THE REPUBLIC OF KENYA

NATIONAL OCCUPATIONAL STANDARDS

FOR

MECHATRONIC 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 blueprint, Vision 2030 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 of Kenya 2010 and this resulted to the formulation of the Policy Framework for Reforming Education and Training (Sessional Paper No. 4 of 2016). A key feature of this policy is the radical change in the design and delivery of the TVET training.

This policy document requires that training in TVET be competency based, curriculum development be industry led, certification be based on demonstration of competence and mode of delivery allows for multiple entry and exit in TVET 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 were developed for developing a competency-based curriculum for Mechatronic Technician. These Occupational Standards will also be the bases 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 Mechatronic sector's growth and development.

PRINCIPAL SECRETARY, VOCATIONAL AND TECHNICAL TRAINING
MINISTRY OF EDUCATION

PREFACE

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

The Technical and Vocational Education and Training Act No. 29 of 2013 and Sessional Paper No. 4 of 2016 on Reforming Education and Training in Kenya, emphasized the need to reform curriculum development, assessment and certification. This called for a shift to CBET in order to address the mismatch between skills acquired through training and skills needed by industry as well as increase the global competitiveness of Kenyan labor force.

The TVET Curriculum Development, Assessment and Certification Council (TVET CDACC), in conjunction with Mechatronic Sector Skills Advisory Committee (SSAC have developed these Occupational Standards for Mechatronic technician. These standards will be the bases for development of competency-based curriculum for Mechatronic technician Level 6.

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, Mechatronic SSAC, expert workers and all those who participated in the development of these Occupational Standards.

Prof. CHARLES M. M. ONDIEKI, PhD, FIET (K), Con. EngTech.
CHAIRPERSON, TVET CDACC

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ACRONYMS

TVET: Technical and Vocational Education and Training

CDACC: Curriculum Development, Assessment and Certification Council

ICT: Information communication technology

SSAC: Sector Skill Advisory Committee

EIA: Environmental Impact Assessment

CBET: Competency Based Education and Training

PPE: Personal Protective Equipment

EMS: Environmental Management System

OSH: Occupational Safety and Health

OSHA: Occupational, Health and Safety Act

CAD: Computer Aided Design

D.C: Direct Current

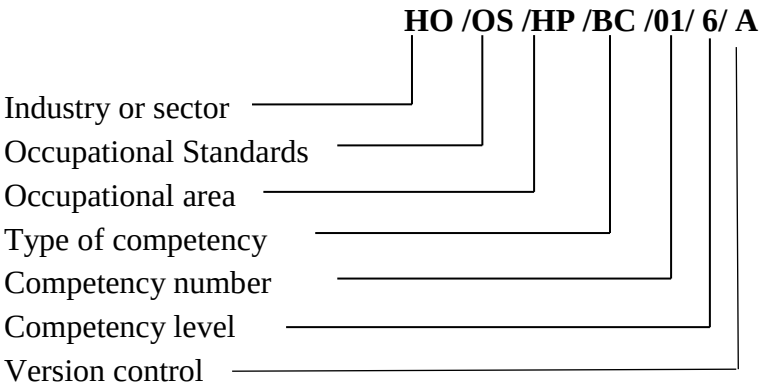
A.C: Alternating Current

PLC: Programmable Logic Control

VSD: Variable Speed Drive

I/O: Input/output

KEY TO UNIT CODE



OVERVIEW

Mechatronic Technician level 6 entails designing of electro-mechanical systems, installing mechatronic systems, maintaining electro-mechanical systems, mechatronic systems instrumentation and control, carrying out mechatronic programming, operating mechatronic systems and managing mechatronic projects. Its qualifications include the following basic and core competencies:

BASIC UNITS OF COMPETENCY	
Unit of competency Code	**Units of competency**
ENG/OS/MC/BC/01/6/A	Demonstrate communication skills
ENG/OS/MC/BC/02/6/A	Demonstrate digital literacy
ENG/OS/MC/BC/03/6/A	Demonstrate entrepreneurial skills
ENG/OS/MC/BC/04/6/A	Demonstrate employability skills
ENG/OS/MC/BC/05/6/A	Demonstrate environmental literacy
ENG/OS/MC/BC/06/6/A	Demonstrate occupational health and safety
COMMON UNITS OF COMPETENCY	
ENG/OS/MC/CC/01/6/A	Prepare and interpret technical drawing
ENG/OS/MC/CC/02/6/A	Apply engineering mathematics
ENG/OS/MC/CC/03/6/A	Perform workshop processes and practices
ENG/OS/MC/CC/04/6/A	Apply electrical and electronics principles
ENG/OS/MC/CC/05/6/A	Apply material science principles
ENG/OS/MC/CC/06/6/A	Apply thermodynamics principles
ENG/OS/MC/CC/07/6/A	Apply fluid mechanics principles
CORE UNITS OF COMPETENCY	
ENG/OS/MC/CR/01/6/A	Design of electro-mechanical systems
ENG/OS/MC/CR/02/6/A	Install mechatronic systems
ENG/OS/MC/CR/03/6/A	Maintain electro-mechanical systems
ENG/OS/MC/CR/04/6/A	Mechatronic systems instrumentation and control
ENG/OS/MC/CR/05/6/A	Carry out mechatronic programming
ENG/OS/MC/CR/06/6/A	Operate mechatronic systems
ENG/OS/MC/CR/07/6/A	Manage mechatronic projects

BASIC UNITS OF COMPETENCY

DEMONSTRATE COMMUNICATION SKILLS

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

Unit description

This unit covers the competencies required in meeting communication needs of clients and colleagues; developing, establishing, maintaining communication pathways and strategies. It also covers competencies for conducting interviews, facilitating group discussion and representing the organization in various forums.

ELEMENTS AND PERFORMANCE CRITERIA

ELEMENT These describe the key outcomes which make the workplace function.	**PERFORMANCE CRITERIA** These are assessable statements which specify the required level of performance for each of the elements. ***Bold and italicized terms are elaborated in the Range***
1. Meet communication needs of clients and colleagues.	1.1 Specific communication needs of clients and colleagues are identified and met. 1.2 Different approaches are used to meet communication needs of clients and colleagues. 1.3 Conflict is addressed promptly and in a timely way and in a manner which does not compromise the standing of the organization.
2. Develop communication strategies.	2.1 Strategies for effective internal and external dissemination of information are developed to meet the organization's requirements. 2.2 Special communication needs are considered in developing strategies to avoid discrimination in the workplace. 2.3 Communication ***strategies*** are analyzed, evaluated and revised where necessary to make sure they are effective.
3. Establish and maintain communication pathways.	3.1 Pathways of communication are established to meet requirements of organization and workforce. 3.2 Pathways are maintained and reviewed to ensure personnel are informed of relevant information.
4. Promote use of communication strategies.	4.1 Information is provided to all areas of the organization to facilitate implementation of the strategy. 4.2 Effective communication techniques are articulated and modelled to the workforce. 4.3 Personnel are given guidance about adapting communication strategies to suit a range of contexts.

ELEMENT These describe the key outcomes which make the workplace function.	PERFORMANCE CRITERIA These are assessable statements which specify the required level of performance for each of the elements. ***Bold and italicized terms are elaborated in the Range***
5. Conduct interview.	5.1 A range of appropriate communication strategies are employed in ***interview situations.*** 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 to ensure that the required message is communicated.
6. Facilitate group discussion.	6.1 Mechanisms which enhance ***effective group interaction*** is defined and implemented. 6.2 Strategies which encourage all group members to participate are used routinely. 6.3 Objectives and agenda for meetings and discussions are routinely set and followed. 6.4 Relevant information is provided to the group to facilitate outcomes. 6.5 Evaluation of group communication strategies is undertaken to promote participation of all parties. 6.6 Specific communication needs of individuals are identified and addressed.
7. Represent the organization.	1.1 When participating in internal or external forums, presentation is relevant, appropriately researched and presented in a manner to promote the organization. 1.2 Presentation is clear and sequential and delivered within a predetermined time. 1.3 Appropriate media is utilized to enhance presentation. 1.4 Differences in views are respected. 1.5 Written communication is consistent with organizational standards. 1.6 Inquiries are responded to in a manner consistent with organizational standards.

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
Communication strategies may include but not limited to:	• Language switch. • Comprehension check. • Repetition. • Asking for confirmation. • Paraphrase. • Clarification request. • Translation. • Restructuring. • Approximation. • Generalization.
Effective group interaction may include but not limited to:	• Identifying and evaluating what is occurring within an interaction in a non-judgmental way. • Using active listening. • Making a decision about appropriate words, behaviour. • Putting together a response which is culturally appropriate. • Expressing an individual perspective. • Expressing own philosophy, ideology and background and exploring its impact with relevance to communication.
Situations may include but not limited to:	• 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:

- Effective communication.
- Active listening.
- Giving/receiving feedback.

- Interpretation of information.
- Role boundaries setting.
- Negotiation.
- Establishing empathy.
- Openness and flexibility in communication.
- Communication skills required to fulfil job roles as specified by the organization.
- Writing communications strategy.
- Applying key elements of communications strategy.

Required Knowledge

The individual needs to demonstrate knowledge of:

- Communication process.
- Dynamics of groups and different styles of group leadership.
- Communication skills relevant to client groups.
- Flexibility in communication.
- Communication skills relevant to client groups.
- 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	Assessment requires evidence that the candidate: 1.1 Developed communication strategies to meet the organization requirements and applied in the workplace 1.2 Established and maintained communication pathways for effective communication in the workplace 1.3 Used communication strategies involving exchanges of complex oral information
2. Resource Implications	The following resources should be provided: 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/Demonstration with Oral Questioning 3.2 Written Examination
4. Context of Assessment	Competency may be assessed individually in the actual workplace or through accredited institution

5. Guidance information for assessment	Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.

DEMONSTRATE DIGITAL LITERACY

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

Unit description

This unit covers the competencies required to effectively using digital devices such as smartphones, tablets, laptops and desktop PCs. It entails identifying and using digital devices such as smartphones, tablets, laptops and desktop PCs for purposes of communication, work performance and management at the work place.

ELEMENTS AND PERFORMANCE CRITERIA

ELEMENT These describe the key outcomes which make up workplace functions.	**PERFORMANCE CRITERIA** These are assessable statements which specify the required level of performance for each of the elements. ***Bold and italicized terms are elaborated in the Range***
1. 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 manufacturer's specification. 1.3 ***Appropriate computer software*** are identified according to manufacturer's specification. 1.4 ***Appropriate computer hardware*** are 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, and software in automated environment.	2.1 ***Data security and privacy are classified*** in accordance with the prevailing technology. 2.2 ***Security threats*** are identified ***and control measures*** are applied in accordance with laws governing protection of ICT. 2.3 Computer threats and crimes are detected. 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 ***Word processing concepts*** are applied in resolving workplace tasks, report writing and documentation. 3.2 ***Word processing utilities*** are applied in accordance with workplace procedures. 3.3 Worksheet layout is prepared in accordance with

ELEMENT These describe the key outcomes which make up workplace functions.	PERFORMANCE CRITERIA These are assessable statements which specify the required level of performance for each of the elements. ***Bold and italicized terms are elaborated in the Range***
	work procedures. 3.4 Worksheets are built and data manipulated in the worksheets in accordance with workplace procedures. 3.5 Continuous data manipulated on worksheet is undertaken in accordance with work requirements 3.6 Database design and manipulation is undertaken in accordance with office procedures. 3.7 Data sorting, indexing, storage, retrieval and security is provided in accordance with workplace procedures.
4. Apply internet and email in communication at workplace.	4.1 Electronic mail addresses are opened and applied in workplace communication in accordance with office policy. 4.2 Office internet functions are defined and executed in accordance with office procedures. 4.3 ***Network configuration*** is determined in accordance with office operations procedures. 4.4 Official World Wide Web is installed and managed according to workplace procedures.
5. Apply Desktop publishing in official assignments.	5.1 Desktop publishing functions and tools are identified in accordance with manufactures specifications. 5.2 Desktop publishing tools are developed in accordance with work requirements. 5.3 Desktop publishing tools are applied in accordance with workplace requirements. 5.4 Typeset work is enhanced in accordance with workplace standards.
6. Prepare presentation packages.	6.1 Types of presentation packages are identified in accordance with office requirements. 6.2 Slides are created and formulated in accordance with workplace procedures. 6.3 Slides are edited and run in accordance with work procedures. 6.4 Slides and handouts are printed according to

ELEMENT These describe the key outcomes which make up workplace functions.	PERFORMANCE CRITERIA These are assessable statements which specify the required level of performance for each of the elements. ***Bold and italicized terms are elaborated in the Range***
	work requirements.

RANGE

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

Variable	Range
Appropriate computer software may include but not limited to:	A collection of instructions or computer tools that enable the user to interact with a computer, its hardware, or perform tasks.
Appropriate computer hardware may include but not limited to:	llection of physical parts of a computer system such as; • Computer case, monitor, keyboard, and mouse • All the parts inside the computer case, such as the hard disk drive, motherboard and video card.
Data security and privacy may include but not limited to:	• Confidentiality of data. • Cloud computing. • Integrity-but-curious data surfing.
Security and control measures may include but not limited to:	• Counter measures against cyber terrorism. • Risk reduction. • Cyber threat issues. • Risk management. • Pass-wording.
Security threats may include but not limited to:	• Cyber terrorism. • Hacking.
Word processing concepts may include but not limited to:	Using a special program to create, edit and print documents.
Network configuration may include but not limited to:	Organizing and maintaining information on the components of a computer network.

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 a 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: 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.	2.1 Tablets. 2.2 Laptops. 2.3 Desktop PCs. 2.4 Desktop computer. 2.5 Calculator. 2.6 Internet. 2.7 Smart phone. 2.8 Operations Manuals.
3. Methods of Assessment.	Competency may be assessed through: 3.1 Written Test. 3.2 Demonstration. 3.3 Practical assignment. 3.4 Interview/Oral Questioning. 3.5 Demonstration.

4. Context of Assessment.	Competency may be assessed in an off and on the job setting.
5. Guidance information for assessment.	Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.

DEMONSTRATE ENTREPRENEURIAL SKILLS

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

Unit description

This unit covers the outcomes required to build and develop the enterprise to be more competitive within a changing business environment, specifically responding to consumer demands while maintaining product quality and accessibility, building a customer base and employee motivation.

ELEMENTS AND PERFORMANCE CRITERIA

ELEMENT These describe the key outcomes that make up workplace functions.	PERFORMANCE CRITERIA These are assessable statements which specify the required level of performance for each of the elements. ***Bold and italicized terms are elaborated in the Range***
1. Develop business Innovative strategies.	1.1 Business innovation strategies are determined in accordance with the organization strategies. 1.2 Business innovation strategies are implemented for the purpose of business growth. 1.3 Track record and normative capability profile of enterprise and similar businesses are reviewed and considered in setting ***strategic directions***. 1.4 Strengths, weaknesses, opportunities and threats are considered when developing new ideas, approaches, goals and directions. 1.5 Decisions about enterprise strategies/directions are made after careful consideration of all relevant information. 1.6 ***Business/corporate plan*** is developed that sets out tactics, resource implications, timeframes, production and sales target.
2. Develop new products/ markets.	2.1 Alternative product/service offerings are canvassed and studied for feasibility. 2.2 Potential and new sources/sellers of supplies and raw materials are identified and canvassed. 2.3 Target markets and buyers are identified and surveyed as to their preferences and brand loyalties.
3. Expand customers and product lines	3.1 Enterprise is built up and sustained through responsiveness to market demands and the regulatory environment. 3.2 Competitive advantage of existing products and

ELEMENT These describe the key outcomes that make up workplace functions.	PERFORMANCE CRITERIA These are assessable statements which specify the required level of performance for each of the elements. ***Bold and italicized terms are elaborated in the Range***
	services is maintained/enhanced through responsive advocacies and strategies. 3.3 Constant listening to stakeholder/client feedback is ensured to maintain loyal client base.
4. Motivate staff/workers.	4.1 Regular dialogue is established and maintained in all levels and relevant sections of the enterprise. 4.2 Flow of communications in both directions is encouraged. 4.3 Helpful mechanisms and benefits are implemented. 4.4 Issues/problems are proactively resolved through win-win solutions wherever practicable.
5. Expand employed capital base.	5.1 Capital employed in business is continuously reviewed as per the strategic plan. 5.2 Business share holdings are reviewed in accordance with the type of business. 5.3 Capital employed is expanded according to organization procedures. 5.4 Types of shares are determined according to strategic plan. 5.5 Shares diversification process is undertaken as per office procedures. 5.6 Role of shareholders is determined and implemented in accordance organization procedures.
6. Undertake county/ regional business expansion.	6.1 Regions for expansion are continuously reviewed in accordance with strategic plan and company's expansion plan. 6.2 County business regulations are reviewed and adhered to in accordance with set procedures. 6.3 Regional laws and regulations are adhered to in accordance with set procedures. 6.4 County/regional business expansion is undertaken in accordance with organization's

ELEMENT These describe the key outcomes that make up workplace functions.	PERFORMANCE CRITERIA These are assessable statements which specify the required level of performance for each of the elements. ***Bold and italicized terms are elaborated in the Range***
	growth/ expansion plan.

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
Strategic directions include but not limited to:	1.1 Business continuity and succession 1.2 Resource access security. 1.3 Core competencies development. 1.4 New developments e.g. technological change, new products.
Business/Corporate plan include but not limited to:	2.1 Action steps and responsibilities of departments and individual workers. 2.2 Resource requirements and budget. 2.3 Tactics and strategies to achieve objectives.
Helpful mechanisms include but not limited to:	3.1 Wage and non-wage benefits. 3.2 Employee awards and recognition systems. 3.3 Employee rights and welfare policies. 3.4 Full-disclosure/transparency policies.

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:

- Assessing a range of alternative products and strategies.
- Critically analyzing information, summarizing and making sense of previous and current market trends.
- Identifying changing consumer preferences and demographics.
- Thinking “outside the box”.
- Ensuring quality consistency.
- Reducing lead time to product/service delivery.
- Managing operations/ production.
- Using formal problem-solving procedures, e.g., root-cause analysis, six sigma.

- Communication skills.
- Applying motivational principles, e.g., positive stroking, and behavior modification.
- Assessing a range of alternatives rather than choosing the easiest option.
- Achieving ownership and credibility for the enterprise vision.
- Critically analyzing information, summarizing and making sense of previous and current market trends.
- Developing solutions and practical strategies that are "outside the box".

Required Knowledge

The individual needs to demonstrate knowledge of:

- Features and benefits of common operational practices, e. g., continuous improvement (kaizen), waste elimination.
- Conflict resolution.
- Health, safety and environment (HSE) principles and requirements.
- Public-relations strategies.
- Basic cost-benefit analysis.
- Basic financial management.
- Business strategic planning.
- Impact of change on individuals, groups and industries.
- Employee assistance.
- Government and regulatory processes.
- Local and international market trends.
- Product promotion strategies.
- Mechanisms in the enterprise.
- Market and feasibility studies.
- Local and global supply chains business models and strategies.
- Government and regulatory processes
- Local and international business environment.
- Concepts of change management.
- Relevant developments in other industries.
- Capital employed.
- Regional/ County business expansion.
- Innovation in business.

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 Demonstrated ability to maintain a profitable and stable enterprise as shown by stakeholder

	feedback, employee testimonies and company financial statements 1.2 Demonstrated ability to conceptualize and plan a micro/small enterprise 1.3 Demonstrated ability to manage/operate a micro/small-scale business 1.4 Demonstrated basic marketing skills
2. Resource Implications.	The following resources should be provided: • Interview guide for entrepreneurs. • Enterprise workers and third parties. • Materials and location relevant to the proposed activity and tasks.
3. Methods of Assessment.	• Case problems. • Interview. • Portfolio. • Third part reports.
4. Context of Assessment.	• Competency may be assessed in workplace or in a simulated workplace setting. • Assessment shall be observed while tasks are being undertaken whether individually or in-group.
5. Guidance information for assessment.	Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.

DEMONSTRATE EMPLOYABILITY SKILLS

UNIT CODE: ENG/OS/MC/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 These describe the key outcomes which make up workplace function.	**PERFORMANCE CRITERIA** These are assessable statements which specify the required level of performance for each of the elements. ***Bold and italicized terms are elaborated in the Range***
1. Conduct self-management	1.1 Personal vision, mission and goals are formulated based on potential and in relation to organization objectives 1.2 Emotions are managed 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. 1.6 Self-esteem and a positive self-image are developed and maintained. 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 as per ***personal objectives*** 1.10 Critics are managed as per personal objectives
2. Demonstrate	2.1 Listening and understanding is demonstrated

interpersonal communication	as per communication policy 2.2 Writing to the needs of the audience is demonstrated as per communication policy 2.3 Speaking, reading and writing is demonstrated as per communication policy 2.4 Negotiation skills are demonstrated as per communication policy 2.5 Empathizing is demonstrated as per the communication policy 2.6 Numeracy is applied as per the communication policy 2.7 Internal and external customers' needs are identified and interpreted as per the communication policy 2.8 Persuasion is demonstrated as per the communication policy 2.9 Communication nnetworks are established as per the SOPs 2.10 Information is shared as per communication structure
3. Demonstrate critical safe work habits	3.1 Stress is managed in accordance with workplace procedures. 3.2 Punctuality and time consciousness is demonstrated in line with workplace policy. 3.3 Personal objectives are integrated with organization goals based on organization's strategic plan. 3.4 ***Resources*** are utilized in accordance with workplace policy. 3.5 Work priorities are set in accordance to workplace procedures. 3.6 Leisure time is recognized in line with organization policy. 3.7 Abstinence from ***drug and substance abuse*** is observed as per workplace policy. 3.8 Awareness of HIV and AIDS is demonstrated in line with workplace requirements. 3.9 Safety consciousness is demonstrated in the workplace based on organization safety policy. 3.10 ***Emerging issues*** are dealt with in accordance with organization policy.
4. Lead a workplace team	4.1 Performance expectations for the ***team*** are

	set 4.2 Duties and responsibilities are assigned in accordance with the organization policy. 4.3 Team parameters and ***relationships*** are identified according to set rules and regulations. 4.4 ***Forms of communication*** in a team are established according to office policy. 4.5 Communication is carried out as per workplace place policy and requirements of the job. 4.6 Team performance is supervised 4.7 ***Feedback*** on performance is collected and analyzed based on established team learning process 4.8 Conflicts are resolved between team members in line with organization rules and regulations. 4.9 ***Gender mainstreaming*** is undertaken in accordance with set regulations. 4.10 Human rights are adhered to in accordance with existing protocol. 4.11 Healthy relationships are developed and maintained for harmonious co-existence in line with workplace.
5. Plan and organize work	5.1 Task requirements are identified as per the workplace objectives 5.2 Task is interpreted in accordance with safety (OHS), environmental requirements and quality requirements 5.3 Work activity is organized with other involved personnel as per the SOPs 5.4 Resources are mobilized, allocated and utilized to meet project goals and deliverables. 5.5 Work activities are monitored and evaluated in line with organization procedures. 5.6 Job planning is documented in accordance with workplace requirements. 5.7 Planning and organizing of work activities is reviewed as per the workplace requirements 5.8 Time is managed achieve workplace set goals and objectives.

6. Maintain professional growth and development	6.1 Personal training needs are identified and assessed in line with the requirements of the job. 6.2 ***Training and career opportunities*** are identified and availed based on job requirements. 6.3 Resources for training are mobilized and allocated based organizations skills needs. 6.4 Licensees and certifications relevant to job and career are obtained and renewed. 6.5 ***Personal growth*** is pursued towards improving the qualifications set for the profession. 6.6 Work priorities and commitments are managed based on requirement of the job and workplace policy. 6.7 Recognitions are sought as proof of career advancement in line with professional requirements.
7. Demonstrate workplace learning	7.1 Own learning is managed as per workplace policy. 7.2 Learning opportunities are sought and allocated based on job requirement and in line with organization policy. 7.3 Contribution to the learning community at the workplace is carried out. 7.4 ***Range of media for learning*** are established as per the training need 7.5 Application of learning is demonstrated in both technical and non-technical aspects based on requirements of the job 7.6 Enthusiasm for ongoing learning is demonstrated 7.7 Time and effort is invested in learning new skills-based job requirements 7.8 Willingness to learn in different context is demonstrated based on available learning opportunities arising in the workplace. 7.9 Awareness of Occupational Health and Safety procedures are demonstrated in use of technology in the workplace. 7.10 Initiative is taken to create more effective and efficient processes and procedures in line

	with workplace policy. 7.11 New systems are developed and maintained in accordance with the requirements of the job. 7.12 Opportunities that are not obvious are identified and exploited in line with organization objectives. 7.13 Opportunities for performance improvement are identified proactively in area of work. 7.14 Awareness of personal role in workplace ***innovation*** is demonstrated.
8. Demonstrate problem solving skills	8.1 Creative, innovative and practical solutions are developed based on the problem 8.2 Independence and initiative in identifying and solving problems is demonstrated. 8.3 Team problems are solved as per the workplace guidelines 8.4 Problem solving strategies are applied as per the workplace guidelines 8.5 Problems are analyzed and assumptions tested as per the context of data and circumstances
9. Manage workplace ethics	9.1 Policies and guidelines are observed as per the workplace requirements 9.2 Self-worth and profession is exercised in line with personal goals and organizational policies 9.3 Code of conduct is observed as per the workplace requirements 9.4 Personal and professional integrity is demonstrated as per the personal goals 9.5 Commitment to jurisdictional laws is demonstrated as per the workplace requirements

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.

Range	**Variable**
Drug and substance abuse include but not limited to:	Commonly abused • Alcohol • Tobacco • Miraa

	• Over-the-counter drugs • Cocaine • Bhang • Glue
Feedback includes but not limited to:	• Verbal • Written • Informal • Formal
Relationships includes but not limited to:	• Man/Woman • Trainer/trainee • Employee/employer • Client/service provider • Husband/wife • Boy/girl • Parent/child • Sibling relationships
Forms of communication include but not limited to:	• Written • Visual • Verbal • Non verbal • Formal and informal
Team includes but not limited to:	• Small work group • Staff in a section/department • Inter-agency group
Personal growth includes but not limited to:	• Growth in the job • Career mobility • Gains and exposure the job gives • Net workings • Benefits that accrue to the individual as a result of noteworthy performance
Personal objectives include but not limited to:	• Long term • Short term • Broad • Specific

Trainings and career opportunities includes but not limited to	• Participation in training programs
	  ○ Technical
	  ○ Supervisory
	  ○ Managerial
	  ○ Continuing Education
	• Serving as Resource Persons in conferences and workshops

Resource include but not limited to:	• Human
	• Financial
	• Technology
	  ○ Hardware
	  ○ Software

Innovation include but not limited to:	• New ideas • Original ideas • Different ideas • Methods/procedures • Processes • New tools
Emerging issues include but not limited to:	• Terrorism • Social media • National cohesion • Open offices
Range of media for learning include but not limited to:	• 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:

- Personal hygiene practices
- Intra and Interpersonal skills
- Communication skills
- Knowledge management
- Interpersonal skills
- Critical thinking skills
- Observation skills
- Organizing skills
- Negotiation skills
- Monitoring skills
- Evaluation skills
- Record keeping skills
- Problem solving skills
- Decision Making skills
- Resource utilization skills
- Resource mobilization skills

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
- Personal hygiene practices
- Workplace communication
- Concept of time
- Time management
- Decision making
- Types of resources
- Work planning
- Resources and allocating resources
- Organizing work
- Monitoring and evaluation
- Record keeping
- Workplace problems and how to deal with them
- Negotiation
- Assertiveness
- Team work
- Gender mainstreaming
- HIV and AIDS
- Drug and substance abuse
- Leadership
- Safe work habits
- Professional growth and development
- Technology in the workplace
- Learning
- Creativity
- Innovation
- Emerging issues
    - Social media
    - Terrorism
    - National cohesion

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 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 ethical performance
2. Resource Implications	The following resources should be provided: 2.1 Case studies/scenarios
3. Methods of Assessment	Competency in this unit may be assessed through: • Oral Interview • Observation • Third Party Reports • Written
4. Context of Assessment	4.1 Competency may be assessed in workplace or in a simulated workplace setting 4.2 Assessment shall be observed while tasks are being undertaken whether individually or in-group
5. Guidance information for assessment	Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.

DEMONSTRATE ENVIRONMENTAL LITERACY

UNIT CODE: ENG/OS/MC/BC/05/6/A

Unit description

This unit specifies the competencies required to follow procedures for environmental hazard control, follow procedures for environmental pollution control, comply with workplace sustainable resource use, evaluate current practices in relation to resource usage, develop and adhere to environmental protection principles/strategies/guidelines, analyze resource use, develop resource conservation plans and implement selected 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. ***Bold and italicized terms are elaborated in the Range***
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 at all times according to environmental regulations and OSHS. 1.3 ***PPE*** is used according to OSHS.
2. Control environmental Pollution control.	2.1 Environmental pollution ***control measures*** are compiled following standard protocol. 2.2 Procedures for solid waste management are observed according Environmental Management and Coordination Act 1999. 2.3 Methods for minimizing ***noise pollution*** complied following environmental regulations.
3. Demonstrate sustainable resource use.	3.1 Methods for minimizing wastage are complied with. 3.2 Waste management procedures are employed following principles of 3Rs (Reduce, Reuse, and Recycle). 3.3 Methods for economizing or reducing resource consumption are practiced.
4. Evaluate current practices in relation to	4.1 Information on resource efficiency systems and procedures are collected and provided to the work group where appropriate. 4.2 Current resource usage is measured and recorded by

ELEMENT These describe the key outcomes which make up workplace function.	PERFORMANCE CRITERIA These are assessable statements which specify the required level of performance for each of the elements. ***Bold and italicized terms are elaborated in the Range***
resource usage.	members of the work group. 4.3 Current purchasing strategies are analyzed and recorded according to industry procedures. 4.4 Current work processes to access information and data is analyzed following enterprise protocol.
5. Identify Environmental legislations/conventions for environmental concerns.	5.1 Environmental legislations/conventions and local ordinances are identified according to the different environmental aspects/impact 5.2 Industrial standard/environmental practices are described according to the different environmental concerns
6. Implement specific environmental programs.	6.1 Programs/Activities are identified according to organizations policies and guidelines. 6.2 Individual roles/responsibilities are determined and performed based on the activities identified. 6.3 Problems/constraints encountered are resolved in accordance with organizations' policies and guidelines 6.4 Stakeholders are consulted based on company guidelines
7. Monitor activities on Environmental protection/Programs.	7.1 Activities are periodically monitored and Evaluated according to the objectives of the environmental program. 7.2 Feedback from stakeholders are gathered and considered in Proposing enhancements to the program based on consultations. 7.3 Data gathered are analysed based on Evaluation requirements. 7.4 Recommendations are submitted based on the findings 7.5 Management support systems are set/established to sustain and enhance the program. 7.6 Environmental incidents are monitored and reported to concerned/proper authorities.
8. Analyze resource use.	8.1 All resource consuming processes are identified. 8.2 Quantity and nature of Resource consumed is determined 8.3 Resource flow is analysed through different parts of the process.

ELEMENT These describe the key outcomes which make up workplace function.	PERFORMANCE CRITERIA These are assessable statements which specify the required level of performance for each of the elements. ***Bold and italicized terms are elaborated in the Range***
	8.4 Waste is classified for possible source of resources.
9. Develop resource Conservation plans.	9.1 Efficiency of use/conversion of resources is determined following 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
PPE may include but are not limited to:	• Mask. • Gloves. • Goggles. • Safety hat. • Overall. • 1.6 Hearing protector.
Environmental pollution Control measures may include but are not limited to:	• 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.
Wastes may include but are not limited to:	• Unnecessary waste. • Necessary waste.
Waste management Procedures may include but are not limited to:	• Sorting. • Storing of items. • Recycling of items. • Disposal of items.

Resources may include but are not limited to:	• Electric. • Water. • Fuel. • Telecommunications. • Supplies. • Materials.
Workplace environmental Hazards may include but are not limited to:	• Biological hazards. • Chemical and dust hazards. • Physical hazards.
Organizational systems and Procedures may include but are not limited to:	• Supply chain, procurement and purchasing. • Quality assurance. • Making recommendations and seeking approvals.
Legislations/Conventions may include but are not limited to:	• EMCA 1999. • Montreal Protocol. • Kyoto Protocol.
Environmental aspects/impacts may include but are not limited to:	• Air pollution. • Water pollution. • Noise pollution. • Solid waste. • Flood control. • Deforestation/Denudation. • Radiation/Nuclear /Radio Frequency/ Microwaves. • Situation. • Soil erosion (e.g. Quarrying, Mining, etc.). • Coral reef/marine life protection.
Industrial standards / Environmental practices may include but are not limited to:	• ISO standards. • Company environmental management systems(EMS)
Periodic may include but are not limited to:	• Hourly. • Daily • Weekly • Monthly • Quarterly • Yearly

Programs/Activities may include but are not limited to:	• Waste disposal (on-site and off-site). • Repair and maintenance of equipment. • Treatment and disposal operations. • Clean-up activities. • Laboratory and analytical test. • Monitoring and evaluation. • Environmental advocacy programs.

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 Demonstration. 3.2 Oral questioning. 3.3 Written examination. 3.4 Interview/Third Party Reports. 3.5 Portfolio (citations/awards from GOs and NGOs, certificate of training – local and abroad). 3.6 Simulations and role-play.
4 Context of Assessment	Competency may be assessed on the job, off the job or a combination of these. Off the job assessment must be undertaken in a closely simulated workplace environment.
5 Guidance information for assessment	Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.

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:

- Following storage methods of environmentally hazardous materials.
- Following disposal methods of hazardous wastes.
- Using PPE.
- Practicing OSHS.
- Complying environmental pollution control.
- Observing solid waste management.
- Complying methods of minimizing noise Pollution.
- Complying methods of minimizing wastage.
- Employing waste management procedures.
- Economizing resource consumption.
- Listing of resources used.
- Measuring current usage of resources.
- Identifying and reporting workplace environmental hazards.
- Conveying all environmental issues.
- Following environmental regulations.
- Identifying environmental regulations.
- Assessing procedures for assessing compliance.

- Collecting information on environmental and resource efficiency systems and procedures, and providing information to the work group.
- Measuring and recording current resource usage.
- Analysing and recording current purchasing strategies.
- Analysing current work processes to access information, data, and assisting identifying areas for improvement.
- Analysing resource flow.
- Determining efficiency of use/conversion of resources.
- Determining causes of low efficiency of use.
- Developing plans for increasing the efficiency of resource use.
- Checking resource use plans.
- Complying with regulations/licensing requirements.
- Determining benefit/cost of plans.
- Ranking proposals based on benefit/cost compared to limited resources.
- Checking proposals meet regulatory requirements.
- Monitoring implementation.
- Making adjustments to plan and implementation.
- Checking new resource usage.

Required Knowledge

The individual needs to demonstrate knowledge of:

- Storage methods of environmentally hazardous materials.
- Disposal methods of hazardous wastes.
- Usage of PPE Environmental regulations.
- OSHS.
- Types of pollution.
- Environmental pollution control measures.
- Different solid wastes
- Solid waste management.
- Different noise pollution.
- Methods of minimizing noise pollution.
- Methods of minimizing wastage.
- Waste management procedures.
- Economizing of resource consumption.
- Principle of 3Rs.
- Types of resources.
- Techniques in measuring current usage of resources.
- Calculating current usage of resources.
- Types of workplace environmental hazards.
- Environmental regulations.
- Environmental regulations applying to the enterprise.
- Procedures for assessing compliance with environmental regulations.

- Collection of information on environmental and resource efficiency systems and procedures.
- Measurement and recording of current resource usage
- Analysis and recording of current purchasing strategies.
- Analysis current work processes to access information and data Analysis of data and information.
- Identification of areas for improvement.
- Resource consuming processes.
- Determination of quantity and nature of resource consumed
- Analysis of resource flow of different parts of the resource flow process.
- Use/conversion of resources.
- Causes of low efficiency of use.
- Increasing the efficiency of resource use.
- Inspection of resource use plans
- Regulations/licensing requirements
- Determine benefit/cost for alternative resource sources.
- Benefit/costs for different alternatives.
- Components of proposals
- Criteria on ranking proposals.
- Regulatory requirements.
- Proposals for improving resource efficiency.
- Implementation of resource efficiency plans.
- Procedures in monitor implementation.
- Adjustments of implementation plan.
- Inspection of new resource usage.

DEMONSTRATE OCCUPATIONAL SAFETY AND HEALTH PRACTICES

UNIT CODE: ENG/OS/MC/BC/06/6/A

Unit description

This unit specifies the competencies required to lead the implementation of workplace safety and health program, 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. ***Bold and italicized terms are elaborated in the Range***
1. Work in a safe and clean environment.	1.1 Work area is cleaned and made safe before use in accordance with organization policy, Factories Act 1977, OSH Act 2007 1.2 Tools and equipment are used as per the manufactures manual 1.3 Health and safety regulations are observed as per OSH Act 2007 1.4 Waste oil, fluids and scrap components are disposed of in accordance with EMC Act 2012
2. Identify workplace hazards	2.1 ***Hazards*** in the workplace and/or its ***indicators*** of its presence, are identified. 2.2 ***Evaluation and/or work environment*** measurements of OSH hazards/risk existing in the workplace is conducted by authorized personnel or agency. 2.3 ***OSH issues and/or concerns*** raised by workers are gathered.
3. Identify and implement appropriate control measures	3.1 ***Prevention and control measures***, including use of s***afety gears / PPE (personal protective equipment)*** for specific hazards identified and implemented. 3.2 ***Appropriate risk controls*** based on result of OSH hazard evaluation is recommended. 3.3 ***Contingency measures***, including ***emergency procedures*** during workplace ***incidents and***

ELEMENT These describe the key outcomes which make up workplace function.	PERFORMANCE CRITERIA These are assessable statements which specify the required level of performance for each of the elements. ***Bold and italicized terms are elaborated in the Range***
	emergencies are recognized and established in accordance with organization procedures.
4. Implement OSH programs, procedures and policies/ guidelines	4.1 Information to work team about company OSH program, procedures and policies/guidelines are provided. 4.2 Implementation of OSH procedures and policies/ guidelines are participated. 4.3 Team members are trained and advised on OSH standards and procedures. 4.4 Procedures for maintaining ***OSH-related records*** are implemented.

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

Variable	Range
Hazards may include but are not limited to:	• Physical hazards – impact, illumination, pressure, noise, • Vibration, extreme temperature, radiation. • Biological hazards- bacteria, viruses, plants, parasites, mites, molds, fungi, and 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);
Indicators may include but are not limited to:	• 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;
Evaluation and/or work environment measurements may include but are not limited to:	• Health Audit; • Safety Audit; • Work Safety and Health Evaluation; • Work Environment Measurements of Physical and Chemical Hazards.
OSH issues and/or concerns may include but are not limited to:	• 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.

Variable	Range
Prevention and control measures may include but are not limited to:	• Eliminate the hazard (i.e., get rid of the dangerous machine • Isolate the hazard (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. give trainings on how to use equipment safely; OSH-related topics, issue warning signage, rotation/shifting work schedule). • Use engineering controls to reduce the risk (i.e. use safety guards to machine). • Use personal protective equipment. • Safety, Health and Work Environment Evaluation. • Periodic and/or special medical examinations of workers.
Safety gears /PPE (Personal Protective Equipment) may include but are not limited to:	• 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.

Variable	Range
Appropriate risk controls may include but are not limited to:	• 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. weargloves and goggles when using the machine)
Contingency measures may include but are not limited to:	• Evacuation. • Isolation. • Decontamination. • (Calling designed) emergency personnel.
Emergency procedures may include but are not limited to:	• Fire drill. • Earthquake drill. • Basic life support/CPR. • First aid. • Spillage control. • Decontamination of chemical and toxic • Disaster preparedness/management • Set of fire-extinguisher.
Incidents and emergencies may include but are not limited to:	• Chemical spills. • Equipment/vehicle accidents. • Explosion • Fire • Gas leak. • Injury to personnel. • Structural collapse. • Toxic and/or flammable vapors emission.

Variable	Range
OSH-related Records may include but are not limited to:	• 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:

- Skills on preliminary identification of workplace hazards/risks
- Knowledge management.
- Critical thinking skills.
- Observation skills.
- Coordinating skills.
- Communication skills.
- Interpersonal skills.
- Troubleshooting skills.
- Presentation skills.
- Training skills.

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 counselling 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.

1. Critical Aspects of Competency	Assessment requires evidence that the candidate: 1.1 Identifies hazards/risks in the workplace and/or its indicators.

	1.2 Requests for evaluation and/or work environment measurements of OSH hazards/risk in the workplace. 1.3 Gathers OSH issues and/or concerns raised by workers. 1.4 Identifies and implements prevention and control measures, including use of PPE (personal protective equipment) for specific hazards. 1.5 Recommends appropriate risk controls based on result of OSH hazard evaluation and OSH issues gathered. 1.6 Establish contingency measures, including emergency procedures in accordance with organization procedures. 1.7 Provides information to work team about company OSH program, procedures and policies/guidelines. 1.8 Participates in the implementation of OSH procedures and policies/guidelines. 1.9 Trains and advises team members on OSH standards and procedures. 1.10 Implements procedures for maintaining OSH-related records.
2. Resource Implications.	The following resources should be provided: 2.1 Workplace or assessment location. 2.2 OSH personal records. 2.3 PPE. 2.4 Health records.
3. Methods of Assessment.	Competency may be assessed through: 3.1 Portfolio Assessment. 3.2 Interview. 3.3 Case Study/Situation. 3.4 Observation/Demonstration and oral questioning.
4. Context of Assessment.	Competency may be assessed on the job, off the job or a combination of these. Off the job assessment must be undertaken in a closely simulated workplace environment.
5. Guidance information for assessment.	Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.

COMMON UNITS OF COMPETENCY

PREPARE AND INTERPRET TECHNICAL DRAWINGS

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

Unit description

This unit covers the competencies required to prepare and interpret technical drawings by a mechatronic technician. 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 of components and application of CAD softwares.

ELEMENTS AND PERFORMANCE CRITERIA

ELEMENT These describe the key outcomes that make up workplace function.	**PERFORMANCE CRITERIA** These are assessable statements which specify the required level of performance for each of the elements. ***Bold and italicized terms are elaborated in the Range***
1. Use and maintain drawing equipment and materials	1.1 ***Drawing equipment*** are obtained according to task requirements 1.2 ***Drawing materials*** are obtained according to task requirements 1.3 Drawing equipment are used and maintained according to manufacturer instructions 1.4 Drawing materials are used according to task requirements 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 plain geometry drawings	2.1 Lettering and line work is done according to drawing rules 2.2 Sketches of ***geometric forms*** are interpreted according to standard conventions 2.3 Different types of angles are constructed according to principles of trigonometry 2.4 Different types of geometric forms are constructed according to standard drawing conventions 2.5 Constructed geometric forms are dimensioned according to drawing requirements

ELEMENT These describe the key outcomes that make up workplace function.	**PERFORMANCE CRITERIA** These are assessable statements which specify the required level of performance for each of the elements. ***Bold and italicized terms are elaborated in the Range***
3. Produce solid geometry drawings	3.1 ***Sketches of patterns*** e.g. are interpreted according to work requirements 3.2 Interpenetrating surface of solids and truncated solids are developed according to work requirements 3.3 ***Interpenetrations of solids*** of equal and unequal is done according to work requirements
4. Produce pictorial and orthographic drawings of components	4.1 Different symbols and abbreviations are identified and their meaning interpreted according to standard drawing conventions 4.2 Isometric sketches and drawings of components are interpreted and produced in accordance with the standard conventions of isometric drawings 4.3 First and third angle orthographic sketches and drawings of components are produced in accordance with the standard conventions of orthographic drawings 4.4 Freehand sketching of different types of geometric forms, tools, equipment, diagrams and components is conducted
5. Produce assembly drawings	5.1 Orthographic views are exploded according to standard conventions of orthographic drawings. 5.2 Pictorial views are exploded according to standard conventions of orthographic drawings. 5.3 Part lists are identified according to drawing specifications 5.4 Sectional views are produced according to standard conventions of drawing. 5.5 Produced drawing is hatched according to standard conventions of drawings.
6. Apply CAD in technical drawing	6.1 ***CAD software*** are identified according to work requirements 6.2 2-D models are produced according to work requirements 6.3 3D models are produced according to work requirements 6.4 Produced models are annotated according to work

ELEMENT These describe the key outcomes that make up workplace function.	**PERFORMANCE CRITERIA** These are assessable statements which specify the required level of performance for each of the elements. ***Bold and italicized terms are elaborated in the Range***
	requirements

RANGE

Variable	Range
Drawing equipment may include but is not limited to:	• Drawing boards • T-square • Set squares • Drawing set • French curves • Computers
Drawing materials may include but is not limited to:	• Drawing papers • Pencils • Erasers • Masking tapes • Paper clips
CAD software may include but is not limited to:	• AutoCAD • Inventor • Solid Works • Archi CAD • Electronic work bench • Circuit maker • Proteus
Sketches of patterns may include but is not limited to:	• Cylinders • Prisms • Pyramids
Interpenetrations of solids may include but is not limited to:	• Cylinder to cylinder • Cylinder to prism • Prism to prism
Environmental legislations may include but is not limited to:	• EMCA 1999 • NEMA Regulations
Personal Protective Equipment may include but is not limited to:	• Dust coats • Closed leather shoes • Goggles for CAD
Geometric forms may include but is not limited to:	• Circles • Triangles • Rectangles • Parallelogram • Polygons • Pyramids • Conic sections • Prisms • Loci

Standard drawing conventions may include but is not limited to:	• Anatomy of engineering drawing (title block, coordinate grid system, revision block, notes and legends) • Drawing scale (paper size and drawing symbols) • International drawing standards

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 relations
- Computer

Required knowledge

The individual needs to demonstrate knowledge of:

- Drawing equipment and materials
- Freehand sketching
- Lettering
- Geometrical constructions
- Types of drawings
- Types of lines
- Engineering calculations
- 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 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 software 2.5 PPE 2.6 Internet
3. Methods of Assessment	Competency may be assessed through: 3.1 Practical tests 3.2 Observation
4. Context of Assessment	Competency may be assessed individually in the actual workplace or a simulated work place setting
5. Guidance information for assessment	Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.

APPLY ENGINEERING MATHEMATICS

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

UNIT DESCRIPTION

This unit describes the competencies required by a Mechatronics Engineering 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, carrying out binomial expansion, calculus, ordinary differential equations, Laplace transforms, power series, Statistics, Fourier series, Vector theory, Matrix, Numerical methods, probability, commercial calculations, estimations, measurements and calculations of quantities in solving problems.

ELEMENTS AND PERFORMANCE CRITERIAELEMENT These describe the key outcomes which make up workplace function.	**PERFORMANCE CRITERIA** These are assessable statements which specify the required level of performance for each of the elements. ***Bold and italicized terms are elaborated in the Range.***
1. Apply Algebra	1.1 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 1.6 Arithmetic and geometric progression problems are solved
2. Apply Trigonometry and hyperbolic functions	2.1 Calculations are performed using trigonometric rules 2.2 Calculations are performed using ***hyperbolic functions***
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	4.1 Polar equations are calculated using coordinate geometry 4.2 Graphs of given polar equations are drawn using the Cartesian plane 4.3 Normal and tangents are determined using coordinate geometry 4.4 Loci of points are determined for given mechanism
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 5.2 Power series are derived through Binomial expansion
6. Apply Calculus	6.0 Derivatives of functions are determined using Differentiation 6.1 Derivatives of hyperbolic functions are determined using Differentiation 6.2 Derivatives of inverse trigonometric functions are determined using Differentiation 6.3 Rate of change and small change are determined using Differentiation. 6.4 Calculation involving stationery points of functions of two variables are performed using differentiation. 6.5 Integrals of algebraic functions are determined using integration 6.6 Integrals of trigonometric functions are determined using integration 6.7 Integrals of logarithmic functions are determined using integration 6.8 Integrals of hyperbolic and inverse functions are determined using integration
7. Solve Ordinary differential equations	7.0 First order and second order differential equations are formed. 7.1 First order and second order differential equations are solved using the method of undetermined coefficients 7.2 First order and second order differential equations are solved from given boundary conditions
8. Apply Laplace transforms	8.1 Laplace transforms are solved using initial and final value theorems

	8.2 Inverse Laplace transforms are solved using partial fractions 8.3 Differential equations are solved using Laplace transforms
9 Apply Power Series	9.1 Power series are obtained using Taylor's Theorem 9.2 Power series are obtained using Maclaurin's theorem
10 Apply Statistics	10.1 Identification, Collection and Organization of data is performed 10.2 Interpretation, analysis and presentation of data in appropriate format is performed 10.3 Mean, median, mode and Standard deviation are obtained from given data
11. Apply Fourier Series	11.1 Fourier series coefficients are obtained using Fourier series techniques 11.2 Fourier series for 2π to T is are obtained using Fourier series techniques 11.3 Fourier series for odd and even functions are obtained using Fourier series techniques 11.4 Harmonic analysis is performed using numerical methods
12.Apply Vector theory	12.1 Calculations involving vector algebra, dot and cross products using vector theory 12.2 Gradient, Divergence and Curl are obtained 12.3 Vector calculations are performed using Green's theorem 12.4 Vector calculations are performed using Stoke's theorem 12.5 Conservative vector fields and line and surface integrals are obtained using Gauss's theorem
13. Apply Matrix	13.1 Determinant and inverse of 3x3 matrix are obtained 13.2 Solutions of simultaneous equations are obtained 13.3 Calculation involving Eigen values and Eigen vectors are performed
14. Apply Numerical methods	14.1 Roots of polynomials are obtained using iterative numerical methods 14.2 Interpolation and extrapolation are performed using numerical methods
15. Apply concepts of probability	15.1 Calculations are performed based on Laws of

for work	probability 15.2 Calculation involving probability distributions, mathematical expectation sampling distributions are performed 15.3 Probability events are determined from dependent, independent and mutually exclusive 15.4 Counting is done using permutation, combination, tree diagrams and Venn diagrams techniques
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 ***figures*** 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**
Hyperbolic functions includ but not limited to:	• Sinh x • Cosh x • Cosec x • Coth x • Tanh x • Sech x
Figures includes but not limited:	• Triangles • Squares

	• Rectangles • Circles • Spheres • Cylinders • Cubes • Polygons • Cuboids • Pyramids
Quantities includes but not limited to:	• Weight, • Mass • Area • Volume • Length • Width • Depth • Perimeter

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: 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 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 equipment 1.12 Collected, Analyzed and presented data 1.13 Applied Numerical methods
2.0 Resource Implications	The following resources should be provided: 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	Competency in this unit may be assessed through: 3.1 Direct Observation 3.2 Demonstration with Oral Questioning 3.3 Written tests
Context of Assessment	Competency may be assessed individually in the actual workplace or through accredited institution
Guidance information for assessment	Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.

PERFORM WORKSHOP PROCESSES AND PRACTICES

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

Unit description

This unit describes the competencies required by a mechatronic technician in order to apply a wide range of workshop processes and practice skills in their work. It involves use of different methods to produce work pieces using basic tools while observing occupational safety and health legislations, regulations and safe working practices, interpret working drawings, select appropriate techniques for a given task to achieve specified results, assemble of metal parts and sub-assemblies as well as perform housekeeping.

ELEMENTS AND PERFORMANCE CRITERIA

ELEMENT These describe the key outcomes which make up workplace function	**PERFORMANCE CRITERIA** These are assessable statements which specify the required level of performance for each of the elements. ***Bold and italicized terms are elaborated in the Range***
1. Use technical drawing to plan work operations	1.1 Technical drawings are produced ***as*** per ***drawing standards*** 1.2 Technical drawings and geometric symbols are read and interpreted as per drawing standards. 1.3 ***Operation plan*** is produced as per the technical drawings.
2. Measure and mark out dimensions on work pieces	2.1 Measuring tools suitable for the work are selected according to task description 2.2 Measuring tools are inspected and calibrated as per requirements 2.3 Dimensions are marked on the work piece as per the working drawing.
3. Use hand tools to cut and file parts	3.1 ***Hand tools*** are selected based on operation plan 3.2 Work piece is cut to specification based on job requirement 3.3 Work piece is filed to specification based on job requirement 3.4 Part are produced to ***specifications*** based on work requirement
4. Use drills to make holes	4.1 Hole centers are marked and center-punched as per operation plan.

ELEMENT These describe the key outcomes which make up workplace function	PERFORMANCE CRITERIA These are assessable statements which specify the required level of performance for each of the elements. ***Bold and italicized terms are elaborated in the Range***
	4.2 Drill bits are selected and mounted according to work requirements 4.3 Work piece is mounted and clamped according to workshop regulations 4.4 Hole is drilled to specification according to work requirements 4.5 Holes inspected to specification according to work requirements
5. Thread using taps and dies	5.1 Taps and dies selected based on operation plan. 5.2 Taps and dies are set up on the work piece according to work specifications 5.3 Work piece is clamped according to work requirements 5.4 ***Threads*** are cut according to work specifications
6. Produce components using a lathe and milling machine	6.1 Work piece is faced according to work specifications 6.2 Work pieces are turned according to work requirements 6.3 Work piece is threaded according to work requirements 6.4 Work piece is drilled according to work requirements 6.5 Work piece is bored according to work requirements 6.6 Work piece is milled according to specified milling operation
7. Assemble metal parts and sub-assemblies	7.1 ***Joining and assembly method*** is selected according to work requirements 7.2 Parts joined, fitted and assembled according to the specified assembly and joinery methods 7.3 Final assembly is inspected as per specification
8. Perform surface finish	8.1 ***Surface finishing method*** is selected according to work requirements

ELEMENT These describe the key outcomes which make up workplace function	PERFORMANCE CRITERIA These are assessable statements which specify the required level of performance for each of the elements. ***Bold and italicized terms are elaborated in the Range***
	8.2 Surface finishing materials are selected according to work requirements 8.3 Work piece is surface finished according to work requirements
9. Perform housekeeping	9.1 Waste is segregated and disposed as per disposal guidelines. 9.2 Housekeeping is carried out as per workplace requirement 9.3 Tools and equipment are stored in accordance to manufacturer requirement
10. Inspect finished work for accuracy and quality	10.1 Inspection tools and methods are selected as per operation plan 10.2 Finished work is inspected as per specification 10.3 Adjustments are made based on inspections results
11. Maintenance of tools and equipment	11.1 Machines and tools are inspected in accordance to manufacturer specifications 11.2 Machines and tools are lubricated according to manufacturer manual 11.3 Tools are ground to manufacturer specification 11.4 Faults on machines and tools are identified and reported according to maintenance manual

RANGE

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

VARIABLE	RANGE
Measuring tools may include but is not limited to:	• Steel rule • Vernier calliper • Micrometre screw gauge

VARIABLE	RANGE
	• Vernier height gauge • Combination set • Bevels
Drawing Standards may include but is not limited to:	• ISO • BS • ANSI
Operation Plan may include but is not limited to:	• Sequence of operations • Measuring tools • Hand tools • Cutting tools • Inspection tools
Marking out tools may include but is not limited to:	• Scribers • Dividers • Dot punch • Centre punch • Engineers square • Straight edge • Surface plate
Work holding devices may include but is not limited to:	• Bench vice • V-Block • Angle plate • G-clamp • Jigs and fixtures • Hand vice
Hand tools may include but is not limited to:	• Files • Saws • Hammers • Chisels • Taps and dies
Threads may include but is not limited to:	• Internal and external threads • V-profile threads
Surface finishing methods may include but is not limited to:	• Filing/deburring • Tumbling • Plating • Painting
Joining and assembly	• Riveting

VARIABLE	RANGE
method may include but is not limited to:	• Fastening • Soldering • Brazing • Welding
Specifications may include but is not limited to:	• Dimensions • Tolerances • Geometry • Surface finish • Functionality

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:

- ❑ Technical drawing
- ❑ Using measuring and inspection tools
- ❑ Using hand tools
- ❑ Using portable and bench drilling machines
- ❑ Soldering and brazing
- ❑ Riveting and fastening
- ❑ Use of the lathe machine
- ❑ Use of milling machine
- ❑ Using grinding machine

Required Knowledge

The individual needs to demonstrate knowledge and understanding of:

- ❑ Occupational Health and Safety Act of Kenya laws 2007 with focus on personal safety, machine safety and workplace
- ❑ National Environment Management Authority Act, Kenya 2004
- ❑ OSH act
- ❑ Equipment manuals
- ❑ Basic technical drawing complyingto ISO, ANSI & BS standards
- ❑ ISO 1101 Geometrical tolerance and where to use the norm
- ❑ Work Planning and documentation
- ❑ Measuring tools
- ❑ Hand tools
- ❑ Bench work
- ❑ Portable and bench drilling machines
- ❑ Lathe machine
- ❑ Grinding machine

- ❑ Inspection and quality control
- ❑ Preventive maintenance of machine tools
- ❑ Metal cutting technology
- ❑ Materials and metallurgy
- ❑ WIBA act (2007)
- ❑ Report writing

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 learner: 1.1 Observed rules and procedures in the workshop 1.2 Interpreted technical drawing 1.3 Produced operation plan 1.4 Produced holes on a work piece 1.5 Threaded using taps and dies 1.6 Assembled metal parts 1.7 Surface finished work piece 1.8 Maintained tools and equipment 1.9 Did housekeeping before, during and after operations
2. Resource Implications	2.1 Hand measuring tools 2.2 Hand marking tools 2.3 Hand tools 2.4 Inspection tools and equipment 2.5 Hand drilling machine 2.6 Bench Drilling machine 2.7 Lathe machine 2.8 Grinding machine 2.9 Milling machines 2.10 Punching tools 2.11 Work benches
3. Methods of Assessment	mpetency may be assessed through: 1.1 Observing the behaviour of the learner 1.2 Oral presentations 1.3 Inspection of written operation procedures 1.4 Inspection of finished product 1.5 Observing housekeeping of the work area and/or machine tool
4. Context of Assessment	Competency may be assessed individually in the actual workplace or through accredited institution
5. Guidance information	Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.

for assessment	

APPLY ELECTRICAL AND ELECTRONICS PRINCIPLES

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

Unit description

This unit describes the competencies required by a mechatronic technician in order to apply a wide range of electrical and electronics principles skills in their work. It involves of use the concept of basic electrical quantities, use the concepts of D.C and A.C circuits in electrical installation, use of basic electrical machine, carrying out power rectification in electrical systems, use of earthing in electrical installations, use of electronic components.

ELEMENTS AND PERFORMANCE CRITERIA

ELEMENT These describe the key outcomes which make up workplace function.	**PERFORMANCE CRITERIA** These are assessable statements which specify the required level of performance for each of the elements. ***Bold and italicized terms are elaborated in the Range.***
.1 Use the concept of basic Electrical quantities	1.1 Basic ***SI units*** in Electrical are identified according to specified procedures 1.2 ***Quantities*** of Charge, force, work and power are identified according to specified procedures 1.3 Calculations involving various electrical quantities are performed according to specified procedures
.2 Use the concepts of D.C and A.C circuits in electrical installations	2.1 Perform calculations involving Ohm's law that is Current, Resistance and voltage according to specified procedures 2.2 Calculations involving parallel and series circuits are performed according to specified procedures 2.3 Calculations involving DC and AC Network theorems are performed. E.g. Kirchhoff's laws, Superposition, Thevinin's, Norton's according to specified procedures
3 Use of basic electrical machine	3.1 Types of various electrical machines are identified according to work specifications 3.2 Calculations involving single phase and three phase AC and DC Motors are performed in accordance to electrical guidelines 3.3 Calculations involving single and three phase AC and DC transformers are performed according to

ELEMENT These describe the key outcomes which make up workplace function.	PERFORMANCE CRITERIA These are assessable statements which specify the required level of performance for each of the elements. ***Bold and italicized terms are elaborated in the Range.***
	electrical guidelines 3.4 Calculations involving single and three phase generators are performed in accordance to electrical guidelines
4 Carry out power rectification in electrical systems	4.1 Power rectification is performed using various ***power rectification methods*** according to prescribed rectification methods 4.2 Power smoothing is done according to prescribed ***power smoothing methods*** 4.3 Power regulation is performed according to selected power regulation methods 4.4 Power supply protection is carried out according to prescribed ***power supply protection methods***
5 Use of earthing in electrical installations	5.1 Earthing types are identified in accordance to Electric Power Act, 1997 standards 5.2 Earthing points on electrical installation are identified according to work requirements 5.3 Calculation involved in determining the earthing type is performed according to prescribed work 5.4 Test on an earthing system is performed in line with the Electric Power Act, 1997 standards
6. Apply lightning protection measures	6.1 Types of lightening strokes are identified according to prescribed procedures 6.2 Components of lightening protection system are identified according to Electric Power Act, 1997 standards 6.3 Test to be carried out in lightening protection system are established in accordance Electric Power Act, 1997 standards 6.4 Application of lightening protection system is determined in accordance to system 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
SI unit may include but is not limited to:	• Power – Watts (W) • Current – Amperes (A) • Resistance – Ohms(Ω) • Voltage – Volts (V)
Quantities may include but is not limited to:	• Charge • Force • Work • Power
Power rectification methods may include but is not limited to:	• Half wave • Full wave • Full wave bridge
Power smoothing methods may include but is not limited to:	• Reservoir • Capacitor filter • R.C filter • Pie filter
Power supply protection methods may include but is not limited to:	• Circuits breakers • Fuses • Switches

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	Assessment requires evidence that the candidate: 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	The following resources should be provided: 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	Competency in this unit may be assessed through: 3.1 Direct Observation 3.2 Demonstration with Oral Questioning 3.3 Written tests
Context of Assessment	Competency may be assessed individually in the actual workplace or through accredited institution
Guidance information for assessment	Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.

APPLY MATERIAL SCIENCE PRINCIPLES

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

Unit Description:

This unit describes the competencies required by a mechatronic technician in order to apply material science principles. It involves analyzing properties of engineering materials, utilize engineering materials, performing heat treatment, material testing and identifying corrosion and its prevention.

ELEMENTS AND PERFORMANCE CRITERIA

ELEMENT These describe the key outcomes which make up workplace function	**PERFORMANCE CRITERIA** These are assessable statements which specify the required level of performance for each of the elements ***(Bold and italicized terms are elaborated in the Range)***
1. Analyse properties of engineering materials	1.1 Type of engineering materials are identified as per prescribed procedures 1.2 ***Physical properties*** of engineering material are determined according material specifications 1.3 ***Mechanical properties*** of engineering materials are identified according to material specifications 1.4 Crystal structures of materials and their characteristics are analysed according to material specifications
2. Utilise ***engineering materials***	2.1 Identify and select engineering material according to production requirements. 2.2 Operation plan is developed according to engineering drawing. 2.3 Appropriate machine is set up according to manufacturer manual 2.4 Production parameters are set according to production requirement 2.5 Production is performed according to work requirements
3. Perform heat treatment	3.1 Safety practices are observed according to OSHA 2007 3.2 ***Heat treatment processes*** are identified according to material specifications 3.3 Procedure in heat treatment processes is identified according to work requirements

	3.4 Heat treatment of metals is performed according to work requirements
4. Perform material testing	4.1 Safety is observed in material testing procedures according to OSHA, 2007 4.2 ***Material testing methods*** are identified according to work requirement 4.3 Procedure of material testing is followed as per material testing method 4.4 Material testing results are tabulated, presented, calculated and interpreted according to testing results 4.5 Material testing equipment are maintained according to manufacturer specifications.
5. Prevent material corrosion	5.1 Safety is observed during corrosion prevention according to OSHA 2007 5.2 ***Corrosion types*** are identified according to work requirements 5.3 ***Methods of corrosion prevention*** are identified according to work requirements 5.4 Corrosion is prevented as per the prescribed corrosion prevention methods

RANGE

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

VARIABLE	**RANGE**
Physical properties may include but is not limited to:	• Density • Color • Texture • Melting point • Thermal conductivity • Electrical resistivity • Electro-magnetism
Mechanical properties may include but is not limited to:	• Ductility • Malleability • Elasticity • Toughness

	• Hardness • Brittleness • Plasticity • Strength
Material testing methods may include but is not limited to:	• Compression test • Hardness tests • Impact tests • Creep tests • Bending tests • Fatigue tests • Torsional tests • Sharing tests
Heat treatment processes may include but is not limited to:	• Annealing • Tempering • Normalizing • Hardening • Case hardening
Engineering materials may include but is not limited to:	• Metals • Metal alloys • Ceramics • Composites • Polymers • Plastics • Wood
Corrosion type may include but is not limited to:	• Galvanic • Stress corrosion cracking
Methods of corrosion prevention may include but is not limited to:	• Painting • Electroplating • Galvinizing • Cathodic • Chromizing

REQUIRED KNOWLEDGE AND SKILLS

The individual needs to demonstrate the following skills

Required Skills

- ❑ Measuring and marking
- ❑ Material testing

- ❑ Use of hand tools
- ❑ Inspection
- ❑ Testing

REQUIRED KNOWLEDGE AND UNDERSTANDING

The individual needs to demonstrate knowledge and understanding of:

- ❑ Occupational Health and Safety Act of Kenya laws 2007 with focus on personal safety, machine safety and workplace
- ❑ National Environment Management Authority Act, Kenya 2004
- ❑ OSH ACT 2007
- ❑ Equipment manuals
- ❑ Mathematics & science
- ❑ Physics and mechanics
- ❑ Metallurgy and materials
- ❑ Inspection and testing
- ❑ WIBA ACT
- ❑ Report writing

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 learner 1.1 Observed safety as per work place procedures 1.2 Demonstrated understanding of physical, chemical and mechanical properties of engineering materials 1.3 Utilized engineering materials 1.4 Performed heat treatment 1.5 Performed material testing 1.6 Demonstrated understanding of corrosion types and its prevention
2. Resource Implications	2.1 Testing materials 2.2 Measuring instruments 2.3 Inspection tools
3. Methods of Assessment	Competency may be accessed through: 3.1 The behaviour of the learner in the working

	environment 3.2 Inpection of finished product 3.3 Process analysis
4. Context of Assessment	Competency may be assessed individually in the actual workplace or through accredited institution
5. Guidance information for assessment	Holistic assessment of other units relevant to the industry sector, workplace and job role is recommended.

APPLY THERMODYNAMICS PRINCIPLES

UNIT CODE: ENG/OS/MC/CC/06/6/A

Unit description

This unit describes the competencies required by a mechatronic technician in order to apply thermodynamics principles in their work. It includes understanding fundamentals of thermodynamics, performing steady flow processes, performing non steady flow processes, understanding perfect gases, generating steam, performing thermodynamics reversibility and entropy, understanding idea gas cycle, demonstrating fuel and combustion, perform heat transfer, understanding heat exchangers, understanding air compressors, understanding gas turbines and understanding of impulse steam turbines

ELEMENTS AND PERFORMANCE CRITERIA

ELEMENT These describe the key outcomes which make up workplace function.	**PERFORMANCE CRITERIA** These are assessable statements which specify the required level of performance for each of the elements. ***Bold and italicized terms are elaborated in the Range.***
1. Understand fundamentals of thermodynamics	1.1 Terms used in thermodynamics are described according to prescribed guidelines 1.2 Thermodynamics processes and cycles are described according to prescribed guidelines 1.3 First law of thermodynamics is applied in accordance to prescribed guidelines
2. Perform compressed air cycles	2.1 Operation principles of air compressors are studied according to manufacture specification 2.2 ***Types of air compressors*** are identified according to manufacturer's specifications 2.3 Work inputs, compressor clearances and varying outputs are calculated according to compressor types 2.4 Multi-staging and intercooling of air compressors is performed according to manufacturer's specifications 2.5 compressed air engines are studied according to manufacturer specifications
3. Understand steam cycles	3.1 Rankine cycle is studied according to thermodynamics principles 3.2 Reheat cycle is studied according to thermodynamics principles 3.3 Stream generation is performed according to user specification 3.4 Steam cycle efficiencies are determined according to

ELEMENT These describe the key outcomes which make up workplace function.	PERFORMANCE CRITERIA These are assessable statements which specify the required level of performance for each of the elements. ***Bold and italicized terms are elaborated in the Range.***
	thermodynamic principles
4. Understand steam engines	4.1 Reciprocating engine principles are studied according to manufacturer specifications 4.2 Valves and timing methods are studied according to user specifications 4.3 Power calculations are performed according to thermodynamic principles 4.4 Ideal thermal and mechanical efficiency are calculated according to thermodynamic principles 4.5 Indicated and brake power are determined according to thermodynamic principles
5. Understand steam turbines	5.1 Reaction, impulse and staging is performed according to manufacture specifications 5.2 Velocity calculations are performed according to manufacturer specifications 5.3 Turbine design considerations are determined according to user specification 5.4 Ideal, thermal and mechanical efficiencies are calculated according to thermodynamic principles 5.5 Condensing arrangements are performed according to user specifications
6. Perform refrigeration	6.1 Reversed Carnot cycle is studied according to thermodynamics principles 6.2 Cycle analysis is performed according to thermodynamic principles 6.3 Heat pumps are studied according to manufacturer specifications 6.4 Absorption refrigeration systems are studied according to manufacturers specifications 6.5 Steam jet refrigeration systems are studied according manufacturer specifications

RANGE

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

Variable	Range
Types of air compressors may include but is not limited to:	• Reciprocating • Rotary • Piston

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 mechanical formulas
- Use of basic mechanical machines
- Perform various unit conversions of mechanical quantities
- Basic mechanical systems design
- Mechanical machine operation
- Logical thinking
- Problem solving
- Applying statistics
- Drawing graphs
- Using different measuring tools

Required knowledge

The individual needs to demonstrate knowledge of:

- Newton's law
- Levers
- Gear trains
- Laws of conservation of energy
- Laws of friction
- Type of forces
- Thermodynamics
- Calculation of fluid pressure and flow rate
- Mechanical advantage and efficiency calculations
- Gas laws
- SI units of mechanical energy.
- Power transmission systems
- Parameters of fluid system

- Operation of mechanical machines
- Mechanical calculation of power, energy, work done, torque and safety factor
- Units of measurement, conversions and abbreviations

EVIDENCE GUIDE

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

1 Critical aspects of Competency	Assessment requires evidence that the candidate: 1.1 Identified Principles of mechanical science 1.2 Performed mechanical calculations of a system 1.3 Identified types of forces on a system 1.4 Calculated resultant forces on plane framework 1.5 Identified application of forces on the production flow 1.6 Tested mechanical properties of a materials 1.7 Identified tools and equipment for measuring system parameters 1.8 Recorded and interpreted measured parameters. 1.9 Operated Power transmission systems
6. Resource Implications	The following resources should be provided: 6.1 Access to relevant workplace or appropriately simulated environment where assessment can take place 6.2 Measuring tools and equipment 6.3 Sample materials to be tested
7. Methods of Assessment	Competency in this unit may be assessed through: 7.1 Direct Observation 7.2 Demonstration with Oral Questioning 7.3 Case studies 7.4 Written tests
Context of Assessment	Competency may be assessed individually in the actual workplace or through accredited institution
Guidance information for assessment	Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.

APPLY FLUID MECHANICS PRINCIPLES

UNIT CODE: ENG/OS/MC/CC/07/6/A

Unit description

This unit describes the competencies required by a mechatronic technician in order to apply a wide range of fluid mechanics principles in their work. It includes understanding flow of fluids, demonstrating knowledge in viscous flow, performing dimensional analysis and operating fluid pumps

ELEMENTS AND PERFORMANCE CRITERIA

ELEMENT These describe the key outcomes which make up workplace function.	**PERFORMANCE CRITERIA** These are assessable statements which specify the required level of performance for each of the elements. ***Bold and italicized terms are elaborated in the Range.***
1. Understand flow of fluids	1.1 Flow rate in pipes is measured according to work requirements 1.2 Losses in pipes are determined according to work requirements 1.3 ***Causes of losses*** in pipes are determined according to work requirements 1.4 Flow losses equations are applied in problem solving according to prescribed fluid principles
2. Demonstrate knowledge in viscous flow	2.1 Viscous flow between parallel surfaces are explained according to prescribed fluid principles 2.2 Viscous flow equations between parallel surfaces are derived and applied according to prescribed fluid principles 2.3 Viscous flow equations in circular pipes are derived and applied in problem solving according to prescribed fluid principles
3. Perform dimensional analysis	3.1 Dimensional analysis is explained according to prescribed fluid principles 3.2 Principle of dimensional homogeneity is explained according to prescribed fluid principles 3.3 Fundamental dimensions are stated according to prescribed fluid principles 3.4 Dimensional units are defined according to prescribed fluid principles 3.5 ***Physical quantities*** are identified according to prescribed fluid principles

	3.6 Dimensional analysis is applied in problem solving according to prescribed fluid principles
4. Operate fluid pumps	4.1 ***Principle of operation*** of pumps is described according to prescribed fluid principles 4.2 Reciprocating pump equation is derived according to prescribed fluid principles 4.3 Centrifugal pump equation is derived according to prescribed fluid principles 4.4 Pump equations are applied in problem solving according to prescribed fluid principles

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**
Causes of losses may include but is not limited to:	• Friction • Enlargement/reduction in cross-sectional areas
Physical quantities may include but is not limited to:	• Mass • Force • Density • Velocity • Acceleration
Principle of operation may include but is not limited to:	• Reciprocating • Centrifugal

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 mechanical formulas
- Use of basic mechanical machines
- Perform various unit conversions of mechanical quantities
- Basic mechanical systems design
- Mechanical machine operation
- Logical thinking
- Problem solving
- Applying statistics
- Drawing graphs

- Using different measuring tools

Required knowledge

The individual needs to demonstrate knowledge of:

- Newton's law
- Levers
- Gear trains
- Laws of conservation of energy
- Laws of friction
- Type of forces
- Thermodynamics
- Calculation of fluid pressure and flow rate
- Mechanical advantage and efficiency calculations
- Gas laws
- SI units of mechanical energy.
- Power transmission systems
- Parameters of fluid system
- Operation of mechanical machines
- Mechanical calculation of power, energy, work done, torque and safety factor
- Units of measurement, conversions and abbreviations

EVIDENCE GUIDE

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

1 Critical aspects of Competency	Assessment requires evidence that the candidate: 1.1 Identified Principles of mechanical science 1.2 Performed mechanical calculations of a system 1.3 Identified types of forces on a system 1.4 Calculated resultant forces on plane framework 1.5 Identified application of forces on the production flow 1.6 Tested mechanical properties of a materials 1.7 Identified tools and equipment for measuring system parameters 1.8 Recorded and interpreted measured parameters. 1.9 Operated Power transmission systems
2 Resource Implications	The following resources should be provided: 2.1 Access to relevant workplace or appropriately simulated environment where assessment can take place 2.2 Measuring tools and equipment 2.3 Sample materials to be tested

3 Methods of Assessment	Competency in this unit may be assessed through: 3.1 Direct Observation 3.2 Demonstration with Oral Questioning 3.3 Case studies 3.4 Written tests
4 Context of Assessment	Competency may be assessed individually in the actual workplace or through accredited institution
5 Guidance information for assessment	Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended.

CORE UNITS OF COMPETENCY

DESIGN ELECTRO-MECHANICAL SYSTEMS

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

Unit description

This unit describes the competencies required by a technician in order to design electro-mechanical systems. It involves observing occupational health and safety, identifying problem and assessing sites, developing multiple model solutions to existing problems, simulating developed models, identifying and selecting product design materials, documenting design work and monitoring and evaluating design performance.

ELEMENTS AND PERFORMANCE CRITERIA

ELEMENT These describe the key outcomes which make up workplace function.	**PERFORMANCE CRITERIA** These are assessable statements which specify the required level of performance for each of the elements. ***Bold and italicized terms are elaborated in the Range.***
1. Observe occupational health and safety	1.1 ***Personal protective equipment*** (PPE) are used according to OSHA 2007 1.2 ***Tools and equipment*** are stored and maintained correctly according to manufacturer's specifications 1.3 Tools and equipment are used correctly according to designated purpose 1.4 Workspace housekeeping is maintained according to Standard operating procedures (SOPs) 1.5 Workplace is planned according to design specifications.
2. Identify problem and assess site	2.1 Problem is defined according to user needs 2.2 Problem is broken down into attainable tasks according to the magnitude of the problem 2.3 Site visit authorization is obtained according to organization policy 2.4 Site specifications are obtained using the right tools and equipment 2.5 Site specifications are documented according to SOPs.
3. Develop multiple model solutions to existing problem	3.1 Existing solutions are examined as per the existing problem 3.2 Multiple ideas are generated according to problem specifications 3.3 ***Pertinent information*** is gathered according to ideas developed 3.4 Gathered information is analysed according to SOPs

	3.5 Best working solution model is selected according to analysed data 3.6 Document selected model solution according to SOPs
4. Simulate developed model	4.1 ***Modelling requirements*** are obtained according to the requirement. 4.2 Model is developed according to design requirements 4.3 Developed model is simulated/tested according to design requirements 4.4 Data is collected and documented according to SOPs 4.5 Model is redesigned according to user needs.
5. Identify and select product design materials	5.1 Individual product components are identified according to design specifications 5.2 Materials needed for the individual components are identified according to design specifications 5.3 Material specification is documented according to product design
6. Document design work	6.1 ***Technical report*** is developed according to the product design 6.2 Operation and maintenance manual is developed according to product design 6.3 The product design is patented according to Industrial Property Act,2001
7. Monitor and evaluate design performance	7.1 Feedback is gathered according to product performance 7.2 Product performance is evaluated according to gathered data 7.3 Report is generated according to product performance

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**
Personal protective equipment may include but is not limited to:	• Goggles • Ear muff • Safety mask • Helmets/head gear • Safety boots • Gloves

Variable	Range
	• Overall/dust coat
Tools and equipment may include but is not limited to:	• Hand tools • Power tools • Machines
Pertinent information may include but is not limited to:	• Functionality • Failure trends • Mechanical strength analysis • Ergonomics • Software needs • Legal regulations
Modelling requirements may include but is not limited to:	• Software • Materials • Tools • Workspace
Technical report may include but is not limited to:	• Data sheet • Design drawings • Design calculations • Power specifications • Variables and constants • Notes

REQUIRED KNOWLEDGE

The individual needs to demonstrate knowledge of:

- Electrical circuit design
- Mechanical structural design
- Computer Aided Design
- Mechatronic programming
- Technical report writing
- PPE
- Data analysis
- Interpretation of technical drawings
- Simulation
- Documentation
- Types of tools and equipment
- Properties of materials
- Electrical and mechanical machine drives

REQUIRED SKILLS

The individual needs to demonstrate skills in:

- Design of mechatronic systems
- Communication skills
- Problem solving
- Model development
- Creativity and innovation
- Data collection and analysis
- Use of tools and equipment
- Technical presentation
- Technical drawing

EVIDENCE GUIDE

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

1. Critical Aspects of Competency.	1.1 Observed occupational health and safety 1.2 Identified design problem and did site assessment 1.3 Developed multiple model solutions to identified problem 1.4 Simulated developed model 1.5 Identified and selected product design materials 1.6 Documented design work 1.7 Monitored and evaluated design performance
2. Resource Implications.	2.1 Computers 2.2 Software 2.3 Projectors 2.4 Whiteboards 2.5 Tools and equipment 2.6 Whiteboard markers
3. Methods of Assessment.	***Competency may be assessed through:*** 3.1 Practical 3.2 Observation 3.3 Questionnaire 3.4 Case studies 3.5 Written examinations 3.6 Oral presentation
4. Context of Assessment.	4.1 Competency may be assessed individually in an actual workplace or in work-simulated conditions within accredited institutions.
5. Guidance information for assessment.	5.1 This unit may be assessed on an integrated basis with others within this occupational sector.

INSTALL MECHATRONIC SYSTEMS

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

Unit description

This unit covers the competencies required to install mechatronic systems. It involves competencies to install system wiring, install electrical devices install piping system, install mechanical system, install electronics equipment system, install sensing devices in system, integrate mechatronic system in system and test and Commission mechatronic system

ELEMENTS AND PERFORMANCE CRITERIA

ELEMENT These describe the key outcomes which make up workplace function.	**PERFORMANCE CRITERIA** These are assessable statements which specify the required level of performance for each of the elements. ***Bold and italicized terms are elaborated in the Range.***
1. Install system wiring	1.1 Circuit diagram is designed according to engineering and user specifications 1.2 ***Wiring Materials*** are identified according to the circuit diagram specifications 1.3 ***Tools and equipment*** are identified according to the job requirement 1.4 Wiring materials are laid out according to the circuit diagram 1.5 ***Mechanical units of wiring*** are installed according to prescribed method of installation 1.6 Electrical system is installed according to circuit diagrams design and user requirement 1.7 Electrical wiring is tested and commissioned for desired operation according design specifications
2. Install electrical devices	2.1 Installation manuals are obtained for system installation according to SOPs 2.2 Work permit is obtained for commencement of system installation according to organization policy 2.3 Individual ***electrical equipment parts*** in the mechatronic system are tested according the prescribed functionality 2.4 Electrical equipment is installed in the Mechatronic system according to the required method of equipment induction 2.5 Documentation of test results is done according to system requirement

3. Install piping system	3.1 Piping diagram is designed according to user specifications 3.2 Piping materials are inspected according to specifications 3.3 ***Piping tools and equipment*** are identified according to the system requirement 3.4 Piping system is installed for mechatronic system according to user specifications 3.5 Piping system is inspected and tested according to system functionality
4. Install mechanical system	4.1 Floor level is checked according to the system specifications 4.2 Working diagram is developed according user specifications 4.3 Foundations of the mechanical equipment structure is laid according to working diagram 4.4 Mechanical equipment and structure is identified and inducted according to system specification 4.5 Mechanical machines/equipment are installed according to the user manual 4.6 Mechanical systems are inspected, tested and commissioned according to the desired functionality
5. Install electronics equipment system	5.4 Electronic equipment in mechatronic is installed according to prescribed method of operation 5.5 A.C and D.C drives are installed in mechatronic systems according to installation manual 5.6 Digital displays and indicators are identified and installed according to prescribed mode of installation 5.7 Monitoring and control systems are installed according to installation manuals 5.8 Electronic equipment is tested according to
6. Install sensing devices in system	6.1 Installation manuals are obtained for system installation 6.2 Tools and equipment are identified according to job specifications 6.3 Sensors are identified according to system functionality 6.4 Sensors are installed in Mechatronic system according to recommended mode of installation 6.5 Calibration equipment in the mechatronic system are installed according to the prescribed mode of installation 6.6 Sensors are tested according to system functionality
7. Integrate	7.1 Individual components of mechatronic system

mechatronic system	are inspected according to system functionality 7.2 Appropriate tools and equipment for the system assembly mechatronic system are identified 7.3 Individual components are assembled to form a mechatronic system according to functionality of the system
8. Test and Commission mechatronic system	8.1 Relevant testing tools and equipment are identified according to system manuals 8.2 Mechatronic system is tested according to system functionality specifications 8.3 Calibration of parameters is done to achieve the desired results 8.4 Documentation of the system is done according to system functionality 8.5 Commissioning of the mechatronic system is done as per the system manuals

RANGE

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

Variable	Range
Wiring Materials may include but is not limited to:	• Cables • Sockets • Circuit breakers • Distribution boards • Consumer units • TPN • Cut outs • Switches • Capacitor Banks • Transformers • Batteries
Tools and equipment may include but is not limited to:	• Hand tools • Power tools • Machines
Mechanical units of wiring may include but is not limited to:	• Junction boxes • Conduits • Meter board
Electrical equipment parts may include but is not limited to:	• Sensors • Actuators
Piping tools and equipment may	• Pipe wrenches

Variable	Range
include but is not limited to:	• Adjustable spanners • Masonry fit

REQUIRED KNOWLEDGE

The individual needs to demonstrate knowledge of:

- Electrical circuit design
- Mechanical structural design
- Computer Aided Design
- Mechatronic programming
- Technical report writing
- Data analysis and interpretation
- Interpretation of technical drawings
- Documentation
- Types of tools and equipment
- Properties of materials
- Electrical and mechanical machine drives
- Pipe work
- Testing and inspection
- Sensors and transducers

REQUIRED SKILLS

The individual needs to demonstrate skills in:

- Design of mechatronic systems
- Communication skills
- Problem solving
- Creativity and innovation
- Data collection and analysis
- Use of tools and equipment
- Technical presentation
- Technical drawing
- Pipe work
- Installation and fabrication

EVIDENCE GUIDE

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

1. Critical Aspects of Competency.	1.1 Installed system wiring 1.2 Installed electrical devices 1.3 Installed piping system 1.4 Installed mechanical system 1.5 Installed electronics equipment system 1.6 Installed sensing devices in system 1.7 Integrated mechatronic system in system

	1.8 Tested and Commissioned mechatronic system
2. Resource Implications.	2.1 Computers 2.2 Software 2.3 Projectors 2.4 Markers 2.5 Whiteboards 2.6 Tools and equipment 2.7 Whiteboard markers
3. Methods of Assessment.	***Competency may be assessed through:*** 3.1 Practical 3.2 Observation 3.3 Questionnaire 3.4 Case studies 3.5 Written examinations 3.6 Oral presentation
4. Context of Assessment.	4.1 Competency may be assessed individually in an actual workplace or in work-simulated conditions within accredited institutions.
5. Guidance information for assessment.	5.1 This unit may be assessed on an integrated basis with others within this occupational sector.

MAINTAIN ELECTRO-MECHANICAL SYSTEMS

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

Unit description

This unit describes the competencies required by a technician in order to maintain electro-mechanical systems. It involves observing occupational health and safety, troubleshooting electro-mechanical faults, servicing and/or repairing electrical and mechanical system faults, testing electro-mechanical systems, scheduling maintenance of electro-mechanical systems.

ELEMENTS AND PERFORMANCE CRITERIA

ELEMENT These describe the key outcomes which make up workplace function.	**PERFORMANCE CRITERIA** These are assessable statements which specify the required level of performance for each of the elements. ***Bold and italicized terms are elaborated in the Range.***
1. Observe occupational health and safety	1.1 ***Personal protective equipment*** (PPE) are used according to OSHA 2007 1.2 ***Tools and equipment*** are stored and maintained correctly according to manufacturer's specifications 1.3 Tools and equipment are used correctly according to designated purpose 1.4 Workspace housekeeping is maintained according to Standard operating procedures (SOPs) 1.5 Workplace is planned according to design specifications. 1.6 Safety signs are placed and observed according to OSHA 2007
2. Troubleshoot electro-mechanical faults	2.1 Proper authorization is obtained according to statutory policy 2.2 Circuit diagram is interpreted according to system manual 2.3 Tools and equipment are identified according to machine manual requirement 2.4 Electro-mechanical fault is identified according to recommended steps/procedures in the service manual
3. Service and/or repair electrical system	3.1 Tools and equipment are operated correctly according to manufacturer specifications. 3.2 Electrical system is serviced according manufacturer specifications. 3.3 ***Faulty devices*** are detached from the system according to necessary safety procedures

	3.4 Faulty devices are repaired/replaced according to the service manual and specifications 3.5 Electrical faults and/or repairs are documented according to SOPs
4. Service and/or repair mechanical system faults	4.1 Tools and equipment are operated correctly according to manufacturer specifications 4.2 Mechanical system is serviced according manufacturer specifications. 4.3 Faulty devices are detached from the system according to necessary safety procedures 4.4 Faulty devices are repaired/replaced according to the service manual and specifications 4.5 Mechanical faults and/or repairs are documented according to SOPs
5. Test electro-mechanical system	5.1 Termination/insulation of electrical wiring contacts are verified according to IEEE standards. 5.2 Validation of mechanical linkages and joints are done according to service manual 5.3 Electro-mechanical system is tested to confirm its proper operation according to manufacturer specifications 5.4 Test results are documented according to SOPs
6. Schedule maintenance of electro-mechanical system	6.1 Normal service schedule is determined according to manufacturer specifications 6.2 New service schedule is developed after breakdown repairs according to operational specifications 6.3 Maintenance schedule is documented according to SOPs

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**
Personal protective equipment may include but is not limited to:	• Goggles • Ear muff • Safety mask • Helmets/head gear • Safety boots • Gloves • Overall/dust coat
Tools and equipment may	• Hand tools

Variable	Range
include but is not limited to:	• Power tools • Machines
Faulty devices may include but is not limited to:	• Sensors • Motor drives • Gears • Pulleys • Bearings • Drive shafts • Instruments • Electrical wiring • Mechanical linkages • Belts and chains

REQUIRED KNOWLEDGE

The individual needs to demonstrate knowledge of:

- Mechatronic programming
- Technical report writing
- PPE
- Interpretation of technical drawings
- Documentation
- Types of tools and equipment
- Electrical and mechanical machine drives
- Machine operation
- Types of maintenance
- Circuit interpretation
- Scheduling/planning for maintenance

REQUIRED SKILLS

The individual needs to demonstrate skills in:

- Communication skills
- Problem solving
- Data collection and analysis
- Use of tools and equipment
- Technical drawing
- Service and repair of system components
- Fault diagnosis
- Interpretation of circuit
- Basics on electrical circuits
- Basics on mechanical installation
- Use of test and measuring instruments
- Planning
- Organisation

EVIDENCE GUIDE

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

1. Critical Aspects of Competency.	1.1 Place and observe safety signs 1.2 Identified electro-mechanical faults 1.3 Serviced and/or repaired electrical system faults 1.4 Serviced and/or repaired mechanical system faults 1.5 Tested electro-mechanical system after service/repair 1.6 Scheduled maintenance of electro-mechanical systems
2. Resource Implications.	2.1 Computers 2.2 Software 2.3 Whiteboards 2.4 Tools and equipment 2.5 Whiteboard markers 2.6 Manuals
3. Methods of Assessment.	***Competency may be assessed through:*** 3.1 Practical 3.2 Observation 3.3 Questionnaire 3.4 Case studies 3.5 Written examinations 3.6 Oral presentation
4. Context of Assessment.	4.1 Competency may be assessed individually in an actual workplace or in work-simulated conditions within accredited institutions.
5. Guidance information for assessment.	5.1 This unit may be assessed on an integrated basis with others within this occupational sector.

PERFORM MECHATRONIC SYSTEMS INSTRUMENTATION AND CONTROL

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

Unit description

This unit covers the competencies required to install mechatronic systems. It involves competencies; observe occupational health and safety, design a control system, document the control system design and specifications, install mechatronic instrumentation and control system, analyze instrumentation and control data and service and/or repair system faults

ELEMENTS AND PERFORMANCE CRITERIA

ELEMENT These describe the key outcomes which make up workplace function.	**PERFORMANCE CRITERIA** These are assessable statements which specify the required level of performance for each of the elements. ***Bold and italicized terms are elaborated in the Range.***
1. Observe occupational health and safety	1.1 ***Personal protective equipment*** (PPE) are used according to OSHA 2007 1.2 ***Tools and equipment*** are stored and maintained correctly according to manufacturer's specifications 1.3 Tools and equipment are used correctly according to designated purpose 1.4 Workspace housekeeping is maintained according to Standard operating procedures (SOPs) 1.5 Workplace is planned according to design specifications.
2. Design a control system	2.1 Mechatronic system to be controlled problem is defined according to user needs 2.2 User manuals for the mechatronics systems are obtained and studied for system functionality 2.3 Circuit diagrams for the control system are modelled according to the functionality of the mechatronic systems 2.4 Resulting models are analysed and their properties determined according to system functionality 2.5 Control variables (outputs) to be controlled are decided according to the prescribed mechatronic system functionality 2.6 Measurement and manipulated variables are selected according to system functionality 2.7 Controller type and its configuration to be is

	selected according to the system performance 2.8 Controller is designed according to the system specifications 2.9 ***Controller components*** and their specifications are selected, acquired and inspected according to the prescribed system functionality 2.10 Tools and equipment are selected according to the control system circuit diagram 2.1 Mechatronic system is analysed to test compatibility with the designed controller according to system specifications 2.2 Controlled mechatronic system is simulated according to system specifications 2.3 Hardware and software are selected and controller implemented according to prescribed system specification 2.4 Testing and validation of the control system is done and tuning done according system specification.
3. Document the control system design and specifications	3.1 ***Technical report*** is developed according to the control system design and specifications. 3.2 Operation and maintenance manual is developed according to control system design and specifications 3.3 The control system design is patented according to Industrial Property Act,2001
4. Install mechatronic instrumentation and control system	4.1 Existing mechatronic system manuals are obtained from the user and studied for the system performance 4.2 Safety and precaution measures are observed according OSHA 4.3 Tools and equipment are selected according system functionality 4.4 Interfacing of the controller and the mechatronic system is done according to prescribed system performance 4.5 System performance is studied, monitored, tested an evaluated according to prescribed system specification 4.6 Calibration of the system is done according to the system functionality 4.7 Documentation is done for future reference and use 4.8 System is commissioned for use according to the prescribed functionality
5. Analyse instrumentation and	5.1 ***Data*** to be analysed is decided according to the inputs and the outputs of the controller and the

control data	mechatronic system performance 5.2 ***Methods of data collection*** is selected according system performance 5.3 Data from the system is collected according to system performance 5.4 Documentation of the collected data is done according to the system performance 5.5 Data is interpreted and analysed according to the system performance 5.6 Interpreted and analysed data is documented for future use
6. Service and/or repair system faults	6.1 Installation manuals are obtained from the user and analysed for functionality of the system 6.2 Safety and precaution measures are observed according OSHA. 6.3 Tools and equipment are selected according to installation and service manuals 6.4 System testing is done for comparison with the manufacturer's specifications and system functionality. 6.5 Fault diagnosis is done according to service manuals instructions 6.6 Faulty units removed and replaced with new ones and moving parts lubricated according to the system performance 6.7 System is tested against the required specifications 6.8 Scheduling of the next service is done according to SOPs 6.9 Documentation is done for future use and reference

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**
Tools and equipment may include but is not limited to:	• Hand tools • Power tools • Machines
PPEs may include but is not limited to:	• Overall/dust coats • Helmets • Nose masks • Ear muffs • Safety boots

Variable	Range
Controller components may include but is not limited to:	• PLC • Contactors • Relays • Displays • Keyboards and keypads • Control Buttons/switches
Data may include but is not limited to:	• Power • Temperature data • Pressure data • Current and voltage • Frequency • Heat
Methods of data collection may include but is not limited to:	• Observation • Experiments • Questionnaires

REQUIRED KNOWLEDGE

The individual needs to demonstrate knowledge of:

- Electrical circuit design
- Mechanical structural design
- Computer Aided Design
- Mechatronic programming
- Technical report writing
- Data analysis and interpretation
- Interpretation of technical drawings
- Documentation
- Types of tools and equipment
- Electrical and mechanical machine drives
- Testing and inspection
- Sensors and transducers
- Robotics and automated processes
- Hydraulics and pneumatics systems
- Service and maintenance of mechatronics processes
- Control and instrumentation
- Integration of control to mechatronic system

REQUIRED SKILLS

The individual needs to demonstrate skills in:

- Communication skills
- Problem solving
- Creativity and innovation

- Data collection and analysis
- Use of tools and equipment
- Technical presentation
- Technical drawing
- Installation and fabrication
- Interpretation of installation manuals
- Integration of robotics and automated processes
- Service and maintenance
- Control and instrumentation interfacing

EVIDENCE GUIDE

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

1 Critical Aspects of Competency.	1.1 Observed occupational health and safety 1.2 Designed a control system 1.3 Documented the control system design and specifications 1.4 Installed mechatronic instrumentation and control system 1.5 Analysed instrumentation and control data 1.6 Serviced and/or repaired system faults
2 Resource Implications.	2.1 Computers 2.2 Software 2.3 Projectors 2.4 Markers 2.5 Whiteboards 2.6 Tools and equipment 2.7 Whiteboard markers
3 Methods of Assessment.	***Competency may be assessed through:*** 3.1 Practical 3.2 Observation 3.3 Questionnaire 3.4 Case studies 3.5 Written examinations 3.6 Oral presentation
4 Context of Assessment.	4.1 Competency may be assessed individually in an actual workplace or in work-simulated conditions within accredited institutions.
5 Guidance information for assessment.	5.1 This unit may be assessed on an integrated basis with others within this occupational sector.

CARRY OUT MECHATRONIC PROGRAMMING

UNIT CODE: ENG/OS/MC/CR/05/6/A

Unit description

This unit describes the competencies required by a technician in order to carry out mechatronic programming. It involves identifying mechatronic programming languages used in machines, developing and customizing a mechatronic program, testing and configuring a mechatronic program, interfacing a mechatronic program with system and maintain mechatronic program.

ELEMENTS AND PERFORMANCE CRITERIA

ELEMENT These describe the key outcomes which make up workplace function.	**PERFORMANCE CRITERIA** These are assessable statements which specify the required level of performance for each of the elements. ***Bold and italicized terms are elaborated in the Range.***
1. Identify mechatronic programming languages used in machine	1.1 System manual is analysed according to manufacturer specifications 1.2 System software and hardware interface is established according to system specifications 1.3 System programmable hardware in use are identified according to system specifications 1.4 System software requirements are identified according to programmable hardware in use
2. Develop and customize a mechatronic program	2.1 Correct software is obtained according to the system requirements 2.2 Flow chart of activities is developed according to the task requirements 2.3 ***Peripheral devices*** to be used are identified according to software operational requirements 2.4 Inputs and outputs of peripheral devices are verified according system manual and program flow charts 2.5 ***Mechatronic program*** is generated and customized according to system requirements 2.6 Mechatronic program is run offline according to system specifications
3. Interface mechatronic program with system	3.1 Correct wiring of peripheral devices is verified according to system manual 3.2 Software and hardware is installed according to system requirements 3.3 Peripheral devices are installed according system specifications 3.4 Mechatronic program is networked with the system according to system requirements

	3.5 Mechatronic program and interface is documented according to SOPs
4. Test and configure mechatronic program	4.1 Mechatronic program is configured according to peripheral device inputs and outputs requirements 4.2 Mechatronic program is run online and tested for errors according to system requirements 4.3 Mechatronic program is debugged in the event of errors according system output
5. Maintain mechatronic program	5.1 Faults are diagnosed in the mechatronic program according to system manual 5.2 Faults in peripheral devices are diagnosed according to system manual 5.3 Mechatronic program is maintained according to system specifications 5.4 Peripheral devices are maintained according system specifications 5.5 Maintenance is scheduled according to manufacturer specifications

RANGE

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

Variable	**Range**
Peripheral devices may include but is not limited to:	• Sensors • Actuators • Instruments • Integrated circuits • Controllers
Mechatronic program may include but is not limited to:	• PLC • SCADA • MATLAB

REQUIRED KNOWLEDGE

The individual needs to demonstrate knowledge of:

- Mechatronic software
- Networking
- Documentation
- Scheduling/planning for maintenance
- Logic

- Algorithms and data structures
- Programming languages
- Scientific methods

REQUIRED SKILLS

The individual needs to demonstrate skills in:

- Coding
- Communication skills
- Programming languages
- Problem solving
- Data collection and analysis
- Service and repair of system components
- Fault diagnosis
- Attention to details

EVIDENCE GUIDE

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

1. Critical Aspects of Competency.	1.1 Identified mechatronic programming languages used in the machines 1.2 Developed and customized mechatronic programs 1.3 Tested and configured mechatronic programs 1.4 Interfaced mechatronic programs with systems in use 1.5 Maintained mechatronic programs
2. Resource Implications.	2.1 Computers 2.2 Software 2.3 Whiteboards 2.4 Whiteboard markers 2.5 Manuals 2.6 Controllers (PLCs etc.)
3. Methods of Assessment.	***Competency may be assessed through:*** 3.1 Practical 3.2 Observation 3.3 Questionnaire 3.4 Case studies 3.5 Written examinations 3.6 Oral presentation
4. Context of Assessment.	4.1 Competency may be assessed individually in an actual workplace or in work-simulated conditions within accredited institutions.
5. Guidance information for assessment.	5.1 This unit may be assessed on an integrated basis with others within this occupational sector.

OPERATE MECHATRONIC SYSTEMS

UNIT CODE: ENG/OS/MC/CR/06/6/A

Unit description

This unit covers the competencies required to operate mechatronic systems. It involves observing occupational health and safety, interpreting installation manuals, installing mechatronic systems, integrating mechatronic systems, testing and commissioning mechatronic system and servicing and maintaining mechatronic system faults

ELEMENTS AND PERFORMANCE CRITERIA

ELEMENT These describe the key outcomes which make up workplace function.	**PERFORMANCE CRITERIA** These are assessable statements which specify the required level of performance for each of the elements. ***Bold and italicized terms are elaborated in the Range.***
1. Observe occupational health and safety	1.1 ***Personal protective equipment*** (PPE) are used according to OSHA 2007 1.2 ***Tools and equipment*** are stored and maintained correctly according to manufacturer's specifications 1.3 Tools and equipment are used correctly according to designated purpose 1.4 Workspace housekeeping is maintained according to Standard operating procedures (SOPs) 1.5 Workplace is planned according to design specifications.
2. Interpret installation manuals	2.1 ***Installation manuals*** are obtained from the user according to equipment specifications 2.2 Manuals are studied and analysed according to the components functionality 2.3 Manuals are stored for future use and references
3. Install mechatronic systems	3.1 ***Mechatronic systems*** components are identified according to the installation manuals and user specifications 3.2 Components are inspected according to the prescribed systems specifications 3.3 ***Tools and equipment*** are selected according to the installation manuals 3.4 Mechatronic system components are assembled together according to installation manuals 3.5 Mechatronic systems are connected to the required power supply according the component power specifications and manuals 3.6 Control systems are interfaced to the system

	according to user specifications and installation manuals 3.7 System programming is done according to functionality of the system 3.8 Program is uploaded to the mechatronic system according to prescribed functionality 3.9 Inspection of the assembled system is done as per installation manuals and system functionality 3.10 Assembled components are tested according to the system specifications 3.11 Documentation is done according to the obtained end results 3.12 Program is debugged and tested according to the system functionality 3.13 Mechatronic system is operationalized according to the user specification
4. Integrate mechatronic systems	4.1 Manuals for the existing system are obtained from the user 4.2 Safety and precaution measures are observed according OSHA 4.3 Existing system is studied and analysed according to its prescribed functionality 4.4 Appropriate tools and equipment are selected according to the installation manuals 4.5 Existing and the new system are tested for compatibility according to the user specification 4.6 New system and the existing system are interfaced together according to the user specification and system functionality 4.7 Interfaced system is calibrated according to the system functionality 4.8 Documentation of the results is done for future reference
5. Test and Commission mechatronic system	5.1 Interfaced system is tested for functionality according to system specifications 5.2 Monitoring, evaluation and assessment of the system performance is done according to the system functionality 5.3 System commissioning is done according to the prescribed user specifications
6. Service and maintain mechatronic system faults	6.1 Safety and precaution measures are observed according OSHA. 6.2 Installation manuals are obtained from the user and analysed for functionality of the system 6.3 Tools and equipment are obtained according the manual specifications 6.4 System testing is done for comparison with the

	manufacturer's specifications and system functionality. 6.5 Fault diagnosis is done according to service manuals instructions 6.6 Faulty units removed and replaced with new ones considering their compatibility with the system 6.7 System is tested against the required specifications 6.8 Documentation is done for future use according to user specifications

RANGE

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

Variable	Range
Tools and equipment may include but is not limited to:	• Hand tools • Power tools • Machines
Mechatronic systems may include but is not limited to:	• Robots • Pneumatics systems • Hydraulic systems • Generators • Safety equipment
Installation manuals may include but is not limited to:	• Electrical and electronic components manuals • Mechanical components manuals • Pneumatics manuals • Hydraulic manuals • Programming manuals • Servicing and troubleshooting manuals

REQUIRED KNOWLEDGE

The individual needs to demonstrate knowledge of:

- Electrical circuit design
- Mechanical structural design
- Computer Aided Design
- Mechatronic programming
- Technical report writing
- Data analysis and interpretation
- Interpretation of technical drawings
- Documentation
- Types of tools and equipment
- Properties of materials

- Electrical and mechanical machine drives
- Testing and inspection
- Sensors and transducers
- Robotics and automated processes
- Hydraulics and pneumatics systems
- Service and maintenance of mechatronics processes
- Control and instrumentation
- Interfacing of mechatronics components
- Integration of mechatronics components

REQUIRED SKILLS

The individual needs to demonstrate skills in:

- Communication skills
- Problem solving
- Creativity and innovation
- Data collection and analysis
- Use of tools and equipment
- Technical presentation
- Technical drawing
- Installation and fabrication
- Interpretation of installation manuals
- Integration of robotics and automated processes
- Service and maintenance

EVIDENCE GUIDE

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

1 Critical Aspects of Competency.	1.1 Observed occupational health and safety 1.2 Interpreted installation manuals 1.3 Installed mechatronic systems 1.4 Integrated mechatronic systems 1.5 Tested and Commissioned mechatronic system 1.6 Serviced and maintained mechatronic system faults
2 Resource Implications.	2.1 Computers 2.2 Software 2.3 Projectors 2.4 Markers 2.5 Whiteboards 2.6 Tools and equipment 2.7 Whiteboard markers
3 Methods of Assessment.	***Competency may be assessed through:*** 3.1 Practical 3.2 Observation 3.3 Questionnaire

		3.4 Case studies 3.5 Written examinations 3.6 Oral presentation
4	Context of Assessment.	4.1 Competency may be assessed individually in an actual workplace or in work-simulated conditions within accredited institutions.
5	Guidance information for assessment.	5.1 This unit may be assessed on an integrated basis with others within this occupational sector.

MANAGE MECHATRONIC PROJECTS

UNIT CODE: ENG/OS/MC/CR/07/6/A

Unit description

This unit describes the competencies required by a technician in order to manage mechatronic projects. It involves selecting and planning mechatronic project technology, coordinating activities for mechatronic projects, coordinating personnel for mechatronic projects, analyzing and documenting mechatronic project activities and managing quality control of mechatronic projects.

ELEMENTS AND PERFORMANCE CRITERIA

ELEMENT These describe the key outcomes which make up workplace function.	**PERFORMANCE CRITERIA** These are assessable statements which specify the required level of performance for each of the elements. ***Bold and italicized terms are elaborated in the Range.***
1. Select and plan mechatronic projects	1.1 Initial task of mechatronic project and document is inspected and analysed according to project needs 1.2 Appropriate technology and technical resources are selected according to project necessity 1.3 Project risk analysis and possible modifications are made according project needs 1.4 Project negotiations are initiated and effected according to client needs
2. Coordinate activities for mechatronic projects	2.1 Action plan and project phases is prepared according to project specifications 2.2 Tasks and responsibilities are delegated according to project specifications 2.3 Tools, equipment and materials are delivered and stored according project requirements 2.4 Track is done to ensure ***project conformity*** according to project requirements
3. Coordinate personnel for mechatronic projects	3.1 Personnel on mechatronic projects are supervised according to project activities 3.2 Mechatronic duties are delegated according to project requirements 3.3 Personnel are hired according to project requirements 3.4 Staff members on mechatronic projects are appraised according to work performance 3.5 Personnel project roster is maintained according to project requirements
4. Analyze and documents mechatronic project activities	4.1 ***Project related activities*** are analysed according to SOPs 4.2 Project activities are documented according to

	project analysis 4.3 ***Project documentation*** is managed according SOPs 4.4 Project reports are prepared according to project requirements
5. Manage quality control of mechatronic projects	5.1 Appropriate tools are used to manage quality according to ***set standards*** 5.2 Continuous work quality assessment is carried out according to project specifications 5.3 Work is done according to set standards 5.4 Multi stage control points are developed according to project 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**
Project conformity may include but is not limited to:	• Project budget • Project quality • Project schedule
Tools and equipment may include but is not limited to:	• Hand tools • Power tools • Machines
Project related activities may include but is not limited to:	• Risk prevention and management • Quality assurance • Time management • Performance improvement
Project documentation may include but is not limited to:	• Receipts • LPOs • Delivery notes • Work schedule • Working time records • Certificates and permits
Set standards may include but is not limited to:	• ISO • KEBS • BS • API • IEEE

REQUIRED KNOWLEDGE

The individual needs to demonstrate knowledge of:

- Project management
- Documentation
- Scheduling/planning for maintenance
- Resource allocation
- Quality control and assurance
- Measurement and instrumentation
- Technical drawing
- Risk assessment
- Standard units used in fluids

REQUIRED SKILLS

The individual needs to demonstrate skills in:

- Measurements
- Equipment inspection and testing
- Communication skills
- Problem solving
- Data collection and analysis
- Documentation
- Management
- Project development
- Attention to details

EVIDENCE GUIDE

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

1. Critical Aspects of Competency.	1.1 Selected and planned mechatronic project technology 1.2 Coordinated activities for mechatronic projects 1.3 Coordinated personnel for mechatronic projects 1.4 Analyzed and documented mechatronic project activities 1.5 Managed quality control of mechatronic projects
2. Resource Implications.	2.1 Computers 2.2 Whiteboards 2.3 Whiteboard markers 2.4 Manuals 2.5 Manila papers 2.6 Drawing and design software
3. Methods of Assessment.	***Competency may be assessed through:*** 3.1 Practical 3.2 Observation 3.3 Questionnaire

	3.4 Case studies 3.5 Written examinations 3.6 Oral presentation
4. Context of Assessment.	4.1 Competency may be assessed individually in an actual workplace or in work-simulated conditions within accredited institutions.
5. Guidance information for assessment.	5.1 This unit may be assessed on an integrated basis with others within this occupational sector.