

**THE REPUBLIC OF KENYA**

**NATIONAL OCCUPATIONAL STANDARDS**

**FOR**

**AUTOBODY TECHNICIAN**

**LEVEL 6**



****



TVET CDACC

P.O BOX 15745-00100

NAIROBI

First published 2020

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**Council Secretary/CEO**

**TVET Curriculum Development, Assessment and Certification Council**

**P.O. Box 15745–00100**

**Nairobi, Kenya**

**Email :** [**info@tvetcdacc.go.ke**](mailto:info@tvetcdacc.go.ke)

# 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 in 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 Autobody Technology. These Occupational Standards will also be the basis for assessment of an individual for competence certification.

It is my conviction that these Occupational Standards will play a great role towards development of competent human resource for the Engineering sector’s growth and 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 labour force.

The TVET Curriculum Development, Assessment and Certification Council (TVET CDACC), in conjunction with Autobody Sector Skills Advisory Committee (SSAC) have developed these Occupational Standards for Autobody Technician. These standards will be the bases for development of competency-based curriculum for Autobody Technology 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 GIZ, Council Members, Council Secretariat, Autobody SSAC, expert workers and all those who participated in the development of these Occupational Standards.

**CHAIRPERSON, TVET CDACC**

# ACKNOWLEDGMENT

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

I thank TVET Curriculum Development, Assessment and Certification Council (TVET CDACC) for providing guidance on the development of these Standards. My gratitude goes to Autobody Sector Skills Advisory Committee (SSAC) members for their contribution to the development of these Standards. I thank all the individuals and organizations who participated in the validation of these Standards not forgetting GIZ.

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

**CHAIRPERSON AUTOBODY SECTOR SKILLS ADVISORY COMMITTEE**

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# ABBREVIATIONS AND ACRONYMS

A Control version

ABT: Auto body Technology

AC: Alternating Current

AHK: Delegation of German Industry and Commerce in Kenya

AIDS Acquired Immunodeficiency Syndrome

ANSYS: Analysis System

BC Basic Unit of Competency

CAD: Computer-Aided Design

CAE: Computer-Aided Engineering

CAM: Computer-Aided Manufacturing

CBET Competency Based Education and Training

CC Common Unit of Competency

CDACC Curriculum Development Assessment Certification Council

CEO Council Secretary

CNC: Computer Numerical Control

CPU Central Processing Unit

CR Core Unit of Unit

DC: Direct Current

EMS: Environmental Management System

FMEA: Failure Moods and Effects Analysis

GIZ: Deutsche Gesellschatt für Internationale Zusammenarbeit

HIV Human Immuno-Deficiency Virus

I/O: Input / Output

ICT Information Communication Technology

ISO: International Organization of Standardization

KEBS: Kenya Bureau of Standards

LAN: Local Access Network

MIG: Metal Inert Gases

OBD: On-board Diagnostics

OS Occupational Standard

OSH: Occupational Safety and Health

OSHA: Occupational, Health and Safety Act

OSHS: Occupational Safety and Health Standards

PC: Personal Computer

PESTEL Political Environmental Social Technological Economic Legal

PLC: Programmable Logic Controller

PPE Personal Protective Equipment

RTD: Resistance Temperature Nature

SOPStandard Operating Procedure

SSAC Sector Skills Advisory Committee

SWOT Strength Weakness Opportunity Threat

TIG: Tungsten Inert Gas

TVET Technical and Vocational Education and Training

WIBA: Work Injury Benefits Act

# **KEY TO UNIT CODE**

**ENG/OS/ABT /BC /01/ 6/ A**

Industry or sector

Occupational Standards

Occupational area

Type of competency

Competency number

Competency level

Version control

# OVERVIEW

Autobody Technology level 6 qualifications consists of competencies that an individual must achieve including design vehicle body, fabricate automotive structure, weld vehicle body parts, panel vehicle structure, repair vehicle body, spray paint vehicle body, trim vehicle body, assemble vehicle body parts, perform vehicle preventive maintenance and drive motor vehicle.

This course consists of the following basic, common and core units of competency as shown below:

**Basic Units of Competency**

|  |  |
| --- | --- |
| **Unit Code** | **Units Title** |
| ENG/OS/ABT/BC/01/6/A | Demonstrate Communication Skills |
| ENG/OS/ABT/BC/02/6/A | Demonstrate Digital Literacy |
| ENG/OS/ABT/BC/03/6/A | Demonstrate Entrepreneurial Skills |
| ENG/OS/ABT/BC/04/6/A | Demonstrate Employability Skills |
| ENG/OS/ABT/BC/05/6/A | Demonstrate Environmental Literacy |
| ENG/OS/ABT/BC/06/6/A | Demonstrate Occupational Health and Safety |

**Common Units of Competency**

|  |  |
| --- | --- |
| **Unit Code** | **Unit Title** |
| ENG/OS/ABT/CC/01/6/A | Apply Engineering Mathematics |
| ENG/OS/ABT/CC/02/6/A | Apply Engineering Mechanic Principles |
| ENG/OS/ABT/CC/03/6/A | Apply Workshop Technology Principles |
| ENG/OS/ABT/CC/04/6/A | Perform Computer Aided Drawing |
| ENG/OS/ABT/CC/05/6/A | Apply the Principles of Thermodynamics |
| ENG/OS/ABT/CC/06/6/A | Apply the Principles of Fluid Mechanics |
| ENG/OS/ABT/CC/07/6/A | Apply Material Science Principles |
| ENG/OS/ABT/CC/08/6/A | Apply Electrical and Electronic Principles |

**Core Units of Competency**

|  |  |
| --- | --- |
| **Unit Code** | **Unit Title** |
| ENG/OS/ABT/CR/01/6/A | Design Vehicle Body Structure |
| ENG/OS/ABT/CR/02/6/A | Fabricate Automotive Structure |
| ENG/OS/ABT/CR/03/6/A | Weld Vehicle Structure |
| ENG/OS/ABT/CR/04/6/A | Panel Vehicle Structure |
| ENG/OS/ABT/CR/05/6/A | Repair Vehicle Body |
| ENG/OS/ABT/CR/06/6/A | Spray Paint Vehicle Body |
| ENG/OS/ABT/CR/07/6/A | Trim Vehicle Body Parts |
| ENG/OS/ABT/CR/08/6/A | Assemble Vehicle Body Parts |
| ENG/OS/ABT/CR/09/6/A | Perform Vehicle Preventive Maintenance |
| ENG/OS/ABT/CR/10/6/A | Drive Motor Vehicle |

**BASIC UNITS OF COMPETENCY**

# DEMONSTRATE COMMUNICATION SKILLS

**UNIT CODE:** ENG/OS/ABT/BC/01/6/A

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  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. Meet communication needs of clients and colleagues | 1. Specific communication needs of clients and colleagues are identified and met based on workplace requirements 2. Different communication approaches are identified and applied according to clients’ needs 3. Conflict is identified and addressed as per the standards of the organization |
| 1. Develop communication strategies | * 1. Strategies for effective internal and external dissemination of information are developed as per organization’s requirements   2. Special communication needs are considered in developing strategies according workplace procedures   3. ***Communication strategies*** are analyzed, evaluated and revised based the workplace needs |
| 1. Establish and maintain communication pathways | * 1. Pathways of communication are established as per organization policy   2. Pathways are maintained and reviewed according to organization procedures |
| 1. Promote use of communication strategies | * 1. Information is provided to all areas of the organization as per strategy requirements   2. Effective communication techniques are articulated and modeled according work requirements   3. Personnel are given guidance about adapting communication strategies as per organization procedures |
| 1. Conduct interview | 1. A range of appropriate communication strategies are employed in ***interview situations*** based on the workplace requirements 2. Records of interviews are made and maintained in accordance with organizational procedures 3. Effective questioning, listening and nonverbal communication techniques are used as per needs |
| 1. Facilitate group discussion | 1. Mechanisms to enhance ***effective group interaction*** are identified and implemented according to workplace requirements 2. Strategies to encourage group participation are identified and used as per organizations’ procedures 3. Meetings objectives and agenda are set and followed based on workplace requirements 4. Relevant information is provided and feedback obtained according to set protocols 5. Evaluation of group communication strategies is undertaken in accordance with workplace guidelines 6. Specific communication needs of individuals are identified and addressed as per individual needs |
| 1. Represent the organization | 1. 7Relevant presentation are researched and presented based on internal or external communication forums requirements 2. Presentation is delivered in a clear and sequential manner as per the predetermined time 3. Presentation is made as per appropriate media 4. Difference views are respected based on workplace procedures 5. Written communication is done as per organizational standards 6. Inquiries are responded according to organizational standard |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Communication strategies may include but not limited to: | * Language switch * Comprehension check * Repetition * Asking confirmation * Paraphrase * Clarification request * Translation * Restructuring * Approximation * Generalization |
| 1. Effective group interaction may include but not limited to: | * Identifying and evaluating what is occurring within an interaction in a nonjudgmental way * Using active listening * Making decision about appropriate words, behavior * Putting together response which is culturally appropriate * Expressing an individual perspective * Expressing own philosophy, ideology and background and exploring impact with relevance to communication |
| 1. 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:

* Communication
* Active listening
* Interpretation
* Negotiation
* Writing

**Required Knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical aspects of Competency | Assessment requires evidence that the candidate:   1. Developed communication strategies to meet the organization requirements and applied in the workplace 2. Established and maintained communication pathways for effective communication in the workplace 3. Used communication strategies involving exchanges of complex oral information |
| 1. Resource Implications | The following resources should be provided:   1. Access to relevant workplace or appropriately simulated environment where assessment can take place 2. Materials relevant to the proposed activity or tasks |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   1. Direct observation 2. Oral questioning 3. Written texts |
| 1. Context of Assessment | Competency may be assessed:   1. On-the-job 2. Off-the –job 3. During Industrial attachment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

**DEMONSTRATE DIGITAL LITERACY**

**UNIT CODE:** ENG/OS/ABT/BC/02/6/A

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  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 appropriate computer software and hardware | * 1. Concepts of ICT are determined in accordance with computer equipment   2. Classifications of computers are determined in accordance with manufacturers specification   3. Appropriate computer software is identified according to manufacturer’s specification   4. Appropriate computer hardware is identified according to manufacturer’s specification   5. Functions and commands of operating system are determined in accordance with manufacturer’s specification |
| 1. Apply security measures to data, hardware, software in automated environment | * 1. ***Data security and privacy are classified*** in accordance with the prevailing technology   2. ***Security threats*** reidentified ***and control measures*** are applied in accordance with laws governing protection of ICT   3. Computer threats and crimes are detected in accordance to Information Management security guidelines   4. Protection against computer crimes is undertaken in accordance with laws governing protection of ICT |
| 1. Apply computer software in solving tasks | * 1. ***Word processing concepts*** are applied in resolving workplace tasks, report writing and documentation as per the job requirements   2. ***Word processing utilities*** are applied in accordance with workplace procedures   3. Worksheet layout is prepared in accordance with work procedures   4. Worksheet is built and data manipulated in the worksheet in accordance with workplace procedures   5. Continuous data manipulated on worksheet is undertaken in accordance with work requirements   6. Database design and manipulation is undertaken in accordance with office procedures   7. Data sorting, indexing, storage, retrieval and security is provided in accordance with workplace procedures |
| 1. Apply internet and email in communication at workplace | * 1. Electronic mail addresses are opened and applied in workplace communication in accordance with office policy   2. Office internet functions are defined and executed in accordance with office procedures   3. ***Network configuration*** is determined in accordance with office operations procedures   4. Official World Wide Web is installed and managed according to workplace procedures |
| 1. Apply Desktop publishing in official assignments | * 1. Desktop publishing functions and tools are identified in accordance with manufactures specifications   2. Desktop publishing tools are developed in accordance with work requirements   3. Desktop publishing tools are applied in accordance with workplace requirements   4. Typeset work is enhanced in accordance with workplace standards |
| 1. Prepare presentation packages | * 1. Types of presentation packages are identified in accordance with office requirements   2. Slides are created and formulated in accordance with workplace procedures   3. Slides are edited and run-in accordance with work procedures   4. Slides and handouts are printed according to work requirements |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Appropriate computer hardware may include but not limited to: | Collection 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 |
| 1. Data security and privacy may include but not limited to: | * Confidentiality of data * Cloud computing * Integrity -but-curious data surfing |
| 1. Security and control measures may include but not limited to: | * Counter measures against cyber terrorism * Risk reduction * Cyber threat issues * Risk management * Pass-wording |
| 1. Security threats may include but not limited to: | * Cyber terrorism * Hacking |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

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

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Software concept
* Functions of computer software and hardware
* Data security and privacy
* Computer security threats and control measures
* Technology underlying cyber-attacks and networks
* Cyber terrorism
* Computer crimes
* Detection and protection of computer crimes
* Laws governing protection of ICT
* Word processing;
* Functions and concepts of word processing.
* Documents and tables creation and manipulations
* Mail merging
* Word processing utilities
* Spread sheets;
* Meaning, formulae, function and charts, uses and layout
* Data formulation, manipulation and application to cells
* Database;
* Database design, data manipulation, sorting, indexing, storage retrieval and security
* Desktop publishing;
* Designing and developing desktop publishing tools
* Manipulation of desktop publishing tools
* Enhancement of typeset work and printing documents
* Presentation Packages;
* Types of presentation Packages
* Creating, formulating, running, editing, printing and presenting slides and handouts
* Networking and Internet;
* Computer networking and internet.
* Electronic mail and world wide web
* Emerging trends and issues in ICT;
* Identify and integrate emerging trends and issues in ICT
* Challenges posed by emerging trends and issues

**EVIDENCE** **GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   * 1. Identified and controlled security threats   2. Detected and protected computer crimes   3. Applied word processing in office tasks   4. Designed, prepared work sheet and applied data to the cells in accordance to workplace procedures   5. Opened electronic mail for office communication as per workplace procedure   6. Installed internet and World Wide Web for office tasks in accordance with office procedures   7. Integrated emerging issues in computer ICT applications   8. Applied laws governing protection of ICT |
| 1. Resource Implications | The following resources should be provided:   * 1. Access to relevant workplace where assessment can take place   2. Appropriately simulated environment where assessment can take place |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Observation   2. Oral questioning   3. Written test   4. Portfolio of Evidence   5. Interview   6. Third party report |
| 1. Context of Assessment | Competency may be assessed:   1. On-the-job 2. Off-the –job 3. During Industrial attachment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

**DEMONSTRATE ENTREPRENEURIAL SKILLS**

**UNIT CODE :** ENG/OS/ABT/BC/03/6/A

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT** | **PERFORMANCE CRITERIA** |
| 1. Demonstrate understanding of an Entrepreneur | 1. Entrepreneurs and Business persons are distinguished as per principles of entrepreneurship 2. ***Types of entrepreneurs*** are identified as per principles of entrepreneurship 3. Ways of becoming an Entrepreneur are identified as per principles of Entrepreneurship 4. ***Characteristics of Entrepreneurs*** are identified as per principles of Entrepreneurship 5. Factors affecting Entrepreneurship development are explored as per principles of Entrepreneurship |
| 1. Demonstrate understanding of Entrepreneurship and self-employment | 1. Entrepreneurship and self-employment are distinguished as per principles of entrepreneurship 2. Importance of self-employment is analysed based on business procedures and strategies 3. ***Requirements for entry into self-employment*** are identified according to business procedures and strategies 4. Role of an Entrepreneur in business is determined according to business procedures and strategies 5. Contributions of Entrepreneurs to National development are identified as per business procedures and strategies 6. Entrepreneurship culture in Kenya is explored as per business procedures and strategies 7. Born or made Entrepreneurs are distinguished as per entrepreneurial traits |
| 1. Identify Entrepreneurship opportunities | 1. Sources of business ideas are identified as per business procedures and strategies 2. Business ideas and opportunities are generated as per business procedures and strategies 3. Business life cycle is analysed as per business procedures and strategies 4. Legal aspects of business are identified as per procedures and strategies 5. Product demand is assessed as per market strategies 6. Types of ***business environment*** are identified and evaluated as per business procedures 7. Factors to consider when evaluating business environment are explored based on business procedure and strategies 8. Technology in business is incorporated as per best practice |
| 1. Create entrepreneurial awareness | 1. ***Forms of businesses*** are explored as per business procedures and strategies 2. Sources of business finance are identified as per business procedures and strategies 3. Factors in selecting source of business finance are identified as per business procedures and strategies 4. ***Governing policies*** on Small Scale Enterprises (SSEs) are determined as per business procedures and strategies 5. Problems of starting and operating SSEs are explored as per business procedures and strategies |
| 1. Apply entrepreneurial motivation | 1. ***Internal and external motivation*** factors are determined in accordance with motivational theories 2. Self-assessment is carried out as per entrepreneurial orientation 3. Effective communications are carried out in accordance with communication principles 4. Entrepreneurial motivation is applied as per motivational theories |
| 1. Develop innovative business strategies | 1. Business innovation strategies are determined in accordance with the organization strategies 2. Creativity in business development is demonstrated in accordance with business strategies 3. ***Innovative business strategies*** are developed as per business principles 4. Linkages with other entrepreneurs are created as per best practice 5. ICT is incorporated in business growth and development as per best practice |
| 1. Develop Business Plan | 1. Identified Business is described as per business procedures and strategies 2. Marketing plan is developed as per business plan format 3. Organizational/Management plan is prepared in accordance with business plan format 4. Production/operation plan in accordance with business plan format 5. Financial plan is prepared in accordance with the business plan format 6. Executive summary is prepared in accordance with business plan format 7. Business plan is presented as per best practice |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Types of entrepreneurs may include but not limited to: | * Innovators * Imitators * Craft * Opportunistic * Speculators |
| 1. Characteristics of Entrepreneurs may include but not limited to: | * Creative * Innovative * Planner * Risk taker * Networker * Confident * Flexible * Persistent * Patient * Independent * Future oriented * Goal oriented |
| 1. Requirements for entry into self-employment may include but not limited to | * Technical skills * Management skills * Entrepreneurial skills * Resources * Infrastructure |
| 1. Internal and external motivation may include but not limited to: | * Interest * Passion * Freedom * Prestige * Rewards * Punishment * Enabling environment * Government policies |
| 1. Business environment may include but not limited to: | * External * Internal * Intermediate |
| 1. Forms of businesses may include but not limited to: | * Sole proprietorship * Partnership * Limited companies * Cooperatives |
| 1. Governing policies may include but not limited to: | * Increasing scope for finance * Promoting cooperation between entrepreneurs and private sector * Reducing regulatory burden on entrepreneurs * Developing IT tools for entrepreneurs |
| 1. Innovative business strategies may include but not limited to: | * New products * New methods of production * New markets * New sources of supplies * Change in industrialization |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

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

**Required Knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

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

# DEMONSTRATE EMPLOYABILITY SKILLS

**UNIT CODE:** ENG/OS/ABT/BC/04/6/A

**UNIT DESCRIPTON**

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. Personal vision, mission and goals are formulated based on potential and in relation to organization objectives 2. Emotional intelligence is demonstrated as per workplace requirements. 3. Individual performance is evaluated and monitored according to the agreed targets. 4. Assertiveness is developed and maintained based on the requirements of the job. 5. Accountability and responsibility for own actions are demonstrated based on workplace instructions. 6. Self-esteem and a positive self-image are developed and maintained based on values. 7. Time management, attendance and punctuality are observed as per the organization policy. 8. Goals are managed as per the organization’s objective 9. Self-strengths and weaknesses are identified based on personal objectives |
| 1. Demonstrate interpersonal communication | 1. Writing skills are demonstrated as per communication policy 2. Negotiation and persuasion skills are demonstrated as per communication policy 3. Internal and external stakeholders’ needs are identified and interpreted as per the communication policy 4. Communication networks are established based on workplace policy 5. Information is shared as per communication policy |
| 1. Demonstrate critical safe work habits | * 1. Stress is managed in accordance with workplace policy.   2. Punctuality and time consciousness is demonstrated in line with workplace policy.   3. Personal objectives are integrated with organization goals based on organization’s strategic plan.   4. ***Resources*** are utilized in accordance with workplace policy.   5. Work priorities are set in accordance to workplace goals and objectives.   6. Leisure time is recognized and utilized in line with personal objectives.   7. ***Drugs and substances of abuse*** are identified and avoided based on workplace policy.   8. HIV and AIDS prevention awareness is demonstrated in line with workplace policy.   9. Safety consciousness is demonstrated in the workplace based on organization safety policy.   10. ***Emerging issues*** are identified and dealt with in accordance with organization policy. |
| 1. Lead a workplace team | 1. Performance targets for the ***team*** are set based on organization’s objectives 2. Duties are assigned in accordance with the organization policy. 3. ***Forms of communication*** in a team are established according to organization’s policy. 4. Team performance is evaluated based on set targets as per workplace policy. 5. Conflicts are resolved between team members in line with organization policy. 6. Gender related issues are identified and mainstreamed in accordance workplace policy. 7. Human rights and fundamental freedoms are identified and respected as Constitution of Kenya 2010. 8. Healthy relationships are developed and maintained in line with workplace. |
| 1. Plan and organize work | 1. Work plans are prepared based on activities and budget. 2. Assigned tasks are interpreted and expectations identified as per the workplace instructions. 3. Task occupational safety and health requirements are identified and observed regulations. 4. Work resources are identified, mobilized, allocated and utilized based on organization work plans. 5. Work activities are monitored and evaluated in line with work plans and workplace policy. 6. Work plans are reviewed based on target and available resources. |
| 1. Maintain professional growth and development | * 1. Personal training needs are identified and assessed in line with the requirements of the job.   2. ***Training and career opportunities*** are identified and utilized based on job requirements.   3. Resources for training are mobilized and allocated based organizations and individual skills needs.   4. Licensees and certifications relevant to job and career are obtained and renewed as per policy.   5. Work priorities and personal commitments are balanced and managed based on requirements of the job and personal objectives.   6. Recognitions are sought as proof of career advancement in line with professional requirements. |
| 1. Demonstrate workplace learning | * 1. Learning opportunities are sought and managed based on job requirement and organization policy.   2. Improvement in performance is demonstrated based on courses attended.   3. Application of learning is demonstrated in both technical and non-technical aspects based on requirements of the job   4. Time and effort is invested in learning new skills based on job requirements   5. Initiative is taken to create more effective and efficient processes and procedures in line with workplace policy.   6. New systems are developed and maintained in accordance with the requirements of the job.   7. Awareness of personal role in workplace ***innovation*** is demonstrated based on requirements of the job. |
| 1. Demonstrate problem solving skills | * 1. Creative, innovative and practical solutions are developed based on the problem   2. Independence and initiative in identifying and solving problems is demonstrated based on requirements of the job.   3. Team problems are solved as per the workplace guidelines   4. Problem solving strategies are applied as per the workplace guidelines   5. Problems are analyzed and assumptions tested as per the context of data and circumstances |
| 1. Manage ethical performance | * 1. Policies and guidelines are observed as per the workplace requirements   2. Self-worth and professionalism is exercised in line with personal goals and organizational policies   3. Code of conduct is observed as per the workplace requirements   4. Integrity is demonstrated as per legal requirement |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Drug and substance abuse may include but not limited to: | Commonly abused   * Alcohol * Tobacco * Miraa * Over-the-counter drugs * Cocaine * Bhang * Glue |
| 1. Feedback may include but not limited to: | * Verbal * Written * Informal * Formal |
| 1. Relationships may include but not limited to: | * Man/Woman * Trainer/trainee * Employee/employer * Client/service provider * Husband/wife * Boy/girl * Parent/child * Sibling relationships |
| 1. Forms of communication may include but not limited to: | * Written * Visual * Verbal * Non verbal * Formal and informal |
| 1. Team may include but not limited to: | * Small work group * Staff in a section/department * Inter-agency group |
| 1. Personal growth may include but not limited to: | * Growth in the job * Career mobility * Gains and exposure the job gives * Net workings * Benefits that accrue to the individual as a result of noteworthy performance |
| 1. Personal objectives may include but not limited to: | * Long term * Short term * Broad * Specific |
| 1. Trainings and career opportunities may includes but not limited to | * Participation in training programs * Serving as Resource Persons in conferences and workshops |
| 1. Resource may include may but not limited to: | * Human * Financial * Technology |
| 1. Innovation may include but not limited to: | * New ideas * Original ideas * Different ideas * Methods/procedures * Processes * New tools |
| 1. Emerging issues may include but not limited to: | * Terrorism * Social media * National cohesion * Open offices |
| 1. Range of media for learning may 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:

* Interpersonal
* Communication
* Critical thinking
* Organizational
* Negotiation
* Monitoring
* Evaluation
* Record keeping
* Problem solving
* Decision Making
* Resource utilization
* Resource mobilization

**Required Knowledge**

The individual needs to demonstrate knowledge of:

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

**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. Conducted self-management   2. Demonstrated interpersonal communication   3. Demonstrated critical safe work habits   4. Demonstrated the ability to lead a workplace team   5. Planned and organized work   6. Maintained professional growth and development   7. Demonstrated workplace learning   8. Demonstrated problem solving skills   9. Demonstrated the ability to manage performance ethically |
| 1. Resource Implications | The following resources should be provided:   1. Access to relevant workplace where assessment can take place 2. Appropriately simulated environment where assessment can take place |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   1. Observation 2. Oral questioning 3. Written test 4. Portfolio of Evidence 5. Interview 6. Third party report |
| 1. Context of Assessment | Competency may be assessed:   1. On-the-job 2. Off-the –job 3. During Industrial attachment |
| 1. Guidance information for assessment | | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# DEMONSTRATE ENVIRONMENTAL LITERACY

**UNIT CODE:** ENG/OS/ABT/BC/05/6/A

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***Bold and italicized terms are elaborated in the Range*** |
| 1. Control environmental hazard | 1. Storage methods for environmentally hazardous materials are strictly followed according to environmental regulations and OSHS. 2. Disposal methods of hazardous wastes are followed according to environmental regulations and OSHS. 3. ***PPE*** is used according to OSHS. |
| 1. Control environmental Pollution | * 1. Environmental pollution ***control measures*** are implemented in accordance with international protocols.   2. Procedures for solid waste management are observed according Environmental Management and Coordination Act 1999   3. Methods for minimizing noise pollution is complied with based on Noise and Excessive Vibration Pollution and Control Regulations, 2009 |
| 1. Demonstrate sustainable resource use | * 1. Methods for minimizing wastage are complied with based on organizational waste management guide   2. Waste management procedures are employed following principles of 3Rs (Reduce, Reuse, Recycle)   3. Methods for economizing and reducing resource consumption are practiced as per the Constitution of Kenya 2010 Article 69 . |
| 1. Evaluate current practices in relation to resource usage | * 1. Information on resource efficiency systems and procedures are collected and provided as per work groups/sector   2. Current resource usage is measured and recorded as per work group   3. Current purchasing strategies are analyzed and recorded according to industry procedures.   4. Current work processes to access information and data is analyzed following enterprise protocol. |
| 1. Identify environmental legislations/conventions for environmental concerns | 1. Environmental legislations/conventions and local ordinances are identified according to the different environmental aspects/impact 2. Industrial standard/environmental practices are described according to the different environmental concerns |
| 1. Implement specific environmental programs | 1. Programs/Activities are identified according to organizations policies and guidelines. 2. Individual roles/responsibilities are determined and performed based on the activities identified. 3. Problems/constraints encountered are resolved in accordance with organizations’ policies and guidelines 4. Stakeholders are consulted based on company guidelines |
| 1. Monitor activities on Environmental protection/Programs | 1. Activities are periodically monitored and Evaluated according to the objectives of the environmental program 2. Feedback from stakeholders are gathered and considered in Proposing enhancements to the program based on consultations 3. Data gathered are analyzed based on Evaluation requirements 4. Recommendations are submitted based on the findings 5. Management support systems are set/established to sustain and enhance the program 6. Environmental incidents are monitored and reported to 7. concerned/proper authorities |
| 1. Analyze resource use | 1. All resource consuming processes are Identified as per the organizational work plan 2. Quantity and nature of resource consumed is determined based on processes 3. Resource flow is analyzed as per different parts of the process. 4. Wastes are classified according to NEMA regulations on waste management. |
| 1. Develop resource Conservation plans | 9.1. Efficiency of use/conversion of resources is determined according to industry protocol.  9.2. Causes of low efficiency of use of resources are Determined based on industry protocol.  9.3. Plans for increasing the efficiency of resource use are developed based on findings. |

**RANGE**

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

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| **Variable** | **Range** |
| 1. PPE may include but not limited to | * + Mask   + Gloves   + Goggles   + Safety hat   + Overall * Hearing protector |
| 1. Control measures may include but 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 |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

* Measuring
* Recording
* Analytical
* Monitoring
* Communication
* Writing

**Required Knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   * 1. Controlled environmental hazard   2. Controlled environmental pollution   3. Demonstrated sustainable resource use   4. Evaluated current practices in relation to resource usage   5. Demonstrated knowledge of environmental legislations and local ordinances according to the different environmental issues /concerns.   6. Described industrial standard environmental practices according to the different environmental issues/concerns.   7. Resolved problems/ constraints encountered based on management standard procedures   8. Implemented and monitored environmental practices on a periodic basis as per company guidelines   9. Recommended solutions for the improvement of the program   10. Monitored and reported to proper authorities any environmental incidents |
| 1. Resource Implications | The following resources should be provided:   * 1. Workplace with storage facilities   2. Tools, materials and equipment relevant to the tasks (e.g. Cleaning tools, cleaning materials, trash bags)   3. PPE, manuals and references   4. Legislation, policies, procedures, protocols and local ordinances relating to environmental protection   5. Case studies/scenarios relating to environmental Protection |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   * 1. Observation   2. Oral questioning   3. Written test   4. Portfolio of Evidence   5. Interview   6. Third party report |
| 1. Context of Assessment | Competency may be assessed   1. On-the-job 2. Off-the –job 3. During Industrial attachment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# DEMONSTRATE OCCUPATIONAL SAFETY AND HEALTH PRACTICES

**UNIT CODE:** ENG/OS/ABT/BC/06/6/A

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***Bold and italicized terms are elaborated in the Range*** |
| 1. Identify workplace hazards and risk | 1.1 ***Hazards*** in the workplace are identified ***based their indicators***  1.2 Risks and hazards are evaluated based on legal requirements.  1.3 ***OSH concerns*** raised by workers are addressed as per legal requirements. |
| 1. Control OSH hazards | 2.1 Hazard prevention ***and control measures*** are implemented as per legal requirement.  2.2 Risk assessment is conductedand a risk matrix developed based on likely impact.  2.3 ***Contingency measures***, including ***emergency procedures*** during workplace ***incidents and emergencies*** are recognized and established in accordance with organization procedures. |
| 1. Implement OSH programs | 3.1 Company OSH program are identified, evaluated and reviewed based on legal requirements.  3.2 Company OSH programs are implemented as per legal requirements.  3.3 Workers are capacity built on OSH standards and procedures as per legal requirements  3.4 ***OSH-related records*** are maintained as per legal requirements. |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Hazards may include but not limited to: | * Physical hazards – impact, illumination, pressure, noise, * vibration, extreme temperature, radiation * Biological hazards- bacteria, viruses, plants, parasites, mites, molds, fungi, insects * Chemical hazards – dusts, fibers, mists, fumes, smoke, gasses, vapors * Ergonomics * Psychological factors – over exertion/ excessive force,   awkward/static positions, fatigue, direct pressure,   * varying metabolic cycles * Physiological factors – monotony, personal relationship, work out cycle * Safety hazards (unsafe workplace condition) –confined space, excavations, falling objects, gas leaks, electrical, poor storage of materials and waste, spillage, waste and debris * Unsafe workers’ act (Smoking in off-limited areas, Substance and alcohol abuse at work) |
| 1. Indicators may include but 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 |
| 1. OSH concerns may include but 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 |
| 1. Safety gears /PPE (Personal Protective Equipment) may include but 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 |
| 1. Appropriate risk controls   may include but 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., wear * gloves and goggles when using the machine) |
| 1. Contingency measures may include but not limited to: | * Evacuation * Isolation * Decontamination * (Calling designed) emergency personnel |
| 1. Incidents and emergencies may include but not limited to: | * Chemical spills * Equipment/vehicle accidents * Explosion * Fire * Gas leak * Injury to personnel * Structural collapse * Toxic and/or flammable vapors emission. |
| 1. OSH-related Records may include but 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:

* Communication
* Interpersonal
* Presentation
* Risk assessment
* Evaluation
* Critical thinking
* Problem solving
* Negotiation

**Required Knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   1. Identified hazards in the workplace based their indicators 2. Evaluated workplace hazards based on legal requirements. 3. Addressed OSH concerns raised by workers as per legal requirements. 4. Implemented hazard prevention and control measures as per legal requirement. 5. Conducted risk assessment as per legal requirement. 6. Developed risk matrix based on likely impact. 7. Recognized and established contingency measures in accordance with organization procedures. 8. Identified, evaluated and reviewed company OSH program based on legal requirements. 9. Implemented company OSH programs as per legal requirements. 10. Capacity built workers on OSH standards and procedures as per legal requirements 11. Maintained OSH-related records as per legal requirements. |
| 1. Resource Implications | The following resources should be provided:   1. Access to relevant workplace where assessment can take place 2. Appropriately simulated environment where assessment can take place |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   1. Observation 2. Oral questioning 3. Written test 4. Portfolio of Evidence 5. Interview 6. Third party report |
| 1. Context of Assessment | Competency may be assessed:   1. On-the-job 2. Off-the –job 3. During Industrial attachment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

**COMMON UNITS OF COMPETENCY**

## APPLY ENGINEERING MATHEMATICS

**UNIT CODE: ENG/OS/ABT /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.

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| --- | --- |
| **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. Calculations involving Indices are performed as per the concept 2. Calculations involving Logarithms are performed as per the concept 3. Scientific calculator is used in solving mathematical problems in line with manufacturer’s manual 4. Simultaneous equations are performed as per the rules 5. Quadratic equations are calculated as per the concept 6. Arithmetic and geometric progression problems are solved |
| * 1. Apply Trigonometry and hyperbolic functions | 1. Calculations are performed using trigonometric rules 2. Calculations are performed using ***hyperbolic functions*** |
| * 1. Apply complex numbers | * 1. Complex numbers are represented using Argand diagrams   2. Operations involving complex numbers are performed   3. Calculations involving complex numbers are performed using De Moivre’s theorem |
| 1. Apply Coordinate Geometry | * 1. Polar equations are calculated using coordinate geometry   2. Graphs of given polar equations are drawn using the Cartesian plane   3. Normal and tangents are determined using coordinate geometry   4. Loci of points are determined for given mechanism |
| 1. Carry out Binomial Expansion | * 1. Roots of numbers are determined using binomial theorem   2. Errors of small changes are determined using binomial theorem   3. Power series are derived through Binomial expansion |
| 1. Apply Calculus | * 1. Derivatives of functions are determined using Differentiation   2. Derivatives of hyperbolic functions are determined using Differentiation   3. Derivatives of inverse trigonometric functions are determined using Differentiation   4. Rate of change and small change are determined using Differentiation.   5. Calculation involving stationery points of functions of two variables are performed using differentiation.   6. Integrals of algebraic functions are determined using integration   7. Integrals of trigonometric functions are determined using integration   8. Integrals of logarithmic functions are determined using integration   9. Integrals of hyperbolic and inverse functions are determined using integration |
| 1. Solve Ordinary differential equations | * 1. First order and second order differential equations are formed.   2. First order and second order differential equations are solved using the method of undetermined coefficients   3. First order and second order differential equations are solved from given boundary conditions |
| 1. Apply Laplace transforms | * 1. Laplace transforms are solved using initial and final value theorems   2. Inverse Laplace transforms are solved using partial fractions   3. Differential equations are solved using Laplace transforms |
| 1. Apply Power Series | * 1. Power series are obtained using Taylor’s Theorem   2. Power series are obtained using Maclaurin’s theorem |
| 1. Apply Statistics | 1. Identification, Collection and Organization of data is performed 2. Interpretation, analysis and presentation of data in appropriate format is performed 3. Mean, median, mode and Standard deviation are obtained from given data |
| 1. Apply Fourier Series | * 1. Fourier series coefficients are obtained using Fourier series techniques   2. Fourier series for 2π to T is are obtained using Fourier series techniques   3. Fourier series for odd and even functions are obtained using Fourier series techniques   4. Harmonic analysis is performed using numerical methods |
| 12.Apply Vector theory | * 1. Calculations involving vector algebra, dot and cross products using vector theory   2. Gradient, Divergence and Curl are obtained   3. Vector calculations are performed using Green’s theorem   4. Vector calculations are performed using Stoke’s theorem   5. Conservative vector fields and line and surface integrals are obtained using Gauss’s theorem |
| 1. Apply Matrix | * 1. Determinant and inverse of 3x3 matrix are obtained   2. Solutions of simultaneous equations are obtained   3. Calculation involving Eigen values and Eigen vectors are performed |
| 1. Apply Numerical methods | * 1. Roots of polynomials are obtained using iterative numerical methods   2. Interpolation and extrapolation are performed using numerical methods |
| 1. Apply concepts of probability for work | * 1. Calculations are performed based on Laws of probability   2. Calculation involving probability distributions, mathematical expectation sampling distributions are performed   3. Probability events are determined from dependent, independent and mutually exclusive   4. Counting is done using permutation, combination, tree diagrams and Venn diagrams techniques |
| 1. Perform commercial calculations | * 1. Exchange rate calculations are done using devaluation and revaluation   2. Sales, stock turnover and profit and loss are determined   3. Incomes, salaries and wages are calculated |
| 1. Perform estimations, measurements and calculations of quantities | * 1. Measurement information in workplace is extracted and interpreted   2. Appropriate workplace measuring tools and equipment are identified and selected   3. Conversions are performed between units of measurement   4. Measurements are estimated and taken   5. Length, width, height, perimeter, area and angles of ***figures*** are calculated   6. Volume and surface area of figures are calculated   7. Information is recorded using mathematical language and symbols appropriate for the task |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Hyperbolic functions may include but not limited to: | * + Sinh x   + Cosh x   + Cosec x   + Coth x   + Tanh x   + Sech x |
| 1. Figures may include but not limited to: | * + Triangles   + Squares   + Rectangles   + Circles   + Spheres   + Cylinders   + Cubes   + Polygons   + Cuboids   + Pyramids |
| 1. Quantities may include 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. Applied Trigonometry and hyperbolic functions   2. Applied complex numbers   3. Determined angles and length in triangles   4. Applied Calculus   5. Solved Ordinary differential equations   6. Applied Laplace transforms   7. Applied Power Series   8. Applied Fourier Series   9. Applied Vector theory   10. Applied Matrix   1.11 Identified and selected measuring equipment  1.12 Collected, Analyzed and presented data  1.13 Applied Numerical methods |
| 1. Resource Implications | The following resources should be provided:   1. Access to relevant workplace where assessment can take place 2. Appropriately simulated environment where assessment can take place |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   * 1. Direct Observation   2. Demonstration with Oral Questioning   3. Written tests |
| 1. Context of Assessment | Competency may be assessed   1. Off the job 2. on the job 3. During industrial attachment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

**APPLY ENGINEERING MECHANICS PRINCIPLES**

**UNIT CODE: ENG/OS/ABT/CC/02/6/A**

**Unit Description**

This unit describes the competencies required by a technician in order to apply engineering mechanics principles in their work. It includes determining forces in a system, determining effects of loads in mechanical systems, analysing mechanical properties of materials, determining nature of friction in mechanical systems, solving problems related to motion, solving mechanical problems relating to simple machines and performing rotor dynamic machines.

**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. Determine forces in a system | * 1. Forces are explained according to prescribed mechanical principles   2. Theorems are stated and explained according to prescribed guidelines   3. Resultant of coplanar forces is determined |
| 1. Determine effects of loads in mechanical systems | * 1. Types of forces are identified according to specified procedures   2. Equilibrium of forces on a plane framework is calculated according to specified procedures   3. Calculations involving point loads are performed according to specified procedures   4. Principle of moments is stated as per reference |
| 1. Analyse mechanical properties of materials | 1. Type of materials are identified as per prescribed procedures 2. ***Physical properties*** of engineering material are determined according material specifications 3. ***Mechanical properties*** of engineering materials are identified according to material specifications 4. Mechanical properties of materials are tested as per specified procedure 5. Direct, shear and torsion stresses are calculated as per specified procedure |
| 1. Determine nature of friction in mechanical systems | * 1. Friction is explained according to prescribed mechanical principles   2. Laws of friction are stated according to prescribed guidelines   3. Effects of friction are identified from experiments according to specified procedures   4. Calculations involving frictional forces are performed according to specified procedure |
| 1. Solve problems related to motion | * 1. Laws of motion are stated according to prescribed guidelines   2. Calculations involving parameters of motion performed according to specified procedures   3. Motion graphs are drawn according to prescribed guidelines |
| 1. Solve mechanical problems relating to simple machines | * 1. ***Simple machines*** are explained according to prescribed mechanical principles   2. Simple machines are described from design according to prescribed guidelines   3. Machine performance indicators are determined according to prescribed guidelines |
| 1. Perform rotor dynamic machines | * 1. Rotating machines are classified according to their rotor dynamics   2. Coordinate systems are defined as per the rotor mechanism   3. Gyroscopic couples are determined according to the angular moments of the system   4. Vibrations of linear and nonlinear dynamical systems are analysed and determined as per the different methods/laws and principles   5. System responses are determined as per the analysis of the mechanism |

**RANGE**

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

| **Variable** | **Range** |
| --- | --- |
| 1. Physical properties | * Density * Colour * Texture * Melting point * Thermal conductivity * Electrical resistivity |
| 1. Mechanical properties | * Ductility * Malleability * Elasticity * Toughness * Hardness * Brittleness * Plasticity * Strength |
| 1. Simple machines | * Pulley * Wedge * Inclined plane * Wheel and axle |

**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
* 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
* Calculation of moments
* Mechanical advantage and efficiency calculations
* SI units of mechanical energy.
* Power transmission systems
* Operation of mechanical machines
* Mechanical calculation of power, energy, work done, torque and safety factor
* Units of measurement, conversions and abbreviations
* Equations of motion
* Drawing graphs

**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. Resolved forces 2. Determined effects of loads in automotive systems 3. Analyzed mechanical properties of materials 4. Determined nature of friction in automotive systems 5. Solved problems related to motion 6. Solved mechanical problems relating to simple machines 7. Performed compressed air cycles 8. Performed rotor dynamic machines |
| 1. Resource implications | The following resources should be provided:   1. Access to relevant workplace where assessment can take place 2. Appropriately simulated environment where assessment can take place |
| 1. Methods of assessment | Competency in this unit may be assessed through:   1. Written examination 2. Observations 3. Oral presentation |
| 1. Context of assessment | Competency may be assessed   1. Off the job 2. On the job 3. During industrial attachment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

**APPLY WORKSHOP TECHNOLOGY PRINCIPLES**

**UNIT CODE: ENG/OS/ABT/CC/03/6/A**

**Unit Description**

This unit describes the competencies required by a technician in order to apply a wide range of workshop processes and practice skills in their work. It involves using technical drawing to plan work operations, choosing appropriate tools and materials, measuring and marking-out dimensions on work pieces, using hand tools to cut and file part, using drills to make holes, thread using taps and dies, producing components using a lathe machine, a milling machine and a grinding machine, demonstrate material workshop processes, assembling metal parts and sub-assemblies, polishing finished work and performing 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. Technical drawings and geometric symbols are read and interpreted as per ***drawing standards***   2. ***Operation plan*** is produced as per the technical drawings   3. Technical drawings are produced as per drawing Standards |
| 1. Choose appropriate tools and materials | 1. Working tools and equipment materials are selected for the task as per workplace requirements 2. Work areas are organized for the task to be done as per workshop policy 3. Work areas are tidied up as per organization policy |
| 1. Measure and mark-out dimensions on work pieces | * 1. ***Measuring tools*** suitable for the work are selected according to task description   2. Measuring tools are inspected and calibrated as per requirements   3. Dimensions are marked on the work piece as per the working drawing |
| 1. Use hand tools to cut and file parts | 1. Hand tools are selected based on operation plan 2. Work piece is cut to specification based on job requirement 3. Work piece is filed to specification based on job requirement 4. Part are produced to specifications based on work requirement |
| 1. Use drills to make holes | * 1. Hole centers are marked and center-punched as per operation plan   2. Drill bits are selected and mounted according to work requirements   3. Work piece is mounted and clamped according to workshop regulations   4. Hole is drilled to specification according to work requirements   5. Hole is inspected to specification according to work requirements |
| 1. Thread using taps and dies | * 1. Taps and dies are selected based on operation plan   2. Taps and dies are set up on the work piece according to work specifications   3. Work piece is clamped according to work requirements   4. ***Threads*** are cut according to work specifications |
| 1. Produce components using a lathe machine | * 1. Work piece is faced according to work specifications   2. Work pieces are turned according to work requirements   3. Work piece is threaded according to work requirements   4. Work piece is drilled according to work requirements   5. Work piece is mounted on a four-jaw chuck   6. Work piece is turned to produce an eccentric part as specified in the requirements   7. Work piece is within specified tolerance requirements   8. Work piece is bored according to work requirements |
| 1. Produce components using a milling machine | * 1. Machine table and head stock are set perpendicularly true to each other   2. Work piece is faced according to work specifications- Work piece is milled according to work requirements   3. Work piece is threaded according to work requirements   4. Work piece is drilled / bored according to work requirements   5. Work piece is within specified tolerance requirements |
| 1. Produce components using a grinding machine | * 1. Work piece is mounted according to work requirements   2. Work piece is finished according to work specifications   3. Work piece is inspected within specified tolerance requirements |
| 1. Demonstrate material workshop processes | * 1. Fitting is carried out as per the production requirement   2. Sheet metal work is performed according to material properties   3. Beaten metal work is performed according to workplace procedures   4. Casting process is performed according to manufacturer’s requirements   5. Welding (arc, TIG, MIG, brazing, soldering) is performed according to production requirement   6. Forging is carried out in accordance to material properties   7. Drawing is done according to work requirements   8. Riveting is operated in accordance to work place procedure   9. Polymer adhesives are maintained according to manufacturer specifications |
| 1. Assemble metal parts and sub-assemblies | * 1. ***Joining and assembly method*** is selected according to work requirements   2. Parts joined, fitted and assembled according to the specified assembly and joinery methods   3. Final assembly is inspected as per work piece specification |
| 1. Polish finished work | * 1. Polishing materials are selected according to work requirements   2. Finished work is cleaned according to work requirements   3. Work is polished specified according to work requirement |
| 1. Perform housekeeping | * 1. Work area is cleaned and organized as per the workplace requirements   2. Waste is separated and disposed as per disposal guidelines   3. Carried out housekeeping as per 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.

| **Variable** | **Range** |
| --- | --- |
| 1. Drawing Standards may include but not limited to: | * ISO * BS * ANSI |
| 1. Operation Plan may include but not limited to: | * Sequence of operations * Measuring tools * Hand tools * Cutting tools * Inspection tools |
| 1. Measuring tools may include but not limited to: | * Steel rule * Vernier caliper * Micrometer screw gauge * Vernier height gauge * Combination set * Bevels |
| 1. Threads may include but not limited to: | * Internal and external threads * V-profile threads |
| 1. Joining and assembly method may include but not limited to: | * Riveting * Fastening * Soldering * Brazing * Welding |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

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

**Required Skills**

The individual needs to demonstrate the following skills:

* + - 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:

* Drawing standards
* Layout planning
* Technical drawing
* Tool room
* Safety
* Hand tools application
* Calibration
* Marking
* Power tools application
* Drilling
* Safety
* Hand tools safety
* Threading
* Hand tools safety
* Threading
* Safety
* Lathe turning
* Safety
* Assembly
* Safety
* Polishing
* House keeping
* Safety
* Waste disposal

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical aspects of competency | Assessment requires evidence that the candidate:   * 1. Observed rules and procedures in the workshop   2. Interpreted technical drawing   3. Produced operation plan   4. Produced holes on a work piece   5. Threaded using taps and dies   6. Assembled metal parts   7. Surface finished work piece   8. Maintained tools and equipment   9. Performed work holding processes   10. Performed welding   11. Carried out metal handling processes   12. Carried out beaten metal work   13. Did housekeeping before, during and after operations |
| 1. Resource implications | The following resources should be provided:   1. Access to relevant workplace where assessment can take place 2. Appropriately simulated environment where assessment can take place |
| 1. Methods of assessment | Competency may be assessed through:   * 1. Oral presentations   2. Written assessments   3. Inspection of written operation procedures   4. Inspection of finished product   5. Observing housekeeping of the work area and/or machine tool |
| 1. Context of assessment | Competency may be assessed   1. Off the job 2. On the job 3. During industrial attachment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

**PERFORM COMPUTER AIDED DRAWING**

**UNIT CODE:** ENG/OS/ABT/CC/04/6/A

**Unit Description**

This unit covers the competencies required to perform Computer Aided Drawing. It involves establishing drawing requirements, identifying key features of Computer-Aided Design (CAD) software, navigating CAD software, producing geometric drawings, producing pictorial drawings of components, producing orthographic drawings of top, font and side views, producing assembly drawings, finalising CAD operations, applying the computer aided drawings in computer aided design, designing a mechanical system using CAD and interpreting the engineering drawings.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements  ***(Bold and italicized terms are elaborated in the Range)*** |
| --- | --- |
| 1. Establish drawing requirements | 1. Information on requirements of the drawing are collected according to customer specification 2. ***Specific drawing outcomes*** are derived according to customer requirement 3. Computing equipment and software are identified according to task requirement 4. Work flow procedure is identified according to SOPs 5. Drawing equipment are identified according to task requirements 6. Drawing materials are gathered according to task requirements 7. Drawing equipment are used as per manufacturer’s instructions 8. Drawing equipment are maintained as per manufacturer’s instructions |
| 1. Identify key features of CAD software | * 1. ***CAD software*** used for detailed drawing are described as per SOPs   2. Differences in CAD process used to generate 2D and 3D models are described according to software functionality   3. ***Multiple views*** generated in CAD drawing models are described according to software functionality |
| 1. Navigate CAD software | * 1. Software templates are identified as per drawing requirement   2. Files are imported into the working space as per drawing requirements   3. Symbols, codes and standards to be applied are identified according to software functionality   4. ***Drawing elements*** are used to draw according to customer specification.   5. ***Editing tools*** are used to manipulate drawing according to customer specification   6. Different views are generated as software functionality |
| 1. Produce geometric drawings | * 1. ***Different types of lines*** used in drawing and their meanings are identified according to standard drawing conventions   2. ***Different types of geometric forms*** are constructed according to standard drawing conventions   3. ***Different types of angles*** are constructed according to principles of trigonometry   4. Different types of angles are applied using appropriate measuring tools   5. ***Geometric drawings*** are developed in accordance with standard conventions |
| 1. Produce pictorial drawings of components | * 1. Symbols are applied in drawings according to standard drawing conventions.   2. Abbreviations are applied in drawings according to standard drawing conventions.   3. Index is developed indicating meanings of symbols and abbreviations used according to standard drawing conventions. |
| 1. Produce orthographic drawings of top, front and side views | * 1. Freehand sketching of geometric forms in orthographic view is developed according to orthographic drawings rules   2. First angle orthographic drawings of components and parts is developed in accordance with the standard conventions of orthographic drawings   3. Third angle orthographic drawings of components and parts is developed in accordance with the standard conventions of orthographic drawings |
| 1. Produce assembly drawings | * 1. Orthographic views are exploded according to standard conventions of orthographic drawings   2. Pictorial views are exploded according to standard conventions of pictorial drawings   3. Sectional views are produced according to standard conventions of drawing   4. Part list is developed according to drawing schematic |
| 1. Finalize CAD operations | * 1. Drawing files are saved in appropriate format according to organizational procedures   2. Drawing Files are exported out of working space for further processing as per organizational procedure   3. Drawings are printed according to organizational procedures   4. Drawings are evaluated according to organizational procedures   5. Improvements to the drawings are suggested according to customer requirement |
| 1. Apply computer aided drawing in computer aided design | * 1. Photo simulations are created according to environmental preparation requirements   2. Potential blockage is analysed through the use of CAD   3. Drawings are used to visualize manufacturing process before implementing it. |
| 1. Design a mechanical system using CAD | * 1. Computer aided engineering (CAE) is used to manufacturing design   2. Improvements to the reduced wastage and accurate analysis results is determine according to manufacturing design   3. Manufacturing database is created according to manufacturing process   4. Improvements of designed documentation is achieved according to the manufacturing design |
| 1. Interpret engineering drawings | * 1. Drawing projections is identified as per the working drawing   2. The scale of drawing is determined to familiarize with as the drawing   3. The basic symbols used are identified as per the drawing   4. Circled numbers are identified as per the working drawing   5. Abbreviations are identified as per the drawing |

**RANGE**

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

| **Variable** | **Range** |
| --- | --- |
| 1. Specific drawing outcomes may include but not limited to: | * 2D modelling * 3D modelling * Drawings for specific engineering applications * Orthographic projections * Isometric drawing * Perspectives * Schematics |
| 1. CAD software may include but not limited to: | * AutoCAD * Inventor * Revit * SOLIDWORKS * ProSteel * X Steel |
| 1. Multiple views may include but not limited to: | * Top view * Front view * Side view |
| 1. Drawing elements may include but not limited to: | * Points * Line angles * Circles and arcs * Planes (horizontal, vertical) * Figures and solids * Shapes |
| 1. Editing tools may include but not limited to: | * Delete, undo and redo commands * Fillet and chamfer commands * Trim, extend and break commands * Zoom and pan commands * Move, copy, and paste commands * Rotate and mirror commands * Object snapping and grouping commands * Dimension and scaling commands |
| 1. Different types of lines may include but not limited to: | * Continuous * Broken * Chain * Freehand * Zigzag |
| 1. Different types of geometric forms may include but not limited to: | * Circle * Rectangle * Triangle * Polygon |
| 1. Different types of angles may include but not limited to: | * Acute * Obtuse * Right |
| 1. Geometric drawings may include but not limited to: | * 2-Dimensional * 3-Dimensional * Orthographic * Isometric |
|  |  |

**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
* Numerical skills
* Technical drawing skills
* Freehand sketching
* Image interpretation
* Use of drawing equipment
* Drawing synthesis
* Communication
* Computer skills
* Software navigation (manipulate drawing entities, modify dimension styles, create and use layers, manipulate the drawing origin, define and utilize symbol libraries, etc.)

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Organizational policies and procedures relevant to creating CAD drawings
* Various CAD programs their capabilities, functions and processes
* Drawing outcomes (orthographic, isometric, perspective,2D, 3D)
* Drawing elements (points, line angles, circles, arcs, planes, solids and figures, dimensions and hatchings shapes, etc.)
* Drawing equipment and materials
* Technical drawing (solid modeling, developing sectioned models, etc.)
* Geometric constructions
* Measurement and scaling
* Engineering calculations (clearance and tolerance)
* Engineering drawing symbols
* Awareness of copyright and intellectual property issues and legislation in relation to drawing

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical aspects of Competency | Assessment requires evidence that the candidate:   1. Applied and adhered to safety procedures 2. Cared and maintained drawing equipment 3. Set up drawing equipment 4. Interpreted circuit, assembly and lay out diagrams 5. Identified key features of CAD Software 6. Navigated CAD software 7. Produced geometric drawings 8. Produced pictorial drawings of components 9. Produced orthographic drawings of components 10. Produced assembly drawings 11. Finalized CAD operations 12. Applied Computer Aided Drawing in CAD 13. Interpreted engineering drawings |
| 1. Resource Implications | The following resources should be provided:   1. Access to relevant workplace where assessment can take place 2. Appropriately simulated environment where assessment can take place |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   1. Practical assessments 2. Observation 3. Supervisor report 4. Written examinations 5. Oral presentation |
| 1. Context of Assessment | Competency may be assessed   1. Off the job 2. On the job 3. During industrial attachment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

**APPLY THERMODYNAMICS PRINCIPLES**

**UNIT CODE: ENG/OS/ABT/CC/05/6/A**

**Unit Description**

This unit describes the competencies required by a technician in order to apply thermodynamics principles in their work. It involves interpreting fundamentals of thermodynamics, performing steady and non-steady flow processes, understanding gas law and steam cycle, performing thermodynamics reversibility and entropy, analysing ideal gas cycle, demonstrating understanding of fuel and combustion, performing heat transfer, using heat exchangers in fluid temperature control, safely operating air compressors, assessing stability and operation of gas turbine combustion systems, describing steam turbines, applying heating and cooling system, applying negative temperature coefficient (NTC), applying thermistors on temperature measurements and applying heat sinks on semiconductors.

**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. Interpret fundamentals of thermodynamics | 1. ***Thermodynamics terms*** are described 2. ***Thermodynamics processes and cycles*** are described 3. First law of thermodynamics is applied |
| 1. Perform steady flow processes | 1. Steady flow energy equation is derived 2. Steady flow energy equation is applied in problem solving 3. Steady flow energy equation is applied in ***utilities*** |
| 1. Perform non steady flow processes | 1. Non-flow energy equation is derived 2. Non-flow energy equation is applied in problem solving |
| 1. Understand gas laws | 1. ***Perfect gas laws*** are stated 2. Gas laws experiments are carried out 3. Gas laws are applied |
| 1. Understand steam cycle | 1. Dryness fraction is determined 2. Relationship between pressure and boiling point is determined 3. Energy balance is carried out 4. Relationship between temperature and pressure is determined |
| 1. Perform thermodynamics reversibility and entropy | 1. Thermodynamics reversibility is explained 2. ***Principles of heat engine*** are explained 3. Second law of thermodynamics is applied 4. Entropy is explained in thermodynamics cycle |
| 1. Analyse ideal gas cycle | 1. Ideal gas cycle processes are explained 2. Air standard efficiency and actual efficiency are differentiated 3. Ideal gas cycle problems are solved |
| 1. Demonstrate understanding of fuel and combustion | 1. ***Fuels a***re classified 2. Properties of fuels are described 3. Combustion equation are derived 4. Combustion equation is applied to combustion and exhaust gas problems |
| 1. Perform heat transfer | 1. Conduction equation is derived and applied from Fourier’s law 2. Heat transfer equation is derived and applied from Newton’s law of cooling and Fourier’s law |
| 1. Use heat exchangers in fluid temperature control | 1. ***Heat exchangers*** are classified 2. Recuperative heat exchangers are described 3. Heat equations are applied to solve heat exchanger problems |
| 1. Operate air compressors | 1. Air compressors are classified 2. ***Types of air compressors*** are described 3. Equations of reciprocating compressors are derived and applied |
| 1. Assess stability and operation of gas turbine combustion systems | 1. Theoretical cycle for gas turbines is explained 2. Open cycle gas turbine is described 3. Closed cycle gas turbine is described 4. Gas turbine equations are derived and applied |
| 1. Describe steam turbines | 1. The impulse steam turbines ***principles of operations*** are described 2. The reaction steam turbines principles of operations are described 3. Impulse steam turbine equation is derived and applied |
| 1. Apply heating and cooling system | * 1. Heat pump are installed according to manufacture manual   2. Air conditioning or refrigeration are constructed and installed according to energy demand   3. Ventilation is constructed according to health demand |
| 1. Apply negative temperature coefficient (NTC) | * 1. Thermistors are classified depending on the temperature of the system   2. NTC thermistors are installed as an inrush current limiter   3. NTC thermistors are applied to the system   4. Thermistors are applied according to their function |
| 1. Apply thermistors on temperature measurements | * 1. Operation of thermistor is determined   2. Resistance is determined depending on the type of material used in the thermistor   3. Graph of relationship between temperature and resistance is drawn   4. The location of the line and how much it changes, is determined according to thermistor construction   5. Change in resistance is converted into measurable data |
| 1. Apply sinks on semiconductors | * 1. Heat sinks is attached to semiconductor   2. Heat sink is calculated using junction-to-ambient thermal resistance   3. Heat sinks of thermal resistance is selected   4. Thermal resistance value obtained is used to design heat sinks   5. Application of heat sinks is determined |

**RANGE**

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

| **Variable** | **Range** |
| --- | --- |
| 1. Terms used in thermodynamics may include but not limited to: | * Chemical energy * Electric energy * Energy * Enthalpy * Entropy * Heat * Internal energy * Kinetic energy * Nuclear energy * Potential energy * Property * Specific Heat * Temperature * Work |
| 1. Thermodynamics processes may include but not limited to: | * Isothermal process * Isobaric process * Isochoric process * Reversible process * Adiabatic process |
| 1. Thermodynamics cycles may include but not limited to: | * Ideal cycle * Carnot cycle * Sterling cycle * Rankine cycle |
| 1. Utilities may include but not limited to: | * Boiler * Turbine (engine) * Compressor (or pump) * Throttling process * Nozzle * Condenser |
| 1. Perfect gas laws may include but not limited to: | * Boyle's law * Charles's law * Gay-Lussac's law * Avogadro's law |
| 1. Principles of heat engines may include but not limited to: | * thermal power station * internal combustion engine * steam locomotive |
| 1. Fuels may include but not limited to: | * Solid fuel * Liquid fuel * Fuel gas * Biofuel * Fossil fuel |
| 1. Heat exchangers may include but not limited to: | * Parallel-flow and counter-flow heat exchanger * Finned and Un-finned tubular heat exchanger * U-tube, single pass straight and two pass straight heat exchanger * Plate-and-frame heat exchanger * Pate-fin heat exchanger. * Micro channel heat exchanger |
| 1. Types of air compressors may include but not limited to: | * Reciprocating * Rotary screw * Sliding valves * Centrifugal |
| 1. Principles of operations may include but not limited to: | * Newton’s laws of motion * Law of conservation of linear momentum * Law of conservation of energy * Archimedes’ principle |

**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

* Problem solving
* Communication skills
* Application of basic mechanical formulas
* Use of basic mechanical machines
* Perform various unit conversions of mechanical quantities
* Basic mechanical systems design
* Mechanical machine operation
* Logical thinking
* Applying statistics
* Drawing graphs
* Using different measuring tools
* Computer literacy
* Use of mathematical tables

**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. Demonstrated understanding of laws of thermodynamics 2. Applied steady flow and non-flow equations 3. Demonstrated understanding of perfect gas laws 4. Demonstrated understanding of dryness fraction 5. Demonstrated understanding of principles of heat engines 6. Demonstrated understanding of ideal gas cycle processes 7. Applied heat equations in heat exchangers 8. Applied heat transfer equation 9. Applied combustion equations 10. Applied gas turbine equations 11. Applied steam turbine equations 12. Applied equation of reciprocating compressors 13. Applied cooling system 14. Applied temperature coefficient |
| 1. Resource Implications | The following resources should be provided:   1. Learning charts 2. Projector 3. White board and marker 4. Steam tables |
| 1. Methods of Assessment | The following resources should be provided:   1. Access to relevant workplace where assessment can take place 2. Appropriately simulated environment where assessment can take place |
| 1. Context of Assessment | Competency may be assessed   1. Off the job 2. On the job 3. During industrial attachment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

**APPLY FLUID MECHANICS PRINCIPLES**

**UNIT CODE:** ENG/OS/ABT/CC/06/6/A

**Unit Description**

This unit describes the competencies required by a technician in order to apply a wide range of fluid mechanics principles in their work. It involves analysing the basic concepts of fluid mechanics, 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. Analyse basic concepts of fluid mechanics | 1. Flow rate in pipes is measured based on the recommended techniques 2. ***Losses in pipes*** are determined according to the prescribed methods 3. ***Causes of losses*** in pipes are determined according specified procedures 4. ***Flow losses equations*** are applied in problem solving according to manufacturer’s specified procedures |
| 1. Demonstrate knowledge in viscous flow | 1. Viscous flow between parallel surfaces are described according to the theoretical specifications 2. ***Viscous flow equations*** between parallel surfaces are derived and applied according to the theoretical specifications 3. Viscous flow equations in circular pipes are derived and applied in problem solving based on theoretical formulas |
| 1. Perform dimensional analysis | 1. Dimensional analysis is explained according to the theoretical specifications 2. Principle of dimensional homogeneity is explained according to the theoretical specifications 3. ***Fundamental dimensions*** are stated according to the theoretical specifications 4. ***Dimensional units*** are defined according to the theoretical specifications 5. Dimensional analysis is applied in problem solving based on the theoretical formulas |
| 1. Operate Fluid pumps | * 1. Principle of operation of ***pumps*** is described according to the theoretical specification   2. Reciprocating pump equation is derived according to the theoretical specifications   3. Centrifugal pump equation is derived according to the theoretical specifications   4. ***Pump equations*** are applied in problem solving based on the recommended theoretical formulas |

**RANGE**

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

| **Variable** | **Range** |
| --- | --- |
| 1. Losses in pipes include but not limited to: | * Major head loss * Minor head loss |
| 1. Causes of losses in pipes include but not limited to: | * Friction * Effects of viscosity * Movement of fluid molecules against each other * Turbulence * Change of section * Valve losses * Bends or other interruption |
| 1. Flow losses equations include but not limited to: | * Bernoulli equation * Darcy-Weisbach equation * Energy equation |
| 1. Viscous flow equation includes but not limited to: | * Hagen–Poiseuille equation * Navier–Stokes equation * Couette flow equation |
| 1. Fundamental dimension includes but not limited to: | * Mass * Length * Time * Temperature |
| 1. Dimensional units include but not limited to: | * Meters, m * Kilogram, kg * Second, s * Kelvin, K |
| 1. Pumps include but not limited to: | * Reciprocating pump * Centrifugal pump |
| 1. Pumps equations include but not limited to: | * Reciprocating pump equations * Centrifugal pump equations |

**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:

* Problem solving
* Creativity and innovation
* Use of tools and equipment
* Technical presentation
* Communication skills

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Meaning of mechanics
* Role of mechanics in science
* Application of fluids in mechanical transmission
* Types of fluids used in mechanical system
* Energy laws
* Calculation of fluid pressure and flow rate
* Gas laws
* SI units of mechanical energy
* Parameters of fluid system

**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. Understood the basic concepts of fluid mechanics   2. Demonstrated knowledge in viscous flow   3. Performed dimensional analysis   4. Operated fluid pumps |
| 1. Resource implications | The following resources should be provided:   1. Access to relevant workplace where assessment can take place 2. Appropriately simulated environment where assessment can take place |
| 1. Methods of assessment | Competency in this unit may be assessed through:   1. Practical demonstration 2. Written reports 3. Oral presentation 4. Observation 5. Case studies 6. Written examination |
| 1. Context of assessment | Competency may be assessed   1. Off the job 2. On the job 3. During industrial attachment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

**APPLY MATERIAL SCIENCE PRINCIPLES**

**UNIT CODE:** ENG/OS/ABT/CC/07/6/A

**Unit Description**

This unit describes the competencies required by a technician in order to apply material science principles. It involves analysing engineering materials properties, applying of material science to engineering, performing heat treatment, performing material testing and preventing material corrosion.

**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 engineering materials’ properties | 1. ***Engineering material types are*** identified as per prescribed procedures 2. ***Physical properties*** of engineering material are determined according to material specifications 3. ***Mechanical properties*** of engineering materials are identified according to material specifications 4. Crystal structures of materials and their characteristics are analyzed according to material specifications |
| 1. Apply material science to engineering | 1. Engineering materials are identified and selected according to production requirements 2. Operation plan is developed according to engineering drawing 3. Appropriate machine is set up according to manufacturer manual 4. Production parameters are set according to production requirement 5. Production is performed according to work requirements |
| 1. Perform heat treatment | 1. Safety practices are observed according to OSHA 2007 2. ***Heat treatment processes*** are identified according to material specifications 3. Heat treatment of metals is performed according to work requirements |
| 1. Perform material testing | 1. Safety is observed in material testing procedures according to OSHA, 2007 2. ***Material testing methods*** are identified according to work requirement 3. Material testing procedure is followed as per material testing method 4. Material testing results are tabulated, presented, calculated and interpreted according to testing results 5. Material testing equipment are maintained according to manufacturer specifications |
| 1. Prevent material corrosion | 1. Safety is observed during corrosion prevention according to OSHA 2007 2. ***Corrosion types*** are identified according to work requirements 3. ***Corrosion prevention*** m***ethods*** are identified according to work requirements 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** |
| --- | --- |
| 1. Engineering material may include but not limited to: | * Metals * Polymers * Ceramics * Composites |
| 1. Physical properties may include but not limited to: | * Density * Colour * Texture * Melting point * Thermal conductivity * Electrical resistivity |
| 1. Mechanical properties may include but not limited to: | * Ductility * Malleability * Elasticity * Toughness * Hardness * Brittleness * Plasticity * Strength |
| 1. Heat treatment processes may include but not limited to: | * Hardening * Case hardening * Annealing * Normalizing * Tempering. |
| 1. Material testing methods may include but not limited to: | * Chemical analysis * Mechanical testing * Metallurgical testing * Thermal analysis * Environmental testing * Failure analysis * Corrosion testing |
| 1. Corrosion types may include but not limited to: | * Galvanic * Stress corrosion cracking |
| 1. Methods of corrosion prevention may include but not limited to: | * Painting * Electroplating * Galvanizing * Cathodic * Chromizing |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

* Measuring and marking
* Material testing
* Use of hand tools
* Inspection and testing

**Required knowledge**

The individual needs to demonstrate knowledge of:

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

**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. Observed safety as per work place procedures 2. Demonstrated understanding of physical, chemical and mechanical properties of engineering materials 3. Apply how production is performed according to work environment 4. Performed heat treatment 5. Performed material testing 6. Demonstrated understanding of corrosion types and its prevention 7. Demonstrated material workshop processes |
| 1. Resource implications | The following resources should be provided:   1. Access to relevant workplace where assessment can take place 2. Appropriately simulated environment where assessment can take place |
| 1. Methods of assessment | Competency in this unit may be assessed through:   1. Written examination 2. Practical tests 3. Oral presentation |
| 1. Context of assessment | Competency may be assessed   1. Off the job 2. On the job 3. During industrial attachment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

**APPLY ELECTRICAL AND ELECTRONICS PRINCIPLES**

**UNIT CODE:** ENG/OS/ABT/CC/08/6/A

**Unit Description**

This unit describes the competencies required by a technician in order to apply electrical and electronics principles in their work. It involves using the concept of basic electrical quantities, applying the concepts of DC and AC circuits in electrical installation, carrying out power rectification in electrical systems, using earthing in electrical installations, using basic electrical machine, applying lightning protection measures, applying safety requirements for electricity, applying principle of electrical measurements, applying principles of electrical/electronic devices and their application and applying principles of digital electronics.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***Bold and italicized terms are elaborated in the Range*** |
| --- | --- |
| 1. Use the concept of basic electrical quantities | 1. Basic ***SI units*** in Electrical are identified according to specified procedures 2. ***Quantitie*s** of charge, force, work and power are identified according to specified procedures 3. Electrical quantities calculations are performed according to specified procedures 4. Application of Instruments used in measuring various types of Electrical parameters |
| 1. Apply the concepts of D.C and A.C circuits in electrical installations | 1. Ohm’s law calculations are performed according to specified procedures 2. Parallel and series circuits calculations are performed according to specified procedures 3. ***DC and AC network theorems*** calculations are performed according to specified procedures |
| 1. Carry out power rectification in electrical systems | 1. Single-phase and three-phase controlled and uncontrolled power rectification is performed using various ***power rectification methods*** according to prescribed rectification methods 2. Power smoothing is done according to prescribed ***power smoothing methods*** 3. Power regulation is performed according to selected power regulation methods 4. Power supply protection is carried out according to prescribed ***power supply protection method*** |
| 1. Use earthing principles in electrical installations | 1. ***Earthing types*** are identified in accordance to Electric Power Act, 1997 standards 2. Earthing points on electrical installation are identified according to work requirements 3. Earthing type calculation is performed according to prescribed work 4. Earthing system test is performed in line with the Electric Power Act, 1997 standards |
| 1. Use basic electrical machine | 1. Electrical machines types are identified according to work specifications 2. Single phase and three phase AC and DC motors calculations are performed in accordance to electrical guideline 3. Single and three phase AC transformers calculations are performed according to electrical guidelines 4. Single and three phase generators calculations are performed in accordance to electrical guidelines 5. DC generators calculations are performed in accordance to electrical guidelines |
| 1. Apply lightning protection measures | 1. ***Types of lightening strokes*** are identified according to prescribed procedures 2. Lightening protection system components are identified according to Electric Power Act, 1997 standards 3. Lightening protection system test are carried out in accordance with Electric Power Act, 1997 standards 4. Lightening protection system applications are determined in accordance to system requirements |
| 1. Apply safety requirements for electricity | * 1. Electrical hazards are identified as per OSH Act 2007   2. Personal protective equipment (PPE) are used according to OSHA 2007   3. National colour code standards for electrical wires are carried out in accordance with Electric Power Act, 1997 standards   4. Principles of electric hazard protection are observed according to work requirements |
| 1. Apply principle of electrical measurements | * 1. Voltage is measured in accordance to electrical guidelines   2. Current is recorded by passing the current over a standard resistor according to specified procedures   3. Resistance of the appliances is calculated in accordance to electrical guideline |
| 1. Apply principle of electrical / electronic devices and their application | * 1. Semiconductors (diodes and transistors) are identified and connected according to prescribed procedures   2. Resistors are connected according to current to passed on it   3. Capacitors are connected based on the amount of voltage to be passed on it and in accordance to electrical guideline   4. Inductors are selected and set up based on their design and area to be inserted   5. Comparators and operational amplifiers (Op-amps) are used to determine whether an input voltage is higher or lower than a reference voltage to establish the outputs limiting values   6. Microprocessors is connected to incorporates the functions of a central processing unit on a single integrated circuit according to prescribed procedures   7. Transducers are selected and connected according to their types and functions in accordance to electrical guidelines   8. Actuators and sensors are identified according to their operations in line with electrical guidelines   9. Rechargeable batteries are connected according to their purpose and capacity   10. Solar panels are installed based on their purpose and capacity |
| 1. Apply principles of digital electronics | * 1. Number system is explained as per the principles of digital electronics   2. ***Types of logic gates*** are identified according to electrical guidelines   3. Logic gates symbols are identified based on the inputs and outputs values   4. Boolean functions are implemented practically using electronic gates in accordance to prescribed procedures   5. Truth table is used to represent the logic gates   6. Gate inputs value is determined depending on the voltage driven into it   7. Gate outputs value is calculated according to the type of logic gate used/operated   8. Digital systems are constructed based on the logic gate used |

**RANGE**

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

| **Variable** | **Range** |
| --- | --- |
| 1. SI units include but not limited to***:*** | * Volt (V) * Ampere (A) * Ohm (Ω) * Watt (W) * Farad (F) * Decibel (db) |
| 1. Quantities may include but not limited to: | * Coulomb (C) * Newton’s (N) * Watt (W), |
| 1. DC and AC network theorems may include but not limited to: | * Kirchhoff’s laws, * Superposition * Thevenin’s theorem * Norton’s theorem |
| 1. Power rectification methods may include but not limited to: | * Full-wave rectification * Half-wave rectification. * Full wave bridge |
| 1. Power smoothing methods may include but not limited to: | * Reservoir * Capacitor filter * RC filter * Pie filter |
| 1. Power supply protection method may include but not limited to: | * Circuits breakers * Fuses * Switches |
| 1. Earthing types may include but not limited to: | * TN-S * TN-C-S * TT * TN-C * IT |
| 1. Types of lightening strokes may include but not limited to: | * Intracloud (IC) * Cloud to cloud (CC) * Cloud to ground (CG) |
| 1. Types of logic gates may include but not limited to: | * AND gate * OR gate * NOT gate * NAND gate * NOR gate * EOR gate * ENOR gate |

**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:
* Application of basic electrical formulas
* Use of basic electrical instruments
* Perform various unit conversions of electrical quantities
* Electrical earthing
* Lightening arrestors
* Power factor correction
* Problem solving
* Applying statistics
* Drawing graphs
* Using different measuring tools

**Required knowledge**

The individual needs to demonstrate knowledge of:

* 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

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical aspects of competency | Assessment requires evidence that the candidate:   1. Applied the correct SI units of electrical quantities 2. Stated, calculate and relates the quantities in Ohm’s law 3. Identified the components of an earthing system 4. Stated and apply various laws in electrical system 5. Differentiated between AC and DC network 6. Applied correct formulas in the calculation of AC and DC machines 7. Used power triangle in calculating power factor 8. Applied various methods in power factor correction 9. Identified types of lightening arrestors and their applications 10. Applied principles of electrical/electronic measurements 11. Applied principles of digital electronics |
| 1. Resource implications | The following resources should be provided:   1. Access to relevant workplace where assessment can take place 2. Appropriately simulated environment where assessment can take place |
| 1. Methods of assessment | Competency in this unit may be assessed through:   1. Direct observation 2. Practical assessments 3. Demonstration with oral questioning 4. Written tests |
| 1. Context of assessment | Competency may be assessed   1. Off the job 2. On the job 3. During industrial attachment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

# CORE UNITS OF COMPETENCY

## DESIGN VEHICLE BODY

**UNIT CODE: ENG/OS/ABT/CR/01/6/A**

**Unit Description**

This unit describes the competencies required by an auto body technician to design a vehicle body. It involves creating vehicle structure, creating bill of materials, analysing job specification sheet, simulating vehicle design, documenting vehicle design and obtaining design approval.

**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. Draw vehicle structure | 1. ***Vehicle structure*** designs are sketched according to Kenya standard for passenger vehicle body construction (KS 372) 2. Truck body and auxiliary devices (hydraulic and pneumatic systems) are designed as per the production manual 3. ***Vehicle ergonomics*** are incorporated in the design as per the standard operating procedures 4. Designs are interpreted and working drawings developed accordingly as per KS 372 and as per the production manuals 5. Viable design is selected and redrawn and modified in CAD software package 6. 2D vehicle diagrams are generated using CAD software as per KS 372 |
| 1. Create bill of materials | 1. Each vehicle component design is examined for compliance with national ***vehicle component standards*** 2. List of ***part assemblies*** is produced based of the working CAD drawings as per KS-372 and KS 1515 3. Costing for components and part assemblies is done and presented in a bill of materials developed as per standard operation procedure |
| 1. Analyse job specification sheet | 1. Each vehicle component meant for assembly is identified according to the standard protocol manual 2. Time lines for completion of the assembly are determined as per the standard production protocol manual 3. Labour cost is calculated as per standard production protocol manual |
| 1. Simulate vehicle design | * 1. 2D drawings are used to create a 3D model, using CAD software   2. Computer renders are generated and scaled clay models produced to accurately represent the final vehicle design   3. A full-size clay model and renders are generated for vehicle design-visualization as per standard operation procedure   4. Interior sketches and models are generated for vehicle design visualization as per standard operation procedure   5. Model approval is obtained as per standard operation procedure |
| 1. Document vehicle design | * 1. Vehicle and truck designs are finalized and complete design sketches and technical drawings are generated as per standard operation procedure   2. Final design sketches and technical drawings, list of materials, job specification sheet and protocol book manuals are compiled as per standard operation procedure   3. Complete vehicle documentation is stored according to standard operation procedure |
| 1. Obtain design approval | * 1. Design approval documents are obtained filled and submitted to relevant national governing authorities in accordance with government regulations   2. Vehicle patent applicant is filled out as per national patent application procedure |

**RANGE**

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

| **Variable** | **Range** |
| --- | --- |
| 1. Vehicle structure may include but not limited to: | * Body-on-frame structure * Unitary body structure * Space structure * Backbone structure * Triangulated tube structure * Monocoque structure * Punt structure * Perimeter space frame structure |
| 1. Vehicle ergonomics may include but not limited to: | * Anthropometrics and its relation to vehicle ergonomics * Driver and passenger comfort-visibility, seating * Dust and fume prevention * Vibrations * Ventilation and temperature control * Interior features and conveniences |
| 1. Vehicle component standards may include but not limited to: | * KS 372, Passenger vehicle body construction * KS ISO 898, Mechanical properties of fasteners * KS 376, Specification for flexible polyurethane (polyester) foams * KS 649, Specification for automobile windscreens and glass * KS 664, Specification for seat belt assemblies for motor vehicles * KS 822, Specification for anchorages for seat belts for automobiles |
| 1. Part assemblies may include but not limited to: | * Service doors * Emergency doors * Floor deck * Gangway * Cant rails * Roof * Window planes and windscreen * Handrails and handholds * Ventilators * Passenger seats * Seatbelt anchorage * Interior lights * Passenger entry steps * Door locks, window locks and boot locks * Electrical wiring * Luggage carriers |

**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:

* Free hand sketching
* Technical drawing
* Interpretation of design standards
* Computer-Aided Design drawing
* CAD design simulation
* Rendering and clay modeling
* Cost accounting

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* KS 372 Standards
* Industrial vehicle design practices
* Vehicle aerodynamics
* Different vehicle materials and their application
* Government vehicle design approval process

**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. Sketched different vehicle structure category designs according to KS 372 standards 2. Sketched different truck structure category designs according to production manual standards 3. Incorporated vehicle ergonomics in the design 4. Modeled vehicle design in CAD software 5. Simulated vehicle design using CAD simulation tools 6. Modified CAD design based on simulation results 7. Generated scaled clay model and interior sketches 8. Created design bill of materials 9. Compiled full vehicle design documentation |
| 1. Resource implications | The following resources should be provided:   1. Access to relevant workplace where assessment can take place 2. Appropriately simulated environment where assessment can take place |
| 1. Methods of assessment | Competency may be assessed through:   1. Practical demonstration of tasks 2. Assessment of design project 3. Observation |
| 1. Context of assessment | Competency may be assessed   1. Off the job 2. On the job 3. During industrial attachment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

## FABRICATE AUTOMOTIVE STRUCTURE

**UNIT CODE:** ENG/OS/ABT/CR/02/6/A

**Unit Description**

This unit describes the competencies required by an Autobody technician to fabricate automotive structure. It involves interpreting engineering drawings, observing occupational health and safety, collecting fabrication materials, cutting work pieces, bending work pieces, constructing fabrication jigs, joining jigged parts, levelling the structure, mounting the fabricated structure, fabricating ancillary units and obtaining structure approvals.

**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. Interpret engineering drawing | 1. ***Work pieces*** are identified as per the working drawings 2. ***Bill of materials*** is analysed according to the working drawings 3. ***Structure rigs*** are identified as per the standard operational procedure |
| 1. Observe occupational health and safety | 1. ***Personal protection equipment*** is used according to observe occupational health and safety 2007 2. ***Tools and equipment*** are used, according to manufacturer’s specifications 3. Tools and equipment are maintained, according to manufacturer’s specifications 4. Workspace housekeeping is maintained according to standard operating procedures (SOPs) |
| 1. Collect fabrication materials | 1. Materials, tools and equipment are selected as per job specifications 2. ***Material handling equipment*** are operated according to manufacturer’s operator instruction 3. Required materials are isolated from the store using the bill of materials as per workshop procedures 4. Identified materials are acquired from the store according to their sizes and shapes 5. Material collection is organized following standard requisition procedure |
| 1. Cut work pieces | 1. ***Cutting Tools and equipment*** required to perform fabrication are identified as per the production protocol book 2. Materials are prepared and marked out using appropriate tools as per the workshop procedures 3. Equipment performance is inspected as per the manufacturer’s manual 4. Work pieces are prepared as per the working drawing 5. Cut pieces are checked against given measurements from the working drawings |
| 1. Bend work pieces | 1. ***Bending machines*** are selected as per the metal sizes and sections 2. Workpieces are prepared as per the working drawing 3. Workpieces are bent according to the required measurements |
| 1. Construct fabrication jigs | 1. ***Fabrication jigs*** are designed as per the working drawings 2. Materials, tools and equipment are selected for jigs as per job specifications 3. Workpiece***s*** are prepared using appropriate tools as per the working drawings 4. Work pieces are joined appropriately according to the design drawing 5. Jigs are mounted in the appropriate distances according to the structure design |
| 1. Join jigged work pieces | 1. Materials, tools and equipment are selected as per job specifications 2. Welding machine settings and electrode are selected as per standard operating procedure 3. Joints are tack welded as per the working drawing 4. Tacked structure is inspected using the designed drawings 5. Complete welding is performed on the structure according to the standard operating procedures |
| 1. Level vehicle structure | 1. Structure diagonals are checked as per the working drawing 2. Structure is levelled appropriately as per the drawing |
| 1. Mount fabricated structure | 1. Fabricated structure is inspected as per the standard operating procedures 2. Fabricated structures are moved to vehicle chassis using appropriate tools and equipment as per the production manual 3. Fabricated structures are mounted to the chassis as per the working specification |
| 1. Fabricate ancillary units | 1. Safety and health are observed as per Workplace procedures 2. Tools and equipment are selected as per job specifications 3. Ancillary material*s* are selected as per the working drawing 4. Workpieces are prepared as per job specifications. Welding machine settings and electrode are selected as per standard operating procedure 5. Workpieces are joined according to the designed drawing 6. ***Ancillary units*** are inspected as per the standard operating procedure |
| 1. Obtain structure approval | 1. Vehicle body structure is inspected according to the companies’ standard operating 2. Vehicle structure is checked and approved as per the ISO standards 3. Structure documentation is prepared as per workshop procedure 4. Vehicle inspection is done as per KS 372 and standard operating procedures |

**RANGE**

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

| **Variable** | **Range** |
| --- | --- |
| 1. Work pieces may include but are not limited to: | * Angle sections * Square * Rectangular tubes * Channel bars * Flat bars * Circular tubes * Round bars |
| 1. Bill of materials   may include but are not limited to: | * Welding rods * Electrode wires * Cutting disc * Grinding disc * Workpieces |
| 1. Structure rigs may include but are not limited to:: | * Under structure * Left side structure * Right side structure * Roof structure * Front structure * Rear structure * Cross members |
| 1. Personal protection equipment may include but are not limited to: | * Overall * Safety boots * Goggles, * Earmuffs * Gloves * Helmet * Safety mask |
| 1. Tools and equipment may include but are not limited to: | * Drilling machine * Impact gun * Tape measure * Scriber * Try square * Vernier caliper * Vernier height gauge * Ball pein hammer * Marking table * Laser Leveler * Hydro pneumatic jack * Rivet gun * Hacksaw * Angle grinder |
| 1. Material handling equipment may include but are not limited to: | * Hoist * Chain * Conveyor belt * Forklift |
| 1. Cutting tools and equipment may include but are not limited to: | * Hacksaw * Circular saw * Angle grinder * Laser cutting machine * Plasma cutting machine * Gas cutting equipment |
| 1. Bending machines may include but are not limited to: | * Hydraulic bending machine * Pneumatic bending equipment * Mechanical pipe benders |
| 1. Fabrication Jigs may include but are not limited to: | * Template jig * Plate jig * Diameter jig * Channel jig * Ring jig * Box jig |
| 1. Ancillary units may include but are not limited to | * Tail lifts * Cranes * Drawbars * Sleeper pods |

**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:

* Measurement
* Designing
* Bench work
* Data analysis
* Material processing
* Metal cutting
* Metal Bending
* Welding and fabrication

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Engineering science
* Operational standards
* Machine operations and maintenance
* Tools and equipment
* Health and safety
* Material science
* Measurement and dimensioning.
* Marking out

**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. Analyzed bill of materials 2. Constructed Jigs 3. Used personal protection equipment 4. Used tools and equipment for each task 5. Welded vehicle structure 6. Mounted vehicle structure 7. Fabricated ancillary units |
| 1. Resource implications | The following resources should be provided:   1. Access to relevant workplace where assessment can take place 2. Appropriately simulated environment where assessment can take place |
| 1. Methods of assessment | Competency may be assessed through:   1. Observation 2. Questionnaire 3. Oral presentation |
| 1. Context of assessment | Competency may be assessed   1. Off the job 2. On the job 3. During industrial attachment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

## WELD VEHICLE BODY PARTS

**UNIT CODE:** ENG/OS/ABT/CR/03/6/A

**Unit Description**

This unit specifies competencies required by an Autobody technician to weld vehicle body parts. It involves levelling vehicle chassis, Arc welding cross members, performing MIG welding, performing TIG welding, performing spot welding and carrying out quality control checks.

**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. Level vehicle chassis | 1. Safety and health are observed and ***Personal Protective Equipment (PPE)*** are utilized as per Workplace procedures and OSHA 2. Working drawings are interpreted as per job specifications 3. Chassis diagonals are checked in reference to the working drawing 4. Chassis midpoint, front and end points are checked for level using appropriate equipment following standard operating procedure 5. Chassis is levelled using appropriate ***tools and equipment*** as per the working drawing |
| 1. Arc-weld vehicle cross members | 1. ***Materials, tools and equipment*** are selected as per job specifications 2. Safety is observed as per workplace procedures and OSHA 3. ***Joints*** are prepared as per working drawings. 4. Arc welding equipment is set up as per job specifications 5. Workpieces are welded using manual metal arc welding process as per job specifications and ISO 9606-1 standard 6. Post weld treatment is performed according to job specifications 7. Weld joint is examined as per ISO 17637 standards |
| 1. Perform MIG welding | 1. ***MIG welding equipment*** is set up as per job specifications 2. Work pieces are weld using MIG process as per job specifications and ISO standard 3. Weld-joint quality is recorded as per welding specification record |
| 1. Perform TIG welding | 1. Materials, tools and equipment are selected as per job specifications 2. ***TIG welding equipment*** is set up as per job specifications 3. Work pieces are welded using TIG process as per job specifications and ISO standard |
| 1. Perform spot welding | 1. ***Spot welding equipment*** is set up as per job specifications 2. Surface joint are prepared as per the working drawings 3. Work pieces are welded using spot process as per job specifications and standard 4. Post weld treatment is performed according to job specifications |
| 1. Carry-out welding quality control | 1. Finished welds are tested for ***common welding faults*** as per the ISO standards 2. ***Non-destructive tests*** are carried out as per the ISO standards 3. ***Destructive tests*** are carried out as per the ISO standards 4. Document test results are done as per workplace procedures 5. Housekeeping is conducted as per workplace procedures |

**RANGE**

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

| **Variable** | **Range** |
| --- | --- |
| 1. Personal Protective Equipment (PPE) may include but not limited to: | * + Welding helmet/ hand shield/ welding goggles   + Respirator   + Fire resistant clothing and apron   + Earmuffs/ ear plugs   + A pair of rubber soled safety boots   + Insulated gloves |
| 1. Materials, tools and equipment may include but not limited to: | * + Metal arc welding equipment   + Metal inert gas welding machines (MIG)   + Tungsten inert gas welding equipment (TIG)   + Resistance spot welding equipment   + Steel sheet metal   + Jigs and fixtures   + Portable grinders   + Electric hand drills   + Assorted consumables filler rods   + Chassis set-up fixture   + Bandoleers/legend set-up fixture   + Laser leveling kit   + Digital angle gauge with level   + Smart tool angle sensor   + Digital protractor   + Marking table   + Vernier height gauge |
| 1. Joints may include but not limited to: | * Butt joint * Lap joint * Edge joint * Tee joint * Corner joint |
| 1. MIG welding equipment may include but not limited to: | * + MIG welding PPE   + MIG welding machine   + MIG welding accessories |
| 1. TIG welding equipment may include but not limited to: | * + TIG welding PPE   + TIG welding machine   + TIG welding accessories |
| 1. Spot welding equipment may include but not limited to: | * + Spot welding PPE   + Spot welding machine * Spot welding accessories |
| 1. Common welding faults may include but not limited to: | * Lack of weld penetration * Distortions * Mounting errors * Voids * Lack of fusion * Methods * Voids crown * Spatter * Whiskers * Porosity and gas pockets * Undercutting   + Voids and cracks |
| 1. Non-destructive tests may include but not limited to: | * Visual inspection * Hydrostatic test * Magnetic particle test * X-ray test * Gamma ray test * Fluorescent penetrant test |
| 1. Destructive tests may include but not limited to: | * Acid etch test * Guided bend and free bend test * Nick break test * Tensile strength test |

**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:

* Diagnose extent of vehicle body structural damage
* Removal of auto body structural and non-structural parts
* Join variety of metals such as low carbon steels, high strength steels and aluminum alloy
* Use MIG, TIG, Metal – arc, welding spot welding equipment
* Prepare material estimate and cost and labor requirements
* Report writing
* First aid
* Negotiation
* Sketching/drawing
* Safety and healthy
* Follow storage methods of environmentally hazardous materials
* Complying methods of minimizing wastage
* Use of PPE
* Follow environmental regulations
* Complying with regulations/licensing requirements

**Required Knowledge**

* The individual needs to demonstrate knowledge of:
* Legislative and organizational requirements and procedures
* National legislation and workplace procedures relevant
* Health and safety
* The environment (including waste disposal) in conformity to OSHA2007
* Appropriate personal, equipment and vehicle protective equipment
* Legal requirements relating to the vehicle and its construction including body configurations and standards e.g. (KS 372:2019 KNBS)
* Working procedures relating to:
* Job task planning and organizing
* Recording vehicle body condition, assess and recommending corrective actions
* Report delays in work completion
* Referral of problems
* The relationship between time, costs and profitability
* Both Standards in auto body welding and building
* Realignment of both structure and paneling of vehicle body and chassis
* Broad knowledge of auto body construction and repair techniques
* Different models of vehicles
* Quality requirements

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical aspects of competency | Assessment requires evidence that the candidate:   1. Observed safety as per workplace procedures and OSHA 2. Selected materials, tools and equipment 3. Prepared joints as per working drawings 4. Set up MIG welding equipment in accordance with job specifications 5. Welded work pieces using MIG process as per job specifications and ISO 9606-1 standard 6. Set up TIG welding equipment in accordance with job specifications 7. Welded workpieces using TIG process as per job specifications and ISO 9606-1 standard 8. Welded workpieces using spot process as per job specification and ISO 9606-1 standard 9. Carried out the destructive tests as per the standard testing procedures 10. Carried out the non-destructive tests as per the standard testing procedures 11. Welded work pieces are examined as per ISO 17637 12. Conducted housekeeping as per workplace procedures |
| 1. Resource implications. | The following resources should be provided:   1. Access to relevant workplace where assessment can take place 2. Appropriately simulated environment where assessment can take place |
| 1. Methods of assessment | Competency may be assessed through:   1. Direct observation 2. Written or oral short answer questions 3. Demonstration 4. Project/work sample/practical assessment 5. Portfolio |
| 1. Context of assessment. | Competency may be assessed   1. Off the job 2. On the job 3. During industrial attachment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

## PANEL VEHICLE STRUCTURE

**UNIT CODE:** ENG/OS/ABT/CR/04/6/A

**Unit Description**

This unit describes the competencies required by an Autobody technician in order to panel vehicle body structure. It involves observing occupational safety and health, grinding vehicle structure, aligning vehicle structure, constructing vehicle boot compartment, vehicle floor panel and vehicle exterior panel, installing wire harness, constructing vehicle interior compartment and documenting and updating protocol book.

**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. Observe occupational health and safety | 1. ***Personal Protective Equipment (PPE)*** are utilized as per OSHA specifications and standard operation procedure 2. ***Tools and equipment*** are stored and maintained correctly according to manufacturer’s specifications 3. Tools and equipment are used correctly according to designated purpose 4. Workspace housekeeping is maintained according to standard operation procedure 5. Workplace is planned according to standard operation procedure |
| 1. Grind vehicle structure | 1. Vehicle structure is inspected for surface grind quality according to standard operation procedure 2. Required grinding tool is identified as per standard operation procedure 3. The vehicle structure is ground to the required finish quality as per standard operation procedure |
| 1. Align vehicle structure | 1. Vehicle structure is inspected for frame alignment as per standard operation procedure 2. Areas to be aligned are identified and aligned as per standard operation procedure |
| 1. Construct vehicle boot compartment | 1. Vehicle boot compartment is inspected according to standard operation procedure 2. Boot compartment material requirements are identified as per the specification sheet and standard operation procedure 3. Construction material and equipment are obtained and prepared as per standard operation procedure 4. Panel is fitted on the vehicle boot and welded as per the KS-372 standards |
| 1. Construct vehicle floor panel | 1. Vehicle floor panel material is inspected as per the specification sheet and standard operation procedure 2. Floor panel material is identified and sized as per specification sheet 3. Panel material is cut and shaped as per specification sheet 4. Floor panels are fitted and welded accordingly as per the KS-372 standards |
| 1. Construct vehicle exterior panel | 1. Vehicle exterior is inspected as per standard operation procedure 2. ***Panel materials*** are identified and sized as per standard operation procedure 3. Panel sheet is cut and bent as per specification sheet 4. Panels are fitted and welded on the structure accordingly as per the KS-372 standards 5. Panelled structure is inspected for proper panel fitting and spacing as standard operation procedure |
| 1. Install wire harness | 1. Vehicle wiring is inspected as per standard operation procedure 2. ***Wiring requirements*** are checked and identified as per specification sheet 3. Electrical cables and insulations are installed as per specification sheet and KS-372 standards |
| 1. Construct vehicle interior compartment | 1. Vehicle interior compartment is inspected as per standard operation standard 2. Material requirement are identified as specification sheet 3. Materials are collected and sized as per the specification sheet 4. Red oxide is applied to avoid corrosion as per standard operation procedure 5. ***Heat insulation material*** is fitted as per the specification sheet and standard operation procedure 6. ***Interior panels*** are riveted and spot welded as per specification sheet and KS-372 standards |
| 1. Document and update protocol book | 1. Specification sheet is reviewed to define the work to be performed 2. Service work done is recorded on the protocol book as per the standard operation procedure 3. Work done on the workshop job card is recorded as per the standard operation procedure |

**RANGE**

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

| **Variable** | **Range** |
| --- | --- |
| 1. Personal Protective Equipment (PPE) may include but not limited to: | * Goggles * Ear plugs * Safety mask * Helmet * Safety boots * Leather gloves * Overall |
| 1. Tools and equipment may include but not limited to: | * Drilling machine * Laser machine * G-clamp * Chain block * Ball pein hammer * MIG welding machine * Arc welding machine * Bench grinder * Sikaflex * Sikaflex gun |
| 1. Panel materials may include but not limited to: | * Galvanized sheet * Black iron sheet * Aluminium checkered sheet |
| 1. Wiring requirements may include but not limited to: | * Circuit breakers * Electromagnetic bell * Interior lighting * Exterior lighting * Electrical accessory components |
| 1. Heat insulation material may include but not limited to: | * Styrofoam * Hood liner |
| 1. Interior panels may include but not limited to: | * Fibre glass * Aluco board * Formica |

**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:

* Interpretation of vehicle specification sheet
* Metal grinding and welding
* Panel alignment and joining
* Body panel riveting
* Insulation material installation

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Kenyan government motor vehicle governing regulations
* Vehicle body material types and their application
* Occupational health and safety standards
* Workshop technology practices
* Electrical installation

**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. Utilized required PPE and observed health and safety regulations during their work   2. Interpreted vehicle dimensions as per specification sheet   3. Ground vehicle structure   4. Aligned vehicle structure   5. Constructed vehicle boot compartment   6. Constructed vehicle interior compartment   7. Constructed vehicle floor panel   8. Joined vehicle exterior panel with panel gap within specification sheet recommendations   9. Installed wire harness |
| 1. Resource implications | The following resources should be provided:   1. Access to relevant workplace where assessment can take place 2. Appropriately simulated environment where assessment can take place |
| 1. Methods of assessment | Competency may be assessed through:   * 1. Practical demonstration of tasks   2. Observation   3. Written examinations |
| 1. Context of assessment | Competency may be assessed   1. Off the job 2. On the job 3. During industrial attachment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

## REPAIR VEHICLE BODY

**UNIT CODE:** ENG/OS/ABT/CR/05/6/A

**Unit Description**

This unit covers the competencies required by an autobody technician to repair vehicle body. It involves observing occupational health and safety, performing damage analysis and estimation, panel beating, plastic welding, fibre glass repair, and vehicle body surface preparation, applying filling material, performing vehicle dent repairs, vehicle body jacking and vehicle chassis pulling, applying undercoat, performing vehicle rust repairs and vehicle welded repairs, documenting and updating protocol book.

**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. Observe occupational health and safety | * 1. ***Personal protective equipment*** (PPE) are used according to OSHA 2007   2. ***Tools and equipment*** are stored and maintained correctly according to manufacturer’s specifications   3. Tools and equipment are used according to designated purpose as per standard operating procedures (SOPs)   4. Workspace housekeeping is maintained according to standard operating procedures (SOPs)   5. Workplace is planned according to design specifications |
| 1. Perform damage analysis and estimation | 1. ***Diagnosis procedures*** of frame and body structure are done as per workshop SOPs 2. Steering and suspension inspection is done and damages identified as per workshop SOPs 3. ***Structural and frame damage patters*** are established as per standard operating procedures. 4. Vehicle damage estimation is done by use of estimating resources as per standard operating procedures 5. Vehicle costing and damage appraisal report is written following standard operating procedures |
| 1. Perform panel beating | * 1. Vehicle body is inspected according to workshop SOPs   2. Damaged panel is identified according to manufacturer standards   3. Damaged panel is straightened using appropriate tools as per workshop SOPs   4. Damaged panel is sand down and body filler is applied for a good finish as per workshop SOPs |
| 1. Perform plastic welding | * 1. Vehicle body is inspected according to workshop SOPs   2. Damaged panel is identified according to manufacturer standards   3. Plastic panel is welded as per the workshop SOPs   4. Welded panel is fitted as per the manufacturer standards |
| 1. Perform fibre glass repairs | * 1. Vehicle body is inspected according to workshop SOPs   2. Damaged area is thoroughly washed with silicon remover according to workshop SOPs   3. Fibre glass filler material is applied according to manufacturer standards   4. Repaired surface is spray-painted as per workshop SOPs |
| 1. Perform vehicle body surface preparation | * 1. Vehicle body is cleaned as per the workshop SOPs   2. Vehicle body is sanded as per the workshop SOPs   3. Resin and hardener are mixed as per the manufacturer’s standards   4. Resin and hardener mixture are applied as per the manufacturer’s standards   5. Applied mixture is sanded using appropriate tool as per the workshop SOPs   6. Cleaning materials are prepared as per the workshop SOPs   7. Surface area is cleaned as per the workshop SOPs |
| 1. Apply filling material | * 1. Vehicle body is inspected according to workshop SOPs   2. Body filler is mixed with hardener as per the manufacturer’s standards   3. Filling material is applied evenly on welded panel as per the workshop SOPs   4. Panels are blended using filler and allowed to cure as per the workshop SOPs |
| 1. Perform vehicle dent repairs | * 1. Vehicle body is inspected according to workshop SOPs   2. Dents are identified according to workshop SOPs   3. Dents are removed according to workshop SOPs |
| 1. Perform vehicle body jacking | * 1. Vehicle body is inspected according to workshop SOPs   2. Body panel section requiring body jacking is identified according to workshop SOPs   3. Body jack is positioned in accordance to workshop SOPs   4. Body jack is operated according to manufacturer’s manual |
| 1. Perform vehicle chassis pulling | * 1. Vehicle chassis is inspected according to workshop SOPs   2. Chassis requiring pulling is identified according to workshop SOPs   3. Vehicle is positioned on the vehicle chassis bench according to workshop SOPs   4. Body hook puller is operated according to manufacturer’s standards |
| 1. Apply undercoat | * 1. Vehicle body is inspected according to workshop SOPs   2. Body section to be applied undercoat is identified according to workshop SOPs   3. Primer is mixed with thinner according to manufacturer’s specification   4. Under coat is applied according to manufacturer’s standards and following workshop SOPs |
| 1. Perform vehicle rust repairs | * 1. Vehicle body is inspected according to workshop SOPs   2. Rusted part is identified according to workshop SOPs   3. Vehicle body is cleaned off the rust as per the workshop SOPs   4. Antirust chemical is applied according to manufacturer’s standards   5. Vehicle body is cleaned using appropriate cleaning agent as per manufacturer’s standards |
| 1. Perform vehicle welded repairs | * 1. Vehicle underlying structure is inspected as per the standard operating procedures   2. Panel is marked out as per standard operating procedure   3. Aluminum repair procedures are followed as per workshop SOPs   4. Panel is welded as per the standard operating procedure   5. Vehicle body is cleaned as per the standard operating procedure |
| 1. Document workshop protocol book | * 1. Specification sheet is reviewed to define the work to be performed.   2. Service work done is recorded on the protocol book as per the manufacturer’s recommendation.   3. Work done on the workshop job card is recorded as per the auto-workshop’s 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** |
| --- | --- |
| 1. Personal protective equipment may include but not limited to: | * Goggles * Ear muff * Safety mask * Helmets * Safety boots * Gum boots * Welding gloves * Rubber gloves * Overall * Dust coat |
| 1. Tools and equipment may include but not limited to: | * Hand tools * Panel beating tools * Power tools * Welding machines * Spray painting gun * Pneumatic tools * Hydraulic tools * Bending machine * Sheet metal cutting machine * Marking table * Cross cutter * Vernier caliper |
| 1. Diagnosis procedures may include but not limited to: | Visually inspect for signs of damage:   * Pulled welds * Split sealers * Cracked paint * Buckles * Panel misalignment   Measure vehicle for:   * Length * Width * Height * Upper body misalignment * Tolerances |
| 1. Structural and frame damage patters may include but not limited to: | Types of structural and frame damage.   * Side sway * Sag * Mash * Diamond * Twist |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

* Communication skills
* Problem solving
* Creativity and innovation
* Use of tools and equipment
* Body structure inspection
* Manufacturer’s standards
* Interpretation of service manuals
* House keeping
* Materials handling

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Safety
* Panel beating
* Welding
* Soldering
* Plastic welding
* Fibre repair
* Spray painting
* Jacking
* Workshop technology
* Aluminum repair procedures
* Damage estimation and costing

**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. Observed occupational health and safety 2. Performed panel beating 3. Repaired identified dents 4. Straightened vehicle chassis 5. Spray painted the worked surface area 6. Documented and updated service records |
| 1. Resource implications. | The following resources should be provided:   1. Access to relevant workplace where assessment can take place 2. Appropriately simulated environment where assessment can take place |
| 1. Methods of assessment | Competency may be assessed through:   1. Practical exam 2. Industrial attachment 3. Written examinations 4. Oral presentation |
| 1. Context of assessment | Competency may be assessed   1. Off the job 2. On the job 3. During industrial attachment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

## SPRAY PAINT VEHICLE BODY

**UNIT CODE:** ENG/OS/ABT/CR/06/6/A

**Unit Description**

This unit describes the competencies required by an auto body technician in order to spray paint vehicle body parts. It involves observing occupational health and safety, performing vehicle body surface preparation, applying vehicle body primer and body bond seal, performing body sanding, spraying paint vehicle body, performing surface refinishing, and documenting and updating protocol book.

**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. Observe occupational health and safety | 1. Personal protective equipment (PPE) are used according to OSHA 2007 2. Tools and equipment are stored and maintained correctly according to manufacturer’s specifications 3. Tools and equipment are used correctly according to designated purpose 4. Workspace housekeeping is maintained according to Standard operating procedures (SOPs) 5. Workplace is planned according to design specifications |
| 1. Perform vehicle body surface preparation | 1. Vehicle body is inspected according to workshop SOPs 2. Vehicle body is cleaned using appropriate ***cleaning agents*** as per the workshop (SOPs) 3. Vehicle ***parts not requiring painting*** are masked using ***covering materials*** according to workshop SOPs |
| 1. Apply vehicle body primer | 1. Etching is mixed with the activator and applied on the metal surface according to workshop SOPs 2. First primer is applied to identify areas that require rectification according to workshop SOPs 3. Bond seal is applied on the joints according to workshop SOPs 4. Spot putty is applied to seal the pinholes and sand marks according workshop SOPs 5. Body Primer is applied according to manufacturer’s specification workshop SOPs |
| 1. Apply body bond seal | 1. Vehicle body is cleaned using appropriate cleaning agents as per standard operating procedures 2. Bond seal is applied appropriately as per the manufacturer’s specifications 3. Bond seal is allowed to cure as per manufacturer’s specifications |
| 1. Perform body sanding | 1. Vehicle body is sand down as per workshop SOPs 2. Vehicle body is cleaned using appropriate cleaning agents as per the workshop (SOPs) 3. Second primer is applied to the vehicle body according to workshop SOPs 4. Process is repeated until manufacturer’s specifications are met |
| 1. Spray paint vehicle body | 1. Vehicle body is cleaned using appropriate cleaning agents as per the workshop (SOPs) 2. Automotive paints are identified according to manufacturer’s specification 3. Appropriate colour matching and mixing is performed according to manufacturer’s specification 4. ***Spraying equipment*** is selected according to manufacturer’s specifications 5. First coat paint is sprayed according to workshop SOPs 6. Second coat paint is sprayed according to workshop SOPs 7. Body valeting is performed according to workshop SOPs 8. Final coat paint is sprayed according to workshop SOPs 9. Vehicle paint is cured according to manufacturer’s specifications |
| 1. Perform surface refinishing | 1. ***Buffing materials*** are selected according to manufacturer’s specifications 2. Vehicle body is prepared for buffing according to workshop SOPs 3. Body buffing is performed according to manufacturer’s specifications 4. Body vehicle cleaning is performed as per workshop SOPs |
| 1. Document and update protocol book | 1. Specification sheet is reviewed to define the work to be performed as per workshop SOPs 2. Service work done is recorded on the protocol book as per the manufacturer’s recommendation 3. Work done on the workshop job card is recorded as per the auto-workshops 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** |
| --- | --- |
| 1. Cleaning agents may include but is not limited to: | * Tack cloth * Standard thinner * Soap * Phosphate based chemical * Pressurized air |
| 1. Parts not to be painted may include but is not limited to: | * Glass * Fuel filter * Wiring harness * Rubber * Engine compartment * Steering wheel |
| 1. Covering materials may include but is not limited to: | * Masking tape * Brown paper |
| 1. Spraying equipment may include but is not limited to: | * Compressor machine * Spraying gun |
| 1. Buffing materials may include but not limited to: | * Polishing wax * Polishing cream |

**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:

* Aligning panels
* Filling gaps
* Panel surface preparation
* Body work equipment assembly and maintenance procedures
* Paint color matching and mixing

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Surface preparation and paint application processes
* Paint types, their automotive code and compatibility code numbers
* Spray paint equipment maintenance
* Body sanding and paint removal methods and equipment
* Observe occupational health and safety and use of PPE
* Quality standards
* Body filler and primer
* Safety hazards with chemicals and flammable materials
* Masking
* Environmental and government regulations
* Polishing, rubbing compounds and selection

**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. Observe occupational health and safety 2. Performed vehicle surface detailing 3. Performed body sanding 4. Applied body bond seal 5. Applied vehicle body primer and paint coat 6. Performed surface refinishing. |
| 1. Resource implications | The following resources should be provided:   1. Access to relevant workplace where assessment can take place 2. Appropriately simulated environment where assessment can take place |
| 1. Methods of assessment | Competency may be assessed through:   1. Practical assessment 2. Observation 3. Written examinations 4. Questionnaires 5. Case studies |
| 1. Context of assessment | Competency may be assessed   1. Off the job 2. On the job 3. During industrial attachment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

## TRIM VEHICLE BODY

**UNIT CODE:** ENG/OS/ABT/CR/07/6/A

**Unit Description**

This unit covers the competencies required by an Autobody technician to trim vehicle body. It involves observing occupational health and safety, collecting trim materials, upholstering vehicle interior, padding vehicle cushion seat, installing vehicle restraints, install airbag, replacing mouldings, emblems and pin-striping, documenting and updating protocol book.

**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. Observe occupational health and safety | 1. ***Personal protective equipment*** (PPE) are used according to OSHA 2007 2. ***Tools and equipment*** are stored and maintained correctly according to manufacturer’s specifications 3. Tools and equipment are used correctly according to designated purpose 4. Workspace housekeeping is maintained according to Standard operating procedures (SOPs) 5. Workplace is planned according to design specifications |
| 1. Collect trim materials | 1. Vehicle is inspected as per workshop standard operating procedures (SOPs) 2. Surface is cleaned and degreased as per workshop SOPs 3. Trim materials are collected as per the specification sheet |
| 1. Upholster vehicle interior | 1. ***Upholstery Material*** is cut and sewed as per the vehicle design and the working drawing 2. Adhesive is applied on surface to be trimmed as per the workshop SOPs 3. Upholstery material is allowed to cure as per the workshop SOPs 4. Cured upholstery material is fitted on the vehicle body according workshop SOPs |
| 1. Pad vehicle cushion seat | 1. Seats frame is inspected as per the working drawing 2. Upholstery materials are cut as per the design drawing 3. Upholstery materials are glued as per workshop SOPs 4. Seat covers are fixed as per the workshop SOPs |
| 1. Install vehicle restraints | 1. Vehicle restraints are identified and collected as per specification sheet 2. Vehicle restraints are mounted on the seat frame as per KS-372 standard 3. Vehicle restraints are secured as per the workshop SOPs |
| 1. Replace mouldings, emblems and pin-striping | 1. Mouldings, emblems and pin-striping are identified and collected as per specification sheet 2. Vehicle surface is cleaned as per the workshop SOPs 3. Mouldings, emblems and pinstripes are replaced workshop SOPs |
| 1. Document and update protocol book | 1. Specification sheet is reviewed to define the work to be performed 2. Service work done is recorded on the protocol book as per the manufacturer’s specification 3. Work done on the workshop job card is recorded as per the workshop SOPs 4. Next service is scheduled as per workshop 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** |
| --- | --- |
| 1. Personal protective equipment may include but is not limited to: | * Goggles * Ear muffs * Safety mask * Head gear * A pair of safety boots * Cotton-leather gloves * Overall |
| 1. Tools and equipment may include but is not limited to: | * Power tools * Hand tools * Trim removal tool kit * Hand scissors * Straight, curved needles and skewers * Industrial Sewing machine * Mold removal wedges * Adhesive remover * Pin-striping brushes * Beugler pin-striper |
| 1. Upholstery material may include but is not limited to: | * Trim fabrics * Faux leather * Headlining material * Cushion foam, felt and fibre board * Adhesive conta glue * Mally floor |

**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:

* Trim work
* Equipment operation
* Assembling
* Maintenance of equipment

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Vehicle trim and accessories
* Car upholstery materials selection and specifications
* Material estimation and costing
* Observe OSHA
* Adhesive use according to direction for use
* Fitting seats and head rests
* Material selection
* Fitting instructions
* Safety information with seat covers with air bags
* Cleaning agents
* Mounting procedure
* Use of manufacturers manual
* Operation of air bag
* Specifications of moulds
* Emblems
* Quality standards

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical aspects of competency | Assessment requires evidence that the candidate:   1. Observed occupational health and safety 2. Upholstered vehicle interior according to the required standard 3. Adequately padded vehicle cushion seats 4. Installed vehicle restrains and air bags correctly 5. Replaced vehicle moldings, emblems and performed pin striping with good results |
| 1. Resource implications | The following resources should be provided:   1. Access to relevant workplace where assessment can take place 2. Appropriately simulated environment where assessment can take place |
| 1. Methods of assessment | Competency may be assessed through:   1. Practical 2. Observation 3. Written examinations |
| 1. Context of assessment | Competency may be assessed   1. Off the job 2. On the job 3. During industrial attachment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

## ASSEMBLE VEHICLE BODY PARTS

**UNIT CODE:** ENG/OS/ABT/CR/08/6/A

**Unit Description**

This unit describes the competencies required by Autobody technician in order to assemble vehicle body parts. It involves observing occupational safety and health, installing vehicle seats, performing vehicle glazing, installing vehicle auxiliary and fluid power systems, installing vehicle electrical components, installing vehicle mechanical components, installing vehicle locks, latches and window regulator, installing safety kits, performing water leak test, performing vehicle road obtaining final approval, documenting and updating protocol book.

**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. Observe occupational health and safety | 1. ***Personal Protective Equipment (PPE)*** are utilized as per OSHA specifications and standard operation procedure 2. ***Tools and equipment*** are stored and maintained correctly according to manufacturer’s specifications. 3. Tools and equipment are used correctly according to designated purpose 4. Workplace housekeeping is maintained according to standard operation procedure 5. Workplace is planned according to standard operation procedure |
| 1. Install vehicle seats | 1. Vehicle floor is marked to locate seat position as per the specification sheet and KS-372 standards 2. Floor panel is drilled as per specification sheet and standard operation procedure 3. Vehicle carpet and seats are installed as per specification sheet and standard operation procedure. 4. Seat frames are tightened on the floor panel as per standard operation procedure. |
| 1. Perform vehicle glazing | 1. Glass and body panel are cleaned thoroughly as per KS-372 standards 2. Adhesive is applied to the mating flange on the body panel as per the standard operation procedure 3. Glass is placed onto the required opening and adhesive beads spread using spacers as per standard operation procedure |
| 1. Install vehicle auxiliary and fluid power systems | 1. Tools and equipment required for the installation are assembled as per the standard operation procedure 2. ***Auxiliary units*** are identified and located for assembly as per the specification sheet and standard operation procedure 3. Auxiliary units are installed as per the specification sheet and standard working procedure 4. ***Fluid power systems*** are identified and located for assembly as per the specification sheet and standard operation procedure 5. Fluid power systems are installed as per the specification sheet and standard working procedure |
| 1. Install vehicle electrical components | 1. ***Electrical components*** are identified according to specification sheet. 2. Functionality of components to be installed is tested as per standard operation procedure 3. Components are installed as per specification sheet and KS 372 standards |
| 1. Install vehicle mechanical components | 1. ***Mechanical components*** are identified according to specification sheet 2. Rule of last in, first out (LIFO) is applied to assemble as per standard operation procedure 3. Dismantled parts are re-fitted as per standard operation procedure |
| 1. Install vehicle locks, latches and window regulator | 1. Vehicle locks, latches and window regulator are identified according to specification sheet 2. Functionality of the components to be installed is tested as per the standard operation procedure 3. Components are installed per specification sheet and standard operation procedure |
| 1. Install safety kits | 1. ***Safety equipment*** to be installed are identified according to specification sheet and KS-372 standards 2. Safety equipment functionality is tested as per standard operation procedure 3. Safety kits is installed as per standard operation procedure and KS-372 standards |
| 1. Perform water leak test | 1. Full outer ***body panels and fittings*** inspection is carried out, body defects are rectified as per standard operation procedure 2. High pressure water jet is applied on vehicle body as per standard operation procedure 3. Water leaks and sealant failure points are checked and affected areas identified as per standard operation procedure 4. Leaking areas are resealed using seam sealant as per standard operating procedures |
| 1. Perform vehicle road test | * 1. Specification sheet components are checked for completeness as per standard operation procedure   2. Necessary modifications and rectification of components are done to address emergent issues as per standard operation procedure   3. Vehicle documentation is checked as per standard operating procedure   4. Official number plates are prepared and installed as per standard operation procedure   5. Vehicle is road tested as per standard operation procedure   6. Defects are identified and rectification done as per standard operation procedure |
| 1. Obtain final approval | 1. ***Documentation*** is compiled as per standard operation procedure 2. ***Final inspectors*** are invited as per KS 372 and standard operating procedures |
| 1. Document and update protocol book | 1. Specification sheet is reviewed to define the work to be performed 2. Service work done is recorded on the protocol book as per the standard operation procedure 3. Work done on the workshop job card is recorded as per the standard operation procedure |

**RANGE**

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

| **Variable** | **Range** |
| --- | --- |
| 1. Personal protective equipment may include but not limited to: | * Goggles * Earmuffs * Safety mask * Helmets * Safety boots * leather gloves * Overall |
| 1. Tools and equipment may include but not limited to: | * Soft hammer * Box spanners * Drilling machine * Rivet gun * Welding machine |
| 1. Auxiliary units may include but not limited to: | * Chevrons * Reflector strip * Round reflectors * Parcel rack |
| 1. Fluid power systems may include but not limited to: | * + - Pneumatic Door     - Hydraulic wheelchair lift ramp     - Cranes     - Winches     - Tail gates     - Truck tipper bodies |
| 1. Electrical components may include but not limited to: | * Radio * Charging sockets * Entertainment systems * Air con system |
| 1. Mechanical components may include but not limited to: | * Side mirrors * Rear view mirror * Fuel filter * Fuel tank * Exhaust system |
| 1. Safety equipment may include but not limited to: | * Fire extinguisher * Life saver * First aid kit |
| 1. Body panels and fittings may include but not limited to: | * Door panels and armrests * Sound deadening * Cigarette lighter * Window planes and windscreen * Handrails and handholds * Ventilator vents * Passenger seats * Seatbelt anchorage * Interior lightings * Door lock actuators and switches |
| 1. Documentation may include but not limited to: | * Approved design documents * Approved body builder documents * Approved materials standards * In stage approval documents * Assembly park list * Marking plate affixed on the body * Internal inspection documents |
| 1. Final inspectors may include but not limited to: | * Government vehicle inspectorate unit * Mechanical Engineers * KEBS * Ministry of transport |

**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:

* Interpretation of vehicle specification sheet
* Metal grinding and welding
* Glass glazing and joining
* Vehicle component installation

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Kenyan government motor vehicle governing regulations
* Vehicle body material types and their application
* Occupational health and safety standards
* Workshop technology practices
* Electrical installation
* Water leak testing procedures
* Vehicle body seals
* Vehicle cooling system
* Working principles of pneumatic and hydraulic systems

**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. Utilized required PPE and observed health and safety regulations during their work   2. Interpreted component installation requirements as per specification sheet   3. Installed vehicle seats with as per KS-372 standard   4. Performed vehicle glazing for front and rear wind screens   5. Installed vehicle auxiliary units   6. Installed bus and truck fluid power systems   7. Installed vehicle electrical harness   8. Installed vehicle mechanical components   9. Installed vehicle locks, latches and window regulator   10. Perform water leak test   11. Installed safety kits   12. Conducted vehicle road test   13. Documented and updating protocol book |
| 1. Resource implications | The following resources should be provided:   1. Access to relevant workplace where assessment can take place 2. Appropriately simulated environment where assessment can take place |
| 1. Methods of assessment. | Competency may be assessed through:   * 1. Practical demonstration of tasks   2. Observation   3. Written examinations |
| 1. Context of assessment. | Competency may be assessed   1. Off the job 2. On the job 3. During industrial attachment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## PERFORM VEHICLE PREVENTIVE MAINTENANCE

**UNIT CODE:** ENG/OS/ABT/CR/09/6/A

**Unit Description**

This unit of competence describes the competencies required by an Autobody Technician to perform preventive maintenance on a vehicle. It involves observing occupational health and safety, assessing vehicle operational condition, replenishing vehicle fluids, replacing service parts, adjusting specified systems, lubricating wear and tear parts, aligning electronic headlamp, resetting service reminders, performing quality test, cleaning the vehicle systems and documenting service records.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes which make up a 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. ***Personal protective equipment*** (PPE) are used according to OSHA 2007   2. Tools and equipment are used according to the designated purpose   3. ***Tools and equipment*** are maintained and stored according to manufacturer’s specifications   4. Workspace housekeeping is maintained according to standard operating procedures (SOPs)   5. Workplace is organized according to design specifications |
| 1. Assess vehicle operational condition | 1. Visible tyre ***wear patterns*** are observed in accordance with tyre manufacturer’s recommendations and legal tire regulations 2. ***Exterior lights*** are checked for functionality as per the manufacturer’s specifications 3. Wipers are checked for wear 4. Wiper nozzles for clogging 5. Instrument cluster is observed for ***warning lights*** remaining on or blinking in line with manufacturer’s recommendations 6. ***On-board diagnosis*** for all systems is performed as per standard operating procedure 7. Brake pads and linings are checked for wear as per manufacturer’s recommendations 8. ***Drive belts*** are checked for wear, abrasion, cracks and tension as per the manufacturer’s recommendations 9. Engine starting is checked for abnormal sound as per manufacturer’s recommendations 10. Vehicle is test-driven and the functioning of its clutch, transmission, brakes, steering and suspension observed as per manufacturer’s recommendations 11. Vehicle is lifted on hoist and observed for under leakages and visible anomalies as per the auto-workshop SOPs |
| 1. Replenish vehicle fluids | 1. Recommendations in manufacturer’s manuals are observed in determining when to replenish fluids, oils and lubricants 2. ***Fluids*** not due for replacement are checked for ***anomalies*** and top up is performed as per manufacturer’s recommendations 3. Used oil is drained into the disposing drain tank as per manufacturer’s recommendations 4. Drain plug is fixed and top up of respective fluids is performed as per manufacturer’s recommendations |
| 1. Replace service parts | 1. Oil filters, air filters, fuel filters, cabin filters, sparkplugs, glow plugs and drive belts are and other faulty parts replaced as per standard operating procedures 2. Wiper blades are replaced in line with manufacturer’s specifications |
| 1. Adjust specified parts | 1. Hand brake lever travel is adjusted as per the manufacturer’s recommendations. 2. Clutch, brake and accelerator pedal play and travel are adjusted as per the manufacturer’s recommendations 3. Wiper nozzles are adjusted |
| 1. Lubricate wear and tear parts | 1. Antirust (WD40) is applied to rusted friction parts according to auto-workshop SOPs 2. Lubricants are applied to door hinges and locks, window winder and window path as per auto-workshop SOPS 3. Grease is applied to ***suspension parts*** and joints as per manufacturer’s recommendations |
| 1. Align electronic headlamp | 1. Vehicle is parked on a flat level ground with headlamps aiming a plain opaque target as per workshop SOPs 2. Vehicle OBD-II port is connected with the VCI and computer in line with manufacturer’s specifications 3. ***Headlamps*** are accessed using controller and the computer in line with the manufacturer’s standard 4. Headlamps are aligned as per the manufacturer’s standards |
| 1. Reset service reminders | 1. Vehicle OBD-II port is connected with the VCI and computer as per the manufacturer’s specifications 2. Cluster/meter controller is accessed using the computer as per the software’s manufacturer’s recommendations 3. ***Service reminders*** are updated in accordance with manufacturer’s recommendations 4. Updates on counters are performed as per manufacturer’s recommendations |
| 1. Perform quality tests | 1. All work performed is rechecked as per the auto workshop SOPs and manufacturer’s recommendations 2. Fluid levels and status are confirmed as per manufacturer’s recommendations 3. Lights functionality is checked in accordance with legal requirements 4. ***Driver operated levers***, wheels, pedals and ***knobs*** are felt for free play and travel as per the manufacturer’s recommendations 5. Versatile road test is performed for: brake effectiveness, steering control and stability, engine power, transmission system effectiveness and shifting characteristics and suspension noise, vibrations and harshness in line with manufacturer’s specifications |
| 1. Clean the vehicle systems | 1. Dust is blown and wiped from sensitive under hood vehicle parts as recommended by the manufacturer 2. ***Vehicle interior***s cleaned and sprayed as per auto-workshop SOPs 3. Vehicle exterior is washed as per auto-workshop SOPs 4. Vehicle body is wiped dry as per the auto-workshop SOPs |
| 1. Document service records | 1. Service work done is recorded in owner’s manuals as per the manufacturer’s recommendations 2. Work done in recorded on the workshop job card as per the auto-workshop SOPs 3. Next service is scheduled as per 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** |
| --- | --- |
| 1. Personal protective equipment may include but not limited to: | * Goggles * Earmuffs * Safety mask * Helmets/head gear * Safety boots * Gloves * Overall/ dust coat |
| 1. Tools and equipment may include but not limited to: | * Hand tools * Power tools * Machines |
| 1. Wear patterns may include but not limited to: | * Side wear * Centre wear * Flat wear * One-side wear |
| 1. Exterior lights may include but not limited to: | * Headlamp * Parking light * Fog light * Brake lights * Reverse lights * Indicator light * Number plate |
| 1. Warning lights may include but not limited to: | * Service reminders lights * ABS light * Overheating light * Check engine light |
| 1. On-board diagnosis tests may include but not limited to: | * Engine test * Gearbox performance * Working of the ABS system * Seat-belt |
| 1. Drive belts may include but not limited to: | * V- belt * Fan belt * Alternator belt * Air Con belt * Timing chain belt * Water pump belt |
| 1. Fluids to be replenished may include but not limited to: | * Engine oil * Gearbox oil * Power steering oil * Brake/clutch fluid * Differential oil |
| 1. Anomalies may include but not limited to: | * Minor service * Major service |
| 1. Suspension parts may include but not limited to: | * Shock absorber/Strut * Control arms * Ball joints |
| 1. Headlamps may include but not limited to: | * Xenon Lamps * Halogen lamps |
| 1. Service reminders may include but not limited to: | * Fluid levels * Brakes * Plugs * Air cleaner element * Any leaks |
| 1. Driver operated levers may include but not limited to: | * Accelerator * Brake pedal * Clutch pedal (Manual cars) * Light lever * Wiper lever |
| 1. Knobs may include but not limited to: | * Bonnet stopper * Door stopper * Boot door stopper * Engine/Gearbox mountings |
| 1. Vehicle interiors may include but not limited to: | * Dashboard * Seats * Mats |

**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:

* Proper usage of tools and equipment
* Interpretation of service manuals
* Technical presentation
* Communication skills
* Problem solving
* Creativity and innovation

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Types, characteristics and purposes of different types of filters and strainers
* Types, characteristics and applications of spark and glow plugs
* Driver operated systems’ play and travel
* Fuel injector nozzles
* Interpreting manufacturer’s manuals
* Types, characteristics and applications of antirust, grease and general lubricants
* Purposes of service reminders and degradation counters
* Principles of preventive maintenance
* Tightening/torque requirements
* Workshop and road safety standards and possible hazards
* Vehicle lighting legal requirements
* Principles of power, torque and speed
* Noise, vibration and harshness detection and analysis
* Effects of water on electronics, friction surfaces and materials
* Effects of pressure on vehicle components and materials
* Pressure testing

**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. Observed occupational health and safety 2. Assessed vehicle operational condition 3. Replenished vehicle fluids 4. Replaced service parts 5. Adjusted specified parts 6. Lubricated wear and tear parts 7. Aligned electronic headlamp 8. Reset service reminders 9. Performed quality test 10. Cleaned the vehicle 11. Documented service records |
| 1. Resource implications | The following resources should be provided:   1. Access to relevant workplace where assessment can take place 2. Appropriately simulated environment where assessment can take place |
| 1. Methods of assessment | Competency in this unit may be assessed through:   1. Practical demonstration of skills 2. Observation 3. Case studies 4. Written examinations 5. Oral presentation |
| 1. Context of assessment | Competency may be assessed   1. Off the job 2. On the job 3. During industrial attachment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

## DRIVE MOTOR VEHICLE

**UNIT CODE:** ENG/OS/ABT/CR/10/6/A

**Unit Description**

This unit covers the competencies required to drive motor vehicle. It involves demonstrating road safety knowledge, demonstrating legal driving requirements knowledge, demonstrating knowledge of the model town board, demonstrating road signs knowledge, demonstrating basic knowledge of light vehicles, starting/stopping manual transmission vehicle, starting/stopping automatic transmission vehicle, demonstrating vehicle control capability, demonstrating situational driving capability and obtaining valid driving license

**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. Demonstrate road safety knowledge | 1. Highway codes are interpreted accordance NTSA Regulations 2. Safety belt is worn in accordance safety rules and regulations 3. Tyres are changed according to manufacturer’s specification 4. Vehicle is parked following High way rules 5. Safety is observed while driving as per the highway code of regulation 6. Accident procedure are followed according to traffic rules 7. Simple first aid steps are performed according traffic first aid guidelines |
| 1. Demonstrate legal driving requirements knowledge | 1. High way codes are observed as per traffic Act 2. Health and safety are observed as per traffic Act 3. Priority vehicles are recognized as per the traffic Act |
| 1. Demonstrate knowledge of the Model town board | 1. One-way traffic rule is observed in accordance to rules of the highway 2. Rules of the roundabout are observed in accordance to traffic rules 3. Change of lanes is observed as per the traffic rules 4. Road signs are observed as per the traffic rules |
| 1. Demonstrate road signs knowledge | 1. ***Road categories*** are explained as per the traffic Act 2. Hand signals are explained as per the traffic Act 3. Road sign boards are explained as per the traffic Act |
| 1. Demonstrate basic knowledge of light vehicles | 1. ***Vehicle systems*** are explained according to manufacturer’s specifications 2. ***Safety equipment*** locations are identified and can be accessed 3. ***Basic operation procedures*** are checked as per manufacturer’s specifications |
| 1. Start manual transmission vehicle | 1. Vehicle is checked according to manufacturer’s specifications 2. Mirror, safety belt and seats are adjusted, according to driver’s height 3. Ignition key is inserted according to manufacturer’s standard 4. Gear is checked to be in the neutral position 5. Engine is started as per manufacturer’s specification 6. Vehicle gears are engaged as per the manufacturer specifications |
| 1. Stop manual transmission vehicle | 1. Speed is reduced by applying pressure on the brake and clutch pedal as per manufacturer’s specification 2. Gears are shifted from high to low gear 3. Vehicle is smoothly stopped as per the manufacturer’s specification |
| 1. Start automatic transmission vehicle | 1. Vehicle is checked according to manufacturer’s specifications 2. Mirror, safety belt and seats are adjusted accordingly driver’s height 3. Ignition key is inserted according to as per the manufacturer’s specification 4. Gear lever is placed in the parking position as per the manufacturer’s specification 5. Engine is started as per the manufacturer’s specification 6. The gear shift is engaged to the drive position as per the manufacturer’s specification 7. Hand brake is released as per the manufacturer’s specification 8. Pressure is applied on the accelerator pedal and the vehicle takes off as per the manufacturer’s specification |
| 1. Stop automatic transmission vehicle | 1. Pressure is reduced on accelerator pedal as per the driving instructional manual 2. Pressure is applied on the brake pedal as per the driving instructional manual 3. Vehicle is smoothly stopped according to manufacturer’s specifications |
| 1. Demonstrate vehicle control capability | 1. Clutch and accelerator are operated without vehicle stalling according to manufacturer’s specifications 2. Clutch and brake pedal are operated without vehicle stalling according to manufacturer’s specifications 3. Kerb parking is with adequate spacing between neighbouring vehicles is performed 4. Vehicle length and width are assessed during parking and turning manoeuvres a per the driving instructional manual 5. Hard braking is performed according to manufacturer’s specifications 6. U-turn is performed according to user manual 7. Forward turn is performed according to user manual 8. Reverse turn is performed according to user manual |
| 1. Demonstrate situational driving capability (on road driving) | 1. Appropriate vehicle speed is chosen in different driving situations 2. Merging and exiting is done safely with minimum disruption to other drivers 3. Lane changing and overtaking is done safely with minimum disruption to other drivers 4. ***Correct driving behaviour*** is observed during driving and at junctions and pedestrian crossings; with or without signals and with or without restricted views |
| 1. Obtain valid driving license | 1. Registration with driving institution is done as per the Government Regulatory institution [NTSA] 2. Training is done as per Government Regulation 3. Driving test is passed as per the Traffic Act |

**RANGE**

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

| **Variable** | **Range** |
| --- | --- |
| 1. Road categories may include but not limited to: | * Class A * Class B * Class C |
| 1. Basic operation procedures may include but not limited to: | * Water level * Oil level * Braking system * Tyre wear * Indicator condition * Check headlight * Horn * Tail light * Wiper |
| 1. Vehicle systems may include but not limited to: | * Engine, ignition, accelerator and exhaust * Controls and instrumentation * Transmission and steering * Braking and suspension * Electrical system |
| 1. Safety equipment may include but not limited to: | * First aid box * Tool box * Life saver * Fire extinguisher |
| 1. Correct driving behaviour may include but not limited to: | * Stopping to check for oncoming traffic at junctions * Giving the right of way to other road uses e.g. pedestrians * Maintaining safe driving distance from the vehicle ahead * Correct use of car lights and car horn as communication tools to other road users. |

**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:

* Road communication skills
* Correct driving behavior
* Vehicle control and distance estimation
* Driving/ manufacturer’s manual interpretation
* Performing first aid procedures

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Government and regulatory processes.
* High way codes
* Traffic rules defined under the National Traffic Act
* Safety equipment
* Traffic signs and signals
* Rules of the round about
* Parking zones
* Rules of the model town board
* Health and safety
* Manufacturers manual
* Driving manuals
* First aid

**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. Demonstrated full understanding of traffic rules, road signs and allowable driving maneuvers on model town board 2. Demonstrated adequate understanding of key vehicle electrical and mechanical systems directly related to driving 3. Performed vehicle condition checks 4. Tyre is changed successfully as specified by manufacture’s driving manual 5. Observed driving safety regulations before the start and during driving process 6. Start/stop procedures and vehicle turning and parking maneuvers are performed successfully during driving practice in maneuver yard, for both manual and automatic transmission vehicles 7. Vehicle is driven without stalling during practical road driving 8. All traffic rules and regulations are observed during practical road driving 9. Correct driving behavior is demonstrated during practical road driving; when merging, existing, lane changing, overtaking, at junctions/pedestrian crossing, in road sections with and without traffic lights |
| 1. Resource implications | The following resources should be provided:   1. Access to relevant workplace where assessment can take place 2. Appropriately simulated environment where assessment can take place |
| 1. Methods of assessment | Competency may be assessed through:   * 1. Practical   2. Observation   3. Written examinations |
| 1. Context of assessment | Competency may be assessed   1. Off the job 2. On the job 3. During industrial attachment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |