

**THE**

**REPUBLIC OF KENYA**

**NATIONAL OCCUPATIONAL STANDARDS**

**FOR**

**PHOTOGRAMMETRY AND REMOTE SENSING**

**TECHNICIAN**

**LEVEL 6**



TVET CDACC

P.O BOX 15745-00100

NAIROBI

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# FOREWORD

The provision of quality education and training is fundamental to the Government’s overall strategy for social economic development. Quality education and training will contribute to achievement of Kenya’s development blueprint, Vision 2030 and sustainable development goals.

Reforms in the education sector are necessary for the achievement of Kenya Vision 2030 and meeting the provisions of the Constitution of Kenya 2010. The education sector had to be aligned to the Constitution of Kenya 2010 and this resulted in the formulation of the Policy Framework for Reforming Education and Training. A key feature of this policy is the radical change in the design and delivery of the TVET training. This policy document requires that training in TVET be competency based, Curriculum development be industry led, certification be based on demonstration of competence and mode of delivery allows for multiple entry and exit in TVET programmes.

These reforms demand that Industry takes a leading role in Curriculum development to ensure the Curriculum addresses its competence needs. It is against this background that these Occupational Standards were developed for the purpose of developing a competency-based Curriculum for Photogrammetry and Remote Sensing 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 Land Survey and Mapping sector’s growth and sustainable development.

**PRINCIPAL SECRETARY, VOCATIONAL AND TECHNICAL TRAINING**

**MINISTRY OF EDUCATION**

# PREFACE

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

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

The TVET Curriculum Development, Assessment and Certification Council (TVET CDACC), in conjunction with Land Survey and Mapping Sector Skills Advisory Committee (SSAC) have developed these Occupational Standards for a surveyor. These standards will be the basis for development of competency-based Curriculum for Photogrammetry and Remote Sensing Level 6.

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

I am grateful to the Council Members, Council Secretariat, Land Survey and Mapping SSAC, expert workers and all those who participated in the development of these Occupational Standards.

**CHAIRPERSON, TVET CDACC**

# ACKNOWLEDGMENT

These Occupational Standards were developed through combined efforts of various stakeholders from private and public organizations. I am thankful to the management of the 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 Land Survey and Mapping 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.

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

**CHAIRPERSON**

**LAND SURVEY AND MAPPING** **SECTOR SKILLS ADVISORY COMMITTEE**

TABLE OF CONTENTS

[FOREWORD ii](#_Toc70349803)

[PREFACE iii](#_Toc70349804)

[ACKNOWLEDGMENT iv](#_Toc70349805)

[ABBREVIATIONS AND ACRONYMS vi](#_Toc70349806)

[KEY TO UNIT CODE vii](#_Toc70349807)

[OVERVIEW viii](#_Toc70349808)

[BASIC UNITS OF COMPETENCY 1](#_Toc70349809)

[DEMONSTRATE COMMUNICATION SKILLS 2](#_Toc70349810)

[DEMONSTRATE NUMERACY SKILLS 6](#_Toc70349811)

[DEMONSTRATE DIGITAL LITERACY 13](#_Toc70349812)

[DEMONSTRATE ENTREPRENEURIAL SKILLS 18](#_Toc70349813)

[DEMONSTRATE EMPLOYABILITY SKILLS 25](#_Toc70349814)

[DEMONSTRATE ENVIRONMENTAL LITERACY 33](#_Toc70349815)

[DEMONSTRATE OCCUPATIONAL SAFETY AND HEALTH PRACTICES 38](#_Toc70349816)

[COMMON UNITS OF COMPETENCY 1](#_Toc70349817)

[APPLY ENGINEERING MATHEMATICS 2](#_Toc70349818)

[APPLY PRINCIPLES OF LAND SURVEYING 7](#_Toc70349819)

[OPERATE PHOTOGRAMMETRIC EQUIPMENT 11](#_Toc70349820)

[APPLY PRINCIPLES OF GIS 16](#_Toc70349821)

[APPLY PRINCIPLES OF CARTOGRAPHY 20](#_Toc70349822)

[APPLY LAND LAWS 23](#_Toc70349823)

[CORE UNITS OF COMPETENCIES 27](#_Toc70349824)

[CONDUCT AERIAL PHOTOGRAMMETRY 28](#_Toc70349825)

[CONDUCT CLOSE-RANGE PHOTOGRAMETRY 34](#_Toc70349826)

[CONDUCT DIGITAL PHOTOGRAMMETRY 38](#_Toc70349827)

[CONDUCT TOPOGRAPHIC MAPPING 44](#_Toc70349828)

[CONDUCT REMOTE SENSING PROJECTS 49](#_Toc70349829)

[CONDUCT SATELLITE PHOTOGRAMMETRY 55](#_Toc70349830)

# ABBREVIATIONS AND ACRONYMS

BC Basic Competency

CC Common Competency

CDACC Curriculum Development, Assessment and Certification Council

CPU Central Processing Unit

CR Core Competency

CU Curriculum

EPS Expanded Polystyrene Systems

ICT Information Communication Technology

OSHA Occupation Safety and Health Act

OSHS Occupation Safety and Health Standards

PC Personal Computer

PPE Personal Protective Equipment

SOPs Standard Operating Procedures

SSAC Sector Skills Advisory Committee

TVET Technical and Vocational Education and Training

# KEY TO UNIT CODE

**LSM /OS /PRS /BC /01/ 6/A**

Industry or sector

Occupational Standards

Occupational area

Type of competency

Competency number

Competency level

Control Version

# OVERVIEW

This course consists of competencies required by a photogrammetry and remote sensing technician to conduct aerial photogrammetry, conduct close range photogrammetry, conduct digital photogrammetry, conduct topographic mapping, conduct remote sensing projects and conduct satellite photogrammetry.

It consists of the following units of competencies:

**BASIC UNITS OF COMPETENCY**

|  |  |
| --- | --- |
| **UNIT CODE** | **UNIT TITLE** |
| LSM/OS/PRS/BC/01/6/A | Demonstrate communication skills |
| LSM/OS/PRS/BC/02/6/A | Demonstrate numeracy skills |
| LSM/OS/PRS/BC/03/6/A | Demonstrate digital literacy |
| LSM/OS/PRS/BC/04/6/A | Demonstrate entrepreneurial skills |
| LSM/OS/PRS/BC/05/6/A | Demonstrate employability skills |
| LSM/OS/PRS/BC/06/6/A | Demonstrate environmental literacy |
| LSM/OS/PRS/BC/07/6/A | Demonstrate occupational safety and health practices |

**COMMON UNITS OF COMPETENCY**

|  |  |
| --- | --- |
| **UNIT CODE** | **UNIT TITLE** |
| LSM/OS/PRS/CC/01/6/A | Apply Engineering Mathematics |
| LSM/OS/PRS/CC/02/6/A | Apply Principles of Land Survey |
| LSM/OS/PRS/CC/03/6/A | Operate Photogrammetric Equipment |
| LSM/OS/PRS/CC/04/6/A | Apply Principles of GIS |
| LSM/OS/PRS/CC/05/6/A | Apply Principles of Cartography |
| LSM/OS/PRS/CC/06/6/A | Apply Land Laws |

**CORE UNITS OF COMPETENCIES**

|  |  |
| --- | --- |
| **UNIT CODE** | **UNIT TITLE** |
| LSM/OS/PRS/CR/01/6/A | Conduct Aerial Photogrammetry |
| LSM/OS/PRS/CR/02/6/A | Conduct Close Range Photogrammetry |
| LSM/OS/PRS/CR/03/6/A | Conduct Digital Photogrammetry |
| LSM/OS/PRS/CR/04/6/A | Conduct Topographic Mapping |
| LSM/OS/PRS/CR/05/6/A | Conduct Remote Sensing Projects |
| LSM/OS/PRS/CR/06/6/A | Conduct Satellite Photogrammetry |

# BASIC UNITS OF COMPETENCY

## DEMONSTRATE COMMUNICATION SKILLS

**UNIT CODE:** LSM/OS/PRS/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 NUMERACY SKILLS

**UNIT CODE:** LSM/OS/PRS/BC/02/6/A

**UNIT DESCRIPTION**

This unit describes the competencies required to demonstrate numeracy skills. It involves; applying a wide range of mathematical calculations for work; applying ratios, rates and proportions to solve problems; estimating, measuring and calculating measurement for work; using detailed maps to plan travel routes for work; using geometry to draw and construct 2D and 3D shapes for work; collecting, organizing and interpreting statistical data; using routine formula and algebraic expressions for work and using common functions of a scientific calculator.

**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 a wide range of mathematical calculations for work | * 1. Mathematical information embedded in a range of workplace tasks and texts is extracted as per workplace procedures.   2. Mathematical information is interpreted and comprehended as per job specifications   3. A range of mathematical and problem solving processes are selected and used as per job specification   4. Different forms of fractions, decimals and percentages are flexibly used as per SOPs   5. Calculation performed with positive and negative numbers as per SOPs   6. Numbers are expressed as powers and roots and are used in calculations as per SOPs   7. Calculations done using routine formulas as per SOPs   8. Estimation and assessment processes are used to check outcome as per workplace procedures   9. Mathematical language is used to discuss and explain the processes, results and implications of the task as per workplace procedures |
| 1. Use and apply ratios, rates and proportions for work | * 1. Information regarding ratios, rates and proportions extracted from a range of workplace tasks and texts as per SOPs   2. Mathematical information related to ratios, rate and proportions is analysed as per SOPs   3. Problem solving processes are used to undertake the task as per workplace procedures   4. Equivalent ratios and rates are simplified as per SOPs   5. Quantities are calculated using ratios, rates and proportions as per SOPS   6. Graphs, charts or tables are constructed to represent ratios, rates and proportions as per SOPs   7. The outcomes reviewed and checked as per job specifications   8. Information is record using mathematical language and symbols as per workplace procedures |
| 1. Estimate, measure and calculate measurement for work | * 1. Measurement information embedded in workplace texts and tasks are extracted and interpreted as per job specifications   2. Appropriate workplace measuring equipment are identified and selected as per job specifications   3. Accurate measurements are estimated and made as per SOPs   4. The area of ***2D shapes*** including compound shapes are calculated as per SOPs   5. The volume of 3D shapes is calculated using relevant formulas as per SOPs   6. Sides of right angled triangles are calculated using Pythagoras’ theorem as per SOPs   7. conversions are perform between units of measurement as per job specification   8. Problem solving processes are used to undertake the task as per workplace Procedures   9. The measurement outcomes are reviewed and checked as per workplace procedures   10. Information is recorded using mathematical language and symbols appropriate for the task as per workplace procedures |
| 1. Use detailed maps to plan travel routes for work | * 1. Different types of maps are identified and interpreted as per job requirements   2. Key features of maps are identified as per job requirements   3. Scales are identified and interpreted as per job requirements   4. Scales are applied to calculate actual distances   5. Positions or locations are determined using directional information as per job requirements   6. Routes are planned by determining directions and calculating distances, speeds and times as per job requirements   7. Information is gathered and identified and relevant factors related to planning a route checked as per job requirements   8. Relevant equipment is select and checked for accuracy and operational effectiveness as per job requirements   9. Task is planned and recorded using specialized mathematical language and symbols appropriate for the task as per job requirements |
| 1. Use geometry to draw 2D shapes and construct 3D shapes for work | * 1. A range of 2D shapes and 3D shapes and their uses in work contexts is identified as per job specifications   2. Features of 2D and 3D shapes are named and described as per job specifications   3. Types of angles in 2D and 3D shapes are identified as per job specifications   4. Angles are drawn, estimated and measured using geometric instruments as per job requirements   5. Angle properties of 2D shapes are named and identified as per SOPs   6. Angle properties are used to evaluate unknown angles in shapes as per SOPs   7. Properties of perpendicular and parallel lines are applied to shapes as per SOPs   8. Understanding and use of symmetry is demonstrated as per SOPs   9. Understanding and use of similarity is demonstrated as per SOPs   10. The workplace tasks and mathematical processes required are identified as per workplace procedures   11. 2D shapes is drawn for work as per job specification   12. 3D shapes is constructed for work as per job specification   13. The outcomes are reviewed and checked as per workplace procedures   14. Specialized mathematical language and symbols appropriate for the task are used as per SOPs |
| 1. Collect, organize, and interpret statistical data for work | * 1. Workplace issue requiring investigation are identified as per workplace procedures   2. Audience / population / sample unit is determined as per workplace procedures as per workplace procedures   3. Data to be collected is identified as per workplace procedures   4. Data collection method is selected as per workplace procedures   5. Appropriate statistical data is collected and organized as per SOPs   6. Data is illustrated in appropriate formats as per SOPs   7. The effectiveness of different types of graphs are compared as per SOPs   8. The summary statistics for collected data is calculated as per SOPs   9. The results / findings are interpreted as per SOPs   10. Data is checked to ensure that it meets the expected results and content as per workplace procedures   11. Information from the results including tables, graphs and summary statistics is extracted and interpreted as per workplace procedure   12. Mathematical language and symbols are used to report results of investigation as per workplace procedure |
| 1. Use routine formula and algebraic expressions for work | * 1. Understanding of informal and symbolic notation, representation and conventions of algebraic expressions is demonstrated as per SOPs   2. Simple algebraic expressions and equations are developed as per job specification   3. Operate on algebraic expressions as per job requirement   4. Algebraic expressions are simplified as per job requirement   5. Substitution into simple routine equations is done as per SOPs   6. Routine formulas used for work tasks are identified and comprehended as per SOPs   7. Routine formulas are evaluate by substitution as per SOPs   8. Routine formulas transposed as per SOPs   9. Appropriate formulas are identified and used for work related tasks as per workplace procedures   10. Outcomes are checked and result of calculation used as per workplace procedures |
| 1. Use common functions of a scientific calculator for work | * 1. Required numerical information to perform tasks is located as per job specification   2. The order of operations and function keys necessary to solve mathematical calculation are determined as per job specification   3. Function keys on a scientific calculator are identified and used as per SOPs   4. Estimations are referred to check reasonableness of problem solving process as per workplace procedures   5. Appropriate mathematical language, symbols and conventions are used to report results as per workplace procedures |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. 2D shapes may include but not limited may include but not limited to: | * Triangles * Square * Rectangle * Triangle |

**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
* Logical thinking
* Computing
* Drawing of graphs
* Applying mathematical formulas
* Analytical

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Types of common shapes
* Differentiation between two dimensional shapes / objects
* Formulae for calculating area and volume
* Types and purpose of measuring instruments
* Units of measurement and abbreviations
* Fundamental operations (addition, subtraction, division, multiplication)
* Rounding techniques
* Types of fractions
* Different types of tables and graphs
* Meaning of graphs, such as increasing, decreasing, and constant value
* Preparation of basic data, tables & graphs

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical aspects of Competency | Assessment requires evidence that the candidate:   1. 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. 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 DIGITAL LITERACY

**UNIT CODE:** LSM/OS/PRS/BC/03/6/A

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

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

**RANGE**

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

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

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

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

**Required Knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE** **GUIDE**

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

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

## DEMONSTRATE ENTREPRENEURIAL SKILLS

**UNIT CODE :** LSM/OS/PRS/BC/04/6/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:** LSM/OS/PRS/BC/05/6/A

**UNIT DESCRIPTON**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

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

**RANGE**

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

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

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

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

**Required Knowledge**

The individual needs to demonstrate knowledge of:

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

1. Professional growth and development
2. Technology in the workplace
3. Innovation
4. 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:** LSM/OS/PRS/BC/06/6/A

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

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

**RANGE**

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

|  |  |
| --- | --- |
| **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:** LSM/OS/PRS/BC/07/6/A

**UNIT DESCRIPTION**

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

**ELEMENTS AND PERFORMANCE CRITERIA**

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

**RANGE**

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

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

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

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

**Required Knowledge**

The individual needs to demonstrate knowledge of:

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

**EVIDENCE GUIDE**

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

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

# COMMON UNITS OF COMPETENCY

## APPLY ENGINEERING MATHEMATICS

**UNIT CODE:** LSM/OS/PRS/CC/01/6/A

**UNIT DESCRIPTION**

This unit describes the competencies required by a technician in order to apply algebra apply trigonometry and hyperbolic functions, apply complex numbers, apply coordinate geometry, carry out binomial expansion, apply calculus, solve ordinary differential equations, carry out mensuration, apply power series, apply statistics, apply numerical methods, apply vector theory and apply matrix.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements.  ***Bold and italicized terms are elaborated in the Range.*** |
| --- | --- |
| * 1. Apply Algebra | * 1. Calculations involving Indices are performed as per the concept   2. Calculations involving Logarithms are performed as per the concept   3. Scientific calculator is used in solving mathematical problems in line with manufacturer’s manual   4. Simultaneous equations are performed as per the rules   5. Quadratic equations are calculated as per the concept |
| * 1. Apply Trigonometry and hyperbolic functions | * 1. Calculations are performed using trigonometric rules   2. Calculations are performed using hyperbolic functions |
| * 1. Apply complex numbers | * 1. Complex numbers are represented using Argand diagrams   2. Operations involving complex numbers are performed   3. Calculations involving complex numbers are performed using De Moivre’s theorem |
| * 1. Apply Coordinate Geometry | * 1. Polar equations are calculated using coordinate geometry   2. Graphs of given polar equations are drawn using the Cartesian plane   3. Normal and tangents are determined using coordinate geometry |
| * 1. Carry out Binomial Expansion | * 1. Roots of numbers are determined using binomial theorem   2. Errors of small changes are determined using binomial theorem |
| * 1. Apply Calculus | * 1. Derivatives of functions are determined using Differentiation   2. Derivatives of hyperbolic functions are determined using Differentiation   3. Derivatives of inverse trigonometric functions are determined using Differentiation   4. Rate of change and small change are determined using Differentiation.   5. Calculation involving stationery points of functions of two variables are performed using differentiation.   6. Integrals of algebraic functions are determined using integration   7. Integrals of trigonometric functions are determined using integration   8. Integrals of logarithmic functions are determined using integration   9. Integrals of hyperbolic and inverse functions are determined using integration |
| * 1. Solve Ordinary differential equations | * 1. First order and second order differential equations are solved using the method of undetermined coefficients   7.2 First order and second order differential equations are solved from given boundary conditions |
| * 1. Carry out Mensuration | * 1. Perimeter and areas of figures are obtained   2. Volume and of Surface area of solids are obtained   3. Area of irregular figures are obtained   4. Areas and volumes are obtained using Pappus theorem |
| * 1. Apply Power Series | * 1. Power series are obtained using Taylor’s Theorem   2. Power series are obtained using McLaurin’s ‘s theorem |
| * 1. Apply Statistics | * 1. Mean, median ,mode and Standard deviation are obtained from given data   2. Calculations are performed based on Laws of probability   3. Calculation involving ***probability distributions*** , mathematical expectation sampling distributions are performed   4. Sampling distribution methods are applied in data analysis   5. Calculations involving use of standard normal table, sampling distribution, T-distribution and Estimation are done   6. Confidence intervals are determined |
| * 1. Apply Numerical methods | * 1. Roots of polynomials are obtained using iterative ***numerical methods***   2. Interpolation and extrapolation are performed using numerical methods |
| * 1. Apply Vector theory | * 1. Vectors and scalar quantities are obtained in two and three dimensions   2. ***Operations*** on vectors are performed   3. Position of vectors is obtained   4. Resolution of vectors is done |
| * 1. Apply Matrix | * 1. Determinant and inverse of 3x3 matrix are obtained   2. Solutions of simultaneous equations are obtained   3. Calculation involving Eigen values and Eigen vectors are performed |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Operations may include but not limited to: | * + Addition   + Subtraction |
| 1. Hyperbolic functions may include but not limited to: | * + Sinh x   + Cosh x   + Cosec x   + Coth x   + Tanh x   + Sech x |
| 1. Probability Distributions may include but not limited to: | * + Binomial   + Poisson   + Normal |
| 1. Numerical Methods may include but not limited to: | * + Newton Raphson   + Gregory Newton |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

* Applying fundamental operations (addition, subtraction, division, multiplication)
* Using and applying mathematical formulas
* Logical thinking
* Problem solving
* Applying statistics
* Drawing graphs
* Using different measuring tools

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Fundamental operations (addition, subtraction, division, multiplication)
* Calculating area and volume
* Types and purpose of measuring instruments
* Units of measurement and abbreviations
* Rounding techniques
* Types of fractions
* Types of tables and graphs
* Presentation of data in tables and graphs
* Vector operations
* Matrix operations

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| * 1. Critical aspects of . Competency | Assessment requires evidence that the candidate:   1. Applied Trigonometry and hyperbolic functions 2. Applied complex numbers 3. Applied Calculus 4. Solved Ordinary differential equations 5. Carried out mensuration 6. Applied Power Series 7. Applied Vector theory 8. Applied Matrix 9. Applied Numerical methods |
| * 1. Resource Implications | The following resources should be provided:   * 1. Access to relevant workplace or appropriately simulated environment where assessment can take place   2. Measuring equipment   3. Materials relevant to the proposed activity or tasks |
| * 1. Methods of Assessment | Competency in this unit may be assessed through:   * 1. Observation   2. Oral questioning   3. Written test   4. Portfolio of Evidence   5. Interview   6. Third party report |
| 1. Context of Assessment | Competency may be assessed   * 1. On job   2. Off job   3. During industrial attachment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY PRINCIPLES OF LAND SURVEYING

**UNIT CODE:** LSM/OS/PRS/CC/02/6/A

**UNIT DESCRIPTION**

This unit describes the competencies required by a land surveyor to operate survey equipment, collect data, process data and present data.

|  |  |
| --- | --- |
| **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. 1. Operate survey 2. equipment | * 1. ***Survey equipment*** is identified.   2. Survey equipment is ***Handled***   3. Survey equipment is ***Set up***   4. Survey equipment is ***Maintained*** |
| 1. 2. Collect data | 2.1 ***Types of data*** are identified.  2.2 Data ***collection methods*** are determined.  2.3 Data ***collection tools*** are identified.  2.4 Data is collected. |
| 1. 3. Process and analyse | 3.1 Data ***processing method*** is determined.  3.2 Data ***processing tools*** are identified.  3.3 Data processing is carried out.   * 1. Data analysis is performed. |
| 1. 4. Present data | 4.1 Data ***presentation format/model*** is selected  4.2 Data presentation format/model is prepared |

**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. Survey equipment may include but not limited to: | * • Theodolite * • Level * • Total station * • GNSS receiver * • Tripod * • Reflector |
| 1. Handle may include but not limited to: | * + Transporting   + Unpacking/packing   + storage |
| 1. Set up may include but not limited to: | * + Centering   + Levelling   + Removal of parallax |
| 1. Maintain may include but not limited to: | * + Repair   + Calibrate   + Adjust |
| 1. Types of data may include but not limited to: | * + Survey maps   + Distances   + Bearings   + Vertical angles   + Levels   + Satellite data |
| 1. Data collection methods may include but not limited to: | • Chaining/Taping  • Theodolite traversing  • Compass survey  • Plane table survey  • Tacheometry  • Levelling  • Total station survey  • Satellite survey |
| 1. Data collectiontools may include but not limited to: | • Chains/tapes  • Compass  • Plane table  • Theodolite  • Level  • Total station  • GNSS receivers |
| 1. 8 Data processing method may include but not limited to: | • Bearing sheet preparation  • Traverse computation  • Reduction of level field note book  • Computer processing |
| 1. Data processing tools may include but not limited to: | • Scientific calculator  • Computer  • CAD software  • Network processing software. |
| 1. presentation format/model may include but not limited to: | • final bearings  • final coordinates  • Reduced levels  • Maps  • profile  • Digital terrain model (DTM)  • Digital elevation model (DEM) |

**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:

* Excellent science, math and engineering skills.
* Analyse and interpret graphical data.
* Planning and organizing
* Land Surveying skills
* excellent communication, negotiating and presentation skills
* Problem solving skills
* Interpersonal skills
* Decision making skills
* Report writing
* Time management skills
* Communication
* Analytical skills
* Basic ICT skills

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Basic ICT
* Survey instruments
* Survey reports
* Land laws
* Data collection methods
* Survey terms

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical aspects of Competency | Assessment requires evidence that the candidate:  1.1 Handle survey equipment  1.2 collect data  1.3 Process and analyse data  1.4 Present data in relevant format/model |
| 1. 2. Resource Implications | The following resources should be provided:   * 1. Access to relevant environment where assessment can take place   2. Equipment and materials relevant to the proposed activity or tasks |
| 1. 3. 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. 4. Context of Assessment | Competency may be assessed   * 1. On job   2. Off 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. |

## OPERATE PHOTOGRAMMETRIC EQUIPMENT

**UNIT CODE: LSM/OS/PRS//CC/03/6/A**

**UNIT DESCRIPTION**

This unit covers the competencies required to operate photogrammetric equipment. Competencies include: Identify equipment types and components, perform stereoscopic viewing, perform interior orientation, perform relative orientation, perform absolute orientation, apply photogrammetric software and perform feature extractions and products compilations.

**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 equipment types and components | * 1. Photogrammetric ***equipment types*** are identified as per project requirement   2. Different types of photogrammetric equipment are operated as per survey procedures   3. Equipment components are assembled as per manufacturer manual   4. Routine maintenance of different equipment is conducted as per manufacturer manual   5. Equipment inventory is maintained and updated as per survey procedures |
| 1. Perform stereoscopic viewing | * 1. Stereoscope is assembled as per instrument manual   2. Baselining of an overlapping stereo pair as per photogrammetry working procedures   3. Parallax is measured and recorded using a parallax bar as per working procedure   4. Heights are derived from the parallax measurements |
| 1. Perform interior orientation | * 1. Camera parameters are set as per photogrammetric procedures   2. Fiducial marks are measured as per photogrammetric procedures   3. RMS error are evaluated as per project accuracy requirements |
| 1. Perform relative orientation | * 1. Parallax in the six standard points are measured as per accuracy requirements   2. Relative orientation parameters are computed as per accuracy requirements   3. Orientation results and load the model are evaluated as per accuracy requirements |
| 1. Perform absolute orientation | * 1. Horizontal and vertical control points are identified and measured as per accuracy requirements   2. Model transformation parameters are computed as per accuracy requirements   3. Results are evaluate as per accuracy requirements |
| 1. Apply photogrammetric software | * 1. Types of software are identified according to project requirements   2. Software fundamentals are established as per software manual   3. ***Digital data file formats*** are converted from one format to another as per project requirement |
| 1. Perform feature extractions and product compilations | * 1. Types of photogrammetric products identified as per client’s requirements   2. Extraction of photogrammetric products is done as per mapping procedures and standards   3. Compilation of photogrammetric products is done as per client requirements and cartographic procedures and standards |

**RANGE**

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

|  |  |
| --- | --- |
| 1. General observation may include but not limited to: | * Any beacons present * Vegetation * Existing features |
| 1. Decisions may include but not limited to: | * Whether to redo the beacons * Whether to place new beacons |
| 1. digital data file formats may include but not limited to: | * JPEG (or JPG) - Joint Photographic Experts Group. * PNG - Portable Network Graphics. * GIF - Graphics Interchange Format. * TIFF - Tagged **Image** File. * PSD - Photoshop Document. * PDF - Portable Document Format. * EPS - Encapsulated Postscript. * AI - Adobe Illustrator Document. |
| 1. Equipment types may include but not limited to: | * Aircraft * Drone * Satellite * Cameras and Sensors * Storage equipment * Computers * Digital Photogrammetric Workstations (DPWs) * Mirror stereoscopes |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

The individual needs to demonstrate knowledge of:

**KNOWLEDGE**

* navigation knowledge
* Survey and photogrammetric knowledge
* geographic knowledge
* Personal Protective Equipment (PPEs)
* Safety measures
* Photogrammetric lab equipment’s
* Survey and photogrammetric instruments
* Map projection
* Map designs
* Remote sensing
* Digital photogrammetric
* Digital image processing
* Satellite imaging knowledge
* Types of monuments and targets
* Traversing
* Aerial Triangulation
* GNSS
* GIS knowledge

**SKILLS**

The individual needs to demonstrate the following skills:

* Operating survey and photogrammetric instruments
* Measuring skills
* Map design skills
* Plotting skills
* Flying skills
* Image interpretation skills
* Project management skills
* Planning and organizing skills
* Design skills
* ICT skills
* Computing skills
* excellent communication, negotiating and presentation skills
* Interpersonal skills
* Analytical skills
* Decision making skills

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   * 1. Performed stereoscopic viewing   2. Performed interior orientation   3. Performed relative orientation   4. Performed absolute orientation   5. Applied photogrammetric software   6. Performed products extractions and compilations |
| 1. Resource Implications | The following resources must be provided:   * 1. Access to relevant workplace, work environment or appropriately simulated environment where assessment can take place   2. Tools, equipment and materials relevant to the proposed activity or tasks |
| 1. Methods of Assessment | Competency may be accessed through:   * 1. Written tests   2. Oral questioning   3. Direct observation   4. Third party reports   5. Case studies   6. Practical tests |
| 1. Context of Assessment | Competency may be assessed:   * 1. On the job   2. Off the job   3. In work placement (attachment) |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry subsector, workplace and job roles is recommended. |

## APPLY PRINCIPLES OF GIS

**UNIT CODE:** LSM/OS/PRS/CC/04/6/A

**UNIT DESCRIPTION**

This unit describes the competencies required by a surveyor to collect data, pre-process data, process data, present data, store and archive data.

|  |  |
| --- | --- |
| **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. Collect data | 1.1 ***Sources of data*** are identified  1.2 Data is ***sorted*** according to ***quality***  1.3 Data is ***captured*** |
| 1. Pre-process data | 2.1 Relevant data sets are selected  2.2 Data is cleaned  2.3 Projections of data are checked  2.4 Scales of data sets are harmonized |
| 1. Process data | 3.1 Geo-referencing is done  3.2 Digitization is performed as per ***parameters***  3.3 Vector layers are overlaid  3.4 ***Attribute*** entry is done  3.5 Data is edited  3.6 Data is integrated  3.7 Analyse Data. |
| 1. Present data | 4.1 Data layers are arranged  4.2 Data is symbolized  4.3 Map layouts are designed  4.4 Web maps are published  4.5 Map is exported to desired format. |
| 1. Store and archive data | * 1. Data is ***customized*** and ***stored***   2. Data is archived in standard exchange formats   3. Metadata is created |

**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. Sources of data may include but not limited to: | * Existing maps * Ground survey * Remote sensing * Photogrammetry * Journals * Digital data banks * Statistic / report |
| * 1. Sorted may include but not limited to: | * Evaluation * Selection * Cleaning * Hierarchy |
| * 1. Quality may include but not limited to: | * Accuracy * Precision * Integrity * Logical consistency * Data lineage |
| * 1. Captured may include but not limited to: | * Digitization * Keyboard entry * Scanning |
| * 1. Parameters may include but not limited to: | * Scale * Units of measure * Coordinate systems * Projections * Datum |
| * 1. Attribute may include but not limited to: | * Spatial attributes * Non-spatial attributes |
| * 1. Customized may include but not limited to: | * Hardcopy * Softcopy * Online |
| * 1. Stored may include but not limited to: | * Servers * External hard disks * Filing cabinets * Catalogs |

**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:

* Basic ICT skills
* GIS data manipulation
* Cartographic skills
* Data collection
* Operating GIS equipment
* Use of GIS software
* International Map of World (IMW) sheet indexing
* Designing maps

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Spatial data models
* Map projections
* Data sources
* Map design
* GIS software
* IMW
* Spatial referencing
* Scales
* Web mapping
* Map publishing

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical aspects of Competency | Assessment requires evidence that the candidate:  1.1 Collected data  1.3 Processed data  1.4 Presented data  1.5 Stored and archived data |
| 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. 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 job   2. Off job   3. During industrial attachment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY PRINCIPLES OF CARTOGRAPHY

**UNIT CODE:** LSM/OS/PRS/CC/05/6/A

**UNIT DESCRIPTION**

This unit describes the competencies required by a surveyor to apply cartographic techniques, communicate using maps, distinguish between maps and plans, determine scale of maps and plans, compile and project maps, apply principles of reference systems and represent relief

|  |  |
| --- | --- |
| **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 cartographic techniques | * 1. Drawing ***equipment***, ***media*** and inks are identified   2. Drawing equipment and media are prepared   3. Mapping scale is applied   4. Rectangular grid is constructed |
| * + - 1. Communicate using maps | * 1. Map communication is demonstrated   2.2 Cartographic symbols are designed |
| * + - 1. Distinguish between maps and plans | * 1. Maps are identified   2. Plans are identified |
| * + - 1. Determine scale of maps and plans | * 1. Scale of maps and plans are identified   2. Scales are determined   3. Scales are applied |
| * + - 1. Compile maps | * 1. Sources of mapping data are identified   2. Maps are compiled in phases   3. Maps are generalized   4. Maps are designed |
| 6. Project maps | 6.1 Map projections are selected  6.2 Map projections are applied |
| 7. Apply principles of reference systems | 7.1 ***Coordinate reference systems*** are selected  7.2 Coordinate reference systems are applied |
| 8. Represent relief | 8.1 contours are generated from spot heights  8.2 ground profiles and sections are drawn  8.3 digital models are generated |

**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. Equipment may include but not limited to: | * + Set square   + Pantographs   + Compass   + Planimeter   + Scale rule   + Straight edge   + Technical pens   + Guillotine |
| 1. Media may include but not limited to: | * + Plastic media   + Polyester   + PVC   + Paper and paper based |
| 1. Coordinate reference systems may include but not limited to: | * + Geographical coordinates   + Rectangular coordinates (Cartesian) |

**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:

* Projecting maps
* Relief interpretation
* Operating cartographic equipment
* Scaling
* Scanning
* Digitizing
* Geo-referencing
* Editing skills
* Text placement

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Cartographic techniques
* Cartographic symbols
* Map projections
* Coordinates conversion
* Cartographic rules
* Standard scales
* Map texts

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical aspects of Competency | Assessment requires evidence that the candidate:  1.1 Apply cartographic techniques  1.2 Communicate using maps  1.3 Distinguish between maps and plans  1.4 Determine scale of maps and plans  1.5 Project maps  1.6 Apply principles of reference systems  1.7 Represent relief |
| 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. 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 job   2. Off job   3. During industrial attachment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## APPLY LAND LAWS

**UNIT CODE:** LSM/OS/PRS/CC/06/6/A

**UNIT DESCRIPTION**

This unit describes the competencies required by a surveyor to identify land laws, verify land ownership, identify legal control over land use, demonstrate understanding of land registration, demonstrate understanding of cadastral processes, demonstrate understanding of land transactions and arbitrate land disputes.

|  |  |
| --- | --- |
| **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. Identify land laws | * 1. ***Sources*** of land laws are identified   2. ***Land laws*** are defined as per source   3. Origin and evolution of land laws in Kenya   4. Principles of land policy. |
| * + - 1. Verify land ownership | * 1. Land ownerships are identified as per ***type of ownership***   2. Land ownership are identified as per ***land tenure system*** |
| * + - 1. Identify legal control over land use | * 1. ***Land uses*** are identified   2. Legal land controls and importance are identified as per the land use |
| * + - 1. Demonstrate understanding of land registration | * 1. Registerable rights and interests in land are identified   2. Land registration processes are identified as per existing laws |
| * + - 1. Demonstrate understanding of laws governing surveying processes | * 1. Understanding of the survey act is demonstrated   2. Land adjudication process is identified as per land adjudication Act   3. Understanding of physical planning act is demonstrated as per the land laws   4. Urban and cities act. |
| * + - 1. Demonstrate understanding of land transactions | * 1. ***Legal instruments*** of land transactions are identified as per the land laws   2. ***Land transaction*** process is identified as per land laws |
| * + - 1. Demonstrate understanding of land disputes arbitration process | * 1. ***Land disputes*** are identified   2. Roles of photogrammetry’s in land arbitration is identified as per land laws.   3. Actors in land dispute arbitration |

**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. Sources may include but not limited to: | * + Common law   + Constitution   + Statutes |
| 1. Land laws may include but not limited to: | * Registered Land Act * Registered Title Act * Survey Act |
| 1. Type of ownerships may include but not limited to: | * + Public   + Private   + Community |
| 1. Land tenure system may include but not limited to: | * + Free hold   + Lease hold |
| 1. Land uses may include but not limited to: | * + Agricultural   + Residential   + Industrial   + Commercial   + Recreation |
| 1. Legal instruments may include but not limited to: | * + Legal documents   + Consent form   + Transfer forms   + Deeds   + Registry index maps (RIMs) |
| 1. Land transaction may include but not limited to: | * Land transfer. * Change of user * Consolidation of land * Subdivision of land |
| 1. Land disputes may include but not limited to: | * + Land ownership disputes   + Boundary disputes   + Land compensation disputes |

**REQUIRED SKILLS AND KNOWLEDGE**

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

**Required Skills**

The individual needs to demonstrate the following skills:

* Interpretation skills
* Analytical skills
* Negotiation skills
* Planning and organizing skills
* Research skills
* Computing skills
* Interpersonal skills
* Decision making skills

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Land laws and statutes
* Conveyancing
* Land policy

**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 land laws   2. Identified legal control over land use   3. Demonstrated understanding of land registration   4. Demonstrated understanding of surveying processes   5. Demonstrated understanding of land transactions |
| * + 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. 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. |

# CORE UNITS OF COMPETENCIES

## CONDUCT AERIAL PHOTOGRAMMETRY

**UNIT CODE: LSM/OS/PRS/CR/01/6/A**

**UNIT DESCRIPTION**

This unit covers the competencies required to conduct aerial photogrammetry.

Competencies include conduct a reconnaissance, perform flight planning, conduct flight mission, perform ground control, perform pre-marking and post-marking, perform aerial triangulation, perform model orientations and perform photogrammetric feature extractions and products compilations.

**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 a reconnaissance | * 1. Data search is conducted for existing topographical maps, imageries and digital elevation models as per the project area   2. Site is visited as per workplace procedures   3. ***General observation*** is made and recorded as per workplace procedures   4. ***Decisions*** are made based on the observations |
| 1. Perform flight planning | * 1. ***Project specifications*** for flight plan are identified based on customer dialog or scope of work   2. ***Flight plan*** is prepared in accordance with client provided specifications   3. Project plan is printed as per the customer specifications   4. Flight diagram is prepared as per aerial survey specifications   5. Authorization to conduct aerial survey mission is sought as per required procedures   6. Decisions on ***resource mobilization*** are allocated as per mission schedule.   7. Weather forecast is obtained for appropriate period to fly as per flight guidelines   8. An appropriate aircraft is obtained for aerial survey as per survey act   9. ***Photogrammetric camera*** is obtained as per the project requirements   10. ***Camera calibration report*** is obtained as per project requirement   11. Flight mission is executed as per flight plan diagram   12. Aerial survey flight data is downloaded and processed as per data quality control |
| 1. Perform ground control | * 1. Monumentation of control points is performed as per techniques   2. Horizontal and vertical controls are established as per the method |
| 1. Perform pre-marking | * 1. Locations of pre-marks are identified as per project requirements   2. Placement of targets on the identified locations as per survey procedures   3. Coordinates of the pre-marked target are determined as per survey procedures |
| 1. Perform post-marking | * 1. selections of post-marks are selected on the acquired photograph as per area survey procedures   2. selected post-marks are identified in the field as per survey procedure   3. preparation of sketch diagrams for each of the identified control is carried out as per survey procedures   4. Coordinates of the post-mark are determined as per survey procedures |
| 1. Perform aerial triangulation | * 1. Project directory is created as per triangulation software requirements   2. Camera data, GPS/IMU data and photographs are imported to the project directory as per photogrammetric software requirements   3. Tie points are measured and transferred as per triangulation procedure adopted   4. Ground control points and check points are identified and measured in the photograph as per triangulation requirements   5. Adjustment of aerial triangulation is performed as per accuracy requirements   6. Quality control process is conducted as per as per project requirements |
| 1. Perform model orientations | * 1. Inner orientation of the model is performed as per aerial survey procedures   2. Relative orientation of the model is performed as per aerial survey procedures   3. Absolute orientation of the model is performed as per aerial survey procedures   4. Quality check of the model is performed as per project requirement |
| 1. Perform photogrammetric feature extractions and product compilations | * 1. Types of photogrammetric products identified as per client’s requirements   2. Extraction of photogrammetric products is done as per aerial mapping procedures and standards   3. Compilation of photogrammetric products is done as per client requirements and cartographic procedures and standards |

**RANGE**

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

|  |  |
| --- | --- |
| **VARIABLES** | **RANGE** |
| 1. General observation may include but not limited to: | * Any beacons present * Vegetation * Existing features |
| 1. Decisions may include but not limited to: | * Whether to redo the beacons * Whether to place new beacons |
| 1. Project specifications may include but not limited to: | * Description of project areas * Focal length of the taking camera * Scale of photography/GSD * Flying height * Overlap * Nature of terrain * Speed of the aircraft * Scale of flight map |
| 1. Flight plan may include but not limited to: | * Background map * Digital terrain model * Film size/storage space * Boundary outline * Exposure stations * Flight lines * Flight directions |
| 1. resource mobilization may include but not limited to: | * Personnel required * Financial requirements * Time schedule * Logistics * Monitoring and evaluation * Risk management * Tools and equipment’s required |
| 1. Photogrammetric camera may include but not limited to: | * Digital photogrammetric cameras * Analog photogrammetric cameras * Metric and non-metric cameras * Camera mounts |
| 1. Camera calibration report may include but not limited to: | * Interior orientation parameters * calibrated camera focal lengths * camera resolution * camera principle point * camera lens distortion * fiducial marks and coordinates * date of camera calibration * manufacturer’s calibration parameters * camera type |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

The individual needs to demonstrate knowledge of:

**KNOWLEDGE**

* navigation knowledge
* Survey and photogrammetric knowledge
* geographic knowledge
* Safety measures
* Photogrammetric lab equipment’s
* Survey and photogrammetric instruments
* Map projection
* Map designs
* Remote sensing
* Digital photogrammetric
* Digital image processing
* Satellite imaging knowledge
* Types of monuments and targets
* Traversing
* Aerial Triangulation
* GNSS
* GIS knowledge

**SKILLS**

The individual needs to demonstrate the following skills:

* Operating survey and photogrammetric instruments
* Measuring skills
* Map design skills
* Plotting skills
* Flying skills
* Image interpretation skills
* Project management skills
* Planning and organizing skills
* Design skills
* ICT skills
* Computing skills
* excellent communication, negotiating and presentation skills
* Interpersonal skills
* Analytical skills
* Decision making skills

**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 a reconnaissance   2. Performed flight planning   3. Conducted flight mission   4. Performed ground control   5. Performed pre-marking   6. Performed post-marking   7. Performed aerial triangulation   8. Performed model orientations   9. Performed photogrammetric product extractions and compilations |
| 1. Resource Implications | The following resources must be provided:   * 1. Access to relevant workplace, work environment or appropriately simulated environment where assessment can take place   2. Tools, equipment and materials relevant to the proposed activity or tasks |
| 1. Methods of Assessment | Competency may be accessed through:   * 1. Written tests   2. Oral questioning   3. Direct observation   4. Third party reports   5. Case studies   6. Practical tests |
| 1. Context of Assessment | Competency may be assessed:   * 1. On the job   2. Off the job   3. During attachment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry subsector, workplace and job roles is recommended. |

## CONDUCT CLOSE-RANGE PHOTOGRAMETRY

**UNIT CODE: LSM/OS/PRS//CR/02/6/A**

**UNIT DESCRIPTION**

This unit covers the competencies required to conduct close-range photogrammetry. Competencies include; conduct a reconnaissance, perform ground control, conduct terrestrial image acquisition, perform model orientation and perform photogrammetric product extractions and compilation.

**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 a reconnaissance | * 1. Data search is conducted for existing topographical maps, imageries and digital elevation models as per the project area   2. Site is visited as per workplace procedures   3. ***General observation*** is made and recorded as per workplace procedures   4. ***Decisions*** are made based on the observations |
| 1. Perform ground control | * 1. Monumentation of control points is performed as per techniques   2. Horizontal and vertical controls are established as per the method |
| 1. Conduct terrestrial image acquisition | * 1. Reflective targets are prepared and placed within project space as per project requirement   2. Camera parameters are calibrated as per project requirement   3. Camera stations are established to ensure image convergence and overlap as per photogrammetric procedures   4. Equipment setup as per close range photogrammetric procedures   5. Image acquisition and quality control as per project requirement   6. Image pre-processing as per digital image processing procedures |
| 1. Perform model orientations | * 1. Inner orientation of the model is performed as per aerial survey procedures   2. Relative orientation of the model is performed as per aerial survey procedures   3. Absolute orientation of the model is performed as per aerial survey procedures   4. Quality check of the model is performed as per project requirement |
| 1. Perform photogrammetric product extractions and compilations | * 1. Types of photogrammetric products identified as per client’s requirements   2. Extraction of photogrammetric products is done as per aerial mapping procedures and standards   3. Compilation of photogrammetric products is done as per client requirements and cartographic procedures and standards |

**RANGE**

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

|  |  |
| --- | --- |
| 1. General observation may include but not limited to: | * Any Existing beacons along the shoreline * Siltation * Aquatic weeds |
| 1. Decisions may include but not limited to: | * Whether to redo the beacons * Whether to place new beacons |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

The individual needs to demonstrate knowledge of:

**KNOWLEDGE**

* navigation knowledge
* Survey and photogrammetric knowledge
* geographic knowledge
* Personal Protective Equipment (PPEs)
* Safety measures
* Photogrammetric lab equipment’s
* Survey and photogrammetric instruments
* Map projection
* Map designs
* Remote sensing
* Digital photogrammetric
* Digital image processing
* Satellite imaging knowledge
* Types of monuments and targets
* Traversing
* Aerial Triangulation
* GNSS
* GIS knowledge

**SKILLS**

The individual needs to demonstrate the following skills:

* Operating survey and photogrammetric instruments
* Measuring skills
* Map design skills
* Plotting skills
* Flying skills
* Image interpretation skills
* Project management skills
* Planning and organizing skills
* Design skills
* ICT skills
* Computing skills
* excellent communication, negotiating and presentation skills
* Interpersonal skills
* Analytical skills
* Decision making skills

**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 a reconnaissance   2. Performed ground control   3. Conducted terrestrial image acquisition   4. Performed model orientations   5. Performed photogrammetric product extractions and compilations |
| 1. Resource Implications | The following resources must be provided:   * 1. Access to relevant workplace, work environment or appropriately simulated environment where assessment can take place   2. Tools, equipment and materials relevant to the proposed activity or tasks |
| 1. Methods of Assessment | Competency may be accessed through:   * 1. Written tests   2. Oral questioning   3. Direct observation   4. Third party reports   5. Case studies   6. Practical tests |
| 1. Context of Assessment | Competency may be assessed:   * 1. On the job   2. Off the job   3. In work placement (attachment) |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry subsector, workplace and job roles is recommended. |

## CONDUCT DIGITAL PHOTOGRAMMETRY

**UNIT CODE: LSM/OS/PRS//CR/03/6/A**

**UNIT DESCRIPTION**

This unit covers the competencies required to conduct digital photogrammetry. Competencies include: conduct a reconnaissance, conduct photogrammetric digital image acquisition, Conduct LiDar data acquisition, perform image processing, perform project setup, perform model orientations ,block triangulation and adjustment and perform photogrammetric product extractions and compilations.

**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 a reconnaissance | * 1. Data search is conducted for existing topographical maps, imageries and digital elevation models as per the project area   2. Site is visited as per workplace procedures   3. ***General observation*** is made and recorded as per workplace procedures   4. ***Decisions*** are made based on the observations |
| 1. Conduct photogrammetric digital image acquisition | * 1. ***Photogrammetric tools*** and ***equipment*** for digital image acquisition are identified as per project requirement   2. digital image is acquired as per ***photogrammetric techniques*** and ***methods*** |
| 1. Conduct LiDar data acquisition | * 1. Mission planning is conducted as per project requirement   2. Lidar data is processed as per project requirement   3. Cloud points are classified and filtered as per project requirement   4. Digital terrain modelling and surface interpolation as per project requirement |
| 1. Perform image processing | * 1. Signals from an image sensor are converted into ***digital images*** as per image processing technique   2. Improve clarity, and remove noise and other artifacts as per ***image processing techniques***   3. Images for display or printing are prepared   4. Images are compressed as per accuracy requirement |
| 1. Perform project setup | * 1. Working directory is created as per project requirement   2. ***Image sensor type*** is defined as per project requirements   3. Projection coordinate system is defined as per project requirement |
| 1. Perform model orientations | * 1. Inner orientation of the model is performed as per aerial survey procedures   2. Relative orientation of the model is performed as per aerial survey procedures   3. Absolute orientation of the model is performed as per aerial survey procedures   4. Quality check of the model is performed as per project requirement |
| 1. Perform image matching | * 1. Techniques of image matching are identified as per photogrammetric procedure |
| 1. Perform block triangulation and adjustment | * 1. Interior orientation is performed as per project requirements   2. Tie points are measured as per project requirements   3. Ground control and check points are measured as per project requirements   4. Adjustment is performed as per project requirements |
| 1. Perform photogrammetric product extractions and compilations | * 1. ***Types of photogrammetric products*** identified as per client’s requirements   2. Extraction of photogrammetric products is done as per aerial mapping procedures and standards   3. Compilation of photogrammetric products is done as per client requirements and cartographic procedures and standards |

**RANGE**

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

|  |  |
| --- | --- |
| **VARIABLE** | **RANGE** |
| 1. General observation may include but not limited to: | * Any beacons present * Vegetation * Existing features |
| 1. Decisions may include but not limited to: | * Whether to redo the beacons * Whether to place new beacons |
| 1. photogrammetric techniques and methods may include but not limited to: | Techniques   * Aerial photogrammetric techniques * Close range photogrammetric techniques * Satellite photogrammetric techniques * Unmanned Aerial Vehicle (UAV) technique   Methods   * Flight planning and evaluation software * Automated Flight management * Conversion from analog to digital * Digital photogrammetric workstation * Digital image processing |
| 1. photogrammetric tools and equipment may include but not limited to: | * Aircraft * Drone * Satellite * Cameras and Sensors * Storage equipment * Computers * Digital Photogrammetric Workstations (DPWs) * Mirror stereoscopes * Digital photogrammetric scanners |
| 1. image processing techniques may include but not limited to: | * Image Enhancement * Image Restoration * Color Image Processing |
| 1. digital images may include but not limited to: | * Mono chrome * Color image * Binary * Infrared * Raster and vector images |
| 1. Image sensor type may include but not limited to: | * Frame * Line scanner * Pushbroom * CCD/CMOS |
| 1. photogrammetric products may include but not limited to: | * Photograph * Orthophoto * Mosaics * Topographical maps * Digital elevation model (DEM) * Profiles and crossectional |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

The individual needs to demonstrate knowledge of:

**KNOWLEDGE**

* navigation knowledge
* Survey and photogrammetric knowledge
* geographic knowledge
* Personal Protective Equipment (PPEs)
* Safety measures
* Photogrammetric lab equipment’s
* Survey and photogrammetric instruments
* Map projection
* Map designs
* Remote sensing
* Digital photogrammetric
* Digital image processing
* Satellite imaging knowledge
* Types of monuments and targets
* Traversing
* Aerial Triangulation
* GNSS
* GIS knowledge

**SKILLS**

The individual needs to demonstrate the following skills:

* Operating survey and photogrammetric instruments
* Measuring skills
* Map design skills
* Plotting skills
* Flying skills
* Image interpretation skills
* Project management skills
* Planning and organizing skills
* Design skills
* ICT skills
* Computing skills
* excellent communication, negotiating and presentation skills
* Interpersonal skills
* Analytical skills
* Decision making skills

**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 a reconnaissance   2. Conducted photogrammetric digital image acquisition   3. Conducted LiDar data acquisition   4. Performed image processing   5. Performed project setup   6. Performed model orientations   7. Performed block triangulation and adjustment   8. Performed photogrammetric product extractions and compilations |
| 1. Resource Implications | The following resources must be provided:   * 1. Access to relevant workplace, work environment or appropriately simulated environment where assessment can take place   2. Tools, equipment and materials relevant to the proposed activity or tasks |
| 1. Methods of Assessment | Competency may be accessed through:   * 1. Written tests   2. Oral questioning   3. Direct observation   4. Third party reports   5. Case studies   6. Practical tests |
| 1. Context of Assessment | Competency may be assessed:   * 1. On the job   2. Off the job   3. In work placement (attachment) |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry subsector, workplace and job roles is recommended. |

## CONDUCT TOPOGRAPHIC MAPPING

**UNIT CODE: LSM/OS/PRS//CR/04/6/A**

**UNIT DESCRIPTION**

This unit covers the competencies required to conduct topographic mapping. Competencies include: conduct a reconnaissance, apply photogrammetric data, apply coordinate reference systems, apply map projections, apply cartographic principles, produce topographic maps and perform storage and archiving

**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 a reconnaissance | * 1. Data search is conducted for existing topographical maps, imageries and digital elevation models as per the project area   2. Site is visited as per workplace procedures   3. ***General observation*** is made and recorded as per workplace procedures   4. ***Decisions*** are made based on the observations |
| 1. Apply photogrammetric data | * 1. Principles of ***photogrammetric data*** are identified and applied to the ***project plan***and ***project survey area***   2. Possible sources of image data for mapping purposes are identified.   3. Properties of different types of image data are identified.   4. Constraints of different types of image data are identified   5. Spatial reference systems are accessed as required   6. Process of obtaining ground control for photogrammetric mapping is reviewed |
| 1. Apply coordinate reference systems | * 1. Appropriate coordinate reference system is identified as per data collected   2. Coordinate transformation is performed as per project requirement |
| 1. Apply map projections | * 1. ***Map projections types*** are selected as per project requirements   2. Map projections are applied as per ***projection properties*** |
| 1. Apply cartographic principles | * 1. Drawing ***equipment***, ***media*** and inks are identified as per project   2. Drawing equipment and media are prepared as per project requirement   3. Mapping scale is applied as per the project area   4. Rectangular grid is constructed as per the project area |
| 1. Produce topographic maps | * 1. Map sheet is prepared based on acceptable grid values   2. Feature is extracted as per cartographic standards   3. Contours are generated from spot heights   4. Map is designed as per Cartographic standards |
| 1. Perform storage and archiving | * 1. Storage media is identified as per data space   2. Data formats are compressed as per data space   3. Metadata is prepared based on data type   4. Data cataloguing is performed as per organizational standards |

**RANGE**

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

|  |  |
| --- | --- |
| **VARIABLE** | **RANGE** |
| 1. General observation may include but not limited to: | * Any beacons present * Vegetation * Existing features |
| 1. Decisions may include but not limited to: | * Whether to redo the beacons * Whether to place new beacons |
| 1. **Photogrammetric data**may include**:** | * 3-D data acquisition and object reconstruction * aerial survey * computer vision * GeoPhoto * geoinformatics * geomatics engineering images * hard copy * stereoplotter * video grammetry |
| 1. **Project plan**may includ**e:** | * evaluation criteria * milestones * performance indicators * project implementation methodology * quality standards * return on investment * risk management strategies * targets |
| 1. **Project survey area**may includ**e:** | * aerial photographs * Other forms of digital data in the horizontal or vertical plane. |
| 1. Map projections types may include but not limited to: | * Cylindrical Map Projections * Conic Map Projections * Azimuthal Map Projection |
| 1. Map projections properties may include but not limited to: | * map characteristics preserved include * distance * direction * shape * area |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

The individual needs to demonstrate knowledge of:

**KNOWLEDGE**

* navigation knowledge
* Survey and photogrammetric knowledge
* geographic knowledge
* Personal Protective Equipment (PPEs)
* Safety measures
* Photogrammetric lab equipment’s
* Survey and photogrammetric instruments
* Map projection
* Map designs
* Remote sensing
* Digital photogrammetric
* Digital image processing
* Satellite imaging knowledge
* Types of monuments and targets
* Traversing
* Aerial Triangulation
* GNSS
* GIS knowledge

**SKILLS**

The individual needs to demonstrate the following skills:

* Operating survey and photogrammetric instruments
* Measuring skills
* Map design skills
* Plotting skills
* Flying skills
* Image interpretation skills
* Project management skills
* Planning and organizing skills
* Design skills
* ICT skills
* Computing skills
* excellent communication, negotiating and presentation skills
* Interpersonal skills
* Analytical skills
* Decision making skills

**EVIDENCE GUIDE**

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

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   * 1. 1.Conducted a reconnaissance   2. Applied photogrammetric data   3. Applied coordinate systems   4. Applied map projections   5. Applied cartographic principles   6. Produced topographic maps   7. Performed storage and archiving |
| 1. Resource Implications | The following resources must be provided:   * 1. Access to relevant workplace, work environment or appropriately simulated environment where assessment can take place   2. Tools, equipment and materials relevant to the proposed activity or tasks |
| 1. Methods of Assessment | Competency may be accessed through:   1. Written tests 2. Oral questioning 3. Direct observation 4. Third party reports 5. Case studies 6. Practical tests |
| 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 subsector, workplace and job roles is recommended. |

## CONDUCT REMOTE SENSING PROJECTS

**UNIT CODE: LSM/OS/PRS//CR/05/6/A**

**UNIT DESCRIPTION**

This unit covers the competencies required to conduct remote sensing projects. Competencies include: conduct a reconnaissance, identify energy source or illumination, **identify radiation and atmosphere interaction, identify radiation interaction target, record energy sensor, conduct image processing, conduct image interpretation and analysis, identify application** and perform product compilation

**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 a reconnaissance | * 1. Data search is conducted for existing topographical maps, imageries and digital elevation models as per the project area   2. Site is visited/if possible as per workplace procedures   3. ***General observation*** is made and recorded as per workplace procedures   4. ***Decisions*** are made based on the observations |
| 1. Identify energy source or illumination | * 1. Types of ***energy source*** are identified as per sensor type   2. ***electromagnetic radiation principles*** are determinedas per energy interactions |
| 1. **Identify radiation and atmosphere interaction** | * 1. Energy interaction with the atmosphere is identified as per energy wavelength      1. ***Scattering*** of electromagnetic radiation is determined as per energy wavelength      2. Absorptionof electromagnetic radiation is observed as per atmospheric window |
| 1. **Identify radiation interaction target** | * 1. Energy interaction with the target is identified as per target type      1. ***Reflection*** is identified as per target type      2. Absorption is identified as per target type      3. Transmission is identified as per target type |
| 1. **Recording of energy by the sensor** | * 1. ***Techniques*** of image acquisition are identified as per user needs   2. ***Types of sensors and platforms*** are identified as per the energy source   3. ***Classification*** *of sensor* are identified as perspectral sensitivity of the sensor   4. Image acquisition is conducted as per application   5. ***Types of images*** are identified as per mode of acquisition |
| 1. **Conduct image processing** | 6.1 Pre-processing is conducted as per image processing techniques  6.2 Image enhancement is conducted as per image type  6.3 image segmentation is conducted as per image type  6.4 ***Image classification*** is conducted as per spectral resolution |
| 1. **Conduct image interpretation and analysis** | * 1. ***Elements*** of visual interpretation are identified as per user specification   2. Digital image interpretation is conducted as per technique   3. ***Meaningful information*** is extracted from the images as per client needs |
| 1. **Identify application** | * 1. ***Application*** of meaningful information is identified as per client needs |
| 1. Perform product compilation | * 1. Types of ***remote sensing products*** identified as per client’s requirements   2. Extraction of remote sensing products is done as per mapping procedures and standards   3. Compilation of remote sensing products is done as per client requirements and cartographic procedures and standards |

**RANGE**

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

|  |  |
| --- | --- |
| **VARIABLE** | **RANGE** |
| 1. General observation may include but not limited to: | * Any beacons present * Vegetation * Existing features |
| 1. Decisions may include but not limited to: | * Whether to redo the beacons * Whether to place new beacons |
| 1. Energy sources may include but not limited to: | * Sun * Terrestrial features * Active sensor |
| 1. Reflection may include but not limited to: | * Specular * Diffuse |
| 1. Classification of sensors may include but not limited to: | * Optical * Thermal * Microwave * Radar |
| 1. Techniques may include but not limited to: | * Scanning * Acquired directly CCDS, CMOS etc. |
| 1. electromagnetic radiation principles may include but not limited to: | * Photon theory * Wave theory * Electromagnetic spectrum |
| 1. Application may include but not limited to: | * Decision making: * Policy formulation * Expansion of knowledge * Disaster mitigation |
| 1. Scattering may include but not limited to: | * Rayleigh scatter * Mie scatter * Non-selective scatter |
| 1. remote sensing products may include but not limited to: | * Survey data resource * Land cover land use map * Change detection * Topo maps |
| 1. Types of images may include but not limited to: | * Panchromatic * Multispectral * Hyperspectral * Analog and digital photograph |
| 1. Types of sensors may include but not limited to: | * Active * Passive |
| 1. Platforms may include but not limited to: | * Ground-based * Aerial-based * Satellite/space shuttles * Unmanned Aerial Vehicle (UAV) |
| 1. image enhancement may include but not limited to: | * Contrast * Grey level stretching * Histogram stretching |
| 1. image classification may include but not limited to: | * supervised classification * unsupervised classification |
| 1. Pre-processing may include but not limited to: | * geometric correction * radiometric correction * geo-referencing |
| 1. Meaningful information may include but not limited to: | * land use land cover (LULC) * Normalized Difference Vegetation Index (NDVI) * Normalized Difference Water Index (NDWI) * DEM * DSM |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

The individual needs to demonstrate knowledge of:

**KNOWLEDGE**

* Survey and photogrammetric knowledge
* geographic knowledge
* remote sensing lab equipment
* Survey and photogrammetric instrument
* Map projection
* Map designs
* Digital image processing
* Satellite imaging knowledge
* Types of monuments and targets
* Aerial Triangulation
* GNSS
* GIS knowledge

**SKILLS**

The individual needs to demonstrate the following skills:

* Operating remote sensing software
* Measuring skills
* Map design skills
* Image interpretation skills
* Project management skills
* Planning and organizing skills
* Design skills
* ICT skills
* Computing skills
* excellent communication, negotiating and presentation skills
* Interpersonal skills
* Analytical skills
* Decision making skills
* Coordinate transformation skills

**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 a reconnaissance   2. Identified energy source or illumination   3. **Identified radiation and atmosphere interaction**   4. **Identified radiation interaction target**   5. **Recorded energy sensor**   6. **Conducted image processing**   7. **Conducted image interpretation and analysis**   8. **Identified application**   9. Performed product compilation |
| 1. Resource Implications | The following resources must be provided:   * 1. Access to relevant workplace, work environment or appropriately simulated environment where assessment can take place   2. Tools, equipment and materials relevant to the proposed activity or tasks |
| 1. Methods of Assessment | Competency may be accessed through:   * 1. Written tests   2. Oral questioning   3. Direct observation   4. Third party reports   5. Case studies   6. Practical tests |
| 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 subsector, workplace and job roles is recommended. |

## CONDUCT SATELLITE PHOTOGRAMMETRY

**UNIT CODE: LSM/OS/PRS//CR/06/6/A**

**UNIT DESCRIPTION**

This unit covers the competencies required to conduct satellite photogrammetry. Competencies include: conduct a reconnaissance, apply stereoscopic satellite imagery, perform ground control, perform project setup, perform photogrammetric model setup and perform product compilation

**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 a reconnaissance | * 1. Data search is conducted for existing topographical maps, imageries and digital elevation models as per the project area   2. Site is visited as per workplace procedures   3. ***General observation*** is made and recorded as per workplace procedures   4. ***Decisions*** are made based on the observations |
| 1. Apply stereoscopic satellite imagery | * 1. Types of satellites for stereoscopic ***satellite imagery*** are identified as per user needs   2. Type of stereoscopic images are acquired based on the availability |
| 1. Perform ground control | * 1. Monumentation of control points is performed as per techniques   2. Horizontal and vertical controls are established as per the method |
| 1. Perform project setup | 4.1 Working directory is created as per project requirement  4.2 ***Image sensor type*** is defined as per project requirements  4.3 Projection coordinate system is defined as per project requirement |
| 1. Perform photogrammetric model setup | * 1. Inner orientation of the model is performed as per aerial satellite orientation   2. Exterior orientation of the model is performed as per satellite orientation   3. Bundle adjustment of the model is performed as per satellite orientation   4. Quality check of the model is performed as per project requirement |
| 1. Perform product compilation | * 1. Types of ***image products*** identified as per client’s requirements   2. Extraction of image features and products is done as per mapping procedures and standards   3. Compilation of image products is done as per client requirements and cartographic procedures and standards |

**RANGE**

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

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. General observation may include but not limited to: | * Any beacons present * Vegetation * Existing features |
| 1. Decisions may include but not limited to: | * Whether to redo the beacons * Whether to place new beacons |
| 1. satellite imagery may include but not limited to: | * SPOT * IRS |
| 1. image products may include but not limited to: | * DSM * DTM * Orth photos * Cloud points |

**REQUIRED KNOWLEDGE AND UNDERSTANDING**

The individual needs to demonstrate knowledge of:

**KNOWLEDGE**

* Survey and photogrammetric knowledge
* geographic knowledge
* remote sensing lab equipment
* Survey and photogrammetric instrument
* Map projection
* Map designs
* Digital image processing
* Satellite imaging knowledge
* Types of monuments and targets
* Aerial Triangulation
* GNSS
* GIS knowledge

**SKILLS**

The individual needs to demonstrate the following skills:

* Operating remote sensing software
* Measuring skills
* Map design skills
* Image interpretation skills
* Project management skills
* Planning and organizing skills
* Design skills
* ICT skills
* Computing skills
* excellent communication, negotiating and presentation skills
* Interpersonal skills
* Analytical skills
* Decision making skills
* Coordinate transformation skills

**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 a reconnaissance   2. Applied stereoscopic satellite imagery   3. Performed project setup   4. Performed ground control   5. Performed photogrammetric model setup   6. Performed product compilation |
| 1. Resource Implications | The following resources must be provided:   * 1. Access to relevant workplace, work environment or appropriately simulated environment where assessment can take place   2. Tools, equipment and materials relevant to the proposed activity or tasks |
| 1. Methods of Assessment | Competency may be accessed through:   * 1. Written tests   2. Oral questioning   3. Direct observation   4. Third party reports   5. Case studies   6. Practical tests |
| 1. Context of Assessment | Competency may be assessed:   * 1. On the job   2. Off the job   3. In work placement (attachment) |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry subsector, workplace and job roles is recommended. |