****

**MINISTRY OF EDUCATION**

**OCCUPATIONAL STANDARDS**

**FOR**

**CIVIL ENGINEERING TECHNICIAN**

**KNQF LEVEL 6**

**OS ISCED PROGRAMME CODE: 0732 554 A**

©2025

All rights reserved. No part of this Curriculum may be reproduced, distributed, or transmitted in any form or by any means, including photocopying, recording, or other electronic or mechanical methods without the prior written permission of ………. except in the case of brief quotations embodied in critical reviews and certain other non-commercial uses permitted by copyright law. For permission requests, write to the …………… at the address below:

**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 Kenya’s development blue print and sustainable development goals.

Reforms in the education sector are necessary for the achievement of Kenya Vision 2030 and meeting the provisions of the Constitution of Kenya 2010. The education sector had to be aligned to the Constitution and this resulted to the formulation of the Policy Framework for Reforming Education and Training (Sessional Paper No. 4 of 2016). A key feature of this policy is the radical change in the design and delivery of the TVET training. The policy document requires that training in TVET shall be competency based, curriculum development shall be industry led, certification shall be based on demonstration of competence and mode of delivery shall allow for multiple entry and exit in TVET programs.

These reforms demand that Industry takes a leading role in curriculum development to ensure the curriculum addresses its competence needs. It is against this background that this Occupational Standard has been developed for the purpose of informing development of a competency-based Highway Engineering technician Level 6 Curriculum. This Occupational Standard will also form the basis for assessment of an individual for competency certification.

It is my conviction that this Occupational Standard will play a great role towards development of a competent human resource for the Construction Sector’s growth and sustainable development.

**CABINET SECRETARY**

**PREFACE**

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

The Technical and Vocational Education and Training Act No.

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

The industry in conjunction with national polytechnics and other national agencies have developed this Civil Engineering technician Level 6 Occupational Standard. The Standard is designed and organized with clear performance criteria for each element of a unit of competency. It also outlines the required knowledge and skills for the performance of prescribed tasks as well as evidence guide for assessment purposes.

PRINCIPAL SECRETARY

.

TABLE OF CONTENTS

[**FOREWORD** 2](#_Toc196928669)

[**PREFACE** 3](#_Toc196928670)

[KEY TO UNIT CODE 5](#_Toc196928671)

[OVERVIEW 7](#_Toc196928672)

[BASIC UNITS OF COMPETENCY 9](#_Toc196928673)

[APPLY DIGITAL LITERACY 9](#_Toc196928674)

[APPLY COMMUNICATION SKILLS 20](#_Toc196928675)

[APPLY WORK ETHICS AND PRACTICES 25](#_Toc196928676)

[APPLY ENTREPRENEURIAL SKILLS 33](#_Toc196928677)

[COMMON UNITS OF COMPETENCY 42](#_Toc196928678)

[APPLY MATHEMATICAL PRINCIPLES 43](#_Toc196928679)

[APPLY ALGEBRA AND GEOMETRY 48](#_Toc196928680)

[TRIGONOMETRY AND COMPLEX NUMBERS 52](#_Toc196928681)

[CALCULUS AND DIFFERENTIAL METHODS 56](#_Toc196928682)

[APPLY STRUCTURAL ANALYSIS PRINCIPLES 61](#_Toc196928683)

[VECTORS, MATRICES AND DATA ANALYSIS 67](#_Toc196928684)

[**APPLY CONSTRUCTION MATERIAL SCIENCE I** 72](#_Toc196928685)

[APPLY CONSTRUCTION MATERIALS SCIENCE II 77](#_Toc196928686)

[PREPARE TECHNICAL DRAWING 83](#_Toc196928687)

[PREPARE FOR MATERIALS TESTING 89](#_Toc196928688)

[CONDUCT MATERIAL TESTING I 94](#_Toc196928689)

[CONDUCT MATERIAL TESTING II 98](#_Toc196928690)

[APPLY WORKSHOP TECHNOLOGY PRACTICES 103](#_Toc196928691)

[APPLY STRUCTURAL ANALYSIS PRINCIPLES I 109](#_Toc196928692)

[APPLY STRUCTURAL ANALYSIS PRINCIPLES 11 113](#_Toc196928693)

[APPLY STRUCTURAL ANALYSIS PRINCIPLES III 118](#_Toc196928694)

[APPLY MEASUREMENTS, ESTIMATION AND COSTING PRINCIPLES I 122](#_Toc196928695)

[APPLY MEASUREMENTS, ESTIMATION AND COSTING PRINCIPLES II 126](#_Toc196928696)

[APPLY MEASUREMENTS, ESTIMATION AND COSTING PRINCIPLES 129](#_Toc196928697)

[APPLY HYDRAULIC PRINCIPLES 134](#_Toc196928698)

[CONDUCT HIGHWAY ENGINEERING RESEARCH PROJECT I 139](#_Toc196928699)

[CONDUCT HIGHWAY ENGINEERING RESEARCH PROJECT II 143](#_Toc196928700)

[CORE UNITS OF COMPETENCY 148](#_Toc196928701)

[PERFORM TRAFFIC SURVEY 148](#_Toc196928702)

[CARRY OUT CIVIL WORKS 1 153](#_Toc196928703)

[CONDUCT MATERIAL TESTING 159](#_Toc196928704)

[CARRY OUT HIGHWAY ENGINEERING SURVEY 167](#_Toc196928705)

[DESIGN ROAD STRUCTURES I 175](#_Toc196928706)

[DESIGN ROAD STRUCTURES II 181](#_Toc196928707)

[CARRY OUT ROAD CONSTRUCTION WORKS 187](#_Toc196928708)

[DESIGN HIGHWAY ENGINEERING STRUCTURES 196](#_Toc196928709)

[DESIGN HIGHWAY ENGINEERING STRUCTURES 200](#_Toc196928710)

[SUPERVISE HIGHWAY ENGINEERING PROJECTS 204](#_Toc196928711)

# KEY TO UNIT CODE

**Sector / Industry**

**Sub Sector**

**Occupational Area**

**Version Control**

**Unit of Competence Number**

**ISCED level, Programme Orientation and Level of Completion**

xx

x

xxx

x

xx

x

**ABBREVIATIONS AND ACRONYMS**

2D- Two Dimensions

3D- Three Dimensions

AP- Arithmetic Progression

BoQ- Bill of quantities

CAD - Computer Aided Design

CESMM- Civil engineering Standard Method of Measurement

CBET - Competency Based Education and Training

CBR- Carlifornia Bearing Ratio

CD - Compact Disk

CPU - Central Processing Unit

CV - Curriculum Vitae

DPM - Damp Proof Membrane

DVD - Digital Versatile Disk

DVI - Digital Visual Interface

EMCA - Environmental Management and Coordination Act

EPS - Expanded Polystyrene

HDMI - High Definition Multimedia Interface

ICT - Information Communication Technology

IOT - Internet of Things

GIS- Geomatics Information Science

GP- Geometric Progression

GPS- Global Positioning System

ISCED - International Standard Classification of Education

MITM - Man in the Middle

NNP - Nyeri National Polytechnic

ODE- Ordinary Differential Equations

PhD - Doctor of Philosophy

POE- Portfolio of Evidence

PPEs - Personal Protective Equipment

RAM - Random Access Memory

SMM - Standard Method of Measurement

SMP- Standard For Mathematics Practice.

TD- Technical Drawing

TVET - Technical Vocational Education and Training

URI - Uniform Resource Identifier

USB - Universal Serial Bus

VGA - Video Graphics Array

CPM - Critical Path Method

PERT - Program Evaluation Review Technique

CIDB - Construction Industry Development Board

HVAC - Heating, Ventilation and Air Conditioning

# OVERVIEW

The Civil Engineering Technician Level 6 consists of competencies that a trainee must achieve to enable them to work in the Construction Sector. It entails conducting material testing, carrying out civil engineering survey, designing road structures, carrying out road construction works, producing civil engineering drawings, carrying out civil engineering construction works, designing civil engineering structures, designing water supply and waste water infrastructure, conducting research in civil engineering field and supervising civil engineering projects.

**BASIC UNITS OF COMPETENCY**

|  |  |
| --- | --- |
| **Unit of competency Code** | **Units of competency** |
| 0611 451 01A | Apply Digital Literacy |
| 0031 441 02A | Apply Communication Skills |
| 0031 541 03A | Apply work ethics and practices |
| 0413 541 04A | Apply Entrepreneurial Skills |

**COMMON UNITS OF COMPETENCY**

|  |  |
| --- | --- |
| **Unit Code** | **Unit Title** |
| 0541 551 05A | Apply Engineering Mathematics |
| 0732 551 06A | Apply algebra and geometry |
| 0722 551 07A | Apply Trigonometry and Complex Numbers |
| 0719 551 08A | Apply Calculus and Differential methods |
| 0732 551 09A | Apply Vectors, Matrices and Data Analysis |
| 0732 551 10A | Prepare Technical Drawing |
| 0722 451 11A | Apply Construction Materials Science 1 |
| 0722 551 12A | Apply Construction Materials Science 11 |
| 0719 551 13A | Apply Workshop Technology Practices |
| 0732 551 14A | Perform Structural Analysis Principles I |
| 0732 551 15A | Perform Structural Analysis Principles II |
| 0732 551 16A | Perform Structural Analysis Principles III |
| 0732 551 17A | Perform Measurements, Estimation and Costing principles I |
| 0732 551 18A | Perform Measurements, Estimation and Costing principles II |
| 0732 551 19A | Perform Measurements, Estimation and Costing principles III |
| 0732 551 20A | Apply hydraulic principles |
| 0732 551 21A | Conduct Civil engineering research project I |
| 0732 551 22A | Conduct Civil engineering research project II |

|  |  |
| --- | --- |
| **CORE UNITS OF COMPETENCY** | |
| 0732 451 23A | Prepare for Material Testing |
| 0732 551 24A | Conduct material testing I |
| 0732 551 25A | Conduct material testing II |
| 0732 451 26A | Carry Out Site Survey |
| 0732 551 27A | Carry Out Engineering Survey I |
| 0732 551 28A | Carry out engineering survey II |
| 0732 551 29A | Design Road Structures I |
| 0732 551 30A | Design Road Structures II |
| 0732 551 31A | Produce Civil Engineering Drawing I |
| 0732 551 32A | Produce Civil Engineering Drawing II |
| 0732 551 33A | Carry Out Road Construction Works I |
| 0732 551 34A | Carry Out Road Construction Works II |
| 0732 551 35A | Design Civil engineering structures I |
| 0732 551 36A | Design Civil engineering structures II |
| 0732 551 37A | Carry out Civil Engineering Works I |
| 0732 551 38A | Carry out Civil Engineering Works II |
| 0732 551 39A | Design Water Supply Infrastructure |
| 0732 551 40A | Design Waste Water Supply Infrastructure |
| 0732 551 41A | Supervise Civil Engineering Projects |

# BASIC UNITS OF COMPETENCY

## APPLY DIGITAL LITERACY

**UNIT CODE:** 0611 541 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 cyber security 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 collaboration | * 1. Netiquette principles are observed as per work requirements   2. Electronic mail communication is executed in accordance with workplace policy   3. Digital content copyright and licenses are identified and applied according to workplace policies and regulatory requirements   4. ***Online*** ***collaboration tools*** are applied in accordance with workplace policies and regulatory requirements |
| 1. Apply 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. ***Cyber security control measures*** are applied in accordance with workplace policies and regulatory requirements |
| 1. Perform online jobs | * 1. ***Online job platforms*** are identified as per the job requirements   2. Online accounts and profiles are created in accordance with the work requirements   3. Online jobs are identified according to the bidder’s skillset   4. Online digital identity is managed according to industry best practices   5. Online job bidding is done as per the specific job requirements   6. Online tasks are executed according to the job requirements   7. Personal online payment account is managed in accordance with financial regulations |
| 1. Apply job entry techniques | * 1. ***Job opportunities*** are sought based on competencies   2. A winning resume/CV is developed as per job advertisement   3. An application/cover letter is developed based on the job advertisement   4. ***certificates and testimonials*** are organized as per resume   5. ***Interview skills*** are demonstrated as per job advertisement |

**RANGE**

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

| **Variable** | **Range** |
| --- | --- |
| 1. Computer devices may include but are not limited to: | 1. Desktops 2. Laptops 3. Smartphones 4. Tablets 5. Smartwatches |
| 1. Computer hardware may include but are not limited to: | 1. The System Unit E.g. Motherboard, CPU, casing, 2. Input Devices e.g. Pointing, keying, scanning, voice/speech recognition, direct data capture devices. 3. Output Devices e.g. hardcopy output and softcopy output 4. Storage Devices e.g. main memory e.g. RAM, secondary storage (Solid state devices, Hard Drives, CDs & DVDs, Memory cards, Flash drives 5. Computer Ports e.g. HDMI, DVI, VGA, USB type C etc. |
| 1. Computer software may include but are not limited to: | 1. System software e.g. Operating System (Windows, Macintosh, Linux, Android, iOS) 2. Application Software e.g. Word Processors, Spreadsheets, Presentations etc 3. Utility Software e.g. Antivirus programs |
| 1. External devices may include but are not limited to: | 1. Printers 2. Projectors 3. Smart Boards 4. Speakers 5. External storage drives 6. Digital/Smart TVs |
| 1. Word processing concepts may include but are not limited to: | 1. Creating word documents 2. Editing word documents 3. Formatting word documents 4. Saving word documents 5. Printing word documents |
| 1. Mouse techniques may include but are not limited to: | * 1. Clicking   2. Double-clicking   3. Right-clicking   4. Drag and drop |
| 1. Internet connection options may include but are not limited to: | * 1. Mobile Networks/Data Plans   2. Wireless Hotspots   3. Cabled (Ethernet/Fiber)   4. Dial-Up   5. Satellite   6. ISDN (Integrated Services Digital Network) |
| 1. Data manipulation may include but are not limited to: | * 1. Use of formulae   2. Use of functions   3. Sorting   4. Filtering   5. Visual representation using charts |
| 1. Electronic presentation concepts may include but are not limited to: | * 1. Creating slides   2. Editing slides   3. Formatting slides   4. Applying slide effects and transitions   5. Creating and playing slideshows   6. Saving presentations   7. Printing slides and handouts |
| 1. Internet services may include but are not limited to: | * 1. Communication Services   2. Information Retrieval Services   3. File Transfer   4. World Wide Web Services   5. Web Services   6. Directory Services   7. Automatic Network Address Configuration   8. NewsGroup   9. Ecommerce |
| 1. Internet access applications/software may include but are not limited to: | * 1. Browsers   2. Email Apps   3. eCommerce Apps |
| 1. Online collaboration tools may include but are not limited to: | * 1. Online Storage   2. Online productivity applications   3. Online meetings,   4. Online learning environments,   5. Online calendars   6. Social networks |
| 1. Data protection and privacy may include but not limited to: | * 1. Confidentiality of data/information   2. Integrity of data/information   3. Availability of data/information |
| 1. Internet security threats may include but not limited to: | * 1. Malware attacks   2. Social engineering attacks   3. Software supply chain attacks   4. Advanced persistent threats (APT)   5. Distributed denial of service (DDoS)   6. Man-in-the-middle attack (MitM)   7. Password attacks   8. IoT Attacks   9. [Phishing Attacks](https://onlinedegrees.sandiego.edu/top-cyber-security-threats/#phishing-attacks)   10. [Ransomware](https://onlinedegrees.sandiego.edu/top-cyber-security-threats/#ransomware) |
| 1. Security threats control measures may include but not limited to: | * 1. Counter measures against cyber terrorism   2. Physical Controls   3. Technical/Logical Controls   4. Operational Controls |
| 1. Online job platforms may include but are not limited to: | * 1. Remotask   2. Data annotation.tech   3. Cloudworker   4. Upwork   5. Oneforma   6. Appen |
| 1. Job opportunities may include but not limited to: | * 1. Self-employment   2. Service provision   3. product development   4. salaried employment |
| 1. Certificates and testimonialsmay include but not limited to: | * 1. Academic credentials   2. Letters of previous employments/ services rendered   3. Letters of commendation   4. Certifications of participation   5. Awards |
| 1. Interview skills may include but not limited to: | * 1. Listening skills   2. Grooming   3. Language command   4. Articulation of issues   5. Body language   6. Time management   7. Honesty   8. 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:

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

**Required skills**

The individual needs to demonstrate the following skills:

1. Active listening
2. Keyboard Skills
3. Mouse Skills
4. Analytical skills
5. Creativity
6. Interpretation Skills
7. Communication
8. Spread sheet operations (applying fundamental operations such as addition, subtraction, division and multiplication)
9. Computer Use Safety Skills
10. Document Editing Skills
11. Document Formatting Skills
12. Document Printing Skills
13. Netiquette Skills
14. Internet Browsing Skills
15. Problem Solving Skills
16. Online Collaboration Skills
17. Cyber security Skills
18. CV writing
19. 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 cyber security 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. Observation   2. Oral assessment   3. Portfolio of evidence   4. Interviews   5. Third party report   6. Written assessment   7. Practical assessment   8. Projects |
| 1. Context of assessment | Competency may be assessed:   * 1. Workplace or simulated workplace |
| 1. Guidance information for assessment | * 1. Holistic assessment with other units relevant to the industry sector and workplace job role is recommended |

## APPLY COMMUNICATION SKILLS

**UNIT CODE:** 0031 541 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 analysed, evaluated, and revised based on workplace needs |
| 1. Apply non-verbal communication skills | * 1. Existing non-verbal communication techniques are identified based on organization policy   2. Existing non-verbal communication techniques are applied based on organization policy   3. Non-verbal communication techniques are articulated to enhance inclusivity according to workplace requirement   4. Non-verbal communication techniques are modelled to enhance inclusivity according to workplace requirement |
| 1. Apply oral communication skills | * 1. Types of oral communication are identified and established as per organization policy   2. Pathways of oral communication are identified and established as per organization policy   3. Pathways of oral communication are reviewed according to organization procedures.   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. 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: | 1. Language switch 2. Comprehension check 3. Repetition 4. Asking confirmation 5. Paraphrasing 6. Clarification request 7. Translation 8. Restructuring 9. Generalization |
| 1. Effective group interaction may include but not limited to: | 1. Identifying and evaluating what is occurring within an interaction in a non-judgmental way. 2. Using active listening 3. Making decision about appropriate words, behaviour 4. Putting together response which is culturally appropriate 5. Expressing an individual perspective 6. Expressing own philosophy, ideology and background and exploring impact with relevance to communication |
| 1. Situations may include but are not limited to: | 1. Establishing rapport 2. Eliciting facts and information 3. Facilitating resolution of issues 4. 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:

1. Active listening
2. Interpretation
3. Negotiation
4. Writing
5. Oral skills
6. Creative thinking
7. Critical thinking
8. Decision making
9. Analytical
10. Innovation
11. Conflict skills
12. Leadership
13. Problem solving skills
14. Management
15. Organizational
16. Teamwork

**Required Knowledge**

The individual needs to demonstrate knowledge of:

1. Communication process
2. Dynamics of groups
3. Styles of group leadership
4. Key elements of communications strategy
5. Principles of effective communication
6. Turn-taking techniques
7. Conflict resolution techniques
8. Work planning
9. Work organization
10. Company policies
11. Company operations and procedure standards
12. Fundamental rights at the workplace
13. Personal hygiene
14. Accountability
15. Workplace problems and how to deal with them

**EVIDENCE GUIDE**

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

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

## APPLY WORK ETHICS AND PRACTICES

**UNIT CODE:** 0417 541 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 | * 1. Teams are formed to enhance productivity based on organization’s objectives   2. Duties are assigned to teams under the organization policy   3. Team activities are managed and coordinated as per set objectives   4. Team performance is evaluated based on set targets as per workplace policy   5. Conflicts are resolved between team members in line with organization policy.   6. Gender and diversity-related issues are identified and mainstreamed in accordance with workplace policy   7. Healthy relationships are developed and maintained in line with the workplace.   8. Adaptability and flexibility are applied in dealing with team members as per workplace policies |
| 1. Maintain professional and personal development | * 1. Personal growth and development needs are identified and assessed in line with the requirements of the job   2. Training and career opportunities are identified and utilized based on job requirements   3. Resources for training are mobilized and allocated based on organizations and individual skills needs   4. Licenses and certifications relevant to the job and career are obtained and renewed as per policy   5. Recognitions are sought as proof of career advancement in line with professional requirements   6. Work priorities and personal commitments are balanced and managed based on the requirements of the job and personal objectives   7. Dynamism and on-the-job learning are embraced in line with the organization’s goals and objectives |
| 1. Apply Problem solving skills | * 1. Creative, innovative and practical solutions are developed based on the problem   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 | * 1. Customers' needs are identified based on their characteristics   2. Customer feedback is allowed and facilitated in line with organization policies   3. Customer concerns and complaints are analyzed and resolved in line with the set organizational culture   4. Proactive customer outreach programs are implemented as per organizational policies   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: | 1. Verbal 2. Written 3. Informal 4. Formal |
| 1. Conflicts include but are not limited to: | 1. Interpersonal Conflict 2. Intrapersonal Conflict 3. Intergroup Conflict 4. Intragroup Conflict |
| 1. Relationships may include but not limited to: | 1. Man/Woman 2. Trainer/trainee 3. Employee/employer 4. Client/service provider 5. Husband/wife 6. Boy/girl 7. Parent/child 8. Sibling relationships |
| 1. Team may include but not limited to: | 1. Small work group 2. Staff in a section/department 3. Inter-agency group 4. Virtual teams |
| 1. Personal growth may include but not limited to: | 1. Growth in the job 2. Career mobility 3. Gains and exposure the job gives 4. Net workings 5. Benefits that accrue to the individual as a result of noteworthy performance |
| 1. Personal objectives may include but not limited to: | 1. Long term 2. Short term 3. Broad 4. Specific |
| 1. Trainings and career opportunities may include but not limited to | * 1. Participation in training programs   2. Serving as Resource Persons in conferences and workshops   3. Capacity building |
| 1. Resource may include may but not limited to: | * 1. Human   2. Financial   3. Technology |
| 1. Creative and innovative may include but not limited to: | * 1. New ideas   2. Original ideas   3. Different ideas   4. Methods/procedures   5. Processes   6. New tools |
| 1. Emerging issues may include but not limited to: | * 1. Artificial Intelligence   2. Data confidentiality   3. National cohesion   4. 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:

1. Active listening
2. Critical thinking
3. Organizational
4. Negotiation
5. Monitoring
6. Evaluation
7. Problem solving
8. Decision Making
9. Leadership
10. Creative/innovative thinking
11. Adaptability
12. Conflict management
13. Emotional intelligence
14. Teamwork

**Required Knowledge**

The individual needs to demonstrate knowledge of:

1. Work values and ethics
2. Company policies and procedures
3. Company operations, procedures and standards
4. Flexibility and adaptability
5. Concept of time and leisure time
6. Decision making
7. Work planning
8. Organizing work
9. Monitoring and evaluation
10. Record keeping
11. Gender and diversity mainstreaming
12. Drug and substance abuse
13. Professional growth and development
14. creativity
15. Innovation
16. problem solving
17. customer care
18. mentoring and coaching.
19. Emerging issues

**EVIDENCE GUIDE**

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

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

## APPLY ENTREPRENEURIAL SKILLS

**UNIT CODE:** 0413 541 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 Skills | 1. **Sources of personal and business** ***funds*** are identified as per financial procedures and standards 2. Personal finances are managed as per financial procedures and standards 3. Savings are managed as per financial procedures and standards 4. Debts are managed as per financial procedures and standards 5. Investments are undertaken as per financial procedures and standards 6. Insurance services are procured as per financial procedures and standards |
| 1. Apply entrepreneurial concept | 1. Entrepreneurs and Business persons are distinguished as per principles of entrepreneurship 2. ***Types of entrepreneurs*** are identified as per principles of entrepreneurship 3. Ways of becoming an entrepreneur are identified as per principles of Entrepreneurship 4. ***Characteristics of Entrepreneurs*** are identified as per principles of Entrepreneurship 5. Salaried employment and self-employment are distinguished as per principles of entrepreneurship 6. ***Requirements for entry into self-employment*** are identified according to business procedures and standards 7. Roles of an Entrepreneur in an enterprise are determined according to business procedures and standards 8. **Contributions of entrepreneurship** to National development are identified as per business procedures and standards |
| 1. Identify entrepreneurial opportunities | 1. Business ideas are identified as per business procedures and standards 2. Factors to consider when evaluating business opportunity viability are explored based on business procedure and standards 3. Entrepreneurial opportunities are evaluated as per business procedures and standards 4. Business ideas and opportunities are generated as per business procedures and standards 5. Business life cycle is analysed as per business procedures and standards |
| 1. Apply business legal aspects | 1. ***Forms of business ownership*** are identified as per legal procedures and practices 2. Business Registration and Licensing processes are identified as per legal procedures and practices 3. Types of Contracts and Agreements are analysed as per legal procedures and practices 4. Employment Laws are identified as per legal procedures and practices 5. Taxation laws are identified as per legal procedures and practices |
| 1. Innovate Business strategies | 1. Business innovation strategies are determined by the organization standards 2. Creativity in business development is demonstrated in accordance with business standards 3. ***Innovative business standards***  are developed as per business principles 4. Linkages with other entrepreneurs are created as per best practice 5. ICT is incorporated in business growth and development as per best practice |
| 1. Develop Business Plan | 1. Business idea is described as per business procedures and standards 2. Business description is developed as per business plan format 3. Marketing plan is developed as per business plan format 4. Organizational/Management plan is prepared in accordance with business plan format 5. Production/operation plan is prepared in accordance with business plan format 6. Financial plan is prepared in accordance with the business plan format 7. Executive summary is prepared in accordance with business plan format 8. Business plan is presented as per best practice 9. Business ideas are incubated as per institutional policy |

**RANGE**

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

| **Variable** | **Range** |
| --- | --- |
| 1. Sources of personal funds mayinclude but not limited to: | 1. Salary/Wages 2. Investments 3. Savings 4. Inheritance 5. Government Benefits |
| 1. Sources of business finance mayinclude but not limited to: | 1. Equity Financing 2. Debt Financing, 3. Personal Savings/Investment 4. Retained Earnings 5. Grants and Subsidies 6. Crowdfunding 7. supplier Credit: 8. Leasing and Asset Financing: |
| 1. Types of entrepreneurs may include but not limited to: | 1. Innovators 2. Imitators 3. Craft 4. Opportunistic 5. Speculators |
| 1. Characteristics of Entrepreneurs may include but not limited to: | 1. Creative 2. Innovative 3. Planner 4. Risk taker 5. Networker 6. Confident 7. Flexible 8. Persistent 9. Patient 10. Independent 11. Future oriented 12. Goal oriented |
| 1. Requirements for entry into self-employment may include but not limited to | 1. Technical skills 2. Management skills 3. Entrepreneurial skills 4. Resources 5. Infrastructure |
| 1. Forms of businesses ownership may include but not limited to: | * 1. Sole proprietorship   2. Partnership   3. Limited companies   4. Cooperatives |
| 1. Innovative business standards may include but not limited to: | * 1. New products   2. New methods of production   3. New markets   4. New sources of supplies   5. 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:

1. Analytical
2. Management
3. Problem-solving
4. Root-cause analysis
5. Communication

**Required Knowledge**

The individual needs to demonstrate knowledge of:

1. Decision making
2. Business communication
3. Change management
4. Competition
5. Risk
6. Net working
7. Time management
8. Leadership
9. Factors affecting entrepreneurship development
10. Principles of Entrepreneurship
11. Features and benefits of common operational practices, e. g., continuous improvement (kaizen), waste elimination,
12. Conflict resolution
13. Health, safety and environment (HSE) principles and requirements
14. Customer care standards
15. Basic financial management
16. Business strategic planning
17. Impact of change on individuals, groups and industries
18. Government and regulatory processes
19. Local and international market trends
20. Product promotion standards
21. Market and feasibility studies
22. Government and regulatory processes
23. Local and international business environment
24. Relevant developments in other industries
25. 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 COMPETENCY

## APPLY MATHEMATICAL PRINCIPLES

**UNIT CODE : 0541 551 05A**

**UNIT DESCRIPTION :**

This unit describes the competencies required in applying basic mathematics. It involves applying basic arithmetic, and applying trigonometry, performing geometrical calculations, carrying out mensuration, applying statistics and applying linear graphs.

**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 arithmetical principles | * 1. Identify and use whole numbers and simple fractions, decimals and percentages as per the concepts   2. Understand place value, ranges, rounding off based on appropriate mathematical concepts   3. Rationalize arithmetic percentages and proportions based on the concepts   4. Express numbers decimal and standard form as per concepts |
| * 1. Perform Trigonometry calculations | * 1. Trigonometric calculations are identified based on trigonometric rules   2. Applied trigonometric rules as per the concepts   3..3 Calculations are performed using trigonometric rules |
| * 1. Perform geometric calculations | 1. Identified geometrical figures based on context 2. Calculated areas of figures as per the given formulae 3. Apply Pythagoras’ theorem based on the concept |
| * 1. Carry out Mensuration calculations | * 1. Identified various ***units of measurement*** as per the course requirements   2. Converted units from one form to another as per mathematical concepts   3. Perimeters and areas of ***figures*** are obtained as per the correct formulae   4. Volume and Surface area of solids are obtained as per the correct formulae   5. Area of irregular figures are obtained as per the correct formulae |
| * 1. Perform statistical calculations | 1. Identified grouped and ungrouped data 2. Organized ungrouped data as per the concept 3. Represented data in frequency tables 4. Calculated the median of grouped and ungrouped data 5. Represented data in a chart form 6. Interpreted data from a given chart |
| * 1. Apply linear graphs | 1. Identify given information as provided in the data set or a problem 2. Appropriate scale is chosen based on quantities or variables 3. Axes are labelled based on appropriate labels 4. ***linear graph*** is plotted based on the given set of data 5. Analyse the graph based on the graph drawn |

**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. Units of measurement may include but not limited to: | * 1. Millimetres   2. Centimetres   3. Inches   4. Feet |
| 1. Figures may include but are not limited to: | * 1. square   2. rectangle   3. triangle   4. polygons   5. circles |
| 1. Linear graphs may include but are not limited to: | * 1. Distance against time   2. Temperature against time   3. Velocity against distance |

**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:

1. Applying fundamental operations (addition, subtraction, division, multiplication)
2. Using and applying mathematical formulas
3. Logical thinking
4. Problem-solving
5. Applying statistics
6. Drawing graphs
7. Using different measuring tool

**Required knowledge**

The individual needs to demonstrate knowledge of:

1. Fundamental operations (addition, subtraction, division, multiplication)
2. Calculating area and volume
3. Types and purpose of measuring instruments
4. Units of measurement and abbreviations
5. Rounding techniques
6. Types of fractions
7. Types of tables and graphs
8. 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. Applied basic arithmetic as per the concept applied 2. Demonstrated ability to apply Trigonometry as per the concept 3. Carried out mensuration as per the objects given 4. Performed Simultaneous equations as per the rules 5. Solved simple algebraic equations as per the concept 6. Demonstrated knowledge of Applied statistics as per the concept required 7. Applied linear graphs as per the data set, quantities or variables provided |
| 1. Resource Implications | The following resources should be provided:   * 1. Access to relevant workplace or appropriately simulated environment where assessment can take place   2. Materials relevant to the proposed activity or tasks |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   1. Practical 2. Projects 3. Portfolio of evidence 4. Third party reports 5. Written tests |
| 1. Context of Assessment | The competency may be assessed in a workplace or a simulated workplace |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY ALGEBRA AND GEOMETRY

**UNIT CODE: 0732 551 06A**

**UNIT DESCRIPTION:**

This unit describes the competencies required by a technician in order to apply a wide range of mathematical skills in their work; it involves applying algebra. It also involves applying coordinate, Geometry principles and carrying out Binomial Expansion.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT** | **PERFORMANCE CRITERIA** |
| * + - 1. Apply algebra operations | * 1. Indices **calculations** are performed as per the concept   2. Logarithms calculations are performed as per the concept   3. Scientific calculator is used in solving mathematical problems in line with manufacturer’s manual   4. Simultaneous equations are performed as per the rules   5. Quadratic equations are calculated as per the concept |
| 1. Apply Coordinate Geometry Principles | * 1. Polar equations are calculated using coordinate geometry   2. Graphs of given polar equations are drawn using the Cartesian plane   3. Normal and tangents are determined using coordinate geometry |
| 1. Carry out Binomial Expansion | * 1. Roots of numbers are determined using binomial theorem   2. Binomial series coefficients are performed as per pascal’s triangle   3. Errors of small changes are determined using binomial theorem |

**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. Calculations may include but not limited to: | * 1. Addition   2. Subtraction |
| 1. Operations may include but not limited to: | * 1. Addition   2. Subtraction   3. Multiplication   4. Division |

**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:

1. Applying fundamental operations (addition, subtraction, division, multiplication)
2. using and applying mathematical formulas
3. logical thinking
4. problem solving
5. applying statistics
6. drawing graphs
7. Using different measuring tools

**Required knowledge**

The individual needs to demonstrate knowledge of:

1. Fundamental operations (addition, subtraction, division, multiplication)
2. calculating area and volume
3. Types of fractions
4. Types of 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. Performs exponential and logarithmic calculations correctly using mathematical principles   2. Solves equations (simultaneous, quadratic, polar) using appropriate methods   3. Uses scientific calculator effectively for mathematical operations   4. Plots graphical representations of equations on coordinate planes   5. Determines geometric properties (tangents, normals) using coordinate geometry   6. Applies binomial theorem for root calculations and series expansion   7. Computes error approximations using mathematical methods   8. Utilizes Pascal's Triangle for binomial coefficient determination |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant assessment environment   3. Resources relevant to the proposed assessment activity or tasks |
| 1. Methods of Assessment | Competency in this unit may be accessed through:   * 1. Practical tests   2. Project   3. Portfolio of evidence   4. Third party report   5. Written tests |
| 1. Context of Assessment | This competency may be assessed in a work place or in an a simulated work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

## TRIGONOMETRY AND COMPLEX NUMBERS

**UNIT CODE: 0722 551 07A**

**UNIT DESCRIPTION:**

This unit describes the competencies required by a technician in order to apply a wide range of mathematical skills in their work; it involves applying Trigonometry and hyperbolic functions, complex numbers and power series

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT** | **PERFORMANCE CRITERIA** |
| 1. Perform Trigonometry and hyperbolic functions | * 1. Trigonometric ratios and identities are derived as per the concept   2. Calculations are performed using trigonometric ratios and identities   3. ***Hyperbolic functi***ons are identified and derived as per the concept   4. Calculations are performed using hyperbolic functions |
| 1. Perform complex number operations | * 1. ***complex numbers*** are represented using Argand diagrams   2. ***Operations*** involving complex numbers are performed   3. Calculations involving complex numbers are performed using De Moivre’s theorem |
| 1. Apply Power Series | * 1. Power series are obtained using Taylor’s Theorem   2. Power series are obtained using Maclaurin’s ‘s theorem   3. Power series are obtained as per the specific theorem |

**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. Operations may include but not limited to: | * 1. Addition   2. Subtraction |
| 1. Hyperbolic functions may include but not limited to: | * 1. Sinh x   2. Cosh x   3. Cosec x   4. Coth x   5. Tanh x   6. Sech x |
| 1. Operations may include but not limited to: | * 1. Addition   2. Subtraction   3. Multiplication   4. Division |

**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:

1. Applying fundamental operations (addition, subtraction, division, multiplication)
2. using and applying mathematical formulas
3. logical thinking
4. problem solving
5. applying statistics
6. drawing graphs
7. Using different measuring tools

**Required knowledge**

The individual needs to demonstrate knowledge of:

1. Fundamental operations (addition, subtraction, division, multiplication)
2. calculating area and volume
3. Types and purpose of measuring instruments
4. Units of measurement and abbreviations
5. Rounding techniques
6. Types of fractions
7. Types of tables and graphs
8. Presentation of data in tables and graphs
9. Vector operations
10. Matrix operations

**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 Trigonometry and hyperbolic functions per the nature of task 2. Applied complex numbers per the nature of task 3. Applied Calculus per the nature of task 4. Solved Ordinary differential equations per the nature of task 5. Carried out mensuration per the nature of task 6. Applied Power Series per the nature of task 7. Applied Latitudes and Longitudes per the nature of task 8. Applied Vector theory per the nature of task 9. Applied Matrix per the nature of task 10. Applied Numerical methods per the nature of task |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant assessment environment   3. Resources relevant to the proposed assessment activity or tasks |
| 1. Methods of Assessment | Competency in this unit may be accessed through:   * 1. Practical tests   2. Project   3. Portfolio of evidence   4. Third party report   5. Written tests |
| 1. Context of Assessment | This competency may be assessed in a work place or in an a simulated work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

## CALCULUS AND DIFFERENTIAL METHODS

**UNIT CODE: 0719 551 08A**

**UNIT DESCRIPTION:**

This unit describes the competencies required by a technician in order to apply a wide range of mathematical skills in their work; it involves applying calculus, ordinary differential equations and numerical methods.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT** | **PERFORMANCE CRITERIA** |
| 1. Perform Calculus Operations | * 1. Derivatives of functions are determined using Differentiation   2. Derivatives of trigonometric and hyperbolic functions are determined using Differentiation   3. Derivatives of inverse trigonometric functions are determined using Differentiation   4. Rate of change and small change are determined using Differentiation.   5. Calculation involving stationery points of functions of two variables are performed using differentiation   6. Integrals of algebraic functions are determined using integration   7. Integrals of trigonometric functions are determined using integration   8. Integrals of logarithmic functions are determined using integration   9. Integrals of hyperbolic and inverse functions are determined using integration |
| 1. Perform numerical methods | * 1. ***Numerical methods*** are identified as pre Numerical Analysis methods   2. Roots of polynomials are obtained using iterative numerical methods   3. Interpolation and extrapolation are performed using numerical methods |
| 1. Solve Ordinary differential equations | * 1. First order differential equations are solved using the method of undetermined coefficients   2. Second order differential equations are solved using the method of undetermined coefficients   3. First order differential equations are solved from given boundary conditions   4. Second order differential equations are solved from given boundary conditions |

**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. Operations may include but not limited to: | * 1. Addition   2. Subtraction |
| 1. Hyperbolic functions may include but not limited to: | * 1. Sinh x   2. Cosh x   3. Cosec x   4. Coth x   5. Tanh x   6. Sech x |
| 1. Numerical methods may include but not limited to: | * 1. Iterative methods   2. Interpolation   3. Extrapolation |
| 1. Operations may include but not limited to: | * 1. Addition   2. Subtraction   3. Multiplication   4. Division |
| 1. Regular solids may include but not limited to: | * 1. Cubes   2. Cuboids   3. Cones   4. Pyramids   5. cylinder |

**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:

1. Applying fundamental operations (addition, subtraction, division, multiplication)
2. using and applying mathematical formulas
3. logical thinking
4. problem solving
5. applying statistics
6. drawing graphs
7. Using different measuring tools

**Required knowledge**

The individual needs to demonstrate knowledge of:

1. Fundamental operations (addition, subtraction, division, multiplication)
2. calculating area and volume
3. Types and purpose of measuring instruments
4. Units of measurement and abbreviations
5. Rounding techniques
6. Types of fractions
7. Types of tables and graphs
8. Presentation of data in tables and graphs
9. Vector operations
10. Matrix operations

**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 differentiation techniques to algebraic, trigonometric, and hyperbolic functions using appropriate rules (power, product, quotient, chain)   2. Solved rate of change problems by calculating first and second derivatives, with applications to velocity, acceleration, and other real-world scenarios   3. Performed integration of algebraic, trigonometric, hyperbolic, and logarithmic functions using appropriate techniques (substitution, etc.)   4. Applied integration methods to calculate areas under curves and volumes of solids of revolution   5. Solved differential equations (first-order and second-order, both homogeneous and non-homogeneous) using appropriate methods (separation of variables, integrating factor)   6. Utilized numerical methods for root-finding (Newton-Raphson, bisection), interpolation (Lagrange), and numerical integration (Trapezoidal, Simpson's rules) |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant assessment environment   3. Resources relevant to the proposed assessment activity or tasks |
| 1. Methods of Assessment | Competency in this unit may be accessed through:   * 1. Practical tests   2. Project   3. Portfolio of evidence   4. Third party report   5. Written tests |
| 1. Context of Assessment | This competency may be assessed in a work place or in an a simulated work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

## VECTORS, MATRICES AND DATA ANALYSIS

**UNIT CODE: 0732 551 09A**

**UNIT DESCRIPTION:**

This unit describes the competencies required by a technician in order to apply a wide range of mathematical skills in their work; it involves applying Vector theory, Matrices and Performing Statistical and probability calculations

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT** | **PERFORMANCE CRITERIA** |
| 1. Perform Statistical and probability calculations | * 1. Identification, Collection and Organization of data is performed   2. Interpretation, analysis and presentation of data in appropriate format is performed   3. Mean, median, mode and Standard deviation are obtained from given data   4. Calculations are performed based on Laws of probability   5. Calculation involving probability distributions, mathematical expectation sampling distributions are performed   6. Sampling distribution methods are applied in data analysis   7. Calculations involving use of standard normal table, sampling distribution, T-distribution and Estimation are done   8. Confidence intervals are determined   9. Testing hypothesis using large samples and small samples are performed   10. Calculations involving Correlation and regression are done   11. Calculations involving rank correlation coefficient and equations of regression line are done |
| 1. Apply Vector theory | * 1. Vectors and scalar quantities are obtained in two and three dimensions as per the natures of the task   2. ***Operations*** on vectors are performed as per vector concepts   3. Position of vectors is obtained as per vector concepts   4. Resolution of vectors is done as per vector concepts |
| 1. Carry out Matrix calculations | * 1. Determinant and inverse of 2x2 matrix are obtained as per the nature of task   2. Determinant and inverse of 3x3 matrix are obtained as per the nature of task   3. Solutions of simultaneous equations are obtained as per the nature of task   4. Calculation involving Eigen values and Eigen vectors are performed as per the nature of task |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Operations may include but not limited to: | * 1. Addition   2. Subtraction |
| 1. Numerical methods may include but not limited to: | * 1. Iterative methods   2. Interpolation   3. Extrapolation |
| 1. Operations may include but not limited to: | * 1. Addition   2. Subtraction   3. Multiplication   4. Division |

**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:

1. Applying fundamental operations (addition, subtraction, division, multiplication)
2. using and applying mathematical formulas
3. logical thinking
4. problem solving
5. applying statistics
6. drawing graphs
7. Using different measuring tools

**Required knowledge**

The individual needs to demonstrate knowledge of:

1. Fundamental operations (addition, subtraction, division, multiplication)
2. Types of tables and graphs
3. Presentation of data in tables and graphs
4. Vector operations
5. Matrix operations

**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 Trigonometry and hyperbolic functions per the nature of task 2. Applied complex numbers per the nature of task 3. Applied Calculus per the nature of task 4. Solved Ordinary differential equations per the nature of task 5. Carried out mensuration per the nature of task 6. Applied Power Series per the nature of task 7. Applied Latitudes and Longitudes per the nature of task 8. Applied Vector theory per the nature of task 9. Applied Matrix per the nature of task 10. Applied Numerical methods per the nature of task |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant assessment environment   3. Resources relevant to the proposed assessment activity or tasks |
| 1. Methods of Assessment | Competency in this unit may be accessed through:   * 1. Practical tests   2. Project   3. Portfolio of evidence   4. Third party report   5. Written tests |
| 1. Context of Assessment | This competency may be assessed in a work place or in an a simulated work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

## PREPARE TECHNICAL DRAWING

**UNIT CODE: 0732 551 10A**

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes that make up workplace function | **PERFORMANCE CRITERIA** |
| 1. Use and maintain drawing equipment and materials | * 1. ***Drawing equipment*** are identified according to task requirements   2. ***Drawing materials*** are identified according to task requirements   3. Drawing equipment are used as per standard conventions   4. Drawing materials are used as per workplace procedures   5. Waste materials are disposed in accordance with workplace procedures |
| 1. Produce plane geometry drawings | * 1. Different ***types of lines*** used in drawings are identified according to standard drawing convention   2. ***Dimensioning and lettering*** are done as per drawing conventions   3. Different types of ***geometric forms*** are constructed according to standard conventions   4. Different ***types of angles*** are constructed according to principles of trigonometry   5. Different types of angles are measured using appropriate measuring tools   6. Angles are bisected according to standard conventions   7. Freehand sketching of different types of geometric forms, tools, equipment, diagrams is conducted |
| 1. Produce solid geometry drawings | * 1. Surface development is interpreted according to standard convention   2. Surface developments are developed in accordance with standard conventions   3. Section development is done according to standard convention   4. Solid geometry drawings are produced based on the developed patterns |
| 1. Produce orthographic and pictorial drawings | * 1. Symbols and abbreviations are identified and their meaning interpreted according to standard drawing conventions   2. ***Pictorial views*** are identified as per drawing conventions   3. Isometric drawings are produced in accordance with standard conventions   4. First and third angle orthographic drawings are produced in accordance with the standard conventions   5. Orthographic elevations are dimensioned in accordance with standard conventions |
| 1. Apply CAD packages | * 1. ***CAD packages*** are selected according to task requirements   2. CAD package instructions are studied and followed as per CAD package manuals   3. CAD packages are applied in production of highway drawings |

**RANGE**

| **Variable** | **Range**  ***May include but is not limited to:*** |
| --- | --- |
| 1. Drawing equipment may include but not limited to: | 1. Drawing boards 2. T and set squares 3. drawing sets 4. computers with CAD packages |
| 1. Drawing materials may include but not limited to: | 1. Drawing papers 2. Pencils 3. Erasers 4. masking tapes 5. paper clips |
| 1. Environmental legislations may include but not limited to: | 1. EMCA 1999 |
| 1. Personal Protective Equipment may include but not limited to: | 1. Dust coats 2. closed leather shoes |
| 1. Geometric forms may include but not limited to: | 1. Circles 2. Triangles 3. Rectangles 4. Parallelogram 5. Polygons 6. Pyramids 7. conic sections 8. prisms 9. loci |
| 1. Standard conventions may include but not limited to: | 1. Anatomy of engineering drawing (title block, coordinate grid system, revision block, notes and legends) 2. Drawing scale (paper size and drawing symbols) 3. International drawing standards |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required skills**

The individual needs to demonstrate the following skills:

1. Critical thinking
2. Drawing
3. Interpretation
4. Drawing equipment handling
5. Analysis and synthesis
6. Communication
7. Inter personal

**Required knowledge**

The individual needs to demonstrate knowledge of:

1. Drawing equipment and materials
2. Freehand sketching
3. Lettering
4. Geometrical constructions
5. Types of drawings
6. Types of lines
7. Isometric drawing conventions, features, characteristics, components
8. Orthographic drawing conventions, features, characteristics, components
9. 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 standard conventions   2. Identified different types of lines used in drawings according to standard drawing convention   3. Constructed different types of angles according to principles of trigonometry   4. Developed Surface developments in accordance with standard conventions   5. Produced Solid geometry drawings based on the developed patterns   6. Identified Pictorial views as per drawing conventions   7. Produced First and third angle orthographic drawings in accordance with the standard conventions   8. Interpreted circuit, assembly and lay out diagrams   9. Applied appropriate technical standards, used proper tools and equipment for a given task   10. . Applied CAD packages in production of highway |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant assessment environment   3. Resources relevant to the proposed assessment activity or tasks |
| 1. Methods of Assessment | Competency in this unit may be accessed through:   * 1. Practical tests   2. Project   3. Portfolio of evidence   4. Third party report   5. Written tests |
| 1. Context of Assessment | This competency may be assessed in a work place or in an a simulated work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY CONSTRUCTION MATERIAL SCIENCE I

**UNIT CODE: 0722 551 11A**

**UNIT DESCRIPTION**

This unit describes the competence in applying Construction materials science. It involves identifying essential construction materials and their properties, selecting quality construction materials, testing construction materials and demonstrating knowledge in the handling and use of construction materials.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  This describes 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 (to be stated in passive voice)  ***Bold and italicized terms*** ***are elaborated in the Range*** |
| 1. Identify essential construction materials | * 1. Use of construction material is identified based on its properties   2. Bills of quantities and working drawings are obtained and interpreted   3. Essential ***construction materials*** are identified based on construction requirements and project scope |
| 1. Identify properties of construction materials | * 1. ***Physical properties*** of construction materials are identified based on the type of construction material and codes of practice   2. ***Chemical properties*** of construction materials are identified based on the type of construction material and codes of practice   3. ***Mechanical properties*** of construction materials are identified based on the type of construction material and codes of practice |
| 1. Select quality construction materials | * 1. Cost implications of construction materials are evaluated and analyzed   2. Quality construction materials are selected based on their costs, availability and project requirements   3. Selection criteria recorded as per work place procedures |
| 1. Test construction materials | * 1. Construction materials are sampled randomly as per job requirement   2. ***Test parameters*** are identified as per the construction requirements and engineer’s instructions   3. Construction materials are tested as per the job requirement |
| 1. Handle construction materials | * 1. Construction materials to be handled are identified according to their uses   2. Safety requirements are identified based on the construction materials   3. Construction materials are handled safely based on the safety requirements |
| 1. Use construction materials | * 1. Construction materials, tools and equipment are assembled based on construction methods   2. construction materials are prepared based on purpose   3. Construction materials are used based on construction process |

**Range**

|  |  |
| --- | --- |
| **Variable** | **Range**  *May include but is not limited to:* |
| 1. Construction materials may include but not limited to: | * 1. Stones   2. bricks   3. clay and clay products   4. lime   5. cement   6. timber and timber products   7. metals and alloys   8. paints and varnishes   9. roofing materials   10. Aggregates   11. Glass and glass products   12. Bitumen and bituminous products |
| 1. Physical properties may include but are not limited to: | * 1. Porosity   2. Surface texture   3. Strength   4. Density   5. Thermal conductivity   6. Wear and tear |
| 1. Chemical properties may include but are not limited to: | * 1. Corrosion resistance   2. Chemical resistance |
| 1. Mechanical properties may include but not limited to: | * 1. Toughness   2. Hardness   3. Fatigue   4. Stress and strain   5. Creep and stress rapture   6. Strength |
| 1. Test parameters may include but not limited to: | * 1. Compression   2. Weathering   3. Durability   4. Water absorption   5. Impurity tests   6. Tensile tests   7. Workability   8. Plasticity   9. Aggregates crushing value   10. Optimum moisture content |

**SKILLS**

1. Analytical
2. Quality control analysis
3. Complex problem solving
4. Critical thinking
5. Engineering drawings interpretation
6. Monitoring
7. Numeracy
8. Communication

**REQUIRED KNOWLEDGE**

1. Applied science
2. Construction materials
3. Materials testing
4. Quality assurance
5. Management of material resources
6. Engineering mathematics
7. Bills of quantities
8. Materials 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. Identified essential construction materials based on its properties   2. Selected quality construction materials based on their costs, availability and project requirements   3. Tested construction materials as per the construction requirements and engineer’s instructions   4. Identified properties of construction materials as per the type of construction material and codes of practice   5. Handled construction materialsbased on the safety requirements and type of materials |
| 1. Resource Implications | The following resources should be provided:   * 1. Access to relevant workplace or appropriately simulated environment where assessment can take place   2. Materials relevant to the proposed activity or tasks |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   * 1. Practical   2. Projects   3. Portfolio of evidence   4. Third party reports   5. Written tests |
| 1. Context of Assessment | The competency may be assessed in a workplace or a simulated workplace |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY CONSTRUCTION MATERIALS SCIENCE II

**UNIT CODE: 0722 551 12A**

**UNIT DESCRIPTION**

This unit describes the competence in Applying Construction Materials Science. It involves Applying Environmental Factors considerations, applying construction walling units, applying construction timber and timber products, applying construction clay products, applying construction metal products, applying construction plastics and Rubber products, applying construction paints and varnishes, applying construction glass and Applying construction concrete.

|  |  |
| --- | --- |
| ELEMENT  These describe the key outcomes which make up workplace function | PERFORMANCE CRITERIA  These are assessable statements which specify the required level of performance of each of the elements  ***Italicized* terms are elaborated in the Range of Variables** |
| 1. Apply Environmental Factors Considerations | * 1. Environmental safety observations are carried out as per regulations   2. Environmental pollution observations are carried out as per regulations   3. Environmental application of sustainable resource use observations is carried out as per regulations   4. Environmental current practices in relation to resource usage observations are carried out as per regulations   5. Environmental legal provisions for environmental concerns observations are carried out as per regulations   6. Specific Environmental programmes observations are carried out as per regulations   7. Monitoring activities on environmental programmes observations are carried out as per regulations |
| 2.Apply construction walling units | * 1. ***Construction walling units*** are identified as per work requirement.   2. Knowledge on ***construction walling units’ properties*** is applied as per work requirement.   3. Knowledge on ***construction walling units*** is applied as per work requirement. |
| 3. Apply construction timber and timber products | * 1. Knowledge on ***timber conversion*** is applied as per work requirement   2. Knowledge on timber preservation is applied as per work requirement.   3. Knowledge on timber and timber products is applied as per work requirement. |
| 4. Apply construction clay products. | * 1. Knowledge onclay products selection is applied as per work   2. requirement. Knowledge on ***clay products properties*** is applied as per work requirement.   3. Knowledge on ***clay products*** is applied as per work requirement. |
| 5. Apply construction metal products. | * 1. Knowledge on metal products selection is applied as per work requirement   2. knowledge on ***metal products properties*** is applied as per work requirement   3. Knowledge on ***metal products*** is applied as per work requirement. |
| 6. Apply construction plastics and Rubber products. | * 1. Knowledge on plastics and rubber products selection is applied as per work requirement.   2. Knowledge on ***plastics and rubber products*** ***properties*** is applied as per work requirements   3. Knowledge on ***plastics and rubber products*** is applied as per work requirements. |
| 7. Apply construction paints and varnishes | * 1. Knowledge on paints and varnishes selection is applied as per work requirement   2. Knowledge on ***paints and varnishes properties*** is applied as per work requirement   3. Knowledge on ***paints and varnishes products*** is applied as per work requirement |
| 9. Apply construction glass | * 1. Knowledge onglass product selection is applied as per work requirement   2. Knowledge on ***glass properties*** is carried out as per work requirement   3. Knowledge on ***glass product selection*** is applied as per work requirement |
| 10. Apply construction concrete | * 1. Knowledge onconcrete mixingis applied as per work requirement   2. Knowledge on concrete properties is carried out as per work requirement   3. Knowledge on concrete products is applied as per work requirement |

**Range**

|  |  |
| --- | --- |
| **Variable** | **Range**  *May include but is not limited to:* |
| 1. Test parameters | * 1. Compression   2. Weathering   3. Durability   4. Water absorption   5. Impurity tests   6. Tensile tests   7. Workability   8. Plasticity   9. Aggregates crushing value   10. Optimum moisture content |
| 1. Timber tests | * 1. Compression   2. Torsion   3. Tension   4. Shear   5. Flexture. |
| 1. metal products | * 1. .Bolts   2. Nuts   3. Screws   4. Pipes   5. Metal windows   6. Cans |
| 1. Metal products properties | * 1. Density   2. Thermal conductivity   3. Specific heat capacity   4. Linear expansion   5. Electrical conductivity   6. Corrosion resistance   7. Oxidation resistance   8. Wear resistance   9. Hardness   10. Tensile strength |
| 1. paints and varnishes products | * 1. Transparent   2. Hard   3. Protective finish   4. Thermoplastic paint |
| 1. concrete properties | * 1. Durability   2. Workability   3. Strength   4. Shrinkage   5. Unit weight   6. Poisson’s ratio   7. Modula ratio |
| 1. Concrete Products | 1. Road curbs 2. Side walk pavement 3. concrete blocks 4. Decorative concrete lattices 5. Concrete slab 6. Pre –cast concrete 7. Culvert rings 8. Road channels. |
| 1. Concrete Tests | 1. Workability 2. Compressive strength test 3. Slump test 4. Drying shrinkage test |

**SKILLS**

1. Analytical
2. Quality control analysis
3. Complex problem solving
4. Critical thinking
5. Engineering drawings interpretation
6. Monitoring
7. Numeracy

**REQUIRED KNOWLEDGE**

1. Applied science
2. Construction materials
3. Materials testing
4. Quality assurance
5. Management of material resources
6. Engineering mathematics
7. Bills of quantities
8. Materials 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. Carried out Environmental safety observations as per organisations safety policy.   2. .Applied Knowledge on timber preservation as per work requirement.   3. .Conducted timber Tests as per the work requirement   4. .Applied Knowledge on paints and varnishes products applied as per work requirement Identified properties of construction materials   5. .Carried out Knowledge on concrete properties as per work requirement   6. .Conducted Concrete Tests as per the work requirement |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant assessment environment.   3. Resources relevant to the proposed assessment activity or tasks. |
| 1. Methods of Assessment | Competency in this unit may be accessed through:   * 1. Practical tests   2. Project   3. Portfolio of evidence   4. Third party report   5. Written tests |
| 1. Context of Assessment | This competency may be assessed in a work place or in an a simulated work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

## APPLY WORKSHOP TECHNOLOGY PRACTICES

**UNIT CODE: 0719 551 13A**

**UNIT DESCRIPTION**

This unit describes the competence in applying workshop technology practices. It entails performing masonry, plumbing and carpentry tasks. It also involves performing electrical and mechanical operations.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT** | **PERFORMANCE CRITERIA** |
| 1. Carry out masonry tasks | * 1. Safety requirements in the workshop environment are identified   2. ***Masonry hand tools*** are used appropriately to perform tasks in masonry workshop   3. ***Masonry power tools*** are used appropriately to perform tasks in masonry workshop |
| 1. Carry out plumbing tasks | * 1. Safety requirements in the workshop environment are identified   2. ***Plumbing hand tools*** are used appropriately to perform tasks in plumbing workshop   3. ***Plumbing power tools*** are used appropriately to perform tasks in plumbing workshop   4. Plumbing tools used in construction works are maintained as per manufacturer’s specifications |
| 1. Carry out carpentry tasks | * 1. Safety requirements in the workshop environment are identified   2. ***Carpentry hand tools*** are used appropriately to perform tasks in carpentry workshop   3. ***Carpentry power tools*** are used appropriately to perform tasks in carpentry workshop   4. Carpentry tools used in construction works are maintained as per manufacturer’s specifications |
| 1. Carry out electrical operations | * 1. Safety requirements in the workshop environment are identified as per workplace procedures   2. ***Conventional tools*** used in electrical workshop are identified as per workplace procedures   3. Power supply sources are identified as per workplace procedures   4. Basic electrical circuits are installed and maintained as per IEE regulations |
| 1. Carry out mechanical operations | * 1. Safety requirements in the workshop environment are identified as per workplace procedures   2. ***Mechanical hand tools*** are used appropriately to perform tasks in mechanical workshop   3. Diesel and petrol engine components are identified based on their functions and engine system   4. Diesel and petrol engines are operated based on manufacturer’s manual   5. Simple engine maintenance is performed as per manufacturer’s specifications   6. ***Water pumps*** are identified based on working principle   7. Basic maintenance is performed on water pumps as per workplace procedures |

**Range**

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Masonry hand tools may include but not limited to: | * 1. Masons trowel   2. Wood float   3. Cold chisels   4. Masons square   5. Spade   6. Shovel   7. Plumb bob |
| 1. Masonry machine tools may include but not limited to: | * 1. Concrete mixer   2. Block cutter   3. Vibrator   4. Pneumatic hammer   5. Compactors |
| 1. Plumbing hand tools may include but not limited to: | * 1. Bench shears   2. Anvil   3. Pipe wrench   4. Pliers |
| 1. Plumbing power tools may include but not limited to: | * 1. Bending machine   2. Welding   3. Sheet metal holding machine   4. Portable power drill   5. Hand grinder |
| 1. Carpentry hand tools may include but not limited to: | * 1. Saws   2. Planes   3. Hammer   4. Carpenter square   5. Marking gauges   6. Hand drill   7. Screw drivers |
| 1. Carpentry power tools may include but not limited to: | * 1. circular saw   2. Thicknesses   3. Portable sander   4. Close cut saw   5. Portable drill machine |
| 1. Conventional tools may include but not limited to: | * 1. phase tester   2. screw driver   3. pliers   4. long nose   5. side cutter   6. draw in wire   7. electrical knife   8. electrical hammer |
| 1. Mechanical hand tools may include but not limited to: | * 1. Arc welding shields   2. Leather gloves   3. Chipping hammers   4. Welding goggles   5. Tongs   6. Hand vices   7. Mole punch   8. Pliers   9. Vernier callipers   10. Scribers   11. Hacksaw   12. Tinsnips   13. Pullers |
| 1. Water pumps may include but not limited to: | * 1. Centrifugal   2. Submersible   3. Reciprocating pump   4. Hand pumps |

**SKILLS**

1. Analytical
2. Critical thinking
3. Problem solving
4. Firefighting
5. Quality control
6. Circuit interpretation

**REQUIRED KNOWLEDGE**

1. Tools and equipment
2. Safety regulations
3. Mathematics
4. Electrical installation
5. Power supply
6. Engine operations
7. Plumbing
8. Water pump operation
9. Masonry
10. Mortar mixing
11. Carpentry and joinery
12. Firefighting
13. Circuit interpretation

**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. Used Masonry power tools appropriately to perform tasks in masonry workshop accordance with the job requirement   2. . Used Plumbing hand tools appropriately to perform tasks in plumbing workshop accordance with the job requirement   3. Used Plumbing power tools appropriately to perform tasks in plumbing workshop accordance with the job requirement   4. Used Carpentry power tools appropriately to perform tasks in carpentry workshop accordance with the job requirement   5. Used Conventional tools in electrical workshop identified as per workplace procedures   6. Installed basic electrical circuits as per IEE regulations   7. Identified diesel and petrol engine components based on their functions and engine system   8. Identified water pumps based on working principle   9. Performed basic maintenance is performed on water pumps as per workplace procedures |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant assessment environment   3. Resources relevant to the proposed assessment activity or tasks |
| 1. Methods of Assessment | Competency in this unit may be accessed through:   * 1. Practical tests   2. Project   3. Portfolio of evidence   4. Third party report   5. Written tests |
| 1. Context of Assessment | This competency may be assessed in a work place or in an a simulated work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

## APPLY STRUCTURAL ANALYSIS PRINCIPLES I

**UNIT CODE: 0732 551 14A**

**UNIT DESCRIPTION:**

This Unit describes the principles required to perform structural designs. It involves

Computing stresses and strain, describing composite materials, computing shear force and bending moments, determination of properties of sections and analyzing forces in 2D frame structures.

**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. 1. Compute stress and strain | 1. Stress and strain are defined in relation to structural design 2. Stress and strain ***calculations*** are computed as per standards. 3. ***Stress-strain diagram*** is drawn as per their relation |
| 1. 2. Describe composite materials | * 1. Composite materials are identified based on the work specifications   2. Compatibility and equilibrium equations are derived based on best practices   3. Composite materials problems are solved based on specifications   4. Forces are determined in composite materials based on design |
| 1. 3. Compute shear force and bending moments | * 1. ***Types of supports and loads*** are identified based on design   2. Shear force and bending at a point on a loaded beam are defined as per the building design codes   3. ***Shear force diagrams*** are drawn based on the loadings on beam   4. ***Bending moment diagrams*** are drawn based on the loadings on beam |
| 1. 4. Determine properties of sections | * 1. Sections properties are identified as per the standards   2. Determination of properties of sections is done as per the standard calculations   3. Computation of compound properties of sections is done as per the standards |
| 1. 5. Compute Horizontal shear stress distribution | * 1. Derivation of Shear stress distribution formula is done as per the standard practice   2. Determination of shear stress for different sections is done as per the work requirement   3. Shearing stress distribution curves are plotted as per the standard practice |

**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. calculations | 1. Stress 2. Strain 3. Young’s modulus |
| 1. Stress-strain diagram | 1. Plasticity limit 2. Failure |
| 1. Types of supports and loads | * 1. Fixed support   2. Pin support   3. Point load   4. Uniform distribution load |
| 1. Shear force diagrams | * 1. Point of contra-flexure   2. Shear forces at points |
| 1. Bending moment diagrams | * 1. Maximum moment   2. Bending points |

**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:

1. Critical thinking
2. Creativity and innovation
3. Time management
4. Accuracy
5. Arithmetic
6. Presentation
7. Problem solving
8. Sketching
9. Teamwork
10. Assertion
11. Drawing
12. Interpretation
13. Analysis and synthesis
14. Communication
15. Interpersonal

**Required knowledge**

The individual needs to demonstrate knowledge of:

1. Freehand sketching
2. Structural drawing and analyses
3. Types of drawings
4. Types of lines
5. Construction techniques
6. Isometric drawing conventions, features, characteristics, components
7. 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. Performed shear force and bending moment calculations as per method of analysis   2. Prepared shear force and bending moment diagrams are as per code of practice   3. Carried out construction structural elements analysis as per code of practice   4. Carried out construction structural elements design as per code of practice   5. Analysed slope and deflection as per the code of practice   6. Analysed moment distribution as per the code of practice   7. Applied three moment theorem as per the work requirement   8. Analysed influence lines as per the work requirement normal and tangent***s*** are determined using coordinate geometry   9. analysed Column and struts as per the code of practice   10. Horizontals shear stresses is analysed as per the code of practice.   11. Analysedcombined stresses are as per the code of practice. |
| * + - 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant assessment environment   3. Resources relevant to the proposed assessment activity or tasks |
| * + - 1. Methods of Assessment | Competency in this unit may be accessed through:   * 1. Practical tests   2. Project   3. Portfolio of evidence   4. Third party report   5. Written tests |
| * + - 1. Context of Assessment | This competency may be assessed in a work place or in an a simulated work place |
| * + - 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

## APPLY STRUCTURAL ANALYSIS PRINCIPLES 11

**UNIT CODE: 0732 551 15A**

**UNIT DESCRIPTION:**

This Unit describes the principles required to perform structural designs. It involves

Computing theory of simple bending, computing horizontal shear stresses, analyzing structural compression members, computing combined stresses and determining retaining walls forces.

**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. Compute Theory of simple bending | 1. Elements of simple bending are identified as per the code of practice 2. Derivation of the simple bending formula is done as per the standard procedure 3. Forces of bending structure members are identified |
| 1. Analyse forces in 2D framed structures | 1. Nature of 2D figures/planes are identified based on design 2. Assumptions taken in analysis of structural framed structures are identified as per code of practice 3. Methods of analyses are identified as per the plane figure requirement |
| 1. Analyse structural compression members | * 1. Column and struts is analysed as per the code of practice.   2. Horizontals shear stresses is analysed as per the code of practice.   3. ***Combined stresses*** are analysed as per the code of practice. |
| 1. Compute slope and deflection | * 1. ***Assumptions*** made in slope and deflection is stated based on Macaulay’s theorem.   2. Slope and deflection are derived based on the design loading   3. Deflection and slope at a point on beam are calculated based on the design requirement |
| 1. Compute Combined stresses | * 1. Stresses are identified in the column based on the design load.   2. Assumptions on combined stresses are made based on the location of the load.   3. Combined stresses at a point in direct and indirect columns are calculated based on the design load. |
| 1. Determine retain walls forces | * 1. Centre of gravity of the wall is determined based on the structural design   2. ***Types of pressures*** present on the retaining walls are identified base on the wall design   3. Lateral thrust due to retained water or earth is calculated based on design load |

**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. calculations | 1. Stress 2. Strain 3. Young’s modulus |
| 1. Stress-strain diagram | 1. Plasticity limit 2. Failure |
| 1. Types of supports and loads | * 1. Fixed support   2. Pin support   3. Point load   4. Uniform distribution load |
| 1. Shear force diagrams | * 1. Point of contra-flexure   2. Shear forces at points |
| 1. Bending moment diagrams | * 1. Maximum moment   2. Bending points |
| 1. Assumptions | 1. All joints of the frame are rigid 2. Angle between the members do not change |
| 1. Types of pressures | * 1. lateral earth pressure.   2. Surcharge loads.   3. Axial loads.   4. Wind on projecting stem.   5. Impact forces.   6. Seismic earth pressure.   7. Seismic wall self-weight forces |

**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:

1. Critical thinking
2. Creativity and innovation
3. Time management
4. Accuracy
5. Arithmetic
6. Presentation
7. Problem solving
8. Sketching
9. Teamwork
10. Assertion
11. Drawing
12. Interpretation
13. Analysis and synthesis
14. Communication
15. Interpersonal

**Required knowledge**

The individual needs to demonstrate knowledge of:

1. Freehand sketching
2. Structural drawing and analyses
3. Types of drawings
4. Types of lines
5. Construction techniques
6. Isometric drawing conventions, features, characteristics, components
7. 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. Performed shear force and bending moment calculations as per method of analysis   2. Prepared shear force and bending moment diagrams are as per code of practice   3. Carried out construction structural elements analysis as per code of practice   4. Carried out construction structural elements design as per code of practice   5. Analysed slope and deflection as per the code of practice   6. Analysed moment distribution as per the code of practice   7. Applied three moment theorem as per the work requirement   8. Analysed influence lines as per the work requirement normal and tangent***s*** are determined using coordinate geometry   9. analysed Column and struts as per the code of practice   10. Horizontals shear stresses is analysed as per the code of practice.   11. Analysedcombined stresses are as per the code of practice. |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant assessment environment   3. Resources relevant to the proposed assessment activity or tasks |
| 1. Methods of Assessment | Competency in this unit may be accessed through:   * 1. Practical tests   2. Project   3. Portfolio of evidence   4. Third party report   5. Written tests |
| 1. Context of Assessment | This competency may be assessed in a work place or in an a simulated work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

## APPLY STRUCTURAL ANALYSIS PRINCIPLES III

**UNIT CODE: 0732 551 16A**

**UNIT DESCRIPTION:**

This Unit describes the principles required to perform structural designs. It involves

Computing slope and deflection, and analysing indeterminate structures.

**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. 1. Compute Slope and Deflection in Beams | 1. Theoretical assumptions of beam theory are applied as per engineering standards (e.g., linear elasticity, small deformations). 2. Mohr’s Moment Area Method is used to calculate slope and deflection as per design requirements. 3. Beam deflection problems are solved using Macaulay’s Method for discontinuous loads as per job specifications. 4. Results are verified using boundary conditions and equilibrium checks as per analysis procedures. |
| 1. 2. Analyze Indeterminate Structures | * 1. **Determinate and indeterminate structures** are distinguished using **equilibrium conditions** as per structural principles.   2. The Three-Moment Theorem is applied to solve continuous beams as per design codes.   3. The Moment Distribution Method is used to analyze indeterminate frames as per project requirements.   4. Solutions are validated through static equilibrium and compatibility checks as per engineering standards. |

**RANGE**

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

|  |  |
| --- | --- |
| Variable | Range  *May include but not limited to:* |
| 1. **equilibrium conditions** | 1. Static Equilibrium 2. Force equilibrium 3. Moment equilibrium 4. Dynamic equilibrium |
|  |  |
| 1. **Determinate and indeterminate structures** | 1. Beams (simply supported, cantilever, continuous) 2. Frames (portal, multi-story) 3. Trusses (simple, compound, complex) |

**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:

1. Critical thinking
2. Creativity and innovation
3. Time management
4. Accuracy
5. Arithmetic
6. Presentation
7. Problem solving
8. Sketching
9. Teamwork
10. Assertion
11. Drawing
12. Interpretation
13. Analysis and synthesis
14. Communication
15. Interpersonal

**Required knowledge**

The individual needs to demonstrate knowledge of:

1. Freehand sketching
2. Structural drawing and analyses
3. Types of drawings
4. Types of lines
5. Construction techniques
6. Isometric drawing conventions, features, characteristics, components
7. 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. Applied beam theory principles including theoretical assumptions (linear elasticity, small deformations) per engineering standards   2. Calculated beam deflections using both Mohr's Moment Area Method and Macaulay's Method per design requirements   3. Analyzed structural systems by distinguishing determinate/indeterminate structures and applying the Three-Moment Theorem per design codes   4. Solved indeterminate frame problems using Moment Distribution Method according to project specifications   5. Verified all solutions through boundary conditions, equilibrium checks, and compatibility verifications per engineering standards |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant assessment environment   3. Resources relevant to the proposed assessment activity or tasks |
| 1. Methods of Assessment | Competency in this unit may be accessed through:   * 1. Practical tests   2. Project   3. Portfolio of evidence   4. Third party report   5. Written tests |
| 1. Context of Assessment | This competency may be assessed in a work place or in an a simulated work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

## APPLY MEASUREMENTS, ESTIMATION AND COSTING PRINCIPLES I

**UNIT CODE: 0732 551 17A**

**UNIT DESCRIPTION**

This unit describes competencies required to Perform measurements and cost estimation. It involves; working up dimensions, taking off quantities, abstracting measured quantities and preparing tender documents

**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 Work up dimensions techniques | * 1. ***Working drawings*** are interpreted as per design   2. Dimensions are scaled as per the design   3. Dimensions timesing are carried out as per SMM/CESMM |
| 2. Apply substructure works taking off principles | * 1. ***Substructure elements*** are documented as per work requirement   2. Substructure elements ***quantities*** are quantified as per work requirement   3. Substructure elements quantities are booked as per work requirementper work requirement |
| 5. Abstract measured quantities | * 1. Abstracting sheet is prepared based on the standard format   2. Description of booked items are transferred to the abstracting sheet as per SMM/CESMM   3. Squared quantities are transferred to the abstracting sheet as per SMM/CESMM   4. Net quantities are calculated as per SMM/CESMM   5. Dimensions are run through as per unit of measurement |
| 6. Prepare bill of quantities | * 1. ***Specifications*** are prepared as per SMM/CESMM   2. Schedule of rates are prepared as per abstracted quantities and standard costing guidelines   3. Bill of quantities is prepared based on specifications and working drawings tacheometry surveying *are carried out as per* work 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. Working drawings may include but not limited to: | * 1. Architectural   2. Structural   3. Electrical   4. Mechanical |
| 1. Substructure elements may include but not limited to: | * 1. Foundation footing   2. Foundation walls   3. Floors   4. Reinforcements   5. Excavation works |
| 1. Quantities may include but not limited to: | * 1. Volumes   2. Areas   3. Linear meters   4. Numbers (enumeration)   5. Items |
| 1. Specifications may include but not limited to: | * 1. Material   2. Workmanship |

**REQUIRED KNOWLEDGE**

1. Mathematics
2. Tender documents
3. Technical drawings
4. Construction technology
5. Quanty survey practice and procedures
6. Stanadrd documents (SMM)
7. Units of measurement
8. Estimation and costing
9. Abstraction
10. Technical terminologies

**SKILLS**

1. Analytical
2. Critical thinking
3. Computer
4. Construction
5. Structural detailing
6. Scaling
7. Design
8. Problem solving

**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. Carried out dimensions timesing as per SMM/CESMM   2. Quantified substructure elements quantities as per work requirement   3. Booked substructure elements quantities as per work requirement   4. Calculated net quantities as per SMM/CESMM   5. Prepared abstracting sheet based on the standard format   6. Prepared specifications as per SMM/CESMM   7. Prepared bill of quantities based on specifications and working |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant assessment environment   3. Resources relevant to the proposed assessment activity or tasks |
| 1. Methods of Assessment | Competency in this unit may be accessed through:   * 1. Practical tests   2. Project   3. Portfolio of evidence   4. Third party report   5. Written tests |
| 1. Context of Assessment | This competency may be assessed in a work place or in an a simulated work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

## APPLY MEASUREMENTS, ESTIMATION AND COSTING PRINCIPLES II

**UNIT CODE: 0732 551 18A**

**UNIT DESCRIPTION**

This unit describes competencies required to Perform measurements and cost estimation. It involves; Applying superstructure works taking off 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 superstructure works taking off principles | * 1. Superstructure elementsare documented as per work requirement   2. Superstructure elements quantitiesare quantified as per work requirement   3. ***Superstructure elements quantities*** are booked as per work requirement. |
| 1. Abstract measured quantities | * 1. Abstracting sheet is prepared based on the standard format   2. Description of booked items are transferred to the abstracting sheet as per SMM/CESMM   3. Squared quantities are transferred to the abstracting sheet as per SMM/CESMM   4. Net quantities are calculated as per SMM/CESMM   5. Dimensions are run through as per unit of measurement |
| 1. Prepare bill of quantities | * 1. ***Specifications*** are prepared as per SMM/CESMM   2. Schedule of rates are prepared as per abstracted quantities and standard costing guidelines   3. Bill of quantities is prepared based on specifications and working drawings tacheometry surveying *are carried out as per* work 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. Working drawings may include but not limited to: | * 1. Architectural   2. Structural   3. Electrical   4. Mechanical |
| 1. Quantities may include but not limited to: | * 1. Volumes   2. Areas   3. Linear meters   4. Numbers (enumeration)   5. Items |
| 1. Superstructure elements quantitiesmay include but not limited to: | * 1. Beams   2. Columns   3. Walls   4. Slab   5. Finishes   6. Windows   7. Doors   8. Roofs   9. Floors |
| 1. Specifications may include but not limited to: | * 1. Material   2. Workmanship |

**REQUIRED KNOWLEDGE**

1. Mathematics
2. Tender documents
3. Technical drawings
4. Construction technology
5. Quanty survey practice and procedures
6. Stanadrd documents (SMM)
7. Units of measurement
8. Estimation and costing
9. Abstraction
10. Technical terminologies

**SKILLS**

1. Analytical
2. Critical thinking
3. Computer
4. Construction
5. Structural detailing
6. Scaling
7. Design
8. Problem solving

**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. Carried out dimensions timesing as per SMM/CESMM   2. Quantified superstructure elements quantities as per work requirement   3. Booked superstructure elements quantities as per work requirement   4. Calculated net quantities as per SMM/CESMM   5. Prepared abstracting sheet based on the standard format   6. Prepared specifications as per SMM/CESMM   7. Prepared bill of quantities based on specifications and working |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant assessment environment   3. Resources relevant to the proposed assessment activity or tasks |
| 1. Methods of Assessment | Competency in this unit may be accessed through:   * 1. Practical tests   2. Project   3. Portfolio of evidence   4. Third party report   5. Written tests |
| 1. Context of Assessment | This competency may be assessed in a work place or in an a simulated work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

## APPLY MEASUREMENTS, ESTIMATION AND COSTING PRINCIPLES

**UNIT CODE: 0732 551 19A**

**UNIT DESCRIPTION**

This unit describes competencies required to Perform measurements and cost estimation. It involves; working up dimensions, taking off quantities, abstracting measured quantities and preparing tender documents

**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 construction external work taking off principles | * 1. External works elementsare documented as per work requirement   2. External works elements quantities are quantified as per work requirement   3. External works elements quantities are booked as per work requirement. |
| 1. Abstract measured quantities | * 1. Abstracting sheet is prepared based on the standard format   2. Description of booked items are transferred to the abstracting sheet as per SMM/CESMM   3. Squared quantities are transferred to the abstracting sheet as per SMM/CESMM   4. Net quantities are calculated as per SMM/CESMM   5. Dimensions are run through as per unit of measurement |
| iPrepare bill of quantities | * 1. ***Specifications*** are prepared as per SMM/CESMM   2. Schedule of rates are prepared as per abstracted quantities and standard costing guidelines   3. Bill of quantities is prepared based on specifications and working drawings tacheometry surveying *are carried out as per* work 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. Working drawings may include but not limited to: | * 1. Architectural   2. Structural   3. Electrical   4. Mechanical |
| 1. Substructure elements may include but not limited to: | * 1. Foundation footing   2. Foundation walls   3. Floors   4. Reinforcements   5. Excavation works |
| 1. Quantities may include but not limited to: | * 1. Volumes   2. Areas   3. Linear meters   4. Numbers (enumeration)   5. Items |
| 1. Superstructure elements quantitiesmay include but not limited to: | * 1. Beams   2. Columns   3. Walls   4. Slab   5. Finishes   6. Windows   7. Doors   8. Roofs   9. Floors |
| 1. Specifications may include but not limited to: | * 1. Material   2. Workmanship |

**REQUIRED KNOWLEDGE**

1. Mathematics
2. Tender documents
3. Technical drawings
4. Construction technology
5. Quanty survey practice and procedures
6. Stanadrd documents (SMM)
7. Units of measurement
8. Estimation and costing
9. Abstraction
10. Technical terminologies

**SKILLS**

1. Analytical
2. Critical thinking
3. Computer
4. Construction
5. Structural detailing
6. Scaling
7. Design
8. Problem solving

**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. Carried out dimensions timesing as per SMM/CESMM   2. Quantified external works elements quantities as per work requirement   3. Booked external works elements quantities as per work requirement.   4. Quantified superstructure elements quantities as per work requirement   5. Calculated net quantities as per SMM/CESMM   6. Prepared abstracting sheet based on the standard format   7. Prepared specifications as per SMM/CESMM   8. Prepared bill of quantities based on specifications and working |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant assessment environment   3. Resources relevant to the proposed assessment activity or tasks |
| 1. Methods of Assessment | Competency in this unit may be accessed through:   * 1. Practical tests   2. Project   3. Portfolio of evidence   4. Third party report   5. Written tests |
| 1. Context of Assessment | This competency may be assessed in a work place or in an a simulated work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

## APPLY HYDRAULIC PRINCIPLES

**UNIT CODE: 0732 551 20A**

**UNIT DESCRIPTION:**

This unit describes competencies required to apply hydraulic principles. It involves; Applying hydrostatic concept, Applying hydrodynamics concepts, Applying hydrology concept, Determining discharge and Applying hydraulic machine concept

|  |  |
| --- | --- |
| **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 hydrostatic concept | * 1. ***Properties of fluids*** are analyzed as per the standards.   2. ***Types of Pressure*** are identified as per the standards   3. Magnitude and position are determined standards specifications   4. Pascal’s law is applied as per the standards   5. Flotation and buoyancy concepts are described as per standards |
| 2 Apply hydrodynamics concepts | * 1. ***Types of Fluid flow*** are outlined as per the standard specification   2. Momentum equation is applied as per impact and deflection of fluid jet   3. Bernoulli’s principles is applied as per standard specification |
| 3. Apply hydrology concept | * 1. ***Concepts of Hydrological cycle*** are identified based on WMO guidelines   2. ***Precipitation types and forms*** are identified based on WMO guidelines   3. Precipitation is determined based on the WMO guidelines   4. Evaporation rate is determined based on WMO guidelines   5. Stream flow is determined based on the WMO guidelines   6. Safety in hydrometry is observed based on work requirements. |
| 4. Determine discharge | * 1. Discharge velocity is determined based on the hydraulic principles   2. Discharge is estimated as per the nature of the discharge channel   3. Reynold’s equation is applied as per the hydraulic principles   4. Head loss is calculated as per the hydraulic principles   5. Equations of non-uniform flow are applied as per the hydraulic principles   6. Channels are designed as per the hydraulic principles |
| 5. Apply hydraulic machine concept | * 1. Types of Pumps are identified as per the hydraulic principles   2. Pump working principles are described as per the type of pump   3. Types of turbines are identified as per the hydraulic principles   4. Turbine working principles are described as per the type of turbine |

**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. Properties of fluid may include but not limited to: | * 1. Viscosity   2. Density   3. Temperature   4. Pressure   5. Specific volume   6. Specific weight   7. Specific gravity   8. Surface tension |
| 1. Types of pressure may include but not limited to: | * 1. Absolute pressure   2. Atmospheric pressure   3. Gauge pressure   4. Differential pressure   5. Vacuum pressure |
| 1. Types of Fluid flow may include but not limited to: | * 1. Laminar and turbulent flow   2. Steady and unsteady flow   3. Uniform and non-uniform flow |
| 1. Concepts of Hydrological cyclemay include but not limited to: | * 1. Precipitation   2. Evaporation   3. Infiltration   4. Condensation   5. Transpiration   6. Runoff |
| 1. Precipitation types and forms may include but not limited to: | * 1. Cyclonic   2. Orophraghic   3. Conventional   4. Snow   5. Rainfall   6. Mist   7. Flakes |

**REQUIRED KNOWLEDGE**

1. Mathematics
2. Construction technology
3. Units of measurement
4. Hydraulic
5. Fluid flow
6. Technical terminologies
7. logical thinking
8. problem solving
9. applying statistics
10. drawing graphs
11. Using different measuring tools

**SKILLS**

1. Analytical
2. Critical thinking
3. Computer
4. Construction
5. Scaling
6. Design
7. Problem solving

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   * 1. Analyzed properties of fluids as per the standards   2. Applied Pascal’s law as per the standards   3. Applied bernoulli’s principles as per standard specification   4. Determined precipitation based on the WMO guidelines   5. Determined evaporation rate based on WMO guidelines   6. Determined stream flow based on the WMO guidelines   7. Calculated head loss as per the hydraulic principles   8. Designed channels as per the hydraulic principles   9. Described pump working principles as per the type of pump   10. Described turbine working principles as per the type of turbine |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant assessment environment   3. Resources relevant to the proposed assessment activity or tasks |
| 1. Methods of Assessment | Competency in this unit may be accessed through:   * 1. Practical tests   2. Project   3. Portfolio of evidence   4. Third party report   5. Written tests |
| 1. Context of Assessment | This competency may be assessed in a work place or in an a simulated work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

## CONDUCT RESEARCH PROJECT I

**UNIT CODE: 0732 551 21A**

**UNIT DESCRIPTION:**

This unit specifies the competencies required to Conduct Research Project**.** It involves 1. Developing research proposal.

|  |  |
| --- | --- |
| **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 research proposal | * 1. Suitable project title is identified as per research methods guidelines   2. Project proposal is prepared as per research methods guidelines   3. Project proposal is submitted in line with the institution assessment guidelines |

**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. Data collection tool may include but not limited to: | 1. Questionnaires 2. Case study 3. Checklist 4. Observations 5. Surveys 6. Interviews |
| 1. Statistical methods may include but not limited to: | 1. Descriptive 2. Diagnostic 3. Prescriptive 4. Predictive |
| 1. Ethical standards and guidelines | 1. Professional integrity 2. Public safety 3. Environmental responsibility 4. Conflict interest 5. Data integrity 6. Informed consent |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

The individual needs to demonstrate knowledge and understanding of:

1. Field assessment procedures
2. Different land condition
3. Different crop condition
4. Different farm tools and material
5. Renewable energy
6. Emerging technologies
7. Maintenance of work area
8. Record keeping procedure
9. Data analysis and presentation
10. Computer application packages
11. Building Project management

**FOUNDATION SKILLS**

1. Communications (verbal and written);
2. Preparing assessment report
3. Determining and selecting building Machinery based on materials and equipment’s conditions
4. Reading and interpretation of manufacturer’s manuals on wok and maintenance
5. Using appropriate fuel and lubricant requirement
6. Operating different building machines
7. Appropriate PPE at different construction work
8. Practicing safety practices and safe operation
9. Assessment of machine performance
10. Troubleshooting and practicing maintenance
11. Information record keeping
12. Decision making;
13. Report writing;
14. Creativity
15. Self-driven

**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. Prepared project proposal as per research methods guidelines   2. Project proposal is submitted in line with the institution assessment guidelines   3. Prepared project design as per the engineering standards   4. Prepared work plan schedule as the project proposal   5. Conducted project tests performance based on scientific approved methods   6. Analysed and presented collected data in line with statistical methods   7. Compiled project report as per the report writing guidelines   8. Presented project report as per the institution guidelines |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant assessment environment   3. Resources relevant to the proposed assessment activity or tasks |
| 1. Methods of Assessment | Competency in this unit may be accessed through:   * 1. Practical tests   2. Project   3. Portfolio of evidence   4. Third party report   5. Written tests |
| 1. Context of Assessment | This competency may be assessed in a work place or in an a simulated work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## CONDUCT RESEARCH PROJECT II

**UNIT CODE: 0732 551 22A**

**UNIT DESCRIPTION:**

This unit specifies the competencies required to Conduct Research Project**.** It involves collecting project data, analysing project data, presenting project report, developing proposed project models.

|  |  |
| --- | --- |
| **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. Collect project data | * 1. ***Data collection tools*** are prepared as per the research standards   2. Project performance indicators are identified as per the system outputs   3. Project tests performance is conducted based on scientific approved methods   4. Data collected based on the performance indicator   5. Data collected is analyzed and presented in line with ***statistical methods*** |
| 1. Analyze project data | * 1. Analysis methods are selected based on the research questions   2. Data accuracy and consistency are verified based on established data quality standards   3. Results are compared according to project performance indicators   4. Statistical significance is determined based on accepted statistical standards and practices |
| 1. Present project report | * 1. Project report is compiled as per the report writing guidelines   2. Project report is presented as per the institution guidelines   3. Project report is presented based on ***ethical standards*** and guidelines |
| 1. Develop proposed project model | * 1. Project design is prepared as per the engineering standards   2. Work plan schedule is prepared as the project proposal   3. Tools and materials are prepared based on the project design   4. Project model is developed based on the design |

**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. Data collection tool may include but not limited to: | 1. Questionnaires 2. Case study 3. Checklist 4. Observations 5. Surveys 6. Interviews |
| 1. Statistical methods may include but not limited to: | 1. Descriptive 2. Diagnostic 3. Prescriptive 4. Predictive |
| 1. Ethical standards and guidelines | 1. Professional integrity 2. Public safety 3. Environmental responsibility 4. Conflict interest 5. Data integrity 6. Informed consent |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

**FOUNDATION SKILLS**

The individual needs to demonstrate the following additional skills:

* 1. Communications (verbal and written);
  2. Preparing assessment report
  3. Determining and selecting building Machinery based on materials and equipment’s conditions
  4. Reading and interpretation of manufacturer’s manuals on wok and maintenance
  5. Using appropriate fuel and lubricant requirement
  6. Operating different building machines
  7. Appropriate PPE at different construction work
  8. Practicing safety practices and safe operation
  9. Assessment of machine performance
  10. Troubleshooting and practicing maintenance
  11. Information record keeping
  12. Decision making;
  13. Report writing;
  14. Creativity
  15. Self-driven

**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. Prepared project proposal as per research methods guidelines   2. Project proposal is submitted in line with the institution assessment guidelines   3. Prepared project design as per the engineering standards   4. Prepared work plan schedule as the project proposal   5. Conducted project tests performance based on scientific approved methods   6. Analysed and presented collected data in line with statistical methods   7. Compiled project report as per the report writing guidelines   8. Presented project report as per the institution guidelines |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant assessment environment   3. Resources relevant to the proposed assessment activity or tasks |
| 1. Methods of Assessment | Competency in this unit may be accessed through:   * 1. Practical tests   2. Project   3. Portfolio of evidence   4. Third party report   5. Written tests |
| 1. Context of Assessment | This competency may be assessed in a work place or in an a simulated work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# **CORE UNITS OF COMPETENCY**

## PREPARE FOR MATERIALS TESTING

**UNIT CODE : 0732 551 23A**

**UNIT DESCRIPTION :**

This unit describes the competencies required in preparing for materials testing. It involves organizing for material testing, sampling construction materials and preparing samples for testing.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the keyoutcomes which make upworkplace 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. Organize for material testing | 1. Preliminary site investigations are conducted as per work requirements. 2. Material laboratory is provided and maintained as per the work requirement 3. Material testing manuals and contract documents are obtained as per job requirement 4. Material testing equipment are acquired as per job requirement 5. Material laboratory personnel are identified according to expertise and qualifications 6. Types of material tests are determined according to test procedures and requirements 7. ***Testing equipment*** are maintained as per the manufacturer’s instructions |
| 1. Sample construction materials | 1. Sources of construction materials are identified as per job requirement 2. Sampling procedures are obtained as per the work specifications 3. ***Sampling tools and equipment*** are assembled as per the job requirements 4. Sampling is carried out as per job requirement 5. Samples awaiting analysis are stored as per job requirement 6. Testing equipment are maintained as per job requirement |
| 1. Prepare samples for testing | 1. ***Sample tests*** are identified as per job requirement 2. Standard manuals and procedures are obtained as per job requirement 3. ***Sample testing tools and apparatus*** are assembled as per job requirement 4. Samples are obtained as per job specification 5. Testing equipment are maintained as per job requirement |
| **Range**   |  |  | | --- | --- | | **Variable** | **Range**  *May include but is not limited to:* | | 1. ***Testing equipment*** may include but not limited to: | 1. Moulds 2. Tamping rods 3. CBR test machine 4. Rammer 5. Ruffle box 6. Casagrande apparatus 7. Penetrometer 8. Weighing machine 9. Oven 10. Measuring cylinder 11. Cone cups 12. Bowl 13. Stirring stick 14. Crushing machine 15. Moisture bags 16. Funnels 17. Standard sieves | | 1. ***Sampling tools and equipment*** may include but are not limited to: | 1. Spade 2. Trowel 3. Jembe 4. Mattock 5. Circular cutters 6. Spatula 7. Chisel 8. Bowls | | 1. ***Sample tests*** may include but are not limited to: | * + - 1. Atterberg limit       2. Proctor/compaction       3. slump test |   **Required SKILLS**   1. Analytical 2. Quality control analysis 3. Complex problem solving 4. Critical thinking 5. Engineering drawings interpretation 6. Monitoring 7. Numeracy 8. Communication   **REQUIRED KNOWLEDGE**   1. Applied science 2. Construction materials 3. Materials testing 4. Quality assurance 5. Management of material resources 6. Engineering mathematics 7. Bills of quantities 8. Materials 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 | 1. Assessment requires evidence that the candidate: 2. Conducted Preliminary site investigations as per work requirements. 3. Obtained Material testing manuals and contract documents as per job requirement 4. Prepared Material testing equipment as per job requirement 5. Identified Types of material tests according to test procedures and requirements 6. Obtained Sampling procedures as per the work specifications 7. Assembled Sampling tools and equipment as per the job requirements 8. Carried out Sampling as per job requirement 9. Stored Samples awaiting analysis as per job requirement 10. Maintained Testing equipment as per job requirement | | 1. Resource Implications | 1. The following resources should be provided: 2. Access to relevant workplace or appropriately simulated environment where assessment can take place 3. Materials relevant to the proposed activity or tasks | | 1. Methods of Assessment | 1. Competency in this unit may be assessed through: 2. Practical 3. Projects 4. Portfolio of evidence 5. Third party reports 6. Written tests | | 1. Context of Assessment | 1. The competency may be assessed in a workplace or a simulated workplace | | 1. Guidance information for assessment | 1. Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. | | |

## CONDUCT MATERIAL TESTING I

**UNIT CODE: 0732 551 24A**

**UNIT DESCRIPTION**

This unit specifies the competencies required to Conduct Material Testing I. It involves performing tests on alignment soils, concrete.

**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. Perform soil tests | * 1. ***Soil tests*** are identified according to contract document   2. Standard manuals and procedures are obtained in accordance with test requirement   3. Soil testing tools and apparatus are assembled based on test requirements   4. Soil samples are obtained according to test requirement   5. Soil tests are conducted as per laboratory manual   6. Results are analyzed as per the soil analysis manual   7. Report is prepared and presented based on contract document requirement   8. Testing equipment are maintained as per the manufacturer’s instructions |
| 1. Perform concrete tests | * 1. ***Concrete tests*** are identified according to contract document   2. Concrete testing tools and apparatus are gathered based on test requirements   3. ***Concrete materials*** are tested as per test requirement   4. Samples are cast and cured as per concrete testing manual   5. Samples are tested and results recorded according to concrete testing manual   6. Analysis of test result is carried out and reported according to contract document   7. Concrete testing equipment are maintained as per the manufacturer’s instructions |

**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. Soil Tests may include but not limited to: | * 1. CBR   2. Atterberg limit   3. Liquid limit   4. Plastic limit   5. Proctor/compaction   6. Field density   7. Particle size distribution |
| 1. Concrete Tests may include but not limited to: | * 1. Compressive strength   2. Slump   3. Cleanliness   4. Particle size distribution |
| 1. Steel tests may include but not limited to: | * 1. Tensile/Strength |
| 1. Bitumen Test may include but not limited to: | * 1. Penetration   2. Cleanliness   3. Viscosity   4. Ductility   5. Flash and Fire Point   6. Float Test   7. Loss on Heating   8. Specific Gravity   9. Softening Point   10. Spread Rate |
| 1. Timber tests may include but not limited to: | * 1. Tensile/Strength   2. Compressive   3. Shear   4. Size |

**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:

1. Technical
2. Interpretation
3. Reporting
4. Analytical
5. Sample handling
6. Interpersonal
7. Observation
8. Time management
9. Leadership
10. Numeracy
11. Computer

**Required Knowledge**

The individual needs to demonstrate knowledge of:

1. Material testing laboratory
2. Sampling procedures
3. Standard manuals and procedures
4. Contract documents
5. Material testing equipment
6. Road construction materials
   1. Types
   2. Sources
   3. Properties
7. Material sampling
8. Test parameters
9. Analysis and interpretation
10. Sample preparation
11. SOPs

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   * 1. Identified and conducted required soil and concrete tests according to contract documents and testing manuals   2. Prepared and maintained testing equipment by assembling appropriate tools and following manufacturer’s instructions   3. Collected samples and performed tests on soil and concrete materials following standard procedures   4. Analyzed test results using approved methods and reported findings based on contract requirements   5. Ensured compliance with testing standards throughout sampling, testing, and reporting processes |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant assessment environment   3. Resources relevant to the proposed assessment activity or tasks |
| 1. Methods of Assessment | Competency in this unit may be accessed through:   * 1. Practical tests   2. Project   3. Portfolio of evidence   4. Third party report   5. Written tests |
| 1. Context of Assessment | This competency may be assessed in a work place or in a simulated work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

## CONDUCT MATERIAL TESTING II

**UNIT CODE: 0732 551 25A**

**UNIT DESCRIPTION**

This unit specifies the competencies required to Conduct Material Testing. It involves performing tests on alignment, structural steel, bitumen materials and timber.

**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. Carry out structural steel tests | * 1. Steel sample is obtained based on structural designs   2. Structural steel testing equipment are identified and calibrated as per manufacturers manual   3. ***Steel tests*** are conducted according to laboratory manual   4. Results are analyzed as per the laboratory manual   5. Report is prepared and presented according to the contract document   6. Steel testing equipment are maintained as per the manufacturer’s instructions |
| 1. Perform bitumen tests | * 1. ***Bitumen tests*** are identified according to contract document   2. Bitumen testing tools and apparatus are assembled based on test requirements   3. Bitumen samples are obtained and prepared as per test requirement   4. Bitumen tests are conducted according to laboratory manual   5. Bitumen tests results are analyzed according to laboratory manual   6. Report is prepared and presented as per contract document   7. Bitumen testing equipment are maintained as per the manufacturer’s instructions |
| 1. Perform timber tests | * 1. ***Timber tests*** are identified according to contract document   2. Timber testing tools and apparatus are assembled based on test requirements   3. Samples are obtained and prepared as per test requirement   4. timber Tests are conducted according to test requirement   5. timber Test results are recorded and analyzed according to contract document   6. Report is prepared and presented as per contract document   7. Testing equipment are maintained as per the manufacturer’s manual |

**RANGE**

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

|  |  |
| --- | --- |
| **VARIABLE** | **RANGE** |
| 1. Steel tests may include but not limited to: | * 1. Tensile/Strength |
| 1. Bitumen Test may include but not limited to: | * 1. Penetration   2. Cleanliness   3. Viscosity   4. Ductility   5. Flash and Fire Point   6. Float Test   7. Loss on Heating   8. Specific Gravity   9. Softening Point   10. Spread Rate |
| 1. Timber tests may include but not limited to: | * 1. Tensile/Strength   2. Compressive   3. Shear   4. Size |

**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:

1. Technical
2. Interpretation
3. Reporting
4. Analytical
5. Sample handling
6. Interpersonal
7. Observation
8. Time management
9. Leadership
10. Numeracy
11. Computer

**Required Knowledge**

The individual needs to demonstrate knowledge of:

1. Material testing laboratory
2. Sampling procedures
3. Standard manuals and procedures
4. Contract documents
5. Material testing equipment
6. Road construction materials
   1. Types
   2. Sources
   3. Properties
7. Material sampling
8. Test parameters
9. Analysis and interpretation
10. Sample preparation
11. SOPs

**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 types of material tests according to test procedures and requirements   2. Carried out soil sampling as per standard sampling procedure   3. Conducted soil tests as per laboratory manual   4. Conducted structural steel tests according to laboratory manual   5. Conducted bitumen test according to laboratory manual   6. Conducted timber tests according to test requirement   7. Carried out analysis of test result and reported according to contract document   8. Testing equipment are maintained as per the manufacturer’s manual |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant assessment environment   3. Resources relevant to the proposed assessment activity or tasks |
| 1. Methods of Assessment | Competency in this unit may be accessed through:   * 1. Practical tests   2. Project   3. Portfolio of evidence   4. Third party report   5. Written tests |
| 1. Context of Assessment | This competency may be assessed in a work place or in a simulated work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

## CARRY OUT SITE SURVEY

**UNIT CODE:** 0732 451 26A

**UNIT DESCRIPTION:**

This unit describes the competencies required in carrying out site survey. It involves undertaking preliminary site survey, setting out civil structures and establishing survey control points.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **EMENT**  These describe the keyoutcomes 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. Undertake preliminary site survey | * 1. Preliminary site survey plan is prepared in as per job requirement   2. ***Survey resources*** are mobilized as per the contract document   3. ***Working drawings*** are interpreted as per job requirement   4. ***Site conditions*** are recorded as per job requirement procedures   5. Original ground level (ogl) is established and documented as per job requirement   6. Reference points are established as per job requirement Preliminary survey report is prepared according to findings |
| 1. Set out civil structures | * 1. ***Setting out*** ***tools and equipment*** are selected according to job requirement.   2. Setting out equipment are calibrated according to manufacturer’s manual   3. Proposed alignment is determined as per job requirement   4. Horizontal and vertical alignment is set out as per job requirement as per job requirement   5. Alignment data is computed as per the job requirements   6. Setting out tools and equipment are maintained as per job requirement |
| 3.Establish survey control points  (LEVELLING) | 1. ***Survey tools and equipment*** are selected according to job requirement. 2. Survey tools and equipment are calibrated as per job requirement 3. ***Site survey control points*** are established as per job requirement 4. ***Levelling works*** is carried out as per work requirements 5. survey tools and equipment are maintained as per job requirement |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Range**   |  |  | | --- | --- | | **Variable** | **Range**  *May include but is not limited to:* | | 1. ***Survey resources*** may include but not limited to: | 1..1 Human resources   * 1. Tools      1. Driving hammers      2. Pegs      3. Measuring tapes      4. Cutting tools   2. Equipment      1. Electric Distance Measurement (EDM) machines      2. Theodolite (CWT)      3. Total Station (TS)      4. Dumpy level      5. Levelling staff   3. Stationery      1. Surveyors filed notebooks      2. Pencil      3. Grid papers   4. Legal documents      1. Field permits      2. Registration certificates   5. Power back-ups   6. Location maps | | 1. ***Working drawings*** may include but are not limited to: | * 1. Topographic maps   2. Site plan   3. Profile drawings | | 1. ***Site conditions*** may include but are not limited to: | * 1. Topography   2. Soil type and profiles   3. Vegetation   4. Settlements   5. Drainage   6. Weather conditions   7. Utility services      1. Underground electric cables      2. Pipe lines      3. Data cables   8. Water table | | 1. ***Setting out*** ***tools and equipment*** may include but not limited to: | * 1. Strings   2. Tape measures   3. Ranging rods   4. Pegs   5. Cutting tools   6. Driving tools   7. Angle measuring tools   8. Plumb bob   9. Marking tools and equipment | | 1. ***Survey tools and equipment*** are may include but not limited to: | * 1. Dumpy level, tilting levels and automatic levels   2. Levelling staff   3. Tilting levels   4. Automatic levels   5. Tape measure   6. Pegs   7. Ranging rods | | 1. ***Site survey control points*** may include but not limited to: | * 1. TBM (temporary benchmark)   2. BM (permanent benchmark)   3. Arbitrary | | 1. ***Levelling works*** may include but not limited to: | * 1. Temporary adjustment   2. Booking levels   3. Calculation of reduced levels   4. Arithmetic checks |   **Required SKILLS**   1. Analytical 2. Quality control analysis 3. Complex problem solving 4. Critical thinking 5. Engineering drawings interpretation 6. Monitoring 7. Numeracy 8. Communication   **REQUIRED KNOWLEDGE**   1. Applied science 2. Construction materials 3. Materials testing 4. Quality assurance 5. Management of material resources 6. Engineering mathematics 7. Bills of quantities 8. Materials 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. Mobilized Survey resources as per the contract document   2. Interpreted Working drawings as per job requirement   3. Recorded Site conditions as per job requirement procedures   4. Established Original ground level (ogl) as per job requirement   5. Set out Horizontal and vertical alignment as per job requirement as per job requirement   6. Computed Alignment data as per the job requirements   7. Maintained Setting out tools and equipment as per job requirement   8. Selected Survey tools and equipment according to job requirement. | | * + 1. Resource Implications | The following resources should be provided:   * 1. Access to relevant workplace or appropriately simulated environment where assessment can take place   2. Materials relevant to the proposed activity or tasks | | * + 1. Methods of Assessment | Competency in this unit may be assessed through:   * 1. Practical   2. Projects   3. Portfolio of evidence   4. Third party reports   5. Written tests | | 1. Context of Assessment | The competency may be assessed in a workplace or a simulated workplace | | 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. | |

## CARRY OUT ENGINEERING SURVEY I

**UNIT CODE: 0732 551 27A**

**UNIT DESCRIPTION**

This unit specifies the competencies required to carry out civil engineering survey**.** It involves; performing traversing works and curve ranging.

**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. Perform traversing works | * 1. ***Traversing tools and equipment*** are selected according to task requirement   2. Traversing tools and equipment are calibrated according to manufacturer’s manual   3. Horizontal and vertical angles are determined based on datum bearings and coordinates   4. Distances are measured according to job requirements   5. Traverses are plotted according to bearings and distances   1.13Traversing tools and equipment are maintained as per the manufacturer’s manual |
| 1. Perform Curve Ranging | * 1. **Curve ranging tools and equipment** are selected according to the specific task.   2. **Principles of curve ranging** are accurately described in relation to horizontal alignment and field procedures.   3. **Methods of overcoming obstacles** encountered during curve ranging are determined and appropriately explained.   4. **Curve setting-out data** is accurately computed using appropriate methods and relevant field parameters. |

**Range**

|  |  |
| --- | --- |
| **Variable** | **Range**  *May include but is not limited to:* |
| * + 1. Traversing tools and equipment | 1. Theodolite 2. Total Station 3. Dumpy Level / Automatic Level 4. Tripod 5. Measuring Tape / Steel Tape 6. EDM Device (Electronic Distance Measurement) 7. Prism and Prism Pole 8. Plumb Bob 9. Survey Pegs and Ranging Rods 10. Field Notebook / Survey Data Collector |
| * + 1. Curve ranging tools and equipment | 1. Theodolite 2. Total Station 3. Curve Set-out Template or Template Board 4. Surveying Prism 5. Measuring Tape or Chain 6. Prism Pole 7. Ranging Rods 8. Curve Radius Gauge or Template 9. Plumb Bob 10. Field Notebook / Survey Data Collector |

**required skills**

1. Instrument Handling and Setup
2. Angle Measurement
3. Distance Measurement
4. Data Recording and Computation
5. Curve Layout and Set-Out
6. Surveying Calculations
7. Problem-Solving for Obstacles
8. Attention to Detail
9. Fieldwork Safety
10. Communication and Teamwork

**required knowlegde**

1. Surveying Principles
2. Types of Traversing and Curve Setting
3. Instrument Calibration and Operation
4. Measurement Techniques
5. Surveying Calculations (e.g., angles, distances, and radii)
6. Curve Alignment and Layout
7. Methods for Overcoming Obstacles in the Field
8. Fieldwork Procedures and Safety Standards
9. Data Recording and Interpretation
10. Relevant Standards and Regulations in Surveying

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| * + 1. Critical Aspects of Competency | 1. **Measured horizontal and vertical angles** based on datum bearings and coordinates. 2. **Measured distances** accurately as per job requirements. 3. **Plotted traverses** based on bearings and distances. 4. **Overcame obstacles** encountered during curve ranging. 5. **Computed data** for setting out curves accurately. |
| * + 1. Resource Implications | The following resources should be provided:   * 1. Access to relevant workplace or appropriately simulated environment where assessment can take place   2. Materials relevant to the proposed activity or tasks |
| * + 1. Methods of Assessment | Competency in this unit may be assessed through:   * 1. Practical   2. Projects   3. Portfolio of evidence   4. Third party reports   5. Written tests |
| * + 1. Context of Assessment | The competency may be assessed in a workplace or a simulated workplace |
| * + 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## **CARRY OUT ENGINEERING SURVEY II**

**UNIT CODE: 0732 551 28A**

**UNIT DESCRIPTION**

This unit specifies the competencies required to carry out civil engineering survey**.** It involves; conducting topographic survey and drafting survey design

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| ELEMENT  These describe the key outcomes which make up workplace function | PERFORMANCE CRITERIA  These are assessable statements, which specify the required level of performance for each of the elements.  ***(Bold and italicized terms are elaborated in the Range)*** |
| 1. Conduct topographic survey | * 1. ***Topographic tools and equipment*** are selected according to job requirement.   2. Topographic tools and equipment are calibrated according to manufacturer’s manual   3. Horizontal distances are determined based on datum coordinates   4. Vertical distances are determined based on datum coordinates   5. Topographic data is collected based on job specification   6. Collected data is analyzed and documented based on findings   7. Topographic tools and equipment are maintained as per the manufacturer’s manual |
| 2. Draft survey design | 1. Site levels are computed based on topographic survey report 2. Reduced levels are produced based on computed site levels 3. Survey cross-sections are drafted based on-site levels 4. Survey cross-sections are interpreted as per site conditions 5. Survey cross-sections are established based on interpreted survey cross-sections and profiles |

**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. ***Topographic tools and equipment*** may include but not limited to: | 1. theodolite 2. Dumpy level 3. GPS receiver 4. Measuring tape 5. Leveling staff 6. Tripod 7. Prisms and prism poles 8. Plumb bob 9. Ranging rods 10. Pegs and markers 11. Field notebook |

**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:

1. Drafting skills
2. Drawings
3. Computer literacy
4. Leadership
5. Reporting
6. Communication
7. Creativity and innovation
8. Interpersonal
9. Problem solving
10. Interpretation
11. Analytical

**Required Knowledge**

The individual needs to demonstrate knowledge of:

1. Type and use of different survey tools and equipment
2. Care and maintenance of survey equipment
3. Construction site conditions
4. Standard construction procedures
5. Contract document
6. Legal and statutory requirements
7. Survey drawings
8. Setting out tools and equipment
9. Setting out methods
10. Manufacturer’s manual
11. Survey data booking and computation
12. Documentation of data
13. Tachometry tools and equipment
14. Levelling tools and equipment
15. Road levels
16. Quality control operations
17. Survey cross-sections

**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. Collected topographic data based on job specification   2. Analyzed and documented collected topographical data based on findings   3. Computed site levels based on topographic survey report   4. Established reduced levels based on computed site levels   5. Drafted survey cross-sections based on-site levels   6. Set out horizontal and vertical alignment based on ogl   7. Computed alignment data as per the job requirements |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place   2. Access to relevant assessment environment   3. Resources relevant to the proposed assessment activity or tasks |
| 1. Methods of Assessment | Competency in this unit may be accessed through:   * 1. Practical tests   2. Project   3. Portfolio of evidence   4. Third party report   5. Written tests |
| 1. Context of Assessment | This competency may be assessed in a work place or in an a simulated work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

## DESIGN ROAD STRUCTURES I

**UNIT CODE: 0732 551 29A**

**UNIT DESCRIPTION**

This unit specifies the competencies required to design basic pavement structures. It involves; conducting site visit, designing pavement structures and carrying out road geometric design.

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace function | **PERFORMANCE CRITERIA**  These are assessable statements, which specify the required level of performance for each of the elements.  ***(Bold and italicized terms are elaborated in the Range)*** |
| 1. Conduct site visit | * 1. ***Road structure*** location is determined based on contract documents   2. Site preparation visit is undertaken as per contract documents   3. Preliminary site visit is conducted as per the work schedule   4. On site data is collected according to job requirements |
| 2. Design pavement structures | * 1. Resources are mobilized in accordance with pavement structure requirements   2. Traffic load is estimated as per traffic survey information   3. ***Pavement type*** is determined as per client/developer/financier preference   4. Pavement structures are designed based on traffic engineering analysis outputs   5. Pavement structural drawings are produced as per design outputs   6. Materials schedules are developed according to design results   7. Detailed report and specifications are prepared and presented as per the contract document |
| 3. Carry out road geometric design | * 1. ***Resources*** are mobilized in accordance with geometric design requirements   2. OGL (original ground levels) are analyzed according to site survey report   3. Horizontal and vertical alignments are designed based on the job requirements   4. ***Road intersections*** are designed as per job specifications   5. Drawings are produced as per design data   6. Report is prepared and presented as per contract document |

**RANGE**

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

|  |  |
| --- | --- |
| **VARIABLE** | **RANGE** |
| 1. Road structures may include but not limited to: | 1. Pavements 2. Footpath 3. Parking 4. Culverts 5. Road furniture 6. Bridges 7. Hydraulic structures |
| 1. On site data may include but not limited to: | * 1. Datum points   2. Settlement   3. Natural features   4. Soil type   5. Water catchment areas   6. Accessibility of utility services   7. Land marks   8. Road reserve |
| 1. Resources may include but not limited to: | * 1. Geometric tools   2. Straight edge   3. Ruler   4. Compass   5. Protractor   6. Computers   7. Auto Cad Software   8. Civil 3D   9. ARCHI CAD   10. GIS |
| 1. Drainage structures may include but not limited to: | * 1. Water bars   2. Ditches   3. French drains   4. Culverts   5. Under drains |
| 1. Hydraulic may include but not limited to: | * 1. Bridges   2. Reservoirs   3. Pipelines   4. Canals   5. Aqueducts   6. Turbines   7. Pumps   8. Flood control structures |
| 1. Retaining walls may include but not limited to: | * 1. Gravity   2. Cantilever   3. Embedded   4. Reinforced   5. Counterfort   6. Buttress |
| 1. Road intersections may include but not limited to: | * 1. Y-junctions   2. T-junctions   3. Under-pass   4. Round about   5. Overpass   6. Cross junctions   7. Interchange |

**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:

1. Technical
2. Drawings
3. Interpretation
4. Creativity
5. Innovation
6. Time management
7. Leadership
8. Numerical
9. CAD
10. Interpersonal

**Required Knowledge**

The individual needs to demonstrate knowledge of:

1. Horizontal alignments
2. Interpretation of drawings
3. Vertical alignments
4. CAD
5. Material testing
6. Runways
7. Relevant manuals
8. Engineers Code of Ethics
9. Engineer’s Act
10. Basic Mathematics and Physics

**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. estimated Traffic load as per traffic survey information   2. determined Pavement type as per client/developer/financier preference   3. designed Pavement structures based on traffic engineering analysis outputs   4. produced Pavement structural drawings as per design outputs   5. designed Horizontal and vertical alignments based on the job requirements   6. produced Drawings according to design output |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant assessment environment   3. Resources relevant to the proposed assessment activity or tasks |
| 1. Methods of Assessment | Competency in this unit may be accessed through:   * 1. Practical tests   2. Project   3. Portfolio of evidence   4. Third party report   5. Written tests |
| 1. Context of Assessment | This competency may be assessed in a work place or in an a simulated work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

## DESIGN ROAD STRUCTURES II

**UNIT CODE: 0732 551 30A**

**UNIT DESCRIPTION**

This unit specifies the competencies required to design basic pavement structures. It involves; designing drainage and hydraulic structures, designing pedestrian and cyclist paths and designing road furniture.

|  |  |
| --- | --- |
| **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. Design drainage and hydraulic structures | * 1. Surface run-off is estimated based on hydrographic survey   2. ***Drainage structures*** are designed based on geometric design manual   3. ***Hydraulic structures*** are designed as per the design manuals and procedures   4. ***Retaining walls*** are designed as per the design manuals and procedures   5. Construction materials are determined based on road construction drawings and specifications |
| 1. Design pedestrian and cyclist paths | * 1. Required resources are mobilized as per design requirements   2. Pedestrian and cyclist traffic are estimated in accordance with traffic survey information   3. Pedestrian and cyclist path location is determined according to road profile   4. Pedestrian and cyclist paths are designed as per design manuals   5. Drawings are produced according to design output   6. Report and material specifications are prepared and presented according to contract document |
| 1. Design Road furniture | * 1. Required resources are mobilized according to design requirements   2. ***Road furniture*** type is determined based on road type and design manuals   3. Road furniture location is determined as per geometric road design   4. Road furniture is designed according to standard road construction procedures   5. Drawings are produced based on design requirements   6. Report and material specifications are prepared and presented as per contract document 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. Road intersections may include but not limited to: | * 1. Y-junctions   2. T-junctions   3. Under-pass   4. Round about   5. Overpass   6. Cross junctions   7. Interchange |
| 1. Pavement types may include but not limited to: | * 1. Rigid   2. Flexible |
| 1. Pavement structures may include but not limited to: | * 1. Sub-grade   2. Sub-base   3. Base   4. Surface |
| 1. Road furniture may include but not limited to: | * 1. Road markings   2. Information signs   3. Warning signs   4. Street lights   5. Traffic lights   6. Guard rails |

**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:

1. Technical
2. Drawings
3. Interpretation
4. Creativity
5. Innovation
6. Time management
7. Leadership
8. Numerical
9. CAD
10. Interpersonal

**Required Knowledge**

The individual needs to demonstrate knowledge of:

1. Interpretation of drawings
2. Vertical alignments
3. CAD
4. Relevant manuals
5. Engineers Code of Ethics
6. Engineer’s Act
7. Basic Mathematics and Physics

**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 Road intersections as per job specifications   2. produced Drawings as per design data   3. designed Drainage structures based on geometric design manual   4. designed Hydraulic structures as per the design manuals and procedures   5. Retaining walls are designed as per the design manuals and procedures   6. designed Pedestrian and cyclist paths as per design manuals   7. produced Drawings according to design output   8. designed Road furniture according to standard road construction procedures |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant assessment environment   3. Resources relevant to the proposed assessment activity or tasks |
| 1. Methods of Assessment | Competency in this unit may be accessed through:   * 1. Practical tests   2. Project   3. Portfolio of evidence   4. Third party report   5. Written tests |
| 1. Context of Assessment | This competency may be assessed in a work place or in an a simulated work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

## 

## PRODUCE CIVIL ENGINEERING DRAWINGS I

**UNIT CODE : 0732 551 32A**

**UNIT DESCRIPTION**

This unit describes the competencies required to produce building drawings. It involves interpreting architectural drawings, preparing structural and civil drawings, interpreting electrical drawings, and mechanical drawings.

|  |  |
| --- | --- |
| ELEMENT  These describe the key outcomes which make up workplace function | PERFORMANCE CRITERIA  These are assessable statements, which specify the required level of performance for each of the elements.  ***(Bold and italicized terms are elaborated in the Range*** |
| 1. Interpret architectural drawings | * 1. Construction dimensions are interpreted according to ***architectural drawings***   2. Drawing specifications are referenced as per the layouts   3. Drawing layouts are interpreted in accordance with the building standards |
| 1. Interpret electrical drawings | * 1. ***Electrical circuit symbols*** are identified according to the electrical code of practice   2. Electrical circuits drawings are sketched in accordance with the architectural layout   3. Electrical connection layout is drawn in accordance with the electrical code of practice |
| 1. Interpret mechanical drawings | * 1. ***Mechanical components*** are identified as per the architectural and structural drawings   2. Mechanical component dimensions are interpreted as per the structural and architectural drawings   3. Mechanical components layout is interpreted as per the structural and architectural drawings design |

**RANGE**

| **Variable** | **Range** |
| --- | --- |
| 1. Construction dimensions may include but not limited to: | * 1. vertical dimensions   2. horizontal dimensions |
| 1. building standards may include but not limited to: | * 1. BS 8110   2. Euro codes   3. Kenya Building Codes, 2022   4. Civil engineering codes |
| 3. Mechanical components may include but not limited to: | * 1. Gas supply   2. Cold and hot water supply systems   3. Plumbing layout   4. Sewer system   5. Fire fighting   6. Ventilation system   7. Water treatment system   8. Refrigeration   9. Building automation system |

**REQUIRED KNOWLEDGE and SKILLS**

**Knowledge**

1. Construction dimensions
2. Architectural drawing
3. Local authority by-laws
4. Building code
5. Structural elements
6. Codes of practice
7. Basic arithmetic
8. Measurement
9. Engineering drawing
10. Plumbing
11. Structural design
12. Mechanical systems
13. Engineering software
14. Civil engineering drawings

**Skills**

1. Measurement
2. Basic arithmetic
3. Design
4. Computer Aided Design
5. planning

**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. Interpreted drawing layouts in accordance with the building standards   2. Sketched electrical circuits drawings in accordance with the architectural layout   3. Interpreted mechanical component dimensions as per the structural and architectural drawings   4. Interpreted mechanical components layout as per the structural and architectural drawings design |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant assessment environment   3. Resources relevant to the proposed assessment activity or tasks |
| 1. Methods of Assessment | Competency in this unit may be accessed through:   * 1. Practical tests   2. Project   3. Portfolio of evidence   4. Third party report   5. Written tests |
| 1. Context of Assessment | This competency may be assessed in a work place or in a simulated work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

## PRODUCE CIVIL ENGINEERING DRAWINGS II

**UNIT CODE : 0732 551 32A**

**UNIT DESCRIPTION**

This unit describes the competencies required to produce building drawings. It involves preparing structural and civil drawings

|  |  |
| --- | --- |
| 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 structural and civil drawings | * 1. ***Structural elements*** are designed according to the codes of practice   2. Detailed plans and sections of designed elements are drawn as per project specifications   3. Bar bending schedule is prepared as per the structural drawings   4. Structural and civil drawings are produced in accordance with project specification |

**RANGE**

| **Variable** | **Range** |
| --- | --- |
| * + - 1. structural elements may include but not limited to: | * 1. Slabs   2. Beams   3. Columns   4. Foundation   5. Stairs |

**REQUIRED KNOWLEDGE and SKILLS**

**Knowledge**

1. Construction dimensions
2. Architectural drawing
3. Local authority by-laws
4. Building code
5. Structural elements
6. Codes of practice
7. Basic arithmetic
8. Measurement
9. Engineering drawing
10. Plumbing
11. Structural design
12. Mechanical systems
13. Engineering software
14. Civil engineering drawings

**Skills**

1. Measurement
2. Basic arithmetic
3. Design
4. Computer Aided Design
5. planning

**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 structural elements in accordance with relevant codes of practice   2. Prepared detailed plans and sections of structural elements as per project specifications   3. Developed accurate bar bending schedules based on structural drawings   4. Produced structural and civil drawings in line with the project specifications |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant assessment environment   3. Resources relevant to the proposed assessment activity or tasks |
| 1. Methods of Assessment | Competency in this unit may be accessed through:   * 1. Practical tests   2. Project   3. Portfolio of evidence   4. Third party report   5. Written tests |
| 1. Context of Assessment | This competency may be assessed in a work place or in a simulated work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

## CARRY OUT ROAD CONSTRUCTION WORKS I

**UNIT CODE: 0732 551 33A**

**UNIT DESCRIPTION:**

This unit describes the competencies required in carry out pavement construction works. It involves Carrying out Earthwork Activities, constructing pavement layers, constructing transportation infrastructure and applying emerging trends in road construction

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the keyoutcomes 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 earthwork activities | * 1. ***Earthwork resources*** are mobilized as per the work requirement   2. ***Site clearance*** activities are carried out based on job requirement   3. Drawings are interpreted as per site layout   4. Setting out for earthworks is conducted based on design output   5. Ground levels are documented according to site level reports   6. Volumes of cut and fill materials is determined in accordance to the ground levels   7. Disposal of waste material is carried out as per the waste disposal regulations   8. Construction tools and equipment are operated and maintained as per the manufacturer’s instruction |
| 1. Construct pavement layers | * 1. Required road construction resources are mobilized as per job requirement.   2. Drawings are interpreted as per the site layout   3. Levelling activities are carried out as per ground levels   4. ***Profile layers*** are laid as per job requirements   5. Maintenance of road structure is undertaken as per maintenance procedures   6. Construction tools and equipment are maintained as per the manufacturer’s instructions |
| 1. Construct transportation infrastructure | * 1. Required resources are mobilized as per contract document   2. Drawings are interpreted as per site layout   3. ***Transportation infrastructure*** is constructed as per the structural and architectural designs   4. Levelling activities are carried out as per standard construction requirements   5. Quality control operations are carried out according to standard construction requirements   6. Transportation infrastructure maintenance is undertaken as per maintenance requirements   7. Construction tools and equipment are maintained as per the manufacturer’s instructions |
| 1. Apply emerging strategies for Road Construction | * 1. ***Emerging trends*** are identified based on recent developments   2. Road construction site is prepared as per job requirement   3. Road construction works are conducted based on the job requirements |

**Range**

|  |  |
| --- | --- |
| **Variable** | **Range**  *May include but is not limited to:* |
| 1. ***Earthwork resources*** may include but not limited to: | * 1. Bull dozers   2. Graders   3. Back hoes   4. Tippers   5. Shovels   6. Excavators   7. Grabbers   8. Rollers   9. Compactors      1. Cranes      2. Dump trucks      3. Off-highway dumpers |
| 1. ***Site clearance*** may include but are not limited to: | * 1. Tree felling and stump removal   2. Boulders removal   3. Bush clearing   4. Grass cutting   5. Stripping   6. Removal cotton soil   7. Isolation and diversion of live services   8. Demolition of buildings, walls and bridges   9. Removal of existing pipelines, public and privately-owned services or supplies   10. Removal of fencing and hedges |
| 1. ***Profile layers*** may include but are not limited to: | * 1. Subgrade   2. Sub base   3. Base course   4. binder   5. Wearing course |
| 1. ***Transportation infrastructure*** may include but not limited to: | 1. parking 2. walk ways 3. cyclist lanes 4. foot bridges 5. bus bays |

**Required SKILLS**

1. Analytical
2. Quality control analysis
3. Complex problem solving
4. Critical thinking
5. Engineering drawings interpretation
6. Monitoring
7. Numeracy
8. Communication

**REQUIRED KNOWLEDGE**

1. Applied science
2. Construction materials
3. Materials testing
4. Quality assurance
5. Management of material resources
6. Engineering mathematics
7. Bills of quantities
8. Materials 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.

|  |  |
| --- | --- |
| Critical Aspects of Competency | Assessment requires evidence that the candidate:   * 1. Mobilised earthwork resources as per the work requirement   2. Carried out site clearance activities based on job requirement   3. Conducted setting out for earthworks based on design output   4. Determined volumes of cut and fill materials in accordance to the ground levels   5. Maintained construction tools and equipment as per the manufacturer’s instruction   6. Mobilized required road construction resources as per job requirement.   7. Carried out levelling activities as per ground levels   8. Laid profile layers as per job requirements   9. Constructed transportation infrastructure as per the working drawings   10. Carried out quality control operations according to standard construction requirements   11. Undertook transportation infrastructure maintenance as per maintenance requirements |
| Resource Implications | The following resources should be provided:   * 1. Access to relevant workplace or appropriately simulated environment where assessment can take place   2. Materials relevant to the proposed activity or tasks |
| Methods of Assessment | Competency in this unit may be assessed through:   * 1. Practical   2. Projects   3. Portfolio of evidence   4. Third party reports   5. Written tests |
| Context of Assessment | The competency may be assessed in a workplace or a simulated workplace |
| Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## CARRY OUT ROAD CONSTRUCTION WORKS II

**UNIT CODE: 0732 551 34A**

**UNIT DESCRIPTION**

This unit specifies the competencies required to perform road construction works. It involves; Constructing Road drainage and hydraulic structures, constructing erosion prevention structures and Installing road furniture

|  |  |
| --- | --- |
| 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. Construct Road drainage and hydraulic structures | * 1. Highway drainage and hydraulic structures construction resources are mobilized as per the job requirement   2. Highway drainage and hydraulic structures are constructed based on designs and specification   3. Highway drainage and hydraulic structures are maintained as per maintenance schedule   4. Construction tools and equipment are maintained as per the manufacturer’s manual |
| 1. Construct erosion prevention structures | * 1. ***Erosion control structures*** are determined based on prevailing site conditions   2. Erosion prevention structure’s location is established according to prevailing site conditions   3. Erosion prevention structures drawings are interpreted as per site layout   4. Erosion prevention structures are constructed in accordance to the contract document   5. Erosion prevention structures are maintained as per maintenance schedule   6. Construction tools and equipment are maintained as per the manufacturer’s manual |
| 1. Install road furniture | * 1. Road furniture installation resources are mobilized according to contract document   2. Road furniture drawings are interpreted according to the contract document   3. Road furniture location is determined according to road design requirements   4. Road furniture are installed as per contract document   5. Road furniture maintenance is carried out based on standard maintenance manual |

**RANGE**

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

|  |  |
| --- | --- |
| **VARIABLE** | **RANGE** |
| 1. Site clearance and demolition activities may include but not limited to: | * 1. Tree felling and stump removal   2. Boulders removal   3. Bush clearing   4. Grass cutting   5. Stripping   6. Removal cotton soil   7. Isolation and diversion of live services   8. Demolition of buildings, walls and bridges   9. Removal of existing pipelines, public and privately-owned services or supplies   10. Removal of fencing and hedges |
| 1. Road construction resources may include but not limited to: | * 1. Machinery   2. Materials   3. Human resources   4. Plant |
| 1. Levelling activities may include but not limited to: | * 1. Setting out   2. Excavation   3. Cutting and filling   4. Reading and booking levels   5. Computing levels |
| 1. Quality control operations may include but not limited to: | * 1. Tests   2. Maximum dry density   3. Cone penetration   4. Plasticity index   5. California Bearing Ratio (CBR)   6. Shear tests   7. Marshall test   8. Monitoring and evaluation |
| 1. Transportation infrastructures may include but not limited to: | * 1. parking   2. walk ways   3. cyclist lanes   4. foot bridges   5. bus bays |
| 1. Road furniture may include but not limited to: | * 1. Traffic signals   2. Traffic warning signs   3. Information signs   4. Street lightings   5. Road markings   6. Pedestrian crossing   7. Guard rails   8. Road barriers   9. Road islands   10. Road kerbs   11. Bollards |
| 1. Types of erosion control structures may include but not limited to: | * 1. Gabions   2. Retaining walls   3. Vegetation   4. Scour check   5. Dykes   6. Benches   7. Catch basins |
| 1. Highway drainage and hydraulic structures may include but not limited to: | * 1. Culverts   2. Side drains   3. Mitre drains   4. Cut-off drains   5. Sub-surface drains   6. Gullies   7. Bridges   8. Drifts   9. Causeways   10. Retaining walls |
| 1. Erosion control structures may include but not limited to: | * 1. Grade control structures   2. Benches   3. Gabions   4. Diversion terraces   5. Scour checks |

**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:

1. Technical
2. Interpretation
3. Numerical
4. Basic management
5. Leadership
6. Analytical
7. Problem solving
8. Communication
9. Creativity
10. Innovation
11. Interpersonal

**Required Knowledge**

The individual needs to demonstrate knowledge of:

1. Construction plant and equipment
2. Housekeeping
3. Setting out
4. Horizontal alignment
5. Vertical alignment
6. Site clearance activities
7. Tree and stump removal
8. Boulders removal
9. Bush clearing
10. Grass cutting
11. Vegetable soil removal

**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. Carried out site clearance and demolition activities based on contract document   2. Conducted setting out for earthworks based on design output   3. Carried out levelling activities as per ground levels   4. Sub-grade layer is constructed according to standard road requirements   5. Constructed sub-base layer as per standard road requirements   6. Constructed base layer according to standard road requirements   7. Constructed road surface layer as per the standard road requirements   8. Carried out quality control operations according to standard road requirements   9. Undertaken maintenance of road structure layers as per maintenance procedures   10. Constructed transportation infrastructure as per the structural and architectural designs   11. Constructed highway drainage and hydraulic structures based on designs and specification   12. Constructed erosion prevention structures in accordance to the contract document   13. Installed road furniture as per contract document |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place   2. Access to relevant assessment environment   3. Resources relevant to the proposed assessment activity or tasks |
| 1. Methods of Assessment | Competency in this unit may be accessed through:   * 1. Practical tests   2. Project   3. Portfolio of evidence   4. Third party report   5. Written tests |
| 1. Context of Assessment | This competency may be assessed in a work place or in an a simulated work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

## 

## DESIGN CIVIL ENGINEERING STRUCTURES I

**UNIT CODE: 0732 551 35A**

**UNIT DESCRIPTION**

This unit covers the competencies required to Design Civil engineering structures. It involves,Designing concrete structures, timber structures and steel structures

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes that make up workplace function | **PERFORMANCE CRITERIA**  These are assessable statements, which specify the required level of performance for each of the elements.  ***(Bold and italicized terms are elaborated in the Range)*** |
| 1. Design concrete structures | * 1. ***Design structures resources*** are gathered as per the work requirement   2. Correct use of the ***BS standard codes*** is adopted as per the task   3. ***Concrete structures*** are designed as per the work requirement   4. ***working drawings*** for structural members are prepared as per the work requirement |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| * + - 1. Design structures resources may include but not limited to: | 1. Design manuals 2. Design elements 3. Tools 4. Laptops |
| * + - 1. British standard may include but not limited to | 1. BS 8110 for reinforced concrete 2. BS 5950 –Steel 3. BS 5268- timber 4. BS 5628- unreinforced masonry 5. BS 6399 - Loads |
| * + - 1. Concrete structures may include but not limited to: | 1. Beam 2. Slab 3. Retaining walls 4. Piles 5. Abutment 6. Arch |

**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:

**Generic skills:**

1. Communication
2. Analytical
3. Organizing
4. Decision making
5. Planning
6. Record keeping
7. Problem solving
8. First aid
9. Supervising
10. Organizing
11. Time management

**Technical skills:**

1. Analysis
2. Reporting
3. Performance appraising
4. Trouble shooting
5. Data logging
6. Technical specifications
7. Safety measures
8. Statutory regulations
9. Occupation Safety and Health
10. Construction
11. Hydraulics
12. Surveying
13. Computer Aided Design

**Required Knowledge**

The individual needs to demonstrate knowledge of:

1. Technical specifications
2. Statutory regulations
3. Construction management
4. Occupational health, safety
5. Quality Assurance
6. Statistics
7. Soil analysis methods
8. Hydraulics
9. Statutory regulations and legislation in water
10. Measurement and costing
11. Construction documents
12. Contract document development

**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. Gathered and applied design resources in accordance with project requirements and specifications 2. Implemented BS standard codes correctly for all structural design tasks 3. Designed concrete structures meeting all project requirements and technical specifications 4. Produced working drawings for structural members according to design standards |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant assessment environment   3. Resources relevant to the proposed assessment activity or tasks |
| 1. Methods of Assessment | Competency in this unit may be accessed through:   * 1. Practical tests   2. Project   3. Portfolio of evidence   4. Third party report   5. Written tests |
| 1. Context of Assessment | This competency may be assessed in a work place or in an a simulated work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## DESIGN CIVIL ENGINEERING STRUCTURES II

**UNIT CODE: 0732 551 36A**

**UNIT DESCRIPTION**

This unit covers the competencies required to Design Civil engineering structures. It involves,Designing concrete structures, timber structures and steel structures

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes that make up workplace function | **PERFORMANCE CRITERIA**  These are assessable statements, which specify the required level of performance for each of the elements.  ***(Bold and italicized terms are elaborated in the Range)*** |
| 1. Design timber structures | * 1. ***Structural timber elements*** are designed as per the work requirement   2. Timber connections are designed as per the work requirement   3. Appropriate timber section are determined as per the work requirement |
| 1. Design steel structures | * 1. ***Steel sections*** are gathered as per the work requirement   2. Load for roof trusses are calculated as per the work requirement   3. Structural members are designed as per the work requirement   4. ***Steel work connections*** are designed as per the work requirement   5. Structural steel work connections are detailed as per the work requirement |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Structural timber elements may include but not limited to: | 1. Beam 2. Piles 3. Hand rail |
| 1. Steel sections may include but not limited to: | 1. Hollow sections 2. I section 3. T section 4. Angle sections 5. U Sections 6. Flat sections |
| 1. Steel work connections may include but not limited to: | 1. Splicing 2. Bolted 3. Welded 4. Riveted |

**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:

**Generic skills:**

1. Communication
2. Analytical
3. Organizing
4. Decision making
5. Planning
6. Record keeping
7. Problem solving
8. First aid
9. Supervising
10. Organizing
11. Time management

**Technical skills:**

1. Analysis
2. Reporting
3. Performance appraising
4. Trouble shooting
5. Data logging
6. Technical specifications
7. Safety measures
8. Statutory regulations
9. Occupation Safety and Health
10. Construction
11. Hydraulics
12. Surveying
13. Computer Aided Design

**Required Knowledge**

The individual needs to demonstrate knowledge of:

1. Technical specifications
2. Statutory regulations
3. Construction management
4. Occupational health, safety
5. Quality Assurance
6. Statistics
7. Soil analysis methods
8. Hydraulics
9. Statutory regulations and legislation in water
10. Measurement and costing
11. Construction documents
12. Contract document development

**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 structural timber elements including appropriate section selection and connections according to project requirements 2. Calculated and applied loads for roof trusses and structural members per design specifications 3. Selected and prepared steel sections including all necessary connections as required 4. Detailed structural steel work connections meeting all project and technical requirements |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant assessment environment   3. Resources relevant to the proposed assessment activity or tasks |
| 1. Methods of Assessment | Competency in this unit may be accessed through:   * 1. Practical tests   2. Project   3. Portfolio of evidence   4. Third party report   5. Written tests |
| 1. Context of Assessment | This competency may be assessed in a work place or in an a simulated work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## CARRY OUT CIVIL ENGINEERING WORKS I

**UNIT CODE :** 0732 551 37A

**UNIT DESCRIPTION**

This unit describes competencies required to carry out building works. It involves carrying out site preliminary works, performing building temporary works and executing substructure works.

|  |  |
| --- | --- |
| **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 site preliminary works | * 1. Construction site is surveyed as per standard construction procedures   2. Site layout is prepared as per standard construction procedures   3. Site boundary is determined as per site layout   4. Construction site is hoarded/screened as per work plan and standard work procedures   5. construction site is cleared as per work plan and standard construction procedures   6. Site utilities are constructed as per work plan and standard work procedures   7. Site preliminary report is prepared as per standard work procedures |
| * + - 1. Perform building temporary works | * 1. Timbering is constructed and dismantled according to standard work procedures   2. Formwork/shuttering is constructed and dismantled according to standard work procedures   3. ***Scaffold*** is erected and dismantled according to standard work procedures   4. ***Shores*** are erected and dismantled according to standard work procedures |
| * + - 1. Execute substructure works | * 1. ***Civil engineering structure***s are set out according to standard work procedures   2. ***Foundations*** are excavated according to standard work procedures   3. Foundations are laid according to standard work procedures   4. Foundation walls are erected according to standard work procedures   5. ***Solid ground floors*** are constructed according to standard construction procedures |

**RANGE**

| **Variable** | **Range** |
| --- | --- |
| 1. Scaffolds may include but not limited to: | * 1. Uprights   2. Cross braces   3. Ledger boards   4. Planks   5. Base plates   6. Guardrails   7. Toe boards   8. Ladders   9. Lifelines   10. Braces   11. Couplers   12. Casters |
| 1. Shores may include but not limited to: | * 1. Uprights   2. Cross braces   3. Ledger boards   4. Planks   5. Base plates   6. Braces   7. Couplers   8. Casters |
| 1. Civil engineering structures may include but not limited to: | * 1. Bridges   2. Dams   3. Tunnels   4. Wastewater collection and treatment infrastructure   5. Water treatment infrastructures/plant   6. Onsite sanitation facilities   7. Railway transport   8. Drainage system   9. Airports   10. Dredging |
| 1. Foundations may include but not limited to: | * 1. Pile foundation   2. Pad foundation   3. Raft foundation   4. Stepped foundation   5. Strip foundation |
| 1. Solid Ground Floors may include but is not limited to: | * 1. Concrete slab-on-ground   2. Reinforced concrete floors   3. Insulated slab floors   4. Suspended concrete slab (for slight elevations)   5. Tiled solid floors |

**REQUIRED KNOWLEDGE and SKILLS**

**Knowledge**

1. Measurement
2. Formwork
3. Scaffolding
4. Wall construction
5. Basic arithmetic
6. Technical drawings
7. Structural design
8. Timber properties
9. Steel properties
10. Plan interpretation
11. Occupational safety and health
12. Codes of practice
13. Roofing materials
14. Types of roofs
15. Materials science
16. Concrete mix ratio
17. Construction machines, tools and equipment
18. Types of bonds
19. Carpentry and joinery
20. Waterproofing
21. Types of fireplace
22. Admixtures and additives
23. Fixtures and fittings

**Skills**

1. Estimating and costing
2. Measurement
3. Basic mathematic
4. Communication
5. Management
6. Structural design
7. Problem solving
8. Critical thinking
9. Construction tools handling
10. Technical drawing
11. Bonding
12. Bar bending
13. Interpreting
14. Cutting and fixing

**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. Hoarded/screened construction site as per work plan and standard work procedures   2. Constructed and dismantled timbering according to standard work procedures   3. Constructed and dismantled formwork/shuttering according to standard work procedures   4. Erected and dismantled scaffold is according to standard work procedures   5. Set out civil engineering structures according to standard work procedures   6. Excavated foundations according to standard work procedures   7. Constructed solid ground floors according to standard construction procedures |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant assessment environment   3. Resources relevant to the proposed assessment activity or tasks |
| 1. Methods of Assessment | Competency in this unit may be accessed through:   * 1. Practical tests   2. Project   3. Portfolio of evidence   4. Third party report   5. Written tests |
| 1. Context of Assessment | This competency may be assessed in a work place or in a simulated work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

## CARRY OUT CIVIL ENGINEERING WORKS II

**UNIT CODE : 0732 551 38A**

**UNIT DESCRIPTION**

This unit describes competencies required to carry out building works. It involves carrying out superstructure works, carrying out building finishes and external work, performing steel works.

|  |  |
| --- | --- |
| **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. Execute superstructure works | * 1. ***Superstructure components*** are set out based on the standard work procedures   2. Superstructures components are constructed based on the standard work procedures   3. Superstructure fittings are carried out according to specifications   4. Superstructure components are inspected based on the contract document   5. ***Civil work finishes*** are carried out as per the work requirement |
| * + - 1. Carry out civil external works | * 1. External paving is laid based on the civil engineering drawings   2. Soft landscaping is performed based on the client’s specifications   3. Drainage system is constructed based on the terrain   4. ***Fences*** and gates are constructed based on the contract documents   5. Waste management is performed as per the environmental regulations   6. Environmental rehabilitation is carried out as per the environmental regulations |
| * + - 1. Perform civil engineering steel works | * 1. Structural drawing is interpreted as per the job requirement   2. ***Steel work Tools and equipment are*** assembled as per work requirements   3. Steel bar is cut to size as per the bar bending schedule   4. steel bar is bent as per the bar bending schedule   5. steel is fixed as per the job requirement |

**RANGE**

| **Variable** | **Range** |
| --- | --- |
| 1. Superstructure components may include but not limited to: | 1. Walls 2. Columns 3. Beams 4. Floors 5. Roofs 6. Staircases 7. Lintels |
| 1. Civil work finishesmay include but not limited to: | * 1. Plastering   2. Painting |
| 1. Fence may include but not limited to: | * 1. Masonry walls   2. Live fence   3. Reinforced concrete walling   4. Wooden post and chain link/barbed wire   5. Steel post and chain link   6. Concrete post and chain link |
| 1. Steel work Tools and equipment may include but not limited to: | 1. Hacksaw 2. Angle grinder 3. Bench vice 4. Clamps 5. Welding machine 6. Cutting torch (oxy-acetylene) 7. Measuring tape 8. Steel rule 9. Try square 10. Marking gauge 11. Centre punch |

**REQUIRED KNOWLEDGE and SKILLS**

**Knowledge**

1. Measurement
2. Formwork
3. Scaffolding
4. Wall construction
5. Basic arithmetic
6. Technical drawings
7. Structural design
8. Timber properties
9. Steel properties
10. Plan interpretation
11. Occupational safety and health
12. Codes of practice
13. Roofing materials
14. Types of roofs
15. Materials science
16. Concrete mix ratio
17. Construction machines, tools and equipment
18. Types of bonds
19. Carpentry and joinery
20. Waterproofing
21. Types of fireplace
22. Admixtures and additives
23. Fixtures and fittings

**Skills**

1. Estimating and costing
2. Measurement
3. Basic mathematic
4. Communication
5. Management
6. Structural design
7. Problem solving
8. Critical thinking
9. Construction tools handling
10. Technical drawing
11. Bonding
12. Bar bending
13. Interpreting
14. Cutting and fixing

**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. Constructed superstructures components based on the standard work procedures   2. Carried out superstructure fittings according to specifications   3. Carried out civil work finishes as per the work requirement   4. Performed soft landscaping based on the clients’ specifications   5. Performed waste management as per the environmental regulations   6. Fixed steel as per the job requirement |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant assessment environment   3. Resources relevant to the proposed assessment activity or tasks |
| 1. Methods of Assessment | Competency in this unit may be accessed through:   * 1. Practical tests   2. Project   3. Portfolio of evidence   4. Third party report   5. Written tests |
| 1. Context of Assessment | This competency may be assessed in a work place or in a simulated work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

## 

## DESIGN WATER SUPPLY INFRASTRUCTURE

**UNIT CODE: 0732 551 39A**

**UNIT DESCRIPTION**

This unit covers the competencies required to design water supply infrastructure. It involves conducting feasibility study and Engineering Survey for water supply design infrastructure, carrying out Water Demand Analysis, preparing technical specifications for water supply infrastructure and preparing water supply infrastructure design report.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the **key outcomes** which make up **workplace function** | **PERFORMANCE CRITERIA**  These are **assessable** statements which specify the required level of performance for each of the elements.  ***Bold and italicized terms are elaborated in the Range*** |
| * 1. Conduct feasibility study | 1. Desktop study is conducted based on job requirement. 2. ***Reconnaissance survey*** is conducted based on desktop study. 3. Feasibility study report is prepared based on reconnaissance survey. |
| * 1. Conduct Engineering Survey | 1. PPEs are donned as per OSH Act No 15 2010. 2. Engineering Survey tools and equipment are identified based on the site conditions and required data. 3. Levelling and profiling is conducted based on the job requirement 4. Profile report is prepared based on Water Supply Design Manual 2005 |
| * 1. Carry out Water Demand Analysis | 1. Population growth rate and trends are determined based on KNBS Census data 2. ***Water demand data*** is determined as per KNBS Census data and Water Supply Design Manual 2005 3. Data clean-up is carried out based on job requirement 4. Water demand data analysis is carried out based on Water Supply Design Manual 2005 |
| * 1. Prepare technical specifications for water supply infrastructure | 1. Water supply infrastructure design parameters are determined based on water demand analysis 2. Construction materials are identified based on project requirements 3. Engineering drawings are prepared based on the Engineering survey data. |
| * 1. Prepare water supply infrastructure design report | 1. Construction appurtenances are selected based on KS, ISO 25/24, BS8110 Standards. 2. Technical specifications are prepared based on KS, ISO 25/24, BS8110 Standards. 3. Bill of quantities are prepared based on CESMM, Construction Cost Handbook 4. Technical design report is prepared based on scope of work |

**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.

|  |  |
| --- | --- |
| Variables | Range |
| 1. Water supply infrastructure may include but not limited to: | * 1. Intake works   2. Treatment works   3. Storage works   4. Distribution systems |
| 1. Design parameters may include but not limited to: | 1. Tunnels and channels    * 1. Cross-sectional area      2. Slope      3. Wetted perimeter      4. Depth      5. Diameter      6. Width      7. Discharge      8. Velocity      9. Loads on tunnels 2. Dams    * 1. Reservoir capacity      2. Embankment height      3. Crest width      4. Bottom width      5. Slope      6. Spillway discharge      7. Outlet pipeline diameter      8. Freeboard      9. Forces and failure modes |
| 1. Surveying tools and equipment may include but not limited to: | * 1. GIS software   2. RTK   3. RTX   4. Theodolite   5. Dumpy level   6. Total station   7. Levelling staff   8. Booking sheet |
| 1. Drawing tools and equipment may include but not limited to: | * 1. CAD Software   2. Pencils   3. Ruler   4. T-square   5. Scale rule   6. Eraser   7. Set square   8. Drawing board |
| 1. Tools for design data collection may include but not limited to: | * 1. Stop watch   2. Checklists   3. Questionnaires   4. Stationery   5. Sampling equipment |
| 1. Properties of material may include but not limited to | * 1. Stress   2. Strain   3. Elasticity   4. Plasticity   5. Stiffness   6. Young’s modulus |
| 1. Section properties of materials may include but not limited to | * 1. Centroids   2. Centre of gravity   3. 1st moment of area   4. 2nd moment of area   5. Section modulus   6. Radius of gyration |
| 1. Structural elements may include but not limited to | * 1. Reinforced concrete structures   2. Timber structures   3. Steel structures |

**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:

**Generic skills:**

1. Communication
2. Analytical
3. Organizing
4. Decision making
5. Planning
6. Record keeping
7. Problem solving
8. First aid
9. Supervising
10. Organizing
11. Time management
12. Supervision

**Technical Skills:**

1. Analysis
2. Reporting
3. Trouble shooting
4. Data logging
5. Surveying
6. Design
7. Soil analysis
8. Hydraulics
9. Measurement
10. Technical drawing
11. CAD
12. GIS

**Required Knowledge**

The individual needs to demonstrate knowledge of:

1. Technical specifications
2. Statutory regulations
3. OSH
4. Quality Assurance
5. Wastewater treatment technologies
6. Basic statistics
7. EIA

**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. Conducted desktop study based on job requirement. 2. Conducted reconnaissance survey is based on desktop study. 3. Prepared feasibility report based on reconnaissance survey. 4. Mapped area based on feasibility study 5. Calculateddesign parameters in accordance with water supply design manual. 6. Prepared design drawings based on calculated parameters. 7. Prepared bill of quantities based on the design drawings 8. Prepared design report based on scope of work |
| * + 1. Resource Implications | The following resources should be provided:   1. Appropriately simulated environment where assessment can take place 2. Access to relevant assessment environment 3. Resources relevant to proposed assessment activity or tasks |
| * + 1. Methods of Assessment | Competency in this unit may be assessed through:   1. Practical 2. Project 3. Written assessment 4. Presentation 5. Portfolio of evidence 6. Third party report 7. Case study |
| * + 1. Context of Assessment | Competency may be assessed:  Workplace or simulated work place |
| * + 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

**DESIGN WASTE WATER INFRASTRUCTURE**

**UNIT CODE: 0732 551 40A**

**UNIT DESCRIPTION**

This unit covers the competencies required to design waste water infrastructure. It involves conducting feasibility study, conducting Engineering Survey, carrying out waste water generation analysis preparing technical specifications for waste water infrastructure and prepare waste water infrastructure design report

This standard applies in Waste water Industry.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the **key outcomes** which make up **workplace function** | **PERFORMANCE CRITERIA**  These are **assessable** statements which specify the required level of performance for each of the elements.  ***Bold and italicized terms are elaborated in the Range*** |
| 1. Conduct feasibility study | 1. Desktop study is conducted based on job requirement. 2. Reconnaissance survey is conducted based on desktop study. 3. Feasibility study report is prepared based on reconnaissance survey. |
| 1. Conduct Engineering Survey | 1. ***PPEs*** are donned as per OSH Act 2010. 2. ***Survey tools*** and ***equipment*** are identified based on the site conditions and required data. 3. Engineering survey is carried out based on job requirements. 4. Engineering survey report is prepared based on workplace policy. |
| 1. Carry out waste water generation Analysis | 1. Population growth rate and trends are determined based on KNBS Census data 2. Wastewater generation data is determined as per KNBS Census data 3. Data clean-up is carried out based on job requirements 4. Wastewater generation data is analyzed based on domestic wastewater treatment in developing countries manual. |
| 1. Prepare technical specifications for waste water infrastructure | 1. ***Wastewater infrastructure design parameters*** are determined based on water demand analysis 2. ***Construction materials*** are identified based on project requirements 3. Engineering drawings are prepared based on the Engineering survey data. |
| 1. Prepare waste water infrastructure design report | 1. Construction appurtenances are selected based on KS, ISO 25/24, BS8110 Standards. 2. Technical specifications are prepared based on KS, ISO 25/24, BS8110 Standards. 3. Bill of quantities are prepared based on CESMM, Construction Cost Handbook 4. Technical design report is prepared based on scope of work |

**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.

|  |  |
| --- | --- |
| Variables | Range |
| 1. PPEs may include but not limited to: | 1. Overalls 2. Hardhat 3. Safety googles 4. Gloves 5. Safety boots 6. Welding googles |
| 1. Survey tools and equipment may include but not limited to: | 1. GIS software 2. RTK 3. RTX 4. Theodolite 5. Dumpy level 6. Total station 7. Levelling staff 8. Booking sheet |
| 1. Wastewater infrastructure may include but not limited to: | 1. Collection point 2. Treatment works 3. Disposal point |
| 1. Wastewater infrastructure design parameters may include but not limited to: | 1. Cross-sectional area 2. Slope 3. Wetted perimeter 4. Depth 5. Diameter 6. Width 7. Discharge 8. Velocity 9. Loads on tunnels 10. Treatment facilities 11. Slope 12. Forces and failure modes 13. Retention time 14. Disposal methods |
| 1. Construction materials may include but not limited to: | 1. Materials and supplies 2. Coarse aggregate 3. Fine aggregate 4. Cement 5. Water 6. Steel bars 7. Timber 8. Iron sheets 9. Conduits/ Pipes 10. Steel-sheets 11. Dumb-proof course 12. Paints and varnishes 13. Celling boards 14. Wire-mesh 15. Construction stones and blocks 16. Nails 17. Valves 18. Pipes and pipe fittings |

**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:

**Generic skills:**

1. Communication
2. Analytical
3. Organizing
4. Decision making
5. Planning
6. Record keeping
7. Problem solving
8. First aid
9. Supervising
10. Organizing
11. Time management
12. Supervision

**Technical Skills:**

1. Analysis
2. Reporting
3. Trouble shooting
4. Data logging
5. Surveying
6. Design
7. Soil analysis
8. Hydraulics
9. Measurement
10. Technical drawing
11. CAD
12. GIS

**Required Knowledge**

The individual needs to demonstrate knowledge of:

1. Technical specifications
2. Statutory regulations
3. OSH
4. Quality Assurance
5. Waste water treatment technologies
6. Basic statistics
7. EIA

**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. Conducted desktop study based on job requirement. 2. Conducted reconnaissance survey is based on desktop study. 3. Prepared feasibility report based on reconnaissance survey. 4. Mapped area based on feasibility study 5. Calculated design parameters in accordance with waste water treatment in developing countries 6. Prepared design drawings based on calculated parameters. 7. Prepared bill of quantities based on the design drawings 8. Prepared design report based on scope of work |
| * + 1. Resource Implications | The following resources should be provided:   1. Appropriately simulated environment where assessment can take place 2. Access to relevant assessment environment 3. Resources relevant to proposed assessment activity or tasks |
| * + 1. Methods of Assessment | Competency in this unit may be assessed through:   1. Practical 2. Project 3. Written assessment 4. Presentation 5. Portfolio of evidence 6. Third party report 7. Case study |
| * + 1. Context of Assessment | Competency may be assessed:  Workplace or simulated work place |
| * + 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

## SUPERVISE CIVIL ENGINEERING PROJECTS

**UNIT CODE : 0732 551 41A**

**UNIT DESCRIPTION**

This unit describes the competencies required to Supervise Civil Engineering projects.

It involves Implementing project timelines, executing construction project quality control, coordinating project site activities and human resources, managing project cost, coordinating project labour, managing project labour, implementing project contract and Managing construction materials, plant, tools and equipment

|  |  |
| --- | --- |
| **ELEMENTS**  These describe the key outcomes that make up workplace function | **PERFORMANCE CRITERIA**  These are assessable statements, which specify the required level of performance for each of the elements.  ***(Bold and italicized terms are elaborated in the Range)*** |
| 1. Implement project timelines | * 1. Work schedules and time programs are prepared based on the project specifications   2. Project timelines are monitored and evaluated based on the project specifications   3. ***Project time schedules*** are controlled based on the project specifications   4. Project timeline reports are prepared and disseminated based on the project specifications |
| 1. Execute construction project quality control | * 1. Construction project quality plans are developed according to the contract specifications   2. ***Construction project resources*** are mobilized according to the contract specifications   3. ***Construction project quality control*** are undertaken according to the contract specifications   4. Construction project quality reports are prepared according to the contract specifications |
| 1. Coordinate project site activities and human resources | * 1. Project health and safety guidelines are developed in line with the OSH act 2007   2. Site health and safety inspections are conducted in line with the OSH act 2007   3. ***Project site security*** is coordinated and monitored in line with the workplace security policy |
| 1. Manage project cost | * 1. 4.1 Project budget is prepared according to the scope of the project   2. Site resources are procured, allocated and monitored according to the project scope   3. ***Project cost variation*** is controlled as per contract document |
| 1. Coordinate project labour | * 1. Project labour guidelines is developed in line with labour laws   2. Labour levelling plan is established based on staff competency   3. Staff is allocated as per the labour levelling plan   4. Labour welfare is managed in accordance to the organisation policy and labour laws   5. Project labour report is prepared and submitted as per the project labour guidelines |
| 1. Implement project contract | * 1. Project documentations are managed as per the   organization policy   * 1. Project stakeholders are engaged as per the project requirements   2. Construction project works are inspected as per the legal procedures   3. ***Project implementation report*** is prepared based on the project activities outcome   4. Project information is managed as per the project guidelines |
| 1. Manage construction materials, plant, tools and equipment | * 1. Site storage facility is prepared as per the   construction standard procedures   * 1. ***Construction materials and equipment*** schedule is prepared as per the project activities   2. Construction materials and equipment are procured based on procurement procedures and project tasks   3. Construction materials and equipment are inspected and issued as per the allocated tasks   4. Used and un-used construction materials and equipment are collected, cleaned and stored as per manufacturer’s instructions   5. Used construction materials are collected and disposed as per the environmental legal requirements and ***disposal methods*** |

**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. Project time schedules may include but not limited to: | * 1. Critical path method(CPM)   2. PERT Chart   3. Gantt Chart |
| 1. Construction project resources may include but not limited to: | * 1. Human   2. Materials   3. Finances |
| 1. Construction project quality control may include but not limited to: | * 1. Inspection   2. Testing   3. Sampling   4. Auditing |
| 1. Project site security may include but not limited to: | * 1. Material   2. Site |
| 1. Project cost variation may include but not limited to: | * 1. Material   2. Labour   3. Overheads |
| 1. Project implementation report may include but is not limited to: | * 1. Daily   2. Monthly   3. Quarterly |
| 1. Construction materials may include but is not limited to: | * 1. Soil   2. Bitumen   3. Asphalt concrete   4. Graded crushed stones   5. Cement   6. Lime   7. Steel reinforcement |
| 1. Construction equipment may include but is not limited to: | * 1. Excavation   2. Lifting   3. Transporting   4. Compactors |
| 1. Disposal methods may include but not limited to: | * 1. Burning   2. Burying   3. Composting   4. Incinerating |

**REQUIRED KNOWLEDGE and SKILLS**

**Knowledge**

1. Construction dimensions
2. Interpretation of Architectural drawing
3. Local authority by-laws
4. Building code
5. Structural elements
6. Codes of practice
7. Basic arithmetic
8. Measurement
9. Engineering drawing
10. Structural design
11. Engineering software
12. Highway engineering drawings
13. Safety practices
14. First Aid
15. Occupation Safety and Health
16. Engineers Act
17. Code of Ethics
18. CAD

**Skills**

1. Measurement
2. Basic arithmetic
3. Design
4. Computer
5. Computer aided design
6. Planning

**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:  Work schedules and time programs are prepared based on the project specifications   * 1. Monitored and evaluated project timelines based on the project specifications   2. Controlled project time schedules based on the project specifications   3. Undertaken construction project quality control according to the contract specifications   4. Prepared project budget according to the scope of the project   5. Conducted site health and safety inspections in line with the OSH act 2007   6. Managed labour welfare in accordance to the organisation policy and labour laws   7. Inspected construction project works as per the legal procedures   8. Prepared construction materials and equipment schedule as per the project activities |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant assessment environment   3. Resources relevant to the proposed assessment activity or tasks |
| 1. Methods of Assessment | Competency in this unit may be accessed through:   * 1. Practical tests   2. Project   3. Portfolio of evidence   4. Third party report   5. Written tests |
| 1. Context of Assessment | This competency may be assessed in a work place or in an a simulated work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |