REPUBLIC OF KENYA

COMPETENCY BASED CURRICULUM

FOR

LAND SURVEYING

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 Kenya's development blue print and sustainable development goals.

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

It is my conviction that this curriculum 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 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.

TVET Curriculum Development, Assessment and Certification Council (TVET CDACC) in conjunction with Land Survey and Mapping Sector Skills Advisory Committee (SSAC) have developed this curriculum.

This curriculum has been developed following the CBET framework policy; the CBETA Standards and guidelines provided by the TVET Authority and the Kenya National Qualification framework designed by the Kenya National Qualification Authority.

The curriculum is designed and organized with an outline of learning outcomes; suggested delivery methods, training/learning resources and methods of assessing the trainee's achievement. The curriculum is competency-based and allows multiple entry and exit to the course.

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 this curriculum.

Prof. CHARLES M. M. ONDIEKI, PhD, FIET (K), Con. Eng. Tech.

CHAIRMAN, TVET CDACC

ACKNOWLEDGEMENT

This curriculum has been designed for competency-based training and has independent units of learning that allow the trainee flexibility in entry and exit. In developing the curriculum, significant involvement and support was received from various organizations.

I recognize with appreciation the role of the SSAC in ensuring that competencies required by the industry are addressed in this curriculum. I also thank all stakeholders in the Land Survey and Mapping sector for their valuable input and all those who participated in the process of developing this curriculum.

I am convinced that this curriculum will go a long way in ensuring that workers in Land Survey and Mapping sector will acquire competencies that will enable them to perform their work more efficiently.

DR. LAWRENCE GUANTAI M'ITONGA, PhD

COUNCIL SECRETARY/CEO

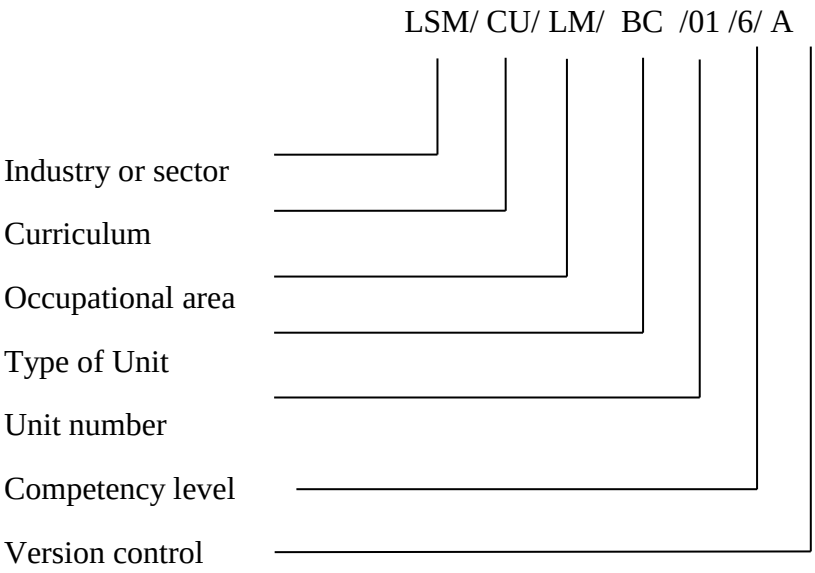
TVET CDACC

Table of Contents

ACRONYMS

BC	: Basic Competency
CDACC	: Curriculum Development, Assessment and Certification Council
CPU	: Central Processing Unit
CC	: Common Competency
CR	: Core Competency
CON	: Construction
ARC	: Architecture
CU	: Curriculum
ICT	: Information Communication Technology
KCPE	: Kenya Certificate of Primary Education
KCSE	: Kenya Certificate of secondary Education
KNQA	: Kenya National Qualifications Authority
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
EPS	: Expanded Polystyrene Systems
NEMA	: National Environmental Management Authority

KEY TO UNIT CODE



COURSE OVERVIEW

This course consists of competencies required by a surveyor to conduct topographic, cadastral, engineering, hydrographic and mining surveys.

It consists of the following units of learning:

BASIC UNITS OF LEARNING

UNIT CODE	UNIT OF LEARNING	DURATION IN HRS	CREDIT FACTORS
LSM/CU/LM/BC/01/6/A	Communication skills	40	4
LSM/CU/LM/BC/02/6/A	Numeracy	60	6
LSM/CU/LM/BC/03/6/A	Digital literacy	60	6
LSM/CU/LM/BC/04/6/A	Entrepreneurship	100	10
LSM/CU/LM/BC/05/6/A	Employability skills	80	8
LSM/CU/LM/BC/06/6/A	Environmental literacy	40	4
LSM/CU/LM/BC/07/6/A	Occupational safety and health practices	40	4
	TOTAL	**420**	**42**

COMMON UNITS OF LEARNING

UNIT CODE	UNIT OF LEARNING	DURATION IN HRS	CREDIT FACTORS
LSM/CU/LM/CC/01/6/A	Applied Mathematics	100	10
LSM/CU/LM/CC/02/6/A	Survey instruments	140	14
LSM/CU/LM/CC/03/6/A	Land laws	120	12
LSM/CU/LM/CC/04/6/A	Photogrammetry and Remote Sensing	120	12
LSM/CU/LM/CC/05/6/A	GIS	120	12
LSM/CU/LM/CC/06/6/A	Cartography	120	12
LSM/CU/LM/CC/07/6/A	**TOTAL**	**720**	**70**

CORE UNITS OF LEARNING

UNIT CODE	UNIT OF LEARNING	DURATION IN HRS	CREDIT FACTORS

LSM/CU/LM/CR/01/6/A	Topographic Survey	200	20
LSM/CU/LM/CR/02/6/A	Engineering Survey	200	20
LSM/CU/LM/CR/03/6/A	Cadastral Survey	200	20
LSM/CU/LM/CR/04/6/A	Hydrographic Survey	200	20
LSM/CU/LM/CR/05/6/A	Mining Survey	200	20
	Industrial attachment	480	48
	TOTAL	1480	148
	GRAND TOTAL	2620	262

The total duration of the course is **2620** hours which include 480 hours of industrial attachment.

Entry Requirements

An individual entering this course should have any of the following minimum requirements:

a) Kenya Certificate of Secondary Education (KCSE) mean grade C- (minus)

Or

b) Equivalent qualifications as determined by Kenya National Qualifications Authority (KNQA)

Industrial attachment

An individual enrolled in this course will be required to undergo an attachment for a period of three months. An individual enrolled in one of the core units of learning will be required to undergo a one month's attachment.

Assessment

The course will be assessed at two levels: internally and externally. Internal assessment is continuous and is conducted by the trainer who is monitored by an accredited internal verifier while external assessment is the responsibility of TVET CDACC.

Certification

A candidate will be issued with a Certificate of Competency for each core unit of competency. To attain the qualification Level 6 in Land Surveying, the candidate must demonstrate competence in all the units of competency as given in qualification pack. These certificates will be issued by TVET CDACC in conjunction with training provider.

BASIC UNITS OF LEARNING

COMMUNICATION SKILLS

UNIT CODE:LSM/CU/LM/BC/01/6/A

Relationship to Occupational Standards
This unit addresses the unit of competency: Demonstrate communication skills

Duration of Unit: 40 hours

Unit Description
This unit covers the competencies required in meeting communication needs of clients and colleagues and developing, establishing, maintaining communication pathways and strategies. It also covers competencies for conducting interview, facilitating group discussion and representing the organization in various forums.

Summary of Learning Outcomes

1. Meet communication needs of clients and colleagues
2. Develop communication strategies
3. Establish and maintain communication pathways
4. Promote use of communication strategies
5. Conduct interview
6. Facilitate group discussion
7. Represent the organization

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Meet communication needs of clients and colleagues	• Communication process • Modes of communication • Medium of communication • Effective communication • Barriers to communication • Flow of communication • Sources of information • Organizational policies • Organization requirements for written and electronic communication methods	• Interview • Written

	• Report writing • Effective questioning techniques (clarifying and probing) • Workplace etiquette • Ethical work practices in handling communication • Active listening • Feedback • Interpretation • Flexibility in communication • Types of communication strategies • Elements of communication strategy	
2. Develop communication strategies	• Dynamics of groups • Styles of group leadership • Openness and flexibility in communication • Communication skills relevant to client groups	• Interview • Written
3. Establish and maintain communication pathways	• Types of communication pathways	• Interview • Written
4. Promote use of communication strategies	• Application of elements of communication strategies • Effective communication techniques	• Interview • Written
5. Conduct interview	• Types of interview • Establishing rapport • Facilitating resolution of issues • Developing action plans	• Interview • Written
6. Facilitate group discussion	• Identification of communication needs • Dynamics of groups • Styles of group leadership	• Interview • Written

	• Presentation of information • Encouraging group members participation • Evaluating group communication strategies	
7. Represent the organization	• Presentation techniques • Development of a presentation • Multi-media utilization in presentation • Communication skills relevant to client groups	• Interview • Written

Suggested Delivery Methods

- Discussion
- Role playing
- Simulation
- Direct instruction
- Practice by trainee

Recommended Resources

- Desktop computers/laptops
- Internet connection
- Projectors
- Telephone

NUMERACY SKILLS

UNIT CODE: LSM/CU/LM/BC/02/6/A

Relationship to Occupational Standards

This unit addresses the unit of competency: Demonstrate numeracy skills

Duration of Unit: 60 hours

Unit Description

This unit describes the competencies required by a worker in order to apply a wide range of mathematical calculations for work; apply ratios, rates and proportions to solve problems; estimate, measure and calculate measurement for work; Use detailed maps to plan travel routes for work; Use geometry to draw and construct 2D and 3D shapes for work; Collect, organize and interpret statistical data; Use routine formula and algebraic expressions for work and use common functions of a scientific calculator

Summary of Learning Outcomes

1. Apply a wide range of mathematical calculations for work
2. Apply ratios, rates and proportions to solve problems
3. Estimate, measure and calculate measurement for work
4. Use detailed maps to plan travel routes for work
5. Use geometry to draw and construct 2D and 3D shapes for work
6. Collect, organize and interpret statistical data
7. Use routine formula and algebraic expressions for work
8. Use common functions of a scientific calculator

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Apply a wide range of mathematical calculations for work	❑ Fundamentals of mathematics • Addition, subtraction, multiplication and division of positive and negative numbers • Algebraic expressions manipulation ❑ Forms of fractions, decimals and percentages ❑ Expression of numbers as powers and roots	❑ Written tests ❑ Assignments ❑ Supervised exercises

2. Apply ratios, rates and proportions to solve problems	❑ Rates, ratios and proportions • Meaning • Conversions into percentages • Direct and inverse proportions determination • Performing calculations • Construction of graphs, charts and tables • Recording of information	❑ Written tests ❑ Oral questioning ❑ Assignments ❑ Supervised exercises
3. Estimate, measure and calculate measurement for work	❑ Units of measurements and their symbols ❑ Identification and selection of measuring equipment ❑ Conversion of units of measurement ❑ Perimeters of regular figures ❑ Areas of regular figures ❑ Volumes of regular figures ❑ Carrying out measurements ❑ Recording of information	❑ Assignments ❑ Supervised exercises ❑ Written tests
4. Use detailed maps to plan travel routes for work	▪ Identification of features in routine maps and plans ▪ Symbols and keys used in routine maps and plans ▪ Identification and interpretation of orientation of map to North ▪ Demonstrate understanding of direction and location ▪ Apply simple scale to estimate length of objects, or distance to location or object ▪ Give and receive directions using both formal and informal language ▪ Planning of routes ▪ Calculation of distance, speed and time	❑ Oral ❑ Written ❑ Practical test ❑ Observation

5. Use geometry to draw and construct 2D and 3D shapes for work	▪ Identify two dimensional shapes and routine three dimensional shapes in everyday objects and in different orientations ▪ Explain the use and application of shapes ▪ Use formal and informal mathematical language and symbols to describe and compare the features of two dimensional shapes and routine three dimensional shapes ▪ Identify common angles ▪ Estimate common angles in everyday objects ▪ Evaluation of unknown angles ▪ Use formal and informal mathematical language to describe and compare common angles ▪ Symmetry and similarity ▪ Use common geometric instruments to draw two dimensional shapes ▪ Construct routine three dimensional objects from given nets	
6. Collect, organize and interpret statistical data	❑ Classification of data • Grouped data • Ungrouped data ❑ Data collection • Observation • Recording ❑ Distinguishing between sampling and census ❑ Importance of sampling ❑ Errors in sampling	❑ Assignments ❑ Supervised exercises ❑ Written tests

	❑ Types of sampling and their limitations e.g. • Stratified random • Cluster • Judgmental ❑ Tabulation of data • Class intervals • Class boundaries • Frequency tables • Cumulative frequency ❑ Diagrammatic and graphical presentation of data e.g. • Histograms • Frequency polygons • Bar charts • Pie charts • Cumulative frequency curves ❑ Interpretation of data	
7. Use routine formula and algebraic expressions for work	❑ Solving linear equations ❑ Linear graphs • Plotting • Interpretation ❑ Applications of linear graphs ❑ Curves of first and second degree • Plotting • Interpretation	❑ Assignments ❑ Supervised exercises ❑ Written tests
8. Use common functions of a scientific calculator	▪ Identify and use keys for common functions on a calculator ▪ Calculate using whole numbers, money and routine decimals and percentages ▪ Calculate with routine fractions and percentages ▪ Apply order of operations to solve multi-step calculations	❑ Oral ❑ Written ❑ Practical test ❑ Observation

	▪ Interpret display and record result	

Suggested Delivery Methods

- Group discussions
- Demonstration by trainer
- Practical work by trainee
- Exercises

Recommended Resources

- Calculators
- Rulers, pencils, erasers
- Charts with presentations of data
- Graph books
- Dice

DIGITAL LITERACY

UNIT CODE:LSM/CU/LM/BC/03/6/A

Relationship to Occupational Standards
This unit addresses the Unit of Competency: Demonstrate digital literacy

Duration of Unit: 60 hours

Unit Description
This unit describes competencies required to use a computer and other digital devices for the purposes of communication, work performance and management at the workplace.

Summary of Learning Outcomes
1. Identify computer software and hardware
2. Apply security measures to data, hardware, software in automated environment
3. Apply computer software in solving tasks
4. Apply internet and email in communication at workplace
5. Apply desktop publishing in official assignments
6. Prepare presentation packages

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Identify computer hardware and software	• Concepts of ICT • Functions of ICT • History of computers • Components of a computer • Classification of computers	• Written tests • Oral presentation • Observation
2. Apply security measures to data, hardware and software	• Data security and control • Security threats and control measures • Types of computer crimes • Detection and protection against computer crimes • Laws governing protection of ICT	• Written tests • Oral presentation • Observation • Project

3. Apply computer software in solving tasks	• Operating system • Word processing • Spread sheets • Data base design and manipulation • Data manipulation, storage and retrieval	• Oral questioning • Observation • Project
4. Apply internet and email in communication at workplace	• Computer networks • Network configurations • Uses of internet • Electronic mail (e-mail) concept	• Oral questioning • Observation • Oral presentation • Written report
5. Apply desktop publishing in official assignments	• Concept of desktop publishing • Opening publication window • Identifying different tools and tool bars • Determining page layout • Opening, saving and closing files • Drawing various shapes using DTP • Using colour pellets to enhance a document • Inserting text frames • Importing and exporting text • Object linking and embedding • Designing of various publications • Printing of various publications	• Oral questioning • Observation • Oral presentation • Written report • Project
6. Prepare presentation packages	• Types of presentation packages • Procedure of creating slides • Formatting slides • Presentation of slides • Procedure for editing objects	• Oral questioning • Observation • Oral presentation • Written report • Project

Suggested Delivery Methods

- Instructor led facilitation of theory
- Demonstration by trainer
- Practical work by trainee
- Viewing of related videos

- Project
- Group discussions

Recommended Resources

- Desk top computers
- Laptop computers
- Other digital devices
- Printers
- Storage devices
- Internet access
- Computer software

ENTREPRENEURSHIP EDUCATION

UNIT CODE: LSM/CU/LM/BC/04/6/A

Relationship to occupational standards

This unit addresses the unit of competency: Demonstrate understanding of entrepreneurship

Duration of unit: 100 hours

Unit Description

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

Summary of Learning Outcomes

1. Demonstrate understanding of who an entrepreneur
2. Demonstrate knowledge of entrepreneurship and self-employment
3. Identify entrepreneurship opportunities
4. Create entrepreneurial awareness
5. Apply entrepreneurial motivation
6. Develop business innovative strategies
7. Develop Business plan

Learning Outcome	Content	Suggested Assessment Methods

1. Demonstrate knowledge of entrepreneurship and self-employment	❑ Importance of self-employment ❑ Requirements for entry into self-employment ❑ Role of an Entrepreneur in business ❑ Contributions of Entrepreneurs to National development	❑ Observation ❑ Case studies ❑ Individual/group assignments ❑ Projects ❑ Written tests
2. Identify entrepreneurship opportunities	❑ Business ideas and opportunities ❑ Sources of business ideas ❑ Business life cycle ❑ Legal aspects of business ❑ Assessment of product demand ❑ Business environment ❑ Factors to consider when evaluating business environment ❑ Technology in business	❑ Observation ❑ Case studies ❑ Individual/group assignments ❑ Projects ❑ Written tests ❑ Oral questions ❑ Third party report ❑ Interviews
3. Create entrepreneurial awareness	❑ Forms of businesses ❑ Sources of business finance ❑ Factors in selecting source of business finance ❑ Governing policies on Small Scale Enterprises (SSEs) ❑ Problems of starting and operating SSEs	❑ Observation ❑ Case studies ❑ Individual/group assignments ❑ Projects ❑ Written tests ❑ Oral questions ❑ Third party report ❑ Interviews

4. Apply entrepreneurial motivation	❑ Internal and external motivation ❑ Motivational theories ❑ Self-assessment ❑ Entrepreneurial orientation ❑ Effective communications in entrepreneurship ❑ Principles of communication ❑ Entrepreneurial motivation	❑ Observation ❑ Case studies ❑ Individual/group assignments ❑ Projects ❑ Written tests ❑ Oral questions ❑ Third party report ❑ Interviews
5. Develop business innovative strategies	❑ Innovation in business ❑ Small business Strategic Plan ❑ Creativity in business development ❑ Linkages with other entrepreneurs ❑ ICT in business growth and development	❑ Observation ❑ Case studies ❑ Individual/group assignments ❑ Projects ❑ Written tests ❑ Oral questions ❑ Third party report
6. Develop Business Plan	❑ Business description ❑ Marketing plan ❑ Organizational/Management plan ❑ Production/operation plan ❑ Financial plan ❑ Executive summary ❑ Presentation of Business Plan	❑ Observation ❑ Case studies ❑ Individual/group assignments ❑ Projects ❑ Written tests ❑ Oral questions ❑ Third party report

Suggested Methods of instruction:

1. Direct instruction
2. Project
3. Case studies
4. Field trips
5. Discussions
6. Demonstration
7. Question and answer

8. Problem solving
9. Experiential
10. Internship
11. Team training
12. Guest speakers

Recommended Resources

1. Case studies
2. Business plan templates
3. Computers
4. Overhead projectors
5. Internet
6. Mobile phone
7. Video clips
8. Films
9. Newspapers and Handouts
10. Business Journals
11. Writing materials

EMPLOYABILITY SKILLS

UNIT CODE: LSM/CU/LM/BC/05/6/A

Relationship to Occupational Standards

This unit addresses the Unit of Competency: Demonstrate employability skills

Duration of Unit: 80 hours

Unit Description

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.

Summary of Learning Outcomes

1. Conduct self-management
2. Demonstrate interpersonal communication
3. Demonstrate critical safe work habits
4. Lead a workplace team
5. Plan and organize work
6. Maintain professional growth and development
7. Demonstrate workplace learning
8. Demonstrate problem solving skills
9. Manage ethical performance

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Conduct self-management	❑ Self-awareness ❑ Formulating personal vision, mission and goals ❑ Strategies for overcoming life challenges ❑ Managing emotions ❑ Emotional intelligence ❑ Assertiveness versus aggressiveness ❑ Expressing personal thoughts, feelings and beliefs	• Observation • Written • Oral interview • Third party report

	• Developing and maintaining high self-esteem • Developing and maintaining positive self-image ❑ Setting performance targets ❑ Monitoring and evaluating performance ❑ Articulating ideas and aspirations ❑ Accountability and responsibility ❑ Good work habits ❑ Self-awareness ❑ Values and beliefs ❑ Self-development ❑ Financial literacy ❑ Healthy lifestyle practices ❑ Adopting safety practices	
2. Demonstrate interpersonal communication	❑ Meaning of interpersonal communication ❑ Listening skills ❑ Types of audience ❑ Public speaking ❑ Writing skills ❑ Negotiation skills ❑ Reading skills ❑ Meaning of empathy ❑ Understanding customers' needs ❑ Establishing communication networks ❑ Assertiveness ❑ Sharing information	•
3. Demonstrate critical safe work habits	❑ Stress and stress management ❑ Time concept ❑ Punctuality and time consciousness ❑ Leisure	• Observation • Written • Oral interview • Third party report

	❑ Integrating personal objectives into organizational objectives ❑ Resources mobilization ❑ Resources utilization ❑ Setting work priorities ❑ Developing healthy relationships ❑ HIV and AIDS ❑ Drug and substance abuse ❑ Managing emerging issues	
4. Lead a workplace team	❑ Leadership qualities ❑ Power and authority ❑ Team building ❑ Determination of team roles and objectives ❑ Team parameters and relationships ❑ Individual responsibilities in a team ❑ Forms of communication ❑ Complementing team activities ❑ Gender and gender mainstreaming ❑ Human rights ❑ Developing healthy relationships ❑ Maintaining relationships ❑ Conflicts and conflict resolution ❑ Coaching and mentoring skills	• Observation • Oral interview • Written • Third party report
5. Plan and organize work	❑ Functions of management ✓ Planning ✓ Organizing ❑ Time management ❑ Decision making concept ❑ Task allocation ❑ Developing work plans	• Observation • Oral interview • Written • Third party report

	❑ Developing work goals/objectives and deliverables ❑ Monitoring work activities ❑ Evaluating work activities ❑ Resource mobilization ❑ Resource allocation ❑ Resource utilization ❑ Proactive planning ❑ Risk evaluation ❑ Problem solving ❑ Collecting, analysing and organising information ❑ Negotiation	
6. Maintain professional growth and development	❑ Avenues for professional growth ❑ Training and career opportunities ❑ Assessing training needs ❑ Mobilizing training resources ❑ Licenses and certifications for professional growth and development ❑ Pursuing personal and organizational goals ❑ Managing work priorities and commitments ❑ Recognizing career advancement	• Observation • Oral interview • Written • Third party report
7. Demonstrate workplace learning	❑ Managing own learning ❑ Mentoring ❑ Coaching ❑ Contributing to the learning community at the workplace ❑ Cultural aspects of work ❑ Networking ❑ Variety of learning context ❑ Application of learning	• Observation • Oral interview • Written • Third party report

	❑ Safe use of technology ❑ Taking initiative/proactivity ❑ Flexibility ❑ Identifying opportunities ❑ Generating new ideas ❑ Workplace innovation ❑ Performance improvement ❑ Managing emerging issues ❑ Future trends and concerns in learning	
8. Demonstrate problem solving skills	❑ Critical thinking process ❑ Data analysis tools ❑ Decision making ❑ Creative thinking ❑ Development of creative, innovative and practical solutions ❑ Independence in identifying and solving problems ❑ Solving problems in teams ❑ Application of problem-solving strategies ❑ Testing assumptions ❑ Resolving customer concerns	• Observation • Oral interview • Written • Third party report
9. Manage ethical performance	❑ Meaning of ethics ❑ Ethical perspectives ❑ Principles of ethics ❑ Ethical standards ❑ Organization code of ethics ❑ Common ethical dilemmas ❑ Organization culture ❑ Corruption, bribery and conflict of interest ❑ Privacy and data protection ❑ Diversity, harassment and mutual respect ❑ Financial responsibility/accountability	• Observation • Oral interview • Written • Third party report

	❑ Etiquette ❑ Personal and professional integrity ❑ Commitment to jurisdictional laws ❑ Emerging issues in ethics	

Suggested Methods of Delivery

- Instructor lead facilitation of theory
- Demonstrations
- Simulation/Role play
- Group Discussion
- Presentations
- Projects
- Case studies
- Assignments

Recommended Resources

- Computers
- Stationery
- Charts
- Video clips
- Audio tapes
- Radio sets
- TV sets
- LCD projectors

ENVIRONMENTAL LITERACY

UNIT CODE: LSM/CU/LM/BC/06/6/A

Relationship to Occupational Standards:
This unit addresses the unit standard: **Demonstrate environmental literacy**
Duration of Unit: 40 hours
Unit Description
This unit describes the competencies required to control environmental hazard, control environmental pollution, comply with workplace sustainable resource use, evaluate current practices in relation to resource usage, identify environmental legislations/conventions for environmental concerns, implement specific environmental programs, monitor activities on environmental protection/programs, analyze resource use and develop resource conservation plans.

Summary of Learning Outcomes

1. Control environmental hazard
2. Control environmental Pollution
3. Demonstrate sustainable resource use
4. Evaluate current practices in relation to resource usage
5. Identify Environmental legislations/conventions for environmental concerns
6. Implement specific environmental programs
7. Monitor activities on Environmental protection/Programs
8. Analyze resource use
9. Develop resource conservation plans

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Control environmental hazard	• Purposes and content of Environmental Management and Coordination Act 1999 • Storage methods for environmentally hazardous materials • Disposal methods of hazardous wastes	• Written questions • Oral questions • Observation of work procedures

	• Types and uses of PPE in line with environmental regulations • Occupational Safety and Health Standards (OSHS)	
2. Control environmental Pollution control	• Types of pollution • Environmental pollution control measures • Types of solid wastes • Procedures for solid waste management • Different types of noise pollution • Methods for minimizing noise pollution	• Written questions • Oral questions • Observation of work procedures • Role play
3. Demonstrate sustainable resource use	• Types of resources • Techniques in measuring current usage of resources • Calculating current usage of resources • Methods for minimizing wastage • Waste management procedures • Principles of 3Rs (Reduce, Reuse, Recycle) • Methods for economizing or reducing resource consumption	• Written questions • Oral questions • Observation of work procedures • Role play
4. Evaluate current practices in relation to resource usage	• Collection of information on environmental and resource efficiency systems and procedures, • Measurement and recording of current resource usage • Analysis and recording of current purchasing strategies. • Analysis of current work processes to access information and data • Identification of areas for improvement	• Written questions • Oral questions • Observation of work procedures • Role play

5. Identify Environmental legislations/conventions for environmental concerns	• Environmental issues/concerns • Environmental legislations /conventions and local ordinances • Industrial standard /environmental practices • International Environmental Protocols (Montreal, Kyoto) • Features of an environmental strategy	• Written questions • Oral questions • Observation of work procedures
6. Implement specific environmental programs	• Community needs and expectations • Resource availability • 5s of good housekeeping • Identification of programs/Activities • Setting of individual roles /responsibilities • Resolving problems /constraints encountered • Consultation with stakeholders	• Written questions • Oral questions • Observation of work procedures • Role play
7. Monitor activities on Environmental protection/Programs	• Periodic monitoring and Evaluation of activities • Gathering feedback from stakeholders • Analyzing data gathered • Documentation of recommendations and submission • Setting of management support systems to sustain and enhance the program • Monitoring and reporting of environmental incidents to concerned /proper authorities	• Oral questions • Written tests • Practical test • Observation
8. Analyze resource use	• Identification of resource consuming processes • Determination of quantity and nature of resource consumed	• Written tests • Oral questions • Practical test • Observation

	• Analysis of resource flow through different parts of the process. • Classification of wastes for possible source of resources.	
9. Develop resource Conservation plans	• Determination of efficiency of use/conversion of resources • Causes of low efficiency of use of resources • Plans for increasing the efficiency of resource use	• Written tests • Oral questions • Practical test • Observation

Suggested Delivery Methods

- Instructor led facilitation of theory
- Practical demonstration of tasks by trainer
- Practice by trainees
- Observations and comments and corrections by trainers

Recommended Resources

- Standard operating and/or other workplace procedures manuals
- Specific job procedures manuals
- Environmental Management and Coordination Act 1999
- Machine/equipment manufacturer's specifications and instructions
- Personal Protective Equipment (PPE)
- ISO standards
- Company environmental management systems (EMS)
- Montreal Protocol
- Kyoto Protocol

OCCUPATIONAL SAFETY AND HEALTH PRACTICES

UNIT CODE:LSM/CU/LM/BC/07/6/A

Relationship to Occupational Standards

This unit addresses the unit of competency: Demonstrate occupational safety and health practices

Duration of Unit: 40 hours

Unit Description

This unit describes the competencies required to comply with regulatory and organizational requirements for occupational safety and health.

Summary of Learning Outcomes

1. Identify workplace hazards and risk
2. Identify and implement appropriate control measures to hazards and risks
3. Implement OSH programs, procedures and policies/guidelines

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Identify workplace hazards and risks	• Identification of hazards in the workplace and/or the indicators of their presence • Evaluation and/or work environment measurements of OSH hazards/risk existing in the workplace • Gathering of OSH issues and/or concerns	• Oral questions • Written tests • Observation of trainees identify hazards and risks
2. Identify and implement appropriate control measure to hazards and risks	• Prevention and control measures e.g. use of PPE • Contingency measures	• Oral questions • Written tests • Practical tests • Observation of implementation

		of control measures
3. Implement OSH programs, procedures and policies/guidelines	• Company OSH program, procedures and policies/guidelines • Implementation of OSH procedures and policies/ guidelines • Training of team members and advice on OSH standards and procedures • Implementation of procedures for maintaining OSH-related records	• Oral questions • Written tests • Practical test • Observation

Suggested Delivery Methods

- Instructor led facilitation of theory
- Demonstration by trainer
- Practical work by trainee
- Viewing of related videos

Recommended Resources

- Standard operating and/or other workplace procedures manuals
- Specific job procedures manuals
- Machine/equipment manufacturer's specifications and instructions
- Personal Protective Equipment (PPE) e.g.
  - Mask
  - Face mask/shield
  - Safety boots
  - Safety harness
  - 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

COMMON UNITS OF LEARNING

APPLIED MATHEMATICS

UNIT CODE: LSM/CU/LM/CC/01/6/A

Relationship to Occupational Standards

This unit addresses the unit of competency: Apply mathematical skills

Duration of Unit: 80 hours

Unit Description

This unit describes competencies required by a technician to apply a wide range of mathematical skills, apply ratios and proportions to solve problems; use algebraic and graphical techniques to analyse mathematical problems; apply concepts of probability; perform commercial calculations and collect, organise and analyse statistical data.

Summary of Learning Outcomes

1. Apply Algebra
2. Apply Trigonometry and hyperbolic functions
3. Apply complex numbers
4. Apply Coordinate Geometry
5. Carry out Binomial Expansion
6. Apply Calculus
7. Solve Ordinary differential equations
8. Carry out Mensuration
9. Apply Power Series
10. Apply Statistics
11. Apply Vector theory
12. Apply Matrix
13. Apply Numerical methods

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Apply Algebra	❑ Base and Index ❑ Law of indices ❑ Indicial equations ❑ Laws of logarithm ❑ Logarithmic equations ❑ Conversion of bases	❑ Written tests ❑ Oral questioning ❑ Assignments ❑ Supervised exercises

	❑ Use of calculator ❑ Reduction of equations ❑ Solution of equations reduced to quadratic form ❑ Solutions of simultaneous linear equations in three unknowns ❑ Solutions of problems involving AP and GP	
2. Apply Trigonometry and hyperbolic functions	❑ Half -angle formula ❑ Factor formula ❑ Trigonometric functions ❑ Parametric equations ❑ Relative and absolute measures ❑ Measures calculation ❑ Definition of hyperbolic equations ❑ Properties of hyperbolic functions ❑ Evaluations of hyperbolic functions Hyperbolic identities ❑ Osborne's Rule ❑ Ashx+bshx=C equation ❑ One-to-one relationship in functions ❑ Inverse functions for one-to-one relationship ❑ Inverse functions for trigonometric functions ❑ Graph of inverse functions ❑ Inverse hyperbolic functions	❑ Written tests ❑ Oral questioning ❑ Assignments ❑ Supervised exercises
3. Apply complex numbers	❑ Definition of complex numbers ❑ Stating complex numbers in numbers in terms of conjugate argument and ❑ Modulus ❑ Representation of complex numbers on the Argand diagram	❑ Assignments ❑ Oral questioning ❑ Supervised exercises ❑ Written tests

	❑ Arithmetic operation of complex numbers Application of De Moivre's theorem ❑ Application of complex numbers to engineering	
4. Apply Coordinate Geometry	❑ Polar equations ❑ Cartesian equation ❑ Graphs of polar equations ❑ Normal and tangents ❑ Definition of a point ❑ Locus of a point in relation to a circle ❑ Loci of points for given mechanism	❑ Assignments ❑ Oral questioning ❑ Practical tests ❑ Observation ❑ Supervised exercises ❑ Written tests
5. Carry out Binomial Expansion	❑ Binomial theorem Power series using binomial theorem Roots of numbers using binomial theorem. ❑ Estimation of errors of small changes using binomial theorem	❑ Assignments ❑ Supervised exercises ❑ Written tests
6. Apply calculus	❑ Definition of derivatives of a function ❑ Differentiation from fist principle ❑ Tables of some common derivatives ❑ Rules of differentiation ❑ Rate of change and small change ❑ Stationery points of functions of two variables ❑ Definition of integration ❑ Indefinite and definite integral ❑ Methods of integration application of integration.	❑ Assignments ❑ Supervised exercises ❑ Written tests

	❑ Integrals of hyperbolic and inverse functions	
7. Solve Ordinary differential equations	❑ Types of first order differential equations ❑ Formation of first order differential equation ❑ Solution of first order differential equations ❑ Application of first order differential equations ❑ Formation of second order differential equations for various systems ❑ Solution of second order differential equations ❑ Application of second order differential equations	❑ Assignments ❑ Oral questioning ❑ Supervised exercises ❑ Written tests
8. Carry out Mensuration	❑ Units of measurements ❑ Perimeter and areas of regular figures ❑ Volume of regular solids ❑ Surface area of regular solids ❑ Area of irregular figures ❑ Areas and volumes using Pappus theorem	❑ Assignments ❑ Supervised exercises ❑ Written tests
9. Apply Power Series	❑ Definition of the term power series ❑ Taylor's theorem ❑ Deduction of Maclaurin's theorem to obtain power series ❑ Application of Taylor's theorem and Maclaurin's theorems in numerical work	❑ Written tests ❑ Assignments ❑ Supervised exercises
10. Apply Statistics	❑ Classification of data o Grouped data	❑ Oral questioning ❑ Written tests ❑ Assignments

	○ Ungrouped data ❑ Data collection ❑ Tabulation of data ○ Class intervals ○ Class boundaries ○ Frequency tables ❑ Diagrammatic and graphical presentation of data e.g. ○ Histograms ○ Frequency polygons ○ Bar charts ○ Pie charts ○ Cumulative frequency curves ❑ Measures of central tendency mean, mode and median ❑ Measures of dispersion ○ Variance and standard deviation ❑ Definition of probability ❑ Laws of probability ❑ Expectation variance and S.D. ❑ Types of distributions ❑ Mean, variance and SD of probability distributions ❑ Application of probability distributions ❑ Standard normal tables ❑ Sampling distributions ❑ Rank correlation coefficient	❑ Supervised exercises

11. Apply Numerical methods	❑ Definition of interpolation and extrapolation ❑ Application of interpolation ❑ Application of interactive methods to solve equations ❑ Application of interactive methods to areas and volumes	❑ Assignments ❑ Oral questioning ❑ Supervised exercises ❑ Written tests
12. Apply Vector theory	❑ Vectors and scalar in two and three dimensions ❑ Operations on vectors: Addition and Subtraction ❑ Position vectors ❑ Resolution of vectors	❑ Assignments ❑ Oral questioning ❑ Supervised exercises ❑ Written tests
13. Apply Matrix methods	❑ Matrix operation ❑ Determinant of 3x3 matrix ❑ Inverse of 3x3 matrix ❑ Solution of linear simultaneous equations in 3 unknowns ❑ Application of matrices	❑ Assignments ❑ Oral questioning ❑ Supervised exercises ❑ Written tests

Suggested Delivery Methods

- Lecturing
- Group discussions
- Demonstration by trainer
- Exercises by trainee

Recommended Resources

- Scientific Calculators
- Rulers, pencils, erasers
- Charts with presentations of data
- Graph books
- Dice
- Computers with internet connection

SURVEY INSTRUMENTS

UNIT CODE: LSM/CU/LM/CC/02/6/A

Relationship to Occupational Standards

This unit addresses the unit of competency: Operate survey instruments

Duration of Unit: 96 hours

Unit Description

This unit describes competencies required by a surveyor to operate linear, angle and linear-angle measuring survey instruments

Summary of Learning Outcomes

1. Operate linear measuring instruments
2. Operate angle measuring instruments
3. Operate height measuring instruments
4. Operate linear-angle measuring instruments

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Operate linear measuring instruments	❑ Units of linear measurements and their conversions ❑ Types of linear measuring instruments and their operations ○ Tape/ Chains ○ Electromagnetic Distance Measurement (EDM) ○ Optical Distance Measurement (ODM) ○ Sonic Distance Measurement (SDM) ○ Tachometry ○ Laser distant meters	❑ Written tests ❑ Oral questioning ❑ Assignments ❑ Supervised exercises

	❑ Accuracy and precision in linear measurements ❑ Error analysis and adjustment ○ Types of errors ○ Sources of errors ○ Adjustment of errors ❑ Care and maintenance of linear measuring equipment	
2. Operate angle measuring instruments	❑ Units of angular measurements and their conversions ❑ Types of angular measuring instruments and their operations ○ Theodolite ○ Compass ○ Sextant ❑ Accuracy and precision in angular measurements ❑ Error analysis and adjustment ○ Types of errors ○ Sources of errors ○ Adjustment of errors ❑ Care and maintenance of angular measuring equipment	❑ Assignments ❑ Supervised exercises ❑ Written tests
3. Operate height measuring instruments	❑ Techniques of height measurements ○ Direct (Levelling) ○ Indirect(Trigonometry) ❑ Types of levelling instruments and their operations ○ Digital levels ○ Ordinary levels ○ Precise levels	❑

	○ Automatic levels ○ Laser levels ❑ Accuracy and precision in height measurements ❑ Error analysis and adjustment ○ Types of errors ○ Sources of errors ○ Adjustment of errors ❑ Care and maintenance of height measuring equipment	
4. Operate linear-angle measuring instruments	❑ Types of linear-angular measuring instruments and their operations ○ Total station ○ GNSS equipment ❑ Accuracy and precision in linear-angular instruments ❑ Error analysis and adjustment ○ Types of errors ○ Sources of errors ○ Adjustment of errors ❑ Care and maintenance of angular measuring equipment	

Suggested Delivery Methods

- Lecturing
- Group discussions
- Demonstration by trainer
- Exercises by trainee

Recommended Resources

- Survey instruments
- Computing instruments
- Booking sheet

- Stationery
- Computers with internet connection

LAND LAWS

UNIT CODE: LSM/CU/LM/CC/03/6/A

Relationship to Occupational Standards

This unit addresses the unit of competency: Apply Land Laws

Duration of Unit: 96 hours

Unit Description

This unit describes 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

Summary of Learning Outcomes

1. Identify land laws
2. Verify land ownership
3. Identify legal control over land use
4. Demonstrate understanding of land registration
5. Demonstrate understanding of cadastral processes
6. Demonstrate understanding of land transactions
7. Arbitrate land disputes

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Identify land laws	❑ Terms in land laws ❑ Sources of land laws o Common law o Constitution o Statues ❑ Types of land laws ❑ Evolution of land laws in Kenya ❑ Principles of land policy	❑ Written tests ❑ Oral questioning ❑ Assignments

2. Verify land ownership	❑ Types of land ownership ○ Community land ○ Public land ○ Private land ❑ Land Tenure systems ○ Free hold ○ Lease hold	❑ Written tests ❑ Oral questioning ❑ Assignments
3. Identify legal control over land use	❑ Types of land use ○ Agricultural ○ Residential ○ Industrial ○ Commercial ○ Recreation ❑ Legal land control ○ Land control regulation Land use conversion ○ Development and use of land regulation. ❑ Importance of legal land controls	❑ Written tests ❑ Oral questioning ❑ Assignments
4. Demonstrate understanding of land registration	❑ Land rights and interest ❑ Importance of land registration ❑ Land registration processes	❑ Written tests ❑ Oral questioning ❑ Assignments
5. Demonstrate understanding of laws governing surveying processes	❑ Land adjudication act ❑ Survey act ❑ Physical planning act ❑ Cities and urban	❑ Written tests ❑ Oral questioning ❑ Assignments
6. Demonstrate understanding of land transactions	❑ Types of land transaction ❑ Legal instruments of land transactions	❑ Written tests ❑ Oral questioning ❑ Assignments
7. Demonstrate understanding of	❑ Types of land disputes ❑ Process of resolving land disputes.	❑ Written tests ❑ Oral questioning ❑ Assignments

land disputes arbitration process	❑ Actors in land dispute arbitration ❑ Role of a surveyor in land disputes resolution	

Suggested Delivery Methods

- Group discussions
- Demonstration by trainer
- Exercises by trainee

Recommended Resources

- Land laws and statutes
- Online resources
- Stationery.

PHOTOGRAMMETRY AND REMOTE SENSING

UNIT CODE: LSM/CU/LM/CC/04/6/A

Relationship to Occupational Standards

This unit addresses the unit of competency: apply principles of photogrammetry and remote sensing

Duration of Unit: 120 hours

Unit Description

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

Summary of Learning Outcomes

1. Collect data
2. Pre-process
3. Process data
4. Present data
5. Store and archive data

Learning Outcomes, Content and Suggested Assessment Methods

Learning outcome	Content	Suggested Assessment Methods
1. Collect data	❑ Principles of photogrammetric data collection ○ Electromagnetic spectrum ○ Types of sensors and platforms ❑ Types of survey data ○ Raster ○ Vector ❑ Sources of photogrammetric data • Aerial photographs • Ground coordinates • Satellite Imagery • Drone Imagery ❑ Methods of data collection • Aerial photography	❑ Observation ❑ Oral Questioning ❑ Written Tests ❑ Projects

	• Download satellite imagery • Drone technology • Land survey ❑ Tools and equipment for data collection • Aircraft • Drone • Satellite • Cameras and Sensors • Storage equipment ❑ Data collection procedures ❑ Data storage	
2. Pre-process data	❑ Tools for data pre-processing • Computers • Digital Photogrammetric Workstations (DPWs) • Software ❑ Orientations • Inner orientation • Relative orientation • Absolute orientation ❑ Aerial triangulation	❑ Observation ❑ Oral Questioning ❑ Written Tests ❑ Projects
3. Process data	❑ Data Extraction Processes • Features • Digital Terrain Models (DTM) • Digital Elevation Models (DEM) • Digital Surface Models (DSM) • Contours • Data editing and cleaning of models • Orthophoto maps ❑ Data management • format • export • import	❑ Observation ❑ Oral Questioning ❑ Written Tests ❑ Projects

4. Present data	❑ Data presentation methods • softcopy • hardcopy • 3D models	❑ Observation ❑ Oral Questioning ❑ Written Tests ❑ Projects
5. Store and archive data	Data archival procedures • Hard copy • Softcopy • Filing • Security ❑ Data retrieval • Sharing • Access rights ❑ Creation of Metadata • Components • Data source	❑ Observation ❑ Oral Questioning ❑ Written Tests ❑ Projects

Suggested Delivery Methods

- Lecturing
- Group discussions
- Demonstration by trainer
- Exercises by trainee
- Video clips

Recommended Resources

- Data
- Computers with Photogrammetric software.
- Plotters and printers
- Projectors
- Smart boards
- Data collection equipment
- Photogrammetric Scanners
- Servers

GIS

UNIT CODE: LSM/CU/LM/CC/05/6/A

Relationship to Occupational Standards

This unit addresses the unit of competency: apply principles of GIS

Duration of Unit: 96 hours

Unit Description

This unit describes the competencies required by a cartographer to collect data, pre-process data, process data, present data, store and archive data and design and publish web-based maps

Summary of Learning Outcomes

1. Collect data
2. Pre-process
3. Process data
4. Store and archive data

Learning Outcomes, Content and Suggested Assessment Methods

Learning outcome	Content	Suggested Assessment Methods
1. Collect data	❑ Components of GIS ❑ Sources of mapping data ❑ Methods of data collection ❑ Data collection equipment ❑ Data models ❑ Data digitization	❑ Observation ❑ Oral Questioning ❑ Written Tests ❑ Projects
2. Pre-process data	❑ Data cleaning ❑ Data selection ❑ Checking of projections ❑ Harmonizing scales ❑ Data evaluation	❑ Observation ❑ Oral Questioning ❑ Written Tests ❑ Projects
3. Process data	❑ Geo-referencing ❑ Digitization ❑ Editing ❑ Layering ❑ Overlay ❑ Attributes entry ❑ Creation of Geo-database	❑ Observation ❑ Oral Questioning ❑ Written Tests ❑ Projects

	❑ Map design	
4. Present data	❑ Arranging data layer ❑ Designing map layouts ❑ Web maps are published ❑ Map is exported ❑	❑ Observation ❑ Oral Questioning ❑ Written Tests ❑ Projects
5. Store and archive data	❑ Cataloguing ❑ Archiving devices ❑ Cloud archiving ❑ Data organization ○ Partitioning drives ○ Spatial indexing ○ metadata ❑ Data compression	❑ Observation ❑ Oral Questioning ❑ Written Tests ❑ Projects

Suggested Delivery Methods

- lectures
- Group discussions
- Demonstration by trainer
- Exercises by trainee

Recommended Resources

- Data
- Computers with GIS software.
- Plotters and printers
- Projectors
- Smart boards
- Data collection equipment
- Scanners
- Servers
- Archiving devices
- Internet

CARTOGRAPHY

UNIT CODE: LSM/CU/LM/CC/06/6/A

Relationship to Occupational Standards

This unit addresses the unit of competency: Apply principles of cartography

Duration of Unit: 120 hours

Unit Description

This unit describes the competencies required

Summary of Learning Outcomes

1. Apply cartographic techniques
2. Communicate using maps
3. Distinguish between maps and plans
4. Determine scale of maps and plans
5. Compile maps
6. Project maps
7. Apply principles of reference systems
8. Represent relief

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Apply cartographic techniques	❑ Meaning of cartographic techniques ❑ Terms used in cartography ❑ Drawing instruments and their use ❑ Care of drawing instruments and materials ❑ Types and characteristics of drawing materials ❑ Drawing media and inks ❑ Properties of good drawing materials ❑ Mapping scales ❑ Classification of mapping scales ❑ Methods of scale change	❑ Observation ❑ Oral questioning ❑ Written tests ❑ Projects

	❑ Map texts ❑ Lettering ❑ Construction of rectangular grid	
2. Communicate using maps	❑ Process of cartographic communication ❑ Cartographic symbols	❑ Observation ❑ Oral questioning ❑ Written tests ❑ Projects
3. Distinguish between maps and plans	❑ Types of maps ❑ Types of plans	❑ Observation ❑ Oral questioning ❑ Written tests ❑ Projects
4. Determine scale of maps and plans	❑ Type of scales ❑ Determination of scales ❑ Application of Scales	❑ Observation ❑ Oral questioning ❑ Written tests ❑ Projects
5. Compile maps	❑ Sources of mapping data ❑ Phases of map compilation ❑ Types of map compilation ❑ Compilation procedure ❑ Generalization ❑ Map design	❑ Observation ❑ Oral questioning ❑ Written tests ❑ Projects
6. Project maps	❑ Meaning of map projection ❑ Basic concepts in map projection ❑ Classification of map projections ❑ Characteristics of map projections ❑ Commonly used projections ❑ Map grids ❑ Factors influencing choice of projection	❑ Observation ❑ Oral questioning ❑ Written tests ❑ Projects
7. Apply principles of reference systems	❑ Meaning of reference systems ❑ Earth's Geometry o Geoid o Spheroid / Ellipsoid o Spherical ❑ Types of coordinate systems o Geographical o Cartesian	❑ Observation ❑ Oral questioning ❑ Written tests ❑ Projects

	○ Projected (UTM, Cassini)	
8. Represent relief	❑ Methods of showing relief ❑ Construction of profiles ❑ Calculation of gradients ❑ Contour interpolation ❑ Inter-visibility	❑ Observation ❑ Oral questioning ❑ Written tests ❑ Projects

Suggested Delivery Methods

- Lecturing
- Demonstration by trainer
- Exercises by trainee
- Group discussions

Recommended Resources

- Scientific Calculators
- Rulers, pencils, erasers
- Charts with presentations of data
- Graph books
- Dice
- Online resources
- Cartographic software

CORE UNITS OF LEARNING

TOPOGRAPHICAL SURVEY

UNIT CODE: LSM/CU/LM/CR/01/6/A

Relationship to Occupational Standards

This unit addresses the unit of competency: Conduct topographical survey

Duration of Unit: 120 hours

Unit Description

This unit describes the competencies required by a surveyor to conduct a reconnaissance, monument control points, determine position of control points, determine position of detail points and prepare topographical map

Summary of Learning Outcomes

1. Conduct a reconnaissance
2. Monument control points
3. Determine position of control points
4. Determine position of detail points
5. Prepare topographical map

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Conduct a reconnaissance	❑ Meaning of reconnaissance ❑ Objectives of reconnaissance ❑ Importance of a reconnaissance ❑ Identification of existing control points ❑ Establishment of new control points ❑ Safety precautions	❑ Observation ❑ Oral questioning ❑ Written tests
2. Monument control points	❑ Meaning of control points ❑ Types of monuments o Wooden pegs o Iron pins (IP)	❑ Observation ❑ Oral questioning ❑ Written tests

	○ Iron pin in concrete (IPC) ○ Iron pin in concrete underground (IPCU) ○ Pillars. ○ Angle iron in Concrete (AIC) ○ Angle iron in concrete underground	❑ Practical assessments
3. Determine position of control points	❑ Types of control points ❑ Importance of control points. ❑ Distance measurements ○ Tapes ○ Distance Measurement (EDM) ○ Optical Distance Measurement (ODM) ○ Distance adjustments ○ Errors ❑ Angle and direction measurements ❑ Establishment of horizontal controls ○ Traversing ○ Triangulateration ○ Global Navigation Satellite System (GNSS) ❑ Establishment of vertical controls; ○ Leveling ○ Trigonometric heighting ○ Global Navigation Satellite System (GNSS)	❑ Observation ❑ Oral questioning ❑ Written tests ❑ Practicals

	❑ Application of control points	
4. Determine position of detail points	❑ Meaning of detail points ❑ Importance of detail points ❑ Picking of detail points and spots heights. ❑ Application of detail points	❑ Observation ❑ Oral questioning ❑ Written tests ❑ Practicals
5. Prepare topographical map	❑ Cartographic map elements ❑ Map scales and precision ❑ Map projections ❑ Coordinate transformations ❑ Plotting of detail points ❑ Plotting of spot height coordinates ❑ Generation of contours ❑ Map designs and layout	❑ Observation ❑ Oral questioning ❑ Practicals

Suggested Delivery Methods

- Teaching
- Demonstration by trainer
- Practical work by trainee
- Demonstration videos
- Projects
- Group projects
- Industrial attachment
- Internship

Recommended Resources

- Survey equipments and tools
- Survey data plans
- CAD software
- Computers
- Stationery
- Online resources
- Storage media
- Transportation
- Store
- Reference Text Books

ENGINEERING SURVEY

UNIT CODE: LSM/CU/LM/CR/02/6/A

Relationship to Occupational Standards

This unit addresses the unit of competency: Conduct engineering survey

Duration of Unit: 140 hours

Unit Description

This unit describes the competencies required by a surveyor to conduct a reconnaissance, conduct control survey, set out engineering works, compute earthworks, conduct underground survey and prepare as built survey map.

Summary of Learning Outcomes

1. Conduct a reconnaissance
2. Conduct control survey
3. Set out engineering works
4. Compute earthworks
5. Conduct underground survey
6. Prepare as built survey map.

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Conduct a reconnaissance	❑ Meaning of reconnaissance ❑ Objectives of reconnaissance ❑ Importance of a reconnaissance ❑ Identification of existing control points ❑ Establishment of new control points ❑ Safety precautions	❑ Observation ❑ Oral questioning ❑ Practicals
2. Conduct control survey	❑ Meaning of control point ❑ Types of control points ❑ Importance of control points ❑ Types of monuments ○ Wooden pegs ○ Iron pins (IP)	❑ Observation ❑ Oral questioning ❑ Written tests ❑ Practical assessments

	○ Iron pin in concrete (IPC) ○ Iron pin in concrete underground (IPCU) ❑ Identification of existing control points ❑ Establishment of new control points ❑ Establishment of horizontal controls ○ Traversing ○ Triangulateration ○ GNSS ❑ Establishment of vertical controls; ○ Leveling ○ Trigonometric heighting ○ Global Navigation Satellite System (GNSS) ❑ Application of control points	
3. Set out engineering works	❑ Meaning of setting out ❑ Purpose and importance of setting out ❑ Methods of setting out ○ By coordinates ○ By theodolite and level ○ By off set ❑ Setting out vertical curves ❑ Setting out horizontal curves ❑ Setting out buildings & Structures ❑ Setting out trenches ❑ Setting out slope stakes	❑ Observation ❑ Oral questioning ❑ Written tests ❑ Practicals
4. Compute earthworks	❑ Meaning of earthworks ❑ Elements of a profile ○ Cross-section profiles ○ Longitudinal profiles ❑ Area computation ○ Regular boundaries ○ Irregular boundaries ❑ Volume computation ○ Cross-sections ○ Spot heights	❑ Observation ❑ Oral questioning ❑ Written tests ❑ Drawings ❑ Practicals

	○ Contours ❑ Mass haul diagrams	
5. Conduct underground survey	❑ Transfer of horizontal and vertical controls from surface to underground ❑ Underground survey procedures ❑ Applications of underground survey	❑ Observation ❑ Oral questioning ❑ Written tests ❑ Practicals
6. Prepare as built survey map	❑ Cartographic map elements ❑ Map scales and precision ❑ Map projections ❑ Coordinate transformations ❑ Map designs and layout	❑ Observation ❑ Oral questioning ❑ Written tests ❑ Practicals

Suggested Delivery Methods

- Teaching
- Demonstration by trainer
- Practical work by trainee
- Demonstration videos
- Projects
- Group projects
- Industrial attachement
- Internship

Recommended Resources

- Survey equipments and tools
- Survey data and Plans
- CAD software
- Computers
- Stationery
- Online resources
- Storage media
- Transportation
- Store
- Reference Text Books

CADASTRAL SURVEY

UNIT CODE: LSM/CU/LM/CR/03/6/A

Relationship to Occupational Standards

This unit addresses the unit of competency: Conduct cadastral survey

Duration of Unit: 142 hours

Unit Description

This unit describes the competencies required by a surveyor to conduct a reconnaissance, conduct control survey, compute theoretical positions of boundaries (beacons), place beacons on the ground, prepare a cadastral plan and compile a cadastral file

Summary of Learning Outcomes

7. Conduct a reconnaissance
8. Conduct control survey
9. Compute theoretical positions of boundaries (beacons)
10. Place beacons on the ground
11. Prepare a cadastral plan
12. Compile a cadastral file

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Conduct a reconnaissance	❑ Meaning of reconnaissance ❑ Objectives of reconnaissance ❑ Importance of a reconnaissance ❑ Land title verification ❑ Subdivision consent ❑ Subdivision approval ❑ Approved subdivision plan ❑ Safety precautions	❑ Observation ❑ Oral questioning ❑ Practicals ❑ Written test
2. Conduct control survey	❑ Meaning of control point ❑ Types of control points ❑ Importance of control points	❑ Observation ❑ Oral questioning ❑ Written tests

	❑ Types of monuments ○ Wooden pegs ○ Iron pins (IP) ○ Iron pin in concrete (IPC) ○ Iron pin in concrete underground (IPCU) ❑ Identification of existing control points ❑ Establishment of new control points ❑ Establishment of horizontal controls ○ Traversing ○ Triangulateration ○ GNSS ❑ Application of control points	❑ Practical assessments
3. Compute theoretical positions of boundaries (beacons)	❑ Computation of theoretical coordinates for beacons ❑ Placing data computations ○ Bearings ○ Distance	❑ Observation ❑ Oral questioning ❑ Written tests ❑ Practicals ❑ Computation check
4. Place beacons on the ground	❑ Types of beacons ○ Iron pins (IP) ○ Iron pin in concrete (IPC) ○ Angle Iron pin in concrete ❑ Transfer of theoretical coordinates to the ground ❑ Accuracy assessment.	❑ Observation ❑ Oral questioning ❑ Written tests ❑ Practicals
5. Prepare a cadastral plan	❑ Cadastral plan elements ❑ Cadastral plan scale and precision ❑ Map projections ❑ Coordinate transformations ❑ Plan plotting ❑ Plan designs and layout	❑ Observation ❑ Oral questioning ❑ Sketches and drawing ❑ Practicals

6. Compile a cadastral file	❑ Content of a cadastral file ❑ Format of a cadastral file ❑ Submission procedure for a cadastral file ❑ Approval of a cadastral file	❑ Observation ❑ Oral questioning ❑ Written tests ❑ Practicals

Suggested Delivery Methods

- Teaching
- Demonstration by trainer
- Practical work by trainee
- Demonstration videos
- Projects
- Group projects
- Industrial attachement
- Internship

Recommended Resources

- Survey instruments
- Land laws and statutes
- Stationery
- Survey data
- Measuring tools
- CAD software
- Computers
- Internet
- Transportation
- Store
- Reference text books

HYDROGRAPHIC SURVEY

UNIT CODE: LSM/CU/LM/CR/04/6/A

Relationship to Occupational Standards

This unit addresses the unit of competency: Conduct hydrographic survey

Duration of Unit: 130 hours

Unit Description

This unit describes the competencies required by a surveyor to conduct a reconnaissance, conduct shore control survey, determine position of sea features and prepare bathymetric and nautical charts

Summary of Learning Outcomes

1. Conduct a reconnaissance
2. Conduct shore control survey
3. Determine position of sea features
4. Prepare bathymetric charts
5. Prepare nautical charts

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Conduct a reconnaissance	❑ Meaning of reconnaissance ❑ Objectives of reconnaissance ❑ Importance of a reconnaissance ❑ Reconnaissance procedure ❑ Safety Of Life At Sea (SOLAS)	❑ Observation ❑ Oral questioning ❑ Practicals
2. Conduct shore control survey	❑ Meaning of control point ❑ Types of monuments ❑ Geodetic control and tidal effects ❑ Establishment of horizontal controls	❑ Observation ❑ Oral questioning ❑ Written tests ❑ Practical assessments

	❑ Establishment of vertical controls ❑ Application of control points	
3. Determine position of sea features	❑ Fundamentals of hydrographic survey ❑ Horizontal positioning ❑ Vertical datum and positioning ❑ Depth determination ❑ Real-time hydrographic mapping ❑ Applications of hydrographic surveys	❑ Observation ❑ Oral questioning ❑ Written tests
4. Prepare bathymetric charts	❑ Meaning of bathymetric charts ❑ Framework of bathymetric charts ❑ Scale and precision of bathymetric charts ❑ Map projections ❑ Data collection and plotting ❑ Design of bathymetric charts ❑ Production of bathymetric charts ❑ Challenges in bathymetric mapping ❑ Elements of bathymetric charts ❑ Uses of bathymetric charts	❑ Observation ❑ Oral questioning ❑ Written tests/drawings and sketches ❑ Practicals
5. Prepare nautical charts	❑ Meaning of nautical charts ❑ Framework of nautical charts ❑ Scale ❑ Map projections ❑ Elements of nautical charts ❑ Data collection ❑ Design of nautical chart ❑ Plotting of nautical charts ❑ Digital production of nautical charts ❑ Uses of nautical charts	❑ Observation ❑ Oral questioning ❑ Sketches and drawings ❑ Practicals

Suggested Delivery Methods

- Teaching
- Demonstration by trainer
- Practical work by trainee
- Demonstration videos
- Projects
- Group discussions
- Group projects

Recommended Resources

- Survey equipments and tools
- Sea vessel
- Stationery
- Survey data
- Mapping software
- Relevant text books.
- Online resources.
- Transportation
- Water body.

MINING SURVEY

UNIT CODE: LSM/CU/LM/CR/05/6/A

Relationship to Occupational Standards

This unit addresses the unit of competency: Conduct mining survey

Duration of Unit: 120 hours

Unit Description

This unit describes the competencies required to by a surveyor to conduct a reconnaissance, establish surface and underground baseline, measure surface and underground works and prepare mine plans

Summary of Learning Outcomes

1. Conduct a reconnaissance
2. Establish surface and underground baseline
3. Measure surface and underground works
4. Prepare mine plans

Learning Outcomes, Content and Suggested Assessment Methods

Learning Outcome	Content	Suggested Assessment Methods
1. Conduct a reconnaissance	❑ Meaning of reconnaissance ❑ Objectives of reconnaissance ❑ Importance of a reconnaissance ❑ Safety precautions	❑ Observation ❑ Oral questioning ❑ Practicals
2. Establish control points	❑ Monumentation of control points ❑ Establishment of vertical controls ❑ Establishment of horizontal controls ❑ Transfer of controls from surface to underground	❑ Observation ❑ Oral questioning ❑ Written tests ❑ Practical assessments

3. Measure surface and underground works	❑ Underground traversing ❑ Levelling ❑ Alignment survey ❑ Tunneling survey ❑ Determination of mine resource volumes ○ Piling ○ Drilling	❑ Observation ❑ Oral questioning ❑ Written tests/ sketches
4. Prepare mine plans and reports	❑ Composition of plans and reports ❑ Format and content of plans and reports ❑ Preparation of plans and reports ❑ Certification of plans and reports	❑ Observation ❑ Oral questioning ❑ Written tests/drawings and sketches ❑ Practicals

Suggested Delivery Methods

- Lecturing
- Demonstration by trainer
- Practical work by trainee
- Demonstration videos
- Projects
- Group discussions
- Group projects
- Internship and attachements
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Recommended Resources

- Survey instruments
- Stationery
- Survey data
- Measuring tools
- Design software
- Computers
- Online resources
- Reference Text books
- Transportation