

**REPUBLIC OF KENYA**

**NATIONAL OCCUPATIONAL STANDARDS**

**FOR**

**MECHANICAL PRODUCTION TECHNICIAN**

**LEVEL 6**

**ISCED CODE: 0715554A**

## 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 institutions be competency based, curriculum development be industry led, certification be based on demonstration of competence and mode of delivery to allow for multiple entry and exit in TVET programmes. These reforms demand that industry takes a leading role in occupational standards development to ensure it addresses competence needs.

It is against this background that these Occupational Standards have been developed for a competency-based mechanical production standard. 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 key role towards development of competent human resource for the engineering sector’s growth and development.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Principal Secretary,

State Department for Technical and Vocational Education and Training,

## 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 (TVET) 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.

Incumbent mechanical engineering industry experts in conjunction with expert subject trainers and other related stakeholders have developed these Occupational Standards for Mechanical Production Technician Level 5. These standards will be the basis for development of competency-based curriculum for Mechanical Production Technician Level 5.

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 everyone who participated in the development of these Occupational Standards.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Cabinet Secretary,

Ministry of Education, Science & Technology

## KEY TO ISCED UNIT CODE



## ACRONYMNS

CBET Competency Based Education and Training

OSHA Occupation Safety and Health Act

PPE Personal Protective Equipment

CAD Computer Aided Design

TVET Technical and Vocational Education and Training

DC Direct Current

DVI Digital Visual Interface

HDMI High-Definition Multimedia Interface

PLC Programmable Logic Controller

RAM Random Access Memory

USB Universal Serial Bus

VGA Video Graphics Array

MMAW manual metal arc welding

CNC Computer numerical control

## TABLE OF CONTENTS

[FOREWORD ii](#_Toc196968122)

[PREFACE iii](#_Toc196968123)

[KEY TO ISCED UNIT CODE iv](#_Toc196968124)

[ACRONYMNS v](#_Toc196968125)

[**TABLE OF CONTENTS** vi](#_Toc196968126)

[OVERVIEW 1](#_Toc196968127)

[SUMMARY OF UNITS OF COMPETENCY 1](#_Toc196968128)

[BASIC UNITS OF COMPETENCY 2](#_Toc196968129)

[APPLY DIGITAL LITERACY 3](#_Toc196968130)

[APPLY COMMUNICATION SKILLS 12](#_Toc196968131)

[APPLY WORK ETHICS AND PRACTICES 16](#_Toc196968132)

[APPLY ENTREPRENEURIAL SKILLS 22](#_Toc196968133)

[COMMON UNITS OF COMPETENCIES 28](#_Toc196968134)

[APPLY MATERIAL SCIENCE AND METALLURGY 29](#_Toc196968135)

[APPLY MATHEMATICS 36](#_Toc196968136)

[APPLY MECHANICAL SCIENCE PRINCIPLES 40](#_Toc196968137)

[APPLY TECHNICAL DRAWING 44](#_Toc196968138)

[APPLY ELECTRONICS AND CONTROL PRINCIPLES 49](#_Toc196968139)

[APPLY THERMO-FLUID PRINCIPLES 54](#_Toc196968140)

[APPLY ENGINEERING MATHEMATICS 63](#_Toc196968141)

[APPLY COMPUTER AIDED DRAWING 69](#_Toc196968142)

[APPLY ENGINEERING MECHANICS 76](#_Toc196968143)

[APPLY CONTROL SYSTEMS 81](#_Toc196968144)

[CORE UNITS OF COMPETENCY 88](#_Toc196968145)

[PERFORM GENERAL FITTING OPERATIONS 89](#_Toc196968146)

[JOIN PARTS BY WELDING 93](#_Toc196968147)

[PERFORM LATHE OPERATIONS 101](#_Toc196968148)

[PERFORM MILLING OPERATIONS 105](#_Toc196968149)

[**FABRICATE SHEET METAL PARTS** 110](#_Toc196968150)

[PERFORM GRINDING OPERATIONS 116](#_Toc196968151)

[PERFORM FORGING WORKS 120](#_Toc196968152)

[PERFORM FOUNDRY WORKS 126](#_Toc196968153)

[OPERATE CNC MILLING MACHINE 133](#_Toc196968154)

[PRODUCE PARTS BY CNC LATHE 140](#_Toc196968155)

## OVERVIEW

This document contains occupational standards designed to prescribe competences required for the qualification of Mechanical Production Technician Level 6. These competences are required to join parts by welding, fabricate sheet metal parts, lathe, milling, grinding, CNC lathe, CNC milling, perform forging works and perform foundry.

The course consists of basic, common and core units of learning as indicated hereafter:

# SUMMARY OF UNITS OF COMPETENCY

|  |  |
| --- | --- |
| **Unit Code** | **Unit Title** |
| **BASIC UNITS OF COMPETENCY** | |
| 0611 441 01A | Apply Digital Literacy |
| 0031 441 02A | Apply Communication Skills |
| 0417 441 03A | Apply Work Ethics and Practices |
| 0413 441 04A | Apply Entrepreneurial Skills |
| **COMMON UNITS OF LEARNING** | |
| 0715 441 05A | Apply material Science and Metallurgy |
| 0541 451 06A | Apply Mathematics |
| 0541 451 07A | Apply mechanical science principles |
| 0732 441 08A | Apply Technical Drawing |
| 0713 441 09A | Apply Electrical and Electronics Principles |
| 0715 541 10A | Apply thermo - fluid principles |
| 0541 541 11A | Apply Engineering Mathematics |
| 0732 551 12A | Apply computer aided drawing |
| 0715 541 13A | Apply engineering mechanics |
| 0713 541 14A | Apply control systems |
| **CORE UNIT OF LEARNING** | |
| 0715 351 15A | Perform general Fitting Operations |
| 0715 351 16A | Join Parts by Welding |
| 0715 351 17A | Perform Lathe Operations |
| 0715 351 18A | Perform Milling Operations |
| 0715 451 19A | Fabricate Sheet Metal Parts |
| 0715 451 20A | Perform Grinding Operations |
| 0715 551 21A | Perform forging works |
| 0715 551 22A | Perform foundry works |
| 0715 551 23A | Operate CNC milling machine |
| 0715 551 24A | Produce parts by CNC lathe |

# BASIC UNITS OF COMPETENCY

## APPLY DIGITAL LITERACY

**UNIT CODE:** 0611 441 01A

**UNIT DESCRIPTION:**

This unit covers the competencies required to demonstrate digital literacy. It involves operating computer devices, solving tasks using the Office suite, accessing online/offline data and information, performing online communication and collaboration, applying cybersecurity skills and performing jobs online. It also involves applying job entry techniques.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes that make up workplace functions | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements  ***(Bold and italicized terms are elaborated in the range)*** |
| --- | --- |
| 1. Operate computer devices | * 1. C***omputer device*** usage is determined as per workplace requirements.   2. ***Computer hardware*** is identified according to job requirements.   3. ***Computer software*** is identified according to workplace requirements.   4. Computer devices are turned on or off as per the correct workplace procedure.   5. ***Mouse techniques*** are applied in solving tasks as per workplace requirements.   6. Keyboardtechniques are applied in solving tasks as per workplace requirements.   7. Computer files and folders are created and managed as per workplace requirements.   8. ***Internet connection option***s are identified and applied in connecting computer devices to the Internet.   9. ***External devices*** are identified and connected to the computer devices as per the job requirement. |
| 1. Solve tasks using Office suite | 1. ***Word processing concepts***are applied in solving workplace tasks as per job requirements. 2. Worksheet data is entered and prepared in accordance with work procedures. 3. Worksheet data is built and edited in accordance with workplace procedures. 4. ***Data manipulation*** on a worksheet is undertaken in accordance with work requirements. 5. Worksheets are saved and printed in accordance with job requirements. 6. ***Electronic presentation concepts***are applied in solving workplace tasks as per job requirements. |
| 1. Manage data and information | * 1. Office ***internet services*** are identified and applied in accordance with office procedures.   2. ***Internet access applications*** are determined in accordance with office operation procedures.   3. Internet search is performed as per job requirements.   4. Online digital content is downloaded in accordance with workplace requirements.   5. Digital content is identified and backed up in accordance with workplace procedures. |
| 1. Perform online communication and collaborations | * 1. Netiquette principles are observed as per work requirements.   2. Electronic mail communication is executed in accordance with workplace policy.   3. Digital content copyright and licenses are identified and applied according to workplace policies and regulatory requirements.   4. ***Online*** ***collaboration tools*** are applied in accordance with workplace policies and regulatory requirements. |
| 1. Apply cybersecurity skills | * 1. ***Data protection*** and ***privacy*** is classified in accordance with workplace policies and regulatory requirements.   2. ***Internet security threats*** are identified as per workplace policies and regulatory requirements.   3. Computer threats and crimes are detected in accordance to Information Management security guidelines   4. ***Cybersecurity control measures*** are applied in accordance with workplace policies and regulatory requirements. |
| 1. Perform online jobs | * 1. ***Online job platforms*** are identified as per the job requirements.   2. Online accounts and profiles are created in accordance with the work requirements.   3. Online jobs are identified according to the bidder’s skillset.   4. Online digital identity is managed according to industry best practices.   5. Online job bidding is done as per the specific job requirements.   6. Online tasks are executed according to the job requirements.   7. Personal online payment account is managed in accordance with financial regulations. |
| 1. Apply job entry techniques | * 1. ***Job opportunities*** are sought based on competencies.   2. A winning resume/CV is developed as per job advertisement.   3. An application/cover letter is developed based on the job advertisement.   4. ***Certificates and testimonials*** are organized as per resume.   5. ***Interview skills*** are demonstrated as per job advertisement. |

**RANGE**

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

| **Variable** | **Range** |
| --- | --- |
| 1. Computer devices may include but are not limited to: | * Desktops * Laptops * Smartphones * Tablets * Smartwatches |
| 1. Computer hardware may include but are not limited to: | * The System Unit E.g. Motherboard, CPU, casing, * Input Devices e.g. pointing, keying, scanning, voice/speech recognition, direct data capture devices. * Output Devices e.g. hardcopy output and softcopy output * Storage Devices e.g. main memory e.g. RAM, secondary storage (Solid state devices, Hard Drives, CDs & DVDs, Memory cards, Flash drives * Computer Ports e.g. HDMI, DVI, VGA, USB type C |
| 1. Computer software may include but are not limited to: | * System software e.g. Operating System (Windows, Macintosh, Linux, Android, iOS) * Application Software e.g. Word Processors, Spreadsheets, Presentations etc. * Utility Software e.g. Antivirus programs |
| 1. External devices may include but are not limited to: | * Printers * Projectors * Smart Boards * Speakers * External storage drives * Digital/Smart TVs |
| 1. Word processing concepts may include but are not limited to: | * Creating word documents * Editing word documents * Formatting word documents * Saving word documents * Printing word documents |
| 1. Mouse techniques may include but are not limited to: | * Clicking * Double-clicking * Right-clicking * Drag and drop |
| 1. Internet connection options may include but are not limited to: | * Mobile Networks/Data Plans * Wireless Hotspots * Cabled (Ethernet/Fiber) * Dial-Up * Satellite * ISDN (Integrated Services Digital Network) |
| 1. Data manipulation may include but are not limited to: | * Use of formulae * Use of functions * Sorting * Filtering * Visual representation using charts |
| 1. Electronic presentation concepts may include but are not limited to: | * Creating slides * Editing slides * Formatting slides * Applying slide effects and transitions * Creating and playing slideshows * Saving presentations * Printing slides and handouts |
| 1. Internet services may include but are not limited to: | * Communication Services * Information Retrieval Services * File Transfer * World Wide Web Services * Web Services * Directory Services * Automatic Network Address Configuration * News Group * Ecommerce |
| 1. Internet access applications/software may include but are not limited to: | * Browsers * Email Apps * e-commerce Apps |
| 1. Online collaboration tools may include but are not limited to: | * Online Storage * Online productivity applications * Online meetings, * Online learning environments, * Online calendars * Social networks |
| 1. Data protection and privacy may include but not limited to: | * Confidentiality of data/information * Integrity of data/information * Availability of data/information |
| 1. Internet security threats may include but not limited to: | * Malware attacks * Social engineering attacks * Software supply chain attacks * Advanced persistent threats (APT) * Distributed denial of service (DDoS) * Man-in-the-middle attack (MitM) * Password attacks * IoT Attacks * [Phishing Attacks](https://onlinedegrees.sandiego.edu/top-cyber-security-threats/#phishing-attacks) * [Ransomware](https://onlinedegrees.sandiego.edu/top-cyber-security-threats/#ransomware) |
| 1. Security threats control measures may include but not limited to: | * Counter measures against cyber terrorism * Physical Controls * Technical/Logical Controls * Operational Controls |
| 1. Online job platforms may include but are not limited to: | * Remo task * Data annotation.tech * Cloud worker * Up work * Oneforma * Appen |
| 1. Job opportunities may include but not limited to: | * Self-employment * Service provision * product development * salaried employment |
| 1. Certificates and testimonialsmay include but not limited to: | * Academic credentials * Letters of previous employments/ services rendered * Letters of commendation * Certifications of participation * Awards |
| 1. Interview skills may include but not limited to: | * Listening skills * Grooming * Language command * Articulation of issues * Body language * Time management * Honesty * Generally knowledgeable in current affairs and technical area |

**REQUIRED KNOWLEDGE AND SKILLS**

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

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Computer Hardware and Software Concepts
* Computer Security Concepts (Data security and privacy)
* Cyber security threats and control measures
* Understanding Computer Crimes
* Detection and protection against computer crimes
* Laws governing protection of ICT in Kenya
* Digital Identity Management
* Netiquette Principles
* Fundamentals of Copyright and Licenses
* Word processing;
* Functions and concepts of word processing;
* Documents and tables creation and manipulations;
* Document editing;
* Document formatting;
* Word processing utilities
* Spreadsheets;
* Meaning, types and importance of spreadsheets;
* Components of spreadsheets;
* Functions, formulae, and charts, uses and layout;
* Data formulation, manipulation and application to cells;
* Editing & formatting spreadsheets;
* Presentation Packages;
* Types of presentation Packages.
* Creating, formulating, running, editing, printing and presenting slides and handouts
* Networking and Internet;
* Internet connectivity.
* Browser and digital content management;
* Managing data, information, and digital content
* Electronic mail and World Wide Web
* Fundamentals of Online Working;
* Online Profile Management;
* e-Portfolio Management;
* Online Jobs Bidding;
* Online Payment Systems;
* Job entry techniques
* Job searching sites
* Interview preparation skills
* Interview handling

**Required skills**

The individual needs to demonstrate the following skills:

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

**EVIDENCE GUIDE**

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

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

## APPLY COMMUNICATION SKILLS

**UNIT CODE:** 0031 441 02A

**UNIT DESCRIPTION**

This unit covers the competencies required to demonstrate communication skills. It involves applying communication channels, written, non-verbal, oral, and group communication skills.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes that make up workplace function | **PERFORMANCE CRITERIA**  These are assessable statements that specify the required level of performance for each of the elements.  ***Bold and italicized terms are elaborated in the Range*** |
| --- | --- |
| 1. Apply communication channels | 1. Specific communication channels are identified and applied based on workplace requirements. 2. Challenges are identified and addressed as per the operational standards of the organization. 3. Communication channels are evaluated to meet workplace needs. |
| 1. Apply written communication skills | * 1. Types of written communication are identified and applied according to the workplace requirements.   2. Written communication needs are identified and implemented according to workplace procedures.   3. Written communication guidelines are analyzed, evaluated, and revised based on workplace needs. |
| 1. Apply non-verbal communication skills | 3.1 Existing non-verbal communication techniques are identified and applied based on organization policy.  3.2 Non-verbal communication techniques are articulated to enhance inclusivity according to workplace requirements.  3.3 Non-verbal communication techniques are modeled to enhance inclusivity according to workplace requirements. |
| 1. Apply oral communication skills | 4.1 Types of oral communication are identified and established as per organization policy.  4.2 Pathways of oral communication are identified and established as per organization policy.  4.3 Pathways of oral communication are reviewed according to organization procedures.  4.4 Pathways of oral communication are maintained according to the organization standards. |
| 1. Apply group communication skills | 1. Group communication strategies are appliedbased on the workplace needs. 2. Groups are organized in accordance with workplace procedures. 3. Effective questioning, listening and non-verbal communication techniques are used as per needs.   5.4 Group communication challenges are identified and addressed according to the workplace needs. |

**RANGE**

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

| **Variable** | **Range** |
| --- | --- |
| 1. Communication strategies may include but are not limited to: | * Language switch * Comprehension check * Repetition * Asking confirmation * Paraphrasing * Clarification request * Translation * Restructuring * Generalization |
| 1. Effective group interaction may include but not limited to: | * Identifying and evaluating what is occurring within an interaction in a non-judgmental way. * Using active listening. * Making 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 are not limited to: | * Establishing rapport * Eliciting facts and information * Facilitating resolution of issues * Developing action plans |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

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

**Required Knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

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

## APPLY WORK ETHICS AND PRACTICES

**ISCED UNIT CODE:** 0417 441 03A

**UNIT DESCRIPTION**

This unit covers competencies required to effectively apply work ethics and practices. It involves the ability to: conduct self-management, promote ethical work practices and values, promote teamwork, manage workplace conflicts, maintain professional and personal development, apply problem-solving and promote customer care.

**ELEMENTS AND PERFORMANCE CRITERIA**

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

**RANGE**

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

| **Variable** | **Range** |
| --- | --- |
| 1. Feedback may include but not limited to: | * Verbal * Written * Informal * Formal |
| 1. Conflicts include but are not limited to: | * Interpersonal Conflict. * Intrapersonal Conflict. * Intergroup Conflict. * Intragroup Conflict. |
| 1. Relationships may include but not limited to: | * Man/Woman * Trainer/trainee * Employee/employer * Client/service provider * Husband/wife * Boy/girl * Parent/child * Sibling relationships |
| 1. Team may include but not limited to: | * Small work group * Staff in a section/department * Inter-agency group * Virtual teams |
| 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 include but not limited to | * Participation in training programs * Serving as Resource Persons in conferences and workshops * Capacity building |
| 1. Resource may include may but not limited to: | * Human * Financial * Technology |
| 1. Creative and innovative 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: | * Artificial Intelligence * Data confidentiality * National cohesion * Open offices |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

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

**Required Knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

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

## APPLY ENTREPRENEURIAL SKILLS

**ISCED UNIT CODE:** 0413 441 04A

**UNIT DESCRIPTION**

This unit covers the competencies required to demonstrate an understanding of entrepreneurship. It involves demonstrating an understanding of financial literacy, applying entrepreneurial concepts identifying entrepreneurship opportunities, applying business legal aspects, developing business innovative strategies, and developing business plans.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes that make up workplace function. | **PERFORMANCE CRITERIA**  These are assessable statements that specify the required level of performance for each of the elements.  ***Bold and italicized terms are elaborated in Range*** |
| --- | --- |
| 1. Apply Financial Literacy | 1. **Sources of personal and business** ***funds*** are identified as per financial procedures and standards 2. Personal finances are managed as per financial procedures and standards 3. Savings are managed as per financial procedures and standards 4. Debts are managed as per financial procedures and standards 5. Investments are undertaken as per financial procedures and standards 6. Insurance services are procured as per financial procedures and standards |
| 1. Apply entrepreneurial concept | 1. Entrepreneurs and Business persons are distinguished as per principles of entrepreneurship 2. ***Types of entrepreneurs*** are identified as per principles of entrepreneurship 3. Ways of becoming an entrepreneur are identified as per principles of Entrepreneurship 4. ***Characteristics of Entrepreneurs*** are identified as per principles of Entrepreneurship 5. Salaried employment and self-employment are distinguished as per principles of entrepreneurship 6. ***Requirements for entry into self-employment*** are identified according to business procedures and standards 7. Roles of an Entrepreneur in an enterprise are determined according to business procedures and standards 8. **Contributions of entrepreneurship** to National development are identified as per business procedures and standards |
| 1. Identify entrepreneurial opportunities | 1. Business ideas are identified as per business procedures and standards 2. Factors to consider when evaluating business opportunity viability are explored based on business procedure and standards 3. Entrepreneurial opportunities are evaluated as per business procedures and standards 4. Business ideas and opportunities are generated as per business procedures and standards 5. Business life cycle is analysed as per business procedures and standards |
| 1. Apply business legal aspects | 1. ***Forms of business ownership*** are identified as per legal procedures and practices 2. Business Registration and Licensing processes are identified as per legal procedures and practices 3. Types of Contracts and Agreements are analysed as per legal procedures and practices 4. Employment Laws are identified as per legal procedures and practices 5. Taxation laws are identified as per legal procedures and practices |
| 1. Innovate Business strategies | 1. Business innovation strategies are determined by the organization standards 2. Creativity in business development is demonstrated in accordance with business standards 3. ***Innovative business standards***  are developed as per business principles 4. Linkages with other entrepreneurs are created as per best practice 5. ICT is incorporated in business growth and development as per best practice |
| 1. Develop Business Plan | 1. Business idea is described as per business procedures and standards 2. Business description is developed as per business plan format 3. Marketing plan is developed as per business plan format 4. Organizational/Management plan is prepared in accordance with business plan format 5. Production/operation plan is prepared in accordance with business plan format 6. Financial plan is prepared in accordance with the business plan format 7. Executive summary is prepared in accordance with business plan format 8. Business plan is presented as per best practice 9. Business ideas are incubated as per institutional policy. |

**RANGE**

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

| **Variable** | **Range** |
| --- | --- |
| 1. Sources of personal funds mayinclude but not limited to: | * Salary/Wages * Investments * Savings * Inheritance * Government Benefits |
| 1. Sources of business finance mayinclude but not limited to: | * Equity Financing * Debt Financing, * Personal Savings/Investment * Retained Earnings * Grants and Subsidies * Crowdfunding * supplier Credit: * Leasing and Asset Financing: |
| 1. Types of entrepreneurs may include but not limited to: | * Innovators * Imitators * Craft * Opportunistic * Speculators |
| 1. Characteristics of Entrepreneurs may include but not limited to: | * Creative * Innovative * Planner * Risk taker * Networker * Confident * Flexible * Persistent * Patient * Independent * Future oriented * Goal oriented |
| 1. Requirements for entry into self-employment may include but not limited to | * Technical skills * Management skills * Entrepreneurial skills * Resources * Infrastructure |
| 1. Forms of businesses ownership may include but not limited to: | * Sole proprietorship * Partnership * Limited companies * Cooperatives |
| 1. Innovative business standards may include but not limited to: | * New products * New methods of production * New markets * New sources of supplies * Change in industrialization |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

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

**Required Knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

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

# COMMON UNITS OF COMPETENCIES

## APPLY MATERIAL SCIENCE AND METALLURGY

**UNIT CODE:** 0715 441 05A

**Unit Description**

This unit describes the competences required in order to apply materials and metallurgy. It includes evaluating properties of engineering materials, using iron materials, aluminium and its alloys, copper and its alloys, common non-metallic materials, performing metal testing and corrosion prevention, and applying heat treatment.

**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. Evaluate properties of engineering materials | * 1. Occupational safety and health procedures are observed as per work requirements   2. ***Engineering materials*** are selected as per task requirement   3. ***Physical properties*** of engineering materials are determined as per task requirement   4. ***Mechanical properties*** of engineering materials are determined as per task requirement   5. ***Thermal properties*** of engineering materials are determined as per task requirement   6. ***Forms of supply*** of engineering materials are selected as per task requirement |
| 1. Apply iron materials | * 1. ***Iron materials*** are selected as per task requirement   2. ***Alloy steels*** are selected as per task requirement   3. Iron material products are designed as per task requirement   4. ***Housekeeping*** is performed as per work requirements |
| 1. Apply aluminium and its alloys | * 1. Aluminium is selected as per task requirement   2. Aluminium alloys are selected as per task requirement   3. Aluminium products are designed as per task requirement   4. Aluminium alloy products are designed as per task requirement   5. Housekeeping is performed as per work requirements |
| 1. Apply copper and its alloys | * 1. Copper is selected as per task requirement   2. Copper alloys are selected as per task requirement   3. Copper products are designed as per task requirement   4. Copper alloy products are designed as per task requirement   5. Housekeeping is performed as per work requirements |
| 1. Apply heat treatment | * 1. ***Heat treatment processes*** are identified   2. Safety practices are observed during heat treatment processes   3. Heat treatment of metals is performed |
| 1. Perform metal testing | * 1. ***Metal preparation*** is performed as per task requirement   2. Testing tools, machines and equipment are set up as per task requirement   3. ***Non-destructive tests*** arecarried out as per task requirement   4. ***Destructive tests*** are carried out as per task requirement   5. Metal testing tools, machines and equipment are maintained as per task requirement   6. Housekeeping is carried out as per work requirement |
| 1. Apply common non-metallic materials | * 1. Non-metallic materials are selected according to task requirements   2. Non-metallic materials are properly handled and stored   3. Housekeeping is carried out as per work requirement |
| 1. Apply material corrosion prevention | * 1. ***Corrosion types*** are identified.   2. ***Methods of corrosion prevention*** are applied |

**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 materials include but are not limited to: | * 1. Metals and alloys   2. Ceramics   3. Composites   4. Polymers (plastics)   5. Wood |
| 1. Physical properties include but are not limited to: | * 1. Color   2. Lustre   3. Opacity   4. Magnetism   5. Texture |
| 1. Mechanical properties include but are not limited to: | * 1. Strength   2. Hardness   3. Ductility   4. Malleability   5. Toughness   6. Rigidity   7. Elasticity   8. Plasticity   9. Brittleness |
| 1. Thermal properties include but are not limited to: | * 1. Melting point   2. Linear expansivity   3. Heat capacity |
| 1. Forms of supply include but are not limited to: | * 1. Ingots   2. Bars   3. Plates   4. Pellets   5. Tubes   6. Pipes   7. Sheets   8. Strips   9. Wires |
| 1. Iron materials include but are not limited to: | * 1. Cast iron   2. Low carbon steel   3. Medium carbon steels   4. High carbon steels   5. Very high carbon steels   6. Alloy steels |
| 1. Alloy steels include but are not limited to: | * 1. Stainless steel   2. Tool steel   3. High speed steel |
| 1. Housekeeping includes but is not limited to: | * 1. Cleaning   2. Lubrication   3. Proper storage of materials and equipment   4. Waste disposal |
| 1. Heat treatment processes include but are not limited to: | * 1. Annealing   2. Normalizing   3. Hardening   4. Quenching |
| 1. Metal preparation includes but is not limited to: | * 1. Pre-cleaning   2. Surface polishing   3. Grinding   4. Cutting   5. Etching |
| 1. Non-destructive tests include but are not limited to: | * 1. Visual Inspection   2. Ultrasonic test   3. Radiographic test   4. Magnetic Particle Test   5. Dye penetrant test   6. Eddy current test   7. Acoustic emission test   8. Xray test   9. Laser test   10. Infrared (thermography) test |
| 1. Destructive tests include but are not limited to: | * 1. Tensile testing   2. Hardness testing   3. Impact test (Charpy and Izod)   4. Fatigue test   5. Creep test   6. Torsion test   7. Bend test   8. Fracture toughness test   9. Corrosion test |
| 1. Corrosion types include but are not limited to: | * 1. Galvanic   2. Stress corrosion cracking |
| 1. Methods of corrosion prevention include but are not limited to: | * 1. Painting   2. Electroplating   3. Galvinizing   4. Cathodic   5. 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:

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

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Materials
* Basic Chemistry
* Material handling
* Safety procedures

**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. Determined physical properties of engineering materials as per task requirement   2. Determined mechanical properties of engineering materials as per task requirement   3. Designed iron material products as per task requirement   4. Designed aluminium products as per task requirement   5. Designed aluminium alloy products as per task requirement   6. Designed copper products are designed as per task requirement   7. Designed copper alloy products as per task requirement   8. Carried out non-destructive tests arecarried out as per task requirement   9. Carried destructive tests out as per task requirement   10. Selected non-metallic materials according to task   11. Applied corrosion prevention types as per task requirement |
| 1. Resource implications | The following resources should be provided:  2.1 Access to relevant workplace where assessment can take place  2.2 Appropriately simulated environment where assessment can take place  2.3 Resources relevant to carrying out the tasks required |
| 1. Methods of assessment | Competency may be assessed through:   1. Project 2. Practical 3. Written tests 4. Portfolio of Evidence |
| 1. Context of assessment | Competency may be assessed:  4.1 At the workplace  4.2 In a simulated work environment |
| 1. Guidance information for assessment | * 1. Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY MATHEMATICS

**UNIT CODE:** 0541 451 06A

**UNIT DESCRIPTION:**

This unit describes the competences required in order to apply algebra, trigonometric functions, coordinate geometry, statistics, vector theorem, matrices and to carry out mensuration.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***Bold and italicized terms are elaborated in the Range.*** |
| --- | --- |
| * 1. Apply algebra | * 1. Calculations involving indices are performed as per task requirement   2. Calculations involving logarithms are performed as per task requirement   3. Scientific calculator is used in solving mathematical problems as per task requirement   4. Simultaneous equations are solved as per task requirement   5. Quadratic equations are solved as per as per task requirement |
| * 1. Apply trigonometric functions | * 1. Calculations involving trigonometry are performed as per task requirement   2. Calculations involving reciprocal trigonometric functions are performed as per task requirement   3. Pythagorean trigonometric identity is applied as per task requirement |
| * 1. Carry out mensuration | * 1. Units of measurements and their symbols are determined as per task requirement   2. Conversion of units of measurement are performed as per task requirement   3. Calculation of length, width, height, perimeter, area and angles of figures is performed as per task requirement   4. Measurements and estimations of quantities is performed as per task requirement |
| * 1. Apply statistics and probability | * 1. Presentation of data is done as per task requirement   2. Measures of ***central tendency*** are obtained as per task requirement   3. Measures of ***dispersion*** are obtained as per task requirement   4. Probability of occurrence of events are 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. Central tendency may include but not limited to: | * + Mean   + Mode   + Median |
| 1. Dispersion may include but not limited to: | * 1. Variance   2. Standard deviation |

**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
* 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

**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. Solved simultaneous equations as per task requirement   2. Solved quadratic equations as per as per task requirement   3. Performed calculations involving trigonometry as per task requirement   4. Determined normal and tangents as per task requirement   5. Performed calculation of length, width, height, perimeter, area and angles of figures as per task requirement   6. Obtained measures of central tendency as per task requirement   7. Resolution of vectors as per task requirement   8. Solved simultaneous equations using matrices as per task requirement |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place   2. Access to relevant work environment   3. Resources relevant to the proposed activities or tasks |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   * 1. Written tests   2. Portfolio of evidence   3. Third party report |
| 1. Context of Assessment | Competency may be assessed in the workplace or simulated workplace |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

## APPLY MECHANICAL SCIENCE PRINCIPLES

**UNIT CODE: 0715 441 07A**

**UNIT DESCRIPTION**

This unit describes the competences required in order to apply mechanical science. It includes resolving forces, determining effects of loads in mechanical systems, analyzing properties of materials, determining the nature of friction in mechanical systems and solving problems related to motion.

**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. Resolve forces | * 1. Theorems of forces are applied according to job requirements   2. Forces are resolved as per force theorems   3. Resultant forces are applied as per job requirements |
| 1. Determine effects of loads in mechanical systems. | 1. ***Types of forces*** are applied as per job requirements 2. Equilibrium of forces and plane framework are calculated as per job requirements 3. Point loads are analyzed as per job requirements 4. Principle of moments is applied as per work requirements. |
| 1. Analyze properties of materials | * 1. ***Mechanical properties*** and stress are applied as per job requirements   2. Mechanical properties of materials are tested as per job requirements   3. Direct stresses are calculated as per job requirements   4. Materials are selected are as per job requirements |
| 1. Determine the nature of friction in mechanical systems | * 1. Friction is applied as per job requirements   2. Laws of friction are applied as per job requirements   3. Effects of friction are established as per job requirements   4.4 Tools and equipment are operated as per job requirements |
| 1. Solve problems related to motion. | * 1. Laws of motion are applied as per job requirements   2. Parameters of motion are calculated as per job requirements   3. Motion graphs are drawn as per job requirements   4. Relationship between linear and angular motion is established as per job 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**  ***May include but not limited to:*** |
| --- | --- |
| 1. Types of forces | * 1. Friction   2. Centrifugal   3. Centripetal   4. Gravitational   5. Inertia   6. Shear |
| 1. Mechanical properties | * 1. Tensile strength   2. Young modulus   3. Brittleness   4. Compressive strength   5. Shear strength   6. Plasticity   7. Modulus of rigidity Elasticity |

**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:

* Use of basic mechanical machines
* Perform various unit conversions of engineering quantities
* Logical thinking
* Problem solving
* Drawing graphs

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Newton’s laws of motion
* Laws of conservation of energy
* Laws of friction
* Types of forces
* Mechanical advantage and efficiency
* Properties of materials
* SI units of physical quantities
* Power, energy, work done, torque and safety factor

**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 as per force theorems   2. Applied principle of moments as per work requirements   3. Applied mechanical properties and stress as per job requirements   4. Calculated direct stresses as per job requirements   5. Applied laws of friction as per job requirements   6. Applied laws of motion as per job requirements |
| 1. Resource implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place   2. Access to relevant work environment   3. Resources relevant to the proposed activities or tasks |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   * 1. Portfolio of evidence   2. Practical test   3. Third party report   4. Written tests   5. Project work |
| 1. Context of Assessment | Competency may be assessed in the workplace or simulated workplace |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

## APPLY TECHNICAL DRAWING

**UNIT CODE:** 0732 441 08A

**UNIT DESCRIPTION**

This unit covers the competences required to apply technical drawings. It involves using technical drawing tools, equipment and materials, producing plane geometry drawings, orthographic drawings of components, solid geometry drawings, isometric drawings and assembly drawings.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT** | **PERFORMANCE CRITERIA**  ***(Bold and italicized terms are elaborated in the Range)*** |
| --- | --- |
| 1. Use and maintain drawing equipment and materials | 1.1 ***Drawing equipment*** are identified and gathered according to task requirements  1.2 ***Drawing materials*** are identified and gathered according to task requirements  1.3 Drawing equipment are used as per task requirement |
| 1. Produce plane geometry drawings | * 1. Different **types of lines** used in drawing and their meanings are identified according to standard drawing conventions   2. Different **types of angles** are constructed as per task requirement   3. Angles are bisected as per task requirement   4. Different types of angles are measured using appropriate measuring tools   5. Different types of plane geometric forms are constructed as per task requirement   6. Different scales are constructed as per task requirement |
| 1. Produce orthographic drawings of components | * 1. First and third angle orthographic sketches and drawings of components are interpreted and produced as per task requirement   2. Freehand sketching of different types of geometric forms, tools, equipment, diagrams and components is conducted as per task requirement   3. Sections of different forms of projection are constructed as per task requirement |
| 1. Produce ***solid geometry drawings*** | * 1. Sketches and drawings of patterns are produced as per task requirement   2. Solids are produced as per task requirement   3. Solids are developed and interpenetrated as per task requirement   4. Different symbols and abbreviations are applied as per task requirement   5. Auxiliary views and true shapes are produced as per task requirement |
| 1. Produce isometric drawings | 1. Isometric sketches and drawings of components are interpreted and produced as per task requirement 2. Isometric curves and circles are interpreted and produced as per task requirement 3. Oblique sketches are constructed as per task requirement |
| 1. Produce assembly drawings | 1. Parts are assembled on orthographic views as per task requirement 2. ***Sectional views*** are produced as per task requirement    1. Produced drawing is hatched as per task requirement    2. Part lists are identified as per task requirement |

**RANGE**

| **Variable** | **Range**  ***May include but is not limited to:*** |
| --- | --- |
| 1. Drawing equipment include but are not limited to: | * + Drawing boards   + T-square   + Set squares   + Drawing set |
| 1. Drawing materials include but are not limited to: | * + Drawing papers   + Pencils   + Erasers   + Masking tapes   + Paper clips |
| 1. Types of lines include but are not limited to: | * + Boarder lines   + Faint continuous lines   + Broken lines   + Chain lines   + Centre lines   + Cutting lines |
| 1. Types of angles include but are not limited to: | * + 30 degrees   + 45 degrees   + 60 degrees   + 90 degrees   + 180 degrees |
| 1. Symbols and abbreviations include but are not limited to: | * + First angle   + Third angle   + E.g. of abbreviations   + Scale- 1:2   + Diameter – D20   + Radius -R20 |
| 1. Isometric sketches and drawings include but are not limited to: | * + Use of 30 degrees |
| 1. Orthographic drawings include but are not limited to: | * + Front view   + End view   + Plan view |
| 1. Pictorial views include but are not limited to: | * + Front view   + End view   + Plan view |
| 1. Sectional views include but are not limited to: | * + Cutting lines   + Assembled view |
| 1. Geometric forms include but are not limited to: | * + Circles   + Triangles   + Rectangles   + Parallelogram   + Polygons   + Pyramids   + Conic sections   + Prisms   + Loci |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required skills**

The individual needs to demonstrate the following skills:

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

**Required knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical aspects of Competency | Assessment requires evidence that the candidate:   * 1. Used drawing equipment as per task requirement   2. Developed patterns as per task requirement   3. Developed and interpenetrated solids as per task requirement   4. Constructed sections of different forms of projection as per task requirement   5. Assembled parts on orthographic views as per task requirement |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place   2. Access to relevant work environment   3. Resources relevant to the proposed activities or tasks |
| 1. Methods of assessment | Competency in this unit may be assessed through:   * 1. Portfolio of evidence   2. Practical test   3. Third party report   4. Written tests   5. Project work |
| 1. Context of Assessment | Competency may be assessed in the workplace or simulated workplace |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

## APPLY ELECTRONICS AND CONTROL PRINCIPLES

**UNIT CODE:** 0713 541 09A

**UNIT DESCRIPTION**

This unit describes the competences required in order to apply electrical and electronics principles. It involves applying basic concepts of electrical quantities, cells and batteries, magnetism and electromagnetism, basic electrical machines and electronics principles.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***Bold and italicized terms are elaborated in the Range.*** |
| --- | --- |
| 1. Apply basic concepts of electrical quantities | * 1. ***SI unit***s in Electrical are identified as per task requirement   2. ***Quantitie***s of Charge, force, work and power are applied as per task requirement   3. Calculations involving Ohm’s law are performed as per task requirement   4. Measuring instruments for electrical quantities are applied as per task requirement |
| 1. Apply DC and AC circuits | 1. Calculations of DC parallel and series circuits are performed as per task requirement 2. Calculations involving series resistor, inductor and capacitors in AC circuits are performed as per task requirement 3. Calculations involving parallel resistor, inductor and capacitors in AC circuits are performed as per task requirement |
| 1. Apply the concept of cells and batteries | 1. Various sources of electricity are used as per task requirement 2. Electrolysis is applied as per task requirement 3. E.M.F and internal resistance of cells is determined as per task requirement 4. Primary and secondary cells are applied as per task requirement 5. Cells and batteries are applied as per task requirement 6. Maintenance of batteries is carried out as per task requirement |
| 1. Apply magnetism and electromagnetism | * 1. Magnetic and nonmagnetic materials are used as per task requirement   2. Magnetic field patterns are utilized as per task requirement   3. Force on current carrying conductor is applied as per task requirement   4. Magnetic circuit quantities are applied as per task requirement   5. Magnetism curve and hysteresis loop are applied as per task requirement   6. Electromagnetic induction principle is applied as per task requirement |
| 1. Apply basic electrical machines | 1. E***lectrical machines*** are applied as per task requirement 2. DC machines are applied as per task requirement 3. AC machines are applied as per task requirement |
| 1. Apply electronics components | 6.1 Capacitors are applied as per task requirement  6.2 Resistors are applied as per task requirement   * 1. Inductors are applied as per task requirement   2. Diodes are applied as per task requirement   3. Application and testing of electronics components is performed as per task requirement |

**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**  May include but not limited to: |
| --- | --- |
| 1. SI unit includes but not limited to: | * 1. Power – Watts (W)   2. Current – Amperes (A)   3. Resistance – Ohms(Ω)   4. Voltage – Volts (V) |
| 1. Quantities includes but not limited to: | * + Charge   + Force   + Work   + Power |
| 1. Electrical machinesinclude but not limited to: | * + DC motors   + Transformers   + Generators DC |

**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:

* Use of electrical instruments
* Power factor correction
* Logical thinking
* Problem solving
* Drawing graphs
* Using different measuring tools

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Electrical power calculations
* Electrical formulas
* Power triangle
* SI units of various electrical parameters
* Types of electrical machines for various uses
* Types and purpose of measuring instruments
* Units of measurement and abbreviations

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical aspects of competency | Assessment requires evidence that the candidate:   * 1. Applied quantities of Charge, force, work and power as per task requirement   2. Performed calculations involving Ohm’s law as per task requirement   3. Performed calculations of DC parallel and series circuits as per task requirement   4. Determined E.M.F and internal resistance of cells as per task requirement   5. Applied force on current carrying conductor as per task requirement   6. Applied electrical machines as per task requirement   7. Applied capacitors as per task requirement   8. Applied resistors as per task requirement   9. Applied inductors as per task requirement |
| 1. Resource implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place   2. Access to relevant work environment   3. Resources relevant to the proposed activities or tasks |
| 1. Methods of assessment | Competency in this unit may be assessed through:   * 1. Oral questioning   2. Portfolio of evidence   3. Practical test   4. Third party report   5. Written tests   6. Project work |
| 1. Context of assessment | Competency may be assessed in the workplace or simulated workplace |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector and workplace job role is recommended. |

## APPLY THERMO-FLUID PRINCIPLES

**UNIT CODE:** 0715 541 10A

**Unit Description**

This unit describes the competences required in order to apply thermodynamics and fluid mechanics in their work. It includes applying steady flow processes, perfect gas, steam cycles, fuel and combustion. It also includes applying heat transfers and exchangers, fluid mechanics concepts and operating of air compressors and 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. Apply Thermodynamic Processes | 1. Apply knowledge of basic thermodynamics 2. The ***Laws of Thermodynamics*** to a Non-flow Process and Steady Flow Process are applied as per the task requirements 3. ***Thermodynamic Processes*** are applied as per the task requirements 4. ***Thermodynamics systems*** are applied as per task requirement 5. Applying heating and expansions of gases and Work done During a Non-flow Process as per the task requirements 6. General Laws for Expansion and Compression are applied as per the task requirements 7. Application of Steady Flow Energy Equation to Engineering Systems as per the task requirements |
| 1. Apply knowledge of perfect gases | 1. ***Laws of Perfect Gases*** are applied as per the task requirements 2. General Gas Equation is derived as per the task requirements 3. Characteristic Equation of Gas is applied as per the task requirements 4. Universal Gas Constant or Molar Constant is determined as per the task requirements 5. ***Specific Heat*** is determinedas per the task requirements |
| 1. Apply knowledge of steam cycle | 1. Thermodynamics ***steam cycles*** are applied as per task requirements 2. Steam systems are controlled and determined as per task requirement 3. Energy balance is carried out in steam cycles as per work requirements. 4. Thermodynamics ***steam turbines*** are applied as per task requirements |
| 1. Apply knowledge of fuel combustion | * 1. Elements and Compounds of fuel are determined as per the task requirement   2. Combustion Equations of Fuels is applied as per the task requirement   3. ***Conversion analysis*** of fuels is determined as per the task requirement   4. Mass of Carbon in Flue Gases and Mass of Flue Gases per kg of Fuel Burnt is determined as per the task requirement   5. Excess Air Supplied is determined as per the task requirement   6. Flue Gas Analysis by Ors at Apparatus is determined as per the task requirement |
| 1. Apply heat transfer and heat exchangers in fluid | 1. ***Heat transfer media*** is selected as per work requirements. 2. *Heat exchangers* are applied as per task requirement 3. Heat transfer is regulated as per task requirement |
| 1. Operate air compressors | 1. Air Compressors are classified as per the task requirements 2. Working of Single Stage Reciprocating Air Compressor is determined as per the task requirements 3. Work-done by a Single Stage Reciprocating Air Compressor without Clearance Volume is determined as per the task requirements 4. Power Required to Drive a Single Stage Reciprocating Air Compressor is determined as per the task requirements 5. Work-done by Reciprocating Air Compressor with Clearance Volume is determined as per the task requirements 6. Multistage Compression is determined as per the task requirements 7. Power Required to Drive a Two-stage Reciprocating Air Compressor is determined as per the task requirements 8. Minimum Work Required for a Two-stage Reciprocating Air Compressor is determined as per the task requirements |
| 1. Apply knowledge of flow of fluids | ***7.***1 **losses of energy in pipes** are determine as per the task requirements  7.2 the hydraulic gradient and total energy lines of the flowing fluids are determined as per the task requirements  7.3 Power Transmission of the flowing fluid Through Pipes are determine as per the task’s requirements |
| 1. Apply knowledge of viscous flow of fluids | ***8.1 Flow of Viscous Fluid*** are determined as per task requirements  8.2 Kinetic energy correction and momentum are determined as per task requirements  ***8.3 power* absorbed in viscous flow** is determined as per the task requirements |
| 1. Apply dimensional and models analysis fluids | ***9.1* Derived quantities** and dimensional homogeneity are determined as per task requirements  ***9.2 Methods of dimensional analysis*** are determined as per the task requirements  ***9.3 Model Analysis*** is applied as per the task requirements  ***9.4******Model Laws*** are applied as per the task requirements |
| 1. Operate fluid pumps | * 1. The parts of ***Fluid pumps*** are identified as per task requirement   2. Worked done and power by the Fluid pumps are determined as per task requirement   3. Specific speed of the centrifugal pump is determined as per the task requirements   4. Variation of Velocity and Acceleration in the Suction and Delivery Pipes Due to Acceleration of the Piston in reciprocating pump is determined as per the task 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. Laws of Thermodynamicsmay include but not limited to: | * First law of thermodynamics * Second law of thermodynamics * Zeroth law of thermodynamics |
| 1. Thermodynamic Processes may include but not limited to: | * Non-flow Process. * Constant Volume Process * Constant Pressure Process * Hyperbolic Process. * Constant Temperature Process * Adiabatic Process * Polytropic Process. |
| 1. Laws of Perfect Gases may include but not limited to: | * Boyle's Law * Charles' Law * Gay-Lussac Law * Joule's Law * Avogadro's Law |
| 1. Specific Heat may include but not limited to: | * Constant Volume * Constant Pressure |
| 1. Steam cycles may include but not limited to: | * Rankine * Carnot * reheat * regenerative |
| 1. Steam turbines may include but not limited to: | * Impulse Turbines * Reaction turbines |
| 1. Conversion analysis may include but not limited to: | * Mass to volume * Volume to mass |
| 1. Thermodynamics systems may include but not limited to: | * Boundary and surrounding * Closed systems * Open systems * Isolated systems * Adiabatic system * Homogeneous systems * Heterogeneous systems |
| 1. Heat transfer media may include but not limited to | * Composite wall * Slab * Thick Cylinder * Thick Sphere |
| 1. Heat exchangers may include but not limited to | * Double pipe heat exchanger * Shell and tube heat exchanger * Plate heat exchanger * Condenser and boiler heat exchanger |
| 1. Air compressor may include but not limited to | * Rotary compressors * Reciprocating compressors * Axial compressors * Centrifugal compressors |
| 1. Fluid pump may include but not limited to: | * Reciprocating pump * Centrifugal pump |
| 1. Model Analysismay include but not limited to: | * Similitude-Types of Similarities * Types of Forces Acting in Moving Fluid * Dimensionless Numbers * Reynold’s Number (Re) * Froude’s Number (Fe) * Euler’s Number (Eu) * Weber’s Number (We) * Mach’s Number (M) |
| 1. losses of energy in pipesmay include but not limited to: | * Loss of Energy (or head) Due to Friction * Loss of Head Due to Sudden Enlargement * Loss of Head Due to Sudden Contraction * Loss of Head at the Entrance of a Pipe * Loss of Head at the Exit of Pipe * Loss of Head Due to an Obstruction in a Pipe * Loss of Head Due to Bend in Pipe * Loss of Head in Various Pipe Fittings |
| 1. Flow of Viscous Fluidmay include but not limited to: | * Circular pipe * Between Two Parallel Plates |
| 1. Power absorbed in viscous flowmay include but not limited to: | * Viscous Resistance of Journal Bearings * Viscous Resistance of Foot-step Bearing * Viscous Resistance of Collar Bearing * Loss of Head Due to Friction in Viscous Flow |
| 1. Model Lawsmay include but not limited to: | * Reynold’s Model Law * Froude Model Law * Euler’s Model Law * Weber Model Law * Mach Model Law * Model Testing of Partially Sub-merged Bodies |
| 1. Methods of dimensional analysis may include but not limited to: | * Rayleigh’s method * Buckingham’s pi-theorem. |
| 1. Derived quantities may include but not limited to: | * Fundamental * Geometric * Kinematic Quantities * Dynamic Quantities |

**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
* Communication skills

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Thermodynamics cycles
* Thermodynamics systems
* Steady flow energy equations
* Laws of thermodynamics
* Perfect gas laws
* Compression and expansion of gases
* Power cycles
  + Rankine cycle
  + Regenerative cycle
  + Reheat cycle
  + Binary cycle
* Types of fuels
* Combustion equations
* Calorific values of fuels
* Combustion analysis
* Principles of heat transfer
* Heat transfer media
* Heat exchangers
* Types of compressors
* Types of fluid pumps
* Dimensional analysis

**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 thermodynamics cycles and systems as per task requirement 2. Applied steady flow energy equations as per laws of thermodynamics. 3. Applied steam systems as per task requirement 4. Controlled fuel combustion as per task requirement 5. Applied heat exchangers as per task requirement 6. Applied air compressor as per work requirements 7. Applied fluid pump as per work requirements 8. Controlled fluid flow discharge losses as per as per task requirement |
| 1. Resource implications | The following resources should be provided:  2.1 Access to relevant workplace where assessment can take place  2.2 Appropriately simulated environment where assessment can take place  2.3 Resources relevant to carrying out the tasks required |
| 1. Methods of assessment | Competency may be assessed through:   1. Practical 2. Written tests 3. Third party report 4. Portfolio of Evidence |
| 1. Context of assessment | Competency may be assessed:  4.1 At the workplace  4.2 In a simulated work environment |
| 1. Guidance information for assessment | * 1. Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY ENGINEERING MATHEMATICS

**UNIT CODE:** 0541 541 11A

**Unit Description**

This unit describes the competences required in order to apply engineering mathematics. It enables the learner to; apply algebra, apply trigonometry and hyperbolic functions, apply complex numbers, perform coordinates geometry, carry out binomial expansion, apply calculus, carry out mensuration, apply statistics, apply vector theorem and apply matrices.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***(Bold and italicised terms are elaborated in the Range)*** |
| --- | --- |
| 1. Apply complex numbers | * 1. Complex numbers are represented on Argand diagrams as per job requirement   2. ***Operations*** involving complex numbers are performed as per job requirement   3. De Moivre’s theorem is applied as per as per job requirement |
| 1. Perform coordinates geometry | * 1. Polar equations are solved as per job requirement   2. Polar equations graphs are drawn as per job requirement   3. Normal and tangents are determined as per job requirement |
| 1. Carry out binomial expansion | * 1. Binomial series is determined as per as per job requirement   2. Roots of numbers are determined as per job requirement   3. Errors of small changes are determined as per job requirement |
| 1. Apply calculus | 1. Derivatives of functions are determined as per job requirement 2. Differentiation is applied as per job requirement 3. Integrals of functions are determined as per job requirement 4. Integration is applied as per job requirement |
| 1. Apply vector theorem | * 1. Vectors and scalar quantities are defined as per job requirement   2. ***Operations*** on vectors are performed as per job requirement   3. Position vectors are determined as per as per job requirement   4. Resolution of vectors is performed as per job requirement   5. Vector and scalar products are obtained as per job requirement |
| 1. Apply matrices | * 1. Matrices operations are performed as per job requirement   2. Inverse of matrices are obtained as per job requirement   3. Simultaneous equations are solved using matrices as per job 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. Operations may include but not limited to: | * 1. Addition   2. Subtraction   3. Multiplication   4. Division |
| 1. binomial expansion | * 1. Powers   2. Coefficients   3. Pascals triangle   4. Expansion   5. Binomial theorem   6. Positive powers of n   7. Negative powers of n   8. Fractional powers of n (roots) |
| 1. calculus | * 1. Power   2. Product   3. Chain   4. Quotient |
| 1. vector theorem | * 1. Dot product   2. Cross product   3. Resolution of vectors   4. Analysis   5. Graphical Methods   6. Triangle theorem   7. Parallel theorem   8. Polygon theorem |

**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:

* 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 and understanding of:

* Basic calculus
* Geometry
* Fundamental operations (addition, subtraction, division, multiplication)
* Calculating area and volume
* 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 and understanding and range.

|  |  |
| --- | --- |
| 1. Critical aspects of competency | Assessment requires evidence that the candidate:   1. Applied complex numbers as per job requirement 2. Applied coordinates geometry as per job requirement 3. Applied calculus as per job requirement 4. Carried out binomial expansion as per job requirement 5. Applied vector as per job requirement 6. Applied matrices as per job requirement |
| 1. Resource implications | The following resources should be provided:  2.1 Access to relevant workplace where assessment can take place  2.2 Appropriately simulated environment where assessment can take place  2.3 Resources relevant to carrying out the tasks required |
| 1. Methods of assessment | Competency may be assessed through:   * 1. Written tests   2. Third party report   3. Portfolio of evidence |
| 1. Context of assessment | Competency may be assessed:   * 1. At the workplace   2. In a simulated work environment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY COMPUTER AIDED DRAWING

**UNIT CODE:** 0732 551 12A

**Unit Description**

This unit covers the competences required to perform computer aided drawing. It involves navigating CAD software, producing geometric, pictorial, and orthographic and assembly drawings as well as designing mechanical components.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements  ***(Bold and italicized terms are elaborated in the Range)*** |
| --- | --- |
| 1. Navigate CAD software | 1. Computing equipment and software are identified according to task requirement 2. Drawing ***CAD software*** is applied as per work requirements 3. CAD Software templates are identified as per drawing requirement 4. ***CAD Files*** are imported into working space as per drawing requirements 5. Symbols, codes and standards to be applied are identified according to software functionality 6. ***Drawing elements*** are applied according to task requirement 7. ***Editing tools*** are applied according to task requirement |
| 1. Produce geometric drawings | * 1. ***Drawing lines*** are identified according to standard drawing conventions   2. ***Geometrical forms*** are constructed according to standard drawing conventions   3. ***Types of angles*** are constructed according to principles of trigonometry   4. ***Geometric drawings*** are developed in accordance with standard conventions |
| 1. Produce pictorial drawings | * 1. Drawing symbols and abbreviations are applied according to standard drawing conventions   2. ***Pictorial drawings*** are produced as per work requirements   3. Pictorial drawings are saved as per work requirements |
| 1. Produce orthographic drawings. | 1. First angle orthographic drawings are developed as per standard conventions of orthographic drawings 2. Third angle orthographic drawings are developed as per standard conventions of orthographic drawings 3. Orthographic drawings are saved as per work requirements |
| 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. Orthographic and pictorial views are assembled as per drawing specifications 4. Sectional views are produced according to standard conventions of drawing 5. Parts list is developed according to drawing schematic |
| 1. Design mechanical components | 1. Mechanical components are designed as per work requirements 2. Computer aided engineering (CAE) is applied in simulation as per work requirements 3. Improvements to increase efficiency is determined according to design analysis results 4. Manufacturing database is created according to manufacturing process 5. Improvements on designed document is achieved according the manufacturing design |

**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. CAD software may include but not limited to: | * + AutoCAD   + Inventor   + SolidWorks |
| 1. CAD Files may include but not limited to | * DWG * STL * DXF * STEP |
| 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. types of lines may include but not limited to: | * Dimension lines * Hidden detail lines * Extension lines * Section lines * Break lines * Chain |
| 1. types of geometric forms may include but not limited to: | * Circle * Rectangle * Triangle * Polygon |
| 1. Types of angles may include but not limited to | * Acute * Obtuse * Right |
| 1. Geometrical drawings may include but not limited to | * 2-Dimensional * 3-Dimensional * Orthographic * Isometric |
| 1. Pictorial drawings may include but not limited to | * Isometric * Oblique * Cabinet * Cavalier |
| 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 |

**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
* Image interpretation
* Drawing synthesis
* Communication
* Computer skills
* Software navigation (manipulates 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.)
* 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 drawing CAD software as per work requirements. 2. ImportedCAD Filesinto working space as per drawing requirements. 3. Used editing tools to manipulate drawing according to customer specification 4. Developed geometric drawings according to standard drawing conventions 5. Produced pictorial drawings as per work requirements. 6. Saved Orthographic drawings as per work requirements Produced geometric drawings. 7. Assembled Orthographic and pictorial views as per drawing specifications. 8. Computer aided engineering (CAE) is applied in simulation as per work requirements. |
| 1. Resource Implications | The following resources should be provided:   1. Appropriately simulated environment where assessment can take place 2. Access to relevant work place 3. Resources relevant to the proposed activity or task. |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   1. Practical assessments 2. Project 3. Third party report 4. Written examinations 5. Portfolio of Evidence |
| 1. Context of Assessment | Competency may be assessed in a work place or a simulated workplace |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

## APPLY ENGINEERING MECHANICS

**UNIT CODE:** 0715 541 11A

**UNIT DESCRIPTION**

This unit of competency describes the competences required in order to apply engineering mechanics principles. This includes applying simple mechanisms, design belts, ropes and chain drives, design toothed gears and gear trains, design mechanical rotor dynamic machines, apply stress and strain concepts, apply simple bending theory and apply torsion theory in mechanical systems.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***Bold and italicized terms are elaborated in the Range.*** |
| --- | --- |
| 1. Apply simple mechanisms | * 1. Mechanisms are designed as per job requirement   2. Mechanisms are selected as per job requirement   3. Linkages are designed as per job requirement |
| 1. Design belts, ropes and chain drives | * 1. Belt drives are designed as per job requirement   2. Rope drives are designed as per job requirement   3. Chain drives are designed as job requirement |
| 1. Design toothed gears and gear trains | * 1. ***Toothed gears*** are designed as per job requirement   2. Toothed gears are selected as per job requirement   3. Gears are serviced as per job requirement |
| 1. Design mechanical rotor dynamic machines | * 1. Pumps are designed as per job requirement   2. Pumps are selected as per job requirement   3. Rotary compressors are designed as per job requirement   4. Fans and vanes are designed as per job requirement |
| 1. Apply stress and strain concepts in mechanical systems | * 1. Common engineering materials are selected as job requirement   2. ***Engineering components*** are designed as job requirement   3. Engineering components are selected as per job requirement |
| 1. Determine loading conditions in mechanical systems | * 1. Structures are designed as per job requirement   2. Structures are selected as per job requirement   3. Beams are designed as per job requirement   4. Beams are selected as per job requirement |
| 1. Apply simple bending theory in mechanical systems | * 1. Beams are designed as per job requirement   2. Beams are selected as per job requirement   3. Shafts are designed as per job requirement   4. Shafts are selected as per job requirement |
| 1. Apply torsion theory in mechanical systems | * 1. Torque of components is obtained as per job requirement   2. Shafts are designed as per job requirement   3. Shafts are designed as per job requirement   4. Angle of twist of components is obtained as per job requirement |

**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**  ***May include but not limited to:*** |
| 1. Simple machines | * 1. Pulley   2. Wedge   3. Inclined plane   4. Pulley   5. Wheel and axle   6. Screw jack |
| 1. Toothed gears | * 1. Bevel gears   2. Spur gears   3. Worm gears   4. Spiral bevel gears   5. Helical gears |
| 1. Engineering components | * 1. Beams   2. Thin cylinders   3. Thin shells |

**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:

* Arithmetic skills
* Mechanical machine operation
* Critical thinking
* Analytical skills

**Required knowledge**

The individual needs to demonstrate knowledge of:

* General Physics
* Engineering Mathematics
* Measurements

**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. Designed simple machines as per job requirement   2. Selected beams and shafts as per job requirement   3. Selected mechanisms as per job requirement   4. Designed belt drives as per laws of tension   5. Selected toothed gears as per job requirement   6. Designed pumps as per job requirement   7. Designed engineering components as per job requirement   8. Designed shafts as per job requirement   9. Obtained torque of components as per job requirement |
| 2. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place   2. Access to relevant work environment   3. Resources relevant to the proposed activities or tasks |
| 3. Methods of Assessment | Competency in this unit may be assessed through:   * 1. Project   2. Practical   3. Written tests   4. Oral Questioning   5. Portfolio of evidence |
| 1. 4. Context of Assessment | Competency may be assessed in a workplace or simulated workplace |
| 1. 5. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY CONTROL SYSTEMS

**UNIT CODE:** 0713 541 14A

**UNIT DESCRIPTION**

This unit describes the competences required in order to apply electronics and control principles. This includes using basic electrical quantities and principles, D.C and A.C circuits in electrical installation, applying safety requirements for electricity, electronics, magnetism and electromagnetism, single and three phase power supply and applying sensors, transducers and control principles, Cells and batteries

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes, which make up workplace function. | **PERFORMANCE CRITERIA**  These are assessable statements, which specify the required level of performance for each of the elements.  ***Bold and italicized terms are elaborated in the Range.*** |
| --- | --- |
| * + 1. Apply safety requirements for electricity | 1. Usage of ***personal protective equipment*** is demonstrated as per job requirement 2. ***Electrical hazards*** are controlled as per job requirement 3. Methods of electric hazard prevention are applied as per job requirement |
| * + 1. Apply understanding of electronics | * 1. ***Electronic component*** is identified as per job requirement   2. Functionality of the electronic components is tested as per job requirement   3. Electronic components are applied in electrical circuits as per job requirement   4. Testing of electronic circuit components is performed as per job requirement |
| * + 1. Perform single and three phase power supply | * 1. Single and three phase concept is applied in as per job requirement   2. Connections of single and three phase power supply are performed as per job requirement   3. Measurement of single and three phase power is performed as per job requirement |
| * + 1. Apply sensors and transducers principles | 1. Types of ***sensors and transducer*** are identified as per job requirement 2. Sensors and transducers mode of action are determined as per job requirement 3. Sensors and transducers components are applied as per job requirement |
| * + 1. Apply control principles | * 1. Modes of control are identified as per job requirement   2. Special features of PLC are applied as per job requirement   3. Operations of PLCs are applied as per job requirement |

**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. Electric hazard includes but not limited to: | * Shocks * Explosions * Electrocution * Burns * Fires * Electric arc |
| 1. Electrical hazard protection includes but not limited to: | * Head protection * Insulating gloves * LOTTO * Eye protection |
| 1. Electronic components includes but not limited to: | * Diodes * Capacitor * Resistors * Transistors * Fuse |
| 1. Sensors and transducermay include but not limited to: | * Temperature * Level * Displacement and proximity * Viscosity * Moisture * Humidity   Pressure |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

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

**Required knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical aspects of competency | Assessment requires evidence that the candidate:   * 1. Performed calculations involving Ohm’s law as per job requirement   2. Performed basic electrical and electronic measurements as per job requirement   3. Performed connections involving parallel and series circuits as per job requirement   4. Carried out measurement of voltages and current in AC and DC as per job requirement   5. Controlled ***electrical hazards*** as per job requirement   6. Applied electronic components in electrical circuits as per job requirement   7. Applied concepts of magnetic fields and magnetic field distribution as per job requirement   8. Applied single and three phase concepts as per job requirement   9. Applied sensors and transducers components as per job requirement   10. Applied operations of PLCs as per job requirement   11. Applied concepts of cells and batteries as per job requirement |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place   2. Access to relevant work environment   3. Resources relevant to the proposed activities or tasks |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   * 1. Project   2. Practical   3. Written tests   4. Portfolio of evidence |
| 1. Context of Assessment | Competency may be assessed in a workplace or simulated workplace |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# CORE UNITS OF COMPETENCY

## PERFORM GENERAL FITTING OPERATIONS

**UNIT CODE** : 0715 351 15A

**UNIT DESCRIPTION**

This unit describes the competencies required by a Mechanical Production Technician in order to perform general fitting operations. It includes carrying out general bench work operations, performing drilling operations, performing grinding operations, performing sawing operations, assembling parts, carrying out maintenance and housekeeping operations.

**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. Carry out general bench work operations | * 1. Safety is observed as per OSHA standards   2. Working drawing is interpreted as per drawing standards   3. Work plan is prepared as per working drawing   4. Fitting tools are identified as per task requirements   5. Measuring and marking out are carried out as per task requirements   6. *Fitting operations* are performed as per task requirements |
| 2. Perform drilling operations | * 1. Safety is observed as per OSHA standards   2. Working drawing is interpreted as per drawing standards   3. Drilling tools are identified as per task requirements   4. Cutting fluid is identified as per task requirements   5. Measuring and marking out are carried out as per task requirements   6. *Drilling operations* are performed as per task requirements |
| 3. Perform grinding operations | * 1. Safety is observed as per OSHA standards   2. Grinding methods are determined as per task requirements   3. Cutting fluid is identified as per task requirements   4. *Grinding machines* and tools are identified as per task requirements   5. Grinding operations are performed as per task requirements   6. Quality of surface finish is checked as per product requirements |
| 4. Perform sawing operations | * 1. Safety is observed as per OSHA standards   2. Sawing methods are determined as per task requirements   3. Cutting fluid is identified as per task requirements   4. *Sawing machines* and tools are identified as per task requirements   5. Sawing operations are performed as per task requirements |
| 5. Assemble parts | * 1. Safety is observed as per OSHA standards   2. Parts are assembled as per working drawings   3. Functionality of assembly is checked as per product requirements |
| 1. Carry out *maintenance* and housekeeping operations | * 1. Machine is cleaned and oiled as per workplace procedures   2. Tools and accessories are cleaned and properly stored as per workplace procedures   3. Bench and floor cleaned and waste segregated as per workplace procedures |

**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. ***Fitting operations*** | May include but not limited to;   1. Filing 2. Threading (taps and dies) 3. Scrapping 4. Riveting 5. Reaming |
| ***4. Drilling operations*** | May include but not limited to;   1. Countersinking 2. Boring 3. Counter boring 4. Drilling 5. Reaming 6. Tapping 7. Step drilling |
| ***5. Grinding machines*** | May include but not limited to;   1. Pedestal grinder 2. Bench grinder 3. Hand grinder 4. Speed cutter 5. Surface grinder |
| ***6. Sawing machines*** | May include but not limited to;   1. Hack saw 2. Slitting saw 3. Band saw 4. Reciprocating saw 5. Circular saw |
| *7.* ***Maintenance*** | May include but not limited to;   1. Corrective maintenance 2. Troubleshooting 3. Problem diagnosing 4. Replacement and repair of faulty parts 5. Routine maintenance |

**REQUIRED KNOWLEDGE AND SKILLS**

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

**Required knowledge**

The individual needs to demonstrate knowledge of:

* OSHA 2007
* WIBA 2007
* Hand tools
* Marking out tools
* Measuring tools
* Power tools
* Repair and maintenance
* Drawing Interpretation
* Job card interpretation

**Required skills**

The individual needs to demonstrate the following skills:

* Technical drawing skills
* Communication skills
* Problem solving skills
* Time management
* Numeracy skills
* Creativity
* Organizational skills

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical aspects of competency | Assessment requires evidence that the candidate:  1.1 Observed safety as per OSHA standards  1.2 Interpreted working drawing as per drawing standards  1.3 Identified fitting tools as per task requirements  1.4 Carried out measuring and marking out as per task requirements  1.5 Performed fitting operations as per task requirements  1.6 Performed drilling operations as per task requirements  1.7 Performed grinding operations as per task requirements  1.8 Checked quality of surface finish as per product requirements  1.9 Performed sawing operations as per task requirements  1.10 Assembled parts as per working drawings  1.11 Checked functionality of assembly as per product requirements  1.12 Cleaned and oiled machine as per workplace procedures  1.13 Cleaned and properly stored tools and accessories as per workplace procedures  1.14 Cleaned floor and bench and segregated waste as per workplace procedures |
| 2. Resource implications | The following resources should be provided:  2.1 Appropriate working environment where assessment can take place   * 1. Resources relevant to the proposed activities or tasks |
| 1. Methods of assessment | Competency in this unit may be assessed through:   * 1. Project work   2. Observation   3. Oral questioning   4. Portfolio of evidence   5. Third party report   6. Written tests |
| 1. Context of assessment | Competency may be assessed in workplace or a simulated workplace environment. |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace job role is recommended. |

## JOIN PARTS BY WELDING

**UNIT CODE:** 0715 451 16A

**UNIT DESCRIPTION**

This unit covers the competencies required in joining parts by welding. It involves carrying out manual metal arc welding, gas welding, brazing and soldering, MIG welding, TIG welding and maintaining welding equipment.

**ELEMENT 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. Carry out manual metal arc welding | * 1. Occupational health and safety standards are observed as per work requirement   2. Working drawing is interpreted as per the job requirement   3. Machines, tools and equipment are assembled as per the job requirement   4. ***Electrodes*** are stored in an air tight container   5. Workpiece is prepared as per the job requirement   6. Manual metal arc welding is performed on steel and copper workpiece up to 6mm thickness as per welding symbols and ***weld positions***   7. Arc welded ***product finishing*** is performed as per job requirement   8. MMAWinspectionis carried out as per job requirement   9. Housekeeping is carried out as per work procedure |
| * + 1. Carry out gas welding, brazing and soldering | * 1. Occupational health and safety standards are observed as per work requirement   2. Working drawing is interpreted as per the job requirement   3. Machines, tools and equipment are assembled as per the job requirement   4. Workpiece is prepared as per the job requirement   5. Gas welding equipment are set up as per machine manual.   6. Gas welding is performed on steel and copper up to 4mm thickness is performed as per job requirement.   7. Gas cutting is performed on steel and copper up to 4mm thickness is performed as per job requirement.   8. Brazing is performed on steel and copper up to 4mm thickness is performed as per job requirement.   9. Soldering is performed on steel and copper up to 4mm thickness is performed as per job requirement.   10. Welded product finishing is performed as per job requirement   11. Gas welding inspectionis carried out as per job requirement   12. Housekeeping is carried out as per work procedure |
| * + 1. Carry out metal inert gas welding (MIG) | * 1. Occupational health and safety standards are observed as per work requirement   2. Working drawing is interpreted as per the job requirement   3. Machines, tools and equipment are assembled as per the job requirement   4. Workpiece is prepared as per the job requirement   5. MIG welding is performed on steel up to 12mm thickness is performed as per job requirement.   6. MIG welding product finishing is performed as per job requirement   7. MIG weldinginspectionis carried out as per job requirement   8. Housekeeping is carried out as per work procedure |
| * + 1. Carry out tungsten inert gas welding (TIG) | * 1. Occupational health and safety standards are observed as per work requirement   2. Working drawing is interpreted as per the job requirement   3. Machines, tools and equipment are assembled as per the job requirement   4. Workpiece is prepared as per the job requirement   5. TIG welding is performed on stainless steel up to 4mm thickness is performed as per job requirement.   6. TIG welding product finishing is performed as per job requirement   7. TIG weldinginspectionis carried out as per job requirement   8. Housekeeping is carried out as per work procedure |
| * 1. Maintain welding tools and equipment | 1. Maintenance schedule is prepared as per manufacturers manual. 2. Welding Machines, tools and equipment are cleaned and lubricated as per the Manual. 3. Welding Machines, tools and equipment are inspected as per the Manual. 4. Faults on welding Machines, tools and equipment are identified and reported/rectified and as per sops. 5. Maintenance report is prepared as per the organization policy. |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range**  May include but not limited to: |
| * 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. Welding equipment | * MMAW welding machine * Gas welding machine * MIG welding machine * TIG welding machine |
| 1. Materials | * Stainless Steel * Plain carbon steel |
| 1. Welded joints | * Lap joint * Butt joint * Corner joint * T-joint * Edge joint |
| 1. Welding positions | * Flat position * Horizontal position * Vertical position * Overhead position |
| 1. Product finishing. | * Buffing * Grinding * Polishing * Plating. * Electro-Coating. * Blasting * Brushing |
| 1. Welding electrodes | * Metal electrodes * Carbon electrodes * Graphite electrodes * Platinum electrodes * Glass electrodes * Tungsten electrode * Aluminum electrode |
| 1. Destructive testing | * Tensile Test * Bend test |
| 1. Non-Destructive testing | * Dye-penetrant |

**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:

* Design of working drawing
* Interpreting working drawings
* Preparing joints
* welding
* Cutting
* Manipulation of electrodes
* Product assessment
* Observation of safety

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Workplace procedures and OSHA
* Welding equipment
* Joint preparation
* Types of electrodes
* Welding techniques and specification procedure
* Setting current on welding equipment
* BS and ISO welded joint standards
* Applications of MMAW, gas welding, brazing and soldering, MIG welding and TIG welding
* Welding and gas cutting techniques
* welding safety procedures
* Workplace housekeeping procedures

**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 and health as per Workplace procedures and OSHA   2. Produced detail design of manual metal arc welding component as per drawing standards.   3. Selected materials, tools and equipment   4. Prepared joints as per working drawing   5. Set up welding equipment in accordance with job specifications   6. Welded work piece using welding equipment process as per job specifications and ISO 9606-1   7. Examined welded Work pieces as per   ISO 17637   * 1. Dressed welded joint as per standard operating procedures   2. Maintained welding equipment as per manufacturers manual.   3. Carried out housekeeping as per organization requirement. |
| 1. Resource Implications | The following resources must be provided:   * 1. Welding workshop equipped with:      1. Welding Machines      2. welding consumables and equipment      3. welding Personal Protective Equipment      4. weld testing equipment |
| 1. Methods of Assessment | 3.1 Observation  3.2 Oral questioning  3.3 Written tests  3.4 Projects |
| 1. Context of Assessment | 4.1 On-job  4.2 Simulated workplace environment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## PERFORM LATHE OPERATIONS

**UNIT CODE :** 0715 351 17A

**UNIT DESCRIPTION**

This unit describes the competencies required by a Mechanical Production Technician in order to perform lathe operations. It includes interpreting working drawings, setting work piece and tool(s) on lathe machine, setting up lathe machine, performing lathe machine operations and carrying out lathe maintenance.

**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 working drawings | * 1. Job card is signed for and interpreted   2. Working drawing is interpreted as per drawing standards   3. Work plan is prepared as per the working drawing   4. Materials are selected as per work plan   5. Tools are identified and selected as per work plan   6. Accessories are identified and selected as per work plan |
| 1. Set work piece and tool(s) on lathe machine | 1. Work piece is mounted as per task requirements 2. Tools are prepared as per set standards 3. Tools and accessories are mounted as per task requirements 4. True running of work piece is checked |
| 1. Set up lathe machine | * 1. Speeds and feeds are selected as per manufacturer’s specifications   2. Cutting fluid is identified as per task requirements   3. *Mode* *of operation* is identified as per task requirements |
| 1. Perform *lathe machine operations* | * 1. Safety is observed as per OSHA standards   2. Housekeeping is observed as per workplace regulations   3. Trial test is performed   4. Machining is carried out as per task requirements   5. Dimensions are checked and adjusted as per task specifications   6. Quality of surface finish is checked as per product specifications |
| 1. Carry out lathe maintenance | * 1. Maintenance requirements are identified as per workplace procedures   2. Preventive maintenance is carried out as per machine manual   3. Corrective maintenance is carried out as per machine manual |

**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. *Mode* *of operation* | * Semi-Automatic * Manual |
| 1. *Lathe machine operations* | May include but not limited to;   * Turning * Drilling * Facing * Chamfering * Threading * Parting * Knurling * Boring * Forming |

**REQUIRED KNOWLEDGE AND SKILLS**

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

**Required knowledge**

The individual needs to demonstrate knowledge of:

* OSHA and WIBA 2007
* Hand tools
* Marking out, measuring and cutting tools
* Repair and maintenance
* Job card and drawing Interpretation

**Required skills**

The individual needs to demonstrate the following skills:

* Technical drawing skills
* Communication skills
* Problem solving skills
* Time management
* Numeracy skills
* Creativity
* Organizational skills

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical aspects of competency | Assessment requires evidence that the candidate:   * 1. Interpreted working drawing as per drawing standards   2. Selected materials as per task requirements   3. Identified and selected tool as per the working drawing   4. Identified and selected accessories per working drawing   5. Mounted work piece as per task requirements   6. Selected speeds and feeds as per manufacturer’s specifications   7. Observed safety as per OSHA standards   8. Carried out machining as per task requirements   9. Checked and adjusted dimensions as per task requirements   10. Checked quality of surface finish as per products specifications |
| 2. Resource implications | The following resources should be provided:  2.1 Appropriate working environment where assessment can take place   * 1. Resources relevant to the proposed activities or tasks |
| 3. Methods of assessment | Competency in this unit may be assessed through:   * 1. Project work   2. Observation   3. Oral questioning   4. Portfolio of evidence   5. Third party report   6. Written tests |
| 4. Context of assessment | Competency may be assessed in workplace or a simulated workplace environment. |
| 5. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace job role is recommended. |

## PERFORM MILLING OPERATIONS

**UNIT CODE** : 0715 351 18A

**UNIT DESCRIPTION**

This unit describes the competencies required by a Mechanical Production Technician in order to perform milling operations. It includes interpreting working drawings, setting work piece and tool(s) on milling machine, setting up milling machine, performing milling machine operations and carrying out milling machine maintenance.

**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 working drawings | * 1. Safety is observed as per OSHA standards   2. Housekeeping is observed as per workplace regulations   3. Working drawing is interpreted as per drawing standards   4. Work plan is prepared as per the working drawing   5. Materials are selected as per task requirements   6. Tools and accessories are identified as per task requirements |
| 2. Set work piece and tool(s) on milling machine | * 1. Work piece is marked out as per task requirements   2. Work piece is mounted and aligned as per task requirements   3. Tools and accessories are selected as per task requirements   4. Tools and accessories are mounted as per task requirements |
| 3. Set up milling machine | * 1. *Mode of milling operation* is identified a requirements   2. Speeds and feeds are selected as per manufacturer’s specifications   3. Cutting fluid is identified as per task requirements |
| 4. Perform milling machine operations | * 1. *Milling machine operations* are identified as per task requirements   2. Machining is carried out as per task requirements   3. Dimensions are checked and adjusted as per working drawing |
| 5. Carry out milling machine maintenance | * 1. Maintenance requirements are identified as per workplace procedures   2. *Preventive maintenance* is carried out as per machine manual   3. Corrective maintenance is carried out as per machine manual |

**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. Mode of milling operation*** | * Semi-Automatic * Manual * Conventional/Up milling * Climb/Down milling |
| ***2. Milling machine operations*** | Milling machine operations may include but not limited to;   * Face milling * Progressive milling * Profile milling * End milling * Form milling * Gang milling * Slitting * Slab milling * Straddle milling |
| ***3. Preventive maintenance*** | May include but not limited to;   * Troubleshooting * Problem diagnosing * Replacement and repair of faulty parts * Routine maintenance |

**REQUIRED KNOWLEDGE AND SKILLS**

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

**Required knowledge**

The individual needs to demonstrate knowledge of:

* OSHA 2007
* WIBA 2007
* Hand tools
* Marking out tools
* Measuring tools
* Power tools
* Repair and maintenance
* Drawing Interpretation
* Job card interpretation

**Required skills**

The individual needs to demonstrate the following skills:

* Technical drawing skills
* Communication skills
* Problem solving skills
* Time management
* Numeracy skills
* Creativity
* Organizational skills

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical aspects of competency | Assessment requires evidence that the candidate:  1.1 Observed safety as per OSHA standards  1.2 Interpreted working drawing as per drawing standards  1.3 Selected materials, tools and accessories as per task requirements  1.4 Marked out work piece is as per task requirements  1.5 Mounted and aligned tools, accessories and work piece as per task requirements  1.6 Selected speeds and feeds as per manufacturer’s specifications  1.7 Carried out machining as per task requirements  1.8 Checked and adjusted dimensions as per working drawing  1.9 Cleaned and oiled machine as per manufacturer’s specifications  1.10 Cleaned work and segregated waste as per workplace procedures |
| 2. Resource implications | The following resources should be provided:   * 1. Appropriate working environment where assessment can take place   2. Resources relevant to the proposed activities or tasks |
| 1. Methods of assessment | Competency in this unit may be assessed through:   * 1. Project work   2. Practical assessment   3. Observation   4. Oral questioning   5. Portfolio of evidence   6. Third party report   7. Written tests |
| 1. Context of assessment | Competency may be assessed in workplace or a simulated workplace environment. |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace job role is recommended. |

## **FABRICATE SHEET METAL PARTS**

**UNIT CODE:** 0715 451 19A

**UNIT DESCRIPTION**

This unit covers the competencies required in fabricating sheet metal parts. It involves preparing working drawing, sheet metal work operation plan and sheet metal work piece, performing sheet metal work operations, inspecting finished work, maintaining sheet metal work tools and equipment.

**ELEMENT AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace function | **PERFORMANCE CRITERIA**  These are assessable statements specifying the required performance level for each element.  ***Bold and italicized terms*** ***are elaborated in the Range*** |
| 1. Prepare working drawing | * 1. Requirements of the sheet metal component are identified as per job specifications.   2. Freehand sketch of the sheet metal component is produced as per the job specification.   3. Working drawing of the sheet metal component is produced as per drawing standards.   4. Sheet metal component working drawing is submitted for approval as per organisation procedure. |
| 1. Prepare sheet metal work operation plan | * 1. Sheet metal work plan are prepared as per working drawing.   2. Identified sheet metal operations and sequenced as per the work requirement.   3. Tools and equipment are identified as per sheet metal operations.   4. Materials are identified as per working drawing specification. |
| 1. Prepare sheet metal work piece | * 1. Personal safety gear is worn as per occupational health and safety requirements.   2. Health and safety procedures are applied as per work requirement.   3. Materials, tools and equipment are selected as per operation plan.   4. Work area is organised as per organisation procedures.   5. Workpiece dimensions are measured and marked out as per working drawing specifications.   6. Workpiece material is cut as per working drawing specifications. |
| 1. Perform sheet metal work operations | * 1. Sheet metal work operations are carried out as per job specifications.   2. Workpieces are joined as per working drawing specifications.   3. Forming operations are carried out on the component as per working drawing specifications.   4. Finishing operations are carried out on the component as per working drawing specifications. |
| 1. Maintain sheet metal work tools and equipment | * 1. Maintenance schedule is prepared as per manufacturer’s manual   2. Moving machine parts are lubricated as per manufacturers manual   3. Faults on machines and tools are identified and reported as per workplace procedures   4. Broken tools are repaired as per manufacturers manual. |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Sheet metal work operations | Sheet metal work operations include but not limited to:   * Cutting * Folding * Bending * Notching * Painting * Shearing * Punching * Stretching * Embossing |
| 1. Personal safety gear   Includes but not limited to: | Personal safety gear includes but not limited to:   * 1. PPEs   2. Gloves   3. Safety boots   4. Safety glasses   5. Face shields |
| 1. Health and Safety procedures   Includes but not limited to: | * 1. PPEs   2. Work permits   3. Waste management   4. Electrical wiring color coding   5. Danger warning signage   6. Barricades   7. High voltage signage   8. Fire extinguishers   9. Health policy |
| 1. Discrepancies | Discrepancies include but not limited to:   * Dents * wrinkles * Riveting faults * Paints |
| 1. Faults on machines | Faults on machines include but not limited to:   * Dull blades * Blade misalignments * Incorrect clearances * Insufficient clamping pressers * Dull or damaged punches and dies |

**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:

* Metal working skills
* Interpretation skills
* Problem solving skills
* Mathematical skills
* Measurements skills

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Knowledge on materials
* Finishing techniques
* Methods of joining
* Forming techniques
* Corrosion and its prevention
* Safety
* Basic engineering principles

**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 requirements of the sheet metal component as per job specification   2. Produced working drawing of the sheet metal component as per drawing standards   3. Sequenced sheet metal operations as per the task requirement   4. Identified tools and equipment as per identified sheet metal operations   5. Applied health and safety procedures as per work requirement.   6. Measured and marked work piece dimensions as per working drawing specification   7. Cut work piece material as per working drawing specifications   8. Carried out sheet metal work operations as per job specifications.   9. Joined work pieces as per working drawing specification   10. Carried out finishing operations on the component as per working drawing specifications.   11. Checked dimensional tolerances as per working drawing specifications.   12. Tested finished work for functionality as per design requirement. |
| 1. Resource Implications | * 1. Cutting Machine   2. Rolling Machine   3. Bending machine   4. Punching machine   5. Drilling machine   6. Hand shearing machine   7. Hand tool and measuring instruments   8. Inspection tools   9. Gas welding set   10. Sheet metal materials   11. Resource materials, manuals for cutting tools and machine tools   12. Material safety data sheets   13. Occupational and safety act Kenya 2007 |
| 1. Methods of Assessment | * 1. Written   2. Observation (project)   3. Third party report |
| 1. Context of Assessment | 4.1 On-job  4.2 Simulated workplace environment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## PERFORM GRINDING OPERATIONS

**UNIT CODE:** 0715 451 20A

**UNIT DESCRIPTION**

This unit covers the competencies required in performing grinding operations. It involves preparing grinding operation plan, setting up grinding machine, operating grinding machine, inspecting ground component, maintaining grinding machine and tools.

**ELEMENT AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace function | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***Bold and italicized terms*** ***are elaborated in the Range*** |
| 1. Prepare grinding operation plan. | 1.1 Working drawing is interpreted according to International Technical Drawing Standards.   * 1. ***Grinding machine types*** are identified according to job specifications.   2. ***Grinding wheel*** is selected as per job requirement.   3. Work piece is prepared as per working drawing specification.   4. ***Grinding operations*** are scheduled as per job description. |
| 1. Set up grinding Machine | * 1. Occupational health and safety standards are observed as per workplace requirement.   2. Grindingmachine is inspected as per manufacturer’s manual.   3. Grinding machine wheel is mounted as permanufacturer’s manual.   4. Cutting fluids are selected according to job specifications.   5. Grinding machine feed and speedare selected based on the manufacturer’s manual. |
| 1. Operate grinding machines. | * 1. Mounted the work piece on the grinding machine   2. Work piece is groundas per job specifications.   3. Grinding machine performance is monitored as per the standard operating procedure. |
| 1. Maintain grinding machine and tools. | * 1. Grinding Machines and tools are cleaned and lubricated as per the Manual.   2. Grinding discs and tools are inspected as per the Manual.   3. Grinding wheel dressing is carried out as per requirement.   4. Grinding wheel truing is carried out as per requirement.   5. Worn out/cracked discs are replaced per manual.   6. Worn out magnetic brushes are replaced as per the machine manual.   7. Maintenance report is prepared as per the organization policy.   8. Performed house keeping |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range**  May include but not limited to: |
| 1. Grinding machine types | * + Portable grinding machine   + Bench grinding machine   + Pedestal grinding machine   + Surface grinding machine   + Cylindrical grinding machine   + Precision grinding machine   + Non-precision grinding machine |
| 1. Grinding wheel | * + Selection   + Mounting and balancing   + Maintenance |
| 1. Faults | * Chatter * Wheel loading * Wheel glazing * Searching of work * Feed lines or spirals on work piece * Bell-mounted * Out-of-round hole distortion |

**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:

* Mathematical skills.
* Problem solving skills.
* Maintenance skills.
* Digital literacy skills
* Product assessment

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Workplace housekeeping procedures
* Occupational Safety and Health Act of Kenya laws 2007 with focus on personal safety, equipment safety and workplace
* Applicable machine operation standards
* Material selection criteria
* Documentation and production processes
* Machine settings
* Engineering Science and Mathematics principles
* Principles of management.
* Applicable machine operation 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:  1.1 prepared operational plan as per the working drawing.   1. Set up grinding machine as per job specifications and manufacturer’s manual 2. Operated grinding machines as per job specifications and manufacturer’s manual 3. Maintained grinding machines and tools as per manufacturer’s manual. 4. Housekeeping performed as per organization’s policy |
| 1. Resource Implications | 1. Appropriately simulated environment where assessment take place. 2. Access to relevant workplace environment. 3. Resources relevant to the proposed activities or tasks |
| 1. Methods of Assessment | 1. Observation 2. Oral questioning 3. Written tests 4. Projects |
| 1. Context of Assessment | Competency may be assessed:  4.1 On the job   * 1. Simulated workplace environment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## PERFORM FORGING WORKS

**UNIT CODE:** 0715 551 21A

**UNIT DESCRIPTION**

This unit covers the competencies required in performing forging works. It involves preparing working drawing, preparing forging operation plan, preparing forging workpiece, operating forging equipment, performing forging operations, inspecting forged components and maintaining forging tools and machines.

**ELEMENT AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace function | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***Bold and italicized terms*** ***are elaborated in the Range*** |
| 1. Prepare working drawing | 1. Requirements of the forging work are identified as per job specification. 2. Freehand sketch of the forging work component is produced as per job specification. 3. Detailed working drawing of the forging work component is produced as per drawing standards. 4. Forging work component detailed working drawing is submitted for approval as per organization procedure. |
| 1. Prepare forging operation plan | * 1. ***Forging operations*** are identified as per working drawing   2. Identified forging operations are sequenced as per the task requirement   3. Tools, equipmentand accessories are identified as per task requirement.   4. Materials are identified as per working drawing specifications. |
| 1. Prepare forging workpiece | 1. ***Personal safety gear*** is worn as per occupational health and safety requirements. 2. Housekeeping is performed as per requirements. 3. Materials, tools and equipment are selected as per operation plan 4. Work area is organized as per organization procedures 5. Workpiece dimensions are measured and marked out as per working drawing specification 6. Workpiece material is cut as per working drawing specification |
| 1. Set up forging tools and equipment | 1. ***Forging equipment*** condition is checked as per manufacturer’s manual 2. Tools and accessories are mounted as per task requirement 3. Forging equipment parameters are set as per manufacturer’s manual |
| 1. Perform forging operations | * 1. Prescribed personal safety gear is worn out as per occupational health and safety standards.   2. Forging workpiece is heated as per the material requirement   3. Forging material is loaded into the die as per task requirement   4. Forging material is shaped in the die as per task requirement   5. ***Finishing processes*** are carried out on the forged component as per task requirement   6. Dimensions are checked as per working drawing specifications   7. Identified discrepancies are rectified as per working drawing specification. |
| 1. Inspect forged components | * 1. Inspection tools and equipment are identified as per operation plan   2. Dimensions tolerances are checked as per working drawing specification   3. Surface finish is checked as per working drawing specification   4. Finished work is tested for functionality as per design requirement.   5. Inspection report is compiled as per standard operating procedures |
| 1. Maintain forging tools, machines and equipment | * + Maintenance schedule is prepared as per manufacturer’s manual   + Moving machine and equipment parts are lubricated as per manufacturers manual   + Faults on machines, tools and equipment are identified and reported as per workplace procedures   + Broken tools are repaired as per manufacturers manual   + Maintenance report is prepared as per organizational requirements. |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range**  May include but not limited to: |
| * + - 1. Forging operations | * + Cold forging   + Hot forging |
| * + - 1. Tools | * + Hammers   + Anvil   + Die   + Tongs   + Presses |
| * + - 1. Personal safety gear | * + Heat resistant clothing   + Heat resistant gloves   + Heat resistant safety boots   + Respirators   + Earmuffs |
| * + - 1. Forging equipment | * + Presses   + Heating furnace   + Forging sticks |
| * + - 1. Finishing processes | * 1. Polishing   2. Buffing   3. Machining   4. Heat treatment |

**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:

* Drawing and design skills
* Communication skills
* Problem solving skills
* Analytical skills
* Forging techniques
* Using measuring and inspection tools and equipment
* Troubleshooting machine faults
* Using manufacturer’s manuals

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* OSHA 2007
* WIBA 2007
* Marking out tools
* Measuring tools
* Power tools
* Machine maintenance
* Engineering drawing and design
* Inspection tools and equipment
* Forging methods

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| Critical aspects of Competency | * 1. Produced detailed working drawing of the forging work component as per drawing standards.   2. Prepared forging operation plan as per working drawing   3. Prepared forging workpiece as per task requirement   4. Set up forging tools and equipment   5. Performed forging operations as per operation plan   6. Inspected forged components as per working drawing specification.   7. Maintained forging tools, machines and equipment as per manufacturer’s manual   8. Performed housekeeping as per OSHA and occupational procedures. |
| Resource Implications | The following resources should be provided:   * 1. A workshop equipped with:      1. Heating equipment      2. Forging tools, equipment and accessories      3. Engineering materials      4. Measuring and inspection tools and equipment |
| Methods of Assessment | Competency in this unit may be assessed through:   1. Observation (Project work, Practical assessment) 2. Oral questioning 3. Written tests 4. Portfolio of evidence 5. Third party report |
| Context of Assessment | Competency in this unit may be assessed through:   1. On the job 2. Simulated work environment i.e., in a training institution |
| Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## PERFORM FOUNDRY WORKS

**UNIT CODE:** 0715 551 22A

**UNIT DESCRIPTION**

This unit covers the competencies required in performing foundry works. It involves preparing working drawing, preparing casting operation plan, produce moulding patterns, prepare moulding sand, make sand mould, melt casting materials, pour molten melting and inspect casting.

**ELEMENT AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace function | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***Bold and italicized terms*** ***are elaborated in the Range*** |
| 1. Prepare working drawing | * 1. Requirements of casting work are identified as per job specifications.   2. Free hand sketch of casting work is produced as per job specification.   3. Detailed drawing of cast work is produced as per drawing standards.   4. Detailed casting drawing is submitted for approval as per organization procedure. |
| 1. Prepare casting operation plan | * 1. Working drawing is interpreted according to technical drawing standards***.***   2. **Casting operations** are identified as per working drawing.   3. Identified operations are sequenced as per job specifications.   4. ***Tools and equipment*** are identified based on operations   5. Materials are identified as per working drawing specifications. |
| 1. Produce moulding patterns | * 1. Safety is observed according to OSHA standards   2. Perform house keeping   3. ***Pattern making Material*** is selected as per the job specification.   4. Pattern making tools and equipment are selected as per the job requirement.   5. ***Pattern*** is selected as per job specification.   6. Pattern is constructed as per working drawing.   7. Pattern parts are assembled as per the specifications. |
| 1. Prepare moulding sand | 1. Moulding tools and equipment are selected as per job specification. 2. ***Moulding sand*** is selected as per job requirements. 3. Moulding sand is conditioned as per specifications. 4. Additives are incorporated as per specification. 5. M***oulding sand is tested*** as per standards. |
| 1. Make sand mould | 1. ***Moulding process*** is selected as per job specification. 2. Pattern is placed on the flask as per the requirements. 3. Flask is filled with the moulding sand as per requirement. 4. Mould cores (cavities) are made as per job requirement. 5. Coal dust is spread in the inner lining of the moulding core. 6. Mould is assembled as per specification. 7. Pouring channels and vents are prepared as per job requirement. |
| 1. Melt casting materials | 1. Materials to be melted are selected as per job specification. 2. ***Furnace*** is selected as per the material. 3. Furnace is set up as per the manual 4. Furnace is charged as per requirements 5. Preheating and fluxing is carried out as per requirements. 6. Temperature is increased gradually to the melting point. 7. Skimming is performed as per the guidelines 8. Temperature is controlled by use ***pyrometer*** as per the guidelines. |
| 1. Carry Out Casting Process | 1. Pouring temperature is observed as per requirement. 2. Molten metal is poured onto the prep-made sand mould as per requirement. 3. The cast is removed from the mould as per job specification. |
| 1. Inspect casting | * 1. ***Inspection tools*** and equipment are assembled as per the work requirements.   2. Visual inspection carried out as per specifications.   3. Dimensions are confirmed as per the job specification.   4. Destructive and non-destruction tests are carried out as the manual.   5. ***Casting defects*** are rectified as per requirements.   6. Heat treatment is carried out as per the standard operating procedures.   7. Cast is ***finished*** as per the dimensions.   8. Inspection report is compiled as per organization requirement. |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range**  May include but not limited to: |
| * + - 1. Foundry tools and equipment | * Hand tools * Moulding boxes * Mechanical tools |
| * + - 1. Pattern making materials | * Wood * Plastic * Metals * Wax |
| * + - 1. Types of patterns | * Two piece pattern * Multi-piece pattern * Match plate pattern * Gated pattern * Skeleton pattern * Cope and drag pattern * Loose piece pattern |
| * + - 1. Types of moulding sand | * Green sand mould * Dry-sand mould * Skin dried sand mould * Shell moulds * Loam sand mould |
| * + - 1. Moulding processes | * Bench moulding * Floor moulding * Pit moulding * Plate moulding * Flask less moulding * Vacuum moulding * Machine moulding |
| * + - 1. Types of furnaces | * Cupola furnace * Induction furnace * Crucible furnace * Blast furnace * Electric furnace |
| * + - 1. Pyrometers may | * Optical pyrometer * Radiation/infrared pyrometer |
| * + - 1. Inspections tools | * + Tools for visual inspection   + Tools for destructive and non-destructive test. |
| * + - 1. Casting defects | * + Porosity defects   + Shrinkage defect   + Warping   + Sinks   + Slags inclusions   + Dross   + Hot tears   + Cold shut |
| * + - 1. Finishing process in casting | * + Trimming   + Machining   + Grinding   + Fettling   + Shot blast   + Heat treatment |

**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:

* Engineering Materials
* Problem solving skills
* Communication skills
* Casting techniques
* Mould making skills
* Pattern making skills
* Digital literacy skills

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Casting methods
* Workplace housekeeping procedures
* Occupational Safety and Health Act of Kenya laws 2007 with focus on personal safety, equipment safety and workplace
* Applicable machine operation standards
* Material selection criteria
* Documentation and production processes
* Machine settings
* Engineering Science and Mathematics principles
* Principles of management Applicable machine operation standards

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| Critical aspects of Competency | Assessment requires evidence that the candidate:   * 1. Produced detailed drawing of cast work is as per drawing standards.   2. Identified tools and equipment based on operations   3. Produced moulding patterns as per job description and working drawing.   4. Prepared moulding sand as per requirements.   5. Made sand mould as per job specification.   6. Melted metal in the furnace as per manufacturer’s manual.   7. Poured molten metal to the mould cavity as per the procedures.   8. Inspected casted parts as per the job requirements   9. Performed housekeeping as per the organization’s policy. |
| Resource Implications | 1. Workplace: Real or simulated work area 2. Appropriate Tools & equipment 3. Materials relevant to the activity |
| Methods of Assessment | 1. Written 2. Oral questioning/interview 3. Observation 4. Third party report 5. Project |
| Context of Assessment | Competency may be assessed:  4.1 On-job  4.2 Simulated workplace environment |
| Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## OPERATE CNC MILLING MACHINE

**UNIT CODE:** 0715 551 23A

**UNIT DESCRIPTION**

This unit covers the competencies required in operating a CNC Milling machine. It involves preparing working drawing, milling operation plan, performing CNC Milling programming, setting up CNC Milling machine, performing CNC Milling operations, carrying out CNC milling operations and maintaining CNC milling machine and tools

**ELEMENT AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace function | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***Bold and italicized terms*** ***are elaborated in the Range*** |
| 1. Prepare working drawing | * 1. Required mechanical components of the milling work are identified as per job specification.   2. Freehand sketch of the mechanical component is produced as per job specification   3. Detailed working drawing of the mechanical component is produced as per drawing standards   4. Mechanical component detailed working drawing is submitted for approval as per organization procedure.   5. Safety is observed as per OSHA standards   6. Perform housekeeping operations |
| 1. Prepare CNC Milling operation plan | * 1. ***CNC Milling machine operations*** are identified as per working drawing   2. Tools are identified as per milling machine operations to be carried out.   3. Materials are identified as per working drawing specification.   4. Identified milling machine operations are sequenced as per the task requirement |
| 1. Set up CNC Milling machine | * 1. Work piece is mounted on the chuck as per the operation plan.   2. CNC Milling Machine ***parameters*** are set as per manufacturers manual   3. ***Clamping devices*** are set and tightened according to standard operating procedures. |
| 1. Perform CNC Milling programming | * 1. Preparatory commands are identified as per operation manual   2. Coordinate system is set as per machine specifications   3. CNC milling machine programs are written according to manufacturer’s manual. |
| 1. Carry out CNC Milling operations | * 1. Program software is loaded into the CNC milling machine as per the software manual   2. Program is simulated on the CNC Milling machine as per software manual   3. Workpiece is machined as per operation plan.   4. Corrective measures are performed, if necessary, as per work requirement.   5. Finished product is removed from the CNC milling machine as per operation plan.   6. CNC Milling machine is shut down as per manufacturers manual. |
| 1. Inspect finished work | * 1. Inspection tools and methods selected as per operation plan   2. Dimensions of finished work are inspected as per drawing specification.   3. Adjustments are made based on inspections results |
| 1. Maintain CNC milling machine and tools | * 1. CNC Milling Machines are inspected as operation manual   2. Trouble shooting is carried out on CNC Milling machines and tools as per maintenance manual   3. Machines and tools are cleaned as per operation manual   4. CNC milling machine parts are lubricated in accordance with service manual.   5. Tools and equipment are stored as per organization policy   6. Regular back-ups and virus checks are performed as per software manual |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| * + - 1. CNC Milling machine operations | CNC Milling machine operations include but not limited to:   * + Flat Milling   + Pocket Milling   + Slot Milling   + Drilling   + Boring   + Threading   + Smoothing   + Deburring   + Engraving   + 5- axis machining |
| * + - 1. CNC Milling Machine parameters | CNC Milling Machine parameters include but not limited to:   * + Spindle speed   + Feed rate   + Cutting speed   + Depth of cut   + Width of depth   + Width of cut   + Feed per tooth |
| * + - 1. CNC Milling machine clamping devices | CNC Milling machine clamping devices include but not limited to:   * + Toggle clamp   + Screw clamps   + Step blocks   + Vacuum tables   + Vacuum cups   + Vices   + Soft jaws |

**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
* Tooling and set up
* Machine operation skills
* Technical drawing
* Measurement and inspection
* Trouble shooting
* Communication skills
* CNC programming

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Knowledge of materials
* Finishing techniques
* CNC Milling machine cutters and equipment
* Heat treatment
* Safety
* Basic Engineering Principles
* Interpreting technical drawing
* Basic Mathematics
* Measurements
* CNC Milling machine defects and correction
* CNC Milling machine components
* CNC Milling machine types
* CNC Milling machine Cutting fluids

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| Critical aspects of Competency | Assessment requires evidence that the candidate:   * 1. Produced detailed working drawing of the mechanical component as per drawing standards.   2. Prepared CNC Milling operation plan as per working drawing specification.   3. Set up CNC Milling machine as per working drawing specification.   4. Carried out CNC Milling operations as per operation plan.   5. Inspected finished work as per working drawing specification.   6. Maintained CNC milling machine and tools as per manufacturers manual.   7. Perform housekeeping as per OSHA. |
| Resource Implications | * 1. CNC Milling machine   2. Cutting tools   3. Work holding devices   4. Coolant system   5. CAD software   6. Safety equipment   7. Materials |
| Methods of Assessment | * 1. Written   2. Oral questioning/interview   3. Observation (project)   4. Third party report |
| Context of Assessment | Competency may be assessed:  4.1 On-job  4.2 Simulated workplace environment |
| Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## PRODUCE PARTS BY CNC LATHE

**UNIT CODE:** 0715 551 24A

**UNIT DESCRIPTION**

This unit covers the competencies required in producing parts by CNC lathe. It involves preparing working drawing and CNC lathe operation plan, setting up CNC lathe machine, programming CNC lathe, performing CNC lathe operations, inspecting finished product and maintaining lathe tools and machines.

**ELEMENT 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*** |
| Prepare working drawing | * 1. Required mechanical components are identified as per job specifications.   2. Free hand sketch of mechanical component is produced as per job specification.   3. Mechanical component detailed design is produced as per drawing standards.   4. Mechanical component detailed design is s submitted for approval as per organization procedure.   5. Perform safety practices as per OSHA standards   6. Perform house keeping |
| Prepare CNC lathe operation plan. | * 1. Working drawing is interpreted according to local and international standards.   2. Toolsare identified based on CNC operations to be carried out.   3. Materials are identified as per working drawing specifications.   4. CNC lathe operations are sequenced as per standard operation procedures. |
| 1. Set up CNC lathe machine | * 1. Machine referencing is carried out as per the manufacturer’s manual.   2. ***Tool set up*** is carried out as per manufacturers manual.   3. Coolant, oil and hydraulic levels are checked as per manufacturers manual.   4. ***Clamping devices*** are set and tightened according to standard operating procedures.   5. Work piece set up is carried out as per job specification. |
| 1. Program CNC lathe | * 1. Tool path geometry and machine function are identified as per the working drawing.   2. CNC lathe ***machine programs*** are written or modified as per working drawing.   3. Machining parameters are determined as per work specifications.   4. Coordinate system is set as per working sequence.   5. Program is generated or inputted as per the working drawing.   6. Machining sequences are simulated for accuracy as per work specifications.   7. Trial runs are conducted to check machine operation and quality of finished work as per operation Manual   8. CNC programs are edited as per requirement.   9. Tool parameters are corrected as per requirement. |
| 1. Perform CNC lathe operations | * 1. Program is loaded on machine interface as per the machine manual.   2. CNC lathe machine operation execution is carried out as per standard machine manual.   3. Monitoring and adjustments are carried out as per requirement.   4. Finished product is safely removed from the machine as per machine manual.   5. CNC lathe machine is shut down as per machine manual. |
| 1. Inspect finished product. | * 1. Inspection tools and methods are selected as per operation plan   2. Dimensions of finished product checked as per drawing specification.   3. Adjustments are made based on inspections results. |
| 1. Maintain CNC lathe tools and machines | * 1. CNC lathe Machines are inspected as manufacturers manual.   2. Faults on machines and tools identified and reported as per organization policy.   3. Preventive maintenance is carried out as per manufacturers manual.   4. Tools and equipment are stored as per organization policy. |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Tool set up | Tool set up **include** but not limited to:   * + Tool mounting   + Tool holding   + Tool offset   + Tool wear compensation |
| 1. Clamping devices | Clamping devices include but not limited to:   * + Pneumatic chuck   + Conventional chuck   + Collets   + Faceplate   + Steady rests |
| 1. Machine programs | Machine programs include but not limited to:   * + G and M   + APT |

**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
* Tooling and set up
* Machine operation skills
* Technical drawing
* Measurement and inspection
* Trouble shooting

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Knowledge of materials
* Finishing techniques
* CNC lathe machine tools and equipment
* Safety
* Basic Engineering Principles
* Preparing engineering drawings
* Basic Mathematics
* Measurements and inspection
* CNC Milling machine defects and correction
* CNC lathe machine components
* CNC lathe machine types
* CNC lathe machine Cutting fluids

**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. Produced detailed working drawing of the mechanical component as per drawing standards.   2. Prepared CNC lathe operation plan as per working drawing specification.   3. Set up CNC lathe machine as per working drawing specification.   4. Carried out CNC lathe operations as per operation plan.   5. Inspected finished work as per working drawing specification.   6. Maintained CNC lathe machine and tools as per manufacturers manual.   7. Perform housekeeping as per OSHA. |
| * + - 1. Resource Implications | The following resources should be provided:   * 1. A workshop equipped with:      1. CNC lathe machine      2. Tool and accessories      3. Engineering materials      4. Measuring and inspection tools and equipment |
| * + - 1. Methods of Assessment | * 1. Written   2. Oral questioning/interview   3. Observation   4. Third party report   5. Case studies |
| * + - 1. Context of Assessment | Competency may be assessed:   1. On the job 2. Simulated workplace environment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |