

**COMPETENCY BASED CURRICULUM**

**FOR**

**ANALYTICAL CHEMISTRY TECHNOLOGY**

**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 (Sessional Paper No. 4 of 2016). A key feature of this policy is the radical change in the design and delivery of the TVET training. This policy document requires that training in TVET 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 Analytical Chemistry 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 and the Sessional Paper No. 4 of 2016 on Reforming Education and Training in Kenya, emphasized the need toreform curriculum development, assessment and certification. This called for a shift to CBET to address the mismatch between skills acquired through training and skills needed by industry as well as increase the global competitiveness of Kenyan labour force.

TVET Curriculum Development, Assessment and Certification Council (TVET CDACC) in conjunction with Analytical Chemistry 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.

This 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, Analytical Chemistry 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 Analytical Chemistry sector Skills Advisory Committee (SSAC) in ensuring that competencies required by the industry are addressed in the curriculum. I also thank all stakeholders in the analytical chemistry 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 business will acquire competencies that will enable them to perform their work more efficiently.

**Dr. LAWRENCE GUANTAI M’ITONGA, PhD COUNCIL SECRETARY/CEO**

**TVET CDACC**

# ACRONYMS

ACHEM : Analytical Chemistry

ANOVA : Analysis of variance

ASC : Applied Science

BC : Basic Competency

CAPI : Computer Assisted Personal Interviewing

CBET : Competency Based Education and Training

CC : Common Competency

CDACC : Curriculum Development Assessment and Certification Council

CR : Core Competency

CU : Curriculum

DB : database

GDG : Focused group discussions

ICT : Information Communication Technology

KCSE : Kenya Certificate of Secondary Education

KNQA : Kenya National Qualifications Authority

MoE : Ministry of Education

OS : Occupational Standard

OSHA : Occupation Safety and Health Act

OSHS : Occupation Safety and Health Standards

PAPI : Paper and Pencil Interviewing

PPE : Personal Protective Equipment

SPSS : Statistical packages in social statistics

SQL : Structured Query Language

SSAC : Sector Skills Advisory Committee

TVET : Technical and Vocational Education and Training

# KEY TO UNIT CODE

 ASC/CU/ACHEM/BC/01/6

Industry or sector

Occupational Standards

Occupational area

Type of competency

Competency number

Competency level

Version control

#

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# COURSE OVERVIEW

Analytical Chemistry level 6 qualification consists of competencies that an individual must achieve in order to prepare research concept, design and data collection tools, Collect and manage research data, carry out Descriptive data analysis, carry out Inferential data analysis, design experiments and Improve industrial Process quality

 The units of competency comprising Analytical Chemistry level 6 qualifications include the following:

**BASIC COMPETENCIES**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit of Learning Code** | **Unit of Learning Title** | **Duration in hours**  | **Credit Factor** |
| ASC/CU/ACHEM/BC/01/6/A | Communication Skills | 40 | 4 |
| ASC/CU/ACHEM/BC/02/6/A | Numeracy Skills | 60 | 6 |
| ASC/CU/ACHEM/BC/03/6/A | Digital literacy  | 60 | 6 |
| ASC/CU/ACHEM/BC/04/6/A | Entrepreneurial Skills | 100 | 10 |
| ASC/CU/ACHEM/BC/05/6/A | Employability Skills | 80 | 8 |
| ASC/CU/ACHEM/BC/06/6/A | Environmental Literacy | 40 | 4 |
| ASC/CU/ACHEM/BC/07/6/A | Occupational Safety and Health Practices | 40 | 4 |
| **TOTAL** | **420** | **42** |

**COMMON COMPETENCY**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit Code** | **Unit Title** | **Duration in hours**  | **Credit Factor** |
| ASC/CU/ACHEM/CC/01/6/A | Physics Principles | 80 | 8 |
| ASC/CU/ACHEM/CC/02/6/A | Standard laboratory practices | 110 | 11 |
| ASC/CU/ACHEM/CC/03/6/A | Inorganic chemistry | 130 | 13 |
| ASC/CU/ACHEM/CC/04/6/A | Physical chemistry | 140 | 14 |
| ASC/CU/ACHEM/CC/05/6/A | Organic chemistry | 120 | 12 |
| ASC/CU/ACHEM/CC/06/6/A | Biochemistry Techniques | 110 | 11 |
| ASC/CU/ACHEM/CC/07/6/A | Statistical methods  | 150 | 15 |
| ASC/CU/ACHEM/CC/08/6/A | Analytical chemistry research | 140 | 14 |
| **TOTAL** | **980** | **98** |

**CORE COMPETENCIES**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit Code** | **Unit Title** | **Duration in hours**  | **Credit Factor** |
| ASC/CU/ACHEM/CR/01/6/A | development of standard operating test procedures | **150** | **15** |
| ASC/CU/ACHEM/CR/02/6/A | Analytical Chemistry Techniques | **200** | **20** |
| ASC/CU/ACHEM/CR/03/6/A | Collection and preparation of analytical chemistry samples | **260** | **26.0** |
| ASC/CU/ACHEM/CR/04/6/A | Analysis and interpretation of analytical chemistry data | **140** | **14** |
| ASC/CU/ACHEM/CR/05/6/A | Management of analytical chemistry laboratory, reagents and instruments  | **145** | **14.5** |
| ASC/CU/ACHEM/CR/06/6/A | Management of analytical chemistry samples | **145** | **14.5** |
|  | Industrial attachment | **480** | **48** |
|  | Analytical chemistry project | **56** | **5.6** |
| **TOTAL**  | **1576** | **157.6** |
| **GRAND TOTAL** | **2976** | **297.6** |

The core units of learning are independent of each other and may be taken independently.

The total duration of the course is 2976 hours, including 480 hours (12 weeks) of field attachment.

**Field Attachment**

It is envisaged that the trainee will have undergone a field training and assessment with a recognized chemistry related firm/industry. At least 480 hours (12 weeks) will be spent on a supervised and assessed field attachment.

**Project/Term paper**

Its required that the trainee will carry out a research project in analytical chemistry related field and submit it to the institution for marking and marks awarded before issue of the final certificate.

**Entry Requirements**

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

1. Attained KCSE Mean Grade C- (minus)

**Or**

1. National Analytical Chemistry Certificate Qualification (Level 5)

**Or**

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

**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 conducted by accredited external assessors appointed by TVET CDACC.

**Certification**

A candidate will be issued with a National certificate of competency on demonstration of competence in a unit of competency. To attain the National Analytical Chemistry Level 6, 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:** ASC/CU/ACHEM/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
* 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
 | * Interview
* Written
 |
| 1. Develop communication strategies
 | * Dynamics of groups
* Styles of group leadership
* Openness and flexibility in communication
* Communication skills relevant to client groups
 | * Interview
* Written
 |
| 1. Establish and maintain communication pathways
 | * Types of communication pathways
 | * Interview
* Written
 |
| 1. Promote use of communication strategies
 | * Application of elements of communication strategies
* Effective communication techniques
 | * Interview
* Written
 |
| 1. Conduct interview
 | * Types of interview
* Establishing rapport
* Facilitating resolution of issues
* Developing action plans
 | * Interview
* Written
 |
| 1. Facilitate group discussion
 | * Identification of communication needs
* Dynamics of groups
* Styles of group leadership
* Presentation of information
* Encouraging group members participation
* Evaluating group communication strategies
 | * Interview
* Written
 |
| 1. 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:** ASC/CU/ACHEM/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
 |
| 1. 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
 |
| 1. 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
 |
| 1. 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
 |
| 1. 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
 |  |
| 1. 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
	+ 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
 | * Assignments
* Supervised exercises
* Written tests
 |
| 1. 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
* Interpret display and record result
 | * Oral
* Written
* Practical test
* Observation
 |

**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:** ASC/CU/ACHEM/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
 |
| 1. 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
 |
| 1. 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
 |
| 1. 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
 |
| 1. 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
 |
| 1. 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 SKILLS

**UNIT CODE:** ASC/CU/ACHEM/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
* Entrepreneurship culture in Kenya
* Born or made entrepreneurs
 | * Observation
* Case studies
* Individual/group assignments
* Projects
* Written tests

Oral questionsThird party reportInterviews |
| 1. 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
 |
| 1. 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
 |
| 1. 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
 |
| 1. 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
* Interviews
 |
| 1. 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
* Interviews
 |

**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:** ASC/CU/ACHEM/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
* 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
 | * Observation
* Written
* Oral interview
* Third party report
 |
| 1. 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
 |  |
| 1. Demonstrate critical safe work habits
 | * Stress and stress management
* Time concept
* Punctuality and time consciousness
* Leisure
* Integratingpersonal objectives into organizational objectives
* Resources mobilization
* Resources utilization
* Setting work priorities
* Developing healthy relationships
* HIV and AIDS
* Drug and substance abuse
* Managing emerging issues
 | * Observation
* Written
* Oral interview
* Third party report
 |
| 1. 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
 |
| 1. Plan and organize work
 | * Functions of management
* Planning
* Organizing
* Time management
* Decision making concept
* Task allocation
* Developing work plans
* 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
 | * Observation
* Oral interview
* Written
* Third party report
 |
| 1. 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
 |
| 1. 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
* 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
 | * Observation
* Oral interview
* Written
* Third party report
 |
| 1. 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
 |
| 1. 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
* Etiquette
* Personal and professional integrity
* Commitment to jurisdictional laws
* Emerging issues in ethics
 | * Observation
* Oral interview
* Written
* Third party report
 |

**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**:ASC/CU/ACHEM/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, analyse 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. Analyse 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
* Types and uses of PPE in line with environmental regulations
* Occupational Safety and Health Standards (OSHS)
 | * Written questions
* Oral questions
* Observation of work procedures
 |
| 1. 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
 |
| 1. 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
 |
| 1. 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
 |
| 1. 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
 |
| 1. 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
 |
| 1. Monitor activities on Environmental protection/Programs
 | * Periodic monitoring and Evaluation of activities
* Gathering feedback from stakeholders
* Analysing 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
 |
| 1. Analyse resource use
 | * Identification of resource consuming processes
* Determination of quantity and nature of resource consumed
* Analysis of resource flow through different parts of the process.
* Classification of wastes for possible source of resources.
 | * Written tests
* Oral questions
* Practical test
* Observation
 |
| 1. 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:** ASC/CU/ACHEM/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
 |
| 1. 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
 |
| 1. 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

## PHYSICS PRINCIPLES

**UNIT CODE:** ASC/CU/ACHEM/CC/01/6/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Apply physics principles

**Duration of Unit:** 44 hours

**Unit Description**

This unit covers the competencies required to apply physics principles. It involves application of unit of measurements, application of the principles of forces, application of the concepts of density and pressure, application of the principles of fluid flow and heat transfer and application of properties of light and sound waves

**Summary of Learning Outcomes**

1. Apply units of measurement and measuring instruments.
2. Apply the principles of forces
3. Solve problems related to motion, work energy and power
4. Apply the concepts of density and pressure
5. Apply the principles of fluid flow and heat transfer
6. Apply properties of light and sound waves

**Learning Outcomes, Content and Suggested Assessment Methods**

| **Learning outcome** | **Content**  | **Suggested assessment methods** |
| --- | --- | --- |
| 1. Apply units of measurement and measuring instruments
 | * Basic quantities and derived quantities
* Units of measurements
* Unit conversions
* Dimensional analysis
* Types of measuring instruments
* Usage and applications of measuring instruments
 | * Assignments
* Oral questioning
* Supervised exercises
* Written tests
 |
| 1. Apply the principles of forces
 | * Types of forces
* Moment of a force
* The principle of moments
* Centre of gravity
* Laws of friction
* Effects of friction
* Benefits of reducing friction
* Tools and equipment
 | * Assignments
* Oral questioning
* Supervised exercises
* Written tests
 |
| 1. Solve problems related to motion, work energy and power
 | * Laws of linear motion
* Parameters of motion
* Force formula
* Motion under gravity
* Motion graphs
* Forms of energy and energy transformations
* Sources of energy
* Problems on Work, energy and power
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| 1. Apply the concepts of density and pressure
 | * Laws and principles appropriate to fluid pressure
* Atmospheric and fluid pressures
* Determination of density
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| 1. Apply the principles of fluid flow and heat transfer
 | * Fluid flow terminologies
* Streamline and turbulent flow
* Determination of Bernoulli’s effect and equation of continuity
* Modes of heat transfer
* Thermal expansion
* Applications of thermal expansion
 | * Assignments
* Oral questioning
* Supervised exercises
* Written tests
 |
| 1. Apply properties of light and sound waves
 | * Electromagnetic spectrum
* Properties of light
* Laws of reflection and refraction
* Types and properties of waves
* Propagation of sound
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |

**Suggested Delivery Methods**

* Group discussions
* Demonstration by trainer
* Exercises by trainee

**Recommended Resources**

* Functional laboratory
* Computers
* Ledgers
* Inventory books

## STANDARD LABORATORY PRACTICES

**UNIT CODE:** ASC/CU/ACHEM/CC/02/6/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Apply standard laboratory practices

**Duration of Unit:** 44 hours

**Unit Description**

This unit describes the competencies required by a technician in order to apply standard laboratory practices. It involves -: Identifying laboratory hazards and risks, managing laboratory hazards, applying laboratory safety procedures, storing laboratory samples, applying emergency response plans, preparing laboratory reagents, storing chemicals and reagents, applying first aid skills, disposing laboratory wastes, maintaining laboratory ware and equipment and Maintaining laboratory hygiene.

**Summary of Learning Outcomes**

1. Identify laboratory hazards and risks
2. Manage laboratory hazards
3. Apply laboratory safety procedures
4. Apply emergency response plans
5. Prepare laboratory reagents
6. Store chemicals and reagents
7. Dispose laboratory wastes
8. Maintain laboratory ware and equipment
9. Maintain laboratory hygiene

**Learning Outcomes, Content and Suggested Assessment Methods**

| **Learning outcome** | **Content**  | **Suggested assessment methods** |
| --- | --- | --- |
| 1. Identify and Manage Laboratory hazards and risks
 | * Types of laboratory hazards and risks
* Prevention of laboratory risks and hazards
* Handling laboratory hazards
* Storage of laboratory reagents, instruments and samples
* Identification of injuries and their treatment
* Identify of poisons and their management
 | * Role playing
 |
| 1. Apply laboratory safety procedure
 | * First aid procedures
* Laboratory waste management
* Safety design features
* Good house keeping
* Laboratory safety procedures
 | * Assignments
* Oral questioning
* Supervised exercises
* Written tests
 |
| 1. Store laboratory samples, chemicals and reagents
 | * Types of stores
* Features of a store
* Labelling of stores and cabinets
* Stock taking and inventory
* Factors that determines storage of chemicals and reagents
* Temperature
* Humidity
* Light
* Air/oxygen
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| 1. Prepare laboratory reagent
 | * Common laboratory reagents and solutions
* Apparatus used for preparing solutions
* Solution preparation methods and precautions;
	+ MSDS (Material Safety data sheet)
* Standardisation of solutions
* Standardising chemicals (salts)
* Maintaining laboratory records
* Units of concentration.
* Types of concentration
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| 1. Maintain laboratory ware and equipment
 | * Calibration
* Cleaning
* Greasing
* Dusting
* Servicing
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| 1. Maintain laboratory hygiene
 | * + Types of disinfectants and antiseptics
	+ Preparation of laboratory disinfectants and antiseptics
	+ Types of stains
	+ Stain removal
	+ Decontamination and cleaning laboratory working areas, benches and equipment
* Segregation and disposal of laboratory wastes
 | * Assignments
* Oral questioning
* Supervised exercises
* Written tests
 |
| 1. Dispose laboratory waste
 | * Types of laboratory wastes
* Methods of waste disposal
* Burying
* Sealed container for radioactive material
* Dilution and flushing out
* Burning and incineration
* Gas traps
* Detoxification
* Disposal specialists
* Recycling
* Sterilisation
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| 1. Specify analytical equipment for procurement
 | * + Stocktaking
	+ Preparation of Requisition
* Record keeping
 |  |
| 1. Receive, qualify and validate the analytical equipment
 | * Confirmation of specification requirements
* receiving the equipment
* Signing
* Inventory.
* Validation of the equipment.
* Qualification of the equipment
* Installation of the equipment
* End user Training
 |  |

**Suggested Delivery Methods**

* Group discussions
* Demonstration by trainer
* Exercises by trainee

**Recommended Resources**

* Functional laboratory
* Reagents and chemicals
* Computers
* Ledgers
* Inventory books
* In-house and NEMA guidelines

## INORGANIC CHEMISTRY

**UNIT CODE:** ASC/CU/ACHEM/CC/03/6/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: apply inorganic chemistry

**Duration of Unit:** 142 hours

**Unit Description**

This unit describes the competencies required by a technician in order to apply inorganic chemistry. It involves: - demonstrating knowledge of periodic table, demonstrating the knowledge of chemical bonding, demonstrating knowledge of chemical equations, demonstrating knowledge of chemical reactions and demonstrating knowledge on qualitative and quantitative analysis of inorganic compound

**Summary of Learning Outcomes**

1. Demonstrate knowledge of periodic table
2. Demonstrate the knowledge of chemical bonding
3. Demonstrate knowledge of chemical equations
4. Demonstrate knowledge of chemical reactions
5. Demonstrate knowledge on qualitative and quantitative analysis of inorganic compound

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning outcome** | **Content**  | **Suggested assessment methods** |
| * + 1. Demonstrate knowledge of atomic structure
 |  |  |
| * + 1. Demonstrate knowledge of periodic table

  | * Atomic structure
* Electronic configuration
* Periodic table
* Treads across the period and down the group
* Blocks classification
* s-block
* p-block
* d-block

  | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| * + 1. Demonstrate the knowledge of chemical bonding and structures
 | * Types of bonding
* Covalent/dative covalent
* Ionic
* Metallic
* Hydrogen
* Properties of bonds
* Structures
* Giant Molecular
* Simple molecular
* Ionic structure
* Metallic structures
* Properties of structures.
* Properties of crystal structures
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| * + 1. Demonstrate knowledge of chemical equations and reactions.
 | * Valences of elements
* Chemical reactions
* Chemical equations
* Balancing of chemical equations

  | * Assignments
* Oral questioning
* Supervised exercises
* Written tests
 |
| * + 1. Demonstrate knowledge on qualitative and quantitative analysis of inorganic compound
 | * Flame test
* Flame photometry
* Atomic Absorption Spectrophotometry (AAS)
* Test for anions and cations
* Acid-base titration
* Redox titration
* Complexometric titration
 |  |
| * + 1. Demonstrate knowledge of nuclear chemistry
 |  |  |

**Suggested Delivery Methods**

* Group discussions
* Demonstration by trainer
* Exercises by trainee

**Recommended Resources**

* Functional laboratory
* Chemicals and reagents
* Text books
* Stationary
* Models
* Periodic table

## PHYSICAL CHEMISTRY

**UNIT CODE:** ASC/CU/ACHEM/CC/04/6/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: apply physical chemistry

**Duration of Unit: 142** hours

**Unit Description**

This unit covers the competencies required to apply physical chemistry. It involves Demonstrating the knowledge of gas behaviour, Demonstrating the knowledge of phase diagrams, Demonstrating the knowledge of thermodynamics, Demonstrating the knowledge of the states of matter, Demonstrating the knowledge of Rate reactions, demonstrating the knowledge of Electrochemistry, Demonstrating the knowledge of Molarity and Demonstrating the knowledge of thermometric analysis

**Summary of Learning Outcomes**

1. Demonstrating the knowledge of gas behaviour
2. Demonstrating the knowledge of phase diagrams
3. Demonstrating the knowledge of thermodynamics
4. Demonstrating the knowledge of the states of matter
5. Demonstrating the knowledge of Rate reactions
6. Demonstrating the knowledge of Electrochemistry
7. Demonstrating the knowledge of Molarity
8. Demonstrating the knowledge of thermometric analysis

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning outcome** | **Content**  | **Suggested assessment methods** |
| * 1. Demonstrate the knowledge of the states of matter.
 | * States of matter
 |  |
| * 1. Demonstrating the knowledge of gas behaviour
 | * Gas laws
* Equation of state
* Van der Waals equation
* Kinetic theory of gases.
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| * 1. Demonstrate knowledge of chemical reactions
 | * Reversible reactions
* Calculation of equilibrium constants in terms of
* Concentration
* Partial pressures
* Degree of dissociation
* Factors affecting equilibrium constants
* Le Chateliers principle
* Application of Le Chateliers principle
* Haber process.
* Contact process
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| * 1. Demonstrating the knowledge of phase diagram
 | * Phase equilibrium diagrams
* Phase rule
* Allotropy
* Eutectic mixtures
* Raoults law
* Immiscibility and mutual solubility
* Distillation
* Henrys law
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| * 1. Demonstrating the knowledge of Rate reactions
 | * Order of reaction
* Velocity constant and molecularity
* Variation of reaction rates with
* Concentration
* Temperature
* Half life
* Activation energy
* Collision theory of gases
* Maxwell distribution
* Catalyst and activation energy
* Activated complexes
* Arrhenius equation
* Catalysis
* Types
* Industrial
* Enzymatic
* Photochemical activation
* Chain reactions
 | * Written test
* Observation
* Third party report
* Oral questioning

Interviews |
| Demonstrating the knowledge of Electrochemistry | * effect of electricity
* Measurement of conductivity of electrolytes
* variation of conductivity with
* temperature
* concentration
* conductimetric titrations
* Kohlrausch’s law
* Ostwald’s dilution law
* electrochemical cells
* redox reactions
* electrode potential
* EMF of a cell
* standard electrodes
* measurement of pH
* Nernst equation
* polarisation
* polarography
* voltammetry
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |
| Demonstrating the knowledge of thermodynamics | * Types of systems
* First law of thermodynamics
* Second law of thermodynamics
* Expression of entropy
* Expansion of gases
* Bond dissociation energy
* Hess’s law
* Enthalpy changes
* Heat capacities
 | * Assignments
* Oral questioning
* Supervised exercises
* Written tests
 |
| Demonstrate the knowledge of thermometric analysis | * Definition of terms
* Thermal transformations
* Differential thermal analysis (DTA)
* Deferential scanning calorimetry (DSC)
* Thermometric titration
 | * Written tests
* Oral questioning
* Assignments
* Supervised exercises
 |

**Suggested Delivery Methods**

* Group discussions
* Demonstration by trainer
* Exercises by trainee
* Use of teaching aids

**Recommended Resources**

* Functional laboratory
* Chemicals and reagents
* Text books
* Stationary
* Projector
* Computers

## ORGANIC CHEMISTRY

**UNIT CODE:** ASC/CU/ACHEM/CC/05/6/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Apply organic chemistry

**Duration of Unit:** 142 hours

**Unit Description:**

This unit covers the competencies required to apply organic chemistry. It involves Demonstrating the knowledge of hydrocarbons, Demonstrating the knowledge of carbonyl compounds, Demonstrating the knowledge of aromatic compounds, demonstrating knowledge of polymer chemistry, demonstrating knowledge on organic spectroscopic techniques and Demonstrating knowledge of formulation chemistry ,

**Summary of Learning Outcomes:**

1. Demonstrating the knowledge of hydrocarbons
2. Demonstrate the knowledge of haloalkanes
3. Demonstrate the knowledge of alkanols
4. Demonstrating the knowledge of carbonyl compounds
5. Demonstrate the knowledge of carboxylic acids
6. Demonstrate the knowledge of carboxylic acid derivatives
7. Demonstrate knowledge of amines and nitrogen compounds
8. Demonstrating the knowledge of aromatic compounds
9. Demonstrate the knowledge of heterocyclic compounds
10. Demonstrate the knowledge of polynuclear aromatic compounds
11. Demonstrating knowledge of polymer chemistry
12. Demonstrating knowledge on organic spectroscopic techniques
13. Demonstrating knowledge of formulation chemistry

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Method** |
| * 1. Demonstrating the knowledge of hydrocarbons
 | * Occurrence
* Naming
* Laboratory preparation
* Properties
* Reactions and mechanisms
* Free radical substitution
* Addition reactions
* Structural isomerism of hydrocarbons
* Cis and trans isomerism
* Tests of unsaturation
* Baeyer’s test
* Bromine water etc.
* Uses of hydrocarbons
 | * Practical exercises
* Oral questioning
* Written test
* Learner portfolio of evidence.
 |
| * 1. Demonstrate the knowledge of haloalkanes
 | * Naming and classification
* Preparation
* Physical properties
* Reactions and mechanism
* SN1
* SN2
* E1
* E2
* Uses of haloalkanes
 | * Oral questioning
* Practical demonstration
* Observation
* Written test
 |
| * 1. Demonstrate the knowledge of hydroxyl compounds.
 | * Naming and classification
* Preparation
* Physical properties
* Reactions and reaction mechanisms
* Uses of alkanols
 | * Oral questioning
* Practical demonstration
* Observation
* Written test
 |
| * 1. Demonstrating the knowledge of carbonyl compounds
 | * Naming
* Preparation
* Physical properties
* Reactions and reaction mechanisms
* Nucleophilic addition
* condensation
* uses of carbonyl compounds
 | * Oral questioning
* Practical demonstration
* Observation
* Written test
 |
| * 1. Demonstrate knowledge of carboxylic acids
 | * Naming and classification
* Preparation
* Physical properties
* Reactions and reaction mechanisms
* Uses of carboxylic acids
 | * Oral questioning
* Practical demonstration
* Observation
* Written test
 |
| * 1. Demonstrate knowledge of carboxylic acid derivatives
 | * Naming
* Preparation
* Physical properties
* Reactions and reaction mechanisms
* Uses of carboxylic acid derivatives
 | * Oral questioning
* Practical demonstration
* Observation
* Written test
 |
| * 1. Demonstrate knowledge of amines and nitrogen compounds
 | * Naming and classification
* Preparation
* Physical properties
* Reactions and reaction mechanisms
* Uses
 | * Oral questioning
* Practical demonstration
* Observation
* Written test
* Learner portfolio of evidence.
 |
| * 1. Demonstrating the knowledge of aromatic compounds
 | * Definition of aromatic compound
* Kekule structures
* Naming of benzene and its derivatives
* Reactions and reaction mechanisms of benzene and substituted derivatives
* Electrophilic substitution
* Nucleophilic substitution
* Oxidation of benzene
 | * Practical exercises
* Oral questioning
* Written test
* Learner portfolio of evidence.
 |
| * 1. Demonstrate the knowledge of heterocyclic compounds
 | * Definition
* Structures
* Naming and classification
* Substitution reactions
* Naturally occurring compounds with heterocyclic rings
* Uses of heterocyclic compounds
 | * Oral questioning
* Practical demonstration
* Observation
* Written test
 |
| * 1. Demonstrate the knowledge of polynuclear aromatic compounds
 | * Definition
* Structures
* Naming and classification
* Properties
* Reactions
* Uses of polynuclear aromatic compounds
 | * Oral questioning
* Practical demonstration
* Observation
* Written test
 |
| * 1. Demonstrate knowledge of polymer chemistry
 | * Definition of terms
* Naming and classification
* Polymerisation reactions
* Uses of polymers
 | * Practical exercises
* Oral questioning
* Written test
* Learner portfolio of evidence.
 |
| * 1. Demonstrate knowledge on organic spectroscopic techniques
 | * Definition of terms
* Types of molecular vibrations
* Stretching
* Bending
* Factors affecting molecular vibration
* Molecular absorption spectroscopy.
* Sampling and sample preparation based on the analytical technique.
* Spectroscopic methods;
* Atomic spectroscopy.
* Infrared spectroscopy.
* Nuclear Magnetic spectroscopy
 | * Practical exercises
* Oral questioning
* Written test
* Learner portfolio of evidence
 |
| * 1. Demonstrate knowledge of formulation chemistry
 | * Definition of terms
* Formulation of adhesives
* Formulation detergents
* Solid soaps
* Fabric softeners
* All-purpose cleaners
* Liquid detergents
* Formulation of cosmetics
* Perfumes/ deodorants
* Body lotions
* Moisturisers
* Finger nail polishers
* Lipsticks
* Hair dyes
* Toothpaste
* Shampoos
* Formulation of paints
* Water based
* Solvents based
* Formulation of inks

• Organic solvents-based inks • Water based inks • Oil, pigment or dyes • Gel based ink• Roller ball ink based* Pharmaceutical products

• Liquid • Dry Syrups • Tablets • Capsules • Injectable | * Practical exercises
* Oral questioning
* Written test
* Learner portfolio of evidence
 |

**Suggested Methods of Delivery**

* Group discussions
* Demonstration by trainer
* Exercises by trainee
* Use of teaching aids

**Recommended Resources**

* Functional laboratory
* Chemicals and reagents
* Text books
* Stationary
* Models
* Projector
* Computers
* Internet
* IR spectrophotometer
* UV visible spectrophotometer
* Nuclear Magnetic Resonance

## BIOCHEMISTRY TECHNIQUES

**UNIT CODE:** ASC/CU/ACHEM/CC/06/6/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Apply biochemistry techniques

**Duration of Unit:** 138 hours

**Unit Description:**

This unit covers the competencies required to apply organic chemistry. It involves demonstrate knowledge of water, acids, bases and buffers, demonstrate knowledge of cell biology, demonstrate knowledge of carbohydrates, demonstrate knowledge of proteins and mineral acids, demonstrate knowledge of lipids, demonstrate knowledge of vitamins and minerals, demonstrate knowledge of enzymes and coenzymes, demonstrate knowledge of biochemical techniques, demonstrate knowledge of metabolism

**Summary of Learning Outcomes:**

1. Demonstrate knowledge of water, acids, bases and buffers
2. Demonstrate knowledge of cell biology
3. Demonstrate knowledge of carbohydrates
4. Demonstrate knowledge of proteins and mineral acids
5. Demonstrate knowledge of lipids
6. Demonstrate knowledge of vitamins and minerals
7. Demonstrate knowledge of enzymes and coenzymes
8. Demonstrate knowledge of biochemical techniques
9. Demonstrate knowledge of metabolism
10. Demonstrate knowledge of nucleic acids

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Method** |
| 1. Introduction to biochemistry
 | * Definition of biochemistry
* Importance of biochemistry in analytical chemistry
* Biomolecules classification
 |  |
| 1. Demonstrate knowledge of water, acids, bases and buffers
 | * Structures and properties of water
* Roles of water in biochemistry
* Calculation of pH of acids, bases and buffers
* Preparation of buffer solutions
 | * Practical exercises
* Oral questioning
* Written test
* Learner portfolio of evidence.
 |
| 1. Demonstrate knowledge of cell biology
 | * Ultrastructure of cells

Prokaryotes Eukaryotes * Types of cell organelles
* Cell fractionation
 | * Oral questioning
* Practical demonstration
* Observation
* Written test
 |
| 1. Demonstrate knowledge of carbohydrates
 | * Classification of carbohydrates
* Sources of carbohydrates
* Physical and chemical properties of carbohydrates
* Functions of carbohydrates
* Biochemical analysis of carbohydrates
 | * Oral questioning
* Practical demonstration
* Observation
* Written test
 |
| 1. Demonstrate knowledge of proteins
 | * Sources of proteins
* Classification of amino acids and proteins
* Basic structure of amino acids and proteins
* Configuration of proteins
* Chemical and physical properties of proteins
 | * Oral questioning
* Practical demonstration
* Observation
* Written test
 |
| 1. Demonstrate knowledge of lipids
 | * Classification of lipids
* Structure of lipids
* Types of fatty acids
* Properties of lipids
* Functions of lipids
* Analysis of lipids
 | * Oral questioning
* Practical demonstration
* Observation
* Written test
 |
| 1. Demonstrate knowledge of vitamins and minerals ions.
 | * Types of vitamins and minerals
* Properties of vitamins
* Functions of vitamins and minerals
* Sources of vitamins and minerals
* Analysis of vitamins and minerals
 | * Oral questioning
* Practical demonstration
* Observation
* Written test
 |
| 1. Demonstrate knowledge of enzymes and coenzymes
 | * Meaning of enzymes and Co-enzymes
* Classification of enzymes
* Nature of enzymes and Co-enzymes
* Mode of action of enzymes
* Enzyme specificity
* Kinetics and inhibition of enzymes
* Analysis of enzymes and coenzymes
 | * Oral questioning
* Practical demonstration
* Observation
* Written test
* Learner portfolio of evidence.
 |
| 1. Demonstrate knowledge of biochemical techniques
 | * Membrane filtration
* Centrifugation
* Electrophoresis
* Column chromatography
* Application of biochemical techniques
 | * Practical exercises
* Oral questioning
* Written test
* Learner portfolio of evidence.
 |
| 1. Demonstrate knowledge of metabolism
 | * Anabolism and catabolism
* Digestion and assimilation of biomolecules
* Disorders associated with metabolism
 | * Oral questioning
* Practical demonstration
* Observation
* Written test
 |
| 1. Demonstrate knowledge of nucleic acids
 | * Types and functions of nucleic acids
* Nucleotides and nucleosides
* Types of bases in nucleic acids
* Structure of DNA and RNA
 | * Oral questioning
* Practical demonstration
* Observation
* Written test
 |
| 1. Emerging issues and treads
 | * Emerging issues and treads
* Challenges posed by Emerging issues and treads
* Ways of managing Challenges posed by Emerging issues and treads
 | * Oral questioning
* Practical demonstration
* Observation
* Written test
 |

**Suggested Methods of Delivery**

* Group discussions
* Demonstration by trainer
* Exercises by trainee
* Use of teaching aids

**Recommended Resources**

* Functional laboratory
* Chemicals and reagents
* Text books
* Stationary
* Models
* Projector
* Computers
* Internet

## STATISTICAL METHODS

**UNIT CODE:** ASC/CU/ACHEM/CC/07/6/A

**Relationship to Occupational Standards**

**This unit addresses the unit of competency:** Apply statistical methods

**Duration of Unit: 44** hours

**Unit Description:**

This unit covers the competencies required to apply statistical methods. It involves Introduction to statistics Apply Sampling and data collection Apply Presentation of data Apply Measures of central tendency Apply Measures of dispersion Apply Elements of probability Apply Probability distribution Apply Moments, skewness and kurtosis Apply Correlation and regression

**Summary of Learning Outcomes:**

1. Introduction to statistics
2. Apply Sampling and data collection
3. Apply Presentation of data
4. Apply Measures of central tendency
5. Apply Measures of dispersion
6. Apply Elements of probability
7. Apply Probability distribution
8. Apply Moments, skewness and kurtosis

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Method** |
| 1. Introduction to statistics
 | * Definition of statistics
* Branches of statistics
* Importance and use.
* Types of variables.
 | * Practical exercises
* Oral questioning
* Written test
* Learner portfolio of evidence.
 |
| 1. Apply Sampling and data collection
 | * Definition of sampling
* Types and limitation of sampling
* Importance of sampling.
* Determination of sample size.
* Determination of confidence levels.
* Types of errors.
* Precision and accuracy determination.
* Sampling and census
* Standard error
* Types of data
* Data collection methods
 | * Practical exercises
* Oral questioning
* Written test
* Learner portfolio of evidence.
 |
| 1. Apply Presentation of data
 | * + Tabulation of data
	+ Classification of data
	+ Presentation of statistical data in chart form
	+ Interpretation of charts
 | * Practical exercises
* Oral questioning
* Written test
* Learner portfolio of evidence.
 |
| 1. Apply Measures of central tendency
 | * Definition of Measures of the central tendency
* Computation of the measures
* Graphical determination of the measures
* Comparison of the measures
* applications
 | * Practical exercises
* Oral questioning
* Written test
* Learner portfolio of evidence.
 |
| 1. Apply Measures of dispersion
 | * Measures of dispersion
* Computation of Measures of dispersion
* Application of Measures of dispersion
* Definition of relative Measures of dispersion
* Computation and interpretation of relative Measures of dispersion
 | * Practical exercises
* Oral questioning
* Written test
* Learner portfolio of evidence.
 |
| 1. Apply Elements of probability
 | * Types of events
* Laws of probability
* Counting techniques
* Mathematical expectation
 | * Practical exercises
* Oral questioning
* Written test
* Learner portfolio of evidence.
 |
| 1. Apply Probability distribution
 | * Types and characteristics of probability distribution
* standard deviation of probability density function
* Mean, variance and standard deviation using binomial distribution
* Poisson distribution
* Normal distribution
 | * Practical exercises
* Oral questioning
* Written test
* Learner portfolio of evidence.
 |
| 1. Apply Moments, skewness and kurtosis
 | * Definition of Moments, skewness and kurtosis
* Computation of Moments, skewness and kurtosis
 | * Practical exercises
* Oral questioning
* Written test
* Learner portfolio of evidence.
 |
| 1. Apply Correlation and regression
 | * Definition of correlation and related terms
* Scatter diagrams
* Definition of Regression
* computation and interpretation of line of best fit
* Application of Correlation and regression.
* Calculation of LOD and LOQ.
* Determination of the equation of the line
* Determination of R2
 | * Practical exercises
* Oral questioning
* Written test
* Learner portfolio of evidence.
 |

**Suggested Methods of Delivery**

* Projects
* Demonstration by trainer
* Practice by the trainee
* Discussions
* Direct instruction

 **Recommended Resources and equipment**

* Journals
* Computers
* Training manuals
* Project samples
* Library text books
* Stationary
* Internet

## ANALYTICAL CHEMISTRY RESEARCH

**UNIT CODE:** ASC/CU/ACHEM/CC/08/6/A

**Relationship to Occupational Standards**

**This unit addresses the unit of competency:** Apply analytical research methods

**Duration of Unit: 44** hours

**Unit Description:**

This unit covers the competencies required to apply analytical chemistry techniques. It involves formulating analytical chemistry problem, developing research proposal, collecting analytical chemistry data, analysing and interpreting analytical chemistry data, preparing analytical chemistry research report and presenting analytical chemistry research report

**Summary of Learning Outcomes:**

1. Formulating analytical chemistry problem
2. Developing research proposal
3. Collecting analytical chemistry data
4. Analysing and interpreting analytical chemistry data
5. Preparing analytical chemistry research report
6. Presenting analytical chemistry research report

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Method** |
| 1. Formulating analytical chemistry problem
 | * Meaning of statement of research problem
* Techniques of selecting research problem
* Statement of research problem
 | * Practical exercises
* Oral questioning
* Written test
* Learner portfolio of evidence.
 |
| 1. Developing research proposal

  | * Definition of research proposal
* Identification of research proposal
* Significance of the proposal
* Types of proposal
* Components of a research proposal
 | * Practical exercises
* Oral questioning
* Written test
* Learner portfolio of evidence.
 |
| 1. Prepare research instruments
 | * Research design.
* Sample design.
* Sample size determination.
* Types of instrument
* Social science research instruments
* Questionnaires
* Observation schedules
* Industrial and scientific research instruments
* Machines
* Hand tools and aids.
* Apparatus and measuring instruments
 |  |
| 1. Collecting analytical chemistry data
 | * Definition
* Sources of data
* Types of data
* Determining data to be collected.
 | * Practical exercises
* Oral questioning
* Written test
* Learner portfolio of evidence.
 |
| 1. Analysing and interpreting analytical chemistry data
 | * Coding and editing data
* Classification of data
* Detection of error and omission in data processing
* Techniques of data processing
* Data presentation
* Data analysis
* Data interpretation
 | * Practical exercises
* Oral questioning
* Written test
* Learner portfolio of evidence.
 |
| 1. Preparing analytical chemistry research report
 | * + Summary of research findings
	+ Conclusion of research finding
	+ Recommendations of research findings
 | * Practical exercises
* Oral questioning
* Written test
* Learner portfolio of evidence.
 |
| 1. Presenting analytical chemistry research report
 | * + Significance of report writing
	+ Types of report
	+ Layout styles
	+ Final research report
	+ Presentation
 | * Practical exercises
* Oral questioning
* Written test
* Learner portfolio of evidence.
 |

**Suggested Methods of Delivery**

* Projects
* Demonstration by trainer
* Practice by the trainee
* Discussions
* Direct instruction

 **Recommended Resources and equipment**

* Journals
* Computers
* Training manuals
* Project samples
* Library text books
* Stationary
* Internet

# CORE UNITS OF LEARNING

## DEVELOPMENT OF STANDARD OPERATING TEST PROCEDURES

**UNIT CODE:** ASC/CU/ACHEM/CR/01/6/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: develop standard operating test procedures

**Duration of Unit: 44** hours

**Unit Description**

This unit of competency describes the skills and knowledge to develop standard operating procedures. It involves developing analytical test purpose, developing analytical test objective, developing analytical test scope, developing analytical quality specifications, developing the test methodology and reviewing/improving test procedures

This unit applies to technical working in all industry sectors. All operations must comply with relevant standards, appropriate procedures and workplace requirements. Although a supervisor may not always be present, the technician will follow standard operating procedures (SOPs) that clearly describe the scope of permitted practice, including varying workplace/test procedures and communicating results to people outside the laboratory.

**Summary of Learning Outcomes**

1. Develop analytical test purpose,
2. Develop analytical test objective,
3. Develop analytical test scope,
4. Develop analytical quality specifications,
5. Develop the test methodology and
6. Review/improve test procedures

**Learning Outcomes, Content and Suggested Assessment Methods**

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| * 1. Develop analytical test purpose and objective.
 | * + Definition of analytical test purpose
	+ Developing analytical test purpose
	+ Examples of analytical chemistry purpose.
	+ Definition of an analytical chemistry objective
	+ Examples of analytical chemistry objectives
	+ Formulation of a test objective
 | * Written test
* Observation
* Third party report
* Oral questioning
* Interviews
 |
| * 1. Develop analytical test scope
 | * Definition of a test scope
* Factors that determine test scope
* Development of a test scope
 | * Written test
* Observation
* Third party report
* Oral questioning
* Interviews
 |
| * 1. Develop analytical quality specifications,
 | * Definition of test quality
* Factors that determine the quality of a test
* Accuracy and calibration of test instruments and equipment
* Determination of test parameters
* Standard calibration curves
 | * Written test
* Observation
* Third party report
* Oral questioning
* Interviews
 |
| * 1. Develop the test methodology
 | * Definition of test methodology
* Determination of test equipment and instruments
* Test inputs- test solutions
* Standardisation of test solutions
* Standardisation factor
* Determination of solution concentration and volume
* Validation of test method
 | * Written test
* Observation
* Third party report
* Oral questioning
* Interviews
 |
| * 1. Review/improve test procedures
 | * Upcoming technologies and methods
* Reliability/ integrity of a test
 | * Written test
* Observation
* Third party report
* Oral questioning
* Interviews
 |

**Suggested Methods of Delivery**

* Projects
* Demonstration by trainer
* Practice by the trainee
* Discussions
* Direct instruction

**Recommended Resources**

1. Printer
2. Stationary
3. Computer
4. Internet
5. Telephone

## COLLECTION AND PREPARATION OF ANALYTICAL CHEMISTRY SAMPLES

**UNIT CODE:** ASC/CU/ACHEM/CC/03/6/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: collect and prepare analytical chemistry samples

**Duration of Unit: 160** hours

**Unit Description:**

This unit covers the competencies required to collect and prepare analytical chemistry samples. It involves Design a sampling plan, implement sampling plan, Label/code analytical samples, Preserve and transport analytical sample

**Summary of Learning Outcomes:**

1. Design a sampling plan
2. Implement sampling plan
3. Label/code analytical samples
4. Preserve and transport analytical sample

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Method** |
| * + 1. Design a sampling plan
 | * + Definition of terms
	+ Analytical Sampling methods
	+ Randomisation
	+ Sample sizes
	+ Types of samples
	+ Factors that determine sampling plan in analytical chemistry
 | * Practical exercises
* Oral questioning
* Written test
* Learner portfolio of evidence.
 |
| * + 1. Implement sampling plan
 | * Determining of sampling points
* Marking of sampling points
* Types Analytical chemistry data
* Sampling tools
* Analytical chemistry data collection
 | * Practical exercises
* Oral questioning
* Written test
* Learner portfolio of evidence.
 |
| * + 1. Label/code analytical samples
 | * Labelling of samples
* Coding of samples.
* Packaging.
 | * Practical exercises
* Oral questioning
* Written test
* Learner portfolio of evidence.
 |
| * + 1. Preserve and transport analytical sample
 | * Sample pre-treatments methods
* Preservation methods
* Safety transportation measures
 | * Practical exercises
* Oral questioning
* Written test
* Learner portfolio of evidence.
 |

**Suggested Methods of Delivery**

* Projects
* Demonstration by trainer
* Practice by the trainee
* Discussions
* Direct instruction

**Recommended Resources and equipment**

1. Sampling tools
2. Chemicals and reagents
3. PPEs
4. Cold box
5. Mobile/ functional laboratory

## ANALYTICAL CHEMISTRY TECHNIQUES

**UNIT CODE:** ASC/CU/ACHEM/CC/02/6/A

**Relationship to Occupational Standards**

**This unit addresses the unit of competency:** Apply analytical chemistry techniques

**Duration of Unit: 99** hours

**Unit Description:**

This unit covers the competencies required to apply analytical chemistry techniques. It involves apply separation techniques, apply knowledge of titrimetric and gravimetric techniques, apply knowledge on chromatographic and electrophoretic methods, apply knowledge of qualitative methods of chemical analysis, apply knowledge of instrumental methods of analysis and applying data analysis techniques.

**Summary of Learning Outcomes:**

1. Apply separation techniques
2. Apply titrimetric and gravimetric techniques
3. Apply chromatographic and electrophoretic method
4. Apply qualitative methods of chemical analysis
5. Apply instrumental methods of analysis
6. Applying data analysis techniques.

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Method** |
| 1. Apply separation techniques
 | * + Decantation
	+ Filtration
	+ Evaporation
	+ Sublimation
	+ Simple distillation
	+ Fractional distillation
	+ Crystallization
	+ Chromatography
	+ Centrifugation
	+ Magnetic separation
	+ Precipitation
	+ electrophoresis
 | * Practical exercises
* Oral questioning
* Written test
* Learner portfolio of evidence.
 |
| 1. Apply titrimetric techniques

  | * Definition of terms
* Theory of indicators
* Types of titrimetric titrations
* Acid-base Titrations
* Redox Titrations.
* Precipitation Titrations.
* Complexometric Titrations
 | * Practical exercises
* Oral questioning
* Written test
* Learner portfolio of evidence.
 |
| 1. Apply gravimetric techniques
 | * Introduction and Definition of terms
* Gravimetric precipitation methods
* Properties of precipitates
* Colloidal
* Crystalline
* Gravimetric calculations
 |  |
| 1. Apply qualitative methods of chemical analysis
 | * Colorimetry
* Distillation
* Vacuum distillation
* Fractional distillation
* Steam
* Extraction
* Distribution law
* Distribution Ratio
* Single stage solvent extraction
* Soxhlet extraction
* Precipitation
* Chromatography
* Paper Chromatography
* Thin layer Chromatography
* Column Chromatography
* Spectroscopy
 | * Practical exercises
* Oral questioning
* Written test
* Learner portfolio of evidence.
 |
| 1. Apply spectroscopic methods
 | * Definition of terms
* Electromagnetic spectrum
* Theory of spectrophotometry
* Instrumentation
* Infra-Red/FTIR
* Ultra Violet Visible
* Nuclear Magnetic Resonance
* Application
 | * Practical exercises
* Oral questioning
* Written test
* Learner portfolio of evidence.
 |
| 1. Apply instrumental methods of analysis
 | * Spectroscopy
* Spectrophotometry

GCHPLCGCMSLCMS* X-ray methods
* XRD
* XRF
* Voltammetry
* Potentiometry
* Amperometry
* Conductometry
 | * Practical exercises
* Oral questioning
* Written test
* Learner portfolio of evidence.
 |
| 1. Apply Calibration/Optimisation of analytical equipment
 | * Importance of calibration
* Basic steps in calibration
* Optimisation
* Shut down operation
 |  |
| 1. Perform cleaning and basic service for analytical equipment
 | * Cleaning
* Cleaning materials
* Cleaning reagents
* Cleaning procedure
* Servicing
* Repairs
* Refurbishing
* Calibration
 |  |

**Suggested Methods of Delivery**

* Projects
* Demonstration by trainer
* Practice by the trainee
* Discussions
* Direct instruction

**Recommended Resources and equipment**

1. Computer
2. Internet connection
3. Stationary
4. Printer
5. Internet
6. Notes

## ANALYSIS AND INTERPRETATION OF ANALYTICAL CHEMISTRY DATA

**UNIT CODE:** ASC/CU/ACHEM/CR/04/6/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Analyse and interpret analytical chemistry data

**Duration of Unit:**  44 hours

**Unit Description**

This unit specifies the competencies required to analyse and interpret analytical data. The analysis involves receiving and inputting analytical data, analysing the analytical data, interpreting output result and preparing report and presenting findings

**Summary of Learning Outcomes**

1. Receive and input analytical data
2. Analyse the analytical data
3. Interpret output result
4. Prepare report and present findings

**Learning Outcomes, Content and Suggested Assessment Methods**

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Receive and input analytical data
 | * Types of analytical chemistry data
* Forms of analytical chemistry data
* Coding of analytical chemistry data
* Entry of analytical chemistry data
 | * Written test
* Observation
* Third party report
* Oral questioning
* Interviews
 |
| 1. Analyse analytical chemistry data
 | * + Detection of Data errors and omissions
	+ Confidence intervals
	+ Calibration graphs
	+ Standard and sample graphs
	+ Standard and test values comparisons
	+ Measures of central tendency vales
	+ Analysis of analytical chemistry data
 | * + Written test
	+ Observation
	+ Third party report
	+ Oral questioning
	+ Interviews
 |
| 1. Interpret output result
 | * + Identification of outliers (Confidence intervals)
	+ Interpretation of results.
	+ Making conclusion
 | * Written test
* Observation
* Third party report
* Oral questioning
* Interviews
 |
| 1. Prepare report and present findings
 | * Types of reports
* Report writing
* PowerPoint presentation
 | * Written test
* Observation
* Third party report
* Oral questioning
* Interviews
 |

**Suggested Methods of Delivery**

* Projects
* Demonstration by trainer
* Practice by the trainee
* Discussions
* Direct instruction

**Recommended Resources**

1. Computer
2. Software
3. Stationary
4. Printer
5. Data sets
6. Projector

## MANAGEMENT OF ANALYTICAL CHEMISTRY LABORATORY, REAGENTS AND INSTRUMENTS

**UNIT CODE:** ASC/CU/ACHEM/CR/05/6/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Manage analytical chemistry laboratory, reagents and instruments.

**Duration of Unit:**  44 hours

**Unit Description**

This unit specifies the competencies required to manage analytical laboratory, reagents and instruments.It involves specifying analytical reagents and lab-ware for procurement, receiving and inventorying analytical reagents and lab-ware, preparing and standardising working solutions, tracking and maintaining reagents and lab-ware re-order levels, maintaining analytical chemical safety and security and performing analytical laboratory housekeeping and safety

**Summary of Learning Outcomes**

1. Specifying analytical reagents and lab-ware for procurement,
2. Receiving and inventorying analytical reagents and lab-ware,
3. Preparing and standardising working solutions,
4. Tracking and maintaining reagents and lab-ware re-order levels,
5. Maintaining analytical chemical safety and security and
6. Performing analytical laboratory housekeeping and safety

**Learning Outcomes, Content and Suggested Assessment Methods**

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Specify analytical reagents and lab-ware for procurement
 | * + Procurement rules and procedures
	+ Lab ware and reagent specifications
	+ Procurement documents
	+ Stock taking
 | * Written test
* Observation
* Third party report
* Oral questioning
* Interviews
 |
| 1. Receive and inventory analytical reagents and lab-ware,
 | * + Lab inventory
	+ Book keeping and lab records practices
	+ Receiving lab ware reagents, instruments and equipment
	+ Checking lab ware reagents, instruments and equipment for intended specifications
 | * + Written test
	+ Observation
	+ Third party report
	+ Oral questioning
	+ Interviews
 |
| 1. Prepare and standardise working solutions
 | * + Standard factor concentration of various reagents
	+ Dilution of lab reagents
	+ Equipment used in preparation of lab reagents
	+ Standardisation of lab reagents
	+ Factors determining storage of standardised lab reagents
 | * Written test
* Observation
* Third party report
* Oral questioning
* Interviews
 |
| 1. Track and maintain reagents and lab-ware re-order levels
 | * Book keeping and records
* Stock taking of lab wares and reagents
* Ordering/requisition of lab wares and reagents
 | * Written test
* Observation
* Third party report
* Oral questioning
* Interviews
 |
| 1. Maintain analytical chemical housekeeping safety laboratory and security
 | * Types of hazards
* Response to hazards
* Handling and storage of lab chemicals and wares.
* Laboratory habits
* Laboratory rules and regulations
* Personal Protective Equipment
 | * Written test
* Observation
* Third party report
* Oral questioning
* Interviews
 |

**Suggested Methods of Delivery**

* Projects
* Demonstration by trainer
* Practice by the trainee
* Discussions
* Direct instruction

**Recommended Resources**

1. Laboratory and its fixtures
2. Reagents
3. Lab equipment and wares
4. Computer
5. Stationary
6. Lab charts

## MANAGEMENT OF ANALYTICAL CHEMISTRY SAMPLES

**UNIT CODE:** ASC/CU/ACHEM/CR/06/6/A

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Manage analytical chemistry samples

**Duration of Unit:**  44 hours

**Unit Description**

This unit specifies the competencies required to manage analytical chemistry samples. It involves receiving, recording and re-labelling analytical samples, securing and storing analytical samples, managing retrieval and movement of samples, collecting and segregating laboratory waste and disposing laboratory waste

**Summary of Learning Outcomes**

1. Receive, recording and re-labelling analytical samples
2. Secure and store analytical samples
3. Manage retrieval and movement of samples
4. Collect and segregate laboratory waste
5. Dispose laboratory waste

**Learning Outcomes, Content and Suggested Assessment Methods**

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| * 1. Receive, recording, re-labelling, retrieval and movement management of analytical samples
 | * Sample Receiving procedure
* Record keeping and documentation
* Filling of documents
* Labelling of samples
 | * Written test
* Observation
* Third party report
* Oral questioning
* Interviews
 |
| * 1. Secure and store analytical samples
 | * Types of stores
* Storage safes
* Types of samples
* Storage conditions
* Factors affecting storage of samples.
* Sample holding time
 | * Written test
* Observation
* Third party report
* Oral questioning
* Interviews
 |
| * 1. Collect, segregate and Dispose laboratory sample-waste
 | * Types of laboratory wastes
* Segregation of laboratory waste
* Factors that determine disposal of laboratory waste
* Methods of waste disposal
* Burying
* Sealed container for radioactive material
* Dilution and flushing out
* Burning and incineration
* Gas traps
* Detoxification
* Disposal specialists
* Recycling
* Sterilisation
* NEMA guidelines
 | * Written test
* Observation
* Third party report
* Oral questioning
* Interviews
 |

**Suggested Methods of Delivery**

* Projects
* Demonstration by trainer
* Practice by the trainee
* Discussions
* Direct instruction

**Recommended Resources**

1. Computer
2. Stationary
3. Printer
4. Safes
5. Fridge
6. cold rooms/mini morgue
7. NEMA disposal procedures