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**REPUBLIC OF KENYA**

**NATIONAL OCCUPATIONAL STANDARDS**

**FOR**

**WATER RESOURCES MANAGEMENT TECHNICIAN**

**LEVEL 6**

|  |  |
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|  |  |
| **KENYA WATER INSTITUTE**  **P.O. BOX 60013-00200**  **NAIROBI** | **TVET CDACC**  **P.O. BOX 15745-00100**  **NAIROBI** |

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**DIRECTOR**

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# FOREWORD

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

Reforms in the education sector are necessary for the achievement of Kenya Vision 2030 and meeting the provisions of the Constitution of Kenya 2010. The education sector had to be aligned to the Constitution and this resulted in the formulation of the Policy Framework for Reforming Education and Training (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 programmes.

These reforms demand that Industry takes a leading role in Curriculum development to ensure the Curriculum addresses its competence needs. It is important to note that the water sector has undergone numerous reforms in the last decade that require new approach to training of personnel for the sector. It is against this background that these Occupational Standards were developed for the purpose of developing a competency-based Curriculum for Water Resources Management Technology Level 6. These Occupational Standards will also be the basis for assessment of an individual for competence certification.

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

**PRINCIPAL SECRETARY**

**MINISTRY OF WATER & SANITATION AND IRRIGATION**

# 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. 14 of 2012 on Reforming Education and Training in Kenya, emphasized the need to reform Curriculum development, assessment and certification. This called for 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.

Kenya Water Institute in conjunction with Water Sector Skills Advisory Committee (SSAC), Water Resources Authority (WRA), Jomo Kenyatta University of Agriculture and Technology (JKUAT) and South Eastern Kenya University (SEKU) with guidance from TVET Curriculum Development, Assessment and Certification Council (TVET CDACC) has developed these Occupational Standards. These Occupational Standards will be the basis for development of competency based Curriculum for Water Resources Management Technology, KNQF Level 6. These Standards will also be the basis for assessment of an individual for competence certification.

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

I am grateful to the KEWI Academic Board, Technical Teams, TVET CDACC, and Water SSAC, Experts drawn from Universities and Water Sector Institutions, and all other stakeholders who participated in the development of these Occupational Standards.

**CHAIRPERSON,**

**KENYA WATER INSTITUTE GOVERNING COUNCIL**

# ACKNOWLEDGMENT

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

I thank TVET Curriculum Development, Assessment and Certification Council (TVET CDACC) for providing guidance on the development of these Standards. My gratitude goes to Water Resources Authority, Hydrological Society of Kenya, Jomo Kenyatta University of Agriculture and South Eastern Kenya University and Technology and the Water Sector Skills Advisory Committee (SSAC) members for their contribution to the development of these Standards. I thank all the individuals and organizations who participated in the validation of these Standards.

My gratitude also goes to Kenya Water Institute, TVET CDACC, Hydrological Society of Kenya, and Experts from key water sector and allied institutions in the development of these standards.

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

**CHAIRPERSON**

**WATER SECTOR SKILLS ADVISORY COMMITTEE**

# ABBRVEVIATIONS AND ACRONYMS

|  |  |
| --- | --- |
| AC | Alternating Current |
| AP | Arithmetic Progression |
| CAD | Computer Aided Design |
| CBET | Competence Based Education and Training |
| CDACC | Curriculum Development, Assessment and Certification Council |
| DC | Direct Current |
| DO | Dissolved oxygen |
| DI | Ductile Iron |
| DTP | Desktop Publishing |
| EMCA | Environmental Management Coordination Act |
| GHS | Globally Harmonized System |
| GI | Galvanized Iron |
| GIS | Geographical Information Systems |
| GPS | Global Positioning System |
| IEE | Institute of Electrical Engineers |
| IWRM | Integrated Water Resources Management |
| KEBS | Kenya Bureau of Standards |
| KEWI | Kenya Water Institute |
| NEMA | National Environmental Management Authority |
| OSH | Occupational Safety and Health |
| PP | Polypropylene |
| RC | Reinforced Concatenate |
| R-L-C | Resistor-Inductor (L) - Circuit |
| SD | Standard Deviation |
| SDGs | Sustainable Development Goals |
| SSAC | Sector Skills Advisory Committee |
| TVET | Technical Vocational Education and Training |
| WRA | Water Resources Authority |
| WASPA | Water Service Providers Association |
| WASREB | Water Services Regulatory Board |
| WHO | World Health Organization |
| WHSA | Water Harvesting Storage Authority |
| WRA | Water Resources Authority |
| WRUA | Water Resources Users Association |
| WSP | Water Service Providers |
| WSTF | Water Sector Trust Fund |

## KEY TO UNIT CODE

**WAT/ OS/ WRMT/ BC/ 01/ 6/A**

Industry or sector

Occupational Standard

Occupational area

Type of Unit

Unit number

Competency level

Version control

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# OVERVIEW

Water Resources Management Technicians Level 6 Occupational Standards consists of competencies that an individual must achieve to enable him/her to provide water resource management technology services. It comprises managing surface and ground water resources, developing groundwater resources as well as developing alternative water sources.

The units of competency for Water Resources Management Technicians Level 6 Occupational Standards include the following:

**Basic Units of Competency**

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

**Common Units of Competency**

|  |  |
| --- | --- |
| **Unit Code** | **Unit Title** |
| WAT/OS/WRMT/CC/01/6/A | Apply Chemistry and Biology Principles |
| WAT/OS/WRMT/CC/02/6/A | Apply Mathematical Skills |
| WAT/OS/WRMT/CC/03/6/A | Apply Physics Principles |
| WAT/OS/WRMT/CC/04/6/A | Apply Workshop Practices |
| WAT/OS/WRMT/CC/05/6/A | Apply Technical Drawings and Computer Aided Design Principles |
| WAT/OS/WRMT/CC/06/6/A | Apply Water Technology Principles |
| WAT/OS/WRMT/CC/07/6/A | Apply Water Management Principles |
| WAT/OS/WRMT/CC/08/6/A | Survey Water Project Sites |

**Core Units of Competency**

|  |  |
| --- | --- |
| **Unit Code** | **Unit Title** |
| WAT/OS/WRMT/CR/01/6/A | Manage Surface Water Resources |
| WAT/OS/WRMT/CR/02/6/A | Manage Groundwater Resources |
| WAT/OS/WRMT/CR/03/6/A | Develop Groundwater Resources |
| WAT/OS/WRMT/CR/04/6/A | Develop Alternative Water Resources |

# BASIC UNITS OF COMPETENCY

## DEMONSTRATE COMMUNICATION SKILLS

**UNIT CODE: WAT/OS/WRMT/BC/01/6/A**

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

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

**RANGE**

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

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

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

* Communication
* Active listening
* Interpretation
* Negotiation
* Writing

**Required Knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

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

## DEMONSTRATE DIGITAL LITERACY

**UNIT CODE: WAT/OS/WRMT/BC/02/6/A**

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

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

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Appropriate computer hardware may include but not limited to: | Collection of physical parts of a computer system such as;   * Computer case, monitor, keyboard, and mouse * All the parts inside the computer case, such as the hard disk drive, motherboard and video card |
| 1. Data security and privacy may include but not limited to: | * Confidentiality of data * Cloud computing * Integrity -but-curious data surfing |
| 1. Security and control measures may include but not limited to: | * Counter measures against cyber terrorism * Risk reduction * Cyber threat issues * Risk management * Pass-wording |
| 1. Security threats may include but not limited to: | * Cyber terrorism * Hacking |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

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

**Required Knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE** **GUIDE**

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

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

## DEMONSTRATE ENTREPRENUERAL SKILLS

**UNIT CODE : WAT/OS/WRMT/BC/03/6/A**

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

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

**RANGE**

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

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

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

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

**Required Knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

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

## DEMONSTRATE EMPLOYABILITY SKILLS

**UNIT CODE: WAT/OS/WRMT/BC/04/6/A**

**UNIT DESCRIPTON**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

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

**RANGE**

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

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

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

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

**Required Knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

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

## DEMONSTRATE ENVIRONMENTAL LITERACY

**UNIT CODE: WAT/OS/WRMT/BC/05/6/A**

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***Bold and italicized terms are elaborated in the Range*** |
| 1. Control environmental hazard | 1.1 Storage methods for environmentally hazardous materials are strictly followed according to environmental regulations and OSHS.  1.2 Disposal methods of hazardous wastes are followed according to environmental regulations and OSHS.  1.3 ***PPE*** is used according to OSHS. |
| 1. Control environmental Pollution | * 1. Environmental pollution ***control measures*** are implemented in accordance with international protocols.   2. Procedures for solid waste management are observed according Environmental Management and Coordination Act 1999   3. Methods for minimizing noise pollution is complied with based on Noise and Excessive Vibration Pollution and Control Regulations, 2009 |
| 1. Demonstrate sustainable resource use | * 1. Methods for minimizing wastage are complied with based on organizational waste management guide   2. Waste management procedures are employed following principles of 3Rs (Reduce, Reuse, Recycle)   3. Methods for economizing and reducing resource consumption are practiced as per the Constitution of Kenya 2010 Article 69 . |
| 1. Evaluate current practices in relation to resource usage | * 1. Information on resource efficiency systems and procedures are collected and provided as per work groups/sector   2. Current resource usage is measured and recorded as per work group   3. Current purchasing strategies are analyzed and recorded according to industry procedures.   4. Current work processes to access information and data is analyzed following enterprise protocol. |
| 1. Identify environmental legislations/conventions for environmental concerns | 5.1 Environmental legislations/conventions and local ordinances are identified according to the different environmental aspects/impact  5.2 Industrial standard/environmental practices are described according to the different environmental concerns |
| 1. Implement specific environmental programs | 6.1 Programs/Activities are identified according to organizations policies and guidelines.  6.2 Individual roles/responsibilities are determined and performed based on the activities identified.  6.3 Problems/constraints encountered are resolved in accordance with organizations’ policies and guidelines  6.4 Stakeholders are consulted based on company guidelines |
| 1. Monitor activities on Environmental protection/Programs | 7.1 Activities are periodically monitored and Evaluated according to the objectives of the environmental program  7.2 Feedback from stakeholders are gathered and considered in Proposing enhancements to the program based on consultations  7.3 Data gathered are analyzed based on Evaluation requirements  7.4 Recommendations are submitted based on the findings  7.5 Management support systems are set/established to sustain and enhance the program  7.6 Environmental incidents are monitored and reported to  concerned/proper authorities |
| 1. Analyze resource use | 8.1. All resource consuming processes are Identified as per the organizational work plan  8.2. Quantity and nature of resource consumed is determined based on processes  8.3. Resource flow is analyzed as per different parts of the process.  8.4. Wastes are classified according to NEMA regulations on waster management . |
| 1. Develop resource Conservation plans | 9.1. Efficiency of use/conversion of resources is determined according to industry protocol.  9.2. Causes of low efficiency of use of resources are Determined based on industry protocol.  9.3. Plans for increasing the efficiency of resource use are developed based on findings. |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. PPE may include but not limited to | * + Mask   + Gloves   + Goggles   + Safety hat   + Overall * Hearing protector |
| 1. Control measures may include but not limited to | * Methods for minimizing or stopping spread and ingestion of airborne particles * Methods for minimizing or stopping spread and ingestion of gases and fumes * Methods for minimizing or stopping spread and ingestion of liquid wastes |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

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

**Required Knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

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

## DEMONSTRATE OCCUPATIONAL SAFETY AND HEALTH PRACTICES

**UNIT CODE: WAT/OS/WRMT/BC/06/6/A**

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

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

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Hazards may include but not limited to: | * Physical hazards – impact, illumination, pressure, noise, * vibration, extreme temperature, radiation * Biological hazards- bacteria, viruses, plants, parasites, mites, molds, fungi, insects * Chemical hazards – dusts, fibers, mists, fumes, smoke, gasses, vapors * Ergonomics * Psychological factors – over exertion/ excessive force,   awkward/static positions, fatigue, direct pressure,   * varying metabolic cycles * Physiological factors – monotony, personal relationship, work out cycle * Safety hazards (unsafe workplace condition) –confined space, excavations, falling objects, gas leaks, electrical, poor storage of materials and waste, spillage, waste and debris * Unsafe workers’ act (Smoking in off-limited areas, Substance and alcohol abuse at work) |
| 1. Indicators may include but not limited to: | * Increased of incidents of accidents, injuries * Increased occurrence of sickness or health complaints/ symptoms * Common complaints of workers related to OSH * High absenteeism for work-related reasons |
| 1. OSH concerns may include but not limited to: | * Workers’ experience/observance on presence of work hazards * Unsafe/unhealthy administrative arrangements (prolonged work hours, no break time, constant overtime, scheduling of tasks) * Reasons for compliance/non-compliance to use of PPEs or other OSH procedures/policies/guidelines |
| 1. Safety gears /PPE (Personal Protective Equipment) may include but not limited to: | * Arm/Hand guard, gloves * Eye protection (goggles, shield) * Hearing protection (ear muffs, ear plugs) * Hair Net/cap/bonnet * Hard hat * Face protection (mask, shield) * Apron/Gown/coverall/jump suit * Anti-static suits * High-visibility reflective vest |
| 1. Appropriate risk controls   may include but not limited to: | * Appropriate risk controls in order of impact are as follows: * Eliminate the hazard altogether (i.e., get rid of the dangerous machine) * Isolate the hazard from anyone who could be harmed (i.e., keep the machine in a closed room and operate it remotely; barricade an unsafe area off) * Substitute the hazard with a safer alternative (i.e., replace the machine with a safer one) * Use administrative controls to reduce the risk (i.e., train workers how to use equipment safely; train workers about the risks of harassment; issue signage) * Use engineering controls to reduce the risk (i.e., attach guards to the machine to protect users) * Use personal protective equipment (i.e., wear * gloves and goggles when using the machine) |
| 1. Contingency measures may include but not limited to: | * Evacuation * Isolation * Decontamination * (Calling designed) emergency personnel |
| 1. Incidents and emergencies may include but not limited to: | * Chemical spills * Equipment/vehicle accidents * Explosion * Fire * Gas leak * Injury to personnel * Structural collapse * Toxic and/or flammable vapors emission. |
| 1. OSH-related Records may include but not limited to: | * Medical/Health records * Incident/accident reports * Sickness notifications/sick leave application * OSH-related trainings obtained |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

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

**Required Knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

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

# COMMON UNITS OF COMPETENCY

## APPLY CHEMISTRY AND BIOLOGY PRINCIPLES

**UNIT CODE:** WAT/OS/WRMT/CC/01/6/A

**UNIT DESCRIPTION**

This unit covers the competencies required to apply chemistry and biology principles. It involves applying inorganic chemistry principles, organic chemistry principles, physical chemistry principles, water chemistry principles and chemical water quality principles. It also entails applying biology and microbial water quality principles.

This standard applies in water sector.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENTS**  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 Inorganic Chemistry principles | 1. Structures of atoms are illustrated based on Bohr’s atomic model. 2. Electron arrangement of the first 30 elements of the periodic. table are illustrated based on ***quantum numbers*** and ***electronic configuration rules.*** 3. The periodic table is analyzed based on groups, periods and ***blocks.*** 4. Acid-base properties of compounds of period three elements are analyzed based on dissolution and hydrolysis. 5. Chemical bonds are identified based on their properties. 6. Chemical structures of substances are represented based on chemical bonding. 7. Hazardous chemicals are identified based on globally harmonized system of classification and labeling of chemicals. 8. Units of concentrations are determined based on physical states. 9. ***Chemical reactions*** are illustrated based on stoichiometric principles. 10. ***Chemical reagents*** and ***solutions*** are prepared based on standard procedures. 11. Chemical safety is observed based on good laboratory practice |
| 1. Apply Organic Chemistry Principles | 1. Organic compounds are classified based on homologous series. 2. Chemical reactions of aliphatic hydrocarbons are illustrated based on their properties. 3. Plastics are identified based on plastics identification code 4. Aerobic and anaerobic processesin water quality testing and wastewater treatment are identified based on biochemical principles |
| 1. Apply Physical Chemistry Principles | 1. Corrosion is illustrated using electrochemical principles 2. Calculations involving redox reactions are performed based on electrochemical series 3. Problems on gases are solved based on kinetic theory and gas laws 4. Solubility of substances compared based on solubility product 5. Salts are classified based on their interactions with water 6. Solutions are prepared based on user requirements 7. Unknown concentrations are determined based on stoichiometric principles 8. Calculations involving chemical kinetics in aqueous medium are performed as per the rate law. 9. Calculations involving chemical equilibria are performed based on Le Chatelier’s principle 10. Enthalpy of reactions determined based on thermochemistry principles 11. Calculations involving thermal equilibria are..based on laws of thermodynamics |
| 1. Water Chemistry | 1. Chemical bonding and structure of water is illustrated based on Bohr’s atomic model 2. Unique Properties of water are identified based on characteristics of similar compounds 3. Levelling effect of water is illustrated based on chemical equilibria 4. Buffering capacity of water is illustrated based on the carbonate system 5. Solubility of substancesin water is determined based on solubility rules 6. Water pollution is evaluated based on type of pollutants 7. Water treatment methods are evaluated based on ***processes*** involved 8. Wastewater treatment methods are evaluated based on processes involved |
| 1. Apply chemical water quality principles | 1. Physicochemical parameters of water quality are identified based on KEBS standards and NEMA regulations 2. Chemical parameters of water quality are identified based on KEBS water quality standards and NEMA effluent discharge regulations 3. Water and effluents for physical/chemical analysis are sampled based on standard operating procedures 4. Physicochemical parameters of water quality are determined based on job requirements. 5. Chemical parameters of water quality are determined based on job requirements. 6. Physical and chemical water quality test reports are interpreted based on job requirements 7. Laboratory safety is observed in accordance with GLP |
| 1. Apply Microbiology Principles | 1. ***Living organisms*** classified based on the ***5 kingdom system*** 2. Cells of organisms are classified based on ***structure*** 3. ***Microorganisms*** are classified based on their **ecological niche** 4. ***Water related infections*** are identified based on causative agents 5. Aquatic ecosystems are maintained based on principles of ecology 6. General biosafety is observed in accordance with GLP |
| 1. Apply microbial water quality principles | 1. Microbiological limits of water quality are identified in accordance with on national standards and regulations 2. Water and effluents for microbial analysis are sampled based on standard operating procedures 3. Microbial parameters of water quality are determined using light and microbiology techniques 4. 7.4 Microbiological water quality reports are interpreted based on national water quality standards and regulations. |

**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. Quantum numbers may include but is not limited to: | * Principal quantum * Angular momentum quantum number * Magnetic quantum number * Electron spin quantum number |
| 1. Electronic Configuration rules may include but is not limited to: | * Main shell rule (2n2 ) * Sub-shell rules * Hund’s rule * Pauli Exclusion Principle * Aufbau Principle |
| 1. Units of concentration may include but is not limited to: | * Molarity * Molality * equivalent weight * Normality * Percentage * Mass/volume * Parts |
| 1. Chemical reactions may include but `is not limited to: | * Precipitation * Acid-base neutralization * Redox * Displacement reactions as redox reactions |
| 1. Toxic effects may include but is not limited to: | * Chronic * Acute |
| 1. Structure may include but is not limited to: | * Acellular * Cellular * Prokaryotic * Eukaryotic |
| 1. Ecological niche may include but is not limited to: | * Habitat * Role |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

* Communication
* Analytical
* Organizing
* Decision making
* Planning
* Problem solving
* Supervising
* Time management
* Instrumentation
* Standard operating procedures
* Water quality testing
* Solutions preparation
* Titration
* GLP
* Report writing

**Required Knowledge**

* Periodic table
* Atomic theory
* Stoichiometry
* Chemical kinetics and chemical equilibria
* MSDS
* GHS
* Measurements

**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. Determined acid-base properties of compounds based on 2. Identified hazardous chemicals based on globally harmonized system of classification and labeling of chemicals 3. Observed general biosafety based on good laboratory practice 4. Prepared chemical solutions based on SOPs. 5. Classified plastics and polymers based on plastics identification code 6. Identified aerobic and anaerobic processes in water quality testing and wastewater treatment based on biochemical principles 7. Determined solubility of substances in water is based on solubility rules 8. Identified unique properties of water based on characteristics of similar compounds 9. Illustrated leveling effect of water based on chemical equilibria 10. Classified microorganisms based on their pathogenic effects. 11. Conducted water quality tests based on job requirements 12. Preserved aquatic ecosystems based on principles of ecology 13. Observed safety based on GLP |
| 1. Resource Implications | The following resources should be provided:   * 1. Periodic table   2. Chemicals and reagents   3. Analytical balances   4. Water quality test kits   5. GHS signage   6. Microscopes   7. Autoclave   8. Water bath   9. Basic laboratory installations |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Written tests   2. Observation   3. Oral questioning   4. Third party reports |
| 1. Context of Assessment | Assessment may be done:   * 1. On–the–job   2. Off-the –job   3. Industrial attachment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY MATHEMATICAL SKILLS

**UNIT CODE:** WAT/OS/WRMT/CC/02/6//A

**UNIT DESCRIPTION**

This unit describes the competencies required to apply mathematical skills. It entails applying algebraic expressions, ratios, rates and proportions, calculus s as well probability and statistics principles.

This standard applies in the water sector.

**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 algebraic expressions. | 1. Informal and symbolic notation, representation and conventions of algebraic expressions is demonstrated based on work requirements. 2. Operations on algebraic expressions are performed based on work requirements. 3. Routine formulae transposition is performed based on job requirements. 4. Outcomes are checked and result of calculation used in work related tasks. |
| 1. Apply ratios, rates and proportions. | * 1. Ratios, rates and proportions of materials are identified based on work environment   2. Concepts on ratios, rate and proportions are applied as per job requirements   3. Graphs, charts or tables are developed based on job requirements.   4. Outcomes from work related tasks, are reviewed and compared based on the work procedures. |
| 1. Apply Calculus principles. | 1. Principles of differentiation are applied based on need. 2. Principles of integration are applied based on need. |
| 1. Apply probability and statistics principles. | * 1. Measures of central tendency concepts are applied based on data sets.   2. Measures of dispersion are applied based on statistical principles.   3. Measures of skewness are analyzed based on graphical interpretation.   4. Concepts of linear regression are analysed based on statistical data.   5. ***Statistical tools*** are applied based on accuracy of data work requirements. |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Statistical tools may include but not limited to: | * t- test * f- test * Q test * ANOVA |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

* Communication
* Analytical
* Arithmetics
* Measurement
* Data analysis
* Statistics
* Logical thinking
* Problem solving
* Sketching
* Drawing graphs

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Common shapes
* Units of measurement and abbreviations
* Unit inter-conversions
* Algebraic expressions
* Ratios, rates and proportions
* Estimation

**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 rationality of estimations in the problem-solving process relation to workplace tasks. 2. Applied appropriate mathematical language, symbols and conventions to report results in accordance with workplace standards. 3. Performed routine calculations based on job requirements. 4. Performed operations on algebraic expressions. 5. Applied concept of algebra based on job requirements. 6. Applied concepts related to ratios, rate and proportions as per work requirements. 7. Determined probabilities of events as in accordance with work assignments. 8. Applied statistical concepts and tools based on work requirements. 9. Used mathematical language to discuss and explain the processes, results and implications based on workplace tasks |
| 1. Resource Implications | The following resources should be provided:   * 1. Measuring equipment   2. Scientific calculators |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   * 1. Direct Observation   2. Oral Questioning   3. Written tests |
| 1. Context of Assessment | Assessment may be done: -   * 1. On–the–job   2. Off-the –job   3. Industrial attachment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY PHYSICS PRINCIPLES

**UNIT CODE:** WAT/OS/WRMT/CC/03/6/A

**UNIT DESCRIPTION**

This unit describes the competence required to apply principles. It involves performing measurements of physical quantities, applying principles of forces, applying principles of classical mechanics, heat transfer, waves and oscillations, as well as density and pressure principle. It also entails applying electromagnetic induction principles.

This standard applies in water sector.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENTS**  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 measurements of physical quantities   . | * 1. Basic quantities and derived quantities are identified based on the SI units   2. Inter conversion of units is performed in accordance with appropriate systems of measurement   3. Dimensional analysis is performed in accordance to units of measurement   4. Measurements are performed using suitableinstruments in accordance with appropriate units |
| 1. Apply principles of forces | * 1. Forces and their effects are identified in accordance to work place tasks   2. Moment of a force is determined in accordance with work place tasks   3. Forces are resolved in accordance with workplace tasks   4. Resultant forces are determined as per reference   5. The principle of moments is applied to solve problems as per reference   6. Centre of gravity of objects is determined in accordance to moments   7. Laws of friction are applied as per reference   8. Effects of friction are identified based on experiments |
| 1. Apply principles of classical mechanics | * 1. Laws of linear ***motion*** are applied as per job requirements.   3.2 Parameters of motion are calculated based on the laws of motion.   * 1. Force formula is derived in accordance with laws of motion   2. Motion under gravity is determined in accordance to the laws of motion   3. Motion graphs are drawn based on parameters of motion.   4. ***Forms of energy*** and energy transformations are identified based on reference   5. Sources of energy are identified based on the forms of energy   6. Problems on work, energy and power are solved based on standard formulas. |
| 1. Apply principles of heat transfer | * 1. Modes of heat transfer are identified based on the type of material   2. Heat transfer is applied based on the modes   3. Thermal expansion is identified based on the type of materials   4. Thermal expansion is applied based on the type of materials |
| 1. Apply principles of waves and oscillations | * 1. Laws of reflection and refraction are applied to determine distance, size objects and refractive indices based on the type of material   2. Properties of waves are applied based on the effects of resonance to structures   3. Propagation of sound is applied to perform calculations based on relation amplitude , wavelength, frequency, and distance analyzed |
| 1. Apply principles of density and pressure | * 1. Laws and principles appropriate to fluid pressure are applied in accordance with reference   2. Atmospheric and fluid pressures are determined using pressure simple gauging instruments. |
| 1. Apply Principles of Electromagnetic Induction | * 1. Concepts and terminology in electromagnetic induction are explained based on electromagnetic principles.   2. Identify magnetic parameters as per relevant laws of magnetism.   3. Magnetic properties of materials are determined in accordance with the orientation of the magnetic dipole orientation.   4. Induced e.m.f. and current are identified as coupled based on Faraday’s laws of electromagnetic induction.   5. Lenz’s law is explained based on the direction of the induced e.m.f.   6. Applications of electromagnetic induction are demonstrated based job requirements |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Motion may include but is not limited to: | * Linear * projectile |
| 1. Forms of energy may include but is not limited to: | * Kinetic * Potential |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

* Communication
* Analytical
* Organizing
* Decision making
* Planning
* Problem solving
* Supervising
* Time management
* Instrumentation
* Standard operating procedures
* OSH
* Measurement
* Circuit interpretation
* Pump operation
* Report writing

**Required Knowledge**

* Optics
* Mechanics
* Newton’s laws of motion
* Pascals’s laws
* Fardadays laws
* Quality assurance

**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 measurement of the physical quantities based on standard procedures. 2. Resolved forces based on job requirements 3. Operated and maintained optical equipment based on SOPs 4. Operated and maintained simple machines based on job requirements. 5. Illustrated change in physical state based on latent heat 6. Demonstrated optical properties of light based on principles of optics. 7. Identified constituents of electromagnetic spectrum based on   Wavelength and frequency   1. Evaluated pressure in fluids based on Pascal’s law. 2. Evaluated fluid flow based on Bernoulli’s Principle. 3. Operated hydraulic machines based on Pascal’s law based on SOPs | |
| 1. Methods of Assessment | | Competency may be assessed through:   * 1. Observation   2. Oral questioning   3. Written tests |
| 1. Context of Assessment | | Assessment may be done: -   * 1. On–the–job   2. Off-the –job   3. Industrial attachment |
| 1. Guidance information for assessment | | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended |

## APPLY WORKSHOP PRACTICE

**UNIT CODE:** WAT/OS/WRMT/CC/04/6/A

**UNIT DESCRIPTION**

This unit describes the competence required to apply workshop practice. It involves applying workshop safety measures, identifying engineering materials, performing masonry tasks, carpentry tasks, plumbing tasks , as well as general electrical tasks, welding tasks and mechanical tasks. It also involves managing workshop wastes.

**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 workshop safety measures | * 1. Personal protective equipment is used based on manufacturer’s instructions, Nature of hazard and legal requirements.   2. Safety measures are observed based on workshop safety rules and regulations   3. Safety provisions are implemented based on National OSH guidelines   4. First aid is administered based on standard operation procedures |
| 1. Identify engineering Materials | 2.1 Engineering materials are classified based on crystalline structure and chemical make up  2.2 Properties of engineering materials are identified based on conventional standards  2.3 Engineering Materials are selected based on workshop operations and engineering service conditions  2.4 Construction materials are selected based on workshop operations and engineering service conditions |
| 1. Perform masonry tasks | 3.1Masonry hand and machine tools are identified selected based on job requirement   * 1. Materials and supplies for masonry works are identified and selected based job requirements.   2. Masonry tools are used as per manufacturer’s specifications   3. Masonry tasks are performed based on instructions.   4. Masonry machines and equipment are troubleshot and reported based on SOPs.   5. Masonry tools are maintained as per manufacturer’s specifications |
| 1. Perform carpentry tasks | 4.1 Carpentry hand tools and machines are identified and selected based job requirements.   * 1. Materials and supplies for carpentry works are identified and selected as per job requirements   2. Carpentry hand tools and machines are used as per manufacturer’s specifications   3. Carpentry tasks are performed based on instructions   4. Carpentry machines and equipment are troubleshoot and reported based on SOPs.   4.6 Carpentry tools are maintained as per manufacturer’s specifications |
| 1. Perform general electrical tasks | 1. Electrical and electronic measurements are conducted based job requirements 2. Errors in electrical measurement are analyzed based on IEE guidelines 3. Circuits diagrams are interpreted as per electric codes and symbols 4. Materials and supplies are identified selected based on job requirements 5. Electrical and electronic installations are conducted as per manufacturers’ manuals 6. Electrical machines and equipment are troubleshot and reported based on SOPs. 7. Electrical equipment are maintained as per manufacturer’s specifications Alternative sources of electric power operated and maintained of alternative based on the SOPs |
| 1. Perform plumbing tasks | 6.1 Plumbing hand and machine tools are identified selected based on job requirement   * 1. Materials and supplies for plumbing works are identified and selected based job requirements.   2. Plumbing tools are used as per manufacturer’s specifications   3. Plumbing tasks are performed based on instructions.   4. Plumping machines and equipment are troubleshoot and reported based on SOPs.   5. Plumbing tools are maintained as per manufacturer’s specifications |
| 1. Perform general welding tasks | 7.1 Welding materials and supplies for welding works are selected based job requirements.   * 1. Welding tools are used as per manufacturer’s specifications   2. Welding tasks are performed based on instructions.   3. Welding machines and equipment are troubleshot and reported based on SOPs.   4. Welding tools are maintained as per manufacturers’ specifications |
| 1. Perform basic mechanical fitting tasks | 1. Selected materials and tools for work based on job requirements 2. Mechanical tasks are performed based on work instructions. 3. Mechanical tools are maintained as per manufacturer’s specifications 4. Pumps are selected based on job requirements 5. Fluid pumping calculations are performed based on fluid flow principles and laws 6. Pump performance parameters are interpreted based on fluid machine principles 7. Pumping sets are operated in accordance with SOPs 8. Pump maintenance schedules are prepared based on manufacturer’s instructions. 9. Maintained tools and equipment tasks based on SOPs. 10. Mechanical machines and equipment are troubleshot and reported based on SOPs. |
| 1. Manage workshop wastes | 1. Workshop is cleaned and waste managed and disposed as per workplace policy and legal requirements 2. Recyclable supplies are cleaned and stored as per workplace policy and legal requirement. 3. Non-recyclable supplies are cleaned and stored as per workplace policy and legal requirements. |

**REQUIRED KNOWLEDGE**

* Communication
* Analytical
* Tools and equipment
* Safety regulations
* Mathematics
* Electrical installation
* Electric Power supply
* Engine operations
* Motor operations
* Plumbing
* Water pump operation
* Masonry
* Mortar mixing
* General welding
* Firefighting
* Electric Circuit interpretation

**SKILLS**

* Critical thinking
* Problem solving
* Firefighting
* Quality control
* 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 PPE based on job requirements.   2. Observed safety measures based on workshop safety rules and regulations   3. Implemented safety provisions based on DOSH guidelines   4. Selected materials based on job requirements   5. Performed masonry tasks based on work instructions.   6. Performed carpentry tasks based on work instructions   7. Performed electrical tasks based on work instructions.   8. Performed plumbing tasks based on work instructions.   9. Performed welding tasks based on work instructions.   10. Performed mechanical tasks based on instructions.   11. Operated and maintained workshop tools and equipment.   12. Diagnosed, troubleshot and reported workshop equipment faults and failures based on SOPs   13. Handled non-recyclable supplies as per legal requirements. |
| 1. Resource Implications | The following resources should be provided:   * 1. Electrical appliances   2. Electric and electronic meters   3. Pumps and pumping units   4. Plumbing materials   5. Masonry materials   6. Welding materials |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Written tests   2. Interview   3. Observation |
| 1. Context of Assessment | Assessment may be done:   * 1. On–the–job   2. Off-the –job   3. Industrial attachment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY TECHNICAL DRAWINGS AND COMPUTER AIDED DESIGN PRINCIPLES

**UNIT CODE:** WAT/OS/WRMT/CC/05/6/A

**UNIT DESCRIPTION**

This unit covers the competencies required to apply technical drawing and computer aided design principles. It involves using and maintaining drawing equipment and materials, producing plane geometry drawings, solid geometry drawings, 3D drawings and working drawings. It also involves applying CAD packages in producing working drawings.

This standard applies in water sector.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the **key outcomes** which make up **workplace function** | **PERFORMANCE CRITERIA**  These are **assessable** statements which specify the required level of performance for each of the elements.  ***(Bold and italicized terms are elaborated in the Range)*** |
| 1. Use and maintain drawing equipment and materials | 1. Drawing materials are identified and gathered according to task requirements 2. Drawing equipment are used and maintained as per manufacturer’s instructions 3. Drawing materials are used as per workplace procedures 4. Symbols and abbreviations interpreted according to standard drawing conventions |
| 1. Produce plane geometry drawings | 1. Lines used in drawing and their meanings are identified according to standard drawing conventions 2. Lettering is done in accordance with BS308. 3. Scales are constructed and interpreted according to standard conventions. 4. Angles are constructed according to standard conventions. 5. ***Geometric forms*** are constructed according to standard conventions |
| 1. Produce solid geometry drawings | * 1. ***Solid geometry*** drawings patterns of are interpreted according to standard conventions   2. Surface developments are produced using standard conventions   3. True shapes, plans and elevations are developed in accordance with standard conventions   4. Freehand sketching is done based on standard format. |
| 1. Produce 3D drawings | 1. First and third angle orthographic drawings are interpreted and produced in accordance with the standard conventions 2. Orthographic elevations are dimensioned in accordance with standard conventions 3. Isometric drawings are interpreted and produced in accordance with standard conventions |
| 1. Produce working drawings | * 1. Suitable scales are identified and interpreted according to standard conventions   2. Plans, elevations and section drawings are produced according to standard conventions.   3. Cross sections and profiles of water structures are produced according to standard conventions.   4. Dimensioning is done to working drawings according to standard. |
| 1. Apply CAD packages | * 1. CAD packages are selected according to task requirements   2. CAD packages are applied in production of drawings |

**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.Geometric forms include but are not limited to: | * Circles * Triangles * Rectangles * Parallelogram * Polygons * Pyramids * conic sections * prisms * loci |
| 2. Solid geometry include but are not limited to: | * Cubes * Cuboids * Pyramids * Cones * Cylinders * Truncated cones * Pyramids * Cylinders * interpenetration |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

* Communication
* Critical thinking
* Sketching
* Drawing
* Lettering
* Geometrical constructions
* Interpretation
* Analytical

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Geometry
* Drawing equipment and materials
* Types of drawings
* Types of lines
* Isometric drawing
* Orthographic drawing

**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 and maintained drawing equipment as per manufacturer’s instructions 2. Drew to scale according to standard conventions. 3. Interpreted scale drawings according to standard conventions. 4. Constructed angles according to standard conventions. 5. Constructed geometric forms according to standard conventions 6. Interpreted drawings of patterns according to standard conventions. 7. Produced surface developments as per standard conventions. 8. Developed true shapes, plans and elevations in accordance with standard conventions. 9. Interpreted first and third angle orthographic drawings and produced in accordance with the standard conventions. 10. Dimensioned orthographic elevations in accordance with standard conventions. 11. Interpreted and produced isometric drawings are in accordance with standard conventions. 12. Applied CAD packages in production of drawings. |
| 1. Resource Implications | The following resources should be provided:   * 1. Drawing tables   2. Drawing sets   3. Computers   4. Internet connectivity   5. CAD packages |
| 1. Methods of Assessment | Competency in this unit may be assessed through:   * 1. Observation   2. Oral Questioning   3. Written tests |
| 1. Context of Assessment | Assessment may be done: -   * 1. On–the–job   2. Off-the –job   3. Industrial attachment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY WATER TECHNOLOGY

**UNIT CODE:** WAT/OS/WRMT/CC/06/6/A

**UNIT DESCRIPTION**

This unit describes the competence required to apply water technology practices. It involves applying basic principles of water supply, wastewater collection and treatment as well as basic irrigation and drainage principles.

This standard applies in water sector.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT** | **PERFORMANCE CRITERIA**  ***(Bold and italicized terms are elaborated in the Range)*** |
| --- | --- |
| 1. Apply basic water supply principles | 1. Water demand is calculated based on use. 2. Sources of water are established based on demand and intended use. 3. Water treatment technologies are employed based on water quality. 4. Water pipes and appurtenances are assessed based on the design 5. Water supply symbols are interpreted based on international standards 6. Water distribution systems are evaluated based on design 7. Water storage structures are evaluated based on water system 8. Work safety is observed based on code of practice |
| 1. Apply principles of wastewater collection and treatment | 1. Wastewater is characterized based on source. 2. ***Industrial wastewater sources*** are characterizedbased on wastewater characteristics 3. Sewer system layout is sketched based on sewerage design manual 4. Sewerage systems are selected based on best practice. 5. Sewer appurtenances are identified based on sewer code. 6. ***Wastewater treatment processes*** are selected based on wastewater characteristics. 7. Wastewater symbols and coding are interpreted based on international standards. 8. ***Wastewater recycling and reuse applications*** are utilized based on national policy. 9. ***Sludge treatment processes*** are identified based on characteristics. 10. Work safety is observed according to code of practice. |
| 1. Apply basic irrigation and drainage principles | 1. Crop water requirement is determined based on agronomic requirements. 2. Quality of irrigation water is analyzed based on national standards. 3. ***Irrigation methods*** are evaluated based on the type of crop, type of soil, resources available, quantity and quality of water 4. Work safety is observed based on code of 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** |
| 1. Sewerage systems may include but is not limited to: | * Separate * Combined * Partially separate |
| 1. Wastewater treatment processes may include but is not limited to: | * Conventional: * Physical * Biological * Sludge treatment * Advanced: * Carbon adsorption * Ion exchange * Membrane processes * Chemical methods * Biological methods * Land treatment systems |
| 1. Wastewater recycling and reuse applications may include but not limited to: | * Direct reuse * Indirect potable reuse * Direct potable reuse * Planned reuse * Reclaimed wastewater * Unplanned reuse * Agricultural irrigation * Land scape irrigation * Industrial recycling and reuse * Ground water recharge * Non potable urban reuse * Potable reuse |
| 1. Sludge treatment processes may include but not limited to: | * Thickening * Stabilization * Digestion * Conditioning * Disinfection * Dewatering * Drying |
| 1. Industrial wastewater sources may include but not limited to: | * Processing: * Food * Textiles * Tannery * Manufacturing: * Paper * Detergents and cosmetics * Agrochemicals |
| 1. Irrigation methods may include but is not limited to: | * Surface methods * Subsurface methods * Overhead methods |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Knowledge**

* Tools and equipment
* Safety regulations
* Mathematics
* Water cycle
* Water pipes
* Plumbing
* Water pump operation
* Pipe fitting

**Skills**

* Communication
* Analytical
* Critical thinking
* Problem solving
* Firefighting
* Quality control
* 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. Identified hydrological processes based on the hydrological cycle. 2. Conducted hydrological measurements based on job requirements. 3. Observed safety in hydrometry based on OSH. 4. Identified geological formations based on geochemistry principles. 5. Interpreted Hydrogeological reports are based on hydrogeological surveys. 6. Collected remote sensing and GIS data based on SOPs. 7. is interpreted remote sensing and GIS data based on work requirements 8. Demonstrated soil and water conservation practices based national policy. 9. Performed work in accordance in accordance with the national legal and regulatory framework. 10. Utilized water resources and services in accordance with IWRM principles. |
| 1. Resource Implications | The following resources should be provided:   * 1. Water distribution system models   2. Population forecasting charts   3. Water supply symbols charts   4. Wastewater symbols chart   5. Wastewater pipes   6. Plumbing supplies and equipment   7. Water quality laboratory supplies and equipment   8. Soil water, plant relationship chart   9. Drainage models   10. PPE |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Written texts   2. Interviews   3. Observations |
| 1. Context of Assessment | Assessment may be done: -   * 1. On–the–job   2. Off-the –job   3. Industrial attachment. |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY WATER MANAGEMENT PRINCIPLES

**UNIT CODE:** WAT/OS/WRMT/CC/07/6/A

**UNIT DESCRIPTION**

This unit describes the competencies required to apply water management principles. It involves applying hydrology, hydrogeology as well as soil and water conservation, remote sensing and GIS principles. It also entails applying water policy and legislation as well integrated water resources management principles.

This standard applies in the Water sector.

**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 hydrology principles | 1. Identify hydrological processes based on hydrological cycle. 2. ***Hydrological measurements*** are conducted based on job requirements. 3. Safety in hydrometry is observed based on OSH. |
| 1. Apply hydrogeology principles | 1. Identify hydrogeological processes based on geophysical principles. 2. ***Geological formations*** are identified based on geochemistry principles. 3. Hydrogeological reports are interpreted based on hydrogeological surveys. |
| 1. Apply soil and water conservation principles | 1. Water and soil status is evaluated based on work environment. 2. Soil erosion is controlled based on best practices. 3. Water conservation practices are demonstrated based on environment. |
| 1. Apply remote sensing and GIS principles | 1. ***Remote sensing and GIS tools*** are identified based on job requirements 2. ***Remote sensing and GIS*** ***data*** is collected based on SOPs. 3. Remote sensing and GIS data is interpreted based on work requirements. |
| 1. Apply water policy and legislation | 1. Water resources are managed in accordance with national ***water policy***. 2. Water and sanitation services are provided in accordance with legislative and regulatory framework. |
| 1. Applied integrated water resources management principles | 1. Principles of IWRM are identified as per Dublin Statements. 2. IWRM practices are demonstrated based on work environment. |

**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. Hydrological data may include but not limited to: | * Rainfall * Humidity * evaporation * Temperature |
| 1. Geological formations may include but not limited to: | * Rocks * Aquifers |
| 1. Remote sensing and GIS tools may include but not limited to: | * Hardware * Software |
| 1. Remote sensing and GIS data may include but not limited to: | * Water quality * land cover |
| 1. Water Policy may include but not limited to: | * National * Regional |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

* Communication
* Analytical
* Applying fundamental operations
* Logical thinking
* Problem solving
* Applying statistics
* Drawing graphs
* Using different measuring tools
* Communication
* Analytical
* Organizing
* Decision making
* Planning
* Supervising
* Time management

**Technical skills:**

* Reporting
* Mapping
* Data logging
* Data analysis
* Instrumentation
* First aid
* Performance appraising
* Record keeping
* Operation and maintenance

**Required knowledge**

The individual needs to demonstrate knowledge of:

* + Community development
  + Instrumentation
  + Technical specifications
  + Statutory regulations
  + OSH
  + Quality Assurance
  + SOPs
  + Statistics

**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 that the candidate:   1. Identified sites for installation of hydrological instruments based on WMO guidelines 2. Installed hydrological Instruments based on WMO guidelines 3. Collected hydrological data based on job requirements. 4. Analyzed hydrological data and quantified based on the collected parameters 5. Mapped rock types and aquifers based on their formation and rock units 6. Established well sites based on groundwater potential 7. Prepared well site establishment reports based on Water Resource Management rules (WRM) 2007\* 8. Demonstrated water and soil conservation practices based on the identified factors 9. Employed water harvesting techniques based on site conditions. 10. Designed simple water harvesting structures based on need. 11. Operated and maintained simple water harvesting structures based on SOPs 12. Applied Principles of IWRM based on Dublin guidelines. 13. Observed safety hydrometry based on OSH | |
| 1. Resource Implications | | The following resources should be provided:   * 1. Field equipment   2. Petrographic microscope   3. Clinometers   4. GPS receivers   5. Maps | |
| 1. 3.Methods of Assessment | | Competency in this unit may be assessed through:   * 1. Oral Questioning   2. Written tests   3. Third party reports | |
| 1. Context of Assessment | | Assessment may be done: -   * 1. On–the–job   2. Off-the –job   3. Industrial attachment | |
| 1. Guidance information for assessment | | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. | |

## SURVEY WATER PROJECT SITES

**UNIT CODE:** WAT/OS/WRMT/CC/08/6/A

**UNIT DESCRIPTION**

This unit covers the competencies required to survey water project sites. It involves conducting reconnaissance surveys, mapping water project site and plotting site profiles and cross sections.

This standard applies in the water sector.

**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 reconnaissance surveys | * 1. Desk study is carried out based on the job requirements   2. Reconnaissance survey tools and equipment are prepared based on SOPs   3. Site reconnaissance survey is conducted based on desk study   4. Reconnaissance survey report is compiled based SOPs |
| * 1. Map water project sites | * 1. Surveying tools and equipment are gathered based on preference and site conditions, functions and usage   2. Surveying materials are selected based on their usage   3. Survey work is carried out based on the scope of work.   4. Surveying equipment are operated based on the manufacturers specifications   5. Surveying equipment, tools and materials are maintained according to manufacturer’s specifications  1. Surveying data is collected and recorded according to the survey act 2. Surveying data is analyzed and processed based on data collection method |
| * 1. Plot site profiles and cross sections | 1. Tools for plotting are employed based on the reconnaissance survey report 2. Profiles and cross sections are plotted based on the identified tools 3. Profiles and cross sections are presented based on standard operating procedures 4. Terrestrial maps are plotted based on site profiles |

**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:**

* Communication
* Analytical
* Organizing
* Decision making
* Planning
* Problem solving
* Supervising
* Time management
* Occupational Safety and health
* First aid
* River gauging

**Technical Skills:**

* Mapping
* Engineering Surveying
* Cartography
* Data collection
* Data analysis
* Trouble shooting
* Reporting
* Record keeping
* Operation and maintenance

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Instrumentation
* Engineering Surveying
* Cartography
* CAD
* Water Resources Management
* Climate change
* Technical specifications
* Statutory regulations
* Occupational health, safety
* Quality Assurance
* Standard operating procedures
* GIS
* Remote sensing

**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 desk study based on the identified site 2. Conducted site reconnaissance survey based on the need 3. Compiled reconnaissance survey report based on the observations 4. Selected surveying materials based on job requirements 5. Conducted site surveying based on job requirements 6. Operated and maintained surveying equipment based on the manufacturers specifications 7. Collected and recorded surveying data according to SOPs 8. Analyzed and processed surveying data based on SOPs 9. Plotted profiles and cross sections based on the scope of work 10. Presented profiles and cross sections based on standard operating procedures |
| 1. Resource Implications | The following resources should be provided:   * 1. Total stations   2. Theodolites   3. Contour maps |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Written tests   2. Observation   3. Oral questioning   4. Third party reports |
| 1. Context of Assessment | Assessment may be done:   * 1. On–the–job   2. Off-the –job   3. Industrial attachment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

# CORE UNITS OF COMPETENCY

## MANAGE SURFACE WATER RESOURCES

**UNIT CODE:** WAT/OS/WRMT/CR/01/6/A

**UNIT DESCRIPTION**

This unit covers the competencies required to manage surface water resources. It involves siting hydro-meteorological monitoring stations, collecting and analyzing hydro-meteorological data, monitoring surface water resources quality and maintaining surface water monitoring equipment. It also entails preparing hydrological reports as well as managing surface water resources customer service.

This standard applies in the water sector

**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. Site hydro-meteorological monitoring stations | 1. Sites for hydro-meteorological monitoring are identified based on World Meteorological Organization (WMO) standards. 2. Hydro-meteorological monitoring equipment is installed based on SOPs. |
| 1. Collect hydro-meteorological data | 2.1 Hydro-meteorological measurements are conducted based on job requirements.   * 1. Hydro-meteorological data is recorded based on SOPs.   2. Safety is observed in accordance with OSH guidelines. |
| 1. Analyze hydro-meteorological data | 1. Tools for ***hydro-meteorological data analysis*** are identified based on work instructions 2. Hydro-meteorological data is analyzed based on SOPs 3. Hydro-meteorological data is interpreted based on national guidelines and regulations. |
| 1. Prepare hydrological report | 1. Hydrological reports are prepared in accordance with WRM format. 2. Hydrological reports are submitted for evaluation as per workplace policy. |
| 1. Monitor surface water resources quality | * 1. Tools and equipment for collecting water resources quality are prepared based scope of work.   2. ***Water resources quality indicators*** are identified based on monitoring protocol.   3. Water resources quality field data is collected based on monitoring protocol.   4. Water resources quality samples are collected based on SOPs   5. Water resources quality samples are analyzed based on indicators   6. Water resources quality data is analyzed and reported based on SOPs   7. Safety is observed in accordance with OSH guidelines. |
| 1. Prepare surface water management plans | 1. Surface water quantity challenges and issues are identified based on hydro-meteorological reports 2. Surface water quality challenges and issues are identified based on water quality monitoring reports 3. Surface water management plans are prepared based on issues reported. |
| 1. Maintain surface water resources monitoring equipment | 1. Surface water resources monitoring ***equipment maintenance activities*** are identified based on equipment. 2. Schedule for maintenance activities is prepared based on WMO guidelines. 3. Surface water resources monitoring equipment are maintained based schedules. 4. Surface water resources monitoring equipment maintenance records are maintained as per workplace policy. |
| 1. Manage surface water resources customer service | 1. Surface water resource users are mapped based on catchment areas. 2. Surface WRUAs are registered based on National guidelines. 3. Surface water abstraction permit are issued in accordance with National regulations. 4. Surface water abstraction is costed and billed in accordance with National guidelines. 5. Conflicts in surface water resource use conflict are managed based on water rights policies. |

**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. Hydro-meteorological data analysis may include but not limited to: | * Double mass analysis * Estimation of missing hydrological data * Flow duration and mass curve * Envelope curves * Hydrological frequency analysis |
| 1. Water resources quality indicators may include but not limited to: | * Physical * Chemical * Microbiological * Macrobiological |
| 1. Equipment maintenance activities may include but not limited to: | * Routine housekeeping * Troubleshooting * Calibration of equipment * Servicing |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

* Communication
* Analytical
* Organizing
* Decision making
* Planning
* Problem solving
* Supervising
* Time management
* Occupational Safety and health
* First aid
* Mapping
* River gauging
* Water sampling
* Data logging
* Data collection
* Data analysis
* Report writing
* Trouble shooting
* Record keeping
* Operation and maintenance

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Hydrology
* Instrumentation
* Technical specifications
* Statutory regulations
* Quality Assurance
* Water pollutants
* Analytical methods
* Water quality management
* Statistics
* OSH
* SOPs
* Remote sensing
* GIS
* IWRM

**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. Installed water quantity and quality monitoring stations based WMO guidelines. 2. Collected hydro-metrological data based on parameters to be measured. 3. Analyzed hydro-metrological data based on parameters 4. Interpreted hydro-metrological data based national guidelines and regulations. 5. Monitored water resources quality based on protocol 6. Presented reports based on job requirements 7. Scheduled equipment maintenance based on manufacturer’s instructions. 8. Maintained monitoring equipment based on WMO guidelines and standard operating procedures. 9. Developed watershed management plan based on bio-physical and chemical, challenges and issues identified. 10. Managed conflicts in water use in accordance with water rights policies. 11. Observed safety in accordance with OSH guidelines. |
| 2. Resource Implications | The following resources should be provided:   * 1. Surveying equipment   2. Hydro-meteorological monitoring equipment   3. GPS   4. GIS software Cameras   5. Water samplers   6. Portable water quality test kits   7. PPE |
| 3.Methods of Assessment | Competency may be assessed through:   * 1. Written tests   2. Interview   3. Oral questioning   4. Third party report |
| 4.Context of Assessment | Assessment may be done:   * 1. On–the–job   2. Off-the –job   3. Industrial attachment |
| 5.Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## MANAGE GROUNDWATER RESOURCES

**UNIT CODE:** WAT/OS/WRMT/CR/02/6/A

**UNIT DESCRIPTION**

This unit covers the competencies required to manage ground water resources. It involves siting hydrogeological monitoring stations, monitoring groundwater quality and levels, conducting hydrogeological surveys and preparing hydrogeological survey reports. It also entails maintaining groundwater monitoring equipment, preparing groundwater resource management plans as well as groundwater resources customer service.

This standard applies in the water sector.

**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.Site hydrogeological monitoring stations | 1. Sites for hydrogeological monitoring are identified based on National guidelines 2. Hydrogeological monitoring equipment is installed based on SOPs. |
| 2.Monitor groundwater levels | 1. Groundwater quantity monitoring networks are establishedbased on national guidelines. 2. ***Groundwater level monitoring tools and equipment*** are installed based on job requirements. 3. Groundwater level data is collected based on SOPS. 4. Data is analyzed based on job requirements. 5. Data is interpreted and reported based on SOPs. 6. Groundwater potential and recharge areas are mapped based on monitoring reports. |
| 3.Conduct hydrogeological surveys | 1. Hydrogeological survey tools and equipmentare mobilized based on job requirements. 2. Hydrogeological survey data is collected based SOPs. 3. Hydrogeological survey data is analyzed and interpreted based on WRA guidelines. 4. Hydrogeological survey report is prepared based on WRA guidelines. |
| 4.Prepare hydrogeological survey reports | * 1. Hydrogeological reports are prepared in accordance with work instructions.   2. Hydrogeological reports are submitted for evaluation as per workplace policy |
| 1. Monitor groundwater resources quality | 1. Tools and equipment for collecting groundwater resources quality are prepared based scope of work. 2. Groundwater resources quality indicators are identified based on monitoring protocol. 3. Groundwater resources quality field data is collected based on monitoring protocol. 4. Groundwater resources quality samples are collected based on SOPs 5. Groundwater resources quality samples are analyzed based on indicators 6. Groundwater resources quality data is analyzed and reported based on SOPs 7. Safety is observed in accordance with OSH guidelines |
| 1. Prepare surface water management plans | 1. Groundwater quantity challenges and issues are identified based on hydro-meteorological reports 2. Groundwater quality challenges and issues are identified based on water quality monitoring reports 3. Groundwater management plans are prepared based on issues reported. |
| 1. Maintain groundwater resources monitoring equipment | 1. Groundwater resources monitoring ***equipment maintenance activities*** are identified based on equipment. 2. Equipment maintenance schedule is prepared based on work instructions. 3. Groundwater resources monitoring equipment are maintained based on schedules. 4. Groundwater resources monitoring equipment maintenance records are maintained as per workplace policy. |
| 1. Manage groundwater resources customer service | 1. Groundwater resource users are mapped based on catchment areas. 2. Ground WRUAs are registered based on National guidelines. 3. Groundwater abstraction permit are issued in accordance with National regulations. 4. Groundwater abstraction is costed and billed in accordance with National guidelines. 5. Conflicts in groundwater resource use conflict are managed based on water rights policies. |

**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. Ground water monitoring station maintenance activities may include but not limited to: | * + Calibration of equipment   + Servicing   + Upgrading/rehabilitation |
| 1. Ground water quantity and quality monitoring tools and equipment may include but not limited to: | * Discrete sampler * Water dipper * Water level recorders * Test pumping unit * Portable water quality kit * Data loggers * Obsevation wells/pieziometer |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

* Communication
* Analytical
* Organizing
* Decision making
* Planning
* Problem solving
* Supervising
* Time management
* Reporting
* Mapping
* Data logging
* Data analysis
* Instrumentation
* Water Sampling
* Water level and yield measurement
* First aid
* Trouble shooting
* Record keeping

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Instrumentation
* Technical specifications
* Statutory regulations
* Occupational health, safety
* Quality Assurance
* Water pollution and control
* Standard operating procedures
* Analytical methods
* Water quality management
* Statistics
* Water treatment
* IWRM
* Geology
* Hydrogeology
* GIS
* Remote sensing
* Hydrology
* Community 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. Established groundwater quality and quantity monitoring networks based on national guidelines. 2. Installedgroundwater quality and quantity monitoring tools and equipment based on national guidelines. 3. Collected groundwater resources data based on parameters to be measured. 4. Analyzed and interpreted groundwater resources monitoring data based on national parameters. 5. Employed groundwater quality and quantity monitoring framework based on national guidelines. 6. Presented groundwater resources data based on various parameters. 7. Prepared equipment maintenance activities schedule based on national guidelines 8. Operated and maintained groundwater monitoring equipment based on SOPs. 9. Developed groundwater resources management plan based on national guidelines. 10. Addressed groundwater resources conflicts based on warer rights guidelines 11. Observed safety based on OSH guidelines |
| 2.Resource Implications | The following resources should be provided:   * 1. Surveying equipment   2. Groundwater level measurement equipment   3. GPS receivers   4. GIS software   5. Water samplers   6. portable water quality test kits   7. PPE |
| 3.Methods of Assessment | Competency may be assessed through:   * 1. Written tests   2. Interview/Oral questioning   3. Third party report |
| 4.Context of Assessment | Assessment may be done:   * 1. On–the–job   2. Off-the –job   3. Industrial attachment |
| 5.Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## DEVELOP GROUNDWATER RESOURCES

**UNIT CODE:** WAT/OS/WRMT/CR/03/6/A

**UNIT DESCRIPTION**

This unit covers the competencies required to develop groundwater resources. It involves establishing boreholes, hand dug wells and artificial ground water recharge structures.

This standard applies in the water sector.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the **key outcomes** which make up **workplace function** | **PERFORMANCE CRITERIA**  These are **assessable** statements which specify the required level of performance for each of the elements.  ***Bold and italicized terms are elaborated in the Range*** |
| 1.Establish boreholes | 1. Drilling tools and equipment are mobilized based on job specification. 2. Drilling site is set upbased on the site conditions. 3. Borehole is drilled in accordance with statutory requirements. 4. Borehole is completed based on the WRM rules 2007\* 5. Test pumpingis carried out based on nature of the borehole. 6. ***Test pumping data*** is analyzed based on SOPs 7. Pumps are installed based on test pump report. 8. Boreholes are protected based on safety and environmental guidelines 9. Borehole completion reports are compiled based on WRM Rules, 2007\* 10. Safety is observed based on OSH guidelines |
| 2.Establish hand dug wells | 1. Site for shallow wells are identified based on work instructions. 2. Tools for digging wells are gathered based on the lithology. 3. Shallow wells are dug based on SOPs. 4. Hand dug wells are protected based on safety and environmental guidelines. 5. Safety is observed based on OSH guidelines. |
| 3.Establish artificial ground water recharge structures | 1. Groundwater recharge sites are surveyed based work instructions. 2. Groundwater recharge methods are identified based site conditions 3. Tools and equipment are mobilized based on ground water recharge method. 4. ***Artificial ground water recharge structures*** are set up based on SOPs. |

**RANGE**

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

|  |  |
| --- | --- |
| Variables | Range |
| 1. Test pumping data may include but not limited to: | * Discharge * Drawdown * Recovery |
| 1. Ground water recharge structures may include but not limited to: | * Recharge wells * Dug wells * Recharge basins * Pits and shafts |

**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:**

* Communication
* Analytical
* Organizing
* Decision making
* Planning
* Problem solving
* Supervising
* Time management
* Inventory management
* Performance appraising
* Drilling operations
* Mapping
* Data logging
* Data analysis
* Instrumentation
* Water sampling and analysis
* Soil Sampling and profiling
* Water level and yield measurement
* First aid
* Trouble shooting
* Operation and maintenance
* Reporting
* Record management

**Required Knowledge**

The individual needs to demonstrate knowledge of:

* Instrumentation
* Technical specifications
* Statutory regulations
* Occupational health and safety
* Quality Assurance
* Water pollution and control
* Standard operating procedures
* Analytical methods
* Statistics
* Water chemistry
* Water quality
* Hydrogeology
* IWRM
* Meteorology

**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 drilling tools and equipment based on job specification. 2. Set up drilling sitebased on the job requirements 3. Drilling borehole as per statutory requirements 4. Conducted test pumpingis based on nature of borehole. 5. Installed pumps based on test pump report. 6. Completed boreholes based on work instructions 7. Compiled Borehole completion report based on WRM Rules, 2007\* 8. Selected sites for shallow well based on work instructions 9. Established hand –dug wells based on the lithology 10. Selected groundwater recharge sites based on job requirements 11. Set up artificial ground water recharge structuresbased on SOPs, 12. Protected groundwater structures based on environmental safety guidelines 13. Observed safety in accordance with OSH guidelines. |
| 1. Resource Implications | The following resources should be provided:   * 1. Drilling rigs   2. Test pumping kits   3. Hand digging tools   4. Software |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Written tests   2. Observation   3. Oral questioning   4. Third party reports |
| 1. Context of Assessment | Assessment may be done:   * 1. On–the–job   2. Off-the –job   3. Industrial attachment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## DEVELOP NEW WATER RESOURCES

**UNIT CODE:** WAT/OS/WRMT/CR/04/6A

**UNIT DESCRIPTION**

This unit covers the competencies required to develop new water resources. It involves promoting water recycling and reuse, desalinating water as well as harvesting and storing atmospheric water.

This standard applies in the Water sector

**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.Promote water recycle and reuse | 1. Sources of water for recycling and re-use are identified as per statutory requirements. 2. Quality of water for recycling and re-use is evaluated based on national standards. 3. Water recycling technologies are employed based on re-use purpose 4. Recycled water wastes are managed in accordance with best environmental health practices |
| 2.Desalinate water | 1. Sources of water for desalination are identified based on technological requirements. 2. Salinity of water is evaluated based on intended use. 3. ***Desalination technologies*** are employed based on the salinity status. 4. Desalination water concentrates are treated and disposed in accordance with best environmental health practices |
| 3. Harvest and store atmospheric water | 1. ***Sources of atmospheric water*** are evaluated based on technological requirements. 2. ***Atmospheric water harvesting technologies*** are employed based on source. 3. Harvested water is stored based on end use. |

**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 recycling technologies may include but not limited to: | | * Physical methods * Chemical methods * Biological methods |
| 1. Sources of atmospheric water | | * Rainwater * Fog * Dew |
| 1. Atmospheric water harvesting technologies may include but not limited to: | | * Cloud seeding * Fog harvesting * Dew harvesting |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

* Communication
* Analytical
* Organizing
* Decision making
* Planning
* Problem solving
* Supervising
* Time management

**Technical skills:**

* Mapping
* Instrumentation
* Water sampling and analysis
* Occupational safety and health
* Water treatment
* Meteorology
* Trouble shooting
* Operation and maintenance
* Reporting
* Record management

**Required Knowledge**

**The individual needs to demonstrate knowledge of:**

* Instrumentation
* Technical specification
* Statutory regulations
* Occupational safety and health
* Quality Assurance
* Water pollution and control
* Standard operating procedures
* Analytical methods
* Statistics
* Water treatment
* Climate change
* Environmental protection
* Water law
* Water policy
* Hydrology
* IWRM
* Meteorology

**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. Employed water recycling technologies based on the status of the water. 2. Employed water desalination technologies based on the salinity status of the water. 3. Harvested and stored atmospheric water harvesting equipment based on need. 4. Identified rainwater harvesting technologies based on atmospheric conditions 5. Promoted water recycle and re-use based on national standards |
| 1. Resource Implications | The following resources should be provided:   * 1. Drones   2. Water reclamation demonstration platforms   3. Membrane filters   4. Water quality test kits |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Written test   2. Oral questioning   3. Third party report |
| 1. Context of Assessment | Assessment may be done:   * 1. On–the–job   2. Off-the –job   3. Industrial attachment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |