but is not limited to:	<ul style="list-style-type: none"> • Insulators • Conductors • Semiconductors
2. Diodes may include but is not limited to:	<ul style="list-style-type: none"> • Photo diodes • Laser • Zener diodes • Light emitting diode • Schottky diodes
3. Transistors may include but is not limited to:	<ul style="list-style-type: none"> • BJTs • FETs
4. Biasing may include but is not limited to:	<ul style="list-style-type: none"> • Forward bias • Reverse bias

Variable	Range
5. Amplifiers may include but is not limited to:	<ul style="list-style-type: none"> • RC coupled amplifiers • Small signal amplifiers • Power amplifiers • Tuned amplifier • Wide band amplifiers • Op-Amp amplifiers
6. Oscillators may include but is not limited to:	<ul style="list-style-type: none"> • Tuned collector • RC phase shift • Colpits • Hartley • Crystal • Blocking
7. Logic gates may include but is not limited to:	<ul style="list-style-type: none"> • AND gates • OR gates • NOR gates • NAND gates • XOR gates • XNOR gates

REQUIRED KNOWLEDGE AND UNDERSTANDING

- The individual needs to demonstrate knowledge and understanding of:
- The manufacturer's warranty requirements relating to electronic materials
- The legal and statutory requirements relating to Electronics
- workplace procedures relevant to:
 - Health and safety;
 - The environment (including waste disposal);
 - Appropriate personal and protective equipment;
- Workplace procedures for:
 - Appropriate use of tools and equipment
 - Electronics operations
 - Number systems and conversions
 - Reporting of technical challenges
- The importance of documenting Electronics operations manuals
- The importance of working within agreed timelines and sharing progress reports.
- The relationship between time and costs.
- The importance of reporting anticipated delays to relevant parties promptly.
- How to find, interpret and use sources of technical information for project activities
- The importance of using the correct sources of technical information.

FOUNDATION SKILLS

The individual needs to demonstrate the following foundation skills:

- Amplifier construction
- Communications (verbal and written);
- Proficient in ICT;
- Time management;
- Analytical
- Problem solving;
- Planning;
- Decision making;
- First aid;
- Electronics biasing

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: 1.1 Identified different semiconductor material 1.2 Demonstrated understanding in biasing of semiconductor materials 1.3 Identified special semiconductor devices 1.4 Performed forward and reverse biasing of semiconductor materials 1.5 Identified different types of transistors 6.11. Demonstrated understanding of rectification basing on standard operating procedures 6.12. Determined number systems and their base conversions as per standard operating procedure 6.13. Performed number system representation in line with standard operating procedure 6.14. Performed Boolean algebra in accordance with established procedures 6.15. Determined logic gates in line with standard operating procedures 6.16. Performed combination of logical circuits as per in accordance with standard operating procedures 1.6 Identified flip flops as per their functionality 1.7 Identified counters and registers in line with standard operating procedure 1.8 Identified memories and programmable logic controllers as per their functionality 1.9 Performed data communication is in line with communication
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	requirements
2. Resource Implications	<p>The following resources must be provided:</p> <ul style="list-style-type: none"> 2.1 Stationeries 2.2 Reference materials 2.3 Practical materials 2.4 Measuring instruments 2.5 Tools <p>Resources the same as that of workplace are advised to be applied</p>
3. Methods of Assessment	<p>Competency may be assessed through:</p> <ul style="list-style-type: none"> 3.1 Oral test 3.2 Written test 3.3 Observation 3.4 Practical Tests
4. Context of Assessment	<p>Competency may be assessed</p> <ul style="list-style-type: none"> 4.1 On job 4.2 Off job 4.3 During industrial Attachment
5. Guidance information for assessment	<p>Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.</p>

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PERFORM WORKSHOP PROCESSES

UNIT CODE: ENG/OS/ET/CC/03/6/A

UNIT DESCRIPTION

This unit covers the competencies required to perform workshop processes. Competencies include applying workshop Safety, use of workshop tools, instruments and equipment, preparation of workshop materials, preparation of workshop for Electrical installation practical, Storage of Electrical tools and materials after practical, troubleshoot and repair workshop tools and equipment.

ELEMENTS AND PERFORMANCE CRITERIA

ELEMENT	PERFORMANCE CRITERIA <i>(Bold and italicised terms are elaborated in the Range)</i>
1. Apply workshop safety	1.1 Proper use of PPE is adhered to as per standard operating procedure 1.2 Workshop rules are followed as per standard operating procedure 1.3 Proper use of safety equipment is followed as per the manufacturer's recommendations 1.4 First Aid procedures are adhered to
2. Use workshop tools, Instruments and equipment	2.1 Workshop tools , Instruments and equipment are Identified 2.2 Tools, Instruments and equipment are used as per the manufacture's manuals 2.3 Calibration of workshop instruments are performed as per the standard operating procedure 2.4 Proper handling of workshop tools, Instruments and equipment should be followed 2.5 Care and Maintenance of workshop tools, Instruments and equipment should be adhered too
3 Prepare workshop tools and instruments for an Electrical installation practical e.g.	3.1 List of required tools and instruments are prepared 3.2 Issuing of required tools and instruments is performed 3.3 Confirmation of the issued tools and instruments is performed 3.4 Functioning of the issued tools and instruments is checked in line with the standard operating procedure 3.5 Sharpening of the cutting tools is performed
4 Prepare workshop for an Electrical practical	4.1 Practical working section is arranged as per the number of practical to be carried out.

ELEMENT	PERFORMANCE CRITERIA <i>(Bold and italicised terms are elaborated in the Range)</i>
	<p>4.2 Power supply availability in every practical section is confirmed as per the practical to be carried out</p> <p>4.3 Tools and materials required are supplied as per the practical to be carried out.</p>
5 Store Electrical tools and materials after practical	<p>5.1 Tools are checked against the issuing list after practicals</p> <p>5.2 Tools are stored out as per their standard operating procedure</p> <p>5.3 Tools are cleaned as per the workshop standard operating procedure</p> <p>5.4 Waste materials are disposed as per the EHS</p> <p>5.5 Tools are stored in their respective sections as per the workshop procedures</p>
6 Troubleshoot and repair/replace workshop tools and equipment	<p>6.1 Faulty tools are identified as per their expected functioning</p> <p>6.2 Faulty component are diagnosed as per the fault diagnosis procedures</p> <p>6.3 Repair/Replace faulty components as per the expected functioning</p> <p>6.4 Repaired/Replaced tool are tested as per the expected functioning.</p>

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. Workshop tools may include but not limited to:	<ul style="list-style-type: none">• Pliers• Hacksaws• Hammer• Spirit levels• Phase Tester• Side cutters
2. Manual may include but not limited to:	<ul style="list-style-type: none">• Operational• Installation• Commissioning• Technical specification /data sheet
3. Parameters may include but not limited to:	<ul style="list-style-type: none">• Light intensity• Sound• Speed• Efficiency• Temperature• Electrical quantities e.g. Voltage, current and resistance levels• Expected output

REQUIRED KNOWLEDGE AND UNDERSTANDING

The individual needs to demonstrate knowledge and understanding of:

- The manufacturer's manual about the operation of various workshop tools and instruments
- The legal and statutory requirements relating to electrical Workshop operation activities.
- workplace procedures relevant to:
 - health and safety;
 - the environment (including waste disposal);
 - appropriate personal and protective equipment;
 - appropriate use of service manuals
- Workplace procedures for:
 - Fault identification and diagnosis
 - Appropriate use of tools and equipment;
 - Repairing, modifying or replacing defective parts or components
- Reporting of technical challenges
- The importance of documenting workshop practical activities and information.
- The importance of working within agreed timelines and sharing progress reports.

- The importance of reporting anticipated delays to relevant parties promptly.
- How to find, interpret and use sources of technical information for workshop practical activities
- The importance of using the correct sources of technical information.
- The purpose of and how to use identification codes.

FOUNDATION SKILLS

The individual needs to demonstrate the following foundation skills:

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

EVIDENCE GUIDE

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

1. Critical Aspects of Competency	<p>Assessment requires evidence that the candidate:</p> <p>10.1 Adhered to the proper use of PPE</p> <p>10.2 Observed the workshop rules</p> <p>10.3 Performed the First Aid procedures in the workshop</p> <p>10.4 Observed workshop procedures in the storage of tools</p> <p>10.5 Safely used testing equipment and tools</p> <p>10.6 Observed EHS in the waste disposal</p> <p>10.7 Properly demonstrated care and maintenance of workshop tools</p> <p>10.8 Obtained, recorded and interpreted test results</p> <p>10.9 Identified faulty tools and instruments</p> <p>10.10 Repaired/Replaced faulty tools</p>
2. Resource Implications	<p><i>The following resources must be provided:</i></p> <p>10.11 Electrical installation tool kit</p> <p>10.12 Testing equipment</p> <p>10.13 Measuring equipment</p> <p>10.14 First Aid kit</p> <p>Resources the same as that of workplace are advised to be applied</p>

3. Methods of Assessment	Competency may be assessed through: 10.15 Oral test 10.16 Observation 10.17 Practical Tests
4. Context of Assessment	Competency may be assessed <ol style="list-style-type: none"> 1. On job 2. Off job 3. During Industrial Attachment
5. Guidance information for assessment	Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.

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APPLY ELECTRICAL PRINCIPLES

UNIT CODE:ENG/OS/ET/CC/04/6/A

UNIT DESCRIPTION

This unit describes the competencies required by a technician in order to apply a wide range of electrical principles in their work. Which includes; use of the concept of basic electrical quantities, use of the concepts of D.C and A.C circuits in electrical installation, use of basic electrical machine, use of power factor in electrical installation, use of earthing in electrical installations, apply lightning protection measures, apply electromagnetic field theory , apply electrodynamics, apply energy and momentum in electromagnetic field, apply transient in electrical circuit analysis, use two port network, demonstrate understanding of refrigeration and air conditioning

ELEMENTS AND PERFORMANCE CRITERIA

ELEMENT	PERFORMANCE CRITERIA
These describe the key outcomes which make up workplace function.	These are assessable statements which specify the required level of performance for each of the elements. <i>Bold and italicized terms are elaborated in the Range.</i>
1. Use the concept of basic Electrical quantities	1.1 Basic <i>SI units</i> in Electrical are identified 1.2 <i>Quantities</i> of Charge, force, work and power are identified 1.3 Perform calculations involving Ohm's law i.e Current, Resistance and voltage 1.4 Calculations involving various electrical quantities are performed
2. Use the concepts of D.C and A.C circuits in electrical installation	2.1 Calculations involving parallel and series circuits are performed 2.2 Calculations involving DC and AC Network theorems are performed. E.g. Kirchoff's laws, Superposition, Thevinin's, Norton's
3. Use of basic electrical machine	3.1 Types of various electrical machines are identified 3.2 Single phase and three phase motor starting methods are performed 3.3 DC motor starting methods are performed 3.4 Calculations involving single phase and three phase AC and DC Motors are performed 3.5 Calculations involving single and three phase AC and DC transformers are performed 3.6 Calculations involving single and three phase generators are performed 3.7 Special machines are identified 3.8 Calculations involving special machines are performed 3.9 Calculations involving Electric Drives are performed
4. Demonstrate understanding of	4.1 Connections of three phase power supply are performed as per the standard operating procedure

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. <i>Bold and italicized terms are elaborated in the Range.</i>
three phase power supply	4.2 Calculations involving three phase power supply connections are performed 4.3 Measurements of three phase power supply is performed 4.4 Interconnections of three phase power supply are performed as per the nature of the load.
5. Use of power factor in electrical installation	5.1 Power triangle is identified i.e. Active, Apparent and reactive power 5.2 The use of power factor is performed 5.3 Calculations involving power factor correction is performed 5.4 Methods of power factor correction are applied
6. Use of earthing in Electrical installations	6.1 Earthing types are identified 6.2 Earthing points on Electrical installation are identified 6.3 Calculation involved in determining the earthing type is performed 6.4 Test on an earthing system is performed in line with the IEE regulations
7. Apply lightning protection measures	7.1 Types of lightening strokes are identified 7.2 Components of lightening protection system are identified 7.3 Test to be carried out in lightening protection system are established 7.4 Application of lightening protection system is determined
8. Apply Electromagnetic field Theory	8.1 Electromagnetic radiation sources are identified 8.2 Detectors of Electromagnetic radiations are determined 8.3 Electromagnetic waves are applied 8.4 Electromagnetics Laws are Identified 8.5 Behaviours and effects of Electromagnetic waves are established
9. Apply Electrostatics	9.1 Electrostatics terms are identified 9.2 Magnetostatics terms are identified 9.3 Electrostatics laws are identified
10. Apply Energy and Momentum in Electromagnetic field	10.1 Energy conservation theorem is identified 10.2 Electromagnetic Energy flow is determined
11. Apply transients in Electrical Circuit Analysis	11.1 Growth and decay in R-L-C circuits are determined 11.2 Calculations involving Growth and decay in R-L-C are performed
12. Use Two Port	12.1 Basic passive networks are performed

ELEMENT	PERFORMANCE CRITERIA
These describe the key outcomes which make up workplace function.	These are assessable statements which specify the required level of performance for each of the elements. <i>Bold and italicized terms are elaborated in the Range.</i>
networks	2.2 Characteristic impedance is determined 2.3 Types of transmission lines and their applications are performed
13. Demonstrate understanding of Refrigeration and Air conditioning	13.1 Use of Refrigeration and Air conditioning is demonstrated 13.2 Installation of the Refrigeration and Air conditioning system is simulated

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. SI unit may include but not limited to:	<ul style="list-style-type: none"> • Power – Watts (W) • Current – Amperes (A) • Resistance – Ohms(Ω) • Voltage – Volts (V)
2. Quantities may include but not limited to:	<ul style="list-style-type: none"> • Charge • Force • Work • Power

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
- Electrical earthing
- Lightening arrestors
- 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
- Earthing testing
- Lightening arrestor testing
- 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	<p>Assessment requires evidence that the candidate:</p> <ul style="list-style-type: none"> 1.1 Applied the correct SI units of Electrical quantities 1.2 Stated, Calculate and relates the quantities in Ohm's law 1.3 Identified the components of an earthing system 1.4 Stated and apply various laws in Electrical system 1.5 Differentiated between AC and DC network 1.6 Applied correct formulas in the calculation of AC and DC machines 1.7 Used power triangle in calculating power factor 1.8 Applied various methods in power factor correction 1.9 Identified types of lightening arrestors and their applications
2. Resource Implications	<p>The following resources should be provided:</p> <ul style="list-style-type: none"> 2.1 Access to relevant workplace or appropriately simulated environment where assessment can take place 2.2 Measuring equipment 2.3 Materials relevant to the proposed activity or tasks
3. Methods of Assessment	<p>Competency in this unit may be assessed through:</p> <ul style="list-style-type: none"> 3.1 Practical Tests 3.2 Oral Questioning 3.3 Written tests
Context of Assessment	<p>Competency may be assessed</p> <ul style="list-style-type: none"> 4.1 On job 4.2 Off job 4.3 During Industrial Attachment
Guidance information for assessment	<p>Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.</p>

PREPARE AND INTERPRET TECHNICAL DRAWINGS

UNIT CODE: ENG/OS/ET/CC/05/6/A

UNIT DESCRIPTION

This unit covers the competencies required to prepare and interpret technical drawings. It involves competencies to select, use and maintain drawing equipment and materials. It also involves producing plain geometry drawings, solid geometry drawings, pictorial and orthographic drawings and application of Computer Aided Design (CAD) packages.

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. <i>(Bold and italicised terms are elaborated in the Range)</i>
1. Use and maintain drawing equipment and materials	1.1 Drawing equipment are identified and gathered according to task requirements 1.2 Drawing materials are identified and gathered according to task requirements 1.3 Drawing equipment are used and maintained as per manufacturer's instructions 1.4 Drawing materials are used as per workplace procedures 1.5 Waste materials are disposed in accordance with workplace procedures and environmental legislations 1.6 Personal Protective Equipment is used according to occupational safety and health regulations
2. Produce plane geometry drawings	2.1 Different types of lines used in drawing and their meanings are identified according to standard drawing conventions 2.2 Different types of geometric forms are constructed according to standard conventions 2.3 Different types of angles are constructed according to principles of trigonometry 2.4 Different types of angles are measured using

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. <i>(Bold and italicised terms are elaborated in the Range)</i>
	<p>appropriate measuring tools</p> <p>2.5 Angles are bisected according to standard conventions</p> <p>2.6 Freehand sketching of different types of geometric forms, tools, equipment, diagrams is conducted</p>
3. Produce solid geometry drawings	<p>3.1 Drawings of patterns are interpreted according to standard conventions</p> <p>3.2 Patterns are developed in accordance with standard conventions</p>
4. Produce orthographic and pictorial drawings	<p>3.3 Symbols and abbreviations are identified and their meaning interpreted according to standard drawing conventions</p> <p>3.4 First and third angle orthographic drawings are interpreted and produced in accordance with the standard conventions</p> <p>4.3 Orthographic elevations are dimensioned in accordance with standard conventions</p> <p>4.4 Isometric drawings are interpreted and produced in accordance with standard conventions</p> <p>4.5 Assembly drawing is produced and interpreted in line with the operating standards</p>
5. Produce electrical drawings	<p>5.1 Electrical symbols and abbreviations are identified and their meaning interpreted according to BS 3939</p> <p>5.2 Electrical drawings are produced in accordance with BS 3939</p>
6. Apply CAD packages	<p>6.1 CAD packages are selected according to task requirements</p> <p>6.2 CAD packages are applied in production of electrical drawings</p>

RANGE

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

Variable	Range
1. Drawing equipment may include but is not limited to:	<ul style="list-style-type: none"> ● Drawing boards ● T and set squares ● drawing sets ● computers with CAD packages

2. Drawing materials may include but is not limited to:	<ul style="list-style-type: none"> • Drawing papers • Pencils • Erasers • masking tapes • paper clips
3. Environmental legislations may include but is not limited to:	<ul style="list-style-type: none"> • EMCA 1999
4. Personal Protective Equipment may include but is not limited to:	<ul style="list-style-type: none"> • Dust coats • closed leather shoes
5. Geometric forms may include but is not limited to:	<ul style="list-style-type: none"> • Circles • Triangles • Rectangles • Parallelogram • Polygons • Pyramids • conic sections • prismsloci
6. Standard conventions may include but is not limited to:	<ul style="list-style-type: none"> • Anatomy of engineering drawing (title block, coordinate grid system, revision block, notes and legends) • Drawing scale (paper size and drawing symbols) • International drawing standards
7. Electrical drawings may include but is not limited to:	<ul style="list-style-type: none"> • Block • Schematic • Circuit • line • wiring diagrams

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
- 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: 1.1 Applied and adhered to safety procedures 1.2 Cared and maintained drawing equipment 1.3 Interpreted circuit, assembly and lay out diagrams 1.4 Applied appropriate technical standards, used proper tools and equipment for a given task 1.5 Produced sketches and drawings 1.6 Applied CAD packages in production of drawings
2. Resource Implications	Resources the same as that of workplace are advised to be applied. 2.1 Drawing room 2.2 Drawing equipment and materials 2.3 Computers 2.4 CAD packages
3. Methods of Assessment	Competency may be assessed through: 3.1 Practical tests 3.2 Written Tests
4. Context of Assessment	Competency may be assessed 4.1 On job 4.2 Off JOB 4.3 During Attachment
5. Guidance information for assessment	Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.

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CORE UNITS OF COMPETENCY

PERFORM ELECTRICAL INSTALLATION

UNIT CODE: ENG/OS/ET/CR/01/6/A

UNIT DESCRIPTION

This unit specifies competencies required for performing electrical installation. Competencies required includes; conducting site survey, performing system sizing, designing installation, preparation of working drawings, planning for logistics, preparation of list of tools equipment and materials, preparation of installation work plan, establishment of installation team, preparation of work site, performing installation, terminating installation, inspecting and testing installation and finally preparation of tenders and service contracts

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 <i>(Bold and italicised terms are elaborated in the Range)</i>
1. Conduct site survey	1.1 The site is surveyed for suitability of the type of installation to be performed in line with contract 1.2 Conditions of the site are evaluated according to the established procedures 1.3 Installation route is identified as per the standard operating procedure 1.4 Measurements are taken as per expected installation. 1.5 Survey report is generated and shared with relevant parties according to the established procedures
2. Perform system sizing	2.1 Load estimation is conducted according to the set standard 2.2 Type and size of protective devices is determined according to IEE regulations 2.3 Cable sizes are calculated for the estimated loads in line with IEE regulations 2.4 System sizes are recorded and shared as per established procedures

<p>ELEMENT</p> <p>These describe the key outcomes which make up workplace function.</p>	<p>PERFORMANCE CRITERIA</p> <p>These are assessable statements which specify the required level of performance for each of the elements</p> <p><i>(Bold and italicised terms are elaborated in the Range)</i></p>
<p>3. Design Electrical installation.</p>	<p>3.1 Electrical installation is designed as per the size of the load.</p> <p>3.2 Wiring type is established in accordance with client's needs.</p> <p>3.3 Electrical design is performed in line with the installation location</p> <p>3.4 Electrical design is performed as per the size of the structure.</p> <p>3.5 Electrical installation design is performed in adherence to IEE regulations.</p> <p>3.6 Electrical installation design is performed in line with the national and international standards</p>
<p>4. Prepare working drawings</p>	<p>4.1 Installation design drawing is interpreted as per the design</p> <p>4.2 Symbols and nomenclatures are applied in accordance with British Standards [BS 3939]</p> <p>4.3 Drawing tools are applied as per the expected task</p> <p>4.4 Components and their ratings are identified as per their applications</p> <p>4.5 Cable sizes and lengths are shown as per the design</p> <p>4.6 Power supply and distribution circuits are drawn in accordance with the design</p> <p>4.7 Phase balancing of the loads is performed according to the usage</p> <p>4.8 Cable routes are clearly indicated in line with design</p> <p>4.9 Working drawing is prepared as per the design and any deviations shared with relevant parties</p>
<p>5. Plan for logistics</p>	<p>5.1 logistics for the particular work and site is determined according to nature of work</p> <p>5.2 Logistics are reported and planned for with the relevant parties according to work schedule</p>
<p>6. Prepare list of tools, equipment and materials.</p>	<p>6.1 Tools, equipment and materials needed for the work are determined and list prepared as per established procedure</p>

<p>ELEMENT</p> <p>These describe the key outcomes which make up workplace function.</p>	<p>PERFORMANCE CRITERIA</p> <p>These are assessable statements which specify the required level of performance for each of the elements</p> <p><i>(Bold and italicised terms are elaborated in the Range)</i></p>
	<p>6.2 Tools, equipment and materials are checked for specifications and functionality as per the standard operating procedure</p> <p>6.3 Tools, equipment and materials are assembled and stored in line with established procedure</p>
<p>7. Prepare installation work plan</p>	<p>7.1 Installation drawing is acquired as per established procedure</p> <p>7.2 The scope of installation work is identified as per activities to be performed</p> <p>7.3 Work is undertaken as per the workplace procedures.</p> <p>7.4 Team members are identified according to the tasks</p> <p>7.5 Work schedule is prepared basing on the scope and the working drawing</p> <p>7.6 Type of permit to work is identified as per EPRA regulations</p> <p>7.7 Permits issuing bodies are identified in accordance to permits required for the work</p> <p>7.8 Permit to work form is filled and submitted to the responsible body as per standard operating procedures</p>
<p>8. Establish installation team</p>	<p>8.1 Communication protocol is designed and distributed among the team members as per work place communication hierarchy</p> <p>8.2 Responsibilities are established and distributed among the team members in accordance with their expertise</p> <p>8.3 Team familiarization is done according to the established procedure</p>
<p>9. Prepare work site</p>	<p>9.1 Special work, hazard and safety requirements are identified in line with nature of work to be performed</p> <p>9.2 Identified hazards and safety issues are mitigated according to OSHA (Occupational Safety and Health Act</p> <p>9.3 Work plan is confirmed in accordance with legislative and regulatory requirements and</p>

<p>ELEMENT</p> <p>These describe the key outcomes which make up workplace function.</p>	<p>PERFORMANCE CRITERIA</p> <p>These are assessable statements which specify the required level of performance for each of the elements</p> <p><i>(Bold and italicised terms are elaborated in the Range)</i></p>
	<p>standard operating procedures.</p> <p>9.4 Work site is prepared for accessibility of <i>utilities</i> in accordance with nature of work to be performed</p>
<p>10. Perform installation</p>	<p>10.1 Installation procedures and technical standards are applied in line with established standards</p> <p>10.2 Working drawing is implemented as per installation requirements</p> <p>10.3 Safety procedures are adhered to for each activity in accordance to OSHA regulations</p> <p>10.4 Accidents and incidents are recorded and reported as per standard operating procedures</p> <p>10.5 Cables, conductors, conduits, enclosures and support systems are installed as per the working drawing</p> <p>10.6 Cables are drawn-in in line with standard operating procedures.</p> <p>10.7 Number and size of cables are laid in a conduit as per the IEE regulations</p>
<p>11. Terminate installation</p>	<p>11.1 Cable lugging is performed as per the standards operating procedure.</p> <p>11.2 Cables are terminated in accordance with IEE regulations</p> <p>11.3 Labelling of cables is performed basing on the complexity of the job.</p>
<p>12. Inspect and test electrical installation</p>	<p>12.1 Type of tests are identified as per nature of installation</p> <p>12.2 Test is performed in line the IEE regulations</p> <p>12.3 Firmness of the installation is established as per standard operating procedure</p> <p>12.4 Continuity test is performed as per standard operating procedure</p> <p>12.5 Ring circuit test is performed as per the standard operating procedure</p> <p>12.6 Earth continuity test is performed in accordance IEE regulations</p> <p>12.7 Short circuit test is performed in accordance IEE regulation</p>

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 <i>(Bold and italicised terms are elaborated in the Range)</i>
	12.8 Earth resistance test is performed in line with IEE regulations 12.9 Open circuit test is performed as per standard operating procedure
13. Prepare tenders and service contracts	13.1 Laws of contracts and tendering are adhered to in line with established standards 13.2 Types and forms of contracts are identified as per the nature of contract 13.3 Types of tenders are identified basing on established standards 13.4 Tender estimating is performed in line with the tendering laws 13.5 Statutory documents in contract and tendering are identified as per established standards

RANGE

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

Variable	Range
1. Installation may include but not limited to:	<ul style="list-style-type: none"> • Domestic installation • Commercial installation • Industrial Installation • Street lighting • Security • IBMS (integrated building Management system)
2. Established Procedures may include but not limited to:	<ul style="list-style-type: none"> • Company rules • Procedures mentioned in contract
3. Design may include but not limited to:	<ul style="list-style-type: none"> • Electrical design for lighting and power • Electrical design for switchgear • Electrical design for alarm systems
4. Standards may include but not limited to:	<ul style="list-style-type: none"> • IEE standard • British Standard • KEBS standard
5. IEE regulations may	<ul style="list-style-type: none"> • 17th Edition

Variable	Range
include but not limited to:	
6. Logistics may include but not limited to:	<ul style="list-style-type: none"> • Personnel, Finance and input materials • Transport and storage • Communications • Security
7. Specifications may include but not limited to:	<ul style="list-style-type: none"> • Tolerance/ range • Make / model • Size • Class
8. Regulations and legislative requirements may include but not limited to:	<ul style="list-style-type: none"> • KPLC procedures • County bylaws • Energy Act, 2006 • National Construction Authority Act • OSHA
9. Work schedule may include but not limited to:	<ul style="list-style-type: none"> • Gantt chart • Block
10. Permit to work may include but not limited to:	<ul style="list-style-type: none"> • KPLC permit • Gate Pass • Daily work permit • Work Tag
11. Utilities may include but not limited to:	<ul style="list-style-type: none"> • Water • electrical power • toilets • communication

REQUIRED KNOWLEDGE AND UNDERSTANDING

- The individual needs to demonstrate knowledge and understanding of:
- The manufacturer's warranty requirements relating to electrical installation systems and related components.
- The legal requirements relating to electrical installations
- Kenyan legislation and workplace procedures relevant to:
 - Health and safety;
 - Environment (including waste disposal);
 - Appropriate personal protective equipment (PPE).
- Workplace procedures for:
 - Work place communication;
 - Time management
 - Materials management
- The importance of documentation and keeping records
- The relationship between time and costs
- The importance of using the correct sources of technical information.

- Interpreting circuits, drawings, specifications and instructions
- Preparing work plans in accordance with legislative and regulatory requirements and standard operating procedures and health and safety requirements
- Importance of contractual agreements
 - Necessary insurance and policies including security bonds, performance bonds, contractors all risks
 - Insurance of contractors' work
 - Keeping records of income
 - Financial statements

FOUNDATION SKILLS

The individual needs to demonstrate the following foundation skills:

- Communications (verbal and written);
- Proficient in electrical principles
- Time management;
- Problem solving;
- Negotiation ;
- Decision making;
- First aid;
- Report writing;
- Planning

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EVIDENCE GUIDE

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

<p>1. Critical Aspects of Competency</p>	<p>Assessment requires evidence that the candidate:</p> <ul style="list-style-type: none"> 1.1 Applied work health and safety procedures 1.2 Interpreted the design and prepared a working drawing 1.3 Applied appropriate standard 1.4 Determined types and sizes of materials and equipment and protective devices 1.5 Demonstrated knowledge of logistics to the given task 1.6 Survey report was generated and shared with the relevant parties 1.7 Measurement were we taken at the site 1.8 Installation planning was performed as per the scope of the work 1.9 Electrical design was performed as per the installation scope 1.10 Load was calculated as per the scope of the installation 1.11 Phases were balanced as per the expected load
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	<p>1.12 Cables and accessories were installed as per the IEE regulation</p> <p>1.13 Cables were terminated as per the IEE regulation</p> <p>1.14 Installation was tested and results documented</p>
2. Resource Implications	<p>The following resources must be provided:</p> <p>Resources same as that of workplace are advised to be applied including Measuring tape, pegs, calculator, stationery, accessories and cables</p>
3. Methods of Assessment	<p>Competency may be assessed through:</p> <p>3.1 Observation</p> <p>3.2 Oral questioning</p> <p>3.3 Practical Tests</p>
4. Context of Assessment	<p>Competency may be assessed</p> <p>4.1 On job</p> <p>4.2 Off job</p> <p>4.3 During Industrial Attachment</p>
5. Guidance information for assessment	<p>Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.</p>

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INSTALL POWER SUPPLY SYSTEMS

UNIT CODE: ENG/OS/ET/CR/02/6/A

UNIT DESCRIPTION

This unit covers competencies required for installing power supply system. Competencies includes; identifying power supply system components, designing power supply system, assembling tools, equipment and materials, installing power supply system, testing installed power supply system and documenting power supply installation report.

ELEMENTS AND PERFORMANCE CRITERIA

ELEMENT These describe the key outcomes which make up workplace function.	PERFORMANCE CRITERIA These are assessable statements which specify the required level of performance for each of the elements <i>(Bold and italicised terms are elaborated in the Range)</i>
1. Identify power supply system components	1.1 Power supply components are identified as per the nature of input current and voltage 1.2 Power supply system components are identified as per the nature of expected current and voltage output 1.3 Power supply system components are identified in accordance with the system configuration 1.4 Power supply system components are identified in consideration of expected load on the system 1.5 Power supply system components are selected in consideration of environmental factors at the installation site 1.6 System components are identified as per sensitivity of the load devices 1.7 Power supply protection components are identified in line with input and output requirements
2. Design power supply system	2.1 Power supply circuits are designed based on input-output requirements 2.2 Type of supply system is selected as per the application 2.3 Power supply system is designed in line with reliability factors 2.4 Power supply system is designed in line with the expected performance ratings

<p>ELEMENT</p> <p>These describe the key outcomes which make up workplace function.</p>	<p>PERFORMANCE CRITERIA</p> <p>These are assessable statements which specify the required level of performance for each of the elements</p> <p><i>(Bold and italicised terms are elaborated in the Range)</i></p>
	<p>2.5 Power supply system is designed in accordance IEE regulations</p> <p>2.6 Power supply system design is performed in consideration of maintenance requirements</p> <p>2.7 System is sized in consideration of expected power loss</p>
<p>3. Assemble tools, equipment and materials</p>	<p>3.1 Tools, equipment and materials are identified as per the tasks to be carried out</p> <p>3.2 Tools, equipment and materials are assembled basing on their functionality</p> <p>3.3 Tools, equipment and materials are assembled in line with safety standards</p> <p>3.4 Tools, equipment and materials are assembled in accordance with precision required (digital instruments and analogue)</p> <p>3.5 Printed circuit board are prepared as per circuit design</p>
<p>4. Install power supply system</p>	<p>4.1 Power supply system is installed as per design</p> <p>4.2 Power supply system is installed in accordance with IEE regulations</p> <p>4.3 Power supply system is installed in accordance with OSHA regulations</p> <p>4.4 Power supply system is installed in line with standard operating procedures</p> <p>4.5 Power supply system is installed in line with various components manufacturers manuals</p> <p>4.6 Earthing/grounding of power supply system is performed as per IEE regulations</p>
<p>5. Test power supply system</p>	<p>5.1 Power supply system components are tested in line with IEE regulations</p> <p>5.2 Power supply system components are tested as per component parameters</p> <p>5.3 Power supply system is tested based on expected functionality</p> <p>5.4 Power supply system is tested in consideration of safety standards required</p>

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 <i>(Bold and italicised terms are elaborated in the Range)</i>
6. Document power supply system installation report	6.1 Power supply system installation report is prepared in accordance with standard operating procedures 6.2 Report is documented and shared with relevant parties as per the contract.

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. International standard may include but not limited to:	<ul style="list-style-type: none"> • ISO 14001 • 90001

REQUIRED KNOWLEDGE AND UNDERSTANDING

The individual needs to demonstrate knowledge and understanding of:

- Transformers
- Rectifiers
- Filters
- Inverters, converters
- Silicon controlled rectifiers
- Electrical standards
- Types of power supply systems
- Electrical design software
- Design tools
- Printed circuit boards and mother boards

FOUNDATION SKILLS

The individual needs to demonstrate the following additional skills:

- Electrical fabrication
- Electrical codes
- Electrical principles
- Depth of knowledge of power supply systems
- Teamwork
- Parameters for normal/abnormal operation of equipment for climate zones
- Decision making;
- Report writing
- Knowledge of “normal” electricity usage
- Environmental regulations
- Read and understand plans and symbols
- Draw plans
- CAD and basic mechanical drafting/illustration

EVIDENCE GUIDE

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

<p>1. Critical Aspects of Competency</p>	<p>Assessment requires evidence that the candidate:</p> <ul style="list-style-type: none"> 1.1 Identified power supply system components basing on input-output current and voltages 1.2 Identified power supply system components in line with system configuration 1.3 Designed power supply system in accordance to input-output parameters 1.4 Applied EHS as per standard operating procedures 1.5 Sized power supply system based on the load size 1.6 Assembled tools, equipment and material as per their functionality 1.7 Installed power supply system as per the design 1.8 Installed power supply system in accordance with system functionality 1.9 Earthed/grounded the installed system as per IEE regulations 1.10 Tested the installed system in consideration of IEE regulations 1.11 Applied testing tools and equipment in regard to their functionality 1.12 Prepared and documented design, installation and test reports as per standard operating procedures
<p>2. Resource</p>	<p>Resources the same as that of workplace are advised to be applied</p>

Implications	Included: Designing tools and materials, sizing tools, transformers, resistors, PCBs, capacitors, diodes, SCRs, inverters, batteries, cables, computers and internet.
3. Methods of Assessment	Competency may be assessed through: 3.1 Oral questioning 3.2 Written tests 3.3 Practical Tests
4. Context of Assessment	Competency may be assessed 4.1 On job 4.2 Off job 4.3 During Industrial Attachment
5. Guidance information for assessment	Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.

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INSTALL ELECTRICAL MACHINE CONTROL SYSTEMS

UNIT CODE: ENG/OS/ET/CR/03/6/A

UNIT DESCRIPTION

This unit covers competencies required to install electrical machine control system. Competencies includes; conducting site survey, designing machine control system, assembling tools, equipment and materials, mounting electrical and electronic components, performing wiring of electrical and electronic components, terminating wiring on electrical and electronic components, configuring and testing the installed electrical machine control system, commissioning and documenting installation report.

ELEMENTS AND PERFORMANCE CRITERIA

<p>ELEMENT</p> <p>These describe the key outcomes which make up workplace function.</p>	<p>PERFORMANCE CRITERIA</p> <p>These are assessable statements which specify the required level of performance for each of the elements.</p> <p><i>(Bold and italicised terms are elaborated in the Range)</i></p>
<p>1. Conduct site survey</p>	<p>1.1.Site is surveyed basing on the suitability of installation to be performed</p> <p>1.2.Conditions of the site are evaluated according to the established procedures</p> <p>1.3.Installation layout is developed as per the standard operating procedure</p> <p>1.4.Measurements are taken in line with expected installation</p> <p>1.5.Survey report is generated and shared with relevant parties in accordance of the contract</p>
<p>2. Design machine control system</p>	<p>2.1. Machine control system is designed as per the scope of the control system</p> <p>2.2. Machine control system is designed in line with the system functionality</p> <p>2.3. Machine control system design is established basing on the system configuration</p> <p>2.4. Machine control design methodology is established in line with standard operating procedure (control signal-decision-action)</p> <p>2.5. Designing is performed in consideration of machine’s manufacturer’s manuals</p>
<p>3. Assemble tools, equipment and materials</p>	<p>3.1.Tools, equipment and materials are identified as per the tasks to be carried out.</p> <p>3.2.Tools, equipment and materials are assembled basing on their functionality</p> <p>3.3.Tools, equipment and materials are configured in consideration of system’s installation requirements</p> <p>3.4.Tools, equipment and materials are assembled in consideration of system parameters</p>
<p>4. Mount electrical and electronic components</p>	<p>4.1.System components are labelled in line with their functions</p> <p>4.2.System components are mounted as per the system design</p> <p>4.3. System components are mounted basing on standard operating procedures</p> <p>4.4.Control panels enclosures and locations are determined as per established standards</p>

<p>ELEMENT</p> <p>These describe the key outcomes which make up workplace function.</p>	<p>PERFORMANCE CRITERIA</p> <p>These are assessable statements which specify the required level of performance for each of the elements.</p> <p><i>(Bold and italicised terms are elaborated in the Range)</i></p>
<p>5. Perform wiring of electrical and electronic components</p>	<p>5.1. Wiring of system components is performed in adherence to IEE regulations</p> <p>5.2. Wiring of components is performed in line with standard operating procedure.</p> <p>5.3. Wiring of electronic components is performed as per the system design</p> <p>5.4. Cable types and rating are selected in accordance with system components' power rating and functionality (power cables and signal cables)</p>
<p>6. Terminate system wiring</p>	<p>5.1 Termination methods are identified basing on load sizes</p> <p>5.2 Wiring is terminated in adherence to IEE regulations</p> <p>5.3 Wiring termination is performed in consideration of OSHA regulation</p> <p>5.4 Wiring labelling is performed in accordance with standard operating procedures</p>
<p>7. Configure and test the installed control system</p>	<p>7.1. Control system is configured basing on the expected system functionality</p> <p>7.2. System components are tested in line with their power ratings</p> <p>7.3. System components are tested based on their functionality</p> <p>7.4. System components are tested in line with manufacturer's manuals</p> <p>7.5. Testing the system is performed as per system functionality</p>
<p>8. Commission the system and document installation report.</p>	<p>8.1. Installation report is prepared in line with standard operating procedures</p> <p>8.2. Installation report is documented and shared with relevant parties based on the contract</p> <p>8.3. User training is performed in accordance with system functionality</p> <p>8.4. Commissioning of the installed system is performed as per standard operating procedure</p> <p>8.5. Commissioning of the installed system is performed in consideration of safety standards</p>

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. Control system design may include but not limited to:	<ul style="list-style-type: none">• PI• PID• PLC• SCADA
2. Control system methodology may include but not limited to:	<ul style="list-style-type: none">• Communication protocols (Ethernet, Modbus, Profibus)
3. IEE regulations on cable jointing may include but not limited to:	<ul style="list-style-type: none">• Electrical wiring and testing• Cable sizes• Cable termination
4. Guidelines in the manufacturer's manuals may include but not limited to:	<ul style="list-style-type: none">• Well Ventilated room• Raised surface• Near the charge controllers
5. System parameters may include but not limited to:	<ul style="list-style-type: none">• Voltages and current• Frequency• Speed• Temperature• Vibration
6. System components may include but not limited to:	<ul style="list-style-type: none">• Power supply• CPU• Input-output modules• Rails• Connectors• Cables• Ferrule• Lugs• Relay
7. Enclosure may include but not limited to:	<ul style="list-style-type: none">• Panels and distribution boards• IP classes
8. IEE regulations on cable laying and termination may include but not limited to:	<ul style="list-style-type: none">• Firmness• Insulation

Variable	Range
9. Expected interference may include but not limited to:	<ul style="list-style-type: none"> • Electromagnetic field
10. IEC standards may include but not limited to:	<ul style="list-style-type: none"> • BS 7691 • IEC 364 • IEC 391 • IEC 445 • IEC 446 • IEC 62257
11. Network protocols may include but not limited to:	<ul style="list-style-type: none"> • TCPIP • UDP • HTT
12. Protection devices may include but not limited to:	<ul style="list-style-type: none"> • RCDs • Lightning arresters • Earth rods • SPDs • Fuses (AC & DC) • Relays • Isolators

REQUIRED KNOWLEDGE AND UNDERSTANDING

The individual needs to demonstrate knowledge and understanding of:

- Control system components
- Electrical wiring
- Electrical design software
- MS Word & Excel
- Network Components and devices
- Color coding
- Use of electrical & mechanical tools
- Troubleshooting
- Electrical power distribution
- Power protection
- Testing techniques
- Measurement
- Electrical standards

FOUNDATION SKILLS

The individual needs to demonstrate the following foundation skills:

- Electrical principles
- Electrical codes

- Life cycle costing for energy systems
- OSHA, WSHA, and industry safety procedures and regulations
- Operate test equipment and interpret results
- Metering and interconnection industry
- Environmental regulations
- Read and understand plans and symbols
- Draw plans
- Use of CAD
- Parameters for normal/abnormal operation of equipment for climate zones
- Knowledge of principles of machine control system
- Research effectively on the internet (including old equipment)
- Computer skills
- Problem solving & decision making
- Analytical
- Troubleshooting
- Work Ethics
- Project management
- Teamwork

EVIDENCE GUIDE

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

<p>1. Critical Aspects of Competency</p>	<p>Assessment requires evidence that the candidate:</p> <p>1.1 Conducted site survey basing on the suitability of the system to be installed</p> <p>1.2 Designed machine control system in regard to expected system functionality</p> <p>1.3 Designed machine control system in line with expected methodology</p> <p>1.4 Designed machine control system based on the scope of the system</p> <p>1.5 Assembled tools, equipment and materials basing on their functionality</p> <p>1.6 Mounted electrical and electronic components in accordance to standard operating procedures</p> <p>1.7 Performed wiring of electrical components as per IEE regulations</p> <p>1.8 Terminated electrical wiring in regard to IEE regulations</p> <p>1.9 Configured and tested the system as per system functionality</p> <p>1.10 Prepared and documented the installation report in line</p>
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	<p>with standard operating procedures</p> <p>1.11 Performed user training and commissioned the control system installation as per the contract</p>
2. Resource Implications	<p>The following resources must be provided:</p> <p>Resources same as that of workplace are advised to be applied Including; PLCs, SCADA, sensors, amplifiers, motors, relays, contactors, controllers, cables, switches, VSDs protection devices etc.</p>
3. Methods of Assessment	<p>Competency may be assessed through:</p> <p>3.1 Observation</p> <p>3.2 Oral questioning</p> <p>3.3 Practical Tests</p> <p>3.4 Written Tests</p>
4. Context of Assessment	<p>Competency may be assessed</p> <p>4.1 On job</p> <p>4.2 Off job</p> <p>4.3 During industrial attachment</p>
5. Guidance information for assessment	<p>Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.</p>

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APPLY ELECTRICAL INSTRUMENTATION

UNIT CODE: ENG/OS/ET/CR/04/6/A

UNIT DESCRIPTION

This unit covers the competencies required to apply electrical instrumentation. Competencies include; demonstrating understanding of measurements, apply analogue instruments, apply electromechanical instruments, apply digital instruments, measurement of electrical and physical quantities, apply waveform analyzing instruments, applying sensors, transducers and calibrating instruments.

ELEMENTS AND PERFORMANCE CRITERIA

ELEMENT These describe the key outcomes which make up workplace function.	PERFORMANCE CRITERIA These are assessable statements which specify the required level of performance for each of the elements. <i>(Bold and italicised terms are elaborated in the Range)</i>
1. Demonstrate understanding of measurements	1.1 Units, dimensions and standards are identified in accordance with engineering practices 1.2 Conversions of units is performed in line with standard operating procedures 1.3 Dimensions of various quantities are determined based on their applications 1.4 Measurement standards are identified as per their applications 1.5 Measurement errors are determined based on standard operating procedures 1.6 Accuracy, precision, resolution, sensitivity and significant figures are determined in line with standard operating procedures 1.7 Instruments are applied as per their functionality
2. Apply analogue instruments	2.1 Analogue meters are classified based on their functionality 2.2 Analogue meters are applied in line with standard operating procedures 2.3 Errors are determined based on the instruments and component error combinations 2.4 Errors are analysed as per standard operating procedures
3. Apply electromechanical instruments	3.1 Permanent magnet moving coil (PMC) instruments are applied as per standard operating procedures 3.2 PMC is applied in accordance with their application in the galvanometers, dc ammeters,

<p>ELEMENT</p> <p>These describe the key outcomes which make up workplace function.</p>	<p>PERFORMANCE CRITERIA</p> <p>These are assessable statements which specify the required level of performance for each of the elements.</p> <p><i>(Bold and italicised terms are elaborated in the Range)</i></p>
	<p>dc voltmeters, ac ammeters and ac voltmeters</p> <p>3.3 Iron moving instruments are applied as per standard operating procedure</p> <p>3.4 Internal resistances for ammeters and voltmeters are determined in line with established procedures</p> <p>3.5 Types of electromechanical instruments are applied basing on their function and range applications</p> <p>3.6 Electrodynamic instruments are applied in accordance with their functionality</p> <p>3.7 Electrodynamic instruments are applied in consideration of their applications as voltmeter, ammeter and wattmeter</p> <p>3.8 Energy meters are applied as per standard operating procedure</p>
<p>4. Apply digital instruments</p>	<p>4.1 Demonstrate understanding of logic gates based on their applications</p> <p>4.2 Demonstrate understanding of digital counting as per standard operating procedures</p> <p>4.3 Demonstrate understanding of flip flops circuits basing on their applications</p> <p>4.4 Demonstrate understanding of LEDs, LCDs, & seven segment displays, encoders, as per standard operating procedure</p> <p>4.5 Analogue to digital converters are determined based on their applications</p> <p>4.6 Digital to analogue converters are determined based on based on applications</p> <p>4.7 Digital instruments accuracy and resolutions are determined as per their functionalities.</p>
<p>5. Measure electrical and physical quantities</p>	<p>5.1 Identify methods of resistance measurements in regard to standard operating procedures</p> <p>5.2 Wheatstone bridge resistance measurement is performed as per standard operating procedures</p> <p>5.3 High resistance measurement are performed as per standard operating procedures</p> <p>5.4 RC, RL and RLC series and parallel circuits are</p>

<p>ELEMENT</p> <p>These describe the key outcomes which make up workplace function.</p>	<p>PERFORMANCE CRITERIA</p> <p>These are assessable statements which specify the required level of performance for each of the elements.</p> <p><i>(Bold and italicised terms are elaborated in the Range)</i></p>
	<p>identified as per standard operating procedure</p> <p>5.5 Q factor is determined based on standard operating procedure</p> <p>5.6 Types of AC and DC bridges are determined in regard to established procedures</p> <p>5.7 Apply digital multimeters as per standard operating procedures</p> <p>5.8 Apply the Q meters in regard to established procedures</p> <p>5.9 Physical quantities are measured according as per the SOPs</p>
<p>6. Apply waveform analysing instruments</p>	<p>6.1 Analogue and digital oscilloscope are identified as per standard operating procedure</p> <p>6.2 Maintenance of oscilloscopes is performed in line with standard operating procedures</p> <p>6.3 Operation of oscilloscopes is performed based on its applications</p> <p>6.4 Oscilloscope specifications are determined in accordance to scope of measurements to be performed</p> <p>6.5 Special oscilloscope are applied as per standard operating procedures</p> <p>6.6 Performance of a spectrum analyser is determined based on its operation</p> <p>6.7 Logic analysers are applied as per standard operating procedures</p>
<p>7. Apply sensors and transducers</p>	<p>7.1 Sensors and transducers are identified in line with their applications</p> <p>7.2 Sensors and transducers are classified as per their functionality</p> <p>7.3 Sensors and transducers are determined in line with their specifications</p> <p>7.4 Signal processors are identified based on their processing ratings</p> <p>7.5 Signal processors are identified in line with their applications</p> <p>7.6 Data presentation methods are determined based on the nature of the output signal displays</p>

<p>ELEMENT</p> <p>These describe the key outcomes which make up workplace function.</p>	<p>PERFORMANCE CRITERIA</p> <p>These are assessable statements which specify the required level of performance for each of the elements.</p> <p><i>(Bold and italicised terms are elaborated in the Range)</i></p>
<p>8. Calibrate instruments</p>	<p>8.1 <i>Digital and analogue instruments</i> are calibrated as per standard procedure</p> <p>8.2 Instruments are calibrated in regard to their deflection range</p> <p>8.3 Electromechanical and electronic ohmmeter are calibrated in line with standard operating procedures</p> <p>8.4 Wattmeter, voltmeter and ammeter is calibrated as per standard operating procedure</p> <p>8.5 Standard calibrating instruments are identified based on their operating parameters</p>

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
<p>1. IEC Standards may include but not limited to:</p>	<ul style="list-style-type: none"> • IEC 62257 • IEC 60364 • IS 732/IEC 60364
<p>2. Output parameters may include but not limited to:</p>	<ul style="list-style-type: none"> • Current • Voltage • Frequency
<p>3. Digital and analogue instruments may include but not limited to:</p>	<ul style="list-style-type: none"> • Voltmeter • Ammeter • Ohmmeter • Wattmeter • Oscilloscope • Spectrum analyzer • Distortion meter • Q meter

REQUIRED KNOWLEDGE AND UNDERSTANDING

The individual needs to demonstrate knowledge and understanding of:

- Digital and analogue instruments
- Analogue electronics
- Digital electronics
- Instrumentation and calibration
- Sensors and transducers
- Physical quantities
- Measurement

FOUNDATION SKILLS

The individual needs to demonstrate the following additional skills:

- Engineering principles
- OSHA, WSHA, and industry safety procedures and regulations
- Operate test equipment and interpret results
- Metering and interconnection
- Teamwork
- Troubleshooting
- Read and understand
- Symbols and schematics

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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: 1.1 Identified units, dimensions and standards in line with engineering practices 1.2 Performed conversions of units in line with standard operating procedures 1.3 Determined dimensions of various quantities in line with their applications 1.4 Classified analogue meters as per their functionality 1.5 Applied analogue meters in line with standard operating procedures 1.6 Identified errors in analogue meters as per effect on measurements 1.7 Applied the permanent- magnet moving coil (PPMC) instrument as per standard operating procedures
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	<p>1.8 Applied PPMC based on the application in the galvanometers, dc ammeters, dc voltmeters, ac ammeters and ac voltmeters</p> <p>1.9 Applied moving iron instruments as per standard operating procedure</p> <p>1.10 Applied electrodynamics instruments as per their functionality</p> <p>1.11 Demonstrated understanding of logic gates in regard to their application</p> <p>1.12 Demonstrated understanding of latches registers and counters.</p> <p>1.13 Demonstrated understanding of flip flops in line with their applications</p> <p>1.14 Demonstrated understanding of LEDs, LCDs, & seven segment displays, encoders, decoders, duplex and optical fibre based on standard operating procedure</p> <p>1.15 Determined analogue to digital converters are determined as per their applications</p> <p>1.16 Identified methods of resistance measurements as per standard operating procedures</p> <p>1.17 Performed Wheatstone bridge resistance measurement as per standard operating procedures</p> <p>1.18 Identified RLC, RC and RL series and parallel circuits in line with standard operating procedure</p> <p>1.19 Determined Q factor using standard operating procedure</p> <p>1.20 Determined types of AC and DC bridges using established procedures</p> <p>1.21 Applied digital multimeters as per standard operating procedures</p> <p>1.22 Identified analogue and digital oscilloscope based on standard operating procedure</p> <p>1.23 Performed maintenance of oscilloscopes in line with standard operating procedures</p> <p>1.24 Performed operation of oscilloscopes as per its applications</p> <p>1.25 Determined oscilloscope specifications based on the scope of measurements to be performed</p> <p>1.26 Applied special oscilloscope as per standard operating procedures</p> <p>1.27 Determined basic circuitry of a distortion meter based on the meter configuration</p> <p>1.28 Determined performance of distortion meter in line with scope of work to be performed</p> <p>1.29 Identified sensors and transducers in line with their applications</p> <p>1.30 Classified sensors and transducers based on their</p>
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	<p>functionality</p> <p>1.31 Determined sensors and transducers in line with their specifications</p> <p>1.32 Identified signal processors in line with their applications</p> <p>1.33 Determined data presentation methods basing on the nature of the output signal displays</p> <p>1.34 Calibrated digital and analogue instruments as per standard operating procedure</p> <p>1.35 Calibrated instruments based on their deflection range</p> <p>1.36 Calibrated electromechanical and electronic ohmmeter as per standard meters</p> <p>1.37 Calibrated wattmeter, voltmeter and ammeter in line with standard operating procedure</p> <p>1.38 Identified standard calibrating instruments based on their operating parameters</p>
2. Resource Implications	<p>Resources the same as that of workplace are advised to be applied</p> <p>Included: Digital and analogue instruments, oscilloscopes, sensors, transducers etc.</p>
3. Methods of Assessment	<p>Competency may be assessed through:</p> <p>3.1 Oral questioning</p> <p>3.2 Practical Tests</p> <p>3.3 Written Tests</p> <p>3.4 Written tests</p>
4. Context of Assessment	<p>Competency may be assessed</p> <p>On job</p> <p>Off job</p> <p>During Industrial Attachment</p>
5. Guidance information for assessment	<p>Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.</p>

PERFORM INDUSTRIAL AUTOMATION

UNIT CODE: SEC/OS/ET/CR/05/6/A

UNIT DESCRIPTION

This unit covers competencies required to perform industrial automation. Competencies include; installing industrial sensors and transducers, installing automation components and hardware, installing machine systems, installing robots and robotic systems, and installing programming software

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. <i>(Bold and italicised terms are elaborated in the Range)</i>
1. Install industrial sensors and transducers	1.1 Sensors and transducers are identified based on their applications 1.2 Actuators are identified as per their output functions 1.3 Active sensors are determined based on their excitation external power 1.4 Passive sensors are determined in line with their signal output 1.5 Signal conditioning is performed in regard to expected energy output 1.6 Operational amplifiers are identified as per their configuration 1.7 Filters are identified as based on expected output frequencies 1.8 Noise in output signals is determined in line with standard operating procedures 1.9 Sensors and transducers are applied in adherence to manufacturer's manuals
2. Install automation components and hardware	2.1 Controllers are applied in accordance to I/O management of the automation system 2.2 Controllers are applied based on their computing and calculating requirements in the system 2.3 Multivariable control is identified in line with expected system performance 2.4 Industrial computers are applied as per nature of tasks required to run the system 2.5 Memory size and distribution is selected basing on the system requirements 2.6 Computer networking is performed based on

<p>ELEMENT</p> <p>These describe the key outcomes which make up workplace function.</p>	<p>PERFORMANCE CRITERIA</p> <p>These are assessable statements which specify the required level of performance for each of the elements.</p> <p><i>(Bold and italicised terms are elaborated in the Range)</i></p>
	<p>system requirements</p> <p>2.7 <i>Distributed Control Systems</i> (DCSs) are installed in line with system configuration</p> <p>2.8 DCSs are connected to sensors and actuators as per the system requirements</p> <p>2.9 DCSs are configured based on the system requirements (batch or continuous oriented)</p> <p>2.10 <i>Programmable Logic Circuits</i> are applied as per electromechanical system control requirements</p> <p>2.11 PLCs are installed as per packaging and semiconductor machine requirements</p> <p>2.12 PLC is selected in regard to complexity of the system</p> <p>2.13 PLC is installed in adherence to OSHA</p> <p>2.14 PLC I/O are connected based on system requirements</p> <p>2.15 PLC software programming is performed in accordance to manufacturer’s standard operating procedures</p> <p>2.16 <i>Human Machine Interfaces</i> are selected based on the operation requirements</p> <p>2.17 HMI are programmed as per standard as per manufacturer’s standard operating procedures</p> <p>2.18 Encoders and resolvers are selected in line with system requirements</p> <p>2.19 Output devices are selected as per microprocessor or microcomputer-based vision processing for inspection and measurement tasks</p> <p>2.20 Bar Codes, <i>Radio Frequency identification</i> (RFID) and Inductive ID are selected based on the system machine visible and readable formats</p> <p>2.21 Power control devices are selected in line with system power ratings</p> <p>2.22 Power control devices are installed in line with OSHA</p> <p>2.23 Power control devices are installed in adherence to IEE regulations</p> <p>2.24 Cables are distributed and terminated in line with OSHA</p>

<p>ELEMENT</p> <p>These describe the key outcomes which make up workplace function.</p>	<p>PERFORMANCE CRITERIA</p> <p>These are assessable statements which specify the required level of performance for each of the elements.</p> <p><i>(Bold and italicised terms are elaborated in the Range)</i></p>
	<p>2.25 Distribution blocks are selected based on the size of cables gauges</p> <p>2.26 Transformers are installed in regard to isolation and transfer of electrical energy requirements of the system</p> <p>2.27 Power supplies are installed based on energy requirements to various circuits in the automation system</p> <p>2.28 Special purpose motors are identified as per their functionality</p> <p>2.29 Variable Frequency Drives are installed based on power conversion requirements of the system</p> <p>2.30 Electrical enclosures are selected in consideration of national and international standards</p>
<p>3. Install machine systems</p>	<p>3.1 Conveyors are installed in line with machine movement configuration</p> <p>3.2 Conveyors are categorized based on material movement requirements</p> <p>3.3 Conveyor accessories are installed in line with conveyor and machine functionality</p> <p>3.4 Indexers are installed based on their functionality</p> <p>3.5 Part feeders are identified as per system requirements</p> <p>3.6 Part feeders are categorized based on their functionality</p> <p>3.7 Escapements are identified in line with the system functionality</p> <p>3.8 Escapements are applied as per conveying system, feeders, pallet indexing systems and assembly configurations</p>
<p>4. Install robots and robotic systems</p>	<p>4.1 Robotic automation is analyzed as per the automation system requirements</p> <p>4.2 Robot configurations are selected in line with specifications of speed, positions to be attained and the cost of the system (articulated robots, SCARA robots and Cartesian coordinate robots)</p> <p>4.3 Robot components are selected based on robot</p>

<p>ELEMENT</p> <p>These describe the key outcomes which make up workplace function.</p>	<p>PERFORMANCE CRITERIA</p> <p>These are assessable statements which specify the required level of performance for each of the elements.</p> <p><i>(Bold and italicised terms are elaborated in the Range)</i></p>
	<p>specifications</p> <p>4.4 Robots and robotic systems are installed in regard to system requirements</p> <p>4.5 Robot movements and positions are configured in consideration of coordinate systems</p>
<p>5. Install programming software</p>	<p>5.1 Software to be installed is selected basing on manufacturer specifications of the hardware</p> <p>5.2 Programming concepts are selected in line with software functionality</p> <p>5.3 PLC, DCS, embedded systems and robot controllers are programmed as per their functionality</p> <p>5.4 Programming languages are selected as per nature of the software to be developed</p> <p>5.5 Program is developed in consideration of reliability, robustness, usability, efficiency, effectiveness, portability, maintenance characteristics</p> <p>5.6 Programming methodologies are selected in line with nature of program to be developed</p> <p>5.7 Pneumatic, hydraulic and electrical circuits are developed by use of CAD programs based on the circuits design</p> <p>5.8 Analysis software is applied in sizing servomotors, determining stresses on mechanical systems and calculating other factors in line with system design</p> <p>5.9 <i>Supervisory control and data acquisition</i> (SCADA) packages are applied as per the nature of automated control system</p>

RANGE

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

Variable	Range
1. Automation system components and hardware may include but not limited to:	<ul style="list-style-type: none"> • Microcontrollers and microprocessor • DCS • PLC • SCADA • RFID • Conveyors • Indexers and escarpments • Robots • Relays • Contactors • Switches • Valves
2. Safety and precautions measures may include but not limited to:	<ul style="list-style-type: none"> • Are activities and precautions taken to improve safety in a workplace • OSHA regulations • IEE regulations • National and international standards
3. Programming software may include but not limited	<ul style="list-style-type: none"> • PLC programming • SCADA programming • SCARA, articulate and Cartesian robotic programming

REQUIRED KNOWLEDGE AND UNDERSTANDING

The individual needs to demonstrate knowledge and understanding of:

- Safety during installation and maintenance of automation system
- National and international standards
- Installation of various automation systems
- Configuration of robots and robotic systems
- Operation monitoring
- Communication networks and protocols
- Manufacturer's specifications and recommendations
- Troubleshooting methods
- Controlled process
- Control components of automation systems
- Programming standards

FOUNDATION SKILLS

The individual needs to demonstrate the following additional skills

- Communications
- Proficient in analysis of automation systems
- Time management;

- Faults troubleshooting
- Decision making;
- Report writing;
- Analytical
- Problem solving;
- Planning

EVIDENCE GUIDE

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

<p>1. Critical Aspects of Competency</p>	<p>Assessment requires evidence that the candidate:</p> <ol style="list-style-type: none"> 1.1 Identified Sensors, transduces as per expected energy forms to be detected 1.2 Identified actuators based on their output functions 1.3 Determined sensors in line with their excitation external power identification 1.4 Identified operational amplifiers based on their configuration 1.5 Identified filters in line with their expected output frequencies 1.6 Determined noise in output signals and eliminated in accordance to standard operating procedures 1.7 Applied controllers based on I/O management of the automation system 1.8 Networked controllers as per the system configuration 1.9 Applied controllers based on their computing and calculating requirements in the system 1.10 Installed distributed Control Systems (DCSs) in line with the configuration of the system 1.11 Connected DCSs to sensors and actuators based on the system requirements 1.12 Configured DCSs based on the system requirements (batch or continuous oriented) 1.13 Applied Programmable Logic Circuits in regard to electromechanical system control requirements 1.14 Installed PLCs in accordance to packaging and semiconductor machine requirements 1.15 Selected PLC based on complexity of the system 1.16 Selected human Machine Interfaces as per operation requirements 1.17 Selected Bar Codes, Radio Frequency identification (RFID) and Inductive ID in line with system complexity
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	<p>1.18 Installed power control devices adherence to OSHA</p> <p>1.19 Installed transformers based on isolation and transfer of electrical energy requirements of the system</p> <p>1.20 Installed conveyors in line with machine movement configuration</p> <p>1.21 Installed indexers are installed as per their functionality</p> <p>1.22 Identified part feeders based on system requirements</p> <p>1.23 Identified escarpments in line with the system functionality</p> <p>1.24 Analysed robotic automation based on automation system requirements</p> <p>1.25 Selected software to be installed in accordance to manufacturer specifications of the hardware</p> <p>1.26 Programmed PLC, DCS, embedded processor, robot controllers in line with their functionality</p> <p>1.27 Developed program in consideration of reliability, robustness, usability, efficiency, effectiveness, portability, maintenance characteristics</p> <p>1.28 Developed pneumatic and electrical circuits are by use of CAD programs based on the circuits design</p>
2. Resource Implications	<p>Resources the same as that of workplace are advised to be applied</p> <p>Included: computers, switches, PLCs, DCS, SCADA programming software, timers, relays, Conveyors, etc.</p>
3. Methods of Assessment	<p>Competency may be assessed through:</p> <p>3.1 Oral questioning</p> <p>3.2 Practical Tests</p> <p>3.3 Observation</p>
4. Context of Assessment	<p>Competency may be assessed</p> <p>4.1 On job</p> <p>4.2 Off job</p> <p>4.3 During Industrial Attachment</p>
5. Guidance information for assessment	<p>Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.</p>

MAINTAIN AUTOMATION AND RADIO FREQUENCY SYSTEMS

UNIT CODE: SEC/OS/ET/CR/06/6/A

UNIT DESCRIPTION

This unit covers competencies required to perform automation and radio frequency systems maintenance. Competencies includes: preparing maintenance schedule, inspecting and testing automation and radio frequency system, preparing a list of tools, equipment and materials, performing maintenance activities, conducting tests on maintained system and documenting maintenance records.

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. <i>(Bold and italicised terms are elaborated in the Range)</i>
1. Prepare maintenance schedule	1.1 Systems to be maintained are identified as per standard operating procedure 1.2 Scope and type of maintenance to be carried out is determined based on the system maintenance requirements 1.3 Maintenance checklist is prepared in line with standard operating procedure 1.4 Manufacturer's manuals are assembled in accordance to system components 1.5 Maintenance team is identified and assembled as per the expertise required 1.6 Maintenance work plan is developed in regard to maintenance activities to be performed.
2. Inspect and test automation and radio frequency systems	2.1 System and equipment are inspected in regard to established procedure 2.2 Main isolation points are identified as per system configuration 2.3 Components and equipment are identified and tested in line with established procedures 2.4 Automation system is tested based on its functionality 2.5 Active and passive radio frequency circuit components are identified based on standard operating procedure 2.6 Oscillators in RF Circuits are identified and

<p>ELEMENT</p> <p>These describe the key outcomes which make up workplace function.</p>	<p>PERFORMANCE CRITERIA</p> <p>These are assessable statements which specify the required level of performance for each of the elements.</p> <p><i>(Bold and italicised terms are elaborated in the Range)</i></p>
	<p>tested in line with their functionality</p> <p>2.7 Amplifiers in RF circuits are identified and tested as per their functionality</p> <p>2.8 Modulation and demodulation of RF signals is performed in line with standard operating procedure</p> <p>2.9 Transmitters in RF circuits are identified and tested as per standard operating procedures</p> <p>2.10 Receivers in RF circuits are identified and tested in line with standard operating procedures</p> <p>2.11 Antenna in RF circuits are identified based on their functionality</p> <p>2.12 Antenna is inspected and tested in accordance to manufacturers' manuals</p> <p>2.13 Speakers in RF circuits are tested as per standard operating procedure</p> <p>2.14 Display components in RF circuits are identified and tested as per standard operating procedure</p> <p>2.15 Radio frequency system is tested as per its functionality</p> <p>2.16 Test results are recorded as per established procedure</p>
<p>3. Prepare a list of maintenance tools, equipment and materials</p>	<p>3.1 Maintenance tools and equipment are identified in regard to maintenance activities to be performed</p> <p>3.2 A list of tools, equipment and materials are prepared in line with established procedure</p> <p>3.3 Tools and equipment are checked for specifications and functionality as per operating procedures</p> <p>3.4 Tools and equipment are calibrated in line with standard operating procedure</p>
<p>4. Perform maintenance activities</p>	<p>4.1 System components to be repaired/replaced are identified in line with standard operating procedure</p> <p>4.2 Cleaning, soldering and tightening of components are performed as per standard operating procedure</p>

<p>ELEMENT</p> <p>These describe the key outcomes which make up workplace function.</p>	<p>PERFORMANCE CRITERIA</p> <p>These are assessable statements which specify the required level of performance for each of the elements.</p> <p><i>(Bold and italicised terms are elaborated in the Range)</i></p>
	<p>4.3 Defective components/parts are repaired/replaced based on established procedures</p> <p>4.4 Repaired/replaced system components are configured in accordance to the system functionality</p> <p>4.5 Maintenance activities are carried out in adherence to OSHA standards</p> <p>4.6 Waste materials are disposed adherence to EHS regulations</p>
<p>5. Conduct system tests</p>	<p>5.1 Type of tests to be carried out are identified in line with maintenance activities</p> <p>5.2 Components to be tested are identified based on the system functionality</p> <p>5.3 Repaired/replaced components are tested in accordance to manufacturer’s manuals</p> <p>5.4 Test-running the system is performed based on the system functionality</p> <p>5.5 Test results are recorded as per standard operating procedures</p>
<p>6. Document maintenance records</p>	<p>6.1 Maintenance checklist is documented in regard to standard operating procedure</p> <p>6.2 Maintenance report is prepared as per standard operating procedure</p> <p>6.3 Maintenance report is shared among parties based on the contract</p>

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.

<p>1. Automation system components may include but not limited to</p>	<ul style="list-style-type: none"> • PLCs • DCSs • SCADA • Relays • Switches • VFDs
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<p>2. Radio frequency system components may include but not limited to</p>	<ul style="list-style-type: none"> • Antenna • Oscillators • Amplifiers • Transmitters • Receiver • Tuners • Mixers • Modulators and demodulators • Filters
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REQUIRED KNOWLEDGE AND UNDERSTANDING

The individual needs to demonstrate knowledge and understanding of:

- Troubleshooting techniques
- Repair/replacing of system components techniques
- Causes of system failures
- Knowledge in electrical principles
- Electrical safety and precautions measures
- Electrical shock prevention measures
- Knowledge in engineering mathematics
- Performance monitoring techniques

FOUNDATION SKILLS

The individual needs to demonstrate the following additional skills:

- Communications (verbal and written);
- Computer literacy
- Electrical principles
- Physics
- Analytical skills
- Time management
- Faults troubleshooting
- Problem solving;
- Planning;
- Decision making;
- 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.

<p>1. Critical Aspects</p>	<p>Assessment requires evidence that the candidate:</p>
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of Competency	<ul style="list-style-type: none"> 1.1 Identified systems to be maintained as per standard operating procedure 1.2 Determined scope and type of maintenance to be carried out based on the system maintenance requirements 1.3 Prepared maintenance checklist as per standard operating procedure 1.4 Assembled manufacturer's manuals in line with system to be maintained 1.5 Identified oscillators in RF Circuits and tested based on their functionality 1.6 Inspected system and equipment as per established procedure 1.7 Identified main isolation points in accordance to system configuration 1.8 Identified components and equipment and tested based on established procedures 1.9 Identified active and passive radio frequency circuit components as per standard operating procedure 1.10 Identified oscillators in RF Circuits and tested them as per their functionality 1.11 Identified amplifiers in RF circuits and tested them as per their functionality 1.12 Identified transmitters in RF circuits and tested them as per standard operating procedures 1.13 Identified receivers in RF circuits and tested them as per standard operating procedures 1.14 Inspected and tested antenna as per manufacturers' manuals 1.15 Tested radio frequency system as per its functionality 1.16 Identified maintenance activities and recorded as per system functionality 1.17 Identified maintenance tools and equipment as per maintenance activities to be performed 1.18 Checked tools and equipment for specifications and functionality as per operating procedures 1.19 Identified system components to be repaired/replaced as per standard operating procedure 1.20 Carried out maintenance activities in line with OSHA standards 1.21 Disposed waste materials in line with EHS regulations 1.22 Performed cleaning, soldering and tightening of components as per standard operating procedure 1.23 Identified components to be tested as per system functionality 1.24 Tested repaired/replaced components as per manufacturer's manuals
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	1.25 Recorded test results as per standard operating procedures
2. Resource Implications	Resources the same as that of workplace are advised to be applied Included: 2.1 Antenna 2.2 Oscillators 2.3 Amplifiers 2.4 Transmitters 2.5 Receiver 2.6 Tuners 2.7 Mixers 2.8 Modulators 2.9 Demodulators 2.10 Filters 2.11 Radio 2.12 Television 2.13 mobile phones 2.14 set top boxes 2.15 switches, etc.
3. Methods of Assessment	Competency may be assessed through: 3.1 Oral questioning 3.2 Practical Tests 3.3 Observation 3.4 Written tests
4. Context of Assessment	Competency may be assessed 4.1 On job 4.2 Off job 4.3 During industrial attachment
5. Guidance information for assessment	Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.